HEXAGON TRANSPORTATION CONSULTANTS, INC.

Fortinet (901 Kifer Road)

Final Transportation Operations Analysis

Prepared for:

City of Sunnyvale

December 5, 2018

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AUTO TRIP REDUCTION STATEMENT

UPDATED: October 2014

SANTA CLARA Valley Transportation Authority

PROJECT INFORMATION		*Relevant TIA Section:*	Chapter 1	
Project Name: Fortinet Transportation Operations Analysis				
Location: 901 Kifer Road, Sunnyvale, CA				
Description: The project proposes to demolish the existing 117,812 square feet of buildings on-site and construct a four-story 172,740 square feet office and R&D building.				
Size (net new):	*D.U. Residential*	54,928	*Sq. Ft. Comm.*	*Acres (Gr.)*
Density:	*D.U. / Acre*	N/A		*Floor Area Ratio (FAR)*
Located within 2000 feet walking distance of an LRT, BRT, BART or Caltrain station or major bus stop? No				

PROJECT AUTO TRIP GENERATION		*Relevant TIA Section:*	Chapter 4	
Auto Trips Generated:	70 net *AM Pk Hr*	85 net *PM Pk Hr*	N/A *Total Weekday*	
Methodology (check one)	☒ **ITE**	☐ **Other** *(Please describe below)*		

AUTO TRIP REDUCTION APPROACH	*Relevant TIA Section:*	N/A	
☐ **Standard** *Complete Table A below*	☐ **Peer/Study-Based** *Complete Table B below*	☐ **Target-Based** *Complete Table C below*	☐

TRIP REDUCTION REQUIREMENTS	*Relevant TIA Sectio*	N/A
Is the project required to meet any trip reduction requirements or targets? Yes/No	**If so, specify percent:**	
Reference code or r		

A. STANDARD APPROACH		*Relevant TIA Section:*	N/A		
Type of Reduction *Specify reduction. See Table 2 in TIA Guidelines*		**% Reduction from ITE Rates**	**Total Trips Reduced (AM/PM/Daily)**	**TOTAL REDUCTION CLAIMED**	
				%	**Trips**
Transit					
Mixed-Use					
Financial Incentives					
Shuttle					

B. PEER/STUDY-BASED APPROACH		N/A	
Basis of Reduction		**TOTAL REDUCTION CLAIMED**	
		%	**Trips**

C. TARGET-BASED APPROACH		Relevant TIA Section:	N/A	
Type of Reduction (check all that apply)			TOTAL REDUCTION CLAIMED	
☐ % Trip Reduction	☐ % SOV mode share	☐ Trip Cap	%	Trips
Description				
Time period for reduction	Peak Hour	Peak Period	Full Day	
	☐ AM/PM	AM/PM	☐	

OTHER TDM/REDUCTION MEASURES			
Bicycle/Pedestrian	Yes	Relevant TIA Section:	Chapter 5
Install sidewalks along its project frontages on San Lazaro Avenue, Kifer Road, and Commercial Street south of the northern driveway. Install ADA-compliant curb ramps at the northwest corner of the Commercial Street and Kifer Road intersection. Provide bicycle lockers			
Parking Management	Yes		Chapter 5
Project proposes 39 parking spaces reserved for car-share. These spaces are located close to the building entrance.The car-share spaces are provided in accordance with City requirements.			
Transit	Yes	Relevant TIA Section:	Chapter 5
Project proposes one shuttle bay on-site directly north of the proposed building.			
Site Planning and Design	No	Relevant TIA Section:	
TDM Program	No	Relevant TIA Section:	

IMPLEMENTATION	Relevant TIA Section:	N/A
Have the project sponsor and Lead Agency agreed to any of the following measures?		
☐Monitoring		
☐Enforcement		
☐Data Sharing		

Executive Summary

This report presents the results of the transportation operations analysis (TOA) conducted for the proposed office and R&D development at 901 Kifer Road in Sunnyvale, CA. The project site is bounded by Central Expressway to the north, Commercial Street to the east, Kifer Road to the south, and the 899 Kifer Road building to the west. Currently, Fortinet owns the buildings at both 899 Kifer Road and 901 Kifer Road[1]. At 901 Kifer Road, Fortinet proposes to demolish nine existing buildings totaling 117,812 square feet (s.f.) and construct a four-story, 172,740 s.f. office and R&D building. The proposed building would be accessed via two driveways on Commercial Street and would be connected to the existing site at 899 Kifer Road via one east-west drive aisle.

This study was conducted for the purpose of identifying the potential near-term traffic impacts related to the proposed development. The purpose of this traffic study is to satisfy the requirements of the City of Sunnyvale. Since the project is expected to generate less than 100 new peak-hour trips, an analysis in accordance with the Santa Clara Valley Transportation Authority (VTA) County Congestion Management Program (CMP) guidelines is not required.

Project Trip Generation

Trip generation resulting from new development proposed within the City of Sunnyvale typically is estimated using the trip rates published in the Institute of Transportation Engineers' (ITE) *Trip Generation Manual, 10th Edition (2017)*. Trip generation rates for the proposed office space are based on the fitted curve equations published for "General Office Building" (Land Use Code 710). Trip generation rates for the proposed R&D space are based on the average rates published for "Research and Development Center" (Land Use Code 760).

Trip Credits

The proposed project would receive trip credits for the trips generated by the existing on-site use. The existing on-site uses include approximately 14,000 s.f. of office space, approximately 47,000 s.f. of R&D space, and approximately 56,500 s.f. of warehouse space. Trip generation rates for the existing office space are based on the fitted curve equations published for "General Office Building" (Land Use Code 710). Trip generation rates for the existing R&D space are based on the average rates published for "Research and Development Center" (Land Use Code 760). Trip generation rates for the existing warehouse space are based on the fitted curve equations published for "Warehousing" (Land Use Code 150).

[1] The report will loosely refer to the proposed project with an address of 901 Kifer Road. The proposed project site actually encompasses 893-909, 917, and 919-921 Kifer Road, and 133-135, 155, 165, 167-171, 181, 183 and 193 Commercial Street.

Net Project Trips

After applying trip credits for the existing on-site uses, the proposed project is estimated to generate a net increase of 70 vehicle trips during the AM peak hour (63 inbound and 7 outbound) and 85 vehicle trips during the PM peak hour (11 inbound and 74 outbound).

The trip generation for the proposed project is summarized in Table ES-1.

Table ES- 1
Trip Generation Summary

Land Use	Size		AM Peak Hour In	AM Peak Hour Out	AM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out	PM Peak Hour Total
Proposed[1]								
Office[2]	120,918	s.f.	120	20	140	22	114	136
R&D[3]	51,822	s.f.	17	5	22	4	21	25
Subtotal	172,740	s.f.	137	25	162	26	135	161
Existing								
Office[2]	14,149	s.f.	*(34)*	*(6)*	*(40)*	*(3)*	*(15)*	*(18)*
R&D[3]	47,072	s.f.	*(15)*	*(5)*	*(20)*	*(3)*	*(20)*	*(23)*
Warehouse[4]	56,591	s.f.	*(25)*	*(7)*	*(32)*	*(9)*	*(26)*	*(35)*
Subtotal	117,812	*s.f.*	*(74)*	*(18)*	*(92)*	*(15)*	*(61)*	*(76)*
Net Project Trips			**63**	**7**	**70**	**11**	**74**	**85**

Notes

R&D = Research and Development, s.f. = square feet

[1] Proposed project is 172,740 s.f. ,with 70% office use and 30% R&D use.
[2] Peak-hour trip generation rates for office use are based on the ITE's *Trip Generation Manual, 10th Edition* fitted curve equations published for "General Office Building" (Land Use Code 710).
[3] Peak-hour trip generation rates for R&D use are based on the ITE's *Trip Generation Manual, 10th Edition* average rates published for "Research and Development Center" (Land Use Code 760).
[4] Peak-hour trip generation rates for warehouse use are based on the ITE's *Trip Generation Manual, 10th Edition* fitted curve equations published for "Warehousing" (Land Use Code 150).

Intersection Level of Service Results

The intersection level of service analysis (see Tables ES-2 and ES-3) concluded that based on City of Sunnyvale intersection impact criteria, the project would generate a significant intersection impact at the unsignalized intersection at Commercial Street and Kifer Road.

The unsignalized intersection of Commercial Street and Kifer Road has an intersection level of service threshold of LOS D. Under background conditions, the LOS would be an unacceptable LOS E during the PM peak hour. The addition of proposed project traffic would deteriorate the intersection to LOS F during the PM peak hour. For the PM peak hour, the proposed project traffic would cause an increase in critical delay of 21.2 seconds and an increase in critical v/c ratio of 0.137. Based on City of Sunnyvale significant impact criteria, the project would generate a significant intersection impact at this intersection during both the PM peak hour.

Mitigation Strategies

Mitigation would require installation of a signal at the intersection of Commercial Street and Kifer Road. Installation of a signal would significantly reduce the delay for southbound vehicles while maintaining minimal delay for westbound and eastbound traffic. The project applicant will be responsible for the signal installation costs. City staff will collect and reserve the signal installation costs for a period of ten years while monitoring the intersection. If a signal is needed the City will construct it as a Capital Improvement Project. If a signal is not needed within the ten-year period City staff will refund the signal installation costs to the project applicant. With this proposed mitigation, the intersection would operate at an acceptable LOS B or better during the AM and PM peak hours. Under the City of Sunnyvale's standards, the proposed mitigation would eliminate the significant impact. With the proposed mitigation, the traffic impact at this intersection would be *less than significant.*

Other Transportation Issues

Hexagon conducted a site plan review, queuing analysis, pedestrian, bicycle and transit facility analysis and parking analysis for the proposed project. Our recommendations are listed below.

Recommendations

- It is recommended that the project explore options to provide shuttle bus service to either/both the Sunnyvale Caltrain station and the Lawrence Caltrain station, which can be addressed in the project's final TDM plan.
- As proposed by the project, the project shall install sidewalks along the project frontage on Kifer Road, on Commercial Street south of the northern driveway, and on San Lazaro Avenue.
- As proposed by the project, the project shall install an ADA compliant ramp at the northwest corner of Kifer Road and Commercial Street.
- Per City design standards, the project-proposed green bike lanes on westbound Kifer Road do not meet design standards and shall not be proposed.

Table ES- 2
Signalized Intersection Level of Service Summary

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing			Existing Plus Project				Background		Background Plus Project			
					Count Date	Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c	Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c
1	Fair Oaks Avenue & US 101 NB Ramps	Signal	E	AM	05/08/18	29.7	C	29.9	C	0.4	0.000	47.2	D	47.3	D	0.3	0.001
				PM	05/08/18	31.3	C	30.9	C	0.7	0.008	48.8	D	50.2	D	1.9	0.007
2	Fair Oaks Avenue & Duane Avenue	Signal	D	AM	05/08/18	36.1	D+	36.0	D+	-0.1	0.002	37.4	D+	37.3	D+	-0.1	0.002
				PM	05/08/18	35.7	D+	35.7	D+	-0.1	0.003	39.5	D	39.5	D	0.2	0.003
3	Wolfe Road & Maude Avenue[1]	Signal	D	AM	12/06/18	-	-	-	-	-	-	23.4	C	23.4	C	-0.1	0.002
				PM	12/06/18	-	-	-	-	-	-	30.5	C	30.5	C	0.0	0.001
4	Wolfe Road & Stewart Drive	Signal	D	AM	11/15/17	14.5	B	14.5	B	-0.3	0.003	13.7	B	13.8	B	-0.2	0.003
				PM	11/15/17	27.8	C	27.7	C	-0.3	0.003	26.8	C	26.7	C	-0.2	0.002
5	Wolfe Road & Arques Avenue	Signal	D	AM	11/14/17	49.4	D	49.3	D	-0.2	0.002	52.0	D-	51.9	D-	-0.2	0.002
				PM	11/14/17	43.9	D	43.8	D	0.0	0.001	44.5	D	44.5	D	0.0	0.000
6	Wolfe Road & Central Expressway Ramps	Signal	E	AM	12/06/17	37.4	D+	37.4	D+	-0.2	0.003	59.3	E+	59.5	E+	0.0	0.003
				PM	12/06/17	**84.4**	**F**	**83.6**	**F**	**-0.9**	**0.000**	**110.7**	**F**	**110.1**	**F**	**-0.7**	**0.001**
7	Wolfe Road & Kifer Road	Signal	D	AM	11/14/17	26.2	C	27.0	C	0.1	0.001	36.7	D+	37.4	D+	0.7	0.010
				PM	11/14/17	36.8	D+	37.4	D+	1.2	0.006	46.5	D	47.7	D	2.6	0.007
8	Wolfe Road & Evelyn Avenue	Signal	D	AM	11/15/17	34.3	C-	34.3	C-	0.0	0.001	34.4	C-	34.4	C-	0.1	0.001
				PM	11/15/17	35.8	D+	35.7	D+	-0.1	0.002	34.0	C-	34.0	C-	0.0	0.002
10	Semiconductor Drive & Kifer Road	Signal	D	AM	09/11/18	14.1	B	14.0	B	0.0	0.010	19.4	B-	19.2	B-	0.0	0.011
				PM	09/11/18	9.4	A	9.3	A	-0.1	0.010	19.1	B-	18.9	B-	-0.1	0.010
11	Lawrence Expressway & Arques Avenue* (County)	Signal	E	AM	04/04/17	48.2	D	48.1	D	0.0	0.000	59.7	E+	59.7	E+	0.1	0.001
				PM	10/04/16	68.1	E	68.0	E	0.1	0.001	**84.3**	**F**	**84.4**	**F**	**0.3**	**0.001**
12	Lawrence Expressway & Kifer Road (County)	Signal	E	AM	03/07/18	54.4	D-	54.4	D-	0.1	0.001	**80.8**	**F**	**80.8**	**F**	**0.3**	**0.001**
				PM	03/07/18	**101.6**	**F**	**103.8**	**F**	**5.6**	**0.007**	**>120**	**F**	**>120**	**F**	**5.5**	**0.008**
13	Lawrence Expressway & Monroe Street/Reed Avenue* (County)	Signal	E	AM	03/07/18	**114.8**	**F**	**115.7**	**F**	**1.2**	**0.002**	**>120**	**F**	**>120**	**F**	**1.3**	**0.002**
				PM	10/05/16	74.1	E	74.7	E	1.0	0.002	**83.8**	**F**	**84.3**	**F**	**0.8**	**0.002**

Notes

** = CMP, County = County of Santa Clara*

Level of service for signal controlled intersection is based on the average intersection delay.

">120" indicates the intersection experiences lengthy delay that is beyond the reasonable calculation range of the HCM 2000 methodology.

BOLD indicates substandard level of service.

[1] The intersection of Wolfe Road and Maude Avenue will be converted from side-street stop control under existing conditions to signal control under background conditions.

Table ES- 3
Unsignalized Intersection Level of Service Summary

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing				Existing Plus Project					Background			Background Plus Project				
					Count Date	Avg. Delay (sec)	LOS	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c	Signal Warrant Met[1]
3	Wolfe Road & Maude Avenue	Side Street Stop	D	AM	12/06/18	25.7	D	No	26.1	D	0.4	0.001	No	-	-	-	-	-	-	-	-
				PM	12/06/18	**67.4**	**F**	**Yes**	**68.6**	**F**	**1.2**	**0.000**	**Yes**	-	-	-	-	-	-	-	-
9	Commercial Street & Kifer Road	Side Street Stop	D	AM	12/06/18	12.3	B	No	12.7	B	0.4	0.012	No	15.0	B	No	15.7	C	0.7	0.023	No
				PM	12/06/18	24.1	C	Yes	31.2	D	7.1	0.073	Yes	**40.3**	**E**	**Yes**	**61.5**	**F**	**21.2**	**0.137**	**Yes**

Notes

Level of service for side street stop controlled intersections is based on the delay experiences by the worst movement.

">120" indicates the intersection experiences lengthy delay that is beyond the reasonable calculation range of the HCM 2000 methodology.

BOLD indicates substandard level of service.

BOLD and boxed indicates a significant impact.

[1] The CA MUTCD peak-hour signal warrant is checked only if the intersection is operating at an unacceptable level of service.

[2] The intersection of Wolfe Road and Maude Avenue will be converted from side-street stop control under existing conditions to signal control under background conditions.

1. Introduction

This report presents the results of the transportation operations analysis (TOA) conducted for the proposed office and R&D development at 901 Kifer Road in Sunnyvale, CA (see Figure 1). The project site is bounded by Central Expressway to the north, Commercial Street to the east, Kifer Road to the south, and the 899 Kifer Road building to the west. Currently, Fortinet owns the buildings at both 899 Kifer Road and 901 Kifer Road[2]. At 901 Kifer Road, Fortinet proposes to demolish nine existing buildings totaling 117,812 square feet (s.f.) and construct a four-story, 172,740 s.f. office and R&D building. The proposed building would be accessed via two driveways on Commercial Street and would be connected to the existing site at 899 Kifer Road via one east-west drive aisle (see Figure 2).

Scope of Study

This study was conducted for the purpose of identifying the potential near-term traffic impacts related to the proposed development. The purpose of this traffic study is to satisfy the requirements of the City of Sunnyvale. Since the project is expected to generate less than 100 new peak-hour trips, an analysis in accordance with the Santa Clara Valley Transportation Authority (VTA) County Congestion Management Program (CMP) guidelines is not required. The traffic study includes an analysis of AM and PM peak hour traffic conditions for 13 intersections in the vicinity of the project site. Two of the study intersections are CMP intersections, and two of the study intersections are unsignalized intersections. The study intersections were selected to include locations where the proposed project is expected to generate 10 or more peak-hour trips per lane.

[2] The report will loosely refer to the proposed project with an address of 901 Kifer Road. The proposed project site actually encompasses 893-909, 917, and 919-921 Kifer Road, and 133-135, 155, 165, 167-171, 181, 183 and 193 Commercial Street.

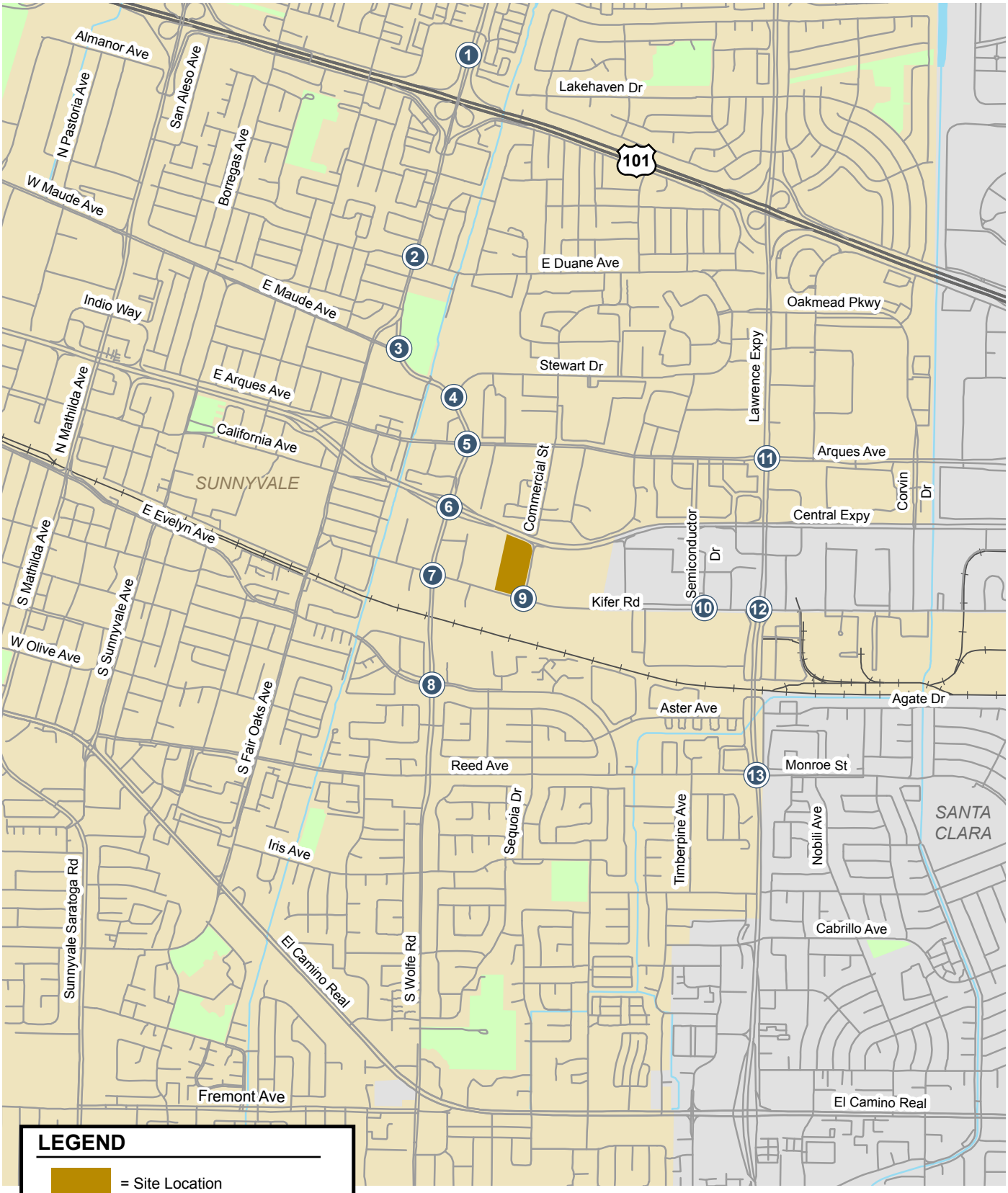


Figure 1
Site Location and Study Intersections

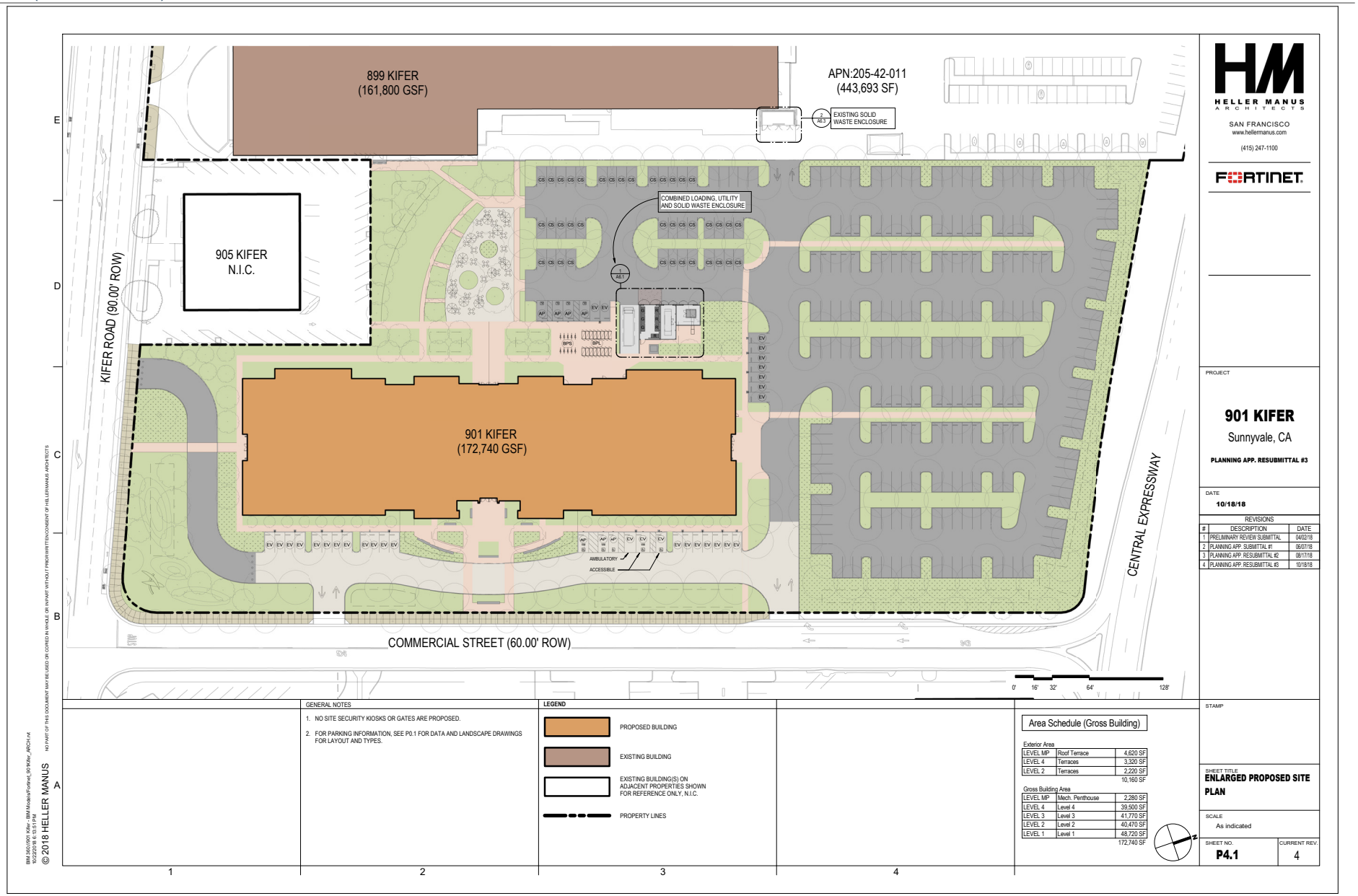


Figure 2
Proposed Project Site Plan

NORTH
Not to Scale

The study intersections are listed below.

Study Intersections

1. Fair Oaks Avenue & US 101 Northbound Ramps
2. Fair Oaks Avenue & Duane Avenue
3. Wolfe Road & Maude Avenue (unsignalized)
4. Wolfe Road & Stewart Drive
5. Wolfe Road & Arques Avenue
6. Wolfe Road & Central Expressway Ramps
7. Wolfe Road & Kifer Road
8. Wolfe Road & Evelyn Avenue
9. Commercial Street & Kifer Road (unsignalized)
10. Semiconductor Drive & Kifer Road
11. Lawrence Expressway & Arques Avenue *
12. Lawrence Expressway & Kifer Road
13. Lawrence Expressway & Monroe Street/Reed Avenue *

* Denotes CMP intersections

Traffic conditions at the study intersections were analyzed for the weekday AM and PM peak hours of commute traffic. In the study area, the AM peak hour typically occurs between 7:00 AM and 10:00 AM, and the PM peak hour typically occurs between 4:00 PM and 7:00 PM. These are the peak commute hours during which most traffic congestion occurs on the roadway network.

Traffic conditions were evaluated for the scenarios described below.

Scenario 1: *Existing Conditions.* Existing conditions are based on recent traffic counts collected at the study intersections. Existing traffic count data is provided in Appendix A.

Scenario 2: *Background Conditions.* Background conditions were estimated by adding to existing traffic volumes the project traffic from approved but not yet completed and occupied developments in the study area. Approved project trips and approved project trip information were obtained from the City of Sunnyvale and the City of Santa Clara. In addition, roadway improvements associated with the approved developments were assumed as directed by City Staff.

Scenario 3: *Existing Plus Project Conditions.* Existing plus project conditions were estimated by adding to existing traffic volumes the additional traffic generated by the project. Existing plus project conditions were evaluated relative to existing conditions in order to determine the effects the project would have on the existing roadway network.

Scenario 4: *Background Plus Project Conditions.* Background traffic volumes with the project were estimated by adding to background traffic volumes the additional traffic generated by the project. Background plus project conditions were evaluated relative to background conditions in order to determine potential project impacts.

Methodology

This section presents the methods used to determine the traffic conditions for each scenario described above. It includes descriptions of the data requirements, the analysis methodologies, and the applicable level of service standards.

Data Requirements

The data required for this traffic study were obtained from the City of Sunnyvale, the City of Santa Clara, the VTA CMP TRAFFIX database, county records for freeways and expressways, Institute of Transportation Engineers' (ITE) *Trip Generation Manual, 10th Edition (2017)*, field observations, and previous traffic studies. The following data were collected from these sources:

- Existing traffic volumes,
- Existing lane configurations,
- Signal timing and phasing,
- Applicable trip generation rates, and
- Approved projects information.

Level of Service Standards and Analysis Methodologies

Traffic conditions at the study intersections were evaluated using level of service (LOS). *Level of Service* is a qualitative description of operating conditions ranging from LOS A, or free-flow conditions with little or no delay, to LOS F, or jammed conditions with excessive delays. The level of service analysis was supplemented with a queuing analysis for selected movements at the study intersections. In addition, the unsignalized intersections of Wolfe Road/Maude Avenue and Commercial Street/Kifer Road were evaluated to determine if the intersections would meet the peak-hour signal warrant. The various analysis methods are described in further detail below.

Signalized Study Intersections

The City of Sunnyvale level of service methodology for signalized intersections is the *Highway Capacity Manual* (HCM) 2000 method. This method is applied using the TRAFFIX software. The HCM 2000 operations method evaluates signalized intersection operations on the basis of average control delay time for all vehicles at the intersection. Since TRAFFIX is also the CMP-designated intersection level of service methodology, the City of Sunnyvale methodology employs the CMP default values for the analysis parameters.

The City of Sunnyvale General Plan level of service standard for signalized intersections is LOS D or better, except that intersections on roadways considered "regionally significant" have a standard of LOS E. In the study area, signalized intersections within Sunnyvale along Lawrence Expressway, El Camino Real, and ramp junctions at Central Expressway and US 101 are considered regionally significant. The correlation between average control delay and level of service is shown in Table 1.

CMP Intersections

The designated level of service methodology for the CMP also is the 2000 HCM operations method for signalized intersections, using TRAFFIX. The CMP level of service standard for signalized intersections within Sunnyvale is LOS E or better.

Table 1
Signalized Intersection Level of Service Definitions Based on Delay

Level of Service	Description	Average Control Delay Per Vehicle (sec/veh)
A	Signal progression is extremely favorable. Most vehicles arrive during the green phase and do not stop at all. Short cycle lengths may also contribute to the very low vehicle delay.	10.0 or less
B+ B B-	Operations characterized by good signal progression and/or short cycle lengths. More vehicles stop than with LOS A, causing higher levels of average vehicle delay.	10.1 to 12.0 12.1 to 18.0 18.1 to 20.0
C+ C C-	Higher delays may result from fair signal progression and/or longer cycle lengths. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant, though may still pass through the intersection without stopping.	20.1 to 23.0 23.1 to 32.0 32.1 to 35.0
D+ D D-	The influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable signal progression, long cycle lengths, or high volume-to-capacity (V/C) ratios. Many vehicles stop and individual cycle failures are noticeable.	35.1 to 39.0 39.1 to 51.0 51.1 to 55.0
E+ E E-	This is considered to be the limit of acceptable delay. These high delay values generally indicate poor signal progression, long cycle lengths, and high volume-to-capacity (V/C) ratios. Individual cycle failures occur	55.1 to 60.0 60.1 to 75.0 75.1 to 80.0
F	This level of delay is considered unacceptable by most drivers. This condition often occurs with oversaturation, that is, when arrival flow rates exceed the capacity of the intersection. Poor progression and long cycle lengths may also be major contributing causes of such delay levels.	greater than 80.0
Source:	Transportation Research Board, 2000 Highway Capacity Manual (Washington, D.C., 2000) p10-16. VTA Traffic Level of Service Analysis Guidelines (June 2003), Table 2.	

Unsignalized Study Intersections

The level of service for the unsignalized intersections was evaluated using the 2000 HCM methodology. Level of service for unsignalized (stop-controlled and yield controlled) intersections is evaluated based on the delay experienced by vehicles on the controlled approaches. For two-way or T-intersections, operations are defined by the average control delay experienced by the worst approach. For all-way stop controlled intersections, the level of service is reported based on the average delay for all approaches. The City of Sunnyvale General Plan level of service standard for unsignalized intersections is LOS D or better.

The correlation between delay and level of service for unsignalized intersections is shown in Table 2.

Table 2
Unsignalized Intersection Level of Service Based on Delay

Level of Service	Description	Average Delay Per Vehicle (sec.)
A	Little or no traffic delay	10.0 or less
B	Short traffic delays	10.1 to 15.0
C	Average traffic delays	15.1 to 25.0
D	Long traffic delays	25.1 to 35.0
E	Very long traffic delays	35.1 to 50.0
F	Extreme traffic delays	greater than 50.0

Source: Transportation Research Board, *2000 Highway Capacity Manual* (Washington, D.C., 2000) p17-2.

Traffic Signal Warrant Analysis

An assessment of the need for signalization was conducted for the unsignalized intersections. For this study, the need for signalization is assessed on the basis of the peak hour volume signal warrant (Warrant #3) described in the 2014 California Manual on Uniform Traffic Control Devices (CA MUTCD). This method provides an indication of whether traffic conditions and peak-hour traffic levels are, or would be, sufficient to justify the installation of a traffic signal. It should be noted that it is just one of the factors/warrants used to indicate whether installation of a traffic control signal is justified.

Vehicle Queuing

For selected high-demand movements at the study intersections, the estimated maximum vehicle queues were compared to the existing or planned storage capacity. The queuing analysis is presented for informational purposes only. The City of Sunnyvale does not have significant impact criteria for intersection queuing. However, in the City of Sunnyvale, a project is said to create an operational deficiency if the with-project conditions increases the 95th percentile queue by one vehicle for a movement that is already over capacity compared to the background conditions.

Vehicle queues were calculated using a Poisson probability distribution, which estimates the probability of "n" vehicles for a vehicle movement using the following formula:

$$P(x = n) = \frac{\lambda^n e^{-(\lambda)}}{n!}$$

Where:

$P(x = n)$ = probability of "n" vehicles in queue per lane

n = number of vehicles in the queue per lane

λ = Average number of vehicles in the queue per lane (vehicles per hour per lane/signal cycles per hour)

The basis of the analysis is as follows: (1) the Poisson probability distribution is used to estimate the 95th percentile maximum number of queued vehicles per signal cycle for a particular movement; (2) the estimated maximum number of vehicles in the queue is translated into a queue length, assuming 25 feet per vehicle; and (3) the estimated maximum queue length is compared to the existing or planned available storage capacity for the movement.

For signalized intersections, the 95th percentile queue length value indicates that during the peak hour, a queue of this length or less would occur on 95 percent of the signal cycles. Or, a queue length larger than the 95th percentile queue would only occur on 5 percent of the signal cycles (about 3 cycles during the peak hour for a signal with a 60-second cycle length). Therefore, left-turn pocket storage designs based on the 95th percentile queue length would ensure that storage space would be exceeded only 5 percent of the time for a signalized movement. The 95th percentile queue length is also known as the "design queue length."

Significant Impact Criteria

Significance criteria are used to establish what constitutes an impact. For this analysis, the criteria used to determine significant impacts on signalized and unsignalized intersections are based on the City of Sunnyvale and VTA's CMP level of service standards.

The effects of the project on other transportation facilities, such as bicycle facilities and transit service, were determined on the basis of engineering judgment.

Definition of Significant Intersection Impacts at Signalized Intersections

The project is said to create a significant adverse impact on traffic conditions at a signalized intersection in the City of Sunnyvale if for the study peak hour:

1. The level of service at the intersection drops below its respective level of service standard when project traffic is added; or,
2. An intersection that operates below its level of service standard under no project conditions experiences an increase in critical-movement delay of four (4) or more seconds, *and* the critical volume-to-capacity ratio (v/c) is increased by 0.01 or more when project traffic is added.

The exception to this threshold is when the addition of project traffic reduces the amount of average control delay for critical movements, i.e., the change in average control delay for critical movements are negative. In this case, the threshold is when the project increases the critical V/C value by 0.01 or more.

The operation of principal arterials and state highways located within urbanized Santa Clara County is measured by the level of service at CMP Intersections. CMP intersections are generally high-volume intersections located along these thoroughfares. The definition of a significant impact at a CMP intersection is the same as for the City of Sunnyvale, except that the standard for acceptable level of service for all CMP and regional intersections is LOS E or better.

A significant impact by the City of Sunnyvale CMP standards is said to be satisfactorily mitigated when measures are implemented that would restore intersection conditions to its LOS standard *or* to an average delay that eliminates the project impact.

Definition of Significant Intersection Impacts at Unsignalized Intersections

Level of service analysis at unsignalized intersections is generally used to determine the need for modification in type of intersection control (i.e. all-way stop or signalization). As part of this evaluation, traffic volumes, delays, and traffic signal warrants are evaluated to determine if the existing intersection control is appropriate.

Per City of Sunnyvale guidelines, for determining the level of service for unsignalized intersections, the average intersection delay is used for all-way stop controlled intersections, and the worst movement delay is used for side-street stop-controlled intersections and yield-controlled intersections. Project impacts at the City's unsignalized intersections would be considered significant if one of the following criteria is met:

1. If an intersection operates at an acceptable LOS (i.e. D or better) without the project and degrades to an unacceptable LOS (i.e. LOS E or F) with the addition of project traffic.

2. If an unsignalized intersection operates at an unacceptable LOS (i.e. LOS E or F) without the project and the addition of project traffic increases:

    a. The average intersection delay by four (4) seconds or more, and the volume-to-capacity value by 0.01 or more for all-way stop controlled intersections; or

    b. The worst movement delay by four (4) seconds or more, and the volume-to-capacity value by 0.01 or more for side-street stop controlled intersections.

3. Intersection meets the warrants(s) for installation of a traffic signal as per the latest edition of California Manual on Uniform Traffic Control Devices.

Report Organization

The remainder of this report is divided into six chapters. Chapter 2 describes the existing roadway network, transit services, and pedestrian and bicycle facilities. Chapter 3 presents the traffic conditions in the study area under background conditions. Chapter 4 describes the methods used to estimate the project traffic on the roadway network and presents the intersection operations under existing plus project and background plus project conditions. Chapter 5 provides an evaluation of other transportation related issues for the proposed project, such as vehicle queuing, potential project impacts on transit, pedestrian, and bicycle facilities, site access and circulation, and parking. Chapter 6 presents the traffic study conclusions, including a summary of any proposed mitigation measures and recommended improvements.

2. Existing Conditions

This chapter describes the existing conditions for transportation facilities in the vicinity of the site, including the roadway network, transit services, and pedestrian and bicycle facilities.

Existing Roadway Network

Regional access to the study area is provided by US 101.

> *US 101* is an eight-lane freeway (three mixed-flow lanes and one HOV lane in each direction) in the vicinity of the site. US 101 extends northward through San Francisco and southward through Gilroy. Access to and from the project area is provided via full interchanges at Fair Oaks Avenue and Lawrence Expressway.

Major roadways within or near the project area include: Lawrence Expressway, Central Expressway, Wolfe Avenue, Kifer Road, and Commercial Street. These roads are described below.

> *Lawrence Expressway* is a north-south, eight-lane expressway with a raised median and a posted speed limit of 50 mph in the study area. It begins at Saratoga Avenue in the south, crosses through Sunnyvale, and extends northward and transitions into Caribbean Drive. Lawrence Expressway connects with US 101 via a full-access freeway interchange. Lawrence Expressway provides access to the project site via Reed Avenue. In the study area, Lawrence Expressway includes sidewalks along both sides and crosswalks at the nearby signalized intersections. Lawrence Expressway generally has shoulders and allows bikes, but does not have designated bike lanes.
>
> *Central Expressway* is an east-west, four-lane to six-lane expressway. In the study area, Central Expressway has two eastbound lanes and two westbound lanes and a posted speed limit of 50 mph. It begins at Trimble Road in the east, crosses Sunnyvale, extends westward and transitions into Alma Street. Central Expressway connects to Lawrence Expressway, Wolfe Road, and Commercial Street in the project vicinity. Pedestrians are prohibited to use Central Expressway. Most sections have shoulders but no designated bike lanes.

Wolfe Road is a four-lane to six-lane, north-south arterial that begins at N. Fair Oaks Avenue, and extends into the City of Cupertino, ending at Stevens Creek Boulevard (its transition point into Miller Avenue). Wolfe Road has a raised center median and a posted speed limit of 35 mph in the study area. Wolfe Road has a full-access interchange with Central Expressway. In the study area, Wolfe Road includes sidewalks and bike lanes on both sides and crosswalks at the nearby signalized intersections. Wolfe Road provides access to the project site via Kifer Road.

Kifer Road is a four-lane roadway that begins west at N. Fair Oaks Avenue and extends east towards Bowers Avenue. Kifer Road includes a center two-way left-turn lane and has a posted speed limit of 40 mph. In the project vicinity, Kifer Road includes bicycle lanes on both sides but lack sidewalks along certain segments of the roadway. Crosswalks are present at the nearby signalized study intersections. The nearby unsignalized study intersection at Kifer Road and Commercial Street does not have crosswalks. Kifer Road provides access to the project site via Commercial Street.

Commercial Street is a two-lane roadway that is broken into two segments. The northern segment extends north from Central Expressway to Arques Avenue, and the southern segment extends south from Central Expressway to Kifer Road. The southern segment of Commercial Street has a posted speed limit of 25 mph and provides direct access to the project site. There are no bike lanes, sidewalks or on-street parking along the southern segment of Commercial Street.

Existing Transit Service

Existing transit service to the study area is provided by VTA, the Altamont Commuter Express (ACE), and Caltrain. These services are described below and shown on Figure 3.

VTA and ACE Bus Services

VTA does not provide bus service that stops within walking distance of the project site. The Altamont Commuter Express (ACE) Gray Shuttle (Route 822) serves the project site. ACE provides commuter rail service between Stockton, Tracy, Pleasanton, and San Jose during commute hours. This free shuttle, funded by the Bay Area Air Quality Management District, transports passengers to and from the ACE Great America Station in Santa Clara. The Gray Shuttle runs on Arques Avenue, Wolfe Road, and Kifer Road, with four eastbound trips in the morning and four westbound trips in the afternoon/evening with headways averaging 60 minutes. Within the project vicinity, the Gray Shuttle stops approximately 1,000 feet west of the project site on Kifer Road.

Caltrain Service

The project site is located approximately half way between the Sunnyvale Caltrain Station and the Lawrence Caltrain Station. Caltrain service to both stations is described below.

Sunnyvale Caltrain Station

The Sunnyvale Caltrain Station, located near the intersection of Frances Street and Evelyn Avenue, provides Caltrain service with approximately 15- to 30-minute headways during the weekday AM and PM commute hours and 60-minute headways during weekday midday and night hours as well as on weekends. The Sunnyvale Caltrain Station provides service for all Local, Limited-Stop, and Baby-Bullet trains. The Sunnyvale Caltrain Station is located approximately 6,500 feet from the project site, which is an approximately a 5- to 7-minute bike ride. There are continuous bike facilities between the Sunnyvale Caltrain station and the project site.

Lawrence Caltrain Station

The Lawrence Caltrain Station, located beneath the Lawrence Expressway overcrossing between Reed Avenue and Kifer Road, provides Caltrain service with approximately 20- to 30-minute headways during the weekday AM and PM commute hours and 60-minute headways during weekday midday and night hours as well as on weekends. The Lawrence Caltrain Station provides service for only Local and Limited-Stop trains. The Baby-Bullet train does not stop at the Lawrence Caltrain Station. The Lawrence Caltrain Station is located approximately 5,000 feet from the project site, which is an approximately 4- to 6-minute bike ride. Between the project site and the Lawrence Caltrain station, bicycle lanes are present along Kifer Road, but San Zeno Way does not provide bicycle facilities.

Three free public Caltrain shuttles provide service at the Lawrence Caltrain Station: the Duane Avenue shuttle, the Bowers-Walsh shuttle, and the Mission shuttle. These shuttles are funded jointly by the Bay Area Air Quality Management District, the Peninsula Corridor Joint Powers Board and private employers. None of these shuttles provide service to the project site.

Existing Pedestrian Facilities

Sidewalks are lacking along both sides of the segments of Kifer Road and of Commercial Street fronting the existing Fortinet campus as well as the proposed project site. Sidewalks are also missing on San Lazaro Avenue north of Kifer Road leading to the driveway of 899 Kifer Avenue. Pedestrian crosswalks and signal heads are present at the nearby signalized study intersections of Wolfe Avenue/Kifer Road, Semiconductor Drive/Kifer Road, and Lawrence Expressway/Kifer Road.

Existing Bicycle Facilities

Bicycle facilities in the project vicinity include bike lanes and bike routes. Bike lanes are lanes on roadways designated for use by bicycles with special lane markings, pavement legends, and signage. Bike routes are streets that accommodate bicycles with pavement markings and signage but are not separate from the travel lanes.

The existing bicycle facilities in the study area are shown on Figure 4. Information about bicycle facilities in the study area is published in the *Sunnyvale Bike Map & Guide to Safe Cycling*, published by the City of Sunnyvale in 2018.The following bicycle facilities exist within the immediate project vicinity:

Bike Lanes:

- Kifer Road
- Evelyn Avenue
- Reed Avenue/Old San Francisco Road between Sunnyvale Avenue and Lawrence Expressway
- Arques Avenue
- Wolfe Road between Reed Avenue and Fair Oaks Avenue

Existing Intersection Lane Configurations

The existing lane configurations at the study intersections were obtained by observations in the field and are shown on Figure 5.

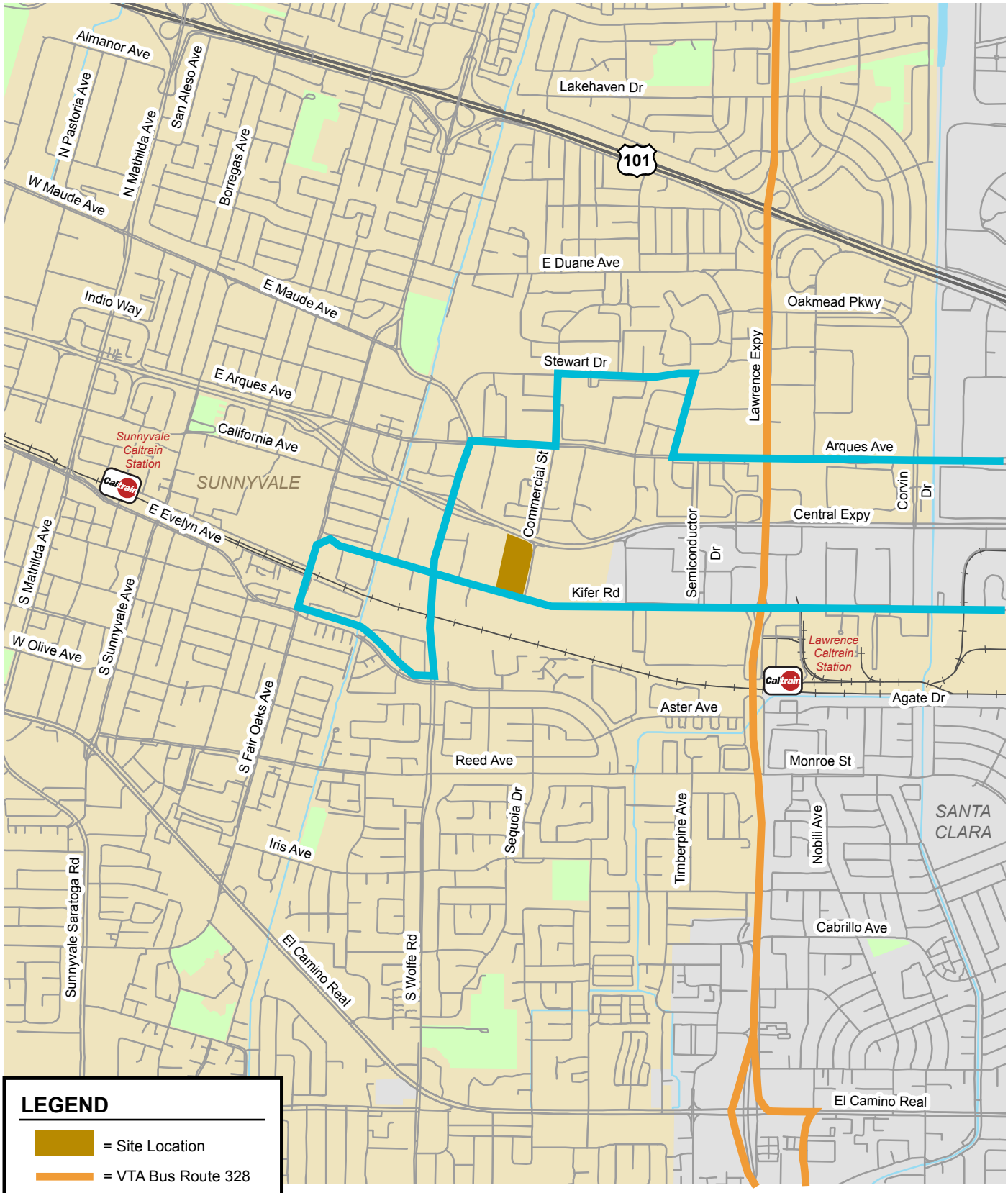


Figure 3
Existing Transit Service

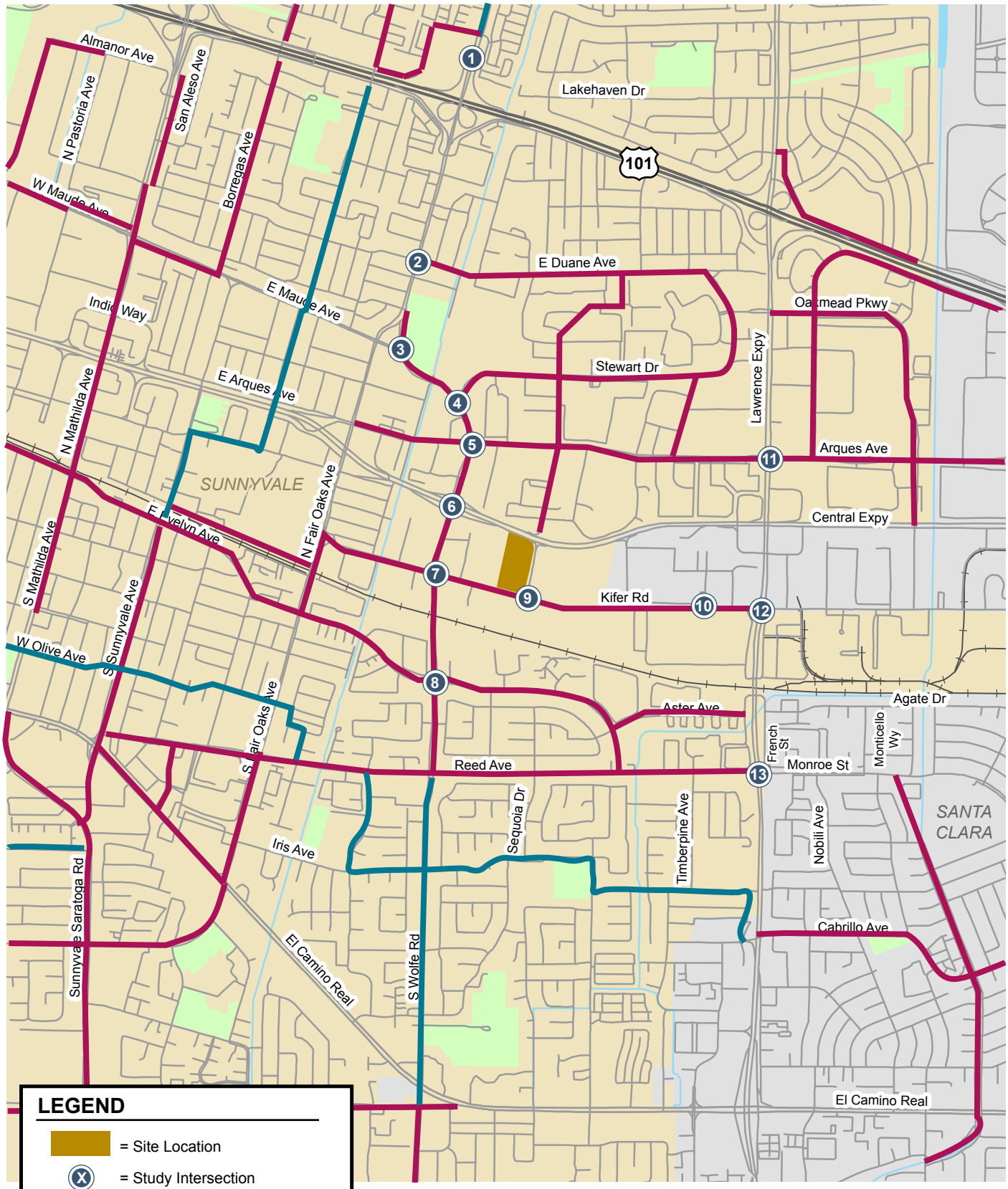
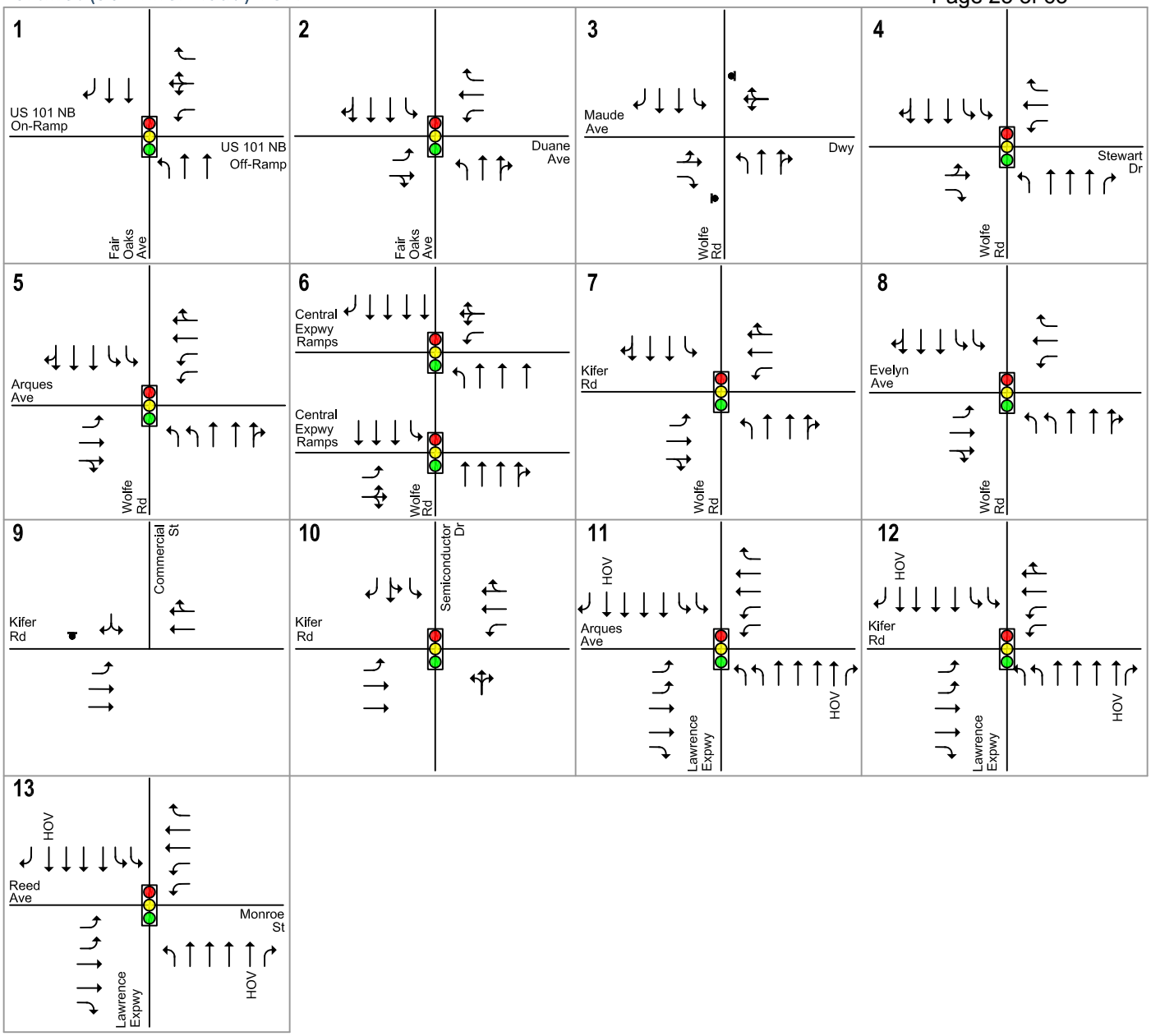


Figure 4
Existing Bicycle Facilities



LEGEND

= Stop Sign

= Signal

Figure 5
Existing Lane Configurations

NORTH
Not to Scale

Existing Traffic Volumes

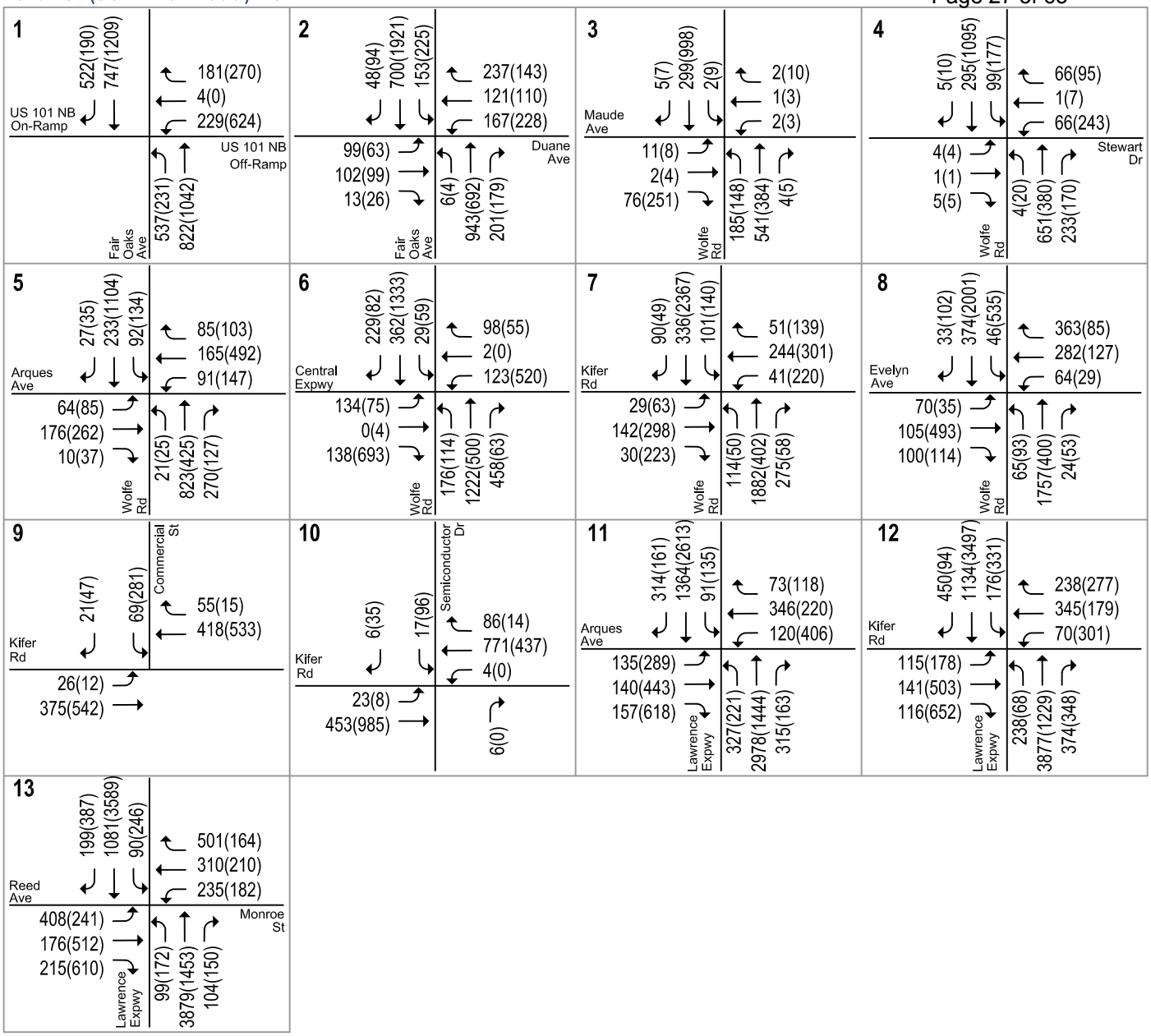
The existing traffic volumes were obtained from peak hour traffic counts collected in 2017 and 2018, except for the PM CMP existing traffic counts, which were collected in October 2016. The existing AM and PM peak hour traffic volumes are shown graphically on Figure 6. Traffic count data are included in Appendix A. Traffic volumes at the study intersections for all scenarios of the traffic study are tabulated in Appendix B.

Existing Intersection Level of Service

The intersection levels of service at the study intersections were evaluated against the City's and CMP standards. The results of the intersection level of service analysis under existing conditions are summarized in Table 3 for the signalized study intersections and Table 4 for the unsignalized study intersections. The results of the analysis show that the majority of the study intersections currently operate at acceptable levels. However, the following study intersections are currently operating below the LOS standard during at least one peak hour:

- Wolfe Road and Maude Avenue (#3) – PM peak hour (LOS F)
- Wolfe Road and Central Expressway Ramps (#6) – PM peak hour (LOS F)
- Lawrence Expressway and Kifer Road (#12) – PM peak hour (LOS F)
- Lawrence Expressway and Monroe Street/Reed Avenue (#13) – AM peak hour (LOS F)

As shown on Table 4, the unsignalized intersection at Wolfe Road and Maude Avenue is currently operating at an unacceptable LOS F during the PM peak hour for the worst approach (the eastbound left-turn movement). This eastbound left-turn movement currently experiences lengthy delays because vehicles must wait for a gap in both directions of travel on Wolfe Road before turning. The peak-hour signal warrant was checked for this intersection, and the results show that this intersection currently meets the peak-hour signal warrant during the PM peak hour. At the time of this report, a signal at this intersection is being studied by City staff. The other unsignalized intersection at Commercial Street and Kifer Road currently operates at LOS C during the PM peak hour and meets the peak-hour signal warrant. The intersection level of service sheets are included in Appendix C. The peak-hour signal warrant worksheet is included in Appendix D.



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

Figure 6
Existing Traffic Volumes

Table 3
Existing Level of Service Summary - Signalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing		
					Count Date	Avg. Delay (sec)	LOS
1	Fair Oaks Avenue & US 101 NB Ramps	Signal	E	AM	05/08/18	29.7	C
				PM	05/08/18	30.4	C
2	Fair Oaks Avenue & Duane Avenue	Signal	D	AM	05/08/18	36.1	D+
				PM	05/08/18	35.7	D+
4	Wolfe Road & Stewart Drive	Signal	D	AM	11/15/17	14.5	B
				PM	11/15/17	27.8	C
5	Wolfe Road & Arques Avenue	Signal	D	AM	11/14/17	49.4	D
				PM	11/14/17	43.9	D
6	Wolfe Road & Central Expressway Ramps	Signal	E	AM	12/06/17	37.4	D+
				PM	12/06/17	**84.4**	**F**
7	Wolfe Road & Kifer Road	Signal	D	AM	11/14/17	26.2	C
				PM	11/14/17	36.8	D+
8	Wolfe Road & Evelyn Avenue	Signal	D	AM	11/15/17	34.3	C-
				PM	11/15/17	35.8	D+
10	Semiconductor Drive & Kifer Road	Signal	D	AM	09/11/18	14.1	B
				PM	09/11/18	9.4	A
11	Lawrence Expressway & Arques Avenue* (County)	Signal	E	AM	04/04/17	48.2	D
				PM	10/04/16	68.1	E
12	Lawrence Expressway & Kifer Road (County)	Signal	E	AM	03/07/18	54.4	D-
				PM	03/07/18	**101.6**	**F**
13	Lawrence Expressway & Monroe Street/Reed Avenue* (County)	Signal	E	AM	03/07/18	**114.8**	**F**
				PM	10/05/16	74.1	E

Notes

** = CMP, County = County of Santa Clara*

Level of service for signal controlled intersection is based on the average intersection delay.

BOLD indicates substandard level of service.

Table 4
Existing Level of Service Summary - Unsignalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing			
					Count Date	Avg. Delay (sec)	LOS	Signal Warrant Met[1]
3	Wolfe Road & Maude Avenue	Side Street Stop	D	AM	12/06/18	25.7	D	No
				PM	12/06/18	**67.4**	**F**	**Yes**
9	Commercial Street & Kifer Road	Side Street Stop	D	AM	12/06/18	12.3	B	No
				PM	12/06/18	24.1	C	Yes

Notes

Level of service for side street stop controlled intersections is based on the delay experiences by the worst movement.

BOLD indicates substandard level of service.

[1] The CA MUTCD peak-hour signal warrant is checked only if the intersection is operating at an unacceptable level of service.

Observed Existing Conditions

Traffic conditions were observed in the field in order to identify existing operational deficiencies and to confirm the accuracy of calculated intersection levels of service. The purpose of this effort was (1) to identify any existing traffic problems that may not be directly related to level of service, and (2) to identify any locations where the level of service analysis does not accurately reflect existing traffic conditions. Hexagon conducted field observations in 2017 and 2018 during the AM peak commute period (7:00 AM to 10:00 AM) and during the PM peak commute period (4:00 PM to 7:00 PM). During the peak commute periods, most of the study intersections had no significant operational issues, and vehicular queues on all approaches were mostly able to clear in one cycle. The observed operational issues at the study intersections are identified below.

Note that the discussion below describes occasional instances when specific movements could not make it through the intersections in one cycle. Intersection level of service calculations for signalized intersections are based on the average delay of all movements within the peak hour. Therefore, if one movement is failing to clear within one signal cycle but other movements receive minimal delays, the intersection could still operate at an acceptable level of service.

Fair Oaks Avenue and US 101 Northbound Ramps

During the AM peak commute period, the northbound left-turn queues were observed to occasionally extend beyond the existing turn pocket storage space and required two signal cycles to clear the intersection.

During the PM peak commute period, the westbound left-turn movement received heavy traffic volumes and occasionally required two signal cycles to clear the intersection.

Fair Oaks Avenue and Duane Avenue

During the AM peak commute period, southbound and westbound left-turn movements received heavy traffic volumes and required two signal cycles to clear the intersection. This congestion was observed to occur only during the peak 15-minute drop-off operations of the nearby King's Academy school.

Wolfe Road and Arques Avenue

During the PM peak hour, westbound left-turn traffic was heavy and consistently required two signal cycles to clear.

Wolfe Road and Central Expressway Ramps

The intersections on Wolfe Road at the Central Expressway eastbound and westbound ramps were observed to operate as one intersection during the AM and PM peak commute periods. Due to the signal operations, the northbound left-turning vehicles and southbound left-turning vehicles were observed to experience long delays. During the AM peak commute period, the northbound left-turn queues were observed to occasionally extend beyond the storage space.

During the PM peak commute period, the southbound through queues were observed to occasionally spillback to the upstream intersection at Wolfe Road/Arques Avenue and required two signal cycles to clear the intersection.

Wolfe Road and Kifer Road

During the PM peak commute period, westbound left-turn traffic was heavy and consistently required two signal cycles to clear.

Wolfe Road and Evelyn Avenue

During the PM peak commute period, the southbound through queues were observed to extend beyond the entrance to the left-turn pocket which would prevent southbound left-turn vehicles from entering the storage space.

Lawrence Expressway & Arques Avenue

During the AM peak commute period, vehicles at the back of the northbound left-turn queues occasionally required two cycles to clear the intersection.

During the PM peak commute period, southbound traffic was consistently heavy and required more than one signal cycle to clear.

3. Background Conditions

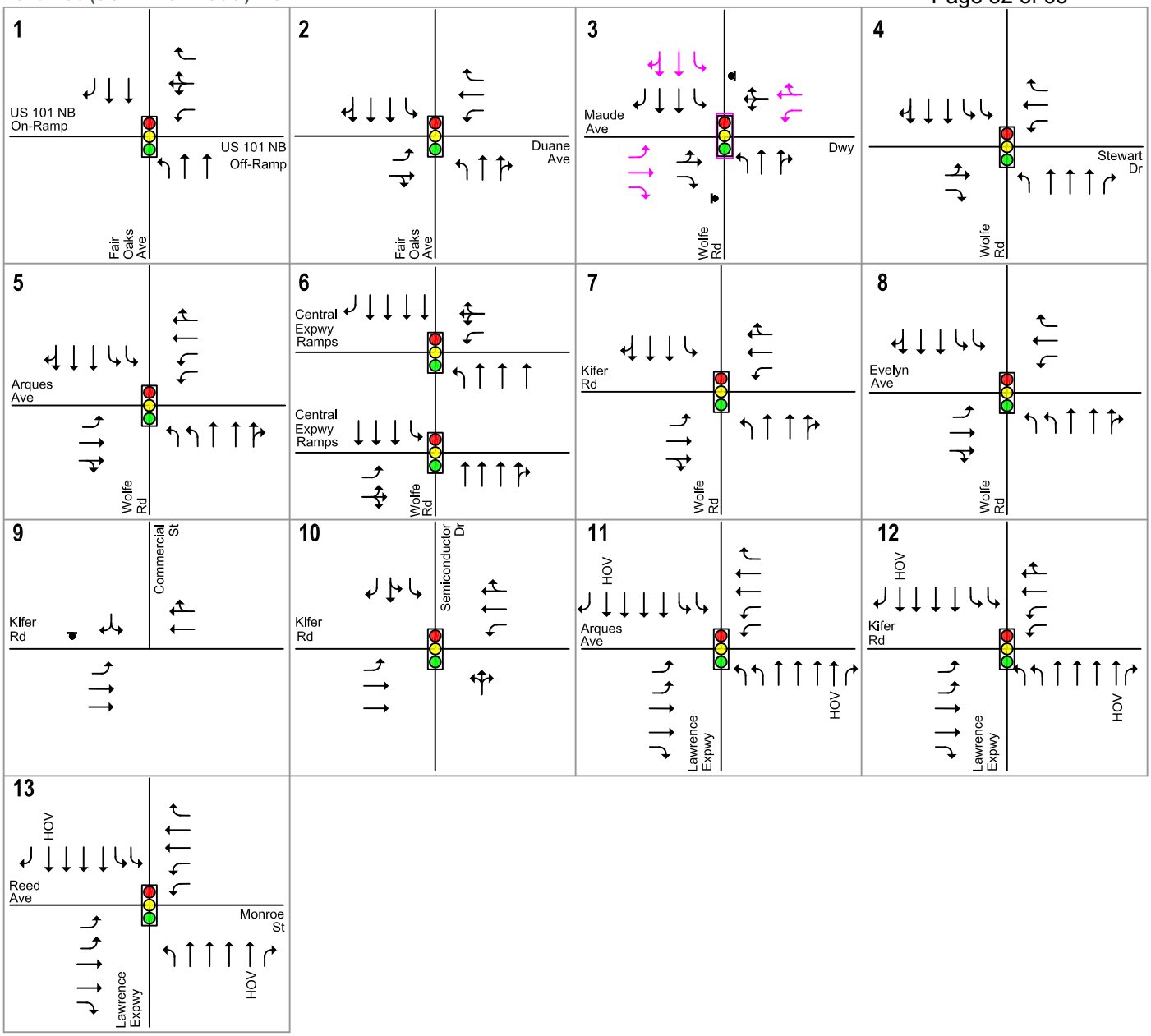
This chapter describes background traffic conditions, which are defined as conditions with the addition of traffic from approved but not yet constructed and occupied projects in the study area. Traffic volumes for background conditions comprise volumes from the existing traffic counts plus traffic generated by approved projects in the vicinity of the site. This chapter describes the procedure used to determine background traffic volumes and the resulting traffic conditions.

Background Transportation Network

It is assumed in this analysis that the transportation network under background conditions, including roadway and intersection lane configurations, would be the same as that described under the existing conditions except at the intersection of Wolfe Road and Maude Avenue. City staff is currently studying the signalization of this currently unsignalized intersection. According to City staff, signals at this intersection are expected to be installed under background conditions (see Figure 7).

Background Traffic Volumes

Background traffic volumes were estimated by adding traffic from approved but not yet completed developments in the study area. Approved developments are those developments that have been approved by local agencies, are under construction, or are built but not yet occupied. Approved project lists were obtained from the City of Sunnyvale and the City of Santa Clara. Based on a review of traffic studies prepared for these projects, the types and sizes of these developments, and their distances from the project site, a total of 44 approved projects were selected for inclusion in the background scenario. Trip generation for all approved projects was based on their respective traffic reports provided by City staff, where available. The approved but not yet completed developments included in this study are show on Figure 8. The AM and PM peak-hour traffic volumes at the study intersections under background conditions are shown on Figure 9.



LEGEND

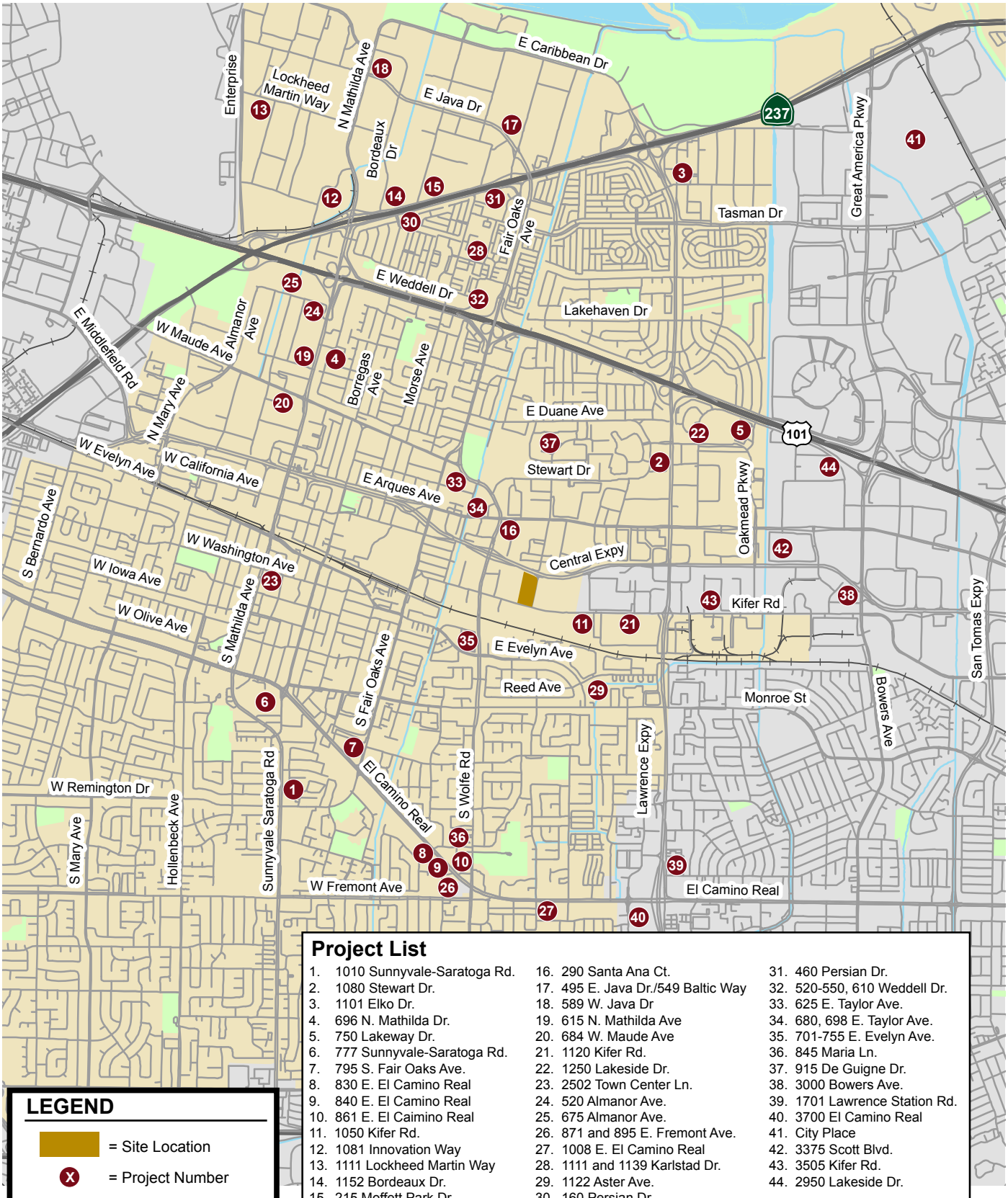
= Stop Sign

= Signal

= Change from Existing

Figure 7
Background Conditions Intersection Lane Configurations

NORTH
Not to Scale



Project List

1. 1010 Sunnyvale-Saratoga Rd.
2. 1080 Stewart Dr.
3. 1101 Elko Dr.
4. 696 N. Mathilda Dr.
5. 750 Lakeway Dr.
6. 777 Sunnyvale-Saratoga Rd.
7. 795 S. Fair Oaks Ave.
8. 830 E. El Camino Real
9. 840 E. El Camino Real
10. 861 E. El Caimino Real
11. 1050 Kifer Rd.
12. 1081 Innovation Way
13. 1111 Lockheed Martin Way
14. 1152 Bordeaux Dr.
15. 215 Moffett Park Dr.
16. 290 Santa Ana Ct.
17. 495 E. Java Dr./549 Baltic Way
18. 589 W. Java Dr
19. 615 N. Mathilda Ave
20. 684 W. Maude Ave
21. 1120 Kifer Rd.
22. 1250 Lakeside Dr.
23. 2502 Town Center Ln.
24. 520 Almanor Ave.
25. 675 Almanor Ave.
26. 871 and 895 E. Fremont Ave.
27. 1008 E. El Camino Real
28. 1111 and 1139 Karlstad Dr.
29. 1122 Aster Ave.
30. 160 Persian Dr.
31. 460 Persian Dr.
32. 520-550, 610 Weddell Dr.
33. 625 E. Taylor Ave.
34. 680, 698 E. Taylor Ave.
35. 701-755 E. Evelyn Ave.
36. 845 Maria Ln.
37. 915 De Guigne Dr.
38. 3000 Bowers Ave.
39. 1701 Lawrence Station Rd.
40. 3700 El Camino Real
41. City Place
42. 3375 Scott Blvd.
43. 3505 Kifer Rd.
44. 2950 Lakeside Dr.

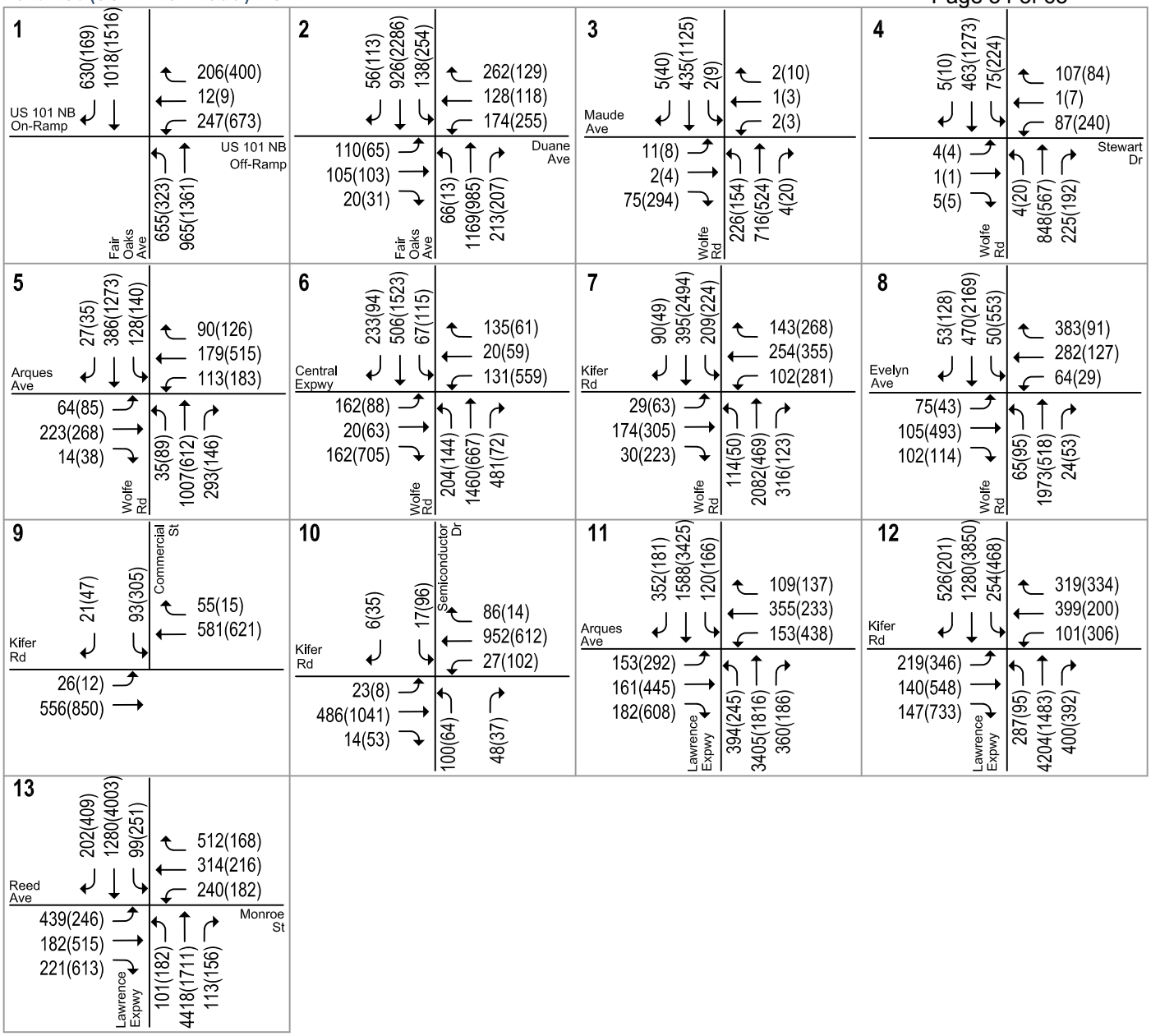
LEGEND

= Site Location

X = Project Number

= City of Sunnyvale

Figure 8
Approved Developments



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

Figure 9
Background Traffic Volumes

Background Intersection Level of Service

The results of the intersection level of service analysis under background conditions are summarized in Table 5 for the signalized study intersections and Table 6 for the unsignalized study intersections. The results of the analysis show that the following study intersections would operate below the LOS standard during at least one peak hour:

- Wolfe Road and Central Expressway Ramps (#6) – PM peak hour (LOS F)
- Commercial Street and Kifer Road (#9) – PM peak hour (LOS F)
- Expressway and Arques Avenue (#11) – PM peak hour (LOS F)
- Lawrence Expressway and Kifer Road (#12) – AM and PM peak hour (LOS F)
- Lawrence Expressway and Monroe Street/Reed Avenue (#13) – AM and PM peak hour (LOS F)

Table 5
Background Level of Service Summary - Signalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing		Background	
					Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS
1	Fair Oaks Avenue & US 101 NB Ramps	Signal	E	AM	29.7	C	47.2	D
				PM	31.3	C	48.8	D
2	Fair Oaks Avenue & Duane Avenue	Signal	D	AM	36.1	D+	37.4	D+
				PM	35.7	D+	39.5	D
3	Wolfe Road & Maude Avenue[1]	Signal	D	AM	-	-	23.4	C
				PM	-	-	30.5	C
4	Wolfe Road & Stewart Drive	Signal	D	AM	14.5	B	13.7	B
				PM	27.8	C	26.8	C
5	Wolfe Road & Arques Avenue	Signal	D	AM	49.4	D	52.0	D-
				PM	43.9	D	44.5	D
6	Wolfe Road & Central Expressway Ramps	Signal	E	AM	37.4	D+	59.3	E+
				PM	**84.4**	**F**	**110.7**	**F**
7	Wolfe Road & Kifer Road	Signal	D	AM	26.2	C	36.7	D+
				PM	36.8	D+	46.5	D
8	Wolfe Road & Evelyn Avenue	Signal	D	AM	34.3	C-	34.4	C-
				PM	35.8	D+	34.0	C-
10	Semiconductor Drive & Kifer Road	Signal	D	AM	14.1	B	19.4	B-
				PM	9.4	A	19.1	B-
11	Lawrence Expressway & Arques Avenue* (County)	Signal	E	AM	48.2	D	59.7	E+
				PM	68.1	E	**84.3**	**F**
12	Lawrence Expressway & Kifer Road (County)	Signal	E	AM	54.4	D-	**80.8**	**F**
				PM	**101.6**	**F**	**>120**	**F**
13	Lawrence Expressway & Monroe Street/Reed Avenue* (County)	Signal	E	AM	**114.8**	**F**	**>120**	**F**
				PM	74.1	E	**83.8**	**F**

Notes

* = *CMP, County = County of Santa Clara*

Level of service for signal controlled intersection is based on the average intersection delay.

">120" indicates the intersection experiences lengthy delay that is beyond the reasonable calculation range of the

BOLD indicates substandard level of service.

[1] The intersection of Wolfe Road and Maude Avenue will be converted from side-street stop control under existing conditions to signal control under background conditions.

Table 6
Background Level of Service Summary - Unsignalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing			Background		
					Avg. Delay (sec)	LOS	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Signal Warrant Met[1]
9	Commercial Street & Kifer Road	Side Street Stop	D	AM	12.3	B	No	15.0	B	No
				PM	24.1	C	Yes	**40.3**	**E**	**Yes**

Notes

Level of service for side street stop controlled intersections is based on the delay experiences by the worst movement.

BOLD indicates substandard level of service.

[1] The CA MUTCD peak-hour signal warrant is checked only if the intersection is operating at an unacceptable level of service.

4. Project Conditions

This chapter describes the method by which project traffic is estimated, roadway traffic operations under existing plus project conditions and background plus project conditions, and any impacts caused by the project. Existing plus project traffic conditions could potentially occur if the project were to be occupied prior to the other approved projects in the area. However, it is unlikely that this traffic condition would occur, since some of the other approved projects expected to add traffic to the study area would likely be built and occupied during the time this project is going through the development review process.

Project Description

The project proposes to demolish the existing buildings on-site and construct a four-story, 172,740 s.f. office and R&D building. It is assumed that the proposed project would be 70% office use and 30% R&D use. Primary access to the project would be provided via two driveways located along Commercial Street. The project would connect with the existing building at 899 Kifer Road and would thus allow the combined campus access from all existing driveways (on San Lazaro Avenue and on Kifer Road) and the proposed driveways on Commercial Street.

Project Trip Estimates

The magnitude of traffic produced by a new development and the locations where that traffic would appear are estimated using a three-step process: (1) trip generation, (2) trip distribution, and (3) trip assignment. In determining project trip generation, the magnitude of traffic traveling to and from the proposed project site was estimated for the AM and PM peak hours. As part of the project trip distribution, the directions to and from which the project trips would travel were estimated. In the project trip assignment, the project trips were assigned to specific streets and intersections. These procedures are described below.

Trip Generation

Through empirical research, data have been collected that quantify the amount of traffic produced by common land uses. Thus, for the most common land uses there are standard trip generation rates that can be applied to help predict the future traffic increases that would result from a new development. The magnitude of traffic added to the roadway system by a particular development is estimated by multiplying the applicable trip generation rates by the size of the development. Trip generation resulting from new development proposed within the City of Sunnyvale typically is estimated using the trip rates published in the Institute of Transportation Engineers' (ITE) *Trip Generation Manual, 10th Edition (2017)*. Trip generation rates for the proposed office space are based on the fitted curve equations

published for “General Office Building” (Land Use Code 710). Trip generation rates for the proposed R&D space are based on the average rates published for “Research and Development Center” (Land Use Code 760).

Trip Credits

The proposed project would receive trip credits for the trips generated by the existing on-site use. The existing on-site uses include approximately 14,000 s.f. of office space, approximately 47,000 s.f. of R&D space, and approximately 56,500 s.f. of warehouse space. Trip generation rates for the existing office space are based on the fitted curve equations published for “General Office Building” (Land Use Code 710). Trip generation rates for the existing R&D space are based on the average rates published for “Research and Development Center” (Land Use Code 760). Trip generation rates for the existing warehouse space are based on the fitted curve equations published for “Warehousing” (Land Use Code 150).

Net Project Trips

After applying trip credits for the existing on-site uses, the proposed project is estimated to generate a net increase of 70 vehicle trips during the AM peak hour (63 inbound and 7 outbound) and 85 vehicle trips during the PM peak hour (11 inbound and 74 outbound).

The trip generation for the proposed project is summarized in Table 7.

Trip Distribution

Trips generated by the proposed project were distributed to the study network based on the existing travel patterns on the surrounding roadway system and the locations of complementary land uses. Employment uses generate mostly inbound trips in the morning and mostly outbound trips in the evening. The majority of the project trips would travel via US 101, Lawrence Expressway, and Central Expressway. The trip distribution for the proposed project is shown on Figure 10.

Trip Assignment

The project trips were assigned to the roadway network based on the direction of approach and departure, roadway network connections, freeway and expressway access points, and the locations of project driveways. To be conservative, it was assumed that all project traffic would use the northern Commercial Street driveway. The net project trips at the study intersections is shown on Figure 11.

Intersection Traffic Volumes Under Project Conditions

Project impacts were evaluated relative to both (1) existing traffic volumes and (2) background traffic volumes. For the existing plus project scenario, the net new trips generated by the proposed project were added to the existing traffic volumes to derive the existing plus project traffic volumes. Figure 12 shows the intersection turning-movement volumes under existing plus project. For the background plus project scenario, the net new trips generated by the proposed project were added to the background traffic volumes to derive the background plus project traffic volumes. Figure 13 shows the intersection turning-movement volumes under background plus project conditions.

Transportation Network Under Project Conditions

It is assumed in this analysis that the transportation network under existing plus project and background plus project conditions, including roadways and intersection lane configurations, would be the same as that described under existing conditions and background conditions at all study intersections, respectively.

Table 7
Trip Generation Summary

Land Use	Size		AM Peak Hour In	AM Peak Hour Out	AM Peak Hour Total	PM Peak Hour In	PM Peak Hour Out	PM Peak Hour Total
Proposed[1]								
Office[2]	120,918	s.f.	120	20	140	22	114	136
R&D[3]	51,822	s.f.	17	5	22	4	21	25
Subtotal	172,740	s.f.	137	25	162	26	135	161
Existing								
Office[2]	14,149	s.f.	*(34)*	*(6)*	*(40)*	*(3)*	*(15)*	*(18)*
R&D[3]	47,072	s.f.	*(15)*	*(5)*	*(20)*	*(3)*	*(20)*	*(23)*
Warehouse[4]	56,591	s.f.	*(25)*	*(7)*	*(32)*	*(9)*	*(26)*	*(35)*
Subtotal	117,812	*s.f.*	*(74)*	*(18)*	*(92)*	*(15)*	*(61)*	*(76)*
Net Project Trips			**63**	**7**	**70**	**11**	**74**	**85**

Notes

R&D = Research and Development, s.f. = square feet

[1] Proposed project is 172,740 s.f. ,with 70% office use and 30% R&D use.

[2] Peak-hour trip generation rates for office use are based on the ITE's *Trip Generation Manual, 10th Edition* fitted curve equations published for "General Office Building" (Land Use Code 710).

[3] Peak-hour trip generation rates for R&D use are based on the ITE's *Trip Generation Manual, 10th Edition* average rates published for "Research and Development Center" (Land Use Code 760).

[4] Peak-hour trip generation rates for warehouse use are based on the ITE's *Trip Generation Manual, 10th Edition* fitted curve equations published for "Warehousing" (Land Use Code 150).

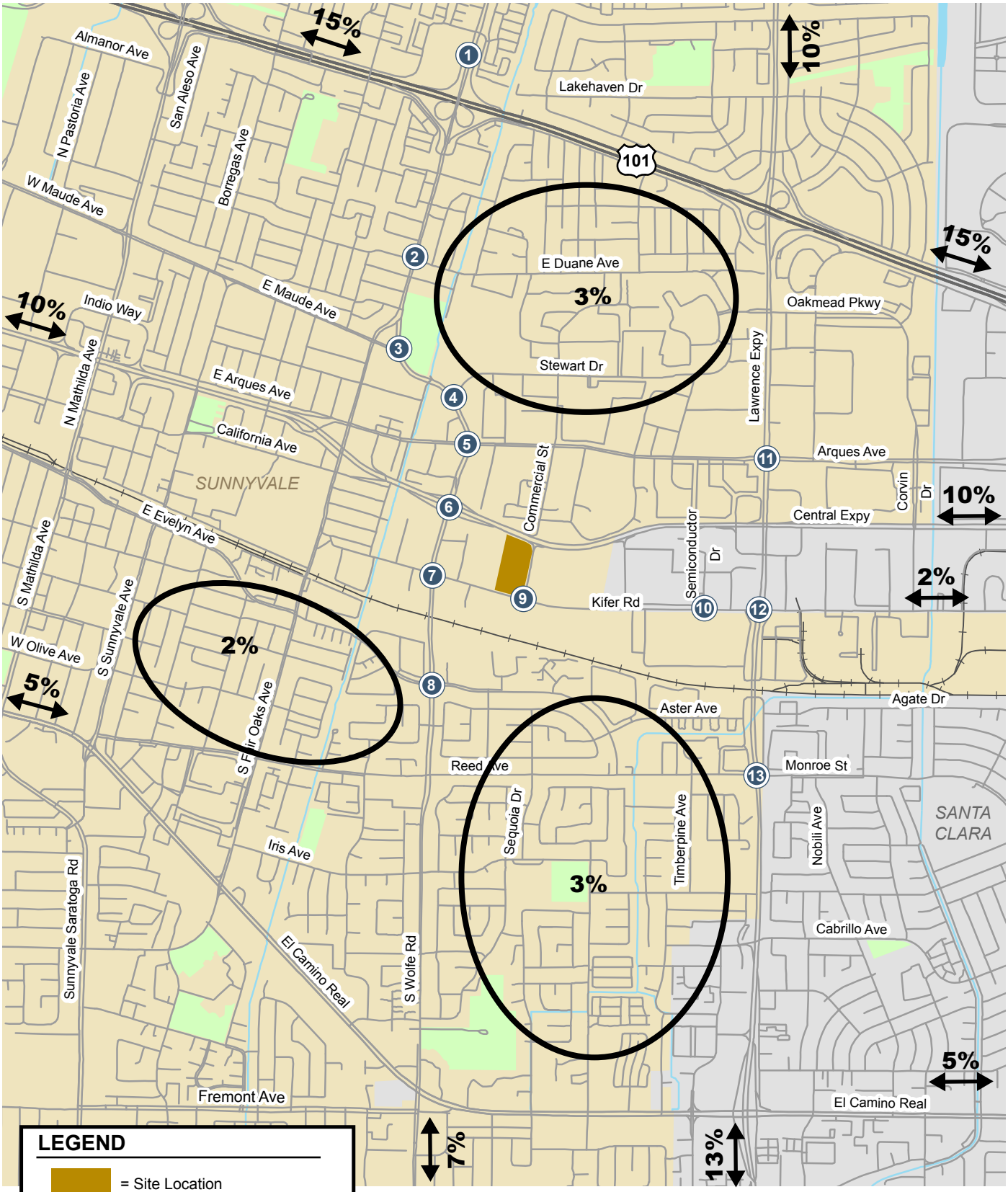
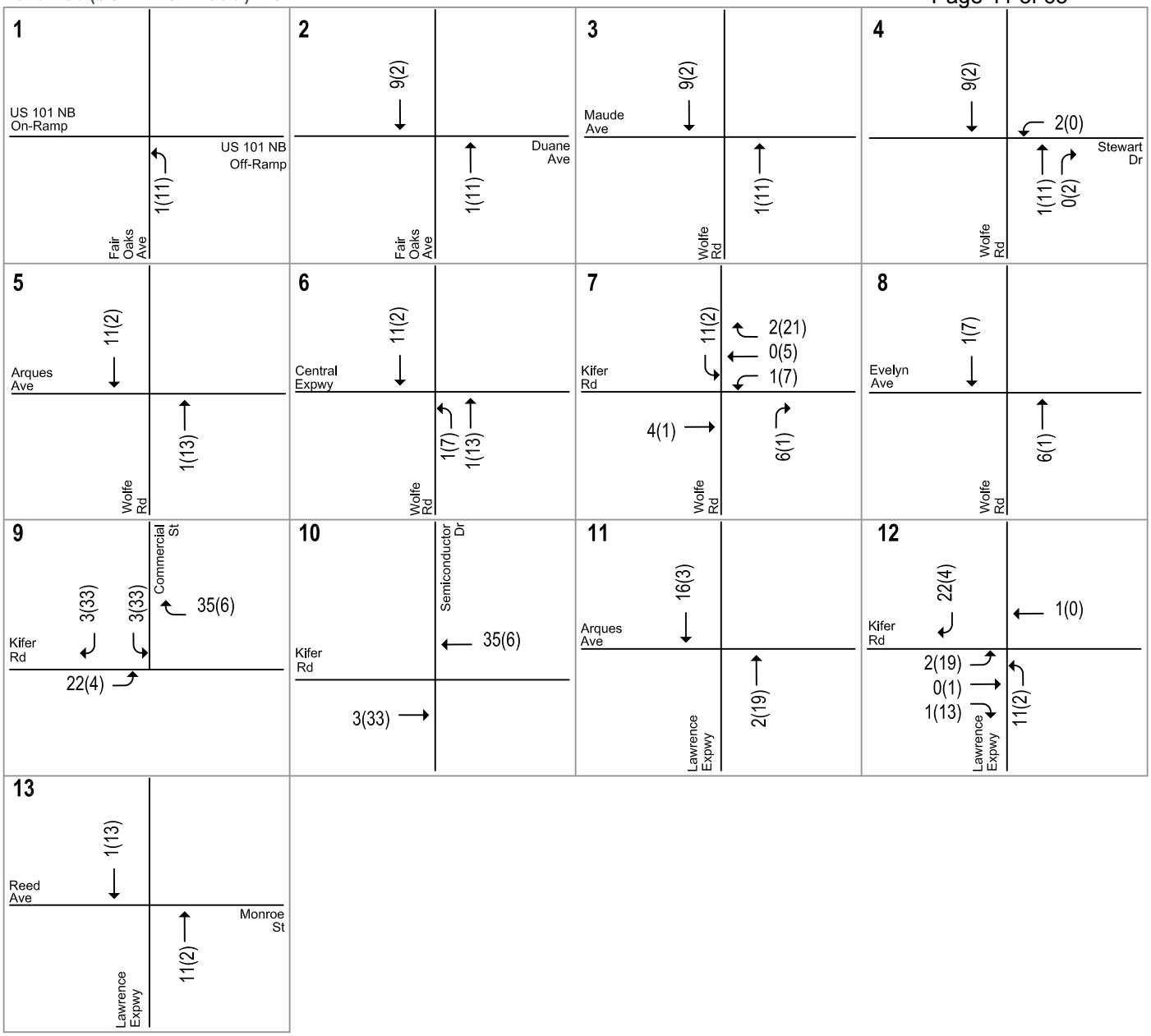


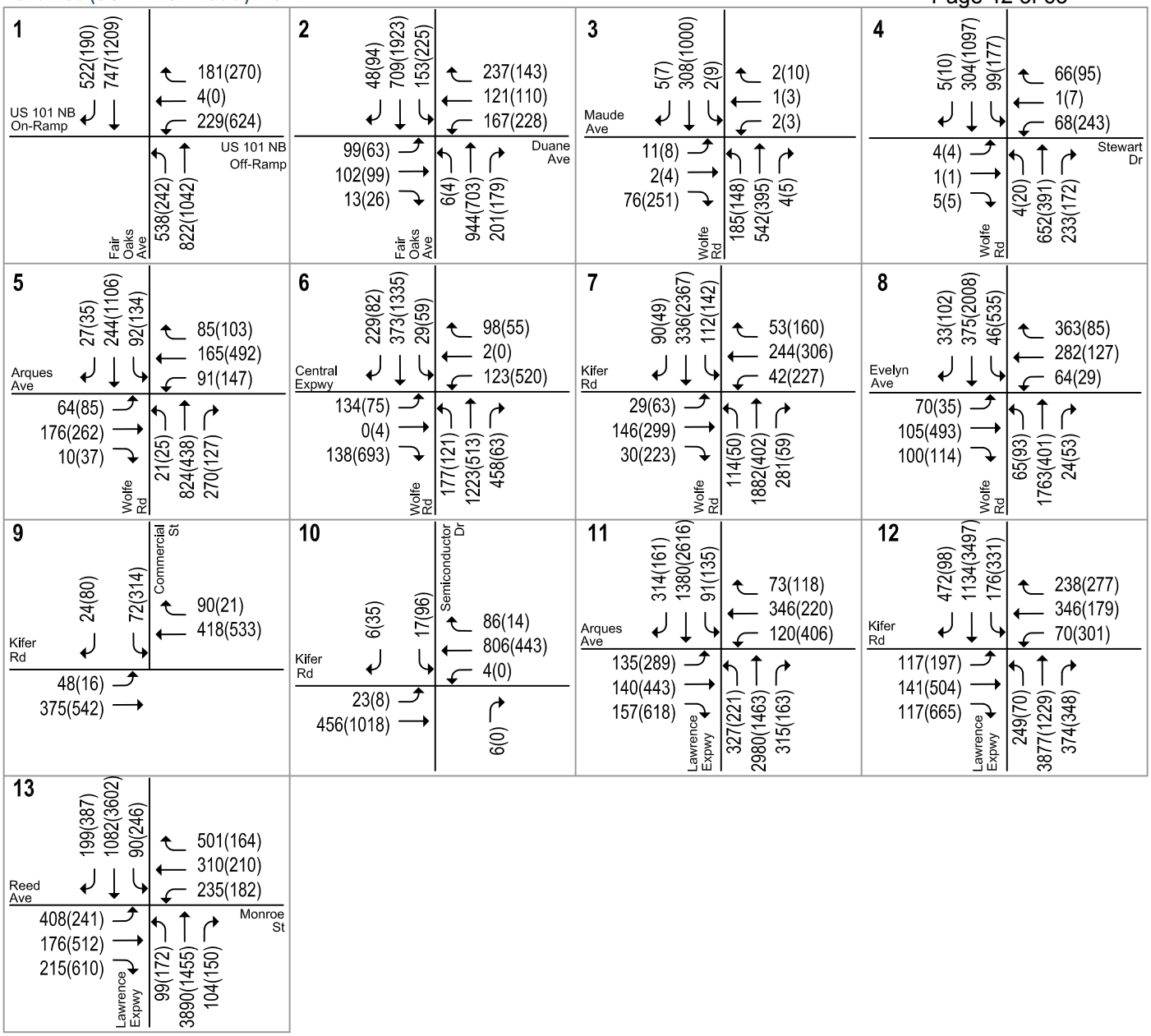
Figure 10
Project Trip Distribution



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

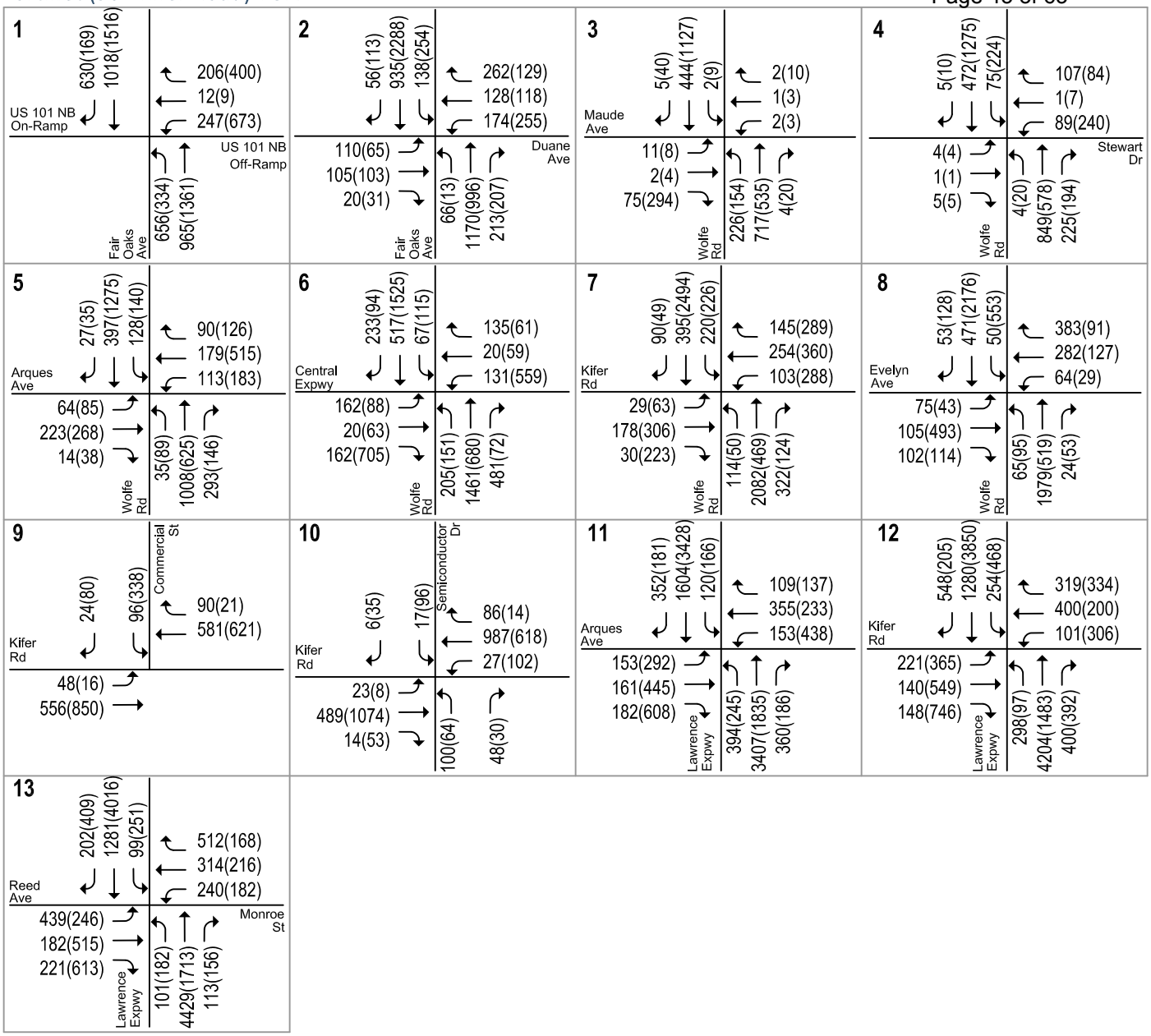
Figure 11
Net Project Trip Assignment



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

Figure 12
Existing Plus Project Traffic Volumes



LEGEND

XX(XX) = AM(PM) Peak-Hour Traffic Volumes

Figure 13
Background Plus Project Traffic Volumes

Existing Plus Project Intersection Level of Service

The results of the intersection level of service analysis under existing plus project conditions are summarized in Table 8 for the signalized study intersections and Table 9 for the unsignalized study intersections. The results of the analysis show that the project would not create a significant impact at any of the study intersections.

Table 8
Existing Plus Project Level of Service Summary - Signalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing		Existing Plus Project			
					Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c
1	Fair Oaks Avenue & US 101 NB Ramps	Signal	E	AM	29.7	C	29.9	C	0.4	0.000
				PM	30.4	C	30.9	C	0.7	0.008
2	Fair Oaks Avenue & Duane Avenue	Signal	D	AM	36.1	D+	36.0	D+	-0.1	0.002
				PM	35.7	D+	35.7	D+	-0.1	0.003
4	Wolfe Road & Stewart Drive	Signal	D	AM	14.5	B	14.5	B	-0.3	0.003
				PM	27.8	C	27.7	C	-0.3	0.003
5	Wolfe Road & Arques Avenue	Signal	D	AM	49.4	D	49.3	D	-0.2	0.002
				PM	43.9	D	43.8	D	0.0	0.001
6	Wolfe Road & Central Expressway Ramps	Signal	E	AM	37.4	D+	37.4	D+	-0.2	0.003
				PM	**84.4**	**F**	**83.6**	**F**	**-0.9**	**0.000**
7	Wolfe Road & Kifer Road	Signal	D	AM	26.2	C	27.0	C	0.1	0.001
				PM	36.8	D+	37.4	D+	1.2	0.006
8	Wolfe Road & Evelyn Avenue	Signal	D	AM	34.3	C-	34.3	C-	0.0	0.001
				PM	35.8	D+	35.7	D+	-0.1	0.002
10	Semiconductor Drive & Kifer Road	Signal	D	AM	14.1	B	14.0	B	0.0	0.010
				PM	9.4	A	9.3	A	-0.1	0.010
11	Lawrence Expressway & Arques Avenue* (County)	Signal	E	AM	48.2	D	48.1	D	0.0	0.000
				PM	68.1	E	68.0	E	0.1	0.001
12	Lawrence Expressway & Kifer Road (County)	Signal	E	AM	54.4	D-	54.4	D-	0.1	0.001
				PM	**101.6**	**F**	**103.8**	**F**	**5.6**	**0.007**
13	Lawrence Expressway & Monroe Street/Reed Avenue* (County)	Signal	E	AM	**114.8**	**F**	**115.7**	**F**	**1.2**	**0.002**
				PM	74.1	E	74.7	E	1.0	0.002

Notes

** = CMP, County = County of Santa Clara*

Level of service for signal controlled intersection is based on the average intersection delay.

BOLD indicates substandard level of service.

Table 9
Existing Plus Project Level of Service Summary - Unsignalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Existing			Existing Plus Project				
					Avg. Delay (sec)	LOS	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c	Signal Warrant Met[1]
3	Wolfe Road & Maude Avenue	Side Street Stop	D	AM	25.7	D	No	26.1	D	0.4	0.001	No
				PM	**67.4**	**F**	**Yes**	**68.6**	**F**	**1.2**	**0.000**	**Yes**
9	Commercial Street & Kifer Road	Side Street Stop	D	AM	12.3	B	No	12.7	B	0.4	0.012	No
				PM	24.1	C	Yes	31.2	D	7.1	0.073	Yes

Notes

Level of service for side street stop controlled intersections is based on the delay experiences by the worst movement.

BOLD indicates substandard level of service.

[1] The CA MUTCD peak-hour signal warrant is checked only if the intersection is operating at an unacceptable level of service.

Background Plus Project Intersection Level of Service

The results of the intersection level of service analysis under background plus project conditions are summarized in Table 10 for the signalized study intersections and Table 11 for the unsignalized study intersections. The results of the analysis show that the project would not create a significant impact at any of the signalized study intersections.

The unsignalized intersection of Commercial Street and Kifer Road has an intersection level of service threshold of LOS D. Under background conditions, the LOS would be an unacceptable LOS E during the PM peak hour. The addition of proposed project traffic would deteriorate the intersection to LOS F during the PM peak hour. For the PM peak hour, the proposed project traffic would cause an increase in critical delay of 21.2 seconds and an increase in critical v/c ratio of 0.137. Based on City of Sunnyvale significant impact criteria, the project would generate a significant intersection impact at this intersection during both the PM peak hour.

Mitigation strategies are discussed in the following section.

Background Plus Project Potential Intersection Mitigation Strategies

Mitigation options were studied for the impacted intersection at Commercial Street and Kifer Road. A significant impact by City of Sunnyvale standards is said to be satisfactorily mitigated when measures are implemented that would restore intersection conditions to its LOS standard *or* to an average delay that eliminates the project impact.

Mitigation would require installation of a signal at the intersection of Commercial Street and Kifer Road. Installation of a signal would significantly reduce the delay for southbound vehicles while maintaining minimal delay for westbound and eastbound traffic. The project applicant will be responsible for the signal installation costs. City staff will collect and reserve the signal installation costs for a period of ten years while monitoring the intersection. If a signal is needed the City will construct it as a Capital Improvement Project. If a signal is not needed within the ten-year period City staff will refund the signal installation costs to the project applicant. With this proposed mitigation, the intersection would operate at an acceptable LOS B or better during the AM and PM peak hours. Under the City of Sunnyvale's standards, the proposed mitigation would eliminate the significant impact. With the proposed mitigation, the traffic impact at this intersection would be *less than significant.*

Table 10
Background Plus Project Level of Service Summary - Signalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Background		Background Plus Project			
					Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c
1	Fair Oaks Avenue & US 101 NB Ramps	Signal	E	AM	47.2	D	47.3	D	0.3	0.001
				PM	48.8	D	50.2	D	1.9	0.007
2	Fair Oaks Avenue & Duane Avenue	Signal	D	AM	37.4	D+	37.3	D+	-0.1	0.002
				PM	39.5	D	39.5	D	0.2	0.003
3	Wolfe Road & Maude Avenue	Signal	D	AM	23.4	C	23.4	C	-0.1	0.002
				PM	30.5	C	30.5	C	0.0	0.001
4	Wolfe Road & Stewart Drive	Signal	D	AM	13.7	B	13.8	B	-0.2	0.003
				PM	26.8	C	26.7	C	-0.2	0.002
5	Wolfe Road & Arques Avenue	Signal	D	AM	52.0	D-	51.9	D-	-0.2	0.002
				PM	44.5	D	44.5	D	0.0	0.000
6	Wolfe Road & Central Expressway Ramps	Signal	E	AM	59.3	E+	59.5	E+	0.0	0.003
				PM	**110.7**	**F**	**110.1**	**F**	**-0.7**	**0.001**
7	Wolfe Road & Kifer Road	Signal	D	AM	36.7	D+	37.4	D+	0.7	0.010
				PM	46.5	D	47.7	D	2.6	0.007
8	Wolfe Road & Evelyn Avenue	Signal	D	AM	34.4	C-	34.4	C-	0.1	0.001
				PM	34.0	C-	34.0	C-	0.0	0.002
10	Semiconductor Drive & Kifer Road	Signal	D	AM	19.4	B-	19.2	B-	0.0	0.011
				PM	19.1	B-	18.9	B-	-0.1	0.010
11	Lawrence Expressway & Arques Avenue* (County)	Signal	E	AM	59.7	E+	59.7	E+	0.1	0.001
				PM	**84.3**	**F**	**84.4**	**F**	**0.3**	**0.001**
12	Lawrence Expressway & Kifer Road (County)	Signal	E	AM	**80.8**	**F**	**80.8**	**F**	**0.3**	**0.001**
				PM	**>120**	**F**	**>120**	**F**	**5.5**	**0.008**
13	Lawrence Expressway & Monroe Street/Reed Avenue* (County)	Signal	E	AM	**>120**	**F**	**>120**	**F**	**1.3**	**0.002**
				PM	**83.8**	**F**	**84.3**	**F**	**0.8**	**0.002**

Notes

* = *CMP, County = County of Santa Clara*

Level of service for signal controlled intersection is based on the average intersection delay.

">120" indicates the intersection experiences lengthy delay that is beyond the reasonable calculation range of the

BOLD indicates substandard level of service.

Table 11
Background Plus Project Level of Service Summary - Unsignalized Intersections

ID #	Intersection	Control	LOS Standard	Peak Hour	Background			Background Plus Project				
					Avg. Delay (sec)	LOS	Signal Warrant Met[1]	Avg. Delay (sec)	LOS	Change in Crit. Delay (sec)	Change in Crit. v/c	Signal Warrant Met[1]
9	Commercial Street & Kifer Road	Side Street Stop	D	AM	15.0	B	No	15.7	C	0.7	0.023	No
				PM	**40.3**	**E**	**Yes**	**61.5**	**F**	**21.2**	**0.137**	**Yes**

Notes

Level of service for side street stop controlled intersections is based on the delay experiences by the worst

BOLD indicates substandard level of service.

BOLD and boxed indicates a significant impact.

[1] The CA MUTCD peak-hour signal warrant is checked only if the intersection is operating at an unacceptable level of service.

5. Other Transportation Issues

This chapter presents an analysis of other transportation issues associated with the project, including:

- operation analysis – vehicle queuing and storage at selected intersections
- potential impacts to transit services and pedestrian and bicycle facilities,
- site access and circulation, and
- parking.

Unlike the level of service impact methodology, which is adopted by the City Council, the analyses in this chapter are based on professional judgment in accordance with the standards and methods employed by the traffic engineering community. Although operational issues are not considered CEQA impacts, they do describe traffic conditions that are relevant to describing the project environment.

Queuing Analysis

The analysis of intersection level of service was supplemented with a queuing analysis for selected movements at the study intersections. Vehicle queues were estimated using a Poisson probability distribution. This analysis provides a basis for determining whether the addition of project trips would exacerbate peak hour queues and delays, as well as estimating future storage requirements at intersections. For signalized intersections, the estimated queue length was compared to the length of the existing turn pockets. For unsignalized intersections, the estimated queue lengths were compared to the storage space available between the limit line and the upstream intersection.

The operations analysis is based on vehicle queuing for high-demand left-turn movements at intersections where 10 or more project trips per lane were added.

Based on the selection criteria of 10 or more project trips per left-turn lane, the following lanes were analyzed during the AM peak hour:

- Southbound left-turn at Wolfe Road and Kifer Road
- Eastbound left-turn at Commercial Street and Kifer Road

Based on the selection criteria of 10 or more project trips per left-turn lane, the following lanes were analyzed during the PM peak hour:

- Northbound left turn at Fair Oaks Avenue and US 101 northbound ramps
- Southbound shared left-through-right at Commercial Street and Kifer Road
- Eastbound left turn at Lawrence Expressway and Kifer Road

The queuing results for the background plus project scenario were compared to the background scenario to determine whether the project would cause extensive queuing issues (see Table 12 for the AM peak hour and Table 13 for the PM peak hour). Under background plus project conditions, left-turn traffic is expected to increase the 95th percentile queue by at least one vehicle for one location that would operate over capacity under background conditions, thus, creating an operational deficiency. The proposed project would create an operational deficiency during the PM peak hour for the eastbound left-turn movement at Lawrence Expressway and Kifer Road.

Below is a detailed discussion of the above identified location under background plus project conditions.

Lawrence Expressway and Kifer Road

The project is expected to add 19 eastbound left-turn vehicles during the PM peak hour to the intersection of Lawrence Expressway and Kifer Road. Under background conditions during the PM peak hour, the 95th percentile queue length would be 650 feet, with the back-of-queue extending out of the turn pocket. Under background plus project conditions, the addition of the proposed project trips during the PM peak hour would extend the 95th percentile queues by 25 feet to 675 feet.

This left-turn movement has two turn lanes with a total queue storage space of approximately 360 feet (approximately 180 feet in each lane). There is no room to further extend these left-turn lanes. However, the Sunnyvale Traffic Impact Fee (TIF) identifies an interchange at this location. At the time of this report, the interchange design has not been finalized. It is assumed that the final interchange design would provide adequate queuing space for the eastbound left-turn movement. The proposed project shall pay the Sunnyvale Traffic Impact Fee (TIF), which would constitute its fair-share contribution toward the cost of the intersection improvements at Lawrence Expressway and Kifer Road.

Table 12
Queuing Analysis Summary - AM Peak Hour

	Wolfe Road and Kifer Road	Commercial Street and Kifer Road
Movement:	**SBL**	**EBL**
Peak Hour:	**AM**	**AM**
Existing		
Cycle/Delay[1] (sec)	160	8.4
Volume (vphpl)	101	26
Avg. Queue (veh/ln.)	4	0
Avg. Queue[2] (ft./ln)	100	0
95th%. Queue (veh/ln.)	8	1
95th%. Queue[2] (ft./ln)	200	25
Storage (ft./ ln.)	365	240
Adequate (Y/N)	Y	Y
Background		
Cycle/Delay[1] (sec)	160	8.9
Volume (vphpl)	209	26
Avg. Queue (veh/ln.)	9	0
Avg. Queue[2] (ft./ln)	225	0
95th%. Queue (veh/ln.)	15	1
95th%. Queue[2] (ft./ln)	375	25
Storage (ft./ ln.)	365	240
Adequate (Y/N)	N	Y
Background Plus Project		
Cycle/Delay[1] (sec)	160	9.1
Volume (vphpl)	220	48
Avg. Queue (veh/ln.)	10	0
Avg. Queue[2] (ft./ln)	250	0
95th%. Queue (veh/ln.)	15	1
95th%. Queue[2] (ft./ln)	375	25
Storage (ft./ ln.)	365	240
Adequate (Y/N)	N	Y
Project Related Operational Deficiency?	No	No

Notes:
[1] Vehicle queue calculations based on cycle length for signalized intersections and movement delay for unsignalized intersections.
[2] Assumes 25 feet per vehicle queued.

Table 13
Queuing Analysis Summary - PM Peak Hour

	Fair Oaks Avenue and US 101 NB Ramps	Commercial Street and Kifer Road	Kifer Road and Lawrence Expressway
Movement:	**NBL**	**SBL-T-R**	**EBL**
Peak Hour:	**PM**	**PM**	**PM**
Existing			
Cycle/Delay[1] (sec)	95	24.1	190
Volume (vphpl)	231	328	178
Avg. Queue (veh/ln.)	6	2	9
Avg. Queue[2] (ft./ln)	150	50	225
95th%. Queue (veh/ln.)	10	5	15
95th%. Queue[2] (ft./ln)	250	125	375
Storage (ft./ ln.)	260	690	360
Adequate (Y/N)	Y	Y	N
Background			
Cycle/Delay[1] (sec)	95	40.3	190
Volume (vphpl)	323	352	346
Avg. Queue (veh/ln.)	9	4	18
Avg. Queue[2] (ft./ln)	225	100	450
95th%. Queue (veh/ln.)	14	7	26
95th%. Queue[2] (ft./ln)	350	175	650
Storage (ft./ ln.)	260	690	360
Adequate (Y/N)	N	Y	N
Background Plus Project			
Cycle/Delay[1] (sec)	95	61.5	190
Volume (vphpl)	334	418	365
Avg. Queue (veh/ln.)	9	7	19
Avg. Queue[2] (ft./ln)	225	175	475
95th%. Queue (veh/ln.)	14	12	27
95th%. Queue[2] (ft./ln)	350	300	675
Storage (ft./ ln.)	260	690	360
Adequate (Y/N)	N	Y	N
Project Related Operational Deficiency?	No	No	**Yes**

Notes:
[1] Vehicle queue calculations based on cycle length for signalized intersections and movement delay for unsignalized intersections.
[2] Assumes 25 feet per vehicle queued.

Potential Impacts to Transit Facilities

Within the immediate project vicinity, only the Altramont Commuter Express (ACE) Gray Shuttle (VTA Route 822) has a stop within walking distance of the project site (approximately 1,000 feet west of the project site). This shuttle provides limited services transporting nearby residents/employees to/from work in the Lawrence Station area and in the Great America Station area. It is expected that the project would result in a minor increase to the shuttle bus usage.

The project site is located approximately 5,000 feet west of the Lawrence Caltrain Station, and approximately 6,500 feet east of the Sunnyvale Caltrain Station. Both Caltrain stations are not within walking distance but are within a short 4- to 7-minute bike ride. Under existing conditions, sidewalks are lacking along certain segments of Kifer Road between the project site and the Lawrence Caltrain station. Kifer Road has continuous bike lanes between the project site and the Lawrence Caltrain station.

Several trains currently operate at or near capacity. Caltrain has plans to increase the number of trains serving the Lawrence Caltrain station. According to the Caltrain electrification EIR, ten more commuter trains are expected to serve the Lawrence Caltrain station on a daily basis. These should provide sufficient capacity to serve the project.

The project should explore options to provide a shuttle bus to either/both the Sunnyvale Caltrain station and the Lawrence Caltrain station. The project could independently fund a shuttle service or coordinate with nearby employers in the area to share a shuttle. The Duane Avenue shuttle, a public/private partnership between the Peninsula Corridor Joint Powers Board and private employers, currently provides shuttle service between the Lawrence Caltrain Station and the Mountain View Caltrain Station with departure and arrivals synced to Caltrain departure and arrivals. The Duane Avenue shuttle currently provides service on Arques Avenue, but not on Kifer Road. The project could request to contribute to the Duane Avenue shuttle and modify the shuttle route to include Kifer Road.

Recommendation

It is recommended that the project explore options to provide shuttle bus service to either/both the Sunnyvale Caltrain station and the Lawrence Caltrain station, which can be addressed in the project's final TDM plan.

Transit Travel Time Impacts

Currently, VTA bus routes 328 and 822 travel within the project vicinity through some of the study intersections. To assess the transit travel time impacts, the bus route travel times in the study area under background plus project conditions were compared to background conditions. Bus route travel times are estimated using published schedules and adjusted based on delays experienced at study intersection movements. VTA does not have established criteria to determine impact to transit services. Therefore, this analysis is presented for information purposes only.

The results show that there would be minimal changes in transit delay in the study area under the project scenario. For the bus routes in the study area, the project would increase route delay by less than 5 seconds compared to background conditions. The project is expected to worsen left-turn queuing at two left-turn movements (identified in above section). None of the transit routes would turn left at these two left-turn movements. The results of the transit travel time comparison are summarized in Table 14.

Table 14
Transit Travel Time Delay Analysis

Route	Peak Hour	Existing		Background	Background + Project		
		Travel Time (min)	Delay in the Study Area (sec)	Delay in the Study Area (sec)	Delay in the Study Area (sec)	Change in Delay (sec)	% Change in Travel Time
VTA 328 [1]							
Northbound	AM	85	277.2	413.8	415.9	2.1	0.04%
Southbound	PM	80	228.5	316.9	318.9	2.0	0.04%
VTA 822 (ACE Gray Shuttle) [2]							
Northbound	PM	35	326.8	381.8	385.7	3.9	0.18%
Southbound	AM	32	333	456.3	459.9	3.6	0.18%

Notes
[1] VTA 328 operates with northbound services during the AM peak commute period and southbound services during the PM peak commute period.
[2] VTA 822 operates with northbound services during the PM peak commute period and southbound services during the AM peak commute period.

Potential Impacts to Pedestrian Facilities

The proposed project is expected to generate few pedestrian walking trips because there are no complementary land uses (i.e. restaurants, Caltrain station, etc.) within a short walking distance. Currently, sidewalks fronting the project site at 901 Kifer Road along Kifer Road and Commercial Street are lacking. The project proposes to install sidewalks along its Kifer Road frontage and along its Commercial Street frontage south of the northern driveway. The existing Fortinet building at 899 Kifer Road does not have sidewalks fronting the property along Kifer Road and San Lazaro Avenue. The project proposes to install sidewalks along its 899 Kifer Road property frontages on Kifer Road and San Lazaro Avenue as well. The project also proposes to install ADA-compliant curb ramps at the northwest corner of the Commercial Street and Kifer Road intersection. These proposed pedestrian sidewalks and curb ramps represent an improvement over existing conditions.

Potential Impacts to Bicycle Facilities

Within the immediate project vicinity, bike lanes are present on Kifer Road (see Figure 4 in Chapter 2). Overall, the project site has good connectivity to existing bicycle facilities. There are no planned bicycle facilities fronting the project site on Commercial Street at the time of this report. The project proposes to install green bike lanes along westbound Kifer Road within 200 feet east of Commercial Street and within 50 feet west of Commercial Street. According to City of Sunnyvale Green Bike Lane Design Standards, one of the conditions required to permit the installation of green bikes on a roadway at conflict points requires the existence of one of the following conflict areas: 1) the bike lane crosses a right turn lane, 2) traffic in a channelized right turn lane crosses a bike lane, or 3) the bike lane is adjacent to a dedicated bus bay. Since none of the required conflict areas exist at the intersection of Commercial Street and Kifer Road, the proposed green bike lanes on westbound Kifer Road do not meet City design standards.

According to City of Sunnyvale Municipal Code Section 19.46.150, nonresidential projects are required to provide bicycle parking in the amount of 5% of the total number of vehicular parking spaces provided. Research and development office and corporate office shall provide secured bicycle parking for a minimum of 75% of the required bicycle parking spaces. As discussed in the Parking section below, the expanded Fortinet campus is proposing a total of 772 parking spaces and would be required to provide 39 bicycle parking spaces, of which at least 29 spaces must be secured bicycle parking spaces. The existing Fortinet building at 899 Kifer Road provides 4 secured bicycle lockers, and the proposed building at 901 Kifer Road proposes 32 secured bicycle lockers and 10 bicycle racks. Therefore, the expanded Fortinet campus proposes a total of 46 bicycle parking spaces (32 secured spaces) and would meet the City's bicycle parking requirements. The bicycle lockers and bicycle racks at the proposed 901 Kifer Road building would be located adjacent to the loading area, which is between the existing and the proposed buildings, providing convenient access for employees in both buildings.

Recommendation

Per City design standards, the proposed green bike lanes on westbound Kifer Road do not meet design standards and shall not be proposed.

Site Access and Circulation

The evaluation of site access and circulation is based on the plan set prepared by Heller Manus Architects, dated October 18, 2018. Site access and circulation was reviewed in accordance with generally accepted traffic engineering standards.

Site Access

Vehicular access to the project site would be provided via two driveways, both located along Commercial Street. The northern driveway is assumed to be the main driveway as it provides convenient access to the parking lot. The southern driveway is assumed to be used mainly for the accessible and electric-vehicle charging spaces in front of the proposed building and for pick-up/drop-off in front of the main building. Both driveways are shown to be 26 feet wide, measured at the throat, and would be full access driveways.

Site Distance at the Project Driveways

The project access points should be free and clear of any obstructions to optimize sight distance, thereby ensuring that exiting vehicles can see pedestrians on the sidewalk and other roadway users travelling on adjacent roadways. Landscaping and parking should not conflict with a driver's ability to locate a gap in traffic and see oncoming pedestrians and bicyclists. Adequate corner sight distance (sight distance triangles) should be provided at all site access points in accordance with City standards.

Commercial Street has a posted speed limit of 25 miles per hour. The Caltrans recommended stopping distance is 150 feet. According to the site plan, there would be no tall vegetation or objects or on-street parking that could block a driver's view 150 feet down the road as they exist the project site. Therefore, there are adequate sight distances at the project driveways.

Site Driveway Operations

The traffic volumes along Commercial Street are low and would allow the project traffic at the site driveways to experience minimal delays. The proposed project traffic making left-turns into and out of the Commercial Street driveways may potentially need to wait for a gap in conflicting traffic; however, this is not expected to have an adverse effect on traffic operations. To be conservative, for the project driveway analysis it was assumed that all project trips would use the northern Commercial Street driveway. In addition, it was assumed that the existing trips heading to and from the 899 Kifer Road site would remain. The delays that would be experienced at the northern Commercial Street driveway were analyzed in TRAFFIX using the HCM 2000 methodology. The results show that all inbound and outbound movements at the driveway would operate with low levels of delay (generally less than fifteen seconds per vehicle) during the AM and PM peak hours. It is estimated that vehicle queues turning into and out of all project driveways would not exceed two vehicles at a time.

The proposed project would include a right-turn pocket for the northern Commercial Street driveway. The turn pocket would include approximately 100 feet of storage, which would be adequate for four vehicles, assuming 25 feet per vehicle. This right-turn pocket would allow southbound right-turning vehicles on Commercial Street entering the project site to not block the southbound travel lane on Commercial Street. It would also improve safety by allowing potential right-turning queues to queue aside from the southbound through lane, as vehicles coming off Central Expressway may not be anticipating potential vehicle queues. Under background plus project conditions, there is estimated to be approximately 35 and 4 southbound right-turn vehicles during the AM and PM peak hours, respectively. For the AM peak hour, this is roughly one vehicle every one to two minutes. This movement would experience minimal delays and minimal queues, and thus, the proposed turn pocket would be adequate to prevent queues from extending beyond the storage area.

Sight Lines at the Central Expressway Off-Ramp

The exit ramp from eastbound Central Expressway to southbound Commercial Street has a posted speed of 15 mph. Also, southbound Commercial Street has a 25 mph speed limit sign located approximately 85 feet south of the exit ramp. The northern project driveway would be located approximately 240 feet south of Central Expressway. Based on the Caltrans recommended stopping site distance, this would accommodate up to a 30 mph design speed. Therefore, the sight distance for exiting Central Expressway would be adequate.

Furthermore, as discussed in the previous section, the proposed right-turn pocket for the northern Commercial Street driveway would be sufficient to prevent project queues from spilling out of the turn pocket. Thus, the proposed project is not expected to have an adverse effect on traffic exiting the Central Expressway off-ramp.

Circulation

The project site proposes one main east-west drive aisle extending from the northern project driveway westward into the existing parking lot at 899 Kifer Road, thus connecting the existing and proposed parking lots. The site plan shows multiple north-south driveway aisles crossing the main east-west drive aisle providing access to the parking spaces. Between the northern and southern project driveways, the project proposes a north-south drive aisle connecting the two driveways. This drive aisle would provide access to the accessible and electric-vehicle charging spaces located in front of the proposed building. The site plan indicates all drive aisles would be between 24 and 26 feet wide and would comply with City standards. The site plan indicates all parking spaces are dimensioned 8.5 feet wide by 18 feet deep and would comply with City standards. The plan shows dead-end aisles located within the proposed parking lot. The site plan shows that sufficient turn-around space would be provided at the dead ends. Overall, the project site plan provides adequate vehicular circulation on site.

Emergency Vehicles, Truck Access and Circulation

All driving aisles on the project site are shown to exceed the minimum 20-foot width requirement for emergency vehicle access and circulation and meet the City standards.

The project proposes a trash enclosure west of the proposed building next to the loading area. On garbage collection days, garbage trucks would drive into the project site and collect the trash. Adequate on-site circulation is provided for garbage trucks.

As shown on the site plan, loading trucks would need to back into the loading space. Adequate on-site circulation is provided for loading trucks.

Shuttle Access and Loading

Shuttle buses would utilize the northern driveway on Commercial Street to access the project site. The drop-off/pick-up point for shuttle buses is shown to be along the north side of the building. Shuttle buses would continue onto the project site where they would loop around the parking bays adjacent to the northwest corner of the 901 Kifer building and exit via the northern project driveway.

Parking

The review of on-site parking is based on the plan set prepared by Heller Manus Architects, dated August 17, 2018, and on the City of Sunnyvale parking requirements.

Vehicle Parking

Since the proposed project would be incorporated into the existing Fortinet building at 899 Kifer Road to form an expanded campus, vehicle parking for the proposed project was checked for the entire expanded campus (see Table 15). With the proposed project, the expanded campus would have a total gross floor area of 334,540 square feet, of which 172,740 belongs to the proposed building. The expanded campus proposes to provide a total of 772 parking spaces, of which 479 spaces are existing and 293 spaces are proposed. The City of Sunnyvale Municipal Code Section 19.46.100 requires parking to be provided between 2 and 4 spaces per 1,000 square feet for this type of development (corporate office). Therefore, the expanded campus would be required to provide between 669 and 1,338 parking spaces. The expanded campus is proposing to provide 772 parking spaces, which would meet the parking requirement.

Table 15
Proposed Project Vehicle Parking Supply and Requirement

Address	Size (s.f.)	Parking Spaces	
		Proposed	Required
899 Kifer Rd - Existing	161,800	479	
901 Kifer Rd - Proposed	172,740	293	
Total	**334,540**	**772**	**669 to 1,338**

Additional Parking Requirements

The City of Sunnyvale Municipal Code Section 19.46.100 specifies that developments with office/R&D uses are required to provide one loading space per lot. The proposed building at 901 Kifer Road proposes to provide one loading space next to the trash enclosures, which would meet City's loading space requirement.

The Sunnyvale Municipal Code also requires that at least 5% of all parking spaces shall be permanently reserved for the exclusive use of car share vehicles, and that at least 3% of all parking spaces shall be provided a minimum of Level 2 electric car chargers. The expanded campus is proposing a total of 772 parking spaces and would be required to provide 39 car-share spaces and 23 electric vehicle charging spaces. The expanded campus proposes to provide 39 car-share spaces and 43 electric vehicle charging spaces, which would meet the City's car-share and electric vehicle charging space requirements.

Accessible Parking

Accessible parking stalls shall be provided in accordance with the 2016 California Building Code (CBC) Table 11B-208.2. According to CBC, accessible parking spaces shall be calculated separately for each parking facility. Since the proposed parking lot at 901 Kifer Road is mostly separated from the existing parking lot at 899 Kifer Road, this analysis is conducted only for the proposed parking lot at 899 Kifer Road. The proposed building at 901 Kifer Road would provide a 293-space parking lot, of which 29 are electric-vehicle charging spaces. Based on CBC requirements, the project would be required to provide seven accessible parking spaces, two of which need to be van-accessible spaces. As shown on the site plan, the project proposes nine accessible parking spaces, three of which are labelled van-accessible. Therefore, the project would meet the CBC accessible parking space requirements.

Accessible parking stalls for electric-vehicle charging spaces shall be provided in accordance with the 2016 CBC Table 11B-228.3.2.1. The proposed building at 901 Kifer Road, providing 29 electric-vehicle charging spaces, would be required to provide 2 EV accessible spaces (1 standard and 1 van-accessible). As shown on the site plan, the project proposes two of the electric-vehicle charging spaces to be accessible (1 standard and 1 van-accessible), which meets the CBC accessible parking space requirements for electric-vehicle charging spaces.

6. Conclusions

This report presents the results of the transportation operations analysis (TOA) conducted for the proposed office and R&D development at 901 Kifer Road in Sunnyvale, CA. The project site is bounded by Central Expressway to the north, Commercial Street to the east, Kifer Road to the south, and the 899 Kifer Road building to the west. Currently, Fortinet owns the buildings at both 899 Kifer Road and 901 Kifer Road[3]. At 901 Kifer Road, Fortinet proposes to demolish nine existing buildings totaling 117,812 square feet (s.f.) and construct a four-story, 172,740 s.f. office and R&D building. The proposed building would be accessed via two driveways on Commercial Street and would be connected to the existing site at 899 Kifer Road via one east-west drive aisle.

This study was conducted for the purpose of identifying the potential near-term traffic impacts related to the proposed development. The purpose of this traffic study is to satisfy the requirements of the City of Sunnyvale. Since the project is expected to generate less than 100 new peak-hour trips, an analysis in accordance with the Santa Clara Valley Transportation Authority (VTA) County Congestion Management Program (CMP) guidelines is not required.

Intersection Level of Service Results

The intersection level of service analysis concluded that based on City of Sunnyvale intersection impact criteria, the project would generate a significant intersection impact at the unsignalized intersection at Commercial Street and Kifer Road.

The unsignalized intersection of Commercial Street and Kifer Road has an intersection level of service threshold of LOS D. Under background conditions, the LOS would be an unacceptable LOS E during the PM peak hour. The addition of proposed project traffic would deteriorate the intersection to LOS F during the PM peak hour. For the PM peak hour, the proposed project traffic would cause an increase in critical delay of 21.2 seconds and an increase in critical v/c ratio of 0.137. Based on City of Sunnyvale significant impact criteria, the project would generate a significant intersection impact at this intersection during both the PM peak hour.

[3] The report loosely refers to the proposed project with an address of 901 Kifer Road. The proposed project site actually encompasses 893-909, 917, and 919-921 Kifer Road, and 133-135, 155, 165, 167-171, 181, 183 and 193 Commercial Street.

Mitigation Strategies

Mitigation would require installation of a signal at the intersection of Commercial Street and Kifer Road. Installation of a signal would significantly reduce the delay for southbound vehicles while maintaining minimal delay for westbound and eastbound traffic. The project applicant will be responsible for the signal installation costs. City staff will collect and reserve the signal installation costs for a period of ten years while monitoring the intersection. If a signal is needed the City will construct it as a Capital Improvement Project. If a signal is not needed within the ten-year period City staff will refund the signal installation costs to the project applicant. With this proposed mitigation, the intersection would operate at an acceptable LOS B or better during the AM and PM peak hours. Under the City of Sunnyvale's standards, the proposed mitigation would eliminate the significant impact. With the proposed mitigation, the traffic impact at this intersection would be *less than significant.*

Other Transportation Issues

Hexagon conducted a site plan review, queuing analysis, pedestrian, bicycle and transit facility analysis and parking analysis for the proposed project. Our recommendations are listed below.

Recommendations

- It is recommended that the project explore options to provide shuttle bus service to either/both the Sunnyvale Caltrain station and the Lawrence Caltrain station, which can be addressed in the project's final TDM plan.
- As proposed by the project, the project shall install sidewalks along the project frontage on Kifer Road, on Commercial Street south of the northern driveway, and on San Lazaro Avenue.
- As proposed by the project, the project shall install an ADA compliant ramp at the northwest corner of Kifer Road and Commercial Street.
- Per City design standards, the project-proposed green bike lanes on westbound Kifer Road do not meet design standards and shall not be proposed.

Fortinet (901 Kifer Road)
Final TOA
Technical Appendices

December 5, 2018

Appendix A
Traffic Counts

Appendix B
Volume Summary

Appendix C
Level of Service Calculations

Appendix D
Signal Warrant Worksheet