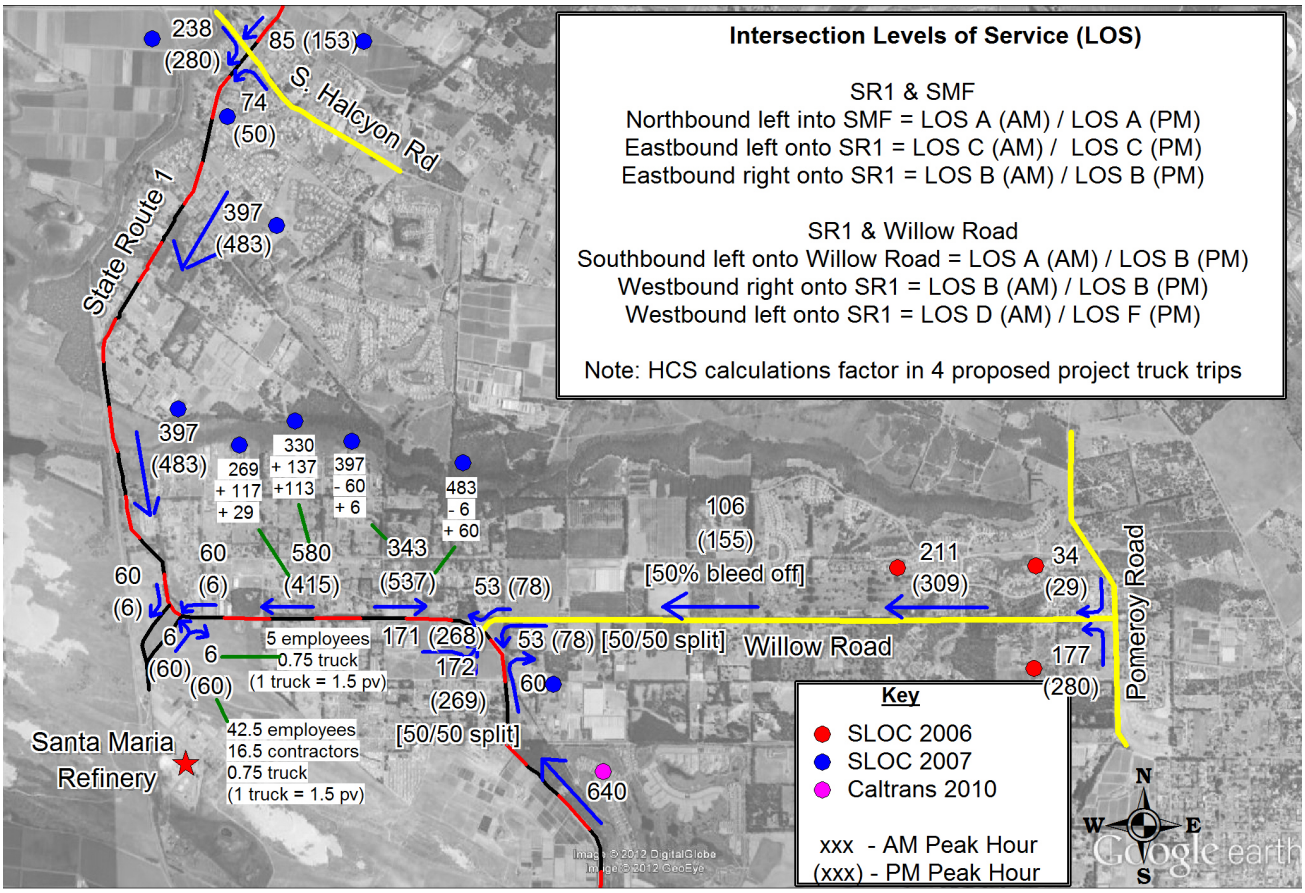
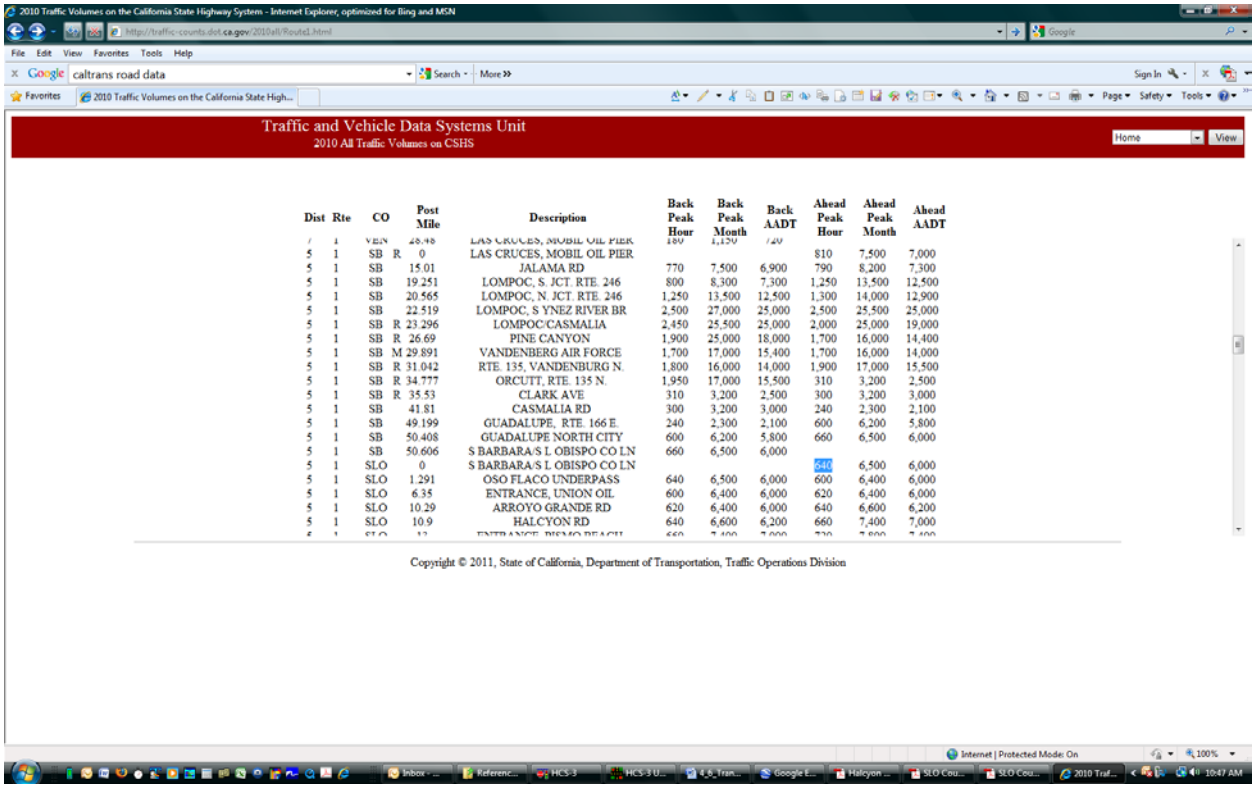
Appendix F – Intersection Traffic Data

Intersection Level of Service Map





Traffic and Vehicle Data Systems Unit
2010 All Traffic Volumes on CSHS

Dist	Rte	CO	Post Mile	Description	Back Peak Hour	Back Peak Month	Back AADT	Ahead Peak Hour	Ahead Peak Month	Ahead AADT
7	1	VEN	28.48	LAS CRUCES, MOBIL OIL PIER	180	1,150	720			
5	1	SB	R 0	LAS CRUCES, MOBIL OIL PIER				810	7,500	7,000
5	1	SB	15.01	JALAMA RD	770	7,500	6,900	790	8,200	7,300
5	1	SB	19.251	LOMPOC, S. JCT. RTE. 246	800	8,300	7,300	1,250	13,500	12,500
5	1	SB	20.565	LOMPOC, N. JCT. RTE. 246	1,250	13,500	12,500	1,300	14,000	12,900
5	1	SB	22.519	LOMPOC, S YNEZ RIVER BR	2,500	27,000	25,000	2,500	25,500	25,000
5	1	SB	R 23.296	LOMPOC/CASMALIA	2,450	25,500	25,000	2,000	25,000	19,000
5	1	SB	R 26.69	PINE CANYON	1,900	25,000	18,000	1,700	16,000	14,400
5	1	SB	M 29.891	VANDENBERG AIR FORCE	1,700	17,000	15,400	1,700	16,000	14,000
5	1	SB	R 31.042	RTE. 135, VANDENBURG N.	1,800	16,000	14,000	1,900	17,000	15,500
5	1	SB	R 34.777	ORCUTT, RTE. 135 N.	1,950	17,000	15,500	310	3,200	2,500
5	1	SB	R 35.53	CLARK AVE	310	3,200	2,500	300	3,200	3,000
5	1	SB	41.81	CASMALIA RD	300	3,200	3,000	240	2,300	2,100
5	1	SB	49.199	GUADALUPE, RTE. 166 E.	240	2,300	2,100	600	6,200	5,800
5	1	SB	50.408	GUADALUPE NORTH CITY	600	6,200	5,800	660	6,500	6,000
5	1	SB	50.606	S BARBARA/S L OBISPO CO LN	660	6,500	6,000			
5	1	SLO	0	S BARBARA/S L OBISPO CO LN				640	6,500	6,000
5	1	SLO	1.291	OSO FLACO UNDERPASS	640	6,500	6,000	600	6,400	6,000
5	1	SLO	6.35	ENTRANCE, UNION OIL	600	6,400	6,000	620	6,400	6,000
5	1	SLO	10.29	ARROYO GRANDE RD	620	6,400	6,000	640	6,600	6,200
5	1	SLO	10.9	HALCYON RD	640	6,600	6,200	660	7,400	7,000
5	1	SLO	12	ENTRANCE, PISMO BEACH	660	7,400	7,000	720	7,800	7,400

Traffic and Vehicle Data Systems Unit
2010 All Traffic Volumes on CSHS

Dist	Rte	CO	Post Mile	Description	Back Peak Hour	Back Peak Month	Back AADT	Ahead Peak Hour	Ahead Peak Month	Ahead AADT
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5	1	SB	R 0	LAS CRUCES, MOBIL OIL PIER				810	7,500	7,000
5	1	SB	15.01	JALAMA RD	770	7,500	6,900	790	8,200	7,300
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5	1	SB	20.565	LOMPOC, N. JCT. RTE. 246	1,250	13,500	12,500	1,300	14,000	12,900
5	1	SB	22.519	LOMPOC, S YNEZ RIVER BR	2,500	27,000	25,000	2,500	25,500	25,000
5	1	SB	R 23.296	LOMPOC/CASMALIA	2,450	25,500	25,000	2,000	25,000	19,000
5	1	SB	R 26.69	PINE CANYON	1,900	25,000	18,000	1,700	16,000	14,400
5	1	SB	M 29.891	VANDENBERG AIR FORCE	1,700	17,000	15,400	1,700	16,000	14,000
5	1	SB	R 31.042	RTE. 135, VANDENBURG N.	1,800	16,000	14,000	1,900	17,000	15,500
5	1	SB	R 34.777	ORCUTT, RTE. 135 N.	1,950	17,000	15,500	310	3,200	2,500
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5	1	SB	41.81	CASMALIA RD	300	3,200	3,000	240	2,300	2,100
5	1	SB	49.199	GUADALUPE, RTE. 166 E.	240	2,300	2,100	600	6,200	5,800
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5	1	SB	50.606	S BARBARA/S L OBISPO CO LN	660	6,500	6,000			
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5	1	SLO	10.29	ARROYO GRANDE RD	620	6,400	6,000	640	6,600	6,200
5	1	SLO	10.9	HALCYON RD	640	6,600	6,200	660	7,400	7,000
5	1	SLO	12	ENTRANCE, PISMO BEACH	660	7,400	7,000	720	7,800	7,400

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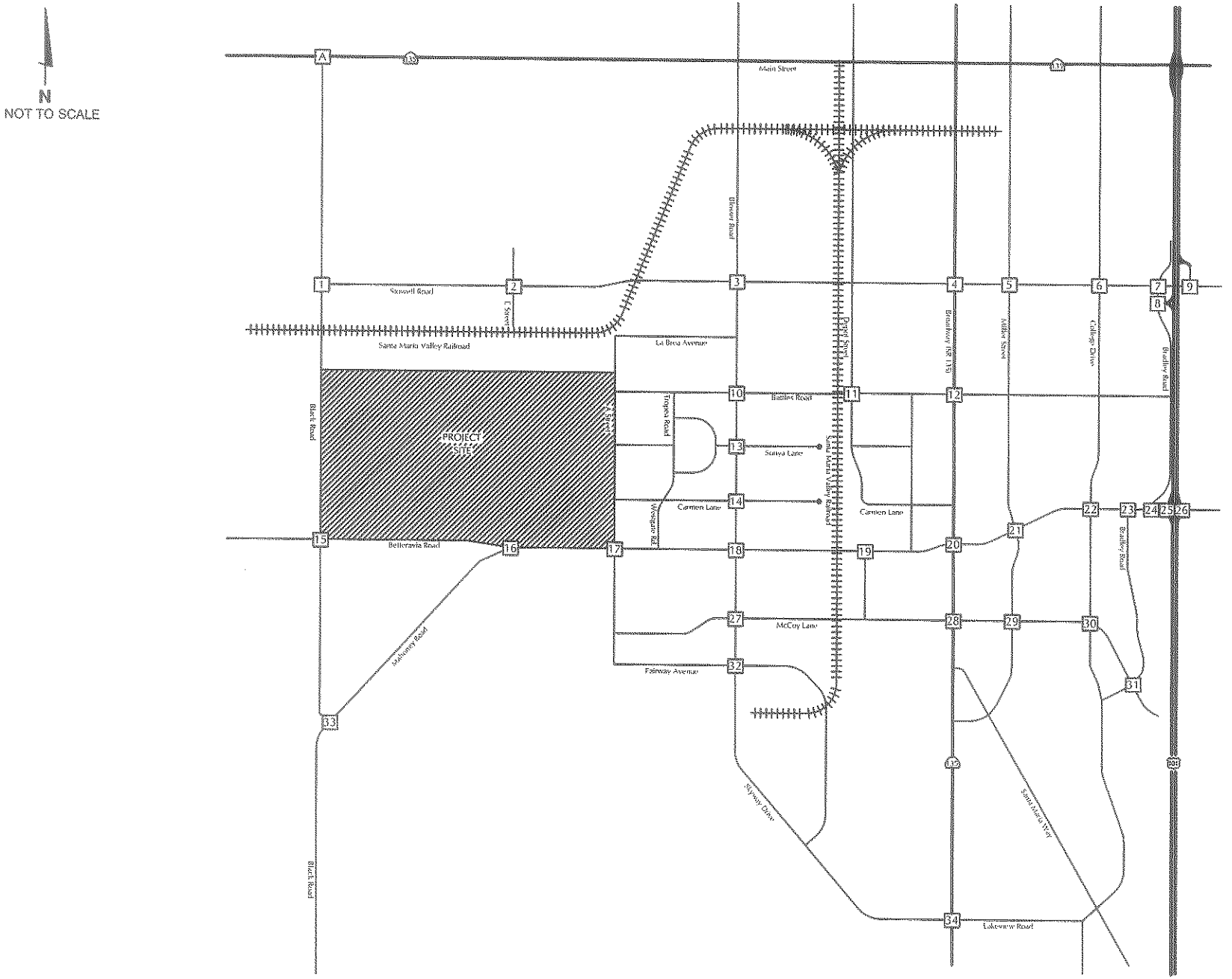
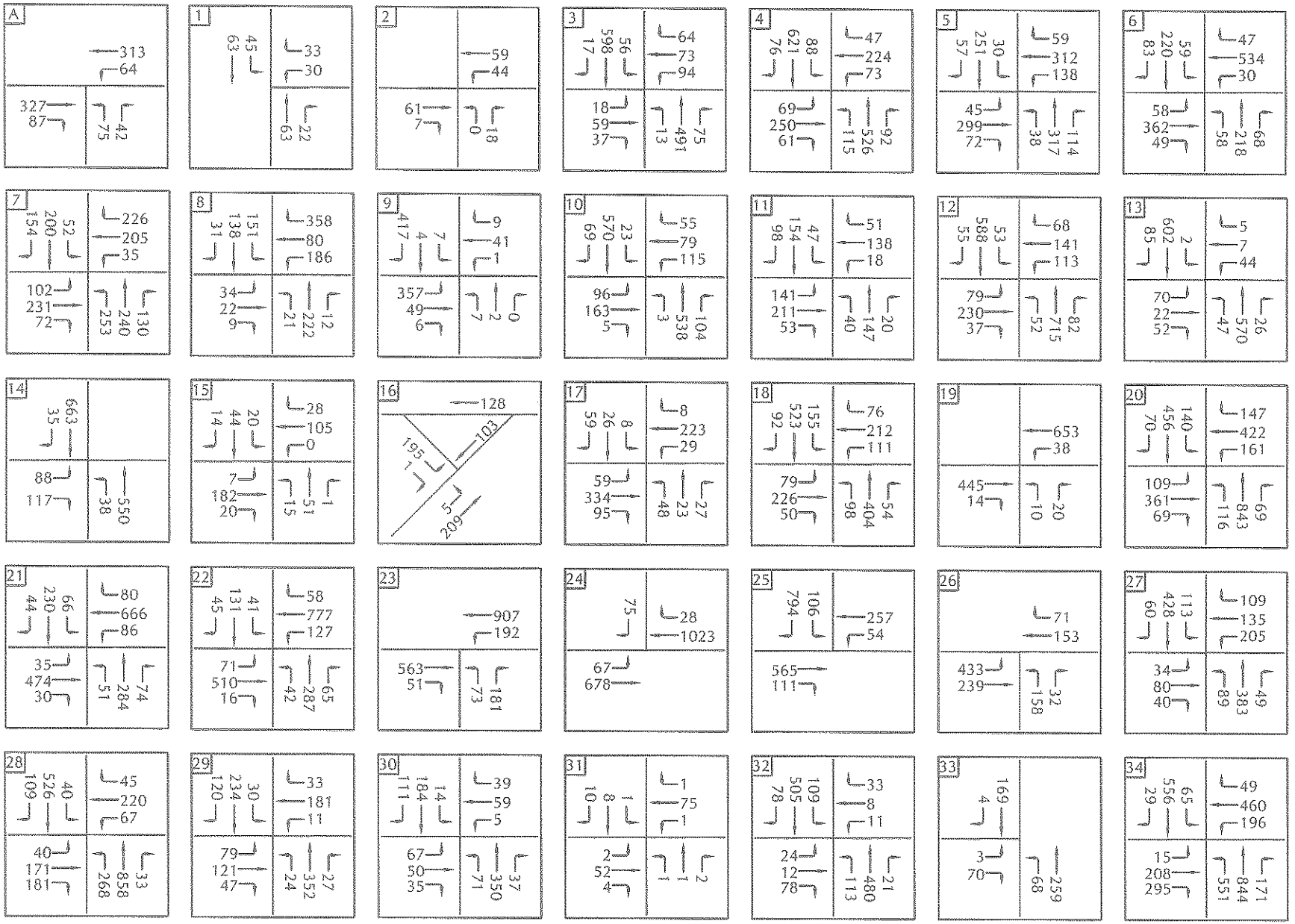


Associated Transportation Engineers

STUDY-AREA INTERSECTIONS

FIGURE 6a

MMF - #09077



ASSOCIATED
TRANSPORTATION
ENGINEERS

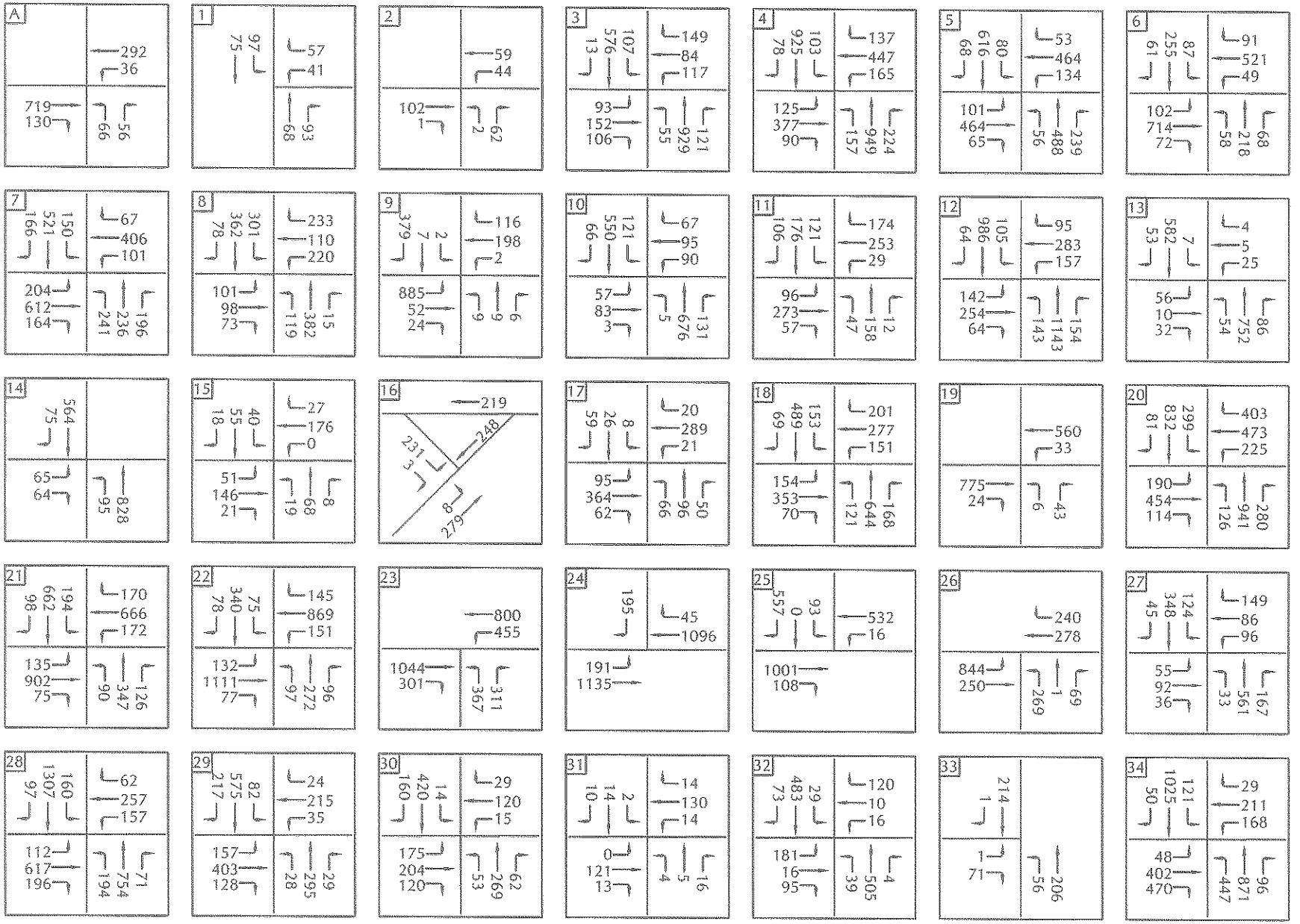
EXISTING A.M. PEAK HOUR TRAFFIC VOLUMES

LEGEND

XX - A.M. Peak Hour Volume

FIGURE 7

MMF - #09077



ASSOCIATED TRANSPORTATION ENGINEERS

EXISTING P.M. PEAK HOUR TRAFFIC VOLUMES

LEGEND

XX - P.M. Peak Hour Volume

FIGURE 8

MMF - #09077

Table 1
Existing (Scenario 1) Intersection Operations

Intersection	Control	A.M. Peak		P.M. Peak	
		ICU	LOS	ICU	LOS
Main Street/Black Road(a)	Stop Sign	11.4 Sec.	B	15.5 Sec.	C
Stowell Road/Black Road(a)	Stop Sign	8.7 Sec.	A	9.2 Sec.	A
Stowell Road/"E" Street(a)	Stop Sign	7.8 Sec.	A	8.8 Sec.	A
Stowell Road/Blosser Road	Signal	0.39	A	0.64	B
Stowell Road/Broadway (SR 135)	Signal	0.52	A	0.76	C
Stowell Road/Miller Street	Signal	0.52	A	0.70	B
Stowell Road/College Drive	Signal	0.45	A	0.52	A
Stowell Road/Bradley Road	Signal	0.46	A	0.65	B
Stowell Road/U.S. 101 NB Ramps(a)	Stop Sign	8.7 Sec.	A	31.4 Sec.	D
Bradley Road/U.S. 101 SB Ramps	Signal	0.39	A	0.59	A
Battles Road/Blosser Road	Signal	0.44	A	0.51	A
Battles Road/Depot Street	Signal	0.39	A	0.53	A
Battles Road/Broadway (SR 135)	Signal	0.45	A	0.64	B
Sonya Lane/Blosser Road(a)	Stop Sign	32.3 Sec.	D	30.6 Sec.	D
Carmen Lane/Blosser Road	Signal	0.54	A	0.60	A
Betteravia Road/Black Road(a)	Stop Sign	8.6 Sec.	A	9.4 Sec.	A
Betteravia Road/Mahoney Road(a)	Stop Sign	12.5 Sec.	B	18.2 Sec.	C
Betteravia Road/"A" Street	Signal	0.49	A	0.47	A
Betteravia Road/Blosser Road	Signal	0.49	A	0.66	B
Betteravia Road/Depot Street(a)	Stop Sign	9.4 Sec.	A	10.8 Sec.	B
Betteravia Road/Broadway (SR 135)	Signal	0.53	A	0.67	B
Betteravia Road/Miller Street	Signal	0.40	A	0.63	B
Betteravia Road/College Drive	Signal	0.44	A	0.60	A
Betteravia Road/Bradley Road	Signal	0.31	A	0.63	B
Betteravia Road/U.S. 101 SB Ramps	Signal	0.47	A	0.55	A
Betteravia Road/U.S. 101 NB Ramps	Signal	0.33	A	0.54	A
McCoy Lane/Skyway Drive	Signal	0.47	A	0.50	A
McCoy Lane/Broadway (SR 135)	Signal	0.53	A	0.90	D
McCoy Lane/Miller Street	Signal	0.33	A	0.53	A
McCoy Lane/College Drive(b)	Roundabout	1.9 Sec.	A	2.2 Sec.	A
McCoy Lane/Bradley Road(b)	Roundabout	1.5 Sec.	A	1.6 Sec.	A
Fairway Avenue/Blosser Road	Signal	0.39	A	0.45	A
Black Road/Mahoney Road(a)	Stop Sign	8.7 Sec.	A	8.9 Sec.	A
Skyway Drive/Broadway (SR 135)	Signal	0.63	B	0.79	C

(a) Stop-Sign intersection. LOS based on average control delay per vehicle in seconds.
(b) Roundabout intersection. LOS based on average control delay per vehicle in seconds.

Table 4.10-2 Level of Service Definitions

LOS	Control Delay[1]		Definition
	Unsignalized	Signalized	
A	< 10.0	< 10.0	Conditions of free unobstructed flow, no delays and all signal phases sufficient in duration to clear all approaching vehicles.
B	10.1-15.0	10.1-20.0	Conditions of stable flow, very little delay, a few phases are unable to handle all approaching vehicles.
C	15.1-25.0	20.1-35.0	Conditions of stable flow, delays are low to moderate, full use of peak direction signal phases is experienced.
D	25.1-35.0	35.1-55.0	Conditions approaching unstable flow, delays are moderate to heavy, significant signal time deficiencies are experienced for short durations during the peak traffic period.
E	35.1-50.0	55.1-80.0	Conditions of unstable flow, delays are significant, signal phase timing is generally insufficient, congestion exists for extended duration throughout the peak period.
F	> 50.0	> 80.0	Conditions of forced flow, travel speeds are low and volumes are well above capacity. This condition is often caused when vehicles released by an upstream signal are unable to proceed because of back-ups from a downstream signal.

1 Average control delay per vehicle in seconds.
Source: 2000 Highway Capacity Manual.

The City typically uses the "Intersection Capacity utilization" (ICU) methodology for assessing traffic operations at intersections. This is the methodology required under the Congestion Management Plan administered by the Santa Barbara County Association of Government (SBCAG). The Highway Capacity Manual Operations Method[1] is the preferred method of Caltrans (Broadway and Main Street are state routes). The Highway Capacity Manual Operations Method was selected for this study because it provides a detailed analyses of intersection operations using factors to account for lane widths, traffic mix (standard vehicles, trucks, buses, etc,), pedestrian and bicycle activity, parking maneuvers, and other such traffic characteristics that would be affected by the proposed Specific Plan.

Existing P.M. peak hour traffic volumes for the key intersections in the study area are listed in Table 4.10-3. All of the key intersections currently operate at LOS C or better during the P.M. peak hour period, which meets the City's LOS D standard.

Table 4.10-3 Existing PM Peak Hour LOS

Intersection	Control	Delay / LOS
Broadway/Fesler Street	Signalized	18.5 Sec/LOS B
Broadway/Main Street	Signalized	21.3 Sec/LOS C
Broadway/Cook Street	Signalized	26.9 Sec/LOS C
Main Street/Pine Street	Signalized	17.0 Sec/LOS B
Main Street/Lincoln Street	Unsignalized	10.4 Sec/LOS B
Main Street/Town Center Drive	Signalized	18.7 Sec/LOS B
Main Street/Miller Street	Signalized	38.6 Sec/LOS B

Source: Downtown Specific Plan, City of Santa Maria, California, Supplemental Traffic Analysis (ATE; April 2006).
Note: LOS based on average delay per vehicle in seconds pursuant to HCM.

[1] Highway Capacity Manual, Highway Research Board Special Report 209, Transportation Research Board, National Research Council, 2000.

Table 4.2-2
Existing PM Peak-Hour Levels of Service

Intersection	Control	ICU/LOS
College Drive/Main Street	Signalized	0.69/LOS B
U.S. 101 SB Off-Ramp-Bradley Road/Main Street	Signalized	0.61/LOS B
U.S. 101 NB On-Ramp-Nicholson Avenue/Main Street	Signalized	0.68/LOS B
Palisade Drive/Main Street	Signalized	0.44/LOS A
Suey Road/Main Street	Signalized	0.43/LOS A

Source: Associated Transportation Engineers. CMP Traffic Analysis for the Marian Hospital Expansion Project. May 2006.

The closest bus stop is located in front of the project site along Church Street. Due to its current location directly in front of the new park and monument, the bus stop will be moved to the west following the buildout of the new facility.

Regional access via public transportation is also available in the City. The Breeze bus service provides service to Vandenburg Air Force Base and Lompoc, the San Luis Obispo Regional Transit Authority provides service to San Luis Obispo County and the Guadalupe Flyer provides regular weekday service between Guadalupe and Santa Maria.

Bicycle Facilities

The use of bicycles instead of automobiles as a means of transportation improves health and fitness, provides enjoyment, and reduces air pollution, traffic congestion, energy consumption, and transportation costs. These benefits justify local and regional government recognition of bicycles as a viable transportation mode for local trips as well as the development and improvement of facilities to accommodate safe and efficient bicycle use. Bikeways are defined into four categories: Multi-Purpose Trail I, Multi-Purpose Trail II, Class II (Bike Lane), and Class III (Bike Route). Each category is discussed below.

Multi-Purpose Trail I bikeways are completely separated joint use facilities designed for shared pedestrian and bicycle use. These faculties may be located along rivers, abandoned and existing railroad, utility rights-of-ways and between parks.

Multi-Purpose Trail II are separated joint use facilities (pedestrian and bicycle) which are used in conjunction with a Class II bike lane. This type of facility gives the bike rider the option of using the bike lane or the separated multi-purpose trail. This facility typically replaces the traditional sidewalk, as it can serve as both the sidewalk and recreational trail.

According to the *South County (Nipomo) Traffic Model Update* report, (March 2006), SR-1 (Cienaga Street) currently carries approximately 11,540 ADT west of Halcyon Road (and Arroyo Grande Creek) and 5,190 ADT east of Halcyon Road (and Arroyo Grande Creek). SR-1 carries approximately 4,190 ADT north of and 10,150 ADT south of Halcyon Road/SR-1 (Mesa View Drive) intersection. According to *2004 Annual Average Daily Truck Traffic on the California State Highway System* (published on Caltrans website), trucks comprise approximately 11% of the average daily traffic through the SR-1 study segment.

Halcyon Road carries an Annual Average Daily Traffic (AADT) of approximately 8,580 vehicles north of and 10,080 vehicles south of SR-1 (Cienaga Street). Halcyon Road carries an AADT of approximately 3,850 vehicles east/south of the SR-1 (Mesa View Drive) intersection. Halcyon Road currently carries approximately two percent truck traffic on a daily basis. Figure TR-1 provides Existing (2004-05) Traffic Volumes and Figure TR-2 provides existing study intersection lane geometrics and control, as used for traffic analysis purposes.

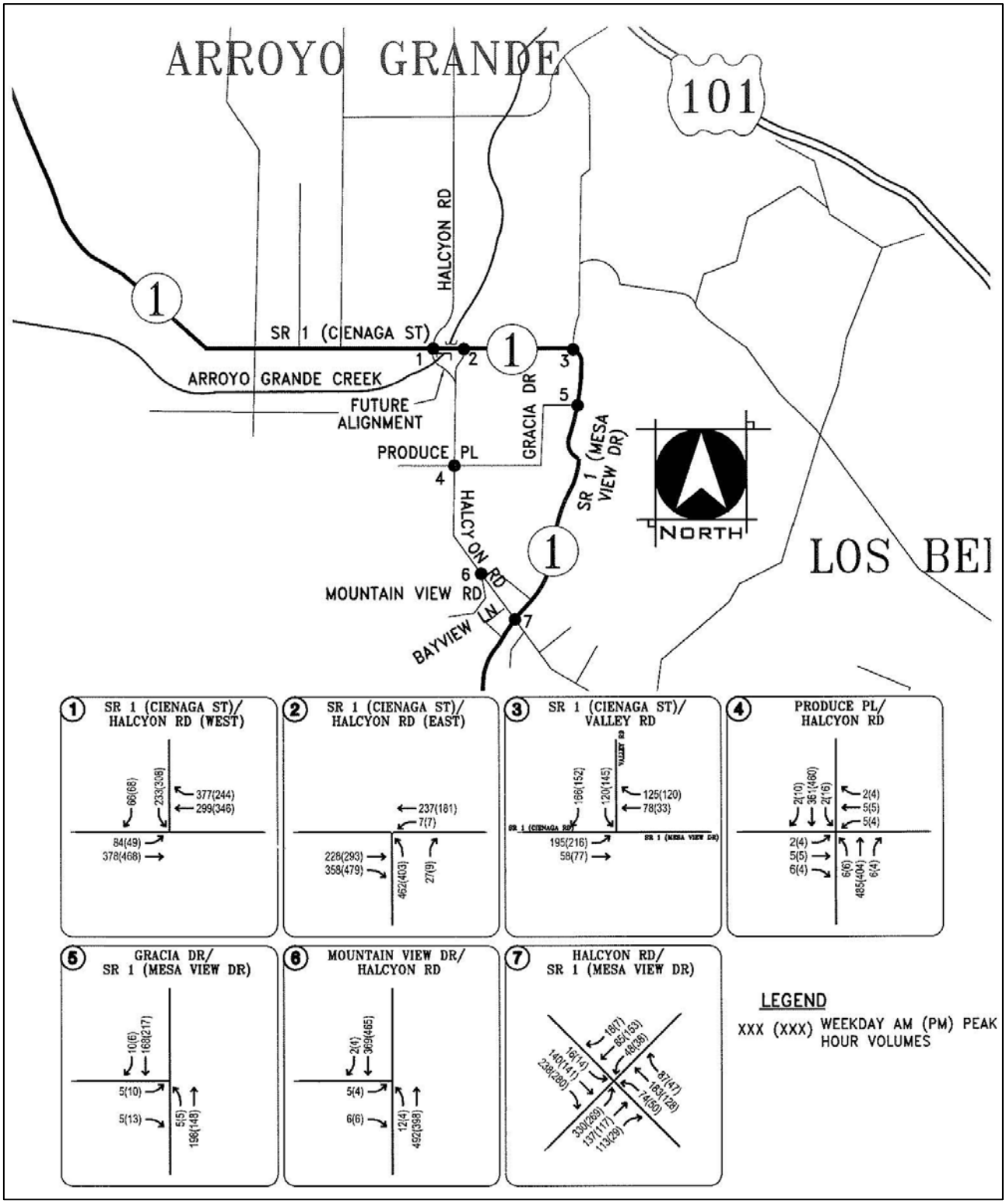
d. Intersection Operations

Traffic flow on rural arterial roadways is most constrained at intersections. Therefore an analysis of traffic flow must examine the operating conditions at critical intersections during peak travel periods. LOS A through F are used to rate roadway and intersection operations. Table TR-2 presents existing intersection traffic operations under existing (2005) traffic volumes shown in Figure TR-1 and existing intersection lane geometrics and control shown in Figure TR-2.

TABLE TR-2
Existing Conditions (2005): Intersection Level of Service

#	Intersection:	Control Type	AM Peak Hour			PM Peak Hour		
			Delay (Sec/Veh)	LOS	Warrant Met?	Delay (Sec/Veh)	LOS	Warrant Met?
1	SR-1 (Cienaga Street)/Halcyon Road (west)	AWSC	39.5	E	Yes	104.9	F	Yes
2	SR-1 (Cienaga Street)/Halcyon Road (east)	AWSC	90.4	F	Yes	256.3	F	Yes
3	SR-1 (Cienaga Street/Mesa View Drive)/ Valley Road	TWSC	10.0	A	Yes	23.3	C	Yes
4	Produce Place/Halcyon Road	TWSC	19.4	C	No	19.1	C	No
5	Gracia Drive/SR-1 (Mesa View Drive)	TWSC	10.3	B	No	10.4	B	No
6	Mountain View Road/Halcyon Road	TWSC	14.4	B	No	10.3	B	No
7	SR-1 (Mesa View Drive)/Halcyon Road	Signal	31.1	C	-	25.1	C	-

Notes:
1. "#" denotes intersection numbers as shown on Figures TR-1 and TR-2.
2. For TWSC intersections, "Worse-Case" movement delay (in seconds/vehicle" are indicated. "Average" control delays (in seconds/vehicle) are indicated for signal-controlled and AWSC intersections.
3. Warrant = MUTCD 2003 based Peak-hour-Volume Warrant #3 (Rural Areas).



Source: Wood Rodgers, Inc., 2006.

Existing (2005) Traffic Volumes
FIGURE TR-1

As shown in Table TR-2, the two "offset" SR-1 (Cienaga Street) intersections with Halcyon Road are currently operating at AM and PM peak hour LOS E or worse conditions under existing intersection lane geometrics and unsignalized control conditions. The remaining study intersections are currently operating at LOS C or better conditions during typical weekday AM and PM peak hour periods. The two "offset" SR-1 (Cienaga Street) intersections with Halcyon Road, and the SR-1/Valley Road intersection currently meet MUTCD 2003 based peak hour signal warrant #3 (rural areas).

e. Roadway Operations

Existing roadway operations under existing roadway capacity configurations were quantified utilizing the roadway ADT based LOS thresholds. The results are summarized in Table TR-3.

TABLE TR-3
Existing (2005) Conditions: Roadway Level of Service

Roadway Segment	Existing Functional Capacity Configuration*	ADT	LOS
Halcyon Road Segments			
North of SR-1 (Cienaga Street)	Two-Lane Collector	8,576	C
Between SR-1 (Cienaga Street) and SR-1 (Mesa View Drive)	Two-Lane Collector	10,074	D
East/South of SR-1 (Mesa View Drive)	Two-Lane Collector	3,854	C
SR-1 Segments			
West of Halcyon Road-West (Cienaga Street)	Two-Lane Arterial	11,544	C
Between Halcyon Road and Valley Road	Two-Lane Arterial	5,186	A
Between Valley Road and Halcyon Road-South	Two-Lane Arterial	4,190	A
South of Halcyon Road-South	Two-Lane Arterial	10,151	B

Note: ADT = Average Daily Traffic
** The indicated Functional Capacity Classifications are obtained from the South County Traffic Model Update Study (March 2006)*

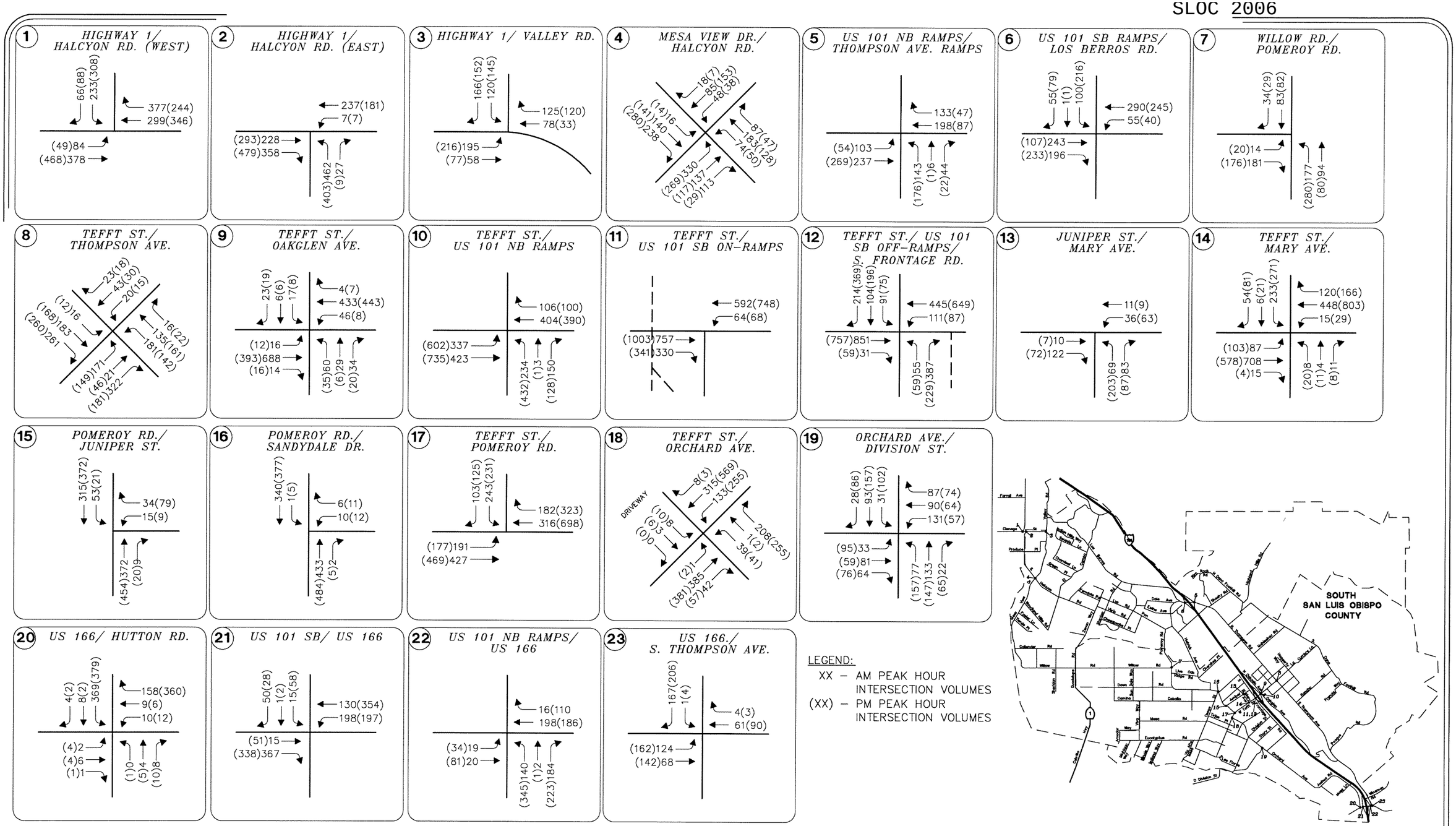
As shown in Table TR-3, all study roadway segments except Halcyon Road are currently operating at LOS C or better on a daily basis with the existing roadway capacity configurations. The Halcyon Road segment between SR-1 (Cienaga Street) and SR-1 (Mesa View Drive) is currently operating at LOS D on a daily basis, mainly due to the 15% grade approaching SR-1 (Mesa View Drive).

f. Roadway Area-Wide Improvements

The *South County Circulation Study* (last update: 2005), as reported in the *South County Traffic Model Update*, projects improvements to be in-place by the year 2025 as follows:

1. Willow Road extension to Thompson Avenue – The Supplemental Environmental Impact Report (SEIR) will be complete by June 2006. The design of the project will

SLOC 2006



LEGEND:

XX – AM PEAK HOUR INTERSECTION VOLUMES

(XX) – PM PEAK HOUR INTERSECTION VOLUMES

South County Nipomo Model Update

Figure 3

EXISTING PEAK HOUR INTERSECTION TRAFFIC VOLUMES

File: T795TG03.dwg (101304) 25-6462-05

Intersections

Existing peak hour intersection traffic operations were quantified by applying existing traffic volumes (shown on Figure 3) and existing intersection lane geometrics and control (shown on Figure 4). Table 4 presents the existing peak hour intersection levels of service.

TABLE 4
EXISTING CONDITIONS: INTERSECTION LEVELS-OF-SERVICE

			AM Peak Hour			PM Peak Hour		
#	Intersection	Control Type	Delay	LOS	Warrant Met?	Delay	LOS	Warrant Met?
1	**Highway 1/Halcyon Road (west)**	**AWSC**	**25.9**	**D**	**Yes**	**41.9**	**E**	**Yes**
2	**Highway 1/Halcyon Road (east)**	**AWSC**	**63.0**	**F**	**Yes**	**107.1**	**F**	**Yes**
3	Highway 1/Valley Road	TWSC	13.4	B	No	22.3	C	No
4	Mesa View Drive/Halcyon Road	Signal	22.7	C	-	22.5	C	-
5	**US 101 NB Ramps/Thompson Avenue**	**TWSC**	**25.8**	**D**	**No**	18.7	C	No
6	US 101 SB Ramps/Los Berros Road	TWSC	20.2	C	No	24.6	C	No
7	Willow Road/Pomeroy Road	TWSC	10.5	B	No	11.0	B	No
8	Tefft Street/Thompson Avenue	Signal	28.6	C	-	26.1	C	-
9	Tefft Street/Oakglen Avenue	Signal	14.4	B	-	8.9	A	-
10	**US 101 NB Ramps/Tefft Street**	**Signal**	**27.2**	**C**[2]	**-**	**31.2**	**C**[2]	**-**
12	**US 101 SB Ramps/South Frontage Road/Tefft Street**[1]	**Signal**	**49.0**	**D**[1]	**-**	**60.5**	**E**[1]	**-**
13	Juniper Street/Mary Avenue	TWSC	11.2	B	No	12.1	B	No
14	Tefft Street/Mary Avenue	Signal	23.1	C	-	24.5	C	-
15	Pomeroy Road/Juniper Street	TWSC	13.5	B	No	13.7	B	No
16	Pomeroy Road/Sandydale Drive	TWSC	14.6	B	No	15.6	C	No
17	Tefft Street/Pomeroy Road	Signal	24.4	C	-	23.7	C	-
18	Tefft Street/Orchard Avenue	Signal	18.8	B	-	17.5	B	-
19	Orchard Avenue/Division Street	Signal	22.3	C	-	27.3	C	-
20	US 166/Hutton Road	TWSC	11.4	B	No	13.8	B	No
21	**US 101 SB Ramps/US 166**	**TWSC**	11.9	B	No	**27.3**	**D**	**No**
22	US 101 NB Ramps/US 166	TWSC	10.3	B	No	18.2	C	Yes
23	US 166/South Thompson Avenue	TWSC	17.3	C	No	9.9	A	No

Legend: TWSC = Two-Way-Stop Control. AWSC = All-Way-Stop Control. , OVR – Over Capacity
Warrant = Caltrans Peak hour-Volume based Signal Warrant-11 (Urban Areas) – for freeway ramp intersections
Warrant = MUTCD Peak hour-Volume based Signal Warrant-11 (Urban Areas) – for all other intersections
Bolded Intersection, Delays, and LOS indicate intersections operating at deficient LOS "D" or worse for intersections within County right-of way, and LOS "E" and "F" for intersections within Caltrans right of way.

1. *Intersection 11 (US 101 SB on-ramp/Tefft Street) forms the fifth leg of Intersection 12.*
2. *Due to closely spaced intersections, queue back-up on Tefft Street in the vicinity of the US 101 SB ramp/Tefft Street intersection may affect the actual travel demand through the US 101 northbound ramp/Tefft Street intersection, thereby resulting in a lower calculated delay and corresponding LOS.*

As shown in Table 4, the SR 1 intersections at Halcyon Road (east and west) are currently operating at deficient LOS "E" or worse during at least one peak hour period. The SR 1/Halcyon Road (east and west) intersections and the US 101 northbound ramp/US 166 intersection meet peak-hour-volume based signal warrants, indicating that the peak-hour-volume of minor-street vehicles experience unacceptable delays and are significantly large to warrant installation of a traffic signal at this location.

The US 101 southbound off-ramp intersection at Tefft Street and South Frontage Road (Intersection 12) operates at unacceptable LOS "D" and "E" during the AM and PM peak hours, respectively. This intersection is closely spaced with the Tefft Street/US 101 SB on-ramp intersection (Intersection 11), such that the US 101 southbound on-ramp is essentially the fifth leg of the US 101 southbound off-ramp/Tefft Street intersection, and the Tefft Street/US 101 NB ramp intersection (Intersection 10). The staggered alignment and close

HCS: Unsignalized Intersections Release 3.2

TWO-WAY STOP CONTROL SUMMARY

Intersection:	Refinery and HWY 1
Analyst:	MRS
Project No.:	102
Date:	5/7/2012
East/West Street:	Refinery Drive
North/South Street:	HWY 1
Intersection Orientation: NS	Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	60	580			397	60
Hourly Flow Rate, HFR	60	580			397	60
Percent Heavy Vehicles	10	--	--		--	--
Median Type	Undivided					
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				6		6
Hourly Flow Rate, HFR				6		6
Percent Heavy Vehicles				10		10
Percent Grade (%)		0			0	
Median Storage	1					
Flared Approach: Exists?						
Storage						
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	60					6		6
C(m) (vph)	1063					218		635
v/c	0.06					0.03		0.01
95% queue length	0.04					0.00		0.00
Control Delay	8.6					22.0		10.7
LOS	A					C		B
Approach Delay							16.4	
Approach LOS							C	

HCS: Unsignalized Intersections Release 3.2

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Intersection:	Refinery and HWY 1
City/State:	
Analyst:	MRS
Project No.:	102
Time period Analyzed:	
Date:	5/7/2012
East/West Street:	Refinery Drive
North/South Street:	HWY 1
Intersection Orientation: NS	Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	60	580			397	60
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	15	145			99	15
Hourly Flow Rate, HFR	60	580			397	60
Percent Heavy Vehicles	10	--	--		--	--
Median Type	Undivided					
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				6		6
Peak Hour Factor, PHF				1.00		1.00
Peak-15 Minute Volume				2		2
Hourly Flow Rate, HFR				6		6
Percent Heavy Vehicles				10		10
Percent Grade (%)		0			0	
Median Storage	1					
Flared Approach: Exists?						
Storage						
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16

Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1		6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	10					10		10
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.2					6.5		6.3
2-stage	4.2					5.5		6.3

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	10					10		10
t(f)	2.3					3.6		3.4

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from table 9-2)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	457					1097		397
s								
Px								

V c,u,x

C r,x
C plat,x

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					397	700		
s						1700		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		397
Potential Capacity		635
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		635
Probability of Queue free St.	1.00	0.99
Step 2: LT from Major St.	**4**	**1**
Conflicting Flows		457
Potential Capacity		1063
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1063
Probability of Queue free St.	1.00	0.94
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	**8**	**11**
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.94	0.94
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	**7**	**10**
Conflicting Flows		1097
Potential Capacity		228
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.94	0.94
Maj. L, Min T Adj. Imp Factor.	0.96	0.96
Cap. Adj. factor due to Impeding mvmnt	0.95	0.96
Movement Capacity		218

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	444	607
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.94	1.00
Movement Capacity	419	607
Probability of Queue free St.	1.00	1.00
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	571	444
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.94
Movement Capacity	571	419
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.94	0.94
Movement Capacity		
Result for 2 stage process:		
a	0.00	0.00
y	0.00	0.00
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		397
Potential Capacity	496	662
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.94	1.00
Movement Capacity	468	662
Part 2 - Second Stage		
Conflicting Flows		700
Potential Capacity	660	478
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.94
Movement Capacity	654	451
Part 3 - Single Stage		
Conflicting Flows		1097
Potential Capacity		228
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.94	0.94
Maj. L, Min T Adj. Imp Factor.	0.96	0.96
Cap. Adj. factor due to Impeding mvmnt	0.95	0.96
Movement Capacity		218
Results for Two-stage process:		
a	0.00	0.00

y			0.00			0.00
C t						218

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				6		6
Movement Capacity (vph)				218		635
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				218		635
Volume				6		6
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	60					6		6
C(m) (vph)	1063					218		635
v/c	0.06					0.03		0.01
95% queue length	0.04					0.00		0.00
Control Delay	8.6					22.0		10.7
LOS	A					C		B
Approach Delay							16.4	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.94	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		

d(M,LT), Delay for stream 1 or 4
N, Number of major street through lanes
d(rank,1) Delay for stream 2 or 5

HCS: Unsignalized Intersections Release 3.2

TWO-WAY STOP CONTROL SUMMARY

Intersection:	Refinery and HWY 1
Analyst:	MRS
Project No.:	102
Date:	5/7/2012
East/West Street:	Refinery Drive
North/South Street:	HWY 1
Intersection Orientation: NS	Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	6	415			483	6
Hourly Flow Rate, HFR	6	415			483	6
Percent Heavy Vehicles	10	--	--		--	--
Median Type	Undivided					
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				60		60
Hourly Flow Rate, HFR				60		60
Percent Heavy Vehicles				10		10
Percent Grade (%)		0			0	
Median Storage	1					
Flared Approach: Exists?						
Storage						
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	6					60		60
C(m) (vph)	1034					294		568
v/c	0.01					0.20		0.11
95% queue length	0.00					0.85		0.33
Control Delay	8.5					20.4		12.1
LOS	A					C		B
Approach Delay							16.2	
Approach LOS							C	

HCS: Unsignalized Intersections Release 3.2

MRS

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Intersection:	Refinery and HWY 1
City/State:	
Analyst:	MRS
Project No.:	102
Time period Analyzed:	
Date:	5/7/2012
East/West Street:	Refinery Drive
North/South Street:	HWY 1
Intersection Orientation: NS	Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	6	415			483	6
Peak-Hour Factor, PHF	1.00	1.00			1.00	1.00
Peak-15 Minute Volume	2	104			121	2
Hourly Flow Rate, HFR	6	415			483	6
Percent Heavy Vehicles	10	--	--		--	--
Median Type	Undivided					
RT Channelized?						No
Lanes	1	1			1	1
Configuration	L	T			T	R
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				60		60
Peak Hour Factor, PHF				1.00		1.00
Peak-15 Minute Volume				15		15
Hourly Flow Rate, HFR				60		60
Percent Heavy Vehicles				10		10
Percent Grade (%)		0			0	
Median Storage	1					
Flared Approach: Exists?						
Storage						
RT Channelized?						No
Lanes				1		1
Configuration				L		R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16

Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1		6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	10					10		10
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.2					6.5		6.3
2-stage	4.2					5.5		6.3

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	10					10		10
t(f)	2.3					3.6		3.4

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from table 9-2)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	489					910		483
s								
Px								

V c,u,x

C r,x
C plat,x

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)					483	427		
s						1700		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		483
Potential Capacity		568
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		568
Probability of Queue free St.	1.00	0.89
Step 2: LT from Major St.	**4**	**1**
Conflicting Flows		489
Potential Capacity		1034
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		1034
Probability of Queue free St.	1.00	0.99
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	**8**	**11**
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	**7**	**10**
Conflicting Flows		910
Potential Capacity		295
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.99
Maj. L, Min T Adj. Imp Factor.	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	1.00
Movement Capacity		294

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	589	556
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity	586	556
Probability of Queue free St.	1.00	1.00
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	553	589
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.99
Movement Capacity	553	586
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	0.99
Movement Capacity		
Result for 2 stage process:		
a	0.00	0.00
y	0.00	0.00
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		483
Potential Capacity	662	604
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.99	1.00
Movement Capacity	658	604
Part 2 - Second Stage		
Conflicting Flows		427
Potential Capacity	603	641
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	0.99
Movement Capacity	539	637
Part 3 - Single Stage		
Conflicting Flows		910
Potential Capacity		295
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.99	0.99
Maj. L, Min T Adj. Imp Factor.	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	1.00
Movement Capacity		294
Results for Two-stage process:		
a	0.00	0.00

y			0.00		0.00	
C t					294	

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)				60		60
Movement Capacity (vph)				294		568
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep				294		568
Volume				60		60
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	L					L		R
v (vph)	6					60		60
C(m) (vph)	1034					294		568
v/c	0.01					0.20		0.11
95% queue length	0.00					0.85		0.33
Control Delay	8.5					20.4		12.1
LOS	A					C		B
Approach Delay							16.2	
Approach LOS							C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	1.00
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		

d(M,LT), Delay for stream 1 or 4 8.5
N, Number of major street through lanes
d(rank,1) Delay for stream 2 or 5

HCS: Unsignalized Intersections Release 3.2

TWO-WAY STOP CONTROL SUMMARY

Intersection:	HWY 1 and Willow
Analyst:	MRS
Project No.:	102
Date:	5/7/2012
East/West Street:	Willow
North/South Street:	HWY 1
Intersection Orientation: NS	Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		640		171	172	
Hourly Flow Rate, HFR		640		171	172	
Percent Heavy Vehicles		--	--	10	--	--
Median Type	Undivided					
RT Channelized?						
Lanes		1		1	1	
Configuration		T		L	T	
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	53		53			
Hourly Flow Rate, HFR	53		53			
Percent Heavy Vehicles	10		10			
Percent Grade (%)		0			0	
Median Storage	1					
Flared Approach: Exists?						
Storage						
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		171	53		53			
C(m) (vph)		907	180		461			
v/c		0.19	0.29		0.11			
95% queue length		0.79	1.35		0.38			
Control Delay		9.9	33.3		13.8			
LOS		A	D		B			
Approach Delay			23.6					
Approach LOS			C					

HCS: Unsignalized Intersections Release 3.2

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Intersection:	HWY 1 and Willow
City/State:	
Analyst:	MRS
Project No.:	102
Time period Analyzed:	
Date:	5/7/2012
East/West Street:	Willow
North/South Street:	HWY 1
Intersection Orientation: NS	Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		640		171	172	
Peak-Hour Factor, PHF		1.00		1.00	1.00	
Peak-15 Minute Volume		160		43	43	
Hourly Flow Rate, HFR		640		171	172	
Percent Heavy Vehicles		--	--	10	--	--
Median Type	Undivided					
RT Channelized?						
Lanes		1		1	1	
Configuration		T		L	T	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	53		53			
Peak Hour Factor, PHF	1.00		1.00			
Peak-15 Minute Volume	13		13			
Hourly Flow Rate, HFR	53		53			
Percent Heavy Vehicles	10		10			
Percent Grade (%)		0			0	
Median Storage	1					
Flared Approach: Exists?						
Storage						
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16

Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		10	10		10			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.5		6.3			
2-stage		4.2	5.5		6.3			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		10	10		10			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from table 9-2)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		640	1154		640			
s								
Px								

V c,u,x

C r,x
C plat,x

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)	640	514						
s		1700						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	640	
Potential Capacity	461	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	461	
Probability of Queue free St.	0.89	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	640	
Potential Capacity	907	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	907	
Probability of Queue free St.	0.81	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.81	0.81
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	1154	
Potential Capacity	210	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.81	0.81
Maj. L, Min T Adj. Imp Factor.	0.86	0.86
Cap. Adj. factor due to Impeding mvmnt	0.86	0.76
Movement Capacity	180	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	473	539
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.81
Movement Capacity	473	437
Probability of Queue free St.	1.00	1.00
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	539	473
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.81	1.00
Movement Capacity	437	473
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.81	0.81
Movement Capacity		
Result for 2 stage process:		
a	0.00	0.00
y	0.00	0.00
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows	640	
Potential Capacity	510	584
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.81
Movement Capacity	510	474
Part 2 - Second Stage		
Conflicting Flows	514	
Potential Capacity	584	496
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.81	0.89
Movement Capacity	474	439
Part 3 - Single Stage		
Conflicting Flows	1154	
Potential Capacity	210	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.81	0.81
Maj. L, Min T Adj. Imp Factor.	0.86	0.86
Cap. Adj. factor due to Impeding mvmnt	0.86	0.76
Movement Capacity	180	
Results for Two-stage process:		
a	0.00	0.00

y	0.00	0.00
C t	180	

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	53		53			
Movement Capacity (vph)	180		461			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	180		461			
Volume	53		53			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		171	53		53			
C(m) (vph)		907	180		461			
v/c		0.19	0.29		0.11			
95% queue length		0.79	1.35		0.38			
Control Delay		9.9	33.3		13.8			
LOS		A	D		B			
Approach Delay				23.6				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.81
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		

d(M,LT), Delay for stream 1 or 4
N, Number of major street through lanes
d(rank,1) Delay for stream 2 or 5

HCS: Unsignalized Intersections Release 3.2

TWO-WAY STOP CONTROL SUMMARY

Intersection:	HWY 1 and Willow
Analyst:	MRS
Project No.:	102
Date:	5/7/2012
East/West Street:	Willow
North/South Street:	HWY 1
Intersection Orientation: NS	Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street: Approach	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		640		268	269	
Hourly Flow Rate, HFR		640		268	269	
Percent Heavy Vehicles		--	--	10	--	--
Median Type	Undivided					
RT Channelized?						
Lanes		1		1	1	
Configuration		T		L	T	
Upstream Signal?		No			No	

Minor Street: Approach	Westbound			Eastbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	78		78			
Hourly Flow Rate, HFR	78		78			
Percent Heavy Vehicles	10		10			
Percent Grade (%)		0			0	
Median Storage	1					
Flared Approach: Exists?						
Storage						
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		268	78		78			
C(m) (vph)		907	107		461			
v/c		0.30	0.73		0.17			
95% queue length		1.44	5.43		0.67			
Control Delay		10.6	116.7		14.4			
LOS		B	F		B			
Approach Delay			65.5					
Approach LOS			F					

HCS: Unsignalized Intersections Release 3.2

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Intersection: HWY 1 and Willow
City/State:
Analyst: MRS
Project No.: 102
Time period Analyzed:
Date: 5/7/2012
East/West Street: Willow
North/South Street: HWY 1
Intersection Orientation: NS Study period (hrs): 1.00

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		640		268	269	
Peak-Hour Factor, PHF		1.00		1.00	1.00	
Peak-15 Minute Volume		160		67	67	
Hourly Flow Rate, HFR		640		268	269	
Percent Heavy Vehicles		--	--	10	--	--
Median Type	Undivided					
RT Channelized?						
Lanes		1		1	1	
Configuration		T		L	T	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	78		78			
Peak Hour Factor, PHF	1.00		1.00			
Peak-15 Minute Volume	20		20			
Hourly Flow Rate, HFR	78		78			
Percent Heavy Vehicles	10		10			
Percent Grade (%)		0			0	
Median Storage	1					
Flared Approach: Exists?						
Storage						
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16

Flow (ped/hr)	0	0	0	0
Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		10	10		10			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.5		6.3			
2-stage		4.2	5.5		6.3			

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		10	10		10			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				
Total Saturation Flow Rate, s (vph)				
Arrival Type				
Effective Green, g (sec)				
Cycle Length, C (sec)				
Rp (from table 9-2)				
Proportion vehicles arriving on green P				
g(q1)				
g(q2)				
g(q)				

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x		640	1445		640			
s								
Px								

V c,u,x

C r,x
C plat,x

Two-Stage Process

	7		8		10		11	
	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)	640	805						
s		1700						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	640	
Potential Capacity	461	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	461	
Probability of Queue free St.	0.83	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	640	
Potential Capacity	907	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	907	
Probability of Queue free St.	0.70	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.70	0.70
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	1445	
Potential Capacity	139	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.70	0.70
Maj. L, Min T Adj. Imp Factor.	0.77	0.77
Cap. Adj. factor due to Impeding mvmnt	0.77	0.64
Movement Capacity	107	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	473	398
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.70
Movement Capacity	473	280
Probability of Queue free St.	1.00	1.00
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	398	473
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.70	1.00
Movement Capacity	280	473
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.70	0.70
Movement Capacity		
Result for 2 stage process:		
a	0.00	0.00
y	0.00	0.00
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows	640	
Potential Capacity	510	426
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.70
Movement Capacity	510	300
Part 2 - Second Stage		
Conflicting Flows	805	
Potential Capacity	426	489
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.70	0.83
Movement Capacity	300	406
Part 3 - Single Stage		
Conflicting Flows	1445	
Potential Capacity	139	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.70	0.70
Maj. L, Min T Adj. Imp Factor.	0.77	0.77
Cap. Adj. factor due to Impeding mvmnt	0.77	0.64
Movement Capacity	107	
Results for Two-stage process:		
a	0.00	0.00

y	0.00	0.00
C t	107	

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)	78		78			
Movement Capacity (vph)	107		461			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep	107		461			
Volume	78		78			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		268	78		78			
C(m) (vph)		907	107		461			
v/c		0.30	0.73		0.17			
95% queue length		1.44	5.43		0.67			
Control Delay		10.6	116.7		14.4			
LOS		B	F		B			
Approach Delay				65.5				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.70
v(il), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(il), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		

d(M,LT), Delay for stream 1 or 4
N, Number of major street through lanes
d(rank,1) Delay for stream 2 or 5

Bakersfield. The road is the main route to commercial and employment opportunities in Santa Maria. Caltrans is proposing to widen SR 166 from Guadalupe to the Santa Maria City limits. Two alternatives are proposed, including maintaining the roadway with two lanes and constructing a continuous two-way left turn lane or adding an additional lane in each direction and providing a continuous two-way left turn lane. The purpose of the widening project is to improve the operational efficiency and safety on SR 166 by reducing conflicts between commuter, tourist, agricultural and truck traffic. However, the current status of the project shows no funding available for the SR 166 Widening project beyond Project Approval & Environmental Document (PA&ED) phase. Currently work on this project is stalled. The City of Guadalupe circulation plan is to maintain the road as a two-lane arterial.

Obispo Street is a north-south two-lane roadway that connects SR 166 with the east side of Guadalupe. The road serves a mixture of residential, commercial and industrial land uses. The Civic Center (which houses City Hall, the police department and one of the City's fire stations) is located on Obispo Street, approximately one mile from SR 166.

Flower Avenue is a two-lane roadway that provides access to residential and other land uses north of State Route 166. The road dead-ends north of 4th St. Flower Avenue establishes the eastern boundary of the City of Guadalupe.

Existing Intersection Operations

Penfield & Smith conducted traffic counts at the study intersections on September 9 and 10, 2003 from 7 to 9 AM and from 4 to 6 PM. The existing peak hour volumes are illustrated in Exhibit 3. As shown in Table 2 below, all three study intersections currently operate within the City's acceptable level of service range during both peak hours.

Table 2
Existing Peak Hour Levels of Service

Intersection	Traffic Control	AM Peak LOS (sec/veh.)	PM Peak LOS (sec./veh.)
SR 166/SR 1	All-way STOP	13.2/LOS B	12.9/LOS B
SR 166/Obispo St.	One-way STOP	13.7/LOS B	12.4/LOS B
SR 166/Flower Ave.	One-way STOP	14.9/LOS B	13.0/LOS B

Future Conditions

The base future traffic volumes were determined based on the volumes provided in the Project Study Report on State Route 166 prepared by Caltrans in June 2001. The twenty year traffic growth rate was determined to be approximately one percent per year. The future traffic volumes are illustrated in Exhibit 4.