APPENDIX H

Marin Avenue Signal Timing Study
(Kimley-Horn and Associates, Inc., May 1997)

Marin Avenue

Signal Timing Study

FINAL REPORT

Prepared For:

City of Albany

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Project No. 0970011.02

Prepared by:

Kimley-Horn
and Associates, Inc.

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1.0 INTRODUCTION

Kimley-Horn and Associates, Inc. was retained to conduct a signal timing analysis along Marin Avenue from Peralta to San Pablo Avenue. The objectives of the study, as defined by the City, are as follows:

- Provide an efficient traffic progression along the corridor
- Encourage a flow that is consistent with the speed limit, i.e. 25 mph
- Provide more or equal consideration for pedestrian movements and side street traffic

2.0 PEDESTRIAN TIMING

Based on a meeting with City staff, pedestrian timings were evaluated along the corridor. The following criteria were used to calculate the pedestrian timing requirements for Marin Avenue:

- Walk Duration: 7 Seconds for Cross Street; 10 Seconds for Main Street; except for Santa Fe which will be 10 seconds for both directions.

- Don't Walk Duration: The Don't walk duration was calculated based on 3.5 feet per second walking rate and for entire crosswalk distance (curb to curb). No reduction was allowed for yellow or all-red period.

Based on the following parameters, Table 1 shows the recommended Walk and Don't Walk durations for each intersection in the corridor:

TABLE 1
RECOMMENDED PEDESTRIAN TIMINGS

Intersection	Walk Duration		Don't Walk Duration	
	Phase		Phase	
	2 (6)	4	2 (6)	4
Masonic	7	10	17	12
Santa Fe	10	10	19	20
Peralta	7	10	20	27

3.0 SIGNAL COORDINATION

Based on the recommended pedestrian timings, Kimley-Horn analyzed signal coordination along Marin Avenue. The objective was to develop the most efficient traffic flow, based on a 25 mph speed progression goal. The SYNCHRO model was used for the signal timing and level of service analysis.

Initially, we evaluated all four intersections in the corridor, including San Pablo Avenue. Since San Pablo Avenue is a major intersection, the required cycle length for this intersection will control all other intersections. Additionally, there is already a coordination plan along San Pablo Avenue, which favors progression along San Pablo, thereby making the Marin Avenue corridor a "slave" to the San Pablo Corridor. Based on a "Coordinability" analysis, there is relatively small attraction to coordinate Masonic with San Pablo Avenue. Typically, a "Coordinability" value of over 50, may be suitable for signal coordination. For both the AM and PM peak hour analysis, the "Coordinability" factor between San Pablo and Masonic was "54" or lower, which indicates a relatively low priority for coordination. (Typically we use "Coordinability" factor above 60 to recommend coordination between two signals). The results of "Coordinability" analysis is attached as a part of the SYNCHRO modeling analysis.

Based on this analysis, it is recommended that San Pablo Avenue be removed from the Marin Avenue corridor. The proposed coordination will only inter-tie Masonic, Santa Fe and Peralta intersections. This will allow a much lower cycle length, which will minimize overall delay for all movements, and will provide more preference for pedestrian movements.

Based on this recommendation, we evaluated various cycle lengths along the corridor for both the AM and PM peak hours. Based on this analysis, the recommended cycle length for both periods should be set at 75 seconds.

Based on the 24-hour tube counts, we reviewed the beginning and ending periods of the coordination plans. The two-way, 24-hour traffic volumes show a relatively flat volume between 7:00 AM and 8:00 PM along the corridor, with some peaking between 8:00 AM to 9:00 AM and 5:00 PM and 7:00 PM. Since the cycle length is the same for morning or afternoon peak periods, and the recommended cycle length is relatively low, we recommend using the same cycle length between 6:30 AM to 8:30 PM. After 8:30 PM to 6:30 PM and during weekend, this system should be set in free "actuated" operation mode.

In order to develop a more effective midday plan, we averaged the AM and PM peak periods to develop the volumes for the midday period. Based on this information, we calculated the coordination timing parameters (split and offsets) for the midday timing plan.

The Tables 2 to 4 show the recommended coordination timing parameters (cycle length, offset and split data). The signal timing plans are based on existing lane configuration and proposed pedestrian timings described in Section 1.0. The complete analysis is included in the Appendix.

TABLE 2
AM PERIOD - COORDINATION PARAMETERS

Intersection	Offset (referenced to beginning of yellow) Sec	Split	
		Phase	
		2	4
Masonic	62	41	34
Santa Fe	18	40	35
Peralta	66	35	40
Cycle Length	75 Seconds		
Effective Period	6:30 AM - 9:30 AM		

TABLE 3
MIDDAY PERIOD - COORDINATION PARAMETERS

Intersection	Offset (referenced to beginning of yellow) Sec	Split	
		Phase	
		2	4
Masonic	73	45	30
Santa Fe	31	42	33
Peralta	35	35	40
Cycle Length	75 Seconds		
Effective Period	9:30 AM - 3:30 PM & 7:30 PM - 8:30 PM		

TABLE 4
PM PERIOD - COORDINATION PARAMETERS

Intersection	Offset (referenced to beginning of yellow) Sec	Split	
		Phase	
		2	4
Masonic	38	47	28
Santa Fe	68	42	33
Peralta	74	35	40
Cycle Length	75 Seconds		
Effective Period	3:30 PM - 7:30 PM		

The recommended timing plans assumes a fully actuated signal operation, i.e. loop detectors functioning in all directions.

Implementation of the coordination plan will require a review of internal hardwired configuration, confirmation of the existing of leased-phone line connection, and a new Master controller. The Master controller can be located at any of the intersections. For the interim period, prior to implementation of hardwired or new leased-phone lines and the new Master controller, the coordination can be implemented using internal "Time-Based Coordination" (TBC), as long as the internal software supports TBC operation.

4.0 TIME SPACE DIAGRAMS

The time-space diagram for each period were generated using the SYNCHRO Model. Time-Space diagram is a graphical representation of the available bandwidth in the corridor during the coordination plan. The diagonal lines represent the duration of the green period in each direction, where vehicles can travel between the three intersections without stopping for the red phase. The wider the bandwidth, the more time the vehicles have to travel in the corridor without stopping. The slope of the diagonal lines represent the travel speed, i.e. 25 miles per hour. If the bandwidth is narrow or no bandwidth is attainable, you will be expected to stop at most or all of the intersections. The objective in a signal coordination plan is maximize the bandwidth and provide the greatest opportunity for vehicles to travel along the corridor without stopping for the red phase.

The time-space diagrams for the Marin Avenue Corridor show a good progression bandwidth of an average of 32 seconds and 22 seconds, in each direction, during AM and PM peak hours, respectively. The midday plan provides an average of 25 seconds bandwidth in each direction.

The time-space diagrams also show that with the lower cycle length, an effective coordination can be attained along Marin Avenue, while providing lower delay and a better response time for the side street traffic and pedestrian movements.

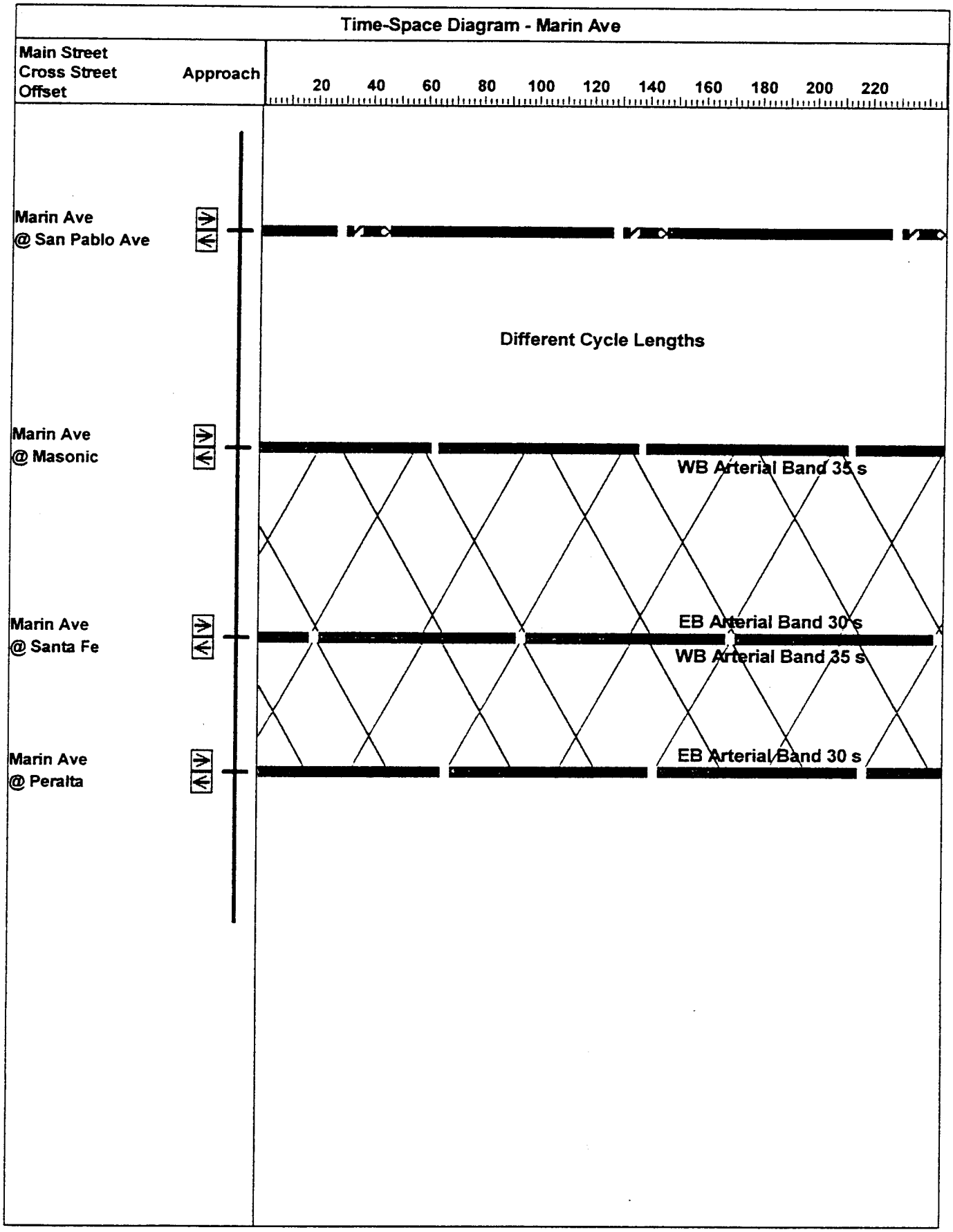


Figure 1 - AM Peak Period Time Space Diagram
Arterial Bandwidths, 70th Percentile Green Times

November 1, 1997

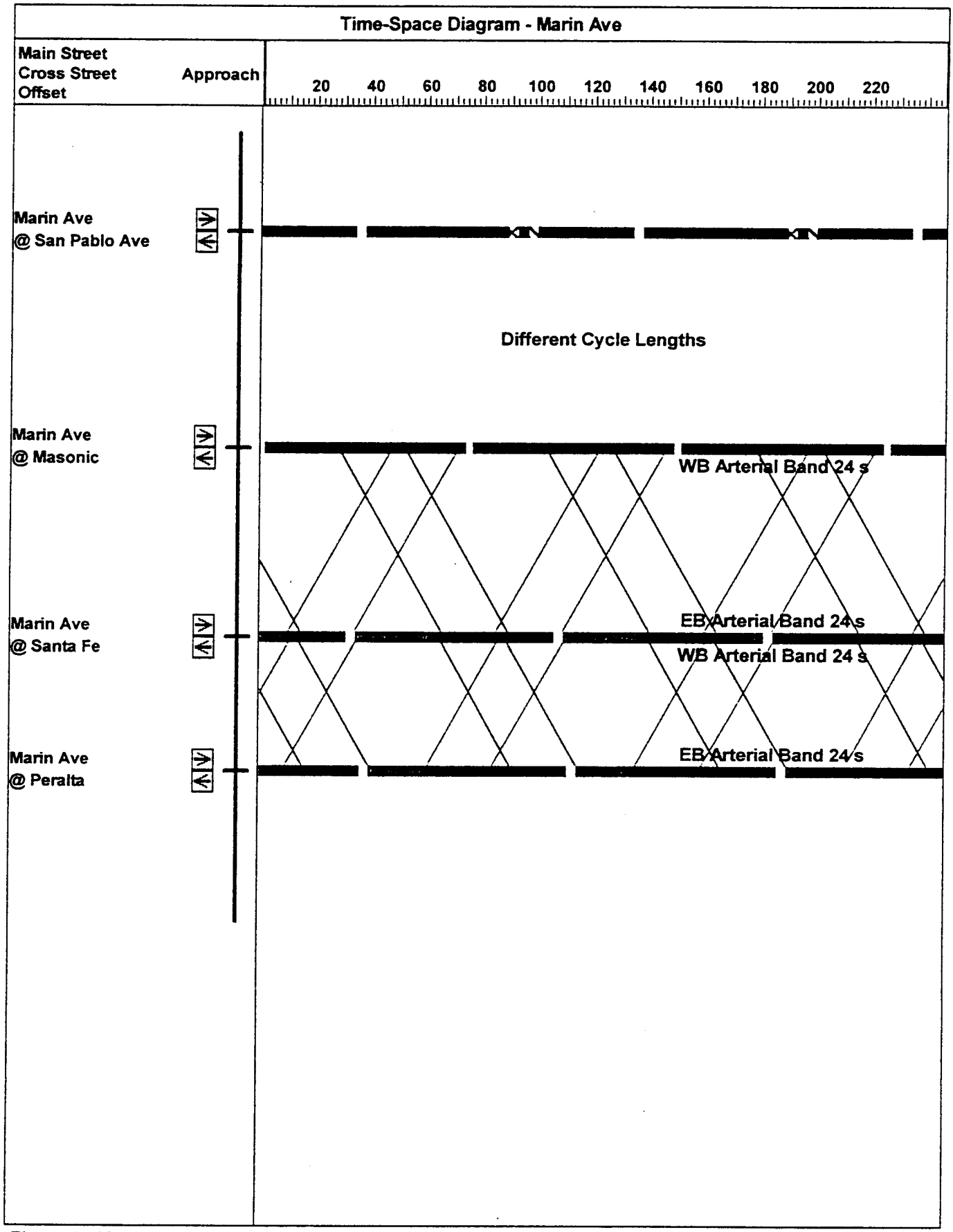


Figure 2 - Midday Period Time Space Diagram
Arterial Bandwidths, 70th Percentile Green Times

November 1, 1997

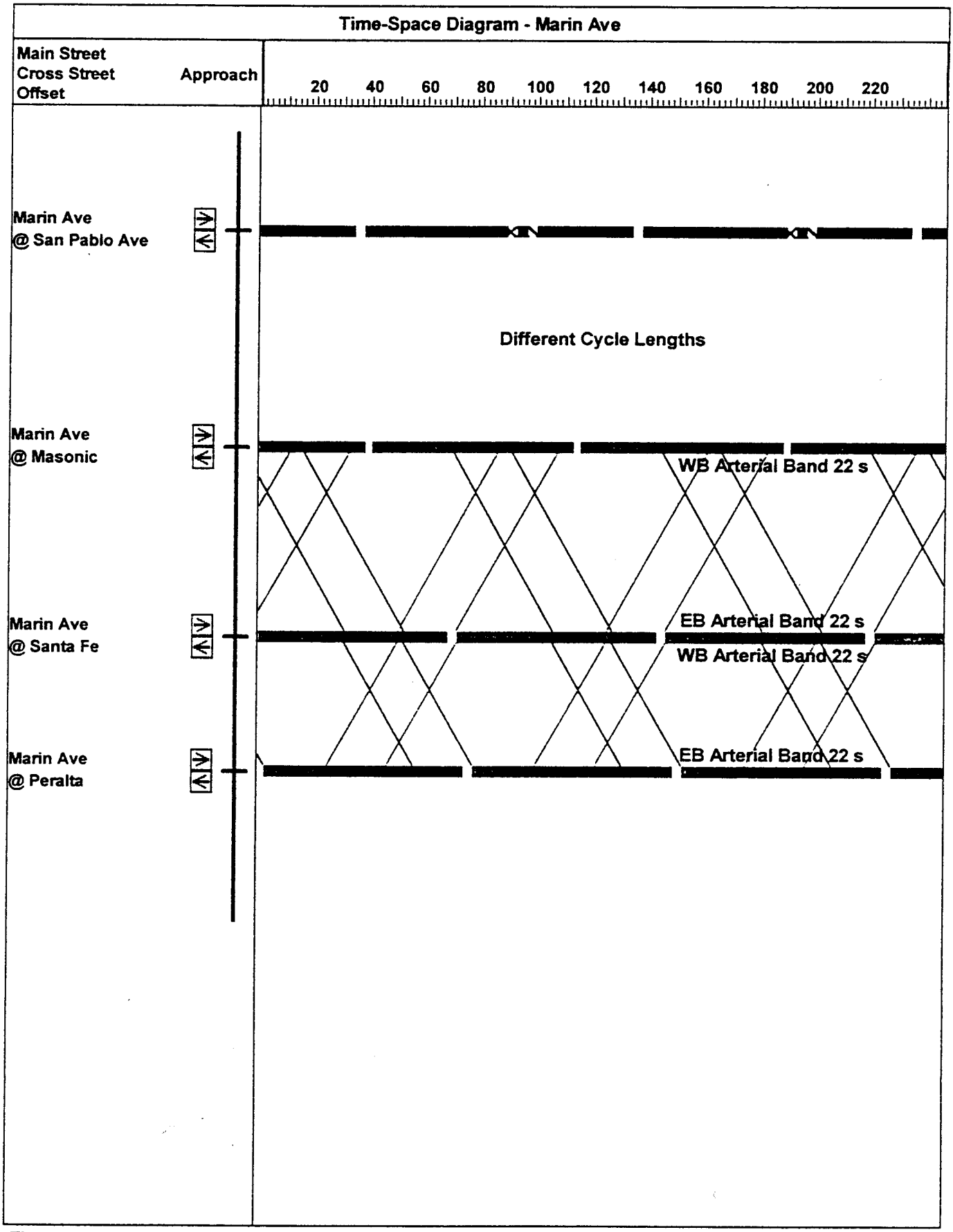


Figure 3 - PM Peak Period Time Space Diagram
Arterial Bandwidths, 70th Percentile Green Times

November 1, 1997

5.0 LEVEL OF SERVICE ANALYSIS

Based on the recommended timing parameters, the level of service and average delay were calculated with the recommended cycle length. The level of service calculations were based on Webster Method. Table 5 shows the summary of the level of service analysis. The results of the analysis is also included in the Appendix.

TABLE 5
LEVEL OF SERVICE WITH RECOMMENDED TIMINGS

Intersection	Level of Service			Average Delay (Sec)		
	AM	Mid	PM	AM	Mid	PM
Masonic	B	B	B	7.0	5.4	5
Santa Fe	B	B	B	7.4	8.7	10.1
Peralta	B	A	B	5.3	4.0	5.6

6.0 OTHER CONSIDERATIONS

In reviewing the timing parameters, we recommend the following additional changes to the timing parameters. These changes will provide a more efficient operation, providing more preference for the side streets. These recommendations can only be implemented with a fully actuated operation, i.e. loop detectors active on all directions.

TABLE 6
OTHER TIMING PARAMETERS

Intersection	Phase			
	2 (6)		4	
	Minimum Initial	Maximum Extension	Minimum Initial	Maximum Extension
Masonic	10	35	6	30
Santa Fe	10	40	6	30
Peralta	10	35	6	24

In addition, there are currently no pedestrian push buttons for the side street crossing at Masonic and Santa Fe. Although, signal can operate without a Pedestrian Push Button, the City may wish to install Push Buttons at these locations, including the special placard explaining the meaning of the pedestrian signal indications.

7.0 CONCLUSIONS

The recommended timing plans should be adequate for CCS to analyze potential lane reductions in the corridor.

In addition, if City decides to implement these plans, the final timing should be field checked and fine-tuned.

APPENDICES

COORDINABILITY ANALYSIS

Link: Marin Ave, San Pablo Ave to Masonic

Variable	Value	Comments
Travel Time (s)	42	Travel Time okay For Coordination
CF1	50	
Traffic / Storage Space	0.22	Storage Space is adequate
CF2	22	
Proportion of Traffic In Platoon	0.78	Traffic moderately platooned
Ap, platoon adjustment	-2	
Main Street Volume (vph)	1960	High Volumes, coordination is high priority
Av, volume adjustment	18	
Cycle Length	100	at San Pablo Ave
Cycle Length	75	at Masonic
Combined Cycle Length	100	
Cycle Length Increase	25	Moderate increase in cycle length
Ac, Cycle Adjustment	-12	
CF, Coordinatability Factor	54	Coordination probably recommended

Link: Marin Ave, Masonic to Santa Fe

Variable	Value	Comments
Travel Time (s)	36	Travel Time okay For Coordination
CF1	58	
Traffic / Storage Space	0.20	Storage Space is adequate
CF2	20	
Proportion of Traffic In Platoon	0.77	Traffic moderately platooned
Ap, platoon adjustment	-3	
Main Street Volume (vph)	1756	High Volumes, coordination is high priority
Av, volume adjustment	16	
Cycle Length	75	at Masonic
Cycle Length	75	at Santa Fe
Combined Cycle Length	75	
Cycle Length Increase	0	
Ac, Cycle Adjustment	0	
CF, Coordinatability Factor	71	Coordination definitely recommended

Link: Marin Ave, Santa Fe to Peralta

Variable	Value	Comments
Travel Time (s)	25	Travel Time okay For Coordination
CF1	72	
Traffic / Storage Space	0.32	Storage Space is adequate
CF2	32	
Proportion of Traffic In Platoon	0.71	Traffic moderately platooned
Ap, platoon adjustment	-6	
Main Street Volume (vph)	1800	High Volumes, coordination is high priority
Av, volume adjustment	16	
Cycle Length	75	at Santa Fe
Cycle Length	75	at Peralta
Combined Cycle Length	75	
Cycle Length Increase	0	
Ac, Cycle Adjustment	0	
CF, Coordinatability Factor	82	Coordination definitely recommended

Link: Marin Ave, San Pablo Ave to Masonic

Variable	Value	Comments
Travel Time (s)	42	Travel Time okay For Coordination
CF1	50	
Traffic / Storage Space	0.20	Storage Space is adequate
CF2	20	
Proportion of Traffic In Platoon	0.78	Traffic moderately platooned
Ap, platoon adjustment	-2	
Main Street Volume (vph)	1877	High Volumes, coordination is high priority
Av, volume adjustment	17	
Cycle Length	100	at San Pablo Ave
Cycle Length	75	at Masonic
Combined Cycle Length	100	
Cycle Length Increase	25	Moderate increase in cycle length
Ac, Cycle Adjustment	-12	
CF, Coordinatability Factor	53	Coordination probably recommended

Link: Marin Ave, Masonic to Santa Fe

Variable	Value	Comments
Travel Time (s)	36	Travel Time okay For Coordination
CF1	58	
Traffic / Storage Space	0.21	Storage Space is adequate
CF2	21	
Proportion of Traffic In Platoon	0.70	Traffic moderately platooned
Ap, platoon adjustment	-6	
Main Street Volume (vph)	1929	High Volumes, coordination is high priority
Av, volume adjustment	17	
Cycle Length	75	at Masonic
Cycle Length	75	at Santa Fe
Combined Cycle Length	75	
Cycle Length Increase	0	
Ac, Cycle Adjustment	0	
CF, Coordinatability Factor	69	Coordination probably recommended

Link: Marin Ave, Santa Fe to Peralta

Variable	Value	Comments
Travel Time (s)	25	Travel Time okay For Coordination
CF1	72	
Traffic / Storage Space	0.34	Storage Space is adequate
CF2	34	
Proportion of Traffic In Platoon	0.69	Traffic moderately platooned
Ap, platoon adjustment	-7	
Main Street Volume (vph)	1947	High Volumes, coordination is high priority
Av, volume adjustment	17	
Cycle Length	75	at Santa Fe
Cycle Length	75	at Peralta
Combined Cycle Length	75	
Cycle Length Increase	0	
Ac, Cycle Adjustment	0	
CF, Coordinatability Factor	82	Coordination definitely recommended

Link: Marin Ave, San Pablo Ave to Masonic

Variable	Value	Comments
Travel Time (s)	42	Travel Time okay For Coordination
CF1	50	
Traffic / Storage Space	0.18	Storage Space is adequate
CF2	18	
Proportion of Traffic In Platoon	0.79	Traffic moderately platooned
Ap, platoon adjustment	-1	
Main Street Volume (vph)	1734	High Volumes, coordination is high priority
Av, volume adjustment	15	
Cycle Length	100	at San Pablo Ave
Cycle Length	75	at Masonic
Combined Cycle Length	100	
Cycle Length Increase	25	Moderate increase in cycle length
Ac, Cycle Adjustment	-12	
CF, Coordinatability Factor	52	Coordination probably recommended

Link: Marin Ave, Masonic to Santa Fe

Variable	Value	Comments
Travel Time (s)	36	Travel Time okay For Coordination
CF1	58	
Traffic / Storage Space	0.23	Storage Space is adequate
CF2	23	
Proportion of Traffic In Platoon	0.73	Traffic moderately platooned
Ap, platoon adjustment	-5	
Main Street Volume (vph)	1938	High Volumes, coordination is high priority
Av, volume adjustment	17	
Cycle Length	75	at Masonic
Cycle Length	75	at Santa Fe
Combined Cycle Length	75	
Cycle Length Increase	0	
Ac, Cycle Adjustment	0	
CF, Coordinatability Factor	70	Coordination probably recommended

Link: Marin Ave, Santa Fe to Peralta

Variable	Value	Comments
Travel Time (s)	25	Travel Time okay For Coordination
CF1	72	
Traffic / Storage Space	0.38	Storage Space is adequate
CF2	38	
Proportion of Traffic In Platoon	0.70	Traffic moderately platooned
Ap, platoon adjustment	-6	
Main Street Volume (vph)	2024	High Volumes, coordination is high priority
Av, volume adjustment	18	
Cycle Length	75	at Santa Fe
Cycle Length	75	at Peralta
Combined Cycle Length	75	
Cycle Length Increase	0	
Ac, Cycle Adjustment	0	
CF, Coordinatability Factor	84	Coordination definitely recommended

AM PEAK PERIOD ANALYSIS

Capacity and Level of Service Analysis Summary

Lane Group	EBT	WBT	NBT	SBT
Perm or Prot?	Perm	Perm	Perm	Perm
Adj Flow (vph)	897	898	147	319
Prot. Satd Flow				
Perm. Satd Flow	2798	3042	1122	1407
Green Ratio	0.51	0.51	0.41	0.41
Lane Grp Cap (vph)	1418	1541	464	582
V/C Ratio	0.63	0.58	0.32	0.55
Critical LG?	Yes			Yes
Uniform Delay, d1	10.2	9.8	11.3	12.7
Platoon Factor	0.55	0.44	1.00	1.00
Incr. Delay, d2	0.7	0.4	0.1	0.9
Webster's Delay	6.3	4.7	11.4	13.5
LOS	B	A	B	B

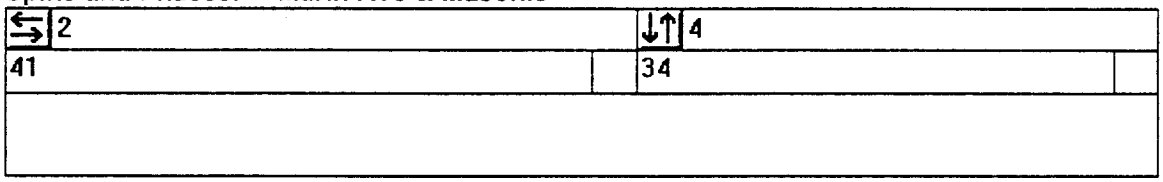
Cycle Length: 75
Lost Time: 6
Sum of Critical V/S Ratios: 0.55
Intersection V/C Ratio: 0.59
Intersection Webster Delay: 7.0
Intersection LOS: B

Lanes, Volumes, and Timings Summary

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	25	690	38	12	725	58	30	52	12	61	120	52
Adj Lane Grp Vol.	0	897	0	0	898	0	0	147	0	0	319	0
Lanes	0	2	0	0	2	0	0	1	0	0	1	0
Satd Flow (Prot)		3504			3497			1457			1600	
Satd Flow (Perm)		2798			3042			1122			1407	
Left Turn Type	Perm			Perm			Perm			Perm		
Right Turn Type			Perm			Perm			Perm			Perm
Phase Number		2			2			4			4	
Phase Lagging?												
Maximum Green (s)		38			38			31			31	
Yellow Time (s)		3			3			3			3	
V/C Ratio		0.63			0.58			0.32			0.55	
Platoon Factor		0.55			0.44			1.00			1.00	
Webster's Delay (s)		6.3			4.7			11.4			13.5	
Level of Service		B			A			B			B	

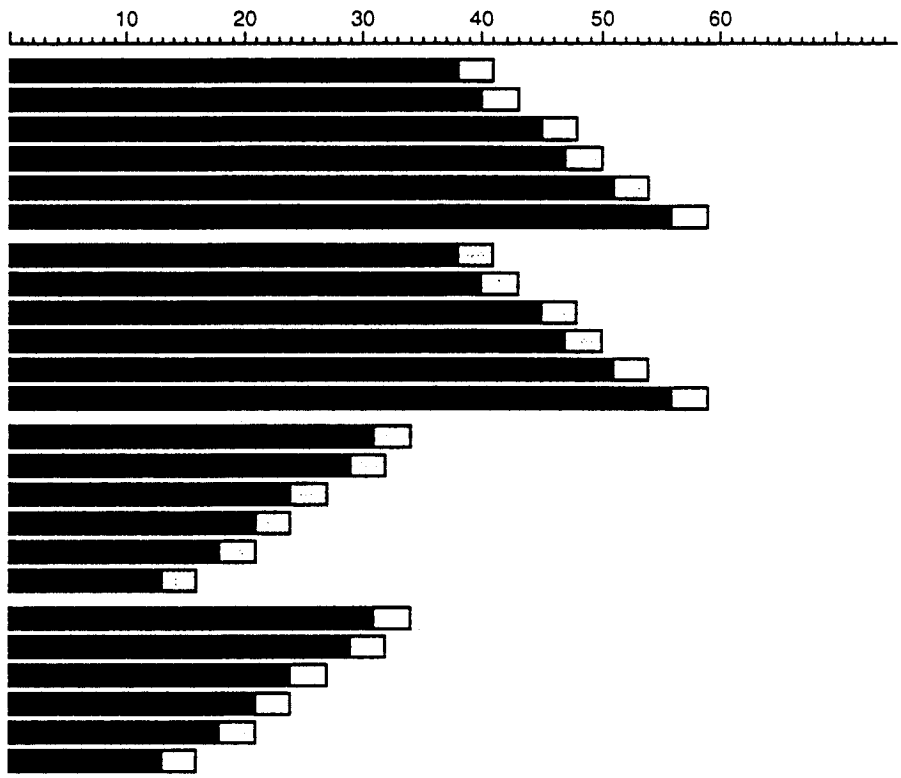
Cycle Length: 75
Control Type: Actuated-Coordinated
Offset: 62 (83%), Referenced to phase 2-EBWB, Start of Yellow
Intersection V/C Ratio: 0.59
Intersection Webster Delay: 7.0
Intersection LOS: B

Splits and Phases: Marin Ave & Masonic



Actuated Signal, Actual Green Times

Phase	%ile	Green	Termination
	Max	38	Max
	90	40	Coordinated
	70	45	Coordinated
	50	47	Coordinated
2 EBT	30	51	Coordinated
	10	56	Coordinated
	Max	38	Max
	90	40	Coordinated
	70	45	Coordinated
	50	47	Coordinated
2 WBT	30	51	Coordinated
	10	56	Coordinated
	Max	31	Max
	90	29	Hold
	70	24	Hold
	50	21	Hold
4 NBT	30	18	Hold
	10	13	Hold
	Max	31	Max
	90	29	Gap Out
	70	24	Gap Out
	50	21	Gap Out
4 SBT	30	18	Gap Out
	10	13	Gap Out



Cycle Length: 75

Capacity and Level of Service Analysis Summary

Lane Group	EBT	WBT	NBT	SBT
Perm or Prot?	Perm	Perm	Perm	Perm
Adj Flow (vph)	858	848	207	279
Prot. Satd Flow				
Perm. Satd Flow	3197	2526	1124	1158
Green Ratio	0.49	0.49	0.43	0.43
Lane Grp Cap (vph)	1577	1246	480	494
V/C Ratio	0.54	0.68	0.43	0.56
Critical LG?		Yes		Yes
Uniform Delay, d1	10.0	11.0	11.5	12.3
Platoon Factor	0.22	0.73	1.00	1.00
Incr. Delay, d2	0.3	1.1	0.4	1.1
Webster's Delay	2.5	9.1	11.9	13.5
LOS	A	B	B	B

Cycle Length: 75
Lost Time: 6
Sum of Critical V/S Ratios: 0.58
Intersection V/C Ratio: 0.63
Intersection Webster Delay: 7.4
Intersection LOS: B

Lanes, Volumes, and Timings Summary

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	15	711	42	49	663	30	46	68	41	87	134	38
Adj Lane Grp Vol.	0	858	0	0	848	0	0	207	0	0	279	0
Lanes	0	2	0	0	2	0	0	1	0	0	1	0
Satd Flow (Prot)		3692			3507			1427			1450	
Satd Flow (Perm)		3197			2526			1124			1158	
Left Turn Type	Perm			Perm			Perm			Perm		
Right Turn Type			Perm			Perm			Perm			Perm
Phase Number		2			2			4			4	
Phase Lagging?												
Maximum Green (s)		36			36			32			32	
Yellow Time (s)		4			4			3			3	
V/C Ratio		0.54			0.68			0.43			0.56	
Platoon Factor		0.22			0.73			1.00			1.00	
Webster's Delay (s)		2.5			9.1			11.9			13.5	
Level of Service		A			B			B			B	

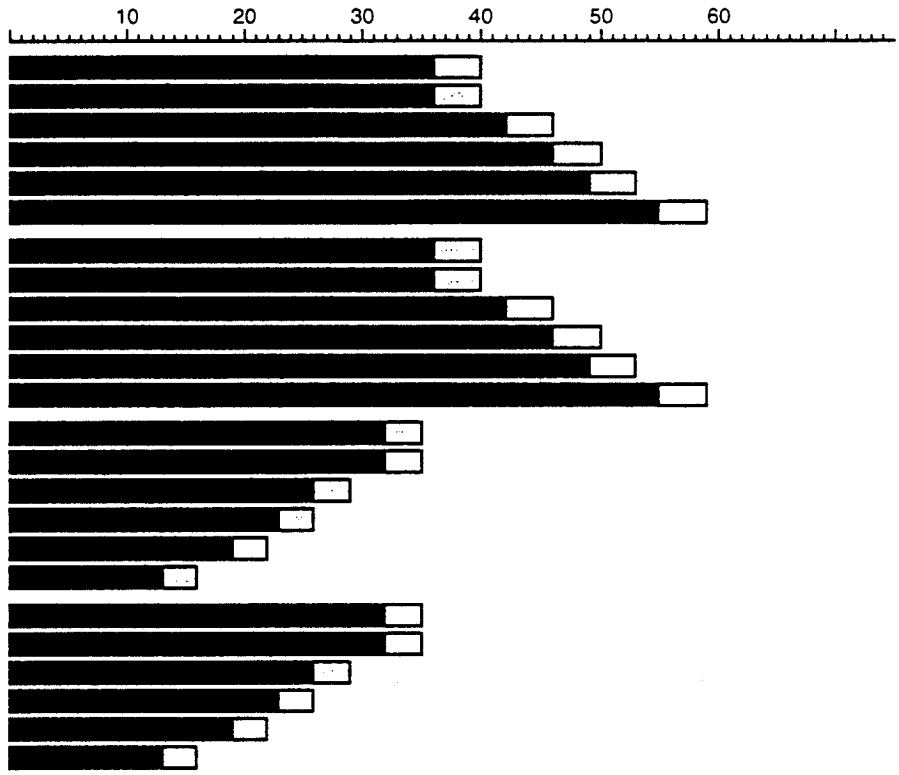
Cycle Length: 75
Control Type: Actuated-Coordinated
Offset: 18 (24%), Referenced to phase 2-EBWB, Start of Yellow
Intersection V/C Ratio: 0.63
Intersection Webster Delay: 7.4
Intersection LOS: B

Splits and Phases: Marin Ave & Santa Fe

2	4
40	35

Actuated Signal, Actual Green Times

Phase	%ile	Green	Termination
	Max	36	Max
	90	36	Coordinated
	70	42	Coordinated
	50	46	Coordinated
2 EBT	30	49	Coordinated
	10	55	Coordinated
	Max	36	Max
	90	36	Coordinated
	70	42	Coordinated
	50	46	Coordinated
2 WBT	30	49	Coordinated
	10	55	Coordinated
	Max	32	Max
	90	32	Hold
	70	26	Hold
	50	23	Hold
4 NBT	30	19	Hold
	10	13	Hold
	Max	32	Max
	90	32	Max Out
	70	26	Gap Out
	50	23	Gap Out
4 SBT	30	19	Gap Out
	10	13	Gap Out



Cycle Length: 75

Capacity and Level of Service Analysis Summary

Lane Group	EBT	WBT	NBT	SBT
Perm or Prot?	Perm	Perm	Perm	Perm
Adj Flow (vph)	952	710	124	116
Prot. Satd Flow				
Perm. Satd Flow	3133	3271	1126	1310
Green Ratio	0.43	0.43	0.49	0.49
Lane Grp Cap (vph)	1337	1396	555	646
V/C Ratio	0.71	0.51	0.22	0.18
Critical LG?	Yes		Yes	
Uniform Delay, d1	13.4	12.0	8.2	8.0
Platoon Factor	0.40	0.19	1.00	1.00
Incr. Delay, d2	1.3	0.3	0.0	0.0
Webster's Delay	6.7	2.6	8.3	8.0
LOS	B	A	B	B

Cycle Length: 75
Lost Time: 6
Sum of Critical V/S Ratios: 0.41
Intersection V/C Ratio: 0.45
Intersection Webster Delay: 5.3
Intersection LOS: B

Lanes, Volumes, and Timings Summary

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Adj Lane Grp Vol.	0	0	0	0	0	0	0	0	0	0	0	0
Lanes	0	0	0	0	0	0	0	0	0	0	0	0
Satd Flow (Prot)												
Satd Flow (Perm)												
Left Turn Type	Split			Split			Split			Split		
Right Turn Type			Perm			Perm			Perm			Perm
Phase Number												
Phase Lagging?												
Maximum Green (s)												
Yellow Time (s)												
V/C Ratio												
Platoon Factor												
Webster's Delay (s)												
Level of Service												

Cycle Length: 75
Control Type: Pretimed
Offset: 0 (0%), Referenced to phase 2-Unused and 6-Unused, Start of Yellow
Intersection V/C Ratio: 0.00
Intersection Webster Delay: 0.0
Intersection LOS: A

Splits and Phases: San Pablo Ave &

MIDDAY PEAK PERIOD ANALYSIS

Capacity and Level of Service Analysis Summary

Lane Group	EBT	WBT	NBT	SBT
Perm or Prot?	Perm	Perm	Perm	Perm
Adj Flow (vph)	930	964	167	229
Prot. Satd Flow				
Perm. Satd Flow	2629	3049	1270	1260
Green Ratio	0.56	0.56	0.36	0.36
Lane Grp Cap (vph)	1472	1707	457	454
V/C Ratio	0.63	0.56	0.37	0.50
Critical LG?	Yes			Yes
Uniform Delay, d1	8.5	8.1	13.4	14.3
Platoon Factor	0.52	0.21	1.00	1.00
Incr. Delay, d2	0.6	0.3	0.2	0.8
Webster's Delay	5.1	2.1	13.7	15.0
LOS	B	A	B	C

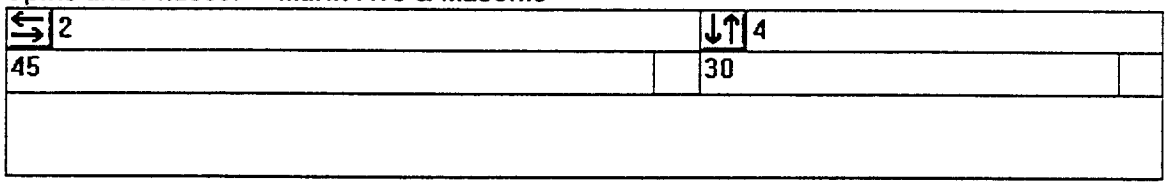
Cycle Length: 75
Lost Time: 6
Sum of Critical V/S Ratios: 0.54
Intersection V/C Ratio: 0.58
Intersection Webster Delay: 5.4
Intersection LOS: B

Lanes, Volumes, and Timings Summary

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	31	728	39	11	748	67	37	101	13	55	105	46
Adj Lane Grp Vol.	0	930	0	0	964	0	0	167	0	0	229	0
Lanes	0	2	0	0	2	0	0	1	0	0	1	0
Satd Flow (Prot)		3507			3493			1472			1440	
Satd Flow (Perm)		2629			3049			1270			1260	
Left Turn Type	Perm			Perm			Perm			Perm		
Right Turn Type			Perm			Perm			Perm			Perm
Phase Number		2			2			4			4	
Phase Lagging?												
Maximum Green (s)		42			42			27			27	
Yellow Time (s)		3			3			3			3	
V/C Ratio		0.63			0.56			0.37			0.50	
Platoon Factor		0.52			0.21			1.00			1.00	
Webster's Delay (s)		5.1			2.1			13.7			15.0	
Level of Service		B			A			B			C	

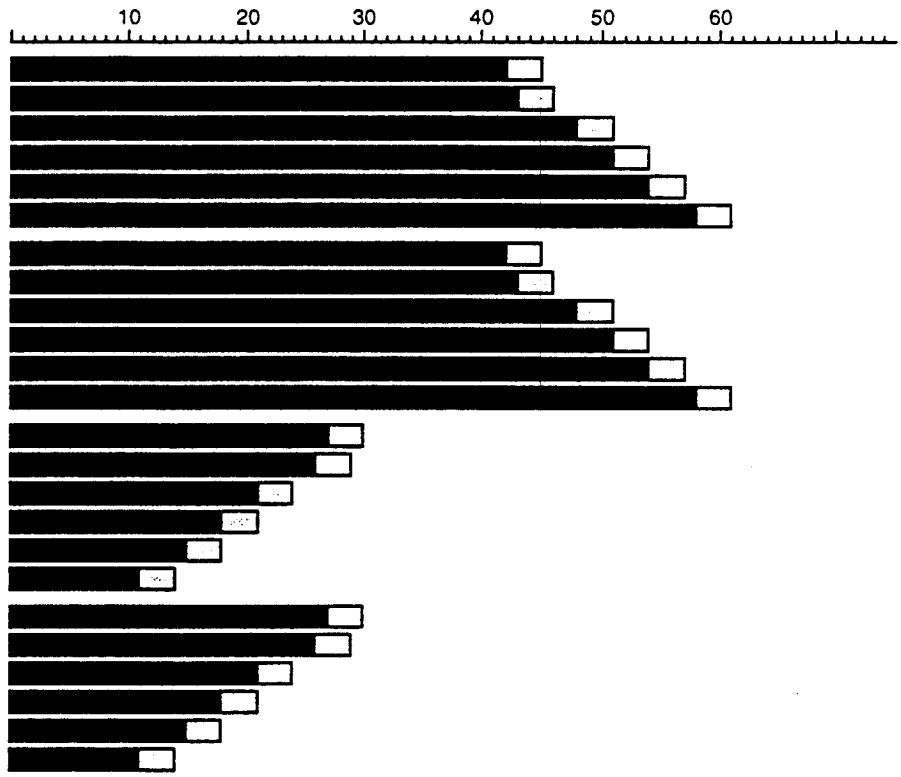
Cycle Length: 75
Control Type: Actuated-Coordinated
Offset: 74 (99%), Referenced to phase 2-EBWB, Start of Yellow
Intersection V/C Ratio: 0.58
Intersection Webster Delay: 5.4
Intersection LOS: B

Splits and Phases: Marin Ave & Masonic



Actuated Signal, Actual Green Times

Phase	%ile	Green	Termination
	Max	42	Max
	90	43	Coordinated
	70	48	Coordinated
	50	51	Coordinated
2 EBT	30	54	Coordinated
	10	58	Coordinated
	Max	42	Max
	90	43	Coordinated
	70	48	Coordinated
	50	51	Coordinated
2 WBT	30	54	Coordinated
	10	58	Coordinated
	Max	27	Max
	90	26	Hold
	70	21	Hold
	50	18	Hold
4 NBT	30	15	Hold
	10	11	Hold
	Max	27	Max
	90	26	Gap Out
	70	21	Gap Out
	50	18	Gap Out
4 SBT	30	15	Gap Out
	10	11	Gap Out



Cycle Length: 75

Capacity and Level of Service Analysis Summary

Lane Group	EBT	WBT	NBT	SBT
Perm or Prot?	Perm	Perm	Perm	Perm
Adj Flow (vph)	965	1017	233	238
Prot. Satd Flow				
Perm. Satd Flow	2227	2401	1311	1138
Green Ratio	0.52	0.52	0.40	0.40
Lane Grp Cap (vph)	1158	1249	524	455
V/C Ratio	0.83	0.81	0.44	0.52
Critical LG?	Yes			Yes
Uniform Delay, d1	11.6	11.4	12.5	13.0
Platoon Factor	0.28	0.45	1.00	1.00
Incr. Delay, d2	3.8	3.0	0.4	0.9
Webster's Delay	7.0	8.2	12.9	13.9
LOS	B	B	B	B

Cycle Length: 75
Lost Time: 6
Sum of Critical V/S Ratios: 0.64
Intersection V/C Ratio: 0.70
Intersection Webster Delay: 8.7
Intersection LOS: B

Lanes, Volumes, and Timings Summary

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	59	735	32	48	760	64	31	118	61	76	104	34
Adj Lane Grp Vol.	0	965	0	0	1017	0	0	233	0	0	238	0
Lanes	0	2	0	0	2	0	0	1	0	0	1	0
Satd Flow (Prot)		3504			3490			1433			1447	
Satd Flow (Perm)		2227			2401			1311			1138	
Left Turn Type	Perm			Perm			Perm			Perm		
Right Turn Type			Perm			Perm			Perm			Perm
Phase Number		2			2			4			4	
Phase Lagging?												
Maximum Green (s)		38			38			30			30	
Yellow Time (s)		4			4			3			3	
V/C Ratio		0.83			0.81			0.44			0.52	
Platoon Factor		0.28			0.45			1.00			1.00	
Webster's Delay (s)		7.0			8.2			12.9			13.9	
Level of Service		B			B			B			B	

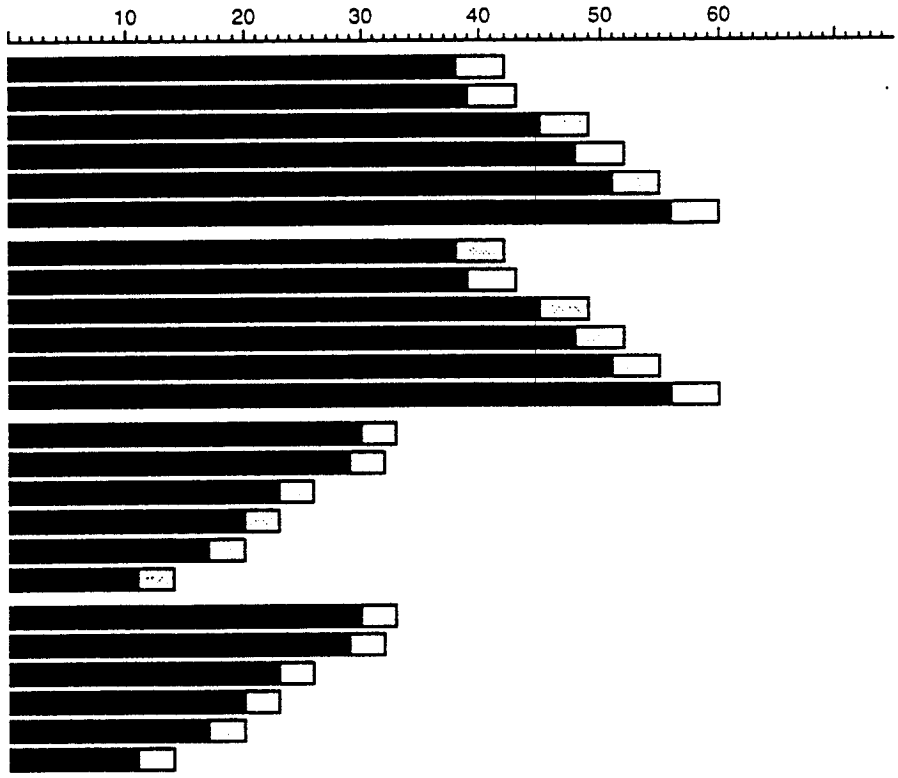
Cycle Length: 75
Control Type: Actuated-Coordinated
Offset: 31 (41%), Referenced to phase 2-EBWB, Start of Yellow
Intersection V/C Ratio: 0.70
Intersection Webster Delay: 8.7
Intersection LOS: B

Splits and Phases: Marin Ave & Santa Fe

2	4
42	33

Actuated Signal, Actual Green Times

Phase	%ile	Green	Termination
	Max	38	Max
	90	39	Coordinated
	70	45	Coordinated
→	50	48	Coordinated
2 EBT	30	51	Coordinated
	10	56	Coordinated
	Max	38	Max
	90	39	Coordinated
	70	45	Coordinated
←	50	48	Coordinated
2 WBT	30	51	Coordinated
	10	56	Coordinated
	Max	30	Max
	90	29	Hold
	70	23	Hold
↑	50	20	Hold
4 NBT	30	17	Hold
	10	11	Hold
	Max	30	Max
	90	29	Gap Out
	70	23	Gap Out
↓	50	20	Gap Out
4 SBT	30	17	Gap Out
	10	11	Gap Out



Cycle Length: 75

Capacity and Level of Service Analysis Summary

Lane Group	EBT	WBT	NBT	SBT
Perm or Prot?	Perm	Perm	Perm	Perm
Adj Flow (vph)	930	884	117	93
Prot. Satd Flow				
Perm. Satd Flow	2816	3180	1212	1338
Green Ratio	0.43	0.43	0.49	0.49
Lane Grp Cap (vph)	1201	1357	598	660
V/C Ratio	0.77	0.65	0.20	0.14
Critical LG?	Yes		Yes	
Uniform Delay, d1	14.0	13.0	8.1	7.9
Platoon Factor	0.12	0.17	1.00	1.00
Incr. Delay, d2	2.3	0.8	0.0	0.0
Webster's Delay	3.9	3.0	8.1	7.9
LOS	A	A	B	B

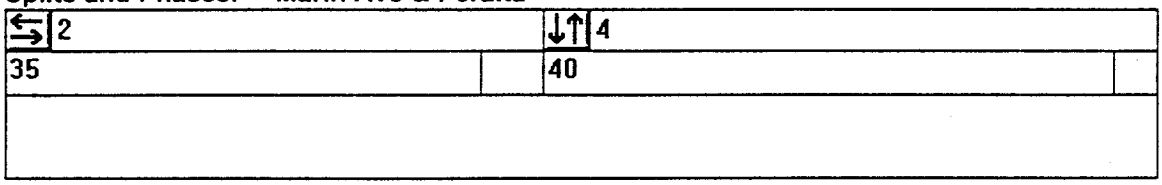
Cycle Length: 75
Lost Time: 6
Sum of Critical V/S Ratios: 0.43
Intersection V/C Ratio: 0.46
Intersection Webster Delay: 4.0
Intersection LOS: A

Lanes, Volumes, and Timings Summary

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	25	730	42	6	727	25	65	21	20	20	33	31
Adj Lane Grp Vol.	0	930	0	0	884	0	0	117	0	0	93	0
Lanes	0	2	0	0	2	0	0	1	0	0	1	0
Satd Flow (Prot)		3504			3522			1423			1410	
Satd Flow (Perm)		2816			3180			1212			1338	
Left Turn Type	Perm			Perm			Perm			Perm		
Right Turn Type			Perm			Perm			Perm			Perm
Phase Number		2			2			4			4	
Phase Lagging?												
Maximum Green (s)		31			31			37			37	
Yellow Time (s)		4			4			3			3	
V/C Ratio		0.77			0.65			0.20			0.14	
Platoon Factor		0.12			0.17			1.00			1.00	
Webster's Delay (s)		3.9			3.0			8.1			7.9	
Level of Service		A			A			B			B	

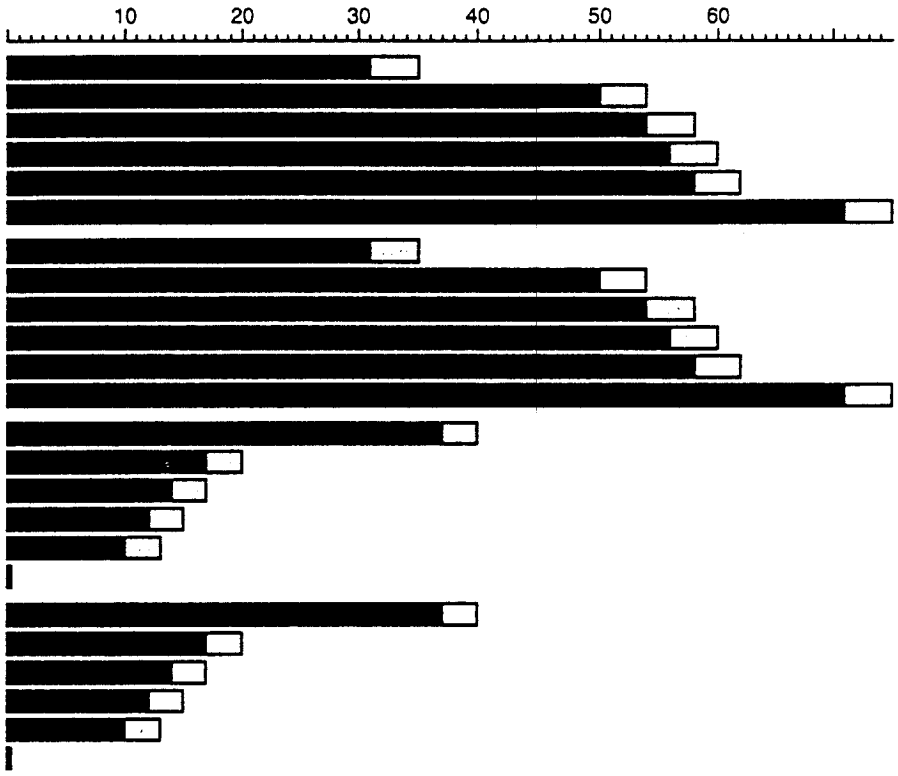
Cycle Length: 75
Control Type: Actuated-Coordinated
Offset: 36 (48%), Referenced to phase 2-EBWB, Start of Yellow
Intersection V/C Ratio: 0.46
Intersection Webster Delay: 4.0
Intersection LOS: A

Splits and Phases: Marin Ave & Peralta



Actuated Signal, Actual Green Times

Phase	%ile	Green	Termination
	Max	31	Max
	90	50	Coordinated
	70	54	Coordinated
	50	56	Coordinated
2 EBT	30	58	Coordinated
	10	71	Coordinated
	Max	31	Max
	90	50	Coordinated
	70	54	Coordinated
	50	56	Coordinated
2 WBT	30	58	Coordinated
	10	71	Coordinated
	Max	37	Max
	90	17	Gap Out
	70	14	Gap Out
	50	12	Gap Out
4 NBT	30	10	Gap Out
	10	0	Skip
	Max	37	Max
	90	17	Hold
	70	14	Hold
	50	12	Hold
4 SBT	30	10	Hold
	10	0	Skip



Cycle Length: 75

PM PEAK PERIOD ANALYSIS

Capacity and Level of Service Analysis Summary

Lane Group	EBT	WBT	NBT	SBT
Perm or Prot?	Perm	Perm	Perm	Perm
Adj Flow (vph)	912	1056	227	180
Prot. Satd Flow				
Perm. Satd Flow	2537	3091	1326	1212
Green Ratio	0.59	0.59	0.33	0.33
Lane Grp Cap (vph)	1488	1813	442	404
V/C Ratio	0.61	0.58	0.51	0.45
Critical LG?	Yes		Yes	
Uniform Delay, d1	7.6	7.4	15.3	14.9
Platoon Factor	0.56	0.09	1.00	1.00
Incr. Delay, d2	0.5	0.4	0.9	0.5
Webster's Delay	4.8	1.0	16.1	15.4
LOS	A	A	C	C

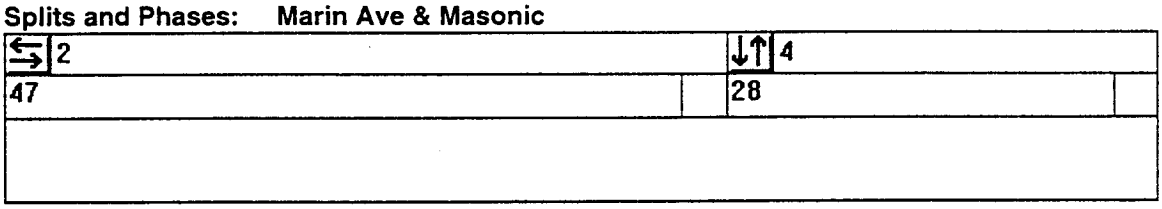
Cycle Length: 75
Lost Time: 6
Sum of Critical V/S Ratios: 0.53
Intersection V/C Ratio: 0.58
Intersection Webster Delay: 5.0
Intersection LOS: B

Lanes, Volumes, and Timings Summary

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	36	766	40	9	770	76	44	150	15	48	89	39
Adj Lane Grp Vol.	0	912	0	0	1056	0	0	227	0	0	180	0
Lanes	0	2	0	0	2	0	0	1	0	0	1	0
Satd Flow (Prot)		3507			3490			1479			1440	
Satd Flow (Perm)		2537			3091			1326			1212	
Left Turn Type	Perm			Perm			Perm			Perm		
Right Turn Type			Perm			Perm			Perm			Perm
Phase Number		2			2			4			4	
Phase Lagging?												
Maximum Green (s)		44			44			25			25	
Yellow Time (s)		3			3			3			3	
V/C Ratio		0.61			0.58			0.51			0.45	
Platoon Factor		0.56			0.09			1.00			1.00	
Webster's Delay (s)		4.8			1.0			16.1			15.4	
Level of Service		A			A			C			C	

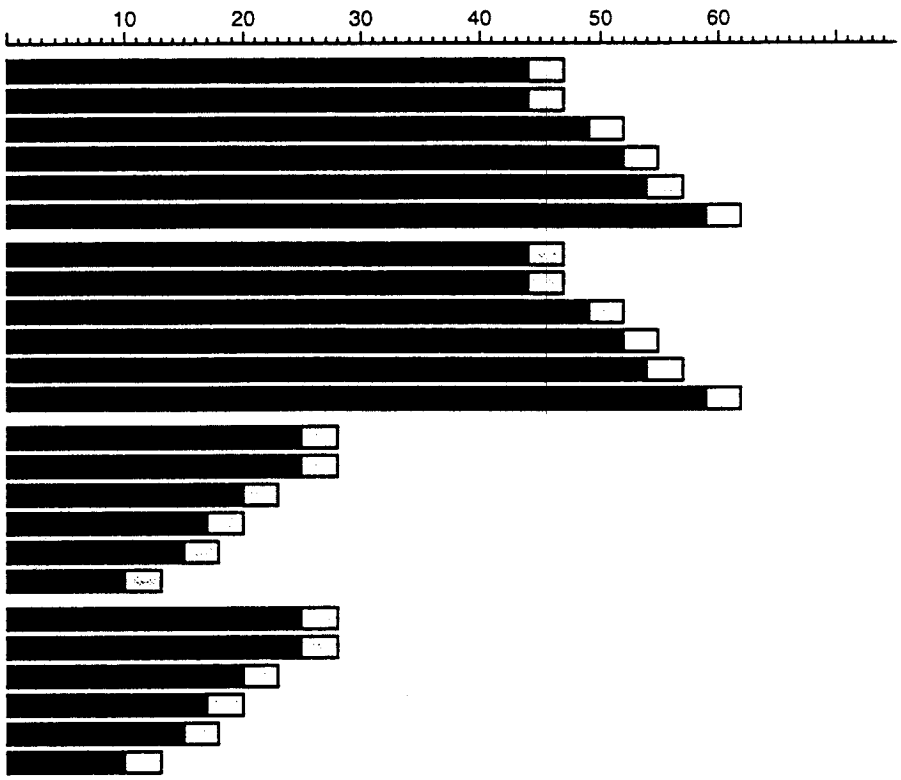
Cycle Length: 75
Control Type: Actuated-Coordinated
Offset: 38 (51%), Referenced to phase 2-EBWB, Start of Yellow
Intersection V/C Ratio: 0.58
Intersection Webster Delay: 5.0
Intersection LOS: B

Splits and Phases: Marin Ave & Masonic



Actuated Signal, Actual Green Times

Phase	%ile	Green	Termination
	Max	44	Max
	90	44	Coordinated
	70	49	Coordinated
	50	52	Coordinated
2 EBT	30	54	Coordinated
	10	59	Coordinated
	Max	44	Max
	90	44	Coordinated
	70	49	Coordinated
	50	52	Coordinated
2 WBT	30	54	Coordinated
	10	59	Coordinated
	Max	25	Max
	90	25	Max Out
	70	20	Gap Out
	50	17	Gap Out
4 NBT	30	15	Gap Out
	10	10	Gap Out
	Max	25	Max
	90	25	Hold
	70	20	Hold
	50	17	Hold
4 SBT	30	15	Hold
	10	10	Hold



Cycle Length: 75

Capacity and Level of Service Analysis Summary

Lane Group	EBT	WBT	NBT	SBT
Perm or Prot?	Perm	Perm	Perm	Perm
Adj Flow (vph)	882	1144	374	199
Prot. Satd Flow				
Perm. Satd Flow	2397	2554	1397	980
Green Ratio	0.52	0.52	0.40	0.40
Lane Grp Cap (vph)	1246	1328	559	392
V/C Ratio	0.71	0.86	0.67	0.51
Critical LG?		Yes	Yes	
Uniform Delay, d1	10.4	11.9	14.0	12.9
Platoon Factor	0.42	0.55	1.00	1.00
Incr. Delay, d2	1.3	4.3	2.2	0.9
Webster's Delay	5.6	10.9	16.2	13.8
LOS	B	B	C	B

Cycle Length: 75
Lost Time: 6
Sum of Critical V/S Ratios: 0.72
Intersection V/C Ratio: 0.78
Intersection Webster Delay: 10.1
Intersection LOS: B

Lanes, Volumes, and Timings Summary

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	44	759	21	48	857	97	16	168	81	65	73	29
Adj Lane Grp Vol.	0	882	0	0	1144	0	0	374	0	0	199	0
Lanes	0	2	0	0	2	0	0	1	0	0	1	0
Satd Flow (Prot)		3514			3483			1436			1441	
Satd Flow (Perm)		2397			2554			1397			980	
Left Turn Type	Perm			Perm			Perm			Perm		
Right Turn Type			Perm			Perm			Perm			Perm
Phase Number		2			2			4			4	
Phase Lagging?												
Maximum Green (s)		38			38			30			30	
Yellow Time (s)		4			4			3			3	
V/C Ratio		0.71			0.86			0.67			0.51	
Platoon Factor		0.42			0.55			1.00			1.00	
Webster's Delay (s)		5.6			10.9			16.2			13.8	
Level of Service		B			B			C			B	

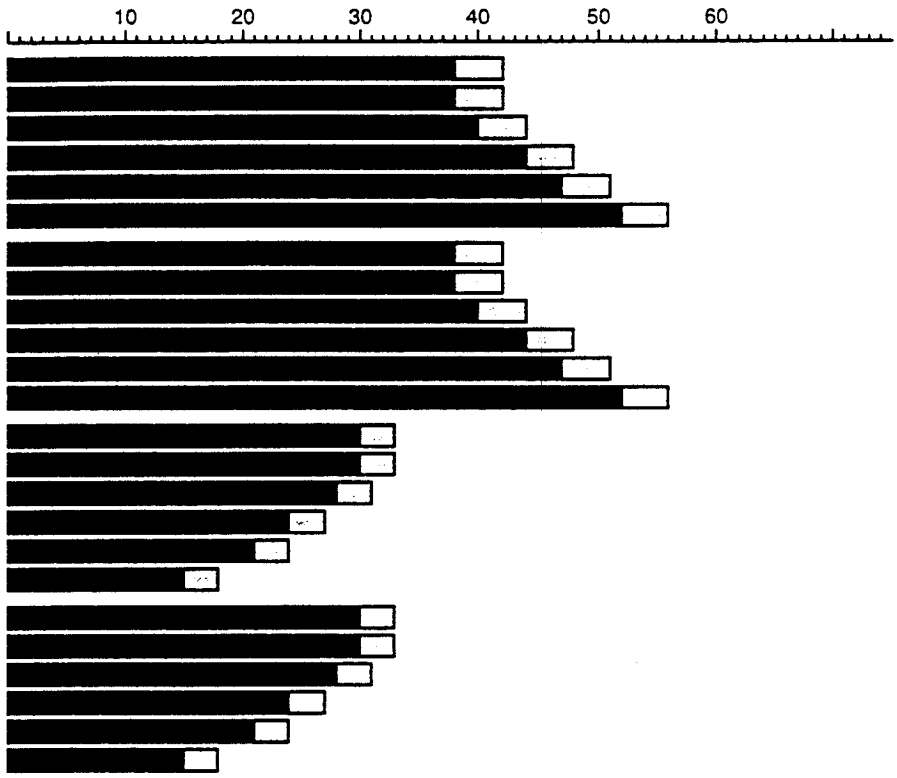
Cycle Length: 75
Control Type: Actuated-Coordinated
Offset: 68 (91%), Referenced to phase 2-EBWB, Start of Yellow
Intersection V/C Ratio: 0.78
Intersection Webster Delay: 10.1
Intersection LOS: B

Splits and Phases: Marin Ave & Santa Fe

2	4
42	33

Actuated Signal, Actual Green Times

Phase	%ile	Green	Termination
	Max	38	Max
	90	38	Coordinated
	70	40	Coordinated
	50	44	Coordinated
2 EBT	30	47	Coordinated
	10	52	Coordinated
	Max	38	Max
	90	38	Coordinated
	70	40	Coordinated
	50	44	Coordinated
2 WBT	30	47	Coordinated
	10	52	Coordinated
	Max	30	Max
	90	30	Max Out
	70	28	Gap Out
	50	24	Gap Out
4 NBT	30	21	Gap Out
	10	15	Gap Out
	Max	30	Max
	90	30	Hold
	70	28	Hold
	50	24	Hold
4 SBT	30	21	Hold
	10	15	Hold



Cycle Length: 75

Capacity and Level of Service Analysis Summary

Lane Group	EBT	WBT	NBT	SBT
Perm or Prot?	Perm	Perm	Perm	Perm
Adj Flow (vph)	880	1046	137	125
Prot. Satd Flow				
Perm. Satd Flow	2511	3141	1162	1270
Green Ratio	0.43	0.43	0.49	0.49
Lane Grp Cap (vph)	1071	1340	573	627
V/C Ratio	0.82	0.78	0.24	0.20
Critical LG?	Yes		Yes	
Uniform Delay, d1	14.4	14.0	8.3	8.1
Platoon Factor	0.13	0.20	1.00	1.00
Incr. Delay, d2	3.7	2.1	0.0	0.0
Webster's Delay	5.5	5.0	8.3	8.1
LOS	B	A	B	B

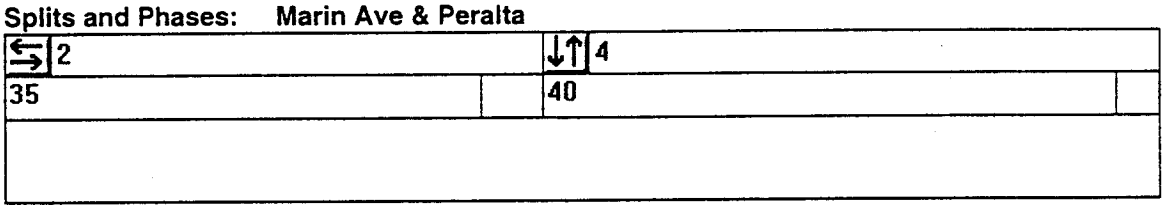
Cycle Length: 75
Lost Time: 6
Sum of Critical V/S Ratios: 0.47
Intersection V/C Ratio: 0.51
Intersection Webster Delay: 5.6
Intersection LOS: B

Lanes, Volumes, and Timings Summary

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Volume (vph)	33	756	24	10	845	32	62	30	13	29	30	33
Adj Lane Grp Vol.	0	880	0	0	1046	0	0	137	0	0	125	0
Lanes	0	2	0	0	2	0	0	1	0	0	1	0
Satd Flow (Prot)		3514			3518			1437			1405	
Satd Flow (Perm)		2511			3141			1162			1270	
Left Turn Type	Perm			Perm			Perm			Perm		
Right Turn Type			Perm			Perm			Perm			Perm
Phase Number		2			2			4			4	
Phase Lagging?												
Maximum Green (s)		31			31			37			37	
Yellow Time (s)		4			4			3			3	
V/C Ratio		0.82			0.78			0.24			0.20	
Platoon Factor		0.13			0.20			1.00			1.00	
Webster's Delay (s)		5.5			5.0			8.3			8.1	
Level of Service		B			A			B			B	

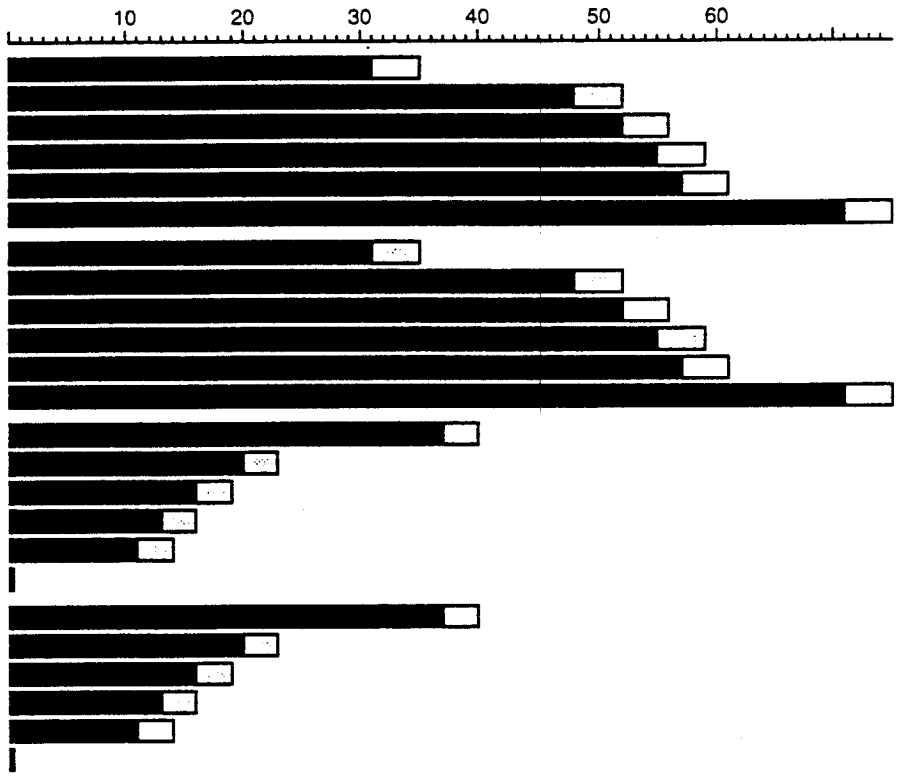
Cycle Length: 75
Control Type: Actuated-Coordinated
Offset: 74 (99%), Referenced to phase 2-EBWB, Start of Yellow
Intersection V/C Ratio: 0.51
Intersection Webster Delay: 5.6
Intersection LOS: B

Splits and Phases: Marin Ave & Peralta



Actuated Signal, Actual Green Times

Phase	%ile	Green	Termination
	Max	31	Max
	90	48	Coordinated
	70	52	Coordinated
	50	55	Coordinated
2 EBT	30	57	Coordinated
	10	71	Coordinated
	Max	31	Max
	90	48	Coordinated
	70	52	Coordinated
	50	55	Coordinated
2 WBT	30	57	Coordinated
	10	71	Coordinated
	Max	37	Max
	90	20	Gap Out
	70	16	Gap Out
	50	13	Gap Out
4 NBT	30	11	Gap Out
	10	0	Skip
	Max	37	Max
	90	20	Hold
	70	16	Hold
	50	13	Hold
4 SBT	30	11	Hold
	10	0	Skip



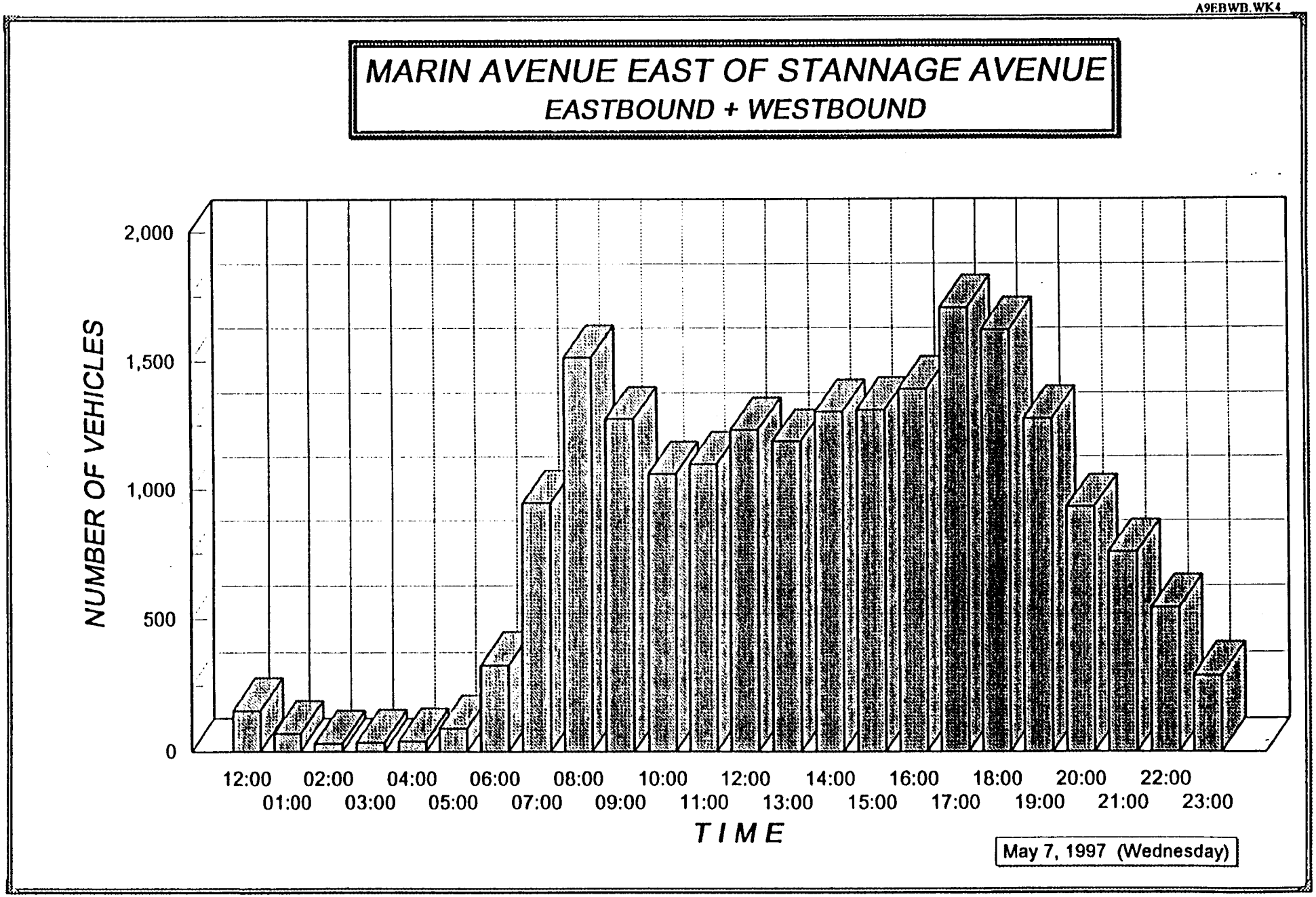
Cycle Length: 75

ADT COUNTS

BAYMETRICS TRAFFIC RESOURCES

1997 TRAFFIC MONITORING

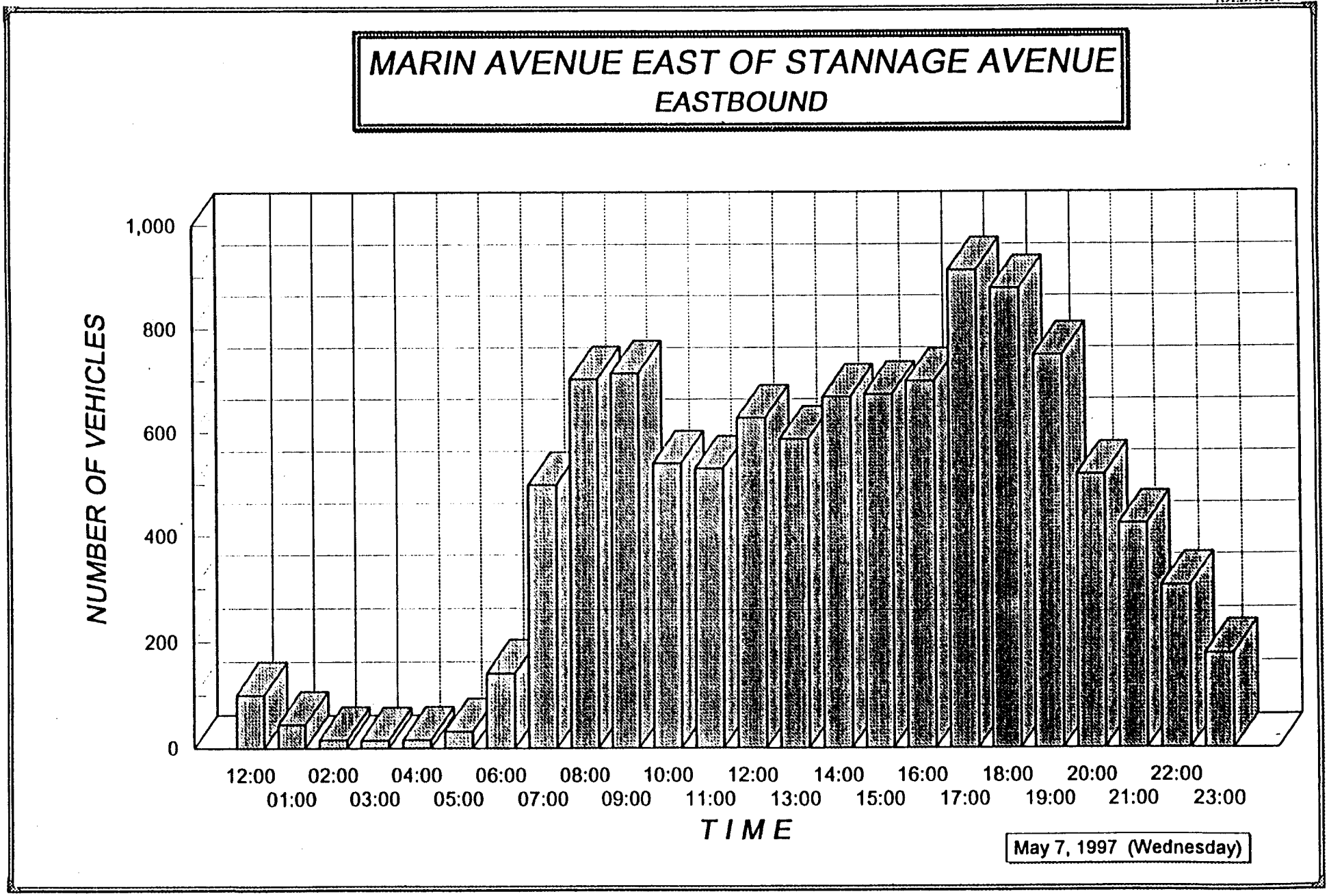
A9EBWB.WK4



BAYMETRICS TRAFFIC RESOURCES

1997 TRAFFIC MONITORING

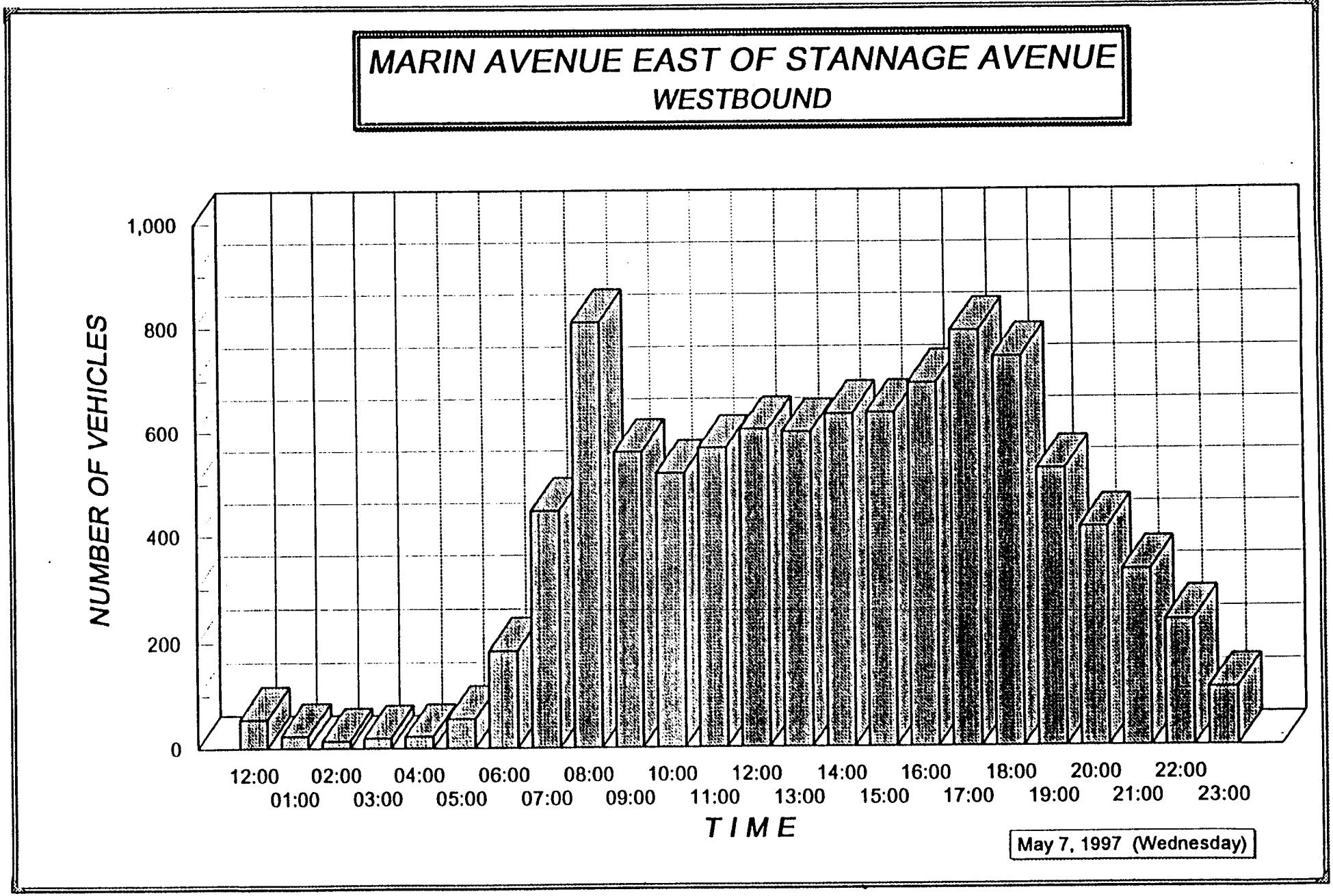
A9EB.WK4



BAYMETRICS TRAFFIC RESOURCES

1997 TRAFFIC MONITORING

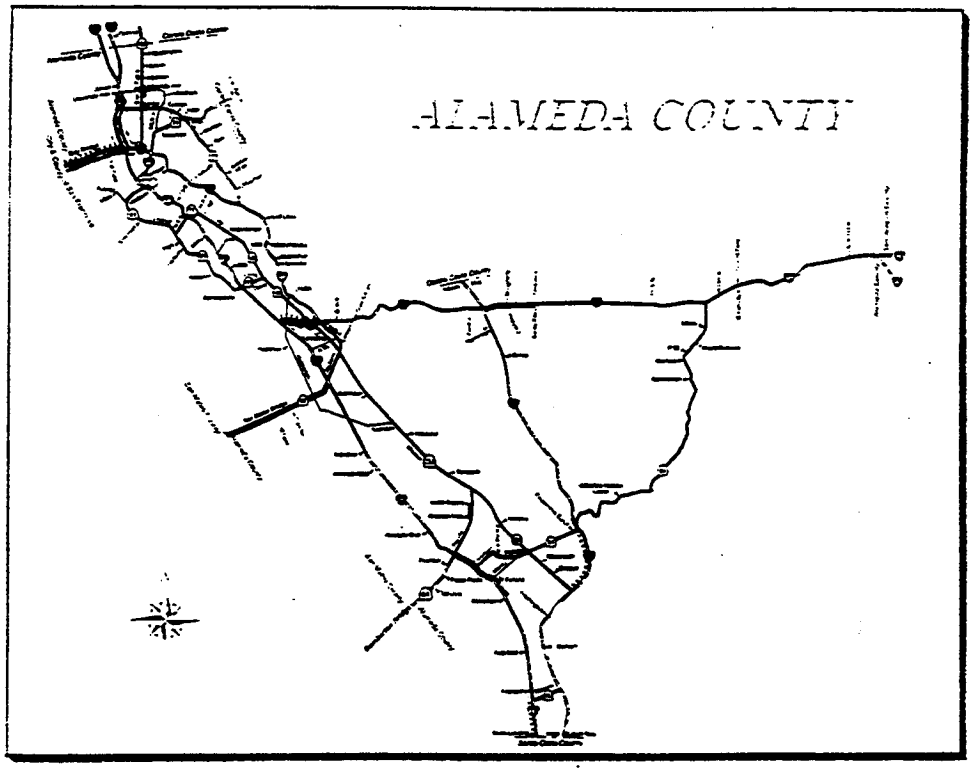
A9WB.WK4



APPENDIX I

1998 Level of Service Monitoring on the Alameda County Congestion Management Program Network (CCS Planning and Engineering, Inc., July 29, 1998)

1998 LEVEL OF SERVICE MONITORING
ON THE
ALAMEDA COUNTY CONGESTION MANAGEMENT PROGRAM NETWORK



FINAL REPORT

prepared for

ALAMEDA COUNTY
CONGESTION MANAGEMENT AGENCY

prepared by

CCS
PLANNING AND ENGINEERING
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ALAMEDA COUNTY CONGESTION MANAGEMENT PROGRAM
1998 LEVEL OF SERVICE MONITORING STUDY

Prepared for

Alameda County Congestion Management Agency

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SUMMARY

This report documents the 1998 travel time and speed surveys for the Alameda County Congestion Management Program (CMP) designated roadway system. The survey program included the following elements:

- "Floating car" travel time surveys on all Alameda County freeways (88 survey segments) and designated CMP arterial roads (200 survey segments) during the 4:00 to 6:00 P.M. peak period.
- Travel time surveys on selected ramp movements and "special segments" (23 survey segments) during the P.M. peak period.
- Travel time surveys on selected freeway segments (22 survey segments) during the 7:00 to 9:00 A.M. peak period.
- Travel time surveys using both auto and transit travel between nine pairs of origins and destinations.

The following table lists the locations of figures in this report which illustrate the levels of service on each road segment in each area of the county.

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SYSTEM PERFORMANCE

Overall average speeds on Alameda County freeways increased by about 1.6 p c compared to 1997, from 47.0 to 47.7 miles per hour. Average speeds on arterials rem ir relatively constant at 25.4 miles per hour

LEVEL OF SERVICE "F" SEGMENTS

A total of 18 segments operated at level of service (LOS) "F" during the P.M. peak p ɜr surveys. Five segments operated at LOS "F" during the A.M. peak period surveys.

First Time LOS F Segments

Three road segments and one ramp connection operated at level of service (LOS) F (1 the P.M. peak period for the first time in 1998:

- Pleasanton/Dublin, I-580 eastbound from I-680 to Santa Rita Road
- Berkeley, University Avenue westbound from San Pablo Avenue to Sixth Street
- Berkeley, San Pablo Avenue northbound from Allston Way to University Avenue
- Oakland, connection from SR 260 eastbound (Posey Tube) to I-880 northbound

LOS F Segments Not in 1991 CMP Baseline (Not "Grandfathered")

Six segments which operated at LOS "F" in 1998 during the P.M. peak period ɔ reported at LOS "F" in one or more previous surveys, but were not LOS "F" when Congestion Management Plan (CMP) baseline conditions were set in 1991 "grandfathered"):

- Oakland, I-80 eastbound from the Toll Plaza to I-580
- Alameda County, I-238 westbound from I-580 to I-880
- Fremont, I-880 northbound from Stevenson Road to Decoto Road
- Hayward area, SR 92 eastbound from the San Mateo County line to the toll gate
- Oakland, ramp from northbound SR 13 to eastbound SR 24
- San Leandro, ramp from northbound I-880 to eastbound I-238

LOS F Segments Included in 1991 CMP Baseline ("Grandfathered")

The remaining eight segments operated at LOS "F" during the 1998 P.M. peak peric also were at LOS "F" during the 1991 CMP baseline year:

- Emeryville/Berkeley, I-80 eastbound from I-580 to University Avenue
- Emeryville/Berkeley, I-80 westbound from University Avenue to I-580
- Oakland, I-80 westbound from I-580 to the toll plaza
- Hayward area, SR 92 eastbound from the toll gate to Clawiter Road
- Hayward, SR 92 eastbound from Clawiter Road to I-880
- Union City, Decoto Road from Union Square to Alavarado-Niles Road

- Oakland, ramp from westbound I-80 to eastbound I-580 (from Oakland towards Hayward)
- Oakland, ramp from westbound I-580 to eastbound I-80 (from Oakland towards Albany)

LOS F Segments in A.M. Peak Period

The A.M. peak period travel time surveys are conducted on selected segments only, and include only a portion of the major roads in Alameda County. The following five segments operated at LOS "F" during the A.M. peak period. All of these segments also operated at LOS "F" during the 1996 and 1997 surveys:

- Oakland, I-80 westbound from I-580 to the toll plaza
- Oakland, I-80 westbound from the toll plaza to the San Francisco County line
- Alameda County, I-238 westbound from I-580 to I-880
- Alameda County, I-880 southbound from Mission Boulevard to Dixon Landing Road
- Alameda County, I-680 southbound from SR 84 to SR 238 Mission Boulevard

IMPROVED SEGMENTS

Table S-1 lists eight segments which operated at LOS F during the 1997 surveys but operated at an improved level of service in the 1998 surveys. Improvements on I-80 through Albany and Berkeley are most likely due to reduced impacts of construction following the completion of the HOV flyover ramp to the Bay Bridge. Improved speeds were monitored on I-880 southbound approaching the San Mateo Bridge; the only change in this section since 1997 was the implementation of ramp metering. However, this segment of I-880 is very much subject to daily fluctuations in congestion and travel speed.

Table S-1
Improved Segments
Segments at LOS F in 1997 and not in 1998

	CMP Route	Direction	Segment Limits		1997 LOS (Speed)	1998 LOS (Speed)	Prior LOS F
			From	To			
P.M. PEAK PERIOD							
1.	I-80	EB	University	Central	F (29.4)	E (34.0)	'91,'92,'96,'97
2.	I-238	EB	I-880	I-580	F (28.0)	D (42.3)	'91,'92,'94,'96,'97
3.	SR 24	EB	I-580	Fish Ranch	F (29.5)	E (38.9)	'91-'97
4.	Hesperian	SB	E. 14th	Fairmont	F (9.8)	E (10.0)	'91,'95,'97
5.	I-880/I-238	Ramp	I-880 SB	I-238 EB	F (18.3)	D (32.6)	'92,'93,'94,'97
A.M. PEAK PERIOD							
6.	I-80	WB	Central	University	F (13.9)	C (51.2)	'97
7.	I-80	WB	University	I-580 Split	F (12.1)	E (39.6)	'97
8.	I-880	SB	A Street	SR 92	F (29.3)	B (58.1)	'96,'97

ORIGIN-DESTINATION SURVEYS

Peak period travel times were surveyed between nine pairs of origins and destinati is Alameda County. Four origin-destination pairs were added in 1998 to supplement the i pairs which were previously surveyed in 1996 and 1997. The surveys compared auto n transit times, and in one case bicycle times.

Auto travel times were generally consistent with previous years on the five origin routes, although travel times have increased each year between Hayward and N w using Hesperian Boulevard. Transit times were significantly longer than previous ye which may be due to changes in transit service or possibly different procedures us d survey personnel. Nearly all of the delays in the 1998 transit surveys were caused b long waits for buses at transfer points.

On the four additional survey routes, transit travel times were more than double th a times between Fremont and north San Jose and between Alameda and the Rockridge a of Oakland. Transit times were more competitive between downtown Oakland Pleasanton (40 percent longer) and between Fremont and Alameda (72 percent lc g On these corridors, BART can be used to bypass congested portions of the I-880 freewa

The bicycle travel time was about 30 percent longer than the auto travel time and faster than transit travel for the five mile survey route from Emeryville to Berkeley. confirms that bicycle travel is very competitive for shorter commutes.

OBSERVATIONS IN GENERAL LOS TRENDS

Overall miles of congestion declined between 1997 and 1998 due to the implementatio new infrastructure and operational improvements. However, congestion on specific r segments has increased, and deficiency plans may be required for the first time. Of e segments identified as LOS F, 13 are exempt from deficiency plan requirements ei because they were "grandfathered" at LOS F in 1991, or because they carry a percentage of traffic originating in other counties. The remaining five segments m subject to deficiency plan requirements; however, there are improvement plans in progr for each of these five segments. The final determination of the need for deficiency plar still being made.

Continued growth in Alameda County, coupled with current trends towards hi percentages of solo drivers, indicates a need for continued monitoring of travel conc i It may also indicate a need for incentives to use alternative modes, and ca improvements to address future needs.

SECTION 1

Introduction

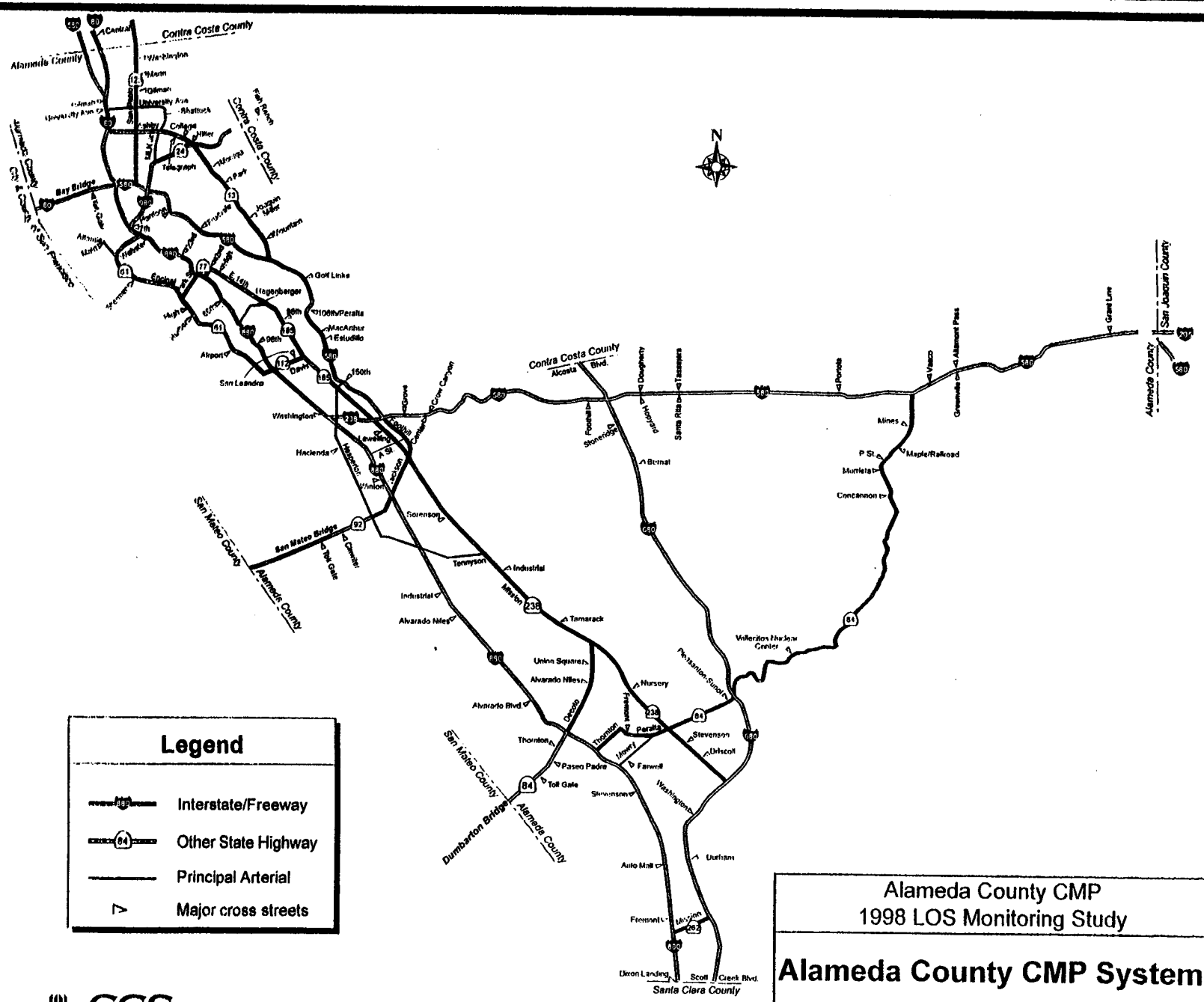
The Congestion Management Program (CMP) statute, passed by the California State Legislature in 1990, requires that all elements of the CMP be monitored at least biennially by the designated Congestion Management Agency (CMA). The Alameda County Congestion Management Agency, as the designated CMA for Alameda County, has established the Alameda County Congestion Management Program (CMP) which requires that Level of Service (LOS) standards be established and monitored biennially in even numbered years on the Alameda County CMP designated roadway system (Figure 1).

The CMP designated roadway system consists of approximately 230 miles. Of this total, 115 miles are freeways, 89 miles are conventional state highways, and 26 miles are city or county arterials. Table 1 summarizes the full list of routes by jurisdiction.

The objectives of this study are:

- to determine the average travel speeds and existing LOS on the system;
- to identify those roadway segments in the County that are operating at LOS "F"; and
- to identify trends in traffic congestion on the CMP network.

A study of PM peak period travel times has been conducted for the CMP network each year since 1991. Beginning in 1994, the study has included A.M. peak period runs on selected freeways. For the past three years, the study has also included comparative travel times between auto and transit for five selected origin-destination pairs that reflect typical work trips in Alameda County. Four additional origin-destination pairs were added in 1998.



Alameda County CMP
1998 LOS Monitoring Study

Figure 1

Alameda County CMP System

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Table 1
Alameda County CMP Designated Roadway System[1]

Jurisdiction	Freeway	Miles	Other State Highways	Miles	Other Arterials	Miles
Albany	I-80 I-580	0.61 0.92	SR 123 (San Pablo Ave.)	1.22	None	--
Berkeley	I-80	3.14	SR 123 (San Pablo Ave.) SR 13 (Ashby/Tunnel Rd.)	2.36 3.87	University Ave. Shattuck Ave. ML King Jr Blvd. Adeline St.	2.04 1.84
Emeryville	I-80	1.31	SR 123 (San Pablo Ave.)	0.68	None	--
Oakland	I-80 I-880 I-980 I-580 SR 24 SR 13	4.09 7.66 2.30 11.28 4.50 5.43	SR 123 (San Pablo Ave.) SR 13 (Tunnel Rd.) SR 61/260 (Tubes) SR 61 (Doolittle Dr.) SR 77 (42nd Ave.) SR 185 (E 14th St.)	1.19 0.10 0.66 2.39 0.31 3.98	MLK Jr. Blvd. Hegenberger Rd. 29th Ave./23rd Ave. -(See Park St-Alameda)	0.89 1.80 0.85
Piedmont	None	--	None	--	None	--
Alameda	None	--	SR 61 (Doolittle Dr., Otis, Webster St) SR 61/260 (Tubes)	4.47 0.65	Atlantic Ave. Park St.	0.80 0.55
San Leandro	I-880 I-580	3.78 2.95	SR 61 (Doolittle Dr.) SR 61/112 (Davis St.) SR 185 (E 14th St.)	0.70 1.78 3.16	150th Ave. Hesperian Blvd.	0.49 0.97
Hayward	I-880 SR 92	4.23 6.36	SR 185 (Mission Blvd.) SR 238 (Mission Blvd.) SR 238 (Foothill Blvd.) SR 92 (Jackson St.)	0.85 3.29 1.50 1.58	A St. Hesperian Blvd. Tennyson Rd.	1.61 2.60 2.32
Union City	I-880	1.70	SR 238 (Mission Blvd.)	2.57	Decoto Rd.	1.76
Fremont	I-680 I-880 SR 84	6.20 11.96 3.17	SR 238 (Mission Blvd.) SR 262 (Mission Blvd.) SR 84 (Thornton, Fremont, Mowry Ave.)	5.03 1.22 10.99	Decoto Rd. Mowry Ave.	1.15 2.96
Newark	SR 84	1.99	None	--	None	--
Pleasanton	I-580 I-680	4.65 5.26	None	--	None	--
Livermore	I-580	4.61	SR 84 (First St.)	4.63	None	--
Dublin	I-680	1.84	None	--	None	--
Unincorporated Areas	I-680 I-580 I-238 I-880	7.91 22.50 1.99 1.93	SR 84 (Vallecitos Rd.) SR 185 (Mission Blvd. & E. 14th) SR 238 (Foothill Blvd.)	7.97 2.47 0.79	Hesperian Blvd.	1.99

[1] As adopted by the Alameda County Congestion Management Agency, October 24, 1991.

LEVEL OF SERVICE

Roads and intersections are evaluated in terms of "level of service" (LOS) w is measure of driving conditions and vehicle delay. Levels of service range from A (bes to (poorest).

- Levels of service A, B and C indicate conditions where traffic can move relatively fr
- Level of service D describes conditions where delay is more noticeable.
- Level of service E describes conditions where traffic volumes are at or close to capac resulting in significant delays.
- Level of service F characterizes conditions where traffic demand exceeds availa capacity, with very slow speeds (stop-and-go), long delays (over one minu intersections) and average speeds which are no more than about one-ha uncongested speed

CMP LEVEL OF SERVICE STANDARDS

The CMP statute requires that a level of service standard be established for the desig CMP system roadways. Each year, member agencies must demonstrate that all C system roadways within their jurisdictions are operating at or above the CMP traffic L standard. A member agency's gas tax subventions may be withheld if the memb does not maintain the traffic LOS standard or have an approved deficiency plan roadways that fall below the LOS standard.

The basic level of service *standard* for CMP monitoring purposes is LOS E. An exceptio made for roadways which operated at LOS F in the 1991 "baseline" conditions. Th roadways were "grandfathered" in at LOS F.

SECTION 2

Study Methodology

The Alameda County CMP has established that measurement of level of service (LOS) be based on average travel speed. The study methodology involves collecting travel time data, computing travel speeds, and comparing the average speeds with the standards established by the CMA.

ROADWAY SEGMENTS

Study segments have been defined differently for each roadway classification.

Freeways

For freeways, major interchanges are used as the segment boundaries. Along more heavily traveled sections, the segments generally span from one to three interchanges. Three or more sections between interchanges were combined into longer analysis segments where traffic volumes entering and exiting are minor or volumes remain relatively constant between interchanges. This is the case, for instance, in the eastern section of the I-580 corridor.

Arterials

For arterials, each section between two adjacent signals was first reviewed to determine its arterial class as either Class I, II, or III. The determination of arterial class is based on "free-flow" speed, access control and land use intensity as defined in the 1985 *Highway Capacity Manual* (Transportation Research Board Special Report 209, Chapter 11, pp. 11-1 to 11-4).

Break points between segments generally occur at jurisdiction boundaries, at points where the number of travel lanes change, at major arterial street crossings, and at points where land use, speed limit, or channelization schemes change significantly. The segment

boundaries for the arterial roadways are identical for both directions and the distanc s generally the same or sufficiently close to be considered equal. Nevertheless, ' ac distances by direction may differ somewhat in cases of very wide intersections.

Freeway-to-Freeway Ramps

Separate travel time/speed runs were conducted for the ramps at freeway to fr e interchanges, since these connections can frequently have very different characteris than the freeways themselves. The ramp locations that have been studied ar e following:

1) I-80 to I-580 connections (Oakland-Emeryville area)
2) I-580 to SR 24 connections (Oakland)
3) SR 13 to SR 24 connections (in the vicinity of the Caldecott Tunnel)
4) I-880 to I-238 connections (in the Hayward area)
5) I-238 to I-580 connections (in the Hayward area)
6) I-580 to I-680 connections (Pleasanton/Dublin)
7) I-880 to SR 260 connections (at the Alameda tubes)

TRAVEL SPEED STANDARDS

Table 2 shows the relationships between average travel speed and LOS that have b approved by the Alameda County CMA, and are used in this study for freeway and ar segments. These LOS speed ranges are based on the 1985 *Highway Capaci* The procedures for LOS determination for other types of roads are described belo

Rural Roads

One of the CMP routes is a two-lane rural roadway, where a special analysis procedure required. This is State Route 84 from the southern city limit of Livermore to I is Boulevard in Fremont. Based on suggested guidelines from the 1985 *Highway Cap Manual*, LOS "A" is deemed to occur when vehicles are traveling at a free flow speed fc given roadway conditions. Special studies were conducted in the 1992 surveys dur g peak, low-volume conditions to document this condition. Level of service "F" is estim t occur when speeds have dropped below 50 percent of the free flow speeds.

Freeway-to-Freeway and State Route-to-Freeway Ramps

The guidelines for establishing LOS for ramps at freeway-to-freeway and state r freeway interchanges are similar to those for rural highways. LOS "A" is deemed t when vehicles are traveling at the free flow speed for the given roadway conditions. Sp studies were previously conducted as a part of the 1992 studies, during off-pea volume conditions to document this condition. Per the suggested guidelines of the *H J Capacity Manual*, LOS "F" would occur when speeds dropped below 50 percent of the flow speeds. Speed ranges for levels of service from B to E were then established intervals.

Table 2
Relationship Between Average Travel Speed and Level of Service
Alameda County Congestion Management Agency

Freeway Levels of Service[1]

LOS	Density (pc/mi/ln)[2]	Speed (mph)	Volume/Capacity Ratio	Maximum Service Flow (pcphpl)[3]
A	≤12	≥ 60	0.35	700
B	≤ 20	≥ 55	0.58	1,000
C	≤ 30	≥ 49	0.75	1,500
D	≤ 42	≥ 41	0.90	1,800
E	≤ 67	≥ 30	1.00	2,000
F	> 67	< 30	—[4]	—

Arterial Levels of Service[5]

Arterial Class	I	II	III
Range of Free Flow Speeds (mph)	45 to 35	35 to 30	35 to 25
Typical Free Flow Speed (mph)	40 mph	33 mph	27 mph
Level of Service	**Average Travel Speed (mph)**		
A	≥ 35	≥ 30	≥ 25
B	≥ 28	≥ 24	≥ 19
C	≥ 22	≥ 18	≥ 13
D	≥ 17	≥ 14	≥ 9
E	≥ 13	≥ 10	≥ 7
F	< 13	< 10	< 7

[1] Based on 1985 *Highway Capacity Manual* (Transportation Research Board Special Report 209), Table 3-1.
[2] Passenger cars per mile per lane.
[3] Maximum service flow under ideal conditions, expressed as passenger cars per hour per lane.
[4] Highly variable, unstable flow; volume/capacity ratio is not applicable.
[5] Based on 1985 *Highway Capacity Manual*, Table 11-1. For Rural Roadways, refer to 1985 *Highway Capacity Manual*, Table 8-1

DATA COLLECTION

Travel time data were collected during the period from March 31, 1998 through M / 1998. The field data consisted of travel time runs during the afternoon peak period of 4 to 6:00 P.M.. In addition, runs were made during the morning peak period (7:00 t 9 A.M.) on selected segments.

The data were collected for all segments of the CMP network except those which w consistently measured at LOS "A" and "B" during previous surveys. Consistent w 1 CMP guidelines, all runs were made on a Tuesday, Wednesday, or Thursday. E segment was surveyed on two or more different days. The travel time runs were or evenly throughout the two hour period.

For the majority of the CMP system, at least six runs were made on each roadway seg n More than six runs were made on many LOS "E" and "F" segments where heavy cong s has been previously reported, where a greater range of fluctuation in travel speed exhibited, or where questionable data was reported. A table has been prepared sh w the number of runs that were conducted on each route, and has been included 1 Technical Appendix to this report.

Floating Car Methodology

Travel speed surveys were conducted using "floating car" techniques, consistent with method described in the "Manual of Traffic Engineering Studies"[1] and the Alame CMA Technical Guidelines. Survey drivers were instructed to maintain an average tr speed so that they passed approximately as many vehicles as the number of vehicles w passed the survey vehicles. For each travel time run, the clock time was recorded at beginning of the run and the stopwatch time was recorded as the survey vehicle pas each check point.

Checkpoints

Checkpoints on freeways were noted as the survey vehicle crossed over or under the r street at an interchange. Checkpoints involving ramps were recorded as the survey vel passed the "gore" point where the inside lane stripes either diverge or merge. Checkpo on arterial streets were noted as the survey vehicle crossed the center of the intersec

Construction Activities

Several CMP roadway segments were under construction during the 1998 study per.. c particular, there were construction activities at the I-80/I-580 interchange, on I-88 Hegenberger Road and at 98th Avenue, and on I-880 at several interchanges in Fr r However, these construction zones, along with I-80 through Emeryville and Berkele, by 1998 completed to a point by where they did not appear to have had an effect or

[1] Paul C. Box and Joseph C. Oppenlander, *Manual of Traffic Engineering Studies*, 4th Edition, Institute Transportation Engineers, Arlington, VA., 1976.

travel time runs. Overall, construction activities were not observed to significantly impact any of the travel time runs.

The completion of several projects may have resulted in travel times which differ from prior years. For example, the completion of the HOV flyover ramp from westbound I-80 to the Bay Bridge, along with completion of some connections to the I-880 Cypress freeway, may have helped to improve travel times on some segments of I-80 while decreasing speeds on others.

Several ongoing construction projects will be completed in the near future, and may cause changes in travel times compared to the surveys presented in this monitoring report. The completion of HOV lanes on I-880 in Fremont should improve travel speeds on those segments of I-880. The completion of the connecting ramp from northbound I-880 to eastbound I-80 in Oakland/Emeryville will change travel speeds on portions of northbound I-880, eastbound I-980, westbound I-580 and eastbound I-80 in Oakland, as well as the connecting freeway-to-freeway ramps.

As a result of freeway construction, the distances between ramp checkpoints may change. These distances will need to be checked and revised accordingly as the construction is completed.

DATA ANALYSIS PROCEDURES

The travel speeds have been determined using the measured times and the distances between check points. These section-by-section and run-by-run travel time and speed data were checked for errors and for abnormal results. Mathematically, the average travel time for a segment was computed as the sum of the average travel times of the individual sections comprising the segment. The average travel speed has been determined by dividing the average travel time for the segment into the segment length. For a more complete discussion of the study methodology, see the description that was included in the initial study for establishing the existing Level of Service.[1]

The LOS results represent the average travel time during the two-hour peak period of 4:00 to 6:00 P.M. or 7:00 to 9:00 A.M. on an average weekday. For many roadway segments, the range of measured speeds are very constant throughout the two-hour period. For others, the travel times within this period can be quite different, especially when the peak congestion lasts for less than two hours.

For arterials, the travel time results are closely related to (1) traffic signal timing, and (2) the vehicle location in the traffic platoon during the study. In analyzing the data, if a travel time run was made at the very beginning of the two hour period, or toward the end of the period, and the data point was significantly different than other runs, the data point was then discarded, and additional travel time runs were made during the time period when traffic congestion was more severe.

[1] Abrams Associates, "Establishing the Existing Level of Service for the Alameda County CMP Designated Roadway System," November 26, 1991.

Some special conditions exist on freeway segments in the vicinity of major off-ramps, v n there may be different speeds in each lane, depending on the lane that is adjac 'o off-ramp. Frequently, the right lane on a freeway can be affected by the off a congestion, and is not caused by the freeway itself. At many of the freeway-to-fre v ramp connections on the CMA network, there is a different LOS than on the adjac freeways. In this study, separate travel time/speed runs were made for the ramps i these connections can frequently have very different characteristics from the fre / themselves.

SECTION 3

Level of Service Results

This section provides the results of the P.M. peak period surveys on freeway, arterial and ramp segments, as well as the A.M. peak period surveys on selected freeway segments. Segments which were operating at LOS "F" are highlighted, as well as segments which have changed significantly since the 1997 surveys.

The 1998 P.M. peak results show that that overall travel times appear to be slightly faster in comparison to 1997. There were a number of locations where decreases in travel speed or a deterioration in level of service were noted. On the other hand, there were several locations where increases in travel speed were recorded. These improved travel times are the result of completed construction projects, improved traffic signal systems, and changes in merging or weaving operations.

The full listing of peak hour speed and level of service results for all CMP network segments is included in the Appendix, on pages A-1 through A-12. The data are subdivided into:

- PM Freeway segments, Pages A-1 to A-3
- PM Arterial segments, Pages A-4 to A-10
- PM Ramps and special segments, Page A-11
- AM peak hour travel time runs, Page A-12

In addition to the speed and LOS results, these tables also show the number of lanes on each segment, and the estimated average daily traffic (ADT) (last updated for 1994 traffic volumes). Each entry also shows the results of the 1997 studies to provide a convenient comparison. The complete field data and study results are contained in a "Technical Compendium of Travel Time Studies - 1998," which is on file at the Alameda County CMA.

P.M. PEAK PERIOD RESULTS

The monitoring of the Alameda County CMP roadway system is based on P.M. peak e level of service. Survey results for the A.M. peak period are presented later in this se ic

Level of Service "F" Segments

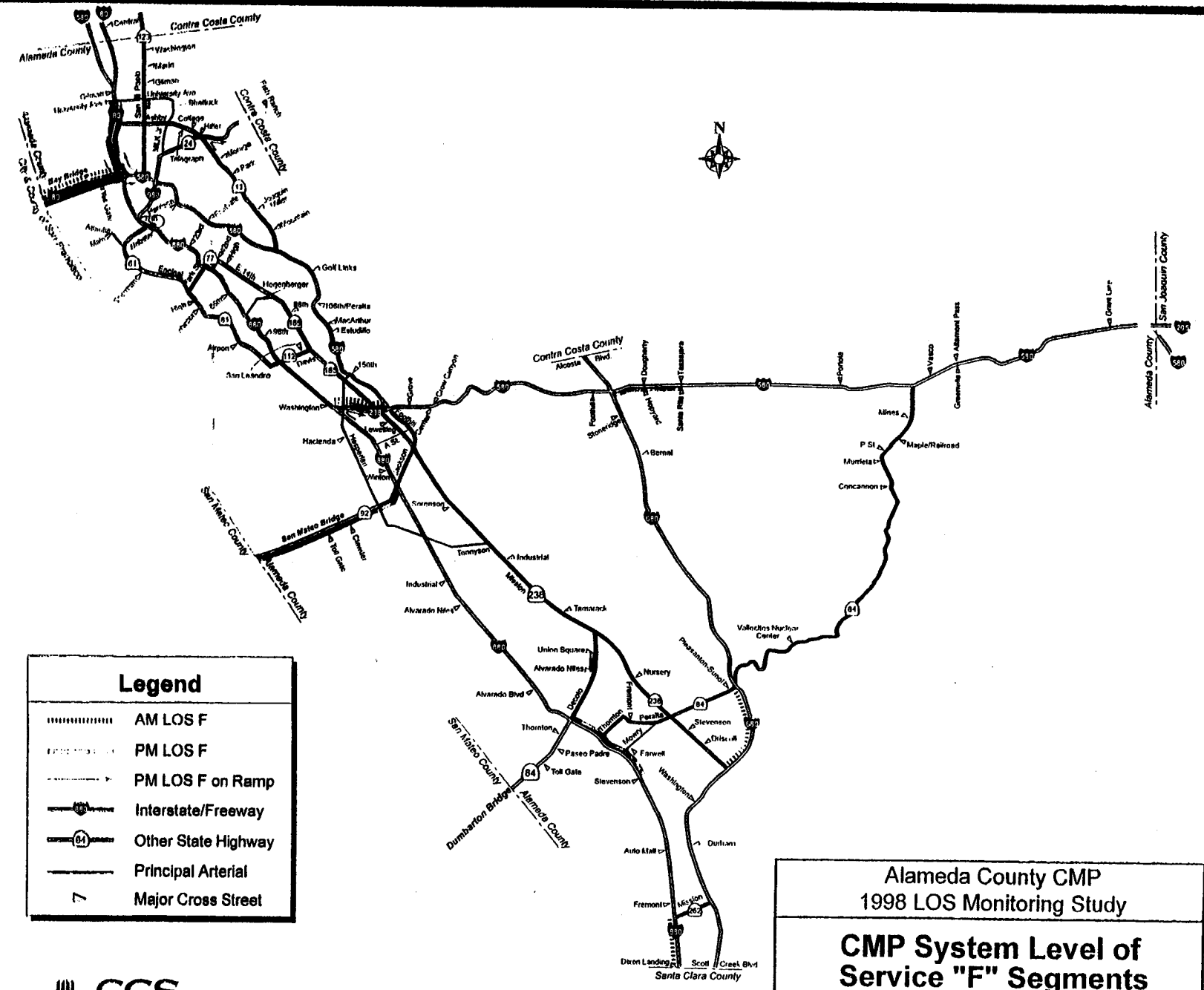
A total of 18 route segments were found to operate at LOS "F" during the weekday PM p period in the 1998 studies. Of these segments, ten are on the freeway system, thr e located on arterial routes, four segments are freeway to freeway ramps and one is a : connector segment. The 1998 LOS "F" segments for the CMP designated roadway sys are shown on Figure 2 and listed in Table 3.

Segments and freeway-to-freeway ramp locations which were LOS "F" for the time (4 locations). Four segments were shown to be operating at LOS "F" for th time. One is I-580 eastbound from I-680 to Santa Rita Road in Pleasanton. Two m e arterial segments in Berkeley: University Avenue westbound from San Pablo Avenu Sixth Street and San Pablo Avenue northbound from Allston Avenue to University A These two segments are strongly influenced by traffic conditions on I-80 and by the timings on the west portion of University Avenue. The fourth is the connector from SR (Posey Tube from Alameda) to the I-880 northbound on-ramp. This section is influen traffic conditions at three signalized intersections (although the connection involves a turn movements) as well as pedestrian activity.

Segments and freeway-to-freeway ramp locations which were LOS "F" ir surveys and continue to operate at LOS "F" (14 locations). There were four segments which have previously been designated as LOS "F" in one or more pre surveys and which continue as LOS "F". Six of these segments were not measured "F" in the 1991 CMP baseline conditions, and therefore are not "grandfathered" segm Eight of the segments were previously measured at LOS "F" in 1991, and therefore are considered deficient according to the CMP ("grandfathered" segments). Conditi several of the LOS "F" segments will be changed due to current or program construction projects, such as the completion of the I-880 Cypress freeway connections completion of HOV lanes on I-880, and planned improvements to the I-880/ interchange.

Segments which have previously been designated at LOS "F", but which improved in the 1998 surveys (5 locations). There were five segments in 1998 v improved from LOS "F" conditions reported in the 1997 surveys:

- I-80 eastbound from University Avenue to the Contra Costa County line improved LOS "F" to "E." This segment probably improved due to the completion of constru in this area.
- I-238 eastbound from I-880 to I-580 improved from LOS "F" to "D."
- SR 24 eastbound from I-580 to Fish Ranch Road, through the Caldecott Tunn surveyed at LOS "E" this year. This segment has been reported as LOS "F" in prior year.



Alameda County CMP 1998 LOS Monitoring Study	Figure
CMP System Level of Service "F" Segments	2

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Table 3
Level of Service "F" Segments, P.M. Peak Period

	CMP Route	From:	To:	Facility Type	Length (miles)	1997	1998	Grandfathered in 1991	Comments
	Segments that have become Level of Service "F" for the first time								
1.	I-580 EB (Pleasanton)	I-680	Santa Rita	Freeway	2.73	E 34.8	F 15.9	N	Significant decrease in speed.
2.	University Avenue WB (Berkeley)	San Pablo	6th	Arterial	0.31	E 13.5	F 7.1	N	May be impacted by revised signal timing.
3.	SR 123 San Pablo Avenue (Berkeley)	Allston	University	Arterial	0.20	D 9.1	F 3.2	N	May be impacted by revised signal timing.
4.	SR 260 Posey Tube (Oakland)	SR 260	I-880 NB	Ramp	0.36	D 24.1	F 15.3	N	Includes street intersections, pedestrian crossings.
	Freeway Segments that are operating at LOS "F"								
5.	I-80 EB (Oakland)	Toll Plaza	I-580/80	Freeway	1.15	F 20.4	F 21.4	N	LOS "F" since 1993.
6.	I-80 EB (Emery-Berk)	I-580/80	University	Freeway	2.80	F 24.0	F 14.8	Y	Speed has continued to decrease since 1996.
7.	I-80 WB (Berk-Emery)	University	I-580 Split	Freeway	2.43	F 14.7	F 23.0	Y	Speed may have increased due to completion of HOV flyover construction.
8.	I-80 WB (Oakland)	I-580 Split	Toll Plaza	Freeway	1.20	F 25.7	F 16.6	Y	Completion of I-880 Cypress may supply additional traffic volume.
9.	I-238 WB (Unincorp)	I-580	I-880	Freeway	1.60	F 23.7	F 29.1	N	Impacted by congestion and ramp metering on I-880.
10.	I-880 NB (Fremont)	Stevenson	Decoto	Freeway	4.04	F 23.8	F 28.1	N	HOV lane will open in near future.

Table 3 (continued)
Level of Service "F" Segments, P.M. Peak Period

	CMP Route	From:	To:	Facility Type	Length (miles)	1997	1998	Grandfathered in 1991	Comments
	Freeway Segments that are operating at LOS "F" (continued)								
11.	SR 92 EB (Hayward-Unincorp)	County Line	Toll Gate	Freeway	2.61	F 22.7	F 9.7	N	LOS F for first time in 1997.
12.	SR 92 EB (Hayward-Unincorp)	Toll Gate	Clawiter	Freeway	1.76	F 25.6	F 23.7	Y	Has been consistently at LOS "F" in previous surveys
13.	SR 92 EB (Hayward)	Clawiter	I-880	Freeway	2.10	E 21.9	F 28.7	Y	Has been at LOS "F" in previous surveys.
	Arterial Segments that are operating at LOS "F"								
14.	Decoto Road WB (Union City)	Union Square	Alvarado-Niles	Arterial	0.25	E 10.8	F 9.7	Y	LOS "F" in most previous surveys. Short segment approaching congested intersection.
	Ramps that are operating at LOS "F"								
15.	I-80 ramp (Oakland)	I-80 WB	I-580 EB	Ramp	0.30	F 10.0	F 18.6	Y	Several construction projects completed.
16.	I-580 ramp (Oakland)	I-580 WB	I-80 EB	Ramp	0.41	E 20.9	F 19.4	Y	Slight decrease in speed. Will change when I-880 Cypress connections are completed
17.	SR 13 ramp (Oakland)	SR 13 NB	SR 24 EB	Ramp	0.32	F 11.8	F 6.0	N	This ramp has always been at LOS "F" since 1992.
18.	I-880 ramp (San Leandro)	I-880 NB	I-238 EB	Ramp	0.33	D 21.5	F 13.9	N	Has been LOS "F" in 93-94.

- Hesperian Boulevard southbound from East 14th Street to Fairmont Drive improved from LOS "F" to "E" based on a very small increase in average speed.
- At the I-880/I-238 interchange, the ramp movement from southbound I-880 to eastbound I-238 improved from LOS "F" to "D." However, the corresponding ramp movement from northbound I-880 to eastbound I-238 changed from LOS "D" to "F" as noted above.

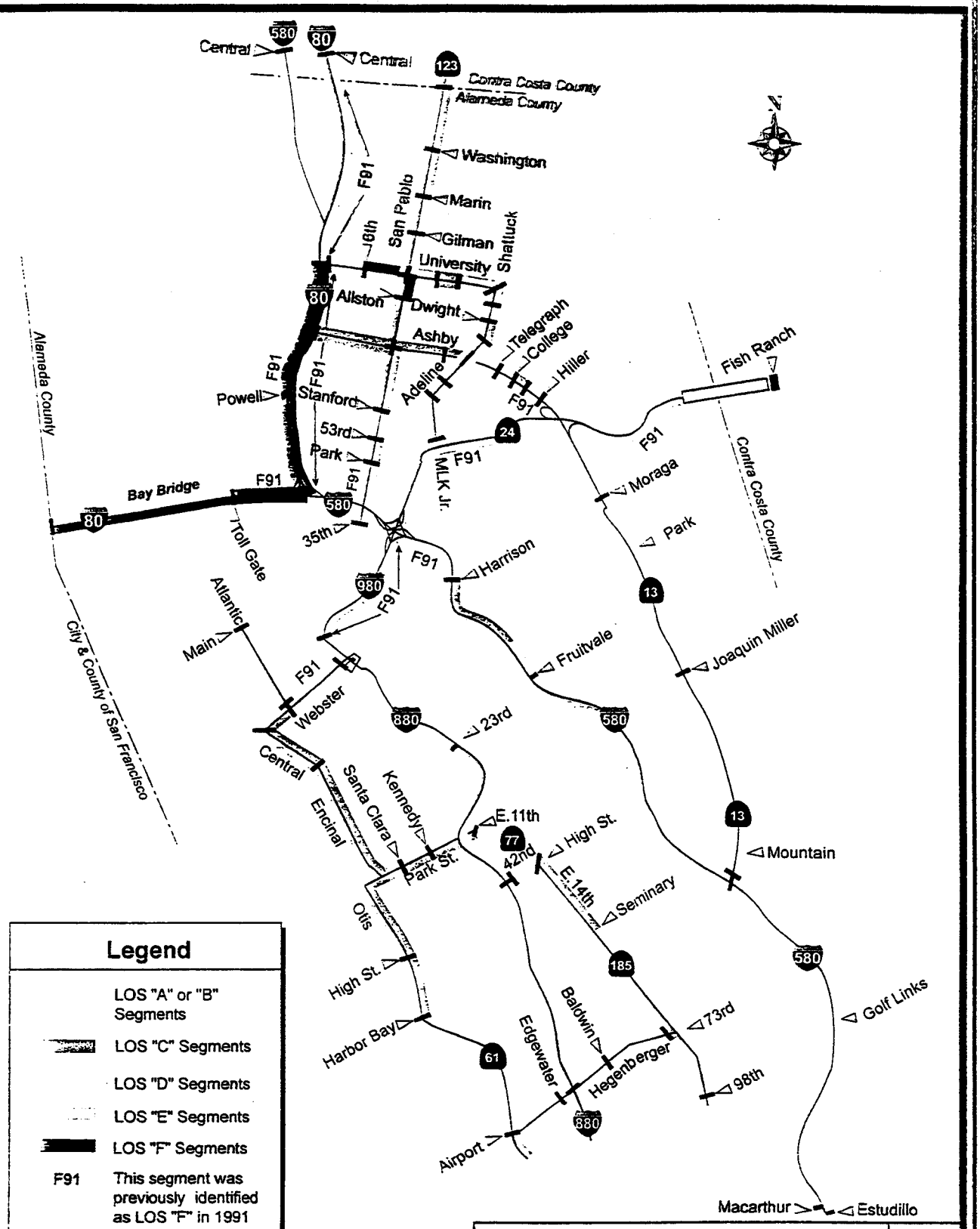
Overall LOS Results

The systemwide statistics for the county arterials and freeways are shown in Table 4. Based on an average of all CMP roads in the County, the overall average speeds on the freeway system increased by about 1.6 percent, while the average arterial speeds remained relatively constant.

Table 4
Average P.M. Peak Period Vehicle Speeds

	1997 Results	1998 Results
Freeways	46.99 mph	47.73 mph
Arterials	25.42 mph	25.35 mph

Figures 3 through 6 show the results of the travel time runs and the resulting LOS for each of the segments on the CMP designated system by Alameda County planning area (see Appendix tables on pages A-1 through A-12 for a full listing of all results).



Alameda County CMP
1998 LOS Monitoring Study

Figure 3

1998 PM Peak Level of Service Results Planning Area 1

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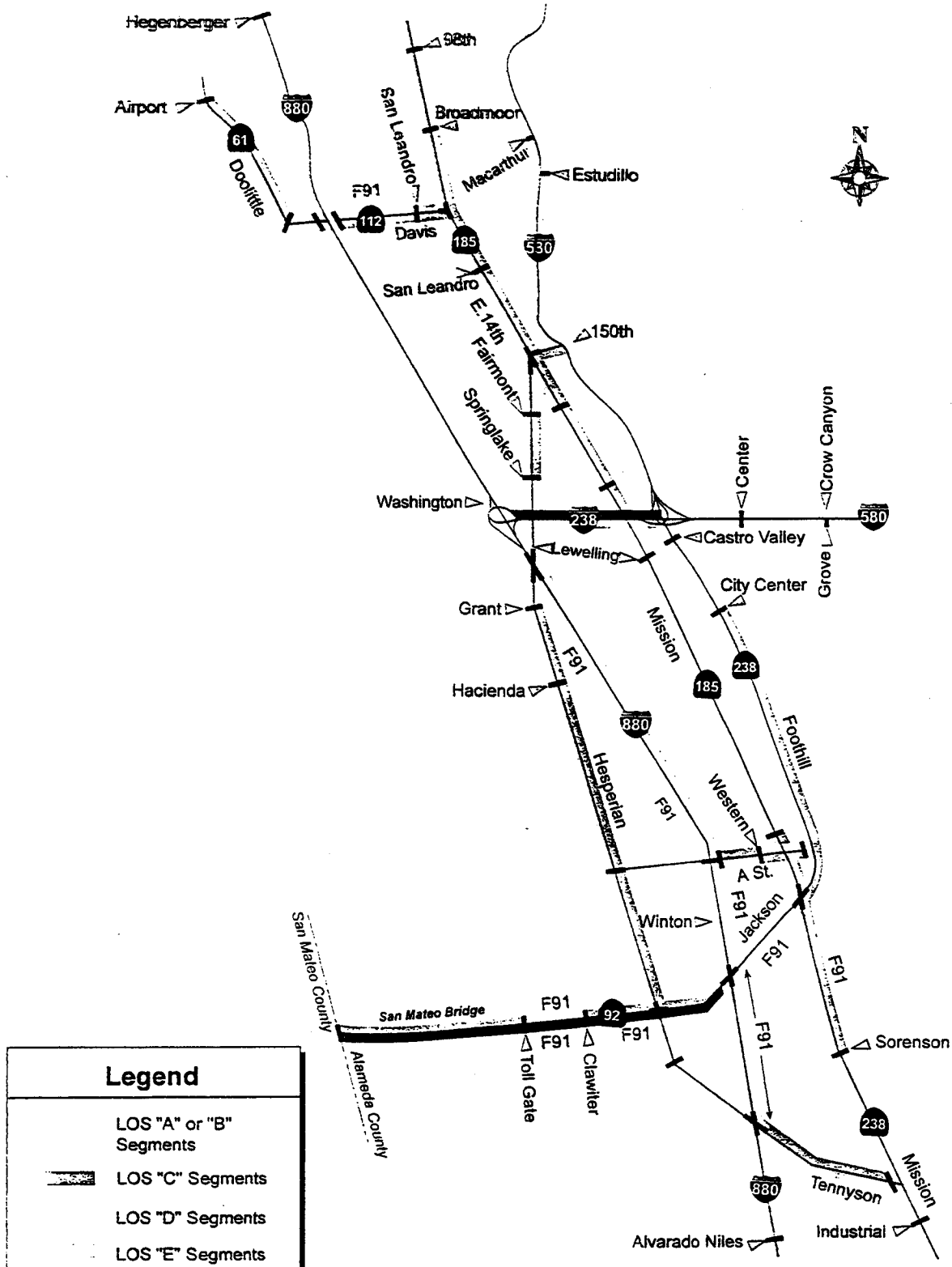

Legend

	LOS "A" or "B" Segments
	LOS "C" Segments
	LOS "D" Segments
	LOS "E" Segments
	LOS "F" Segments
F91	This segment was previously identified as LOS "F" in 1991 when the CMP was first adopted.

Alameda County CMP
1998 LOS Monitoring Study

1998 PM Peak Level of Service Results Planning Area 2

Figure 4

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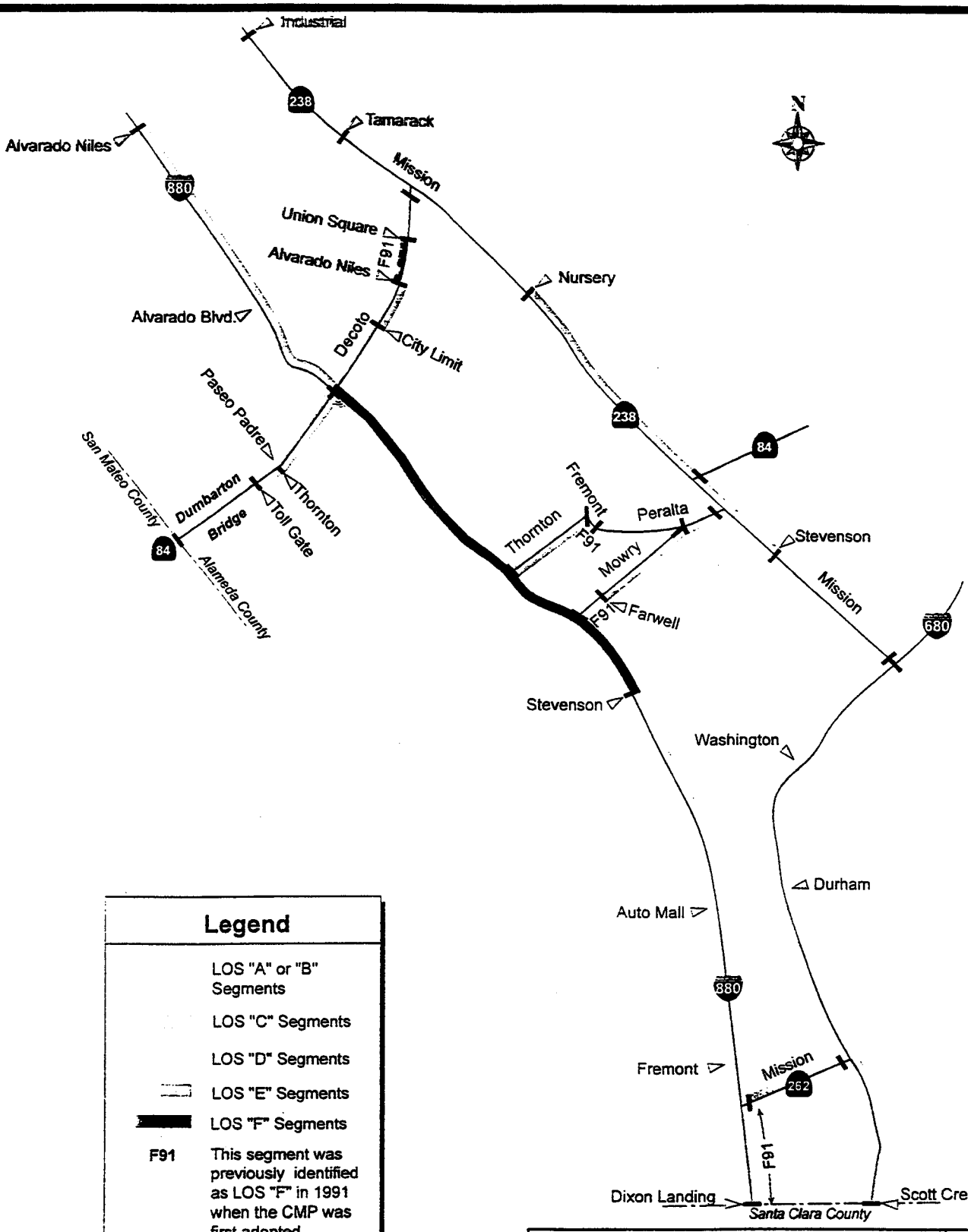

Alameda County CMP
1998 LOS Monitoring Study

Figure 5

1998 PM Peak Level of Service Results Planning Area 3

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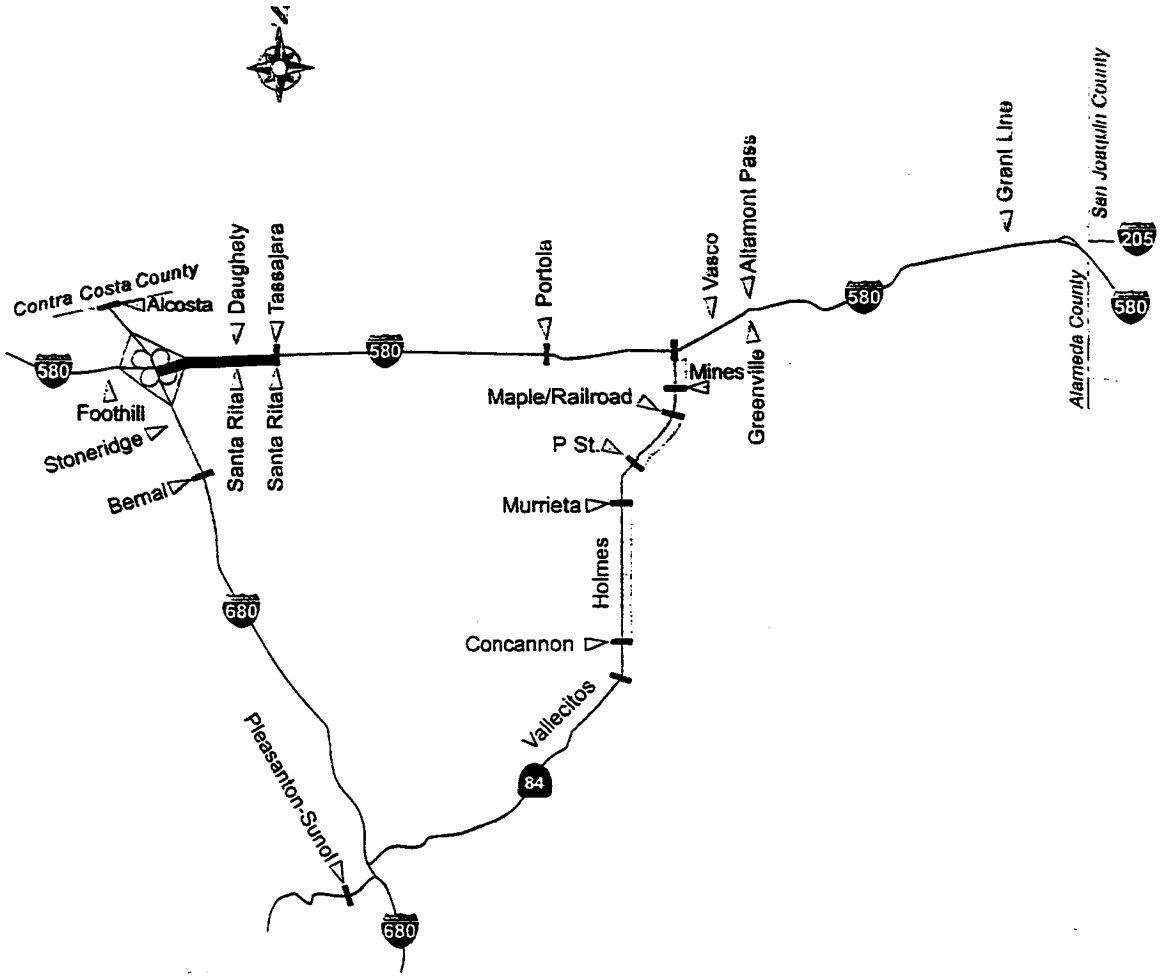

Legend

	LOS "A" or "B" Segments
	LOS "C" Segments
	LOS "D" Segments
	LOS "E" Segments
	LOS "F" Segments
F91	This segment was previously identified as LOS "F" in 1991 when the CMP was first adopted.

Alameda County CMP
1998 LOS Monitoring Study

Figure 6

1998 PM Peak Level of Service Results Planning Area 4

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Segments with Notable Changes in the Last Year

Table 5 shows those roadways and segments for which the 1998 P.M. peak surveys reported significant changes in the travel time results as compared to previous surveys. The changes noted are on routes where there has been a change of two or more level of service grades between 1997 and 1998 and/or changes in travel speeds of 20 percent or more.

Some of the speed increases are on routes that have been previously affected by construction activities, while some changes may have occurred due to improvements or changes in signal timing. The implementation of ramp metering on I-880 in the Hayward area may have impacted speeds on the I-880 freeway, on the connecting I-238 freeway, and on parallel arterial streets.

Comparisons to Previous Studies

The 1998 P.M. peak period travel time and speed survey results were compared to the survey results from 1991 to 1997 on the major routes on the Alameda County CMP system. Table 6 shows these results for the freeway system, while Table 7 lists the major arterial routes. For each route, the segments have been aggregated to show the entire length of the route throughout Alameda County.

Freeways. The 1998 P.M. peak period freeway speeds on several congested corridors decreased compared to previous years. The I-80 eastbound corridor time matched the slowest previous time, averaging 20.2 miles per hour. The I-880 eastbound time continued to increase, and was about five percent higher than 1997. However, the 1998 surveys included faster P.M. peak period travel times on many "off-peak" direction freeway routes such as southbound I-580 between I-80 and I-238, southbound I-680, southbound I-880, southbound SR 13 and westbound SR 24. These changes could be due to changes in traffic conditions, completion of construction activities, or even different survey personnel.

The travel time on westbound I-80 decreased by about 12 percent compared to 1997, most likely due to the completion of major construction activities. The most significant corridor improvement was on eastbound SR 24 through the Caldecott Tunnel, which increased from a typical speed of about 30 miles per hour to 39 miles per hour in 1998. No particular road improvement or change in conditions was identified to account for this increase in speed.

Arterials. Travel times increased on 13 arterial routes and decreased on 9 arterial routes between 1997 and 1998. The most significant increase in travel time occurred on northbound San Pablo Avenue, where the average speed decreased from 18 to 13 miles per hour (29 percent slower). The most significant travel time improvements were on southbound Hesperian Boulevard (15 percent improvement), eastbound SR 84 in Livermore (14 percent improvement), and westbound Decoto Road (13 percent improvement). Each of these routes returned to travel times consistent with prior years, after slower surveyed times in 1997.

Table 5
Segments with Significant Changes from Previous Year
P.M. Peak Period

CMP Route	Segment	Change in Speed Data	Comments
I-80 EB	San Francisco County Line to Toll Plaza	Increase from 35 to 50 mph.	Completion of connecti SB I-880 Cypress freeway
I-80 EB	I-580 to University	Decrease from 25 to 15 mph.	
I-80 WB	Central to University	Increase from 30 to 61 mph.	completion of construction and new flyover.
I-238 EB	I-880 to I-580	Increase from 28 to 42 mph.	
I-580 EB	I-80 to Harrison	Increase from 40 to 63 mph.	
I-580 EB	Grove to I-680 I-680 to Santa Rita	Decrease from 59 to 43 mph. Decrease from 35 to 16 mph.	Increased commute to Sa Joaquin and Contra Co counties.
I-880 NB	Tennyson to SR 92	Decrease from 51 to 40 mph.	Merge conditions from Sa Mateo Bridge.
I-880 SB	High to I-238	Increase from 37-45 to 56-62 mph.	Reduced construction act at interchanges.
I-880 SB	A Street to SR 92	Increase from 43 to 57 mph.	Completion of ram project.
I-880 SB	Stevenson to Mission	Increase from 49 to 64 mph.	
SR 13 NB	Mountain to Moraga	Increase from 46 to 60 mph.	
SR 24 WB	Fish Ranch to I-580	Increase from 48 to 60 mph.	
SR 92 EB	County line to Toll Gate	Decrease from 23 to 10 mph.	
Hegenberger Rd.	East 14th to Baldwin in both directions	Increase from 15-17 to 29-35 mph.	Return to 1996 speed l
Hesperian SB	Grant to Hacienda	Increase from 16 to 34 mph.	Return to 1996 speed l
SR 13 Ashby Ave EB	I-80 to San Pablo ML King to Shattuck	Increase from 13 to 19 mph. Decrease from 14 to 8 mph.	
SR 92 Jackson WB	Mission to I-880	Increase from 18 to 28 mph.	
SR 123 San Pablo NB	35th to Park Allston to University	Decrease from 19 to 13 mph. Decrease from 9 to 3 mph.	
SR 238 Foothill SB	I-580 to Castro Valley	Increase from 23 to 46 mph.	

Table 6
Comparison of PM Peak Travel Times and Speeds on Freeways

CMP Route	Direction	From	To	Length (miles)	1991	1992	1993	1994	1995	1996	1997	1998
I-80	EB	Tollgate	Central	6.35	15:56 *23.5*	18:24 *20.4*	18:12 *20.6*	17:19 *21.7*	18:32 *20.2*	18:23 *20.8*	16:37 *20.8*	18:50 ***20.2***
	WB	Central	Tollgate	6.11	14:27 *25.3*	15:26 *23.7*	16:31 *22.1*	15:41 *23.3*	12:52 *28.4*	14:53 *24.6*	17:37 *24.9*	13:07 ***28.0***
I-580	EB	SR 238/ Foothill	I-205	30.33	32:55 *56.3*	33:40 *55.0*	33:24 *55.4*	33:37 *55.1*	33:05 *49.9*	33:04 *55.0*	n/a *n/a*	n/a ***n/a***
	WB	I-205	SR 238/ Foothill	30.11	32:10 *57.2*	33:05 *55.6*	33:14 *55.4*	32:07 *57.3*	32:48 *56.1*	29:30 *61.3*	n/a *n/a*	n/a ***n/a***
I-580	SB	I-80	I-238	16.18	18:18 *52.6*	18:35 *51.8*	19:37 *49.1*	21:53 *44.0*	20:08 *47.8*	18:13 *53.2*	23:09 *41.9*	16:16 ***60.0***
	NB	I-238	I-80	15.28	16:11 *57.7*	16:50 *55.5*	16:48 *55.6*	18:20 *51.0*	18:18 *50.1*	15:36 *52.2*	17:26 *54.3*	14:58 ***61.2***
I-680	NB	Scott Creek Rd.	Alcosta (On)	21.13	21:59 *58.1*	22:31 *56.7*	23:07 *55.2*	22:31 *56.7*	23:01 *55.4*	24:16 *52.2*	25:59 *48.8*	25:07 ***50.5***
	SB	Alcosta (On)	Scott Creek Rd.	21.27	21:45 *59.0*	22:05 *58.1*	22:36 *56.8*	23:23 *54.9*	22:48 *56.3*	21:04 *60.6*	22:49 *55.9*	19:06 ***66.8***
I-880	NB	Dixon Landing	I-980	31.42	40:49 *44.8*	41:15 *44.4*	39:00 *46.9*	42:37 *42.9*	42:59 *42.6*	50:26 *45.5*	47:05 *40.0*	49:21 ***38.2***
	SB	I-980	Dixon Landing	30.93	41:55 *43.0*	44:41 *40.4*	43:17 *41.7*	47:36 *37.9*	41:55 *43.0*	40:31 *45.8*	42:45 *43.4*	37:19 ***49.7***
SR 13	NB	Mountain	Hiller	5.42	6:12 *53.6*	6:40 *49.9*	7:09 *46.5*	6:51 *48.5*	6:45 *51.3*	6:45 *48.1*	8:00 *43.6*	6:06 ***53.2***
	SB	Hiller	Mountain	5.43	6:04 *56.4*	5:46 *59.4*	6:02 *56.7*	6:31 *52.5*	6:48 *48.5*	6:55 *47.2*	5:45 *56.9*	5:31 ***59.1***
SR 24	EB	I-580 (On)	Fish Ranch Rd.	4.52	9:19 *30.1*	9:35 *29.2*	9:14 *30.3*	9:25 *29.8*	9:34 *29.3*	11:10 *24.3*	9:21 *29.5*	6:59 ***38.9***
	WB	Fish Ranch Rd.	I-580 (Off)	4.47	5:00 *30.1*	4:58 *29.2*	5:07 *30.3*	5:01 *29.8*	4:41 *29.3*	5:24 *24.3*	5:33 *29.5*	4:30 ***59.5***

Table 7
Comparison of PM Peak Travel Times and Speeds on Arterials

CMP Route	Direction	From	To	Length (miles)	1991	1992	1993	1994	1995	1996	1997	1998
Hesperian Blvd.	NB	Tennyson	14th St.	5.62	19:35 *17.2*	19:19 *17.5*	19:07 *17.6*	18:40 *18.1*	18:04 *18.7*	16:06 *20.5*	18:32 *18.2*	17:18 *19.5*
	SB	14th St.	Tennyson	5.60	17:20 *19.4*	16:05 *20.9*	16:03 *20.9*	17:38 *19.1*	16:56 *19.8*	16:10 *20.7*	18:40 *18.0*	16:13 *20.7*
SR 13 Ashby	EB	I-80	Hiller	3.75	15:17 *14.7*	13:19 *16.9*	12:00 *18.8*	13:40 *16.5*	14:29 *15.5*	13:40 *16.5*	13:03 *17.3*	14:26 *15.6*
	WB	Hiller	I-80	3.78	14:13 *16.0*	13:09 *17.2*	16:47 *13.5*	13:49 *16.4*	15:25 *14.7*	15:09 *15.0*	13:35 *16.8*	14:06 *16.1*
SR 61	SB	Atlantic	Davis	7.56	18:40 *24.9*	18:07 *25.0*	23:06 *19.6*	18:30 *24.5*	18:32 *24.5*	19:36 *23.1*	19:09 *23.7*	19:01 *23.9*
	NB	Davis	Atlantic	7.57	19:32 *24.3*	18:38 *25.5*	21:07 *22.5*	18:41 *25.5*	18:31 *25.7*	18:78 *24.1*	19:34 *23.2*	19:24 *23.4*
SR 84 Fremont	WB	SR 238	I-880 SB	4.29	10:07 *25.0*	8:27 *30.5*	10:30 *24.5*	10:56 *23.5*	13:49 *18.6*	10:27 *24.6*	10:41 *24.1*	11:42 *22.0*
	EB	I-880 SB	SR 238	4.29	11:21 *24.3*	10:24 *24.8*	11:50 *21.8*	11:45 *21.9*	13:08 *19.6*	11:38 *22.1*	13:48 *18.7*	12:56 *19.9*
SR 84 Livermore	WB	I-580 WB	Concannon	5.04	9:20 *32.4*	10:36 *28.5*	10:59 *27.5*	9:27 *32.0*	11:18 *26.8*	11:03 *27.4*	9:52 *25.2*	11:01 *27.5*
	EB	Concannon	I-580 WB	5.04	11:32 *26.2*	10:32 *28.7*	9:35 *31.6*	10:23 *29.1*	8:02 *37.6*	10:46 *28.1*	10:23 *23.7*	11:12 *27.0*
SR 123 San Pablo Ave.	SB	Carlson	35th St.	5.44	16:26 *19.0*	16:32 *19.7*	15:19 *21.3*	14:22 *22.7*	17:15 *18.9*	18:09 *18.0*	18:08 *18.0*	18:15 *17.9*
	NB	35th St.	Carlson	5.45	16:56 *20.1*	15:32 *21.1*	17:30 *18.7*	18:12 *18.0*	15:30 *21.1*	17:42 *18.5*	18:23 *17.8*	26:00 *12.6*
SR 185	SB	42nd St.	SR 92/238	10.47	42:55 *14.1*	28:47 *21.8*	34:34 *18.2*	n/a *n/a*	33:36 *18.7*	30:31 *20.6*	30:47 *20.4*	29:12 *21.5*
	NB	SR 93/238	42nd St.	10.47	38:34 *18.6*	28:54 *21.7*	32:14 *19.5*	n/a *n/a*	30:37 *20.5*	28:40 *21.8*	30:09 *20.5*	31:02 *20.2*

Table 7 (continued)
Comparison of PM Peak Travel Times and Speeds on Arterials

CMP Route	Direction	From	To	Length (miles)	1991	1992	1993	1994	1995	1996	1997	1998
SR 238 Mission	NB	I-680 NB	Jackson	12.35	24:05 *30.7*	n/a *n/a*	26:24 *28.0*	27:30 *26.9*	24:36 *30.1*	27:10 *27.3*	28:06 *26.4*	27:04 *27.4*
	SB	Jackson	I-680 NB	12.35	24:28 *30.3*	n/a *n/a*	31:09 *23.8*	28:15 *26.2*	28:15 *26.2*	26:45 *27.7*	24:45 *30.0*	27:20 *27.1*
MLK/Shattuck	NB	SR 24	University	2.78	7:02 *17.5*	6:43 *18.3*	6:09 *20.0*	6:07 *20.1*	10:30 *11.7*	12:01 *13.7*	10:59 *15.2*	11:41 *14.3*
	SB	University	SR 24	2.76	10:07 *16.4*	9:12 *18.0*	9:06 *18.2*	9:59 *16.6*	10:55 *15.2*	10:26 *15.7*	10:21 *16.0*	10:45 *15.4*
University Ave.	EB	I-80 Off	Shattuck Pl.	2.05	7:02 *17.5*	6:43 *18.3*	6:09 *20.0*	6:07 *20.1*	5:50 *21.1*	7:07 *17.2*	7:27 *16.5*	7:21 *16.7*
	WB	Shattuck Pl.	I-80 Off	2.05	6:38 *18.5*	6:30 *18.9*	7:47 *15.8*	7:07 *17.3*	6:04 *20.3*	7:27 *16.5*	8:44 *14.1*	9:51 *12.5*
Decoto Rd.	WB	SR 238	County Line	8.97	11:46 *45.7*	12:43 *42.3*	12:45 *42.2*	13:56 *38.6*	14:03 *38.3*	16:30 *32.6*	15:45 *34.2*	13:58 *38.5*
	EB	County Line	SR 238	8.94	12:41 *42.3*	14:01 *28.3*	13:53 *38.6*	14:40 *36.6*	16:31 *32.5*	17:89 *30.0*	16:28 *30.5*	17:06 *31.4*
SR 84 Niles Canyon	EB	SR 238	Concannon	15.35	n/a *n/a*	n/a *n/a*	n/a *n/a*	25:20 *36.4*	24:27 *37.7*	25:17 *34.3*	n/a *n/a*	n/a *n/a*
	WB	Concannon	SR 238	15.01	n/a *n/a*	n/a *n/a*	n/a *n/a*	20:37 *43.7*	20:43 *43.5*	25:58 *41.4*	n/a *n/a*	n/a *n/a*

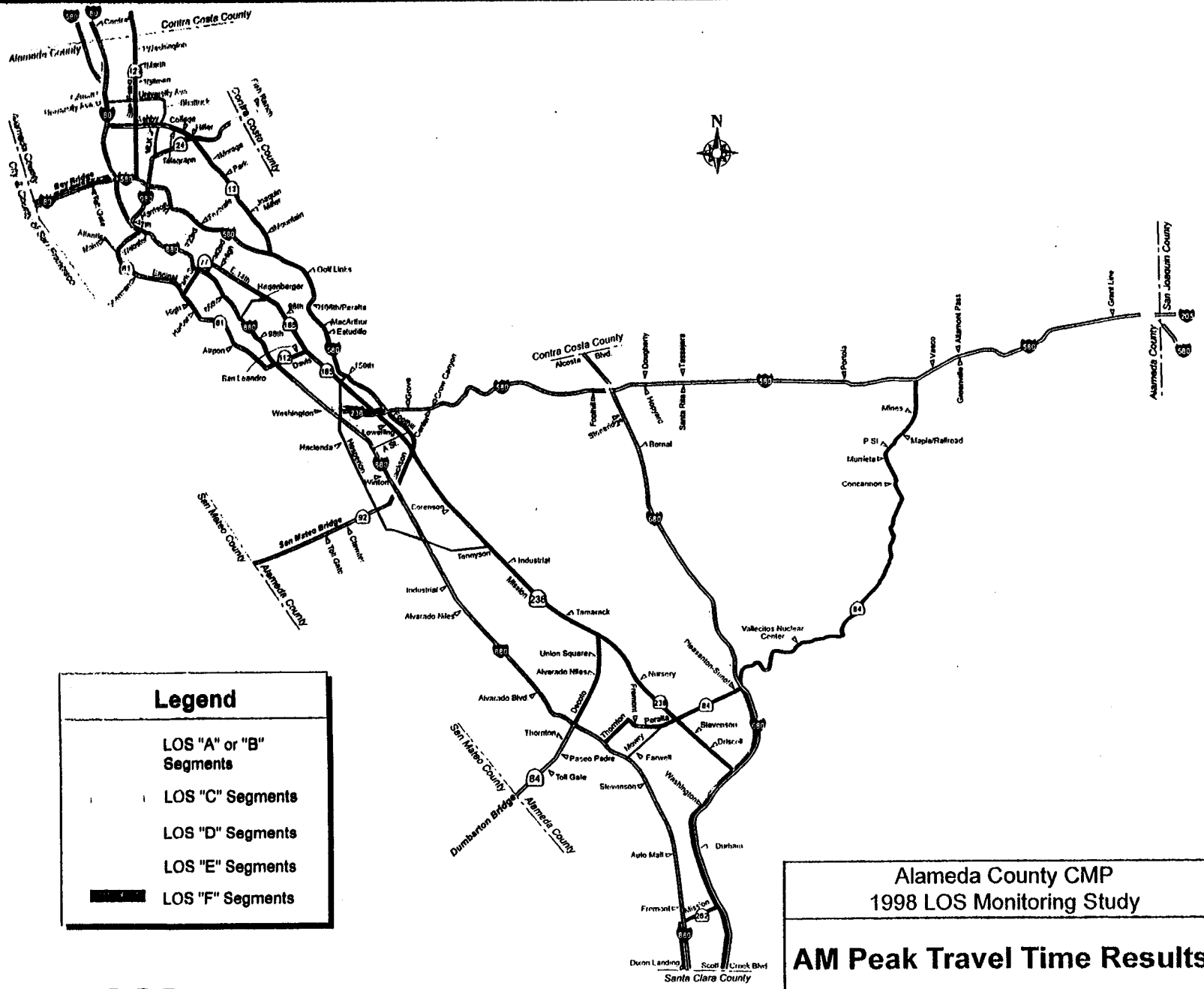
A.M. PEAK PERIOD RESULTS

The A.M. peak period was first surveyed in 1994, and then again in 1996 and 1997. T A.M. peak data was collected only for selected segments that were considered to b most critical freeway segments during the morning commute peak hours. The stu methodology was the same as for the P.M. studies. Approximately 58 miles of the network, comprising 22 distinct segments, were studied to determine the A.M. peak le service.

The results of the A.M. studies are not used to determine CMP conformity findings, bu to provide supplemental information for use by the CMA, and for use in the Countyw traffic model. The results of the A.M. surveys are shown in Figure 7 and are included Appendix on page A-12.

There are five segments (out of 22 studied) that were found to be at LOS "F" durin A.M. peak surveys. These are listed on Table 8 and shown in Figures 2 and 7. All of segments were previously identified as LOS "F" in previous surveys (I-80 WB v measured for the first time in 1997).

Three segments which were LOS "F" in 1997 were surveyed at improved levels of servic 1998. Surveys on westbound I-80 from Central to I-580 indicated average speeds mph. or more. This improvement may be due to the completion of construction an opening of the new HOV flyover ramp to the Bay Bridge. Southbound I-880 from A Stree SR 92 improved to LOS "B", although follow-up surveys were more representative of "E" or "F" conditions. This indicates instability in the day to day flow patterns, and indicate the influence of the recently implemented ramp metering system in the corridor.



Alameda County CMP
1998 LOS Monitoring Study

AM Peak Travel Time Results

Figure 7

CCS PLANNING AND ENGINEERING INCORPORATED

c:\project\1998\98012\r2\fig7.fh5

Table 8
Level of Service "F" Segments, A.M. Peak Period

	CMP Route	From:	To:	Facility Type	Length (miles)	1997	1998	Grandfathered in 1991	Comments
1.	I-80 WB (Oakland)	I-580 Split	Toll Plaza	Freeway	1.20	F 10.0	F 5.6	n/a	Completion of I-880 Cypress may supply additional traffic volume.
2.	I-80 WB (Oakland)	Toll Plaza	S.F. County Line	Freeway	2.00	F 16.9	F 17.2	n/a	
3.	I-238 WB (Unincorp)	I-580	I-880	Freeway	1.70	F 20.5	F 20.6	n/a	
4.	I-880 SB (Uninc.)	Mission	Dixon Landing	Freeway	1.27	F 13.5	F 9.6	n/a	HOV lane will open in near future.
5.	I-680 SB (Uninc.)	SR 84 Niles Canyon	SR 238 Mission	Freeway	4.60	F 18.6	F 12.9	n/a	Average speeds decreased by 30 percent.

SECTION 4

Travel Time Studies of Origin-Destination Pairs

This section describes travel time surveys between selected origin and destination (O-D) points. The purpose of these studies is to evaluate the comparative performance of various transportation modes for the Annual Performance Report required by the CMP. These surveys provide insight into journey-to-work travel times between major employment centers and residential areas in Alameda County. Both auto and transit trips were surveyed for nine O-D Pairs, eight during the P.M. peak period and one during the A.M. peak period. In addition, bicycle travel times were recorded for one origin-destination pair between Emeryville and Berkeley. To supplement the nine O-D pairs, Alameda County CMA staff and Alameda County Technical Advisory Committee (ACTAC) members provided information on their commute trips.

ORIGIN-DESTINATION PAIRS

Nine origin-destination (O-D) pairs have been selected by the CMA Board and by ACTAC to simulate typical commute trips on the County's major travel corridors. The first five pairs have also been surveyed in 1996 and 1997, while the last four were surveyed for the first time in 1998. These O-D pairs and the specific routes that were followed are listed in Table 9.

A tenth O-D pair will be added in future survey years, and will measure the effectiveness of new HOV lanes on I-880 through the Fremont area, as well as any new express transit services which are introduced between Alameda and Santa Clara counties.

Table 9
Origin-Destination Pairs

O-D Pair	Peak Period	Origin	Destination	Transit/Bus Route	Highway Travel
1	P.M.	**Hayward** Kaiser Med. Ctr, 27400 Hesperian	**Newark** Residence near Lafayette St. at Newark Blvd.	Walk to Hesperian, AC 97 to AC 29 at Union City BART Stn., to Newark/Lafayette, walk to door.	Walk to parking; Hesperian to Union City Blvd., to Newark Blvd., to Lafayette St.; park and walk to door.
2	P.M.	**Emeryville** Chiron, 4560 Horton St. nr. 53rd & Hollis	**Berkeley** Residence near Marin Circle at Los Angeles Ave.	Walk to 53rd and San Pablo, AC 72 to AC 43 at Solano Way, exit at Marin Circle, walk to door.	Walk to parking; 53rd St. to San Pablo, to Hopkins, to Marin Circle; park and wlak to door.
3	P.M.	**Hayward** Cal State University at Carlos Bee Ave.	**Livermore** Residence near Portola and North Livermore Ave.	Walk to AC 92, to Hayward BART, BART to Dub/Pleas Stn., Wheels 12X to Portola & N. Murietta (Wheels 10 to Wheels 15 in 1998), walk to Portola and N. Livermore.	Walk to parking; Carlos Bee to Mission, to "A"/Redwood, to I-580, to Portola exit, to N. Livermore Ave.; park and walk to door.
4	P.M.	**Oakland** 1333 Broadway office building	**San Leandro** Residence near Manor St. and Chapel Ave.	Walk to BART 12th St., BART to San Leandro Stn., to AC 84, walk to door.	Walk to parking; local streets to I-880, to Marina, to Chapel; park and walk to door.
5	P.M.	**Fremont** NUMMI Plant 45500 Fremont Blvd.	**Pleasanton** Residence near Valley Ave. and Greenwood Rd.	Walk to AC 22 to Fremont BART, BART to Dub/Pleas Stn., Wheels 8 (10 in 1998) to Greenwood and Valley, walk to door.	Walk to parking; Fremont Blvd. to Durham, to I-680, to Sunol Blvd., to Greenwood; park and walk to door.

Table 9 (continued)
Origin-Destination Pairs

O-D Pair	Peak Period	Origin	Destination	Transit/Bus Route	Highway Travel
6	A.M.	Fremont	San Jose	Future Transit Service	Future HOV Lane
7	A.M.	**Fremont** Residence near Thornton Ave. at Fremont Blvd.	**San Jose** Hitachi, 201 Tasman at Zanker	Walk to AC 27, transfer to AC 28 at Fremont BART, transfer to SCVTA 20 in Milpitas, walk to door.	From residential driveway to Thornton, to I-880, to SR 237, to Zanker; park and walk to door.
8	P.M.	**Oakland** Federal Bldg., Jefferson at 14th	**Pleasanton** Residence near Hopyard Rd. and Valley Ave.	Walk to BART 12th St., BART to Dub/Pleas Stn., Wheels 8, walk to door.	Walk to parking; local streets to I-880 to I-238 to I-580, to Hopyard to Valley; park.and walk to door.
9	P.M.	**Fremont** Washington Hospital at Mowry Ave.	**Alameda** Bay Farm Island, Residence near Searidge at Robert Davey	Walk to Fremont BART, BART to Coliseum, AC 49 to Alameda, walk to door.	Walk to parking; Mowry to I-880, to Hegenberger, to Doolittle, to Island; park and walk to door.
10	P.M.	**Alameda** Naval Air Station, Atlantic at Main	**Oakland** Business near College Ave. at Lawton	AC 10 to BART 12th St., BART to Rockridge, walk to door.	Walk to parking; Atlantic to Webster, to I-880, to I-980, to SR 24, Claremont exit to Clifton, to Lawton, to College; park and walk to door.

SURVEY METHODOLOGY

Surveyors either drove or took transit between the designated origin and destinati ir documenting their travel times and identifying any anomalies which they encountered r the course of their trip (i.e., traffic accidents). Whenever possible, the auto and transit started on the same day at the same time. Surveys were conducted on mid-week (Tuesday through Thursday) during the period from May 12th through May 21st. routes were surveyed on two different days. The data for O-D Pairs 1-5 and 8-10 w collected during the P.M. peak period (4:00 to 6:00 P.M.), while O-D Pair 7 was sur between 7:00 and 9:00 A.M. (O-D Pair 6 was not surveyed this year).

Selected travel time data were recorded for each trip. Table 10 lists the trip compor which were noted for each type of trip.

Table 10
Time Components of Origin-Destination Surveys

Auto Trip	Transit Trip
• Start time at origin door (walk)	• Start time at origin door (walk)
• Auto departs parking	• Arrive at first transit stop
• Merge onto 1st freeway	• Board 1st bus/rail
	• Exit 1st bus/rail
• Merge onto 2nd freeway	• Board 2nd bus/rail
	• Exit 2nd bus/rail
• Exit from freeway	• Board 3rd bus/rail
• Arrive at parking	• Exit 3rd bus/rail
• Arrive at destination door (walk)	• Arrive at destination door (walk)

For the analysis of transit trip data, no more than half of a route's scheduled headway used as the initial waiting time. The actual waiting time was used for all other tra transfers.

The Emeryville-Berkeley O-D Pair 2 was also surveyed by bicycle. Two travel time stu were conducted on this route, one each by two different riders. These data were collected between 4:00 and 6:00 P.M., on a day with good weather, and no incidents accidents affecting traffic flow. The times do not include parking the bicycle, walking to final destination, or changing clothes at the work site.

ORIGIN-DESTINATION SURVEY RESULTS

Table 11 lists the results of the 1998 origin-destination surveys, and also includes a comparison with the 1996 and 1997 surveys for the first five O-D pairs.

Auto Times

The 1998 auto travel times for the first five O-D pairs are generally consistent with the surveys from previous years.

The auto travel time on O-D Pair 1 from Hayward to Newark has increased each year, possibly due to increased congestion on southbound Hesperian Boulevard or Newark Boulevard.

The auto travel time on O-D Pair 2, Emeryville-Berkeley, was highly variable. Based on the segment surveys, this is most likely due to varying congestion conditions on northbound San Pablo Avenue approaching University Avenue in Berkeley.

The auto travel times were also highly variable on the four new O-D pairs. Each of these O-D pairs traverses a highly congested freeway segment, including I-880 south to SR 237 in Fremont and Milpitas (O-D Pair 7), I-580 eastbound east of I-680 in Pleasanton (O-D Pair 8), I-880 southbound from downtown Oakland (O-D Pair 9) and I-880 northbound through Fremont and Hayward (O-D Pair 10). The high congestion levels on these freeway segments can result in widely varying speeds influenced by even minor incidents.

Transit Times

The 1998 transit travel times on the original five O-D pairs were significantly higher than the travel times in previous years. The most significant components of transit travel time were excessive wait times at transfer locations. Observations about each O-D pair are listed below.

O-D Pair 1. The transfer wait between AC Transit Lines 97 and 29 ranged from 17 to 30 minutes. Survey personnel waited for a second AC Transit bus to the destination (Line 27) rather than walking from the Line 29 stop; the times in Table 11 assume a 12 minute walk time for the 0.6 mile distance for consistency with prior years.

O-D Pair 2. Run 1 was not included in the average due to an unreasonable initial wait time for AC Transit Line 72 of 39 minutes. Transfer wait time to AC Transit Line 43 ranged from 1 to 17 minutes. Trips include about 6 minutes walk at origin and 8 minutes at destination.

O-D Pair 3. Surveyors used Wheels Lines 10 and 15 rather than 12X used in prior surveys in order to achieve shorter walk to destination (using the 12X involves a 0.75 mile walk, or about 15 minutes). Therefore, results are not consistent with prior years. No excessive wait times or transfer times during survey.

Table 11
Origin-Destination Pair Travel Times

O-D Pair	Origin	Destination	Mode	Driving Distance	1996 Average (minutes)	1997 Average (minutes)	1998 Average (minutes)	1998 No. of Runs	1998 Range of Times	1998 Percent Variation
1	Hayward	Newark	Auto	11.2 mi	19	20	24	3	22-26	17%
P.M.			Transit		68	80	88*	2	84-92	9%
2	Emeryville	Berkeley	Auto	4.8 mi	23	25	25	4	20-35	60%
P.M.			Transit		48	54	61*	3	59-98	64%
			Bike		34	30	33	2	32-34	6%
3	Hayward	Livermore	Auto	34.5 mi	54	51	53	4	48-56	15%
P.M.			Transit		142	102	144	2	143-145	1%
4	Oakland	San Leandro	Auto	10.8 mi	38	34	35	4	32-38	16%
P.M.			Transit		46	48	74	2	72-75	4%
5	Fremont	Pleasanton	Auto	18.0 mi	34	38	31	4	30-32	5%
P.M.			Transit		115	105	130	1	130	--
7	Fremont	San Jose	Auto	n/a	--	--	39	5	34-46	30%
A.M.			Transit		--	--	129*	2	129-184	35%
8	Oakland	Pleasanton	Auto	n/a	--	--	58	5	50-74	40%
P.M.			Transit		--	--	81	3	73-92	23%
9	Fremont	Alameda	Auto	n/a	--	--	50	5	39-58	37%
P.M.			Transit		--	--	86	2	86-86	0%
10	Alameda	Oakland	Auto	n/a	--	--	21	6	15-25	44%
P.M.			Transit		--	--	51	4	37-63	53%

* Average transit time adjusted to eliminate unrepresentative wait times. See discussion in text.

O-D Pair 4. Travel times included 4 to 7 minute walk at origin, 9 to 12 minute wait for BART, 15 minute BART ride, 8 to 11 minute wait for AC Line 84, and 30 minute ride on AC Transit Line 84. Surveyors in prior years may have exited the bus earlier and walked a further distance to the destination in order to achieve a shorter overall travel time.

O-D Pair 5. Travel time includes 11 minute walk and wait at origin, 14 minute wait for BART transfer, and 13 minute transfer wait for Wheels Line 10. Only one survey run was completed in 1998.

O-D Pair 7. Initial waits for AC Transit Line 27 were about 23 minutes (reduced to 15 minutes for average based on 30 minute peak headway). Run 1 included a 56 minute transfer wait for the AC Transit Line 28 at the Fremont BART station, which should be atypical (Run 2 included only a 2 minute wait; Run 1 reduced to 15 minutes for average). The transfer wait time to SCVTA Line 20 was 13 to 15 minutes.

O-D Pair 8. There were no particularly excessive times on any runs. Run 3 involved longer wait times for both BART trains (12 minutes and 13 minutes) than the other two runs.

O-D Pair 9. These runs included an 11 to 16 minute walk to BART, and a 27 to 33 minute ride on AC Transit Line 49. Wait and transfer times were not excessive.

O-D Pair 10. The largest variations were in the initial wait time for AC Transit Line 10 (7 to 17 minutes) and the wait time for BART (1 to 15 minutes).

Bicycle Times

The bicycle times between Emeryville and Berkeley were consistent with previous years. One rider used side streets, including designated bicycle routes, while the other rider used the surveyed auto route along San Pablo Avenue. Compared to autos, a bicycle can bypass much of the most significant congestion along a street such as San Pablo Avenue.

Comparison of Travel Modes

The transit travel times on most of the surveyed origin-destination pairs were over double the auto times. As noted above, most of the transit delay is associated with transfers between lines. This is particularly an issue when the passenger must transfer to a bus line which does not operate at frequent intervals. Actual commuters who regularly use transit are more likely to time their trips to match known bus transfer schedules, and will probably have lower average travel times than these surveys indicate.

The transit travel time on the Oakland to Pleasanton trip (O-D Pair 8) was only 40 percent higher than auto, and the transit time on the Fremont to Alameda trip (O-D Pair 9) was about 70 percent higher than auto. On these corridors, BART service can be used to bypass congested freeway corridors, resulting in competitive transit times despite the additional times involved in bus transfers.

The bicycle travel time is very competitive on the Emeryville to Berkeley trip (O-D Pair 2). Bicycle commute trips may involve some additional time to deal with bicycle storage and changing clothes, which can add about 5 to 10 minutes to the total commute time.

SUPPLEMENTAL COMMUTE TRAVEL TIME SURVEYS

In order to supplement the O-D survey work, eight Alameda County CMA staff and Alamec County Technical Advisory Committee (ACTAC) members volunteered to collect O-D a representing their typical commute between home and work during both the A.M. and I peak periods. The results of these surveys are shown in Table 12.

Commute distances ranged from 6 miles to 39 miles. Three of the eight commuters c lived and worked in Alameda County (pairs 1, 2, and 3). Their auto travel times rang from 22 minutes to 27 minutes. The remaining five commuters live outside Alameda Cc r and the auto travel times ranged from 26 minutes to 58 minutes. One commute trip (p was made by carpool and single occupant vehicle. Using the carpool lane resulted in a r savings of three minutes in the A.M. peak hour and five minutes in the P.M. peak hour. T those who recorded travel times for both transit and auto (pair 1 and pair 3), transit t times appeared to be relatively competitive with the auto.

Only two pairs can be compared directly to last year's commute surveys (pair 2 and pa Both pairs were made by auto and experienced an increase in travel time between 19 and 1998, particularly during the P.M. peak period.

Table 12
Supplemental Origin-Destination Pair Travel Times
Alameda County CMA Staff and ACTAC Members

O-D Pair	Time	Origin	Destination	Mode	Driving Distance (miles)	1997 Average Time (minutes)	1998			
							Average Time (minutes)	No. of Runs	Range of Times	Percent Variation
1	A.M.	Fremont	Hayward City Hall	Auto	11	n/a	24	6	22-26	17%
				Auto/BART		n/a	30	3	23-35	40%
				Walk/BART		n/a	26	2	23-28	19%
1	P.M.	Hayward City Hall	Fremont	Auto	11	n/a	26	6	21-31	38%
				Auto/BART		n/a	30	2	28-32	13%
				Walk/BART		n/a	42	1	0	0%
2	A.M.	Albany	Downtown Oakland	Auto	8	22	27	8	24-35	41%
2	P.M.[1]	Downtown Oakland	Albany	Auto	8	19	24	6	19-32	54%
3	A.M.	East Oakland	Downtown Oakland	Auto	6	n/a	23	3	20-29	39%
				Walk/Bus		n/a	32	6	28-37	28%
3	P.M.	Downtown Oakland	East Oakland	Auto	6	n/a	22	1	0	0%
				Walk/Bus		n/a	33	1	0	0%
4	A.M.	Kentfield	Port of Oakland	Auto	25	n/a	41 (44%)[2]	8	37-45	20%
4	P.M.	Port of Oakland	Kentfield	Auto	25	n/a	50 (50%)[2]	8	46-58	24%
5	A.M.	San Francisco/ Van Ness	Alameda	Walk/Bus/BART/ Carpool	16	n/a	58	6	56-61	9%
				Bike/BART		n/a	50	1	0	0%
5	P.M.	Alameda	San Francisco/ Van Ness	Carpool/BART/ Bus/Walk		n/a	56	3	52-60	14%
6	A.M.[3]	Novato	Oakland	Auto	n/a	n/a	41	8	40-45	12%
6	P.M.[3]	Oakland	Novato	Auto		n/a	58	6	50-65	26%

Table 12 (continued)
Supplemental Origin-Destination Pair Travel Times
Alameda County CMA Staff and ACTAC Members

O-D Pair	Time	Origin	Destination	Mode	Driving Distance (miles)	1997 Average Time (minutes)	1998			
							Average Time (minutes)	No. of Runs	Range of Times	Percent Variation
7	A.M.	Sunnyvale	San Leandro City Hall	Auto	39	n/a	48	7	44-53	19%
				Carpool		n/a	45	5	44-48	9%
7	P.M.	San Leandro City Hall	Sunnyvale	Auto		n/a	57	4	50-61	19%
				Carpool		n/a	52	3	49-55	12%
8	A.M.	Orinda	Downtown Oakland	Auto	10	25	26	4	24-28	15%
8	P.M.	Downtown Oakland	Orinda	Auto		27	33	5	26-50	73%
9	A.M.	Martinez	Downtown Oakland	BART	24	52	n/a	n/a	n/a	n/a
9	P.M.	Downtown Oakland	Martinez	BART		87	n/a	n/a	n/a	n/a
10	A.M.	Richmond	Lake Merritt	n/a		n/a	n/a	n/a	n/a	n/a
10	P.M.	Lake Merritt	Richmond	BART		54	n/a	n/a	n/a	n/a
11	A.M.	El Cerrito	Downtown Oakland	BART		29	n/a	n/a	n/a	n/a
				Bike		50	n/a	n/a	n/a	n/a
11	P.M.	Downtown Oakland	El Cerrito	n/a		n/a	n/a	n/a	n/a	n/a

Notes:
1. Travel time for the P.M. trip begins at garage exit after fee has been paid.
2. Percent indicates what portion of the average travel time takes place in Alameda County.
3. A.M. trip starts at approximately 6:05 A.M. and P.M. trip starts at approximately 3:45 P.M..
4. A.M. trip starts at approximately 6:30 A.M..

SECTION 5

Monitoring Program Results

This section summarizes observations about traffic conditions on Alameda County freeways and CMP designated arterials. Overall miles of congestion have declined because of the implementation of new infrastructure and operational improvements (e.g., I-80 flyover to the Bay Bridge, ramp metering, signal coordination). However, congestion on specific segments has increased, potentially requiring deficiency plans for the first time since the LOS monitoring program was established in 1991. These deficiencies were anticipated and improvements to address the deficient segments are already under development as described below.

DEFICIENT SEGMENTS

Of the 18 LOS F segments described in Table 3 (page 3-4), nine are exempt from deficiency plan requirements because they were grandfathered in from the 1991 LOS surveys, four are exempt because of statutory requirements (e.g., interregional traffic, construction activity), and five may require deficiency plans. A final determination of the need for a deficiency plan is still being made, but each of the deficient areas has an improvement underway or identified as part of previous planning efforts:

- Two of the five segments potentially requiring deficiency plans are in Berkeley, on University Avenue westbound between San Pablo Avenue and 6th Street and on San Pablo Avenue northbound between Allston Way and University Avenue. Both segments have improvements identified as part of the San Pablo Avenue Corridor Study.

- The third segment potentially requiring a deficiency plan is from the SR 260 Posey Tube to I-880 northbound, a special state-route-to-freeway connection that uses City of Oakland streets. Improvements for this segment have been identified in the I-880/Broadway/Jackson Interchange Study. Funding for the Project Study Report (PSR) is included in the 1998 STIP. The ACCMA will be reviewing the technical assumptions for this ramp at the request of the City of Oakland.

- The fourth segment is on I-580 eastbound between I-680 and Santa Rita R segment may be improved as a result of the I-580/I-680 interchange construct

- The fifth segment is the freeway-to-freeway ramp connector from I-880 northbound t 238 eastbound. The interim I-238 widening may improve operations on this ramp PSR for the I-238 widening has been approved by Caltrans and preliminary engin is underway. There is funding in the 1998 STIP for construction of the improvements

The freeway-to-freeway ramp from I-880 northbound to I-238 eastbound has been re at LOS F in previous monitoring studies, and therefore it was not included in the list of segments which were LOS F for the first time in 1998 (Summary, page S-2 and Ta page 3-4). However, a deficiency plan was not required for this ramp in prior years considerations such as construction activity and interregional traffic.

OBSERVATIONS IN GENERAL LOS TRENDS

Growth in Alameda County is expected to continue. The recent 1998 Commute P published by RIDES shows an increase in the number of commuters driving alone ar decrease in the number of commuters carpooling and taking transit. This indicates a for continued monitoring and incentives to use alternative modes, such as fir incentives and guaranteed ride home coupled with capital improvements to address fu needs.

APPENDIX

Freeway Segments - PM Peak

CMP Route	Segment Limits From:	To:	Jurisdiction	Plan Area	Length (miles)	No of Lanes	1994 ADT	Prior LOS "F" 91	92	93	94	95	96	97	1997 Results Speed	LOS	1998 Results Speed	LOS
I-80 - EB	SF County Line	Toll Gate Outlet	Oak	1	2.06	10	250,000								35.2	E	49.7	C
I-80 - EB	Toll Gate Outlet	I-580 SB Merge	Oak	1	1.15	10	250,000			•	•	•	•	•	20.4	•(F)•	21.4	•(F)•
I-80 - EB	I-580/80 Merge	University	Emery - Berk	1	2.80	10	239,000	•	•	•	•	•		•	24.0	•(F)•	14.8	•(F)•
I-80 - EB	University	Central	Berk - Alb	1	2.40	10	232,000	•	•				•	•	29.4	•(F)•	34.0	E
I-80 - WB	Central	University	Alb - Berk	1	2.48	10	232,000								30.3	E	60.8	A
I-80 - WB	University	I-580 Split	Berk - Emery	1	2.43	10	239,000	•	•		•	•	•	•	14.7	•(F)•	23.0	•(F)•
I-80 - WB	I-580 Split	Toll Plaza	Oak	1	1.20	10	250,000	•	•	•				•	25.7	•(F)•	16.6	•(F)•
I-80 - WB	Toll Plaza	SF County	Oak	1	2.00	10	250,000					•			32.1	E	42.8	D
I-238 - EB	I-880	I-580	Uninc-San L	2	2.28	6	135,000	•	•		•		•	•	28.0	•(F)•	42.3	D
I-238 - WB	I-580	I-880	Uninc-San L	2	1.60	6	135,000							•	23.7	•(F)•	29.1	•(F)•
I-580 - EB	I-238/Fthl Off	Grove	Unincorp	2	2.88	8	127,000								51.8	C	62.8	A
I-580 - EB	Grove	I-680	Uninc - Plea	4	7.74	8	135,000								59.2	B	43.1	D
I-580 - EB	I-680	Santa Rita	Plea	4	2.73	8	140,000								34.8	E	15.9	•(F)•
I-580 - EB	Santa Rita	Portola	Unincorp	4	4.47	8	122,000								53.5	C	42.8	D
I-580 - EB	Portola	SH 84/1st	Liv	4	2.70	8	115,000								---	A	70.9	A
I-580 - EB	SH 84/1st	I-205 (SJ Co) Off	Liv - Uninc	4	9.81	8	97,000								---	A	---	A
I-580 - WB	I-205 (SJ Co)	SH 84/1st St	Uninc - Liv	4	10.00	8	97,000								---	A	---	A
I-580 - WB	SH 84/1st St	Portola Ave	Liv	4	2.52	8	115,000								---	A	71.5	A
I-580 - WB	Portola Ave	Tassajara Rd	Unincorp	4	4.71	8	122,000								58.0	B	67.2	A
I-580 - WB	Tassajara Rd	I-680	Plea	4	2.87	8	140,000								56.3	B	57.7	B
I-580 - WB	I-680	Center	Plea - Uninc	4	8.07	8	135,000								57.5	B	59.8	B
I-580 - WB	Center	I-580/238	Unincorp	2	1.94	8	127,000								49.7	C	51.6	C
I-580 - SB	I-80	Harrison	Oak	1	2.67	8	200,000	•	•						39.9	E	63.4	A
I-580 - SB	Harrison	SH 13 Off	Oak	1	5.09	8	190,000								59.2	B	51.2	C
I-580 - SB	SH 13 Off	MacArthur	Oak - SL	1	4.09	8	130,000								56.4	B	65.4	A
I-580 - SB	MacArthur	I-580/238	SL - Hay	2	4.33	8	124,000								58.0	B	64.9	A
I-580 - NB	I-238	Estudillo	Hay - SL	2	3.95	8	124,000								56.5	B	70.5	A
I-580 - NB	Estudillo	SH 13 Off	SL - Oak	1	4.39	8	130,000								60.0	A	61.2	A
I-580 - NB	SH 13 Off	Fruitvale	Oak	1	2.87	8	190,000								61.7	A	68.2	A
I-580 - NB	Fruitvale	Harrison	Oak	1	2.22	8	195,000								51.7	C	50.0	C
I-580 - NB	Harrison	SH 24 On-ramp	Oak	1	1.16	8	200,000								51.8	C	60.4	A
I-580 - NB	SH-24 On-ramp	I-80/580 Split	Oak	1	0.69	8	250,000								34.0	E	41.3	D

1998 Level of Service Results

Freeway Segments - PM Peak

CMP Route	Segment Limits From:	To:	Jurisdiction	Plan Area	Length (miles)	No of Lanes	1994 ADT	Prior LOS "F" 91	92	93	94	95	96	97	1997 Results Speed	LOS	1998 Results Speed	LOS
I-580 - WB	Central	I-80 Jct	Alb	1	0.77	4	77,000								49.2	C	47.7	D
I-580 - EB	I-80 Jct	Central	Alb	1	1.07	4	77,000								50.3	C	56.7	B
I-680 - NB	Scott Creek	SR 238	Fre	3	5.98	6	108,000								38.6	E	33.5	E
I-680 - NB	SR 238	SR 84	Unincorp	3	5.13	6	98,000								54.5	C	58.3	B
I-680 - NB	SR 84	Bernal Ave	Uninc - Plea	4	4.97	6	87,000								55.7	B	67.0	A
I-680 - NB	Bernal Ave	I-580	Plea	4	3.22	6	92,000								55.6	B	62.3	A
I-680 - NB	I-580	Alcosta	Dub	4	1.83	6	115,000								55.2	B	69.1	A
I-680 - SB	Alcosta	I-580	Dub	4	1.84	6	115,000								53.2	C	67.8	A
I-680 - SB	I-580	Bernal	Plea	4	3.30	6	92,000								56.7	B	70.0	A
I-680 - SB	Bernal	SR 84	Unincorp	4	5.12	6	87,000								62.4	A	71.1	A
I-680 - SB	SR 84	SR 238	Unincorp	3	4.60	6	98,000								55.5	B	60.8	A
I-680 - SB	SR 238	Scott Creek	Fre	3	6.41	6	108,000								52.5	C	66.8	A
I-880 - NB	Dix Landing	SR 262/Mission	Fre	3	2.08	8	120,000	•	•						39.4	E	32.9	E
I-880 - NB	SR 262/Mission	Stevenson	Fre	3	3.98	8	116,000						•		40.1	E	33.5	E
I-880 - NB	Stevenson	Decoto	Fre	3	4.04	8	146,000						•	•	23.8	•(F)•	28.1	•(F)•
I-880 - NB	Decoto	Alv-Niles	Fre - Un Cty	3	2.68	8	140,000								36.0	E	36.3	E
I-880 - NB	Alv-Niles	Tennyson	Un Cty - Hay	3	2.66	8	160,000								46.9	D	29.9	D
I-880 - NB	Tennyson	SR 92	Hay	2	1.14	8	166,000	•	•						50.8	C	39.8	E
I-880 - NB	SR 92	A St	Hay	2	1.52	8	210,000	•	•						48.3	D	35.1	E
I-880 - NB	A St	I-238	Unincorp	2	1.82	8	191,000				•	•			39.8	E	34.6	E
I-880 - NB	I-238	Hegenberger	SL - Oak	2	5.33	8	167,000								58.7	B	61.1	A
I-880 - NB	Hegenberger	High/42nd	Oak	1	2.47	8	168,000								50.9	C	60.3	A
I-880 - NB	High/42nd	I-980	Oak	1	3.70	8	161,000								39.5	E	45.5	D
I-880 - SB	I-980	23rd	Oak	1	2.78	8	165,000								35.5	E	41.2	D
I-880 - SB	23rd St	High/42nd	Oak	1	1.34	8	162,000								47.9	D	50.6	C
I-880 - SB	High/42nd	Hegenberger	Oak	1	2.27	8	168,000								37.1	E	56.4	B
I-880 - SB	Hegenberger	I-238	Oak - SL	1	4.98	8	167,000	•	•						44.8	D	56.9	B
I-880 - SB	I-238	A St	Unin - Hay	2	2.03	8	191,000	•	•						40.7	E	61.5	A
I-880 - SB	A St	Rt 92	Hay	2	1.81	8	210,000								42.8	D	56.8	B
I-880 - SB	Rt 92	Tennyson	Hay	2	0.96	8	166,000								40.1	E	41.4	D
I-880 - SB	Tennyson	Alv-Niles	Hay - UC	2	2.59	8	160,000								42.9	D	45.1	D
I-880 - SB	Alv-Niles	Decoto	UC - Fre	3	[illegible]	8	140,000								43.8	D	33.[illegible]	E
I-880 - SB	Decoto	Stevenson	Fre	3	[illegible]	8	146,000								49.7	C	51.[illegible]	C
[illegible]0 - SB	[illegible]ison	SR [illegible] lissic			4	8	16,00[illegible]								48.7	D		

Freeway Segments - PM Peak

CMP Route	Segment Limits From:	To:	Jurisdiction	Plan Area	Length (miles)	No of Lanes	1994 ADT	Prior LOS "F" 91	92	93	94	95	96	97	1997 Results Speed	LOS	1998 Results Speed	LOS
I-980 - WB	SR 24 @ 580	I-880	Oak	1	2.27	8	167,000								41.3	D	46.1	D
I-980 - EB	I-880	SR 24 @ 580	Oak	1	2.33	8	167,000	•							37.4	E	30.5	E
SR 13 - NB	Mountain On	Joa Miller/Linc	Oak	1	2.09	4	44,000								45.9	D	60.1	A
SR 13 - NB	Joa Miller/Linc	Moraga Ave	Oak	1	1.77	4	51,000								45.7	D	57.9	B
SR 13 - NB	Moraga Ave	Hiller (Sig)	Oak	1	1.56	4	58,000								38.5	E	41.9	D
SR 13 - SB	Hiller Sig	Moraga Ave	Oak	1	1.66	4	58,000								47.1	D	48.4	D
SR 13 - SB	Moraga Ave	Joa Miller/Linc	Oak	1	2.03	4	51,000								59.4	B	71.0	A
SR 13 - SB	Joa Miller/Linc	I-580 Ramp	Oak	1	1.74	4	44,000								60.7	A	60.4	A
SR 24 - EB	I-580 On-ramp	Fish Ranch	Oak	1	4.52	8	147,000	•	•	•	•	•	•	•	29.5	•(F)•	38.9	E
SR 24 - WB	Fish Ranch	I-580 Off-ramp	Oak	1	4.47	8	147,000								48.3	D	59.5	B
SR 84 - EB	San M CL	Toll Gate Outlet	Uninc - Hay	2	3.17	6	50,000								56.6	B	59.4	B
SR 84 - EB	Toll Gate Outlet	Thornton	Uninc - Hay	2	0.65	6	50,000								51.8	C	37.7	E
SR 84 - EB	Thornton	I-880	Newark	3	2.21	6	46,000								41.2	D	33.9	E
SR 84 - WB	I-880	Toll Gate	Newark	3	2.89	6	50,000								46.3	D	54.8	C
SR 84 - WB	Toll Gate	San M CL	Uninc - Hay	2	3.17	6	50,000								55.9	B	62.0	A
SR 92 - EB	San M CL	Toll Gate Outlet	Uninc - Hay	2	2.61	6	72,000							•	22.7	•(F)•	9.7	•(F)•
SR 92 - EB	Toll Gate Outlet	Clawiter	Uninc - Hay	2	1.76	6	72,000	•	•	•	•		•	•	25.6	•(F)•	23.7	•(F)•
SR 92 - EB	Clawiter	I-880	Hay	2	2.10	6	83,000	•	•		•	•		•	21.9	•(F)•	28.7	•(F)•
SR 92 - WB	I-880	Clawiter	Hay	2	2.01	6	83,000								49.3	C	53.9	C
SR 92 - WB	Clawiter	Toll Gate	Uninc - Hay	2	1.87	6	72,000	•	•						44.7	D	40.6	E
SR 92 - WB	Toll Gate	San M CL	Uninc - Hay	2	2.61	6	72,000								48.0	D	49.3	C

1998 Level of Service Results

Arterial Segments - PM Peak Hour

CMP Route	Segment Limits From:	To:	Jurisdiction	Length (miles)	Arterial Class	Plan Area	No of Lanes	Prior LOS "F" 91	92	93	94	95	96	97	1997 Results Speed	LOS	1998 Results Speed	LOS
150th St - EB	Hesperian	I-580	SL	0.49	II	2	2								12.4	E	18.8	C
150th St - WB	I-580	Hesperian	SL	0.49	II	2	2								17.6	D	12.5	E
A Street - EB	I-880	Western	Hay	1.08	II	2	2								29.2	B	28.3	B
A Street - EB	Western	SR 238	Hay	0.53	III	2	2								7.1	E	13.3	C
A Street - WB	SR 238	Western	Hay	0.53	III	2	2								14.0	C	19.9	B
A Street - WB	Western	I-880	Hay	1.08	II	2	2								18.6	C	21.8	C
Atlantic - EB	Main	Webster	Ala	0.80	II	1	2								29.8	B	19.5	C
Atlantic - WB	Webster	Main	Ala	0.80	II	1	2								28.9	B	25.0	B
Hegenberger - EB	Edgewater	Baldwin	Oak	0.71	I	1	3								26.1	C	21.1	D
Hegenberger - EB	Baldwin	E 14th	Oak	1.09	I	1	3								16.8	E	29.1	B
Hegenberger - WB	E 14th	Baldwin	Oak	1.09	I	1	3								15.4	E	34.8	B
Hegenberger - WB	Baldwin	Edgewater	Oak	0.71	I	1	3								31.6	B	17.3	D
Hesperian - NB	Tennyson	SH 92 - WB	Hay	0.36	I	2	3								15.1	E	17.3	D
Hesperian - NB	SH 92	A St	Hay	2.19	II	2	3		•						18.9	C	22.4	C
Hesperian - NB	A St	Hacienda	Unin	0.65	II	2	2								18.5	C	18.6	C
Hesperian - NB	Hacienda	Grant	Unin	0.66	II	2	2								23.5	C	22.6	C
Hesperian - NB	Grant	Llewelling	Unin	0.28	II	2	2								15.8	D	17.3	D
Hesperian - NB	Llewelling	Springlake	Unin	0.40	II	2	2								15.8	D	17.3	D
Hesperian - NB	Springlake	Fairmont	SL	0.65	II	2	2								18.8	C	18.9	C
Hesperian - NB	Fairmont	14th	SL	0.33	II	2	2								15.3	D	12.7	E
Hesperian - SB	14th	Fairmont	SL	0.31	II	2	2	•				•		•	9.8	••F••	10.0	E
Hesperian - SB	Fairmont	Springlake	SL	0.65	II	2	2	•	•						17.0	D	19.0	C
Hesperian - SB	Springlake	Llewelling	Unin	0.40	II	2	2								14.0	D	15.8	D
Hesperian - SB	Llewelling	Grant	Unin	0.28	II	2	2								21.8	C	21.1	C
Hesperian - SB	Grant	Hacienda	Unin	0.66	II	2	2								15.5	D	34.0	A
Hesperian - SB	Hacienda	A St	Unin	0.65	II	2	2								25.4	B	22.8	C
Hesperian - SB	A St	SH 92	Hay	2.19	II	2	3								20.5	C	23.0	C
Hesperian - SB	SH 92 - WB	Tennyson	Hay	0.46	I	2	3								18.6	D	19.8	D

Arterial Segments - PM Peak Hour

CMP Route	Segment Limits From:	To:	Jurisdiction	Length (miles)	Arterial Class	Plan Area	No of Lanes	Prior LOS "F" 91	92	93	94	95	96	97	1997 Results Speed	LOS	1998 Results Speed	LOS
Mowry - EB	I-880	Farwell	Fre	0.34	II	3	2	•	•						15.3	D	14.6	D
Mowry - EB	Farwell	SH 84	Fre	2.62	II	3	2								23.4	C	21.9	C
Mowry - WB	SH 84	Farwell	Fre	2.62	II	3	2								21.6	C	27.5	B
Mowry - WB	Farwell	I-880	Fre	0.34	II	3	2								21.8	C	26.6	B
Park/23rd - EB	Encinal	Santa Clara	Ala	0.23	II	1	2								15.8	D	13.0	E
Park/23rd - EB	Santa Clara	Kennedy	Ala	0.67	III	1	2								18.2	C	14.7	C
Park/23rd - EB	Kennedy	E 11th	Ala - Oak	0.50	II	1	2								21.5	C	22.7	C
Park/23rd - WB	E 11th	Kennedy	Oak - Ala	0.45	II	1	2								23.8	C	28.0	B
Park/23rd - WB	Kennedy	Santa Clara	Ala	0.67	III	1	2								13.8	C	13.4	C
Park/23rd - WB	Santa Clara	Encinal	Ala	0.23	II	1	2								15.2	D	12.0	E
MLK Jr Way - NB	SH 24	Adeline	Oak	0.90	II	1	2								17.8	D	16.6	D
Adeline - NB	MLK Jr - South	MLK Jr - North	Berk	0.29	II	1	2								13.3	E	11.0	E
Adeline - NB	MLK Jr - North	Shattuck	Berk	0.63	II	1	2								21.3	C	16.1	D
Shattuck NB	Shattuck	Dwight	Berk	0.32	II	1	2								18.9	C	18.8	C
Shattuck NB	Dwight	Allston	Berk	0.40	III	1	2								10.8	D	12.4	D
Shattuck NB	Allston	University	Berk	0.20	III	1	2								8.5	E	8.9	E
Shattuck SB	University	Allston	Berk	0.20	III	1	2								14.5	C	11.9	D
Shattuck SB	Allston	Dwight	Berk	0.40	III	1	2								12.5	D	14.2	D
Shattuck SB	Dwight	Shattuck	Berk	0.32	II	1	2								20.7	C	28.7	B
Adeline - SB	Shattuck	MLK Jr - North	Berk	0.63	II	1	2								16.9	D	14.5	D
Adeline - SB	MLK Jr - North	MLK Jr - South	Berk	0.29	II	1	2					•			10.8	E	10.0	E
MLK Jr Way - SB	Adeline	SH 24	Oak	0.88	II	1	2								20.0	C	18.4	C
Tennyson - EB	Hesperian	I-880	Hay	0.87	I	2	2								14.8	E	20.6	D
Tennyson - EB	I-880 NB	Rt 238	Hay	1.44	II	2	2								18.6	C	19.6	C
Tennyson - WB	Rt 238	I-880	Hay	1.49	II	2	2								19.5	C	22.1	C
Tennyson - WB	I-880	Hesperian	Hay	0.84	I	2	2								19.2	D	21.3	D
University - EB	I-80 SB	6th	Berk	0.39	II	1	2								20.4	C	29.6	B
University - EB	6th	San Pablo	Berk	0.31	II	1	2								14.5	D	13.5	E
University - EB	San Pablo	Sacramento	Berk	0.56	II	1	2								16.2	D	16.6	D
University - EB	Sacramento	ML King	Berk	0.48	II	1	2								19.9	C	20.2	C
University - EB	ML King	Shattck Pl	Berk	0.30	III	1	2								12.3	D	10.6	D

1998 Level of Service Results

Arterial Segments - PM Peak Hour

CMP Route	Segment Limits From:	To:	Jurisdiction	Length (miles)	Arterial Class	Plan Area	No of Lanes	Prior LOS "F" 91	92	93	94	95	96	97	1997 Results Speed	LOS	1998 Results Speed	LOS
University - WB	Shattck Pl	ML King	Berk	0.30	III	1	2								10.3	D	8.5	E
University - WB	ML King	Sacramento	Berk	0.48	II	1	2								16.4	D	20.3	C
University - WB	Sacramento	San Pablo	Berk	0.56	II	1	2								13.6	E	10.9	E
University - WB	San Pablo	6th	Berk	0.31	II	1	2								13.5	E	7.1	••F••
University - WB	6th	I-80 SB	Berk	0.40	II	1	2								17.5	D	36.9	A
SR 13 Ashby - WB	Hiller	Domingo	Oak - Berk	0.79	II	1	2								32.5	A	24.0	B
SR 13 Ashby - WB	Domingo	College	Berk	0.49	III	1	1								18.0	C	14.8	C
SR 13 Ashby - WB	College	Telegraph	Berk	0.37	III	1	1								12.2	D	12.2	D
SR 13 Ashby - WB	Telegraph	Shattuck	Berk	0.38	III	1	1	•	•						9.3	E	11.9	D
SR 13 Ashby - WB	Shattuck	ML King	Berk	0.25	III	1	1	•	•						10.5	D	13.6	C
SR 13 Ashby - WB	ML King	San Pablo	Berk	0.86	III	1	1								16.5	D	14.6	C
SR 13 Ashby - WB	San Pablo	I-80 Ramps	Berk	0.64	II	1	2								.23.8	C	23.3	C
SR 13 Ashby - EB	I-80	San Pablo	Berk	0.61	II	1	2								13.4	E	18.6	C
SR 13 Ashby - EB	San Pablo	ML King	Berk	0.86	III	1	1								23.7	B	19.1	B
SR 13 Ashby - EB	ML King	Shattuck	Berk	0.25	III	1	1								13.5	C	8.2	E
SR 13 Ashby - EB	Shattuck	Telegraph	Berk	0.38	III	1	1								23.6	B	26.6	A
SR 13 Ashby - EB	Telegraph	College	Berk	0.37	III	1	1								12.4	D	9.4	D
SR 13 Ashby - EB	College	Domingo	Berk	0.49	III	1	1	•							14.8	C	13.4	C
SR 13 Ashby - EB	Domingo	Hiller	Berk - Oak	0.79	II	1	2								19.4	B	19.1	B
SR 61 - SB	Atlantic	Cent/Webster	Ala	0.55	III	1	2								16.2	D	17.8	C
SR 61 - SB	Cent/Webster	Sher/Encino	Ala	0.74	II	1	2								17.4	C	20.3	C
SR 61 - SB	Sher/Encino	Park	Ala	1.22	II	1	1								22.3	C	21.9	C
SR 61 - SB	Park	High/Otis	Ala	1.05	II	1	1								21.9	C	21.9	C
SR 61 (Doolittle) - SB	High	Harbor Bay	Ala	0.91	I	1	1								19.6	D	20.0	D
SR 61 - SB	Harbor Bay	Airport Dr	Oak	2.14	I	1	1								35.0	B	31.0	B
SR 61 (Doolittle) - SB	Airport	Davis	Oak - SL	0.95	I	1	2								29.3	B	30.4	B
SR 61 (Doolittle) - NB	Davis	Airport	SL - Oak	0.94	I	2	2								25.4	C	25.4	C
SR 61 - NB	Airport Dr	Harbor Bay	Ala	2.15	I	1	1								34.4	B	31.4	B
SR 61 (Doolittle) - NB	Harbor Bay	High/Otis	Ala	0.91	I	1	1								21.2	D	24.6	C
SR 61 - NB	High/Otis	Park	Ala	1.05	II	1	1								30.4	A	20.0	C
SR 61 - NB	Park/Encnal	Sher/Cent	Ala	1.22	II	1	1								17.1	D	20.9	C
SR [illegible]B	Sher/Cent	Web/Cent	Ala	0.74	II	1	2								18.4	C	21.0	C
SR [illegible]B	Cent/Web	Atlantic	Ala	0.55	III	1	2								14.6	C	[illegible]	C

Arterial Segments - PM Peak Hour

CMP Route	Segment Limits From:	To:	Jurisdiction	Length (miles)	Arterial Class	Plan Area	No of Lanes	Prior LOS "F" 91	92	93	94	95	96	97	1997 Results Speed	LOS	1998 Results Speed	LOS
SR 77 (42nd) - EB	I-880 NB	E 14th	Oak	0.32	I	1	2								22.7	C	18.3	D
SR 77 (42nd) - WB	E 14 th	I-880 NB	Oak	0.30	I	1	2								23.7	C	32.8	B
Decoto - WB	SH 238/Mission	Union Square	UC	0.85	II	3	2								25.9	B	25.1	B
Decoto - WB	Union Square	Alv-Niles Rd	UC	0.25	II	3	2	•	•	•	•		•		10.8	E	9.7	••F••
Decoto - WB	Alv-Niles Rd	Fremont CL	UC	0.66	II	3	2								23.3	B	25.0	B
Decoto - WB	Fremont CL	I-880 NB (off)	Fre	1.15	II	3	2								19.5	C	26.9	B
Decoto - EB	I-880 NB (off)	Union City CL	Fre	1.15	II	3	2								16.5	D	16.5	D
Decoto - EB	Union City CL	Alv-Niles Rd	UC	0.66	II	3	2								14.7	D	18.5	C
Decoto - EB	Alv-Niles Rd	Union Square	UC	0.25	II	3	2								16.3	D	17.3	D
Decoto - EB	Union Square	SH 238/Mission	UC	0.85	II	3	2								25.6	B	26.3	B
SR 84 (Fre) - WB	SH 238	Mowry	Fre	0.90	I	3									25.3	C	22.0	C
SR 84 (Fre) - WB	Mowry	Fremont	Fre	1.72	I	3									28.8	B	21.8	D
SR 84 (Fre) - WB	Fremont	Thornton	Fre	0.33	II	3		•	•		•				13.9	E	17.8	D
SR 84 (Fre) - WB	Thornton	I-880 SB	Fre	1.34	II	3									22.9	C	23.8	C
SR 84 (Fre) - EB	I-880 SB	Fremont	Fre	1.34	II	3									17.2	D	23.9	C
SR 84 (Fre) - EB	Fremont	Peralta	Fre	0.33	II	3									13.3	E	14.2	D
SR 84 (Fre) - EB	Peralta	Mowry	Fre	1.72	I	3									25.4	C	21.8	D
SR 84 (Fre) - EB	Mowry	SH 238	Fre	0.90	I	3									15.2	E	15.9	E
SR 84 (Liv) - SB	I-580	N Mines	Liv	0.79	I	4									27.9	A	29.8	A
SR 84 (Liv) - SB	N Mines	Railroad	Liv	1.35	I	4									34.4	B	31.9	B
SR 84 (Liv) - SB	Railroad	P St	Liv	0.62	III	4									18.8	B	16.1	C
SR 84 (Liv) - SB	P St	4th/Murr	Liv	0.35	II	4									13.6	D	17.5	D
SR 84 (Liv) - SB	4th/Murr	Concannon	Liv	1.04	I	4									27.8	C	29.0	B
SR 84 (Liv) - WB	Concannon	Holmes	Unin-Liv	0.92	I	3									---	A	44.4	A
SR 84 (Liv) - EB	Holmes	Concannon	Liv-Unin	0.92	I	4									---	A	36.1	A
SR 84 (Liv) - EB	Concannon	4th/Murr	Liv	1.04	I	4									24.0	C	24.2	C
SR 84 (Liv) - EB	4th	P St	Liv	0.35	II	4									14.6	D	17.6	D
SR 84 (Liv) - EB	P St	Railroad	Liv	0.62	III	4									16.1	C	16.6	C
SR 84 (Liv) - EB	Railroad	N Mines	Liv	1.35	I	4									36.1	A	34.7	B
SR 84 (Liv) - EB	N Mines	I-580	Liv	0.79	I	4									25.2	C	33.3	C

1998 Level of Service Results

Arterial Segments - PM Peak Hour

CMP Route	Segment Limits From:	To:	Jurisdiction	Length (miles)	Arterial Class	Plan Area	No of Lanes	Prior LOS "F" 91	92	93	94	95	96	97	1997 Results Speed	LOS	1998 Results Speed	LOS
SR 84 - EB	SR 238	Ple-Sunol Rd	Fre	6.70	Rural2	3									36.4	B	See note	
SR 84 - EB	Ple-Sunol Rd	Holmes	Unin	7.75	Rural2	3									---	---	on p. A-10	
SR 84 - WB	Holmes	Ple-Sunol Rd	Unin	7.75	Rural2	3									---	---	---	---
SR 84 - WB	Ple-Sunol Rd	SR 238	Fre	6.70	Rural2	3									---	---	---	---
SR 92 (Jackson) - EB	I-880	Mission	Hay	1.58	II	2	3	•	•						15.8	D	12.4	E
SR 92 (Jackson) - WB	Mission	I-880	Hay	1.58	II	2	3								18.4	D	27.6	B
SR 112 (Davis) - EB	Doolittle	I-880	SL	0.97	II	2	2								22.7	C	16.9	D
SR 112 (Davis) - EB	I-880	San Leandro	SL	0.54	II	2	2	•							20.6	C	19.7	C
SR 112 (Davis) - EB	San Leandro	14th	SL	0.27	III	2	2								13.4	C	13.4	C
SR 112 (Davis) - WB	E 14th	San Leandro	SL	0.28	III	2	2								12.4	D	14.3	C
SR 112 (Davis) - WB	San Leandro	I-880	SL	1.00	II	2	2								26.5	B	25.5	B
SR 112 (Davis) - WB	I-880	Doolittle	SL	0.50	II	2	2								19.7	C	15.2	D
SR 123 San Pablo - SB	Carlson	Washington	Alb	0.53	II	1	2								25.2	B	33.8	A
SR 123 San Pablo - SB	Washington	Marin	Alb	0.44	III	1	2								16.7	C	19.7	B
SR 123 San Pablo - SB	Marin	Gilman	Alb - Berk	0.47	II	1	2								18.4	C	17.8	D
SR 123 San Pablo - SB	Gilman	University	Berk	0.85	II	1	2								16.1	D	15.6	D
SR 123 San Pablo - SB	University	Allston	Berk	0.20	III	1	2								13.9	C	12.2	D
SR 123 San Pablo - SB	Allston	Ashby	Berk	1.08	II	1	2								19.3	C	18.2	C
SR 123 San Pablo - SB	Ashby	Stanford	Berk	0.81	II	1	2								20.4	C	22.0	C
SR 123 San Pablo - SB	Stanford	53rd	Oak	0.27	II	1	2								23.0	C	17.3	D
SR 123 San Pablo - SB	53rd	Park	Emer	0.35	II	1	2								14.2	D	15.2	D
SR 123 San Pablo - SB	Park	35th	Emer - Oak	0.44	II	1	2	•							14.8	D	13.2	E
SR 123 San Pablo - NB	35th	Park	Oak - Emer	0.44	II	1	2								19.2	C	13.2	E
SR 123 San Pablo - NB	Park	53rd	Emer	0.35	II	1	2								22.4	C	20.4	C
SR 123 San Pablo - NB	53rd	Stanford	Oak	0.27	II	1	2								11.4	E	10.1	E
SR 123 San Pablo - NB	Stanford	Ashby	Oak	0.81	II	1	2								16.5	D	11.2	E
SR 123 San Pablo - NB	Ashby	Allston	Berk	1.08	II	1	2								20.6	C	16.4	D
SR 123 San Pablo - NB	Allston	University	Berk	0.20	III	1	2								9.1	D	3.2	••F••
SR 123 San Pablo - NB	University	Gilman	Berk	0.85	II	1	2								16.3	D	14.0	D
SR [illegible]an Pablo - NB	Gilman	Marin	Alb - Berk	0.47	II	1	2								16.8	D	11.5	E
SR [illegible]San Pablo - NB	Marin	Washington	Alb	0.45	III	1	2								26.7	A	[illegible]	C
[illegible]3 San [illegible]- N	[illegible]ashi[illegible]	son	lb	.53	I		[illegible]								23	C	[illegible]	[illegible]

Arterial Segments - PM Peak Hour

CMP Route	Segment Limits From:	To:	Jurisdiction	Length (miles)	Arterial Class	Plan Area	No of Lanes	Prior LOS "F" 91	92	93	94	95	96	97	1997 Results Speed	LOS	1998 Results Speed	LOS
SR 185 (14th) - SB	42nd	Seminary	Oak	1.06	II	1	2								23.0	C	23.6	C
SR 185 (14th) - SB	Seminary	73rd	Oak	0.80	II	1	2								19.3	C	18.5	C
SR 185 (14th) - SB	73rd Ave	98th Ave	Oak	1.39	II	1	2								16.7	D	20.5	C
SR 185 (14th) - SB	98th	Broadmoor	Oak	0.74	II	1	2								25.2	B	21.4	C
SR 185 (14th) - SB	Broadmoor	Davis	SL	0.72	II	2	2								19.8	C	22.8	C
SR 185 (14th) - SB	Davis	San Leandro	SL	1.04	III	2	2								19.3	C	19.9	C
SR 185 (14th) - SB	San L Blvd	Hesperian	SL	0.94	II	2	2								30.3	A	28.7	A
SR 185 (14th) - SB	Hesperian	Bayfair	SL	0.46	II	2	2								26.0	B	20.2	C
SR 185 (14th) - SB	Bayfair	170th	Unin	1.24	II	3	2								20.2	C	25.7	B
SR 185 (14th) - SB	170th	Llewelling	Unin	0.21	II	3	2								32.9	A	30.3	A
SR 185 (14th) - SB	Llewelling	Sunset	Unin	1.02	II	3	2								24.4	B	27.0	B
SR 185 Hayward - SB	Sunset	SR 92/238	Hay	0.85	III	2	2								13.1	C	13.1	C
SR 185 Hayward - NB	SR 92/238	Sunset	Hay	0.85	III	2	2								16.4	C	17.1	C
SR 185 (14th) - NB	Sunset	Llewelling	Unin	1.11	III	3	2								21.4	C	26.1	B
SR 185 (14th) - NB	Llewelling	170th	Unin	0.21	II	3	2								28.6	B	26.2	B
SR 185 (14th) - NB	170th	Bayfair	Unin	1.24	II	3	2								25.6	B	23.8	C
SR 185 (14th) - NB	Bayfair	Hesperian	SL	0.46	II	2	2								19.5	C	22.6	C
SR 185 (14th) - NB	Hesperian	San L Blvd	SL	0.93	II	2	2								22.4	C	21.9	C
SR 185 (14th) - NB	San Leandro	Davis	SL	1.03	III	2	2								19.7	B	18.9	C
SR 185 (14th) - NB	Davis	Broadmoor	SL	0.72	II	2	2								28.0	B	21.9	C
SR 185 (14th) - NB	Broadmoor	98th	Oak	0.74	II	1	2								17.0	D	17.8	D
SR 185 (14th) - NB	98th Ave	73rd Ave	Oak	1.36	II	1	2								19.0	C	15.1	D
SR 185 (14th) - NB	73rd Ave	Seminary	Oak	0.80	II	1	2								14.8	D	15.6	D
SR 185 (14th) - NB	Seminary	42nd	Oak	1.06	II	1	2								23.8	C	23.9	C
SR 238 (Foothill) - NB	Jackson	City Center	Hay	0.62	III	2	3								11.6	D	15.7	C
SR 238 (Foothill) - NB	City Center	I-580	Unin-Hay	0.73	II	3	3								15.9	D	11.7	E
SR 238 (Foothill) - NB	I-580 Ramp	I-580 Merge	Unin	0.71	I	3									36.6	A	51.3	A
SR 238 (Foothill) - SB	I-580	Cstro V Blvd	Unin	0.86	I	3									22.6	C	45.8	A
SR 238 (Foothill) - SB	Cstro V Blvd	City Center	Hay-Unin	1.03	II	2	3								19.2	C	26.5	B
SR 238 (Foothill) - SB	City Center	Jackson	Hay	0.62	III	2	3								14.8	C	19.4	B

1998 Level of Service Results

Arterial Segments - PM Peak Hour

CMP Route	Segment Limits From:	To:	Jurisdiction	Length (miles)	Arterial Class	Plan Area	No of Lanes	Prior LOS "F" 91	92	93	94	95	96	97	1997 Results Speed	LOS	1998 Results Speed	LOS
SR 238 (Mission) - NB	680 NB Rmp	Stevenson	Fre	2.46	I	3	2								30.4	B	34.4	B
SR 238 (Mission) - NB	Stevenson	Nursery	Fre	2.57	I	3	2								23.3	C	24.5	C
SR 238 (Mission) - NB	Nursery	Tamarack	UC	2.07	I	3	2								29.5	B	29.7	B
SR 238 (Mission) - NB	Tamarack	Industrial	UC - Hay	1.96	I	3	2								38.2	A	34.6	B
SR 238 (Mission) - NB	Industrial	Sorenson	Hay	1.47	II	2	2								26.9	B	26.6	B
SR 238 (Mission) - NB	Sorenson	Jackson	Hay	1.82	II	2	2	•	•						18.2	C	19.7	C
SR 238 (Mission) - SB	Jackson	Sorenson	Hay	1.82	II	2	2								28.4	B	23.0	C
SR 238 (Mission) - SB	Sorenson	Industrial	Hay	1.47	II	2	2								34.7	A	29.7	B
SR 238 (Mission) - SB	Industrial	Tamarack	Hay - UC	1.96	I	2	2								33.8	B	37.5	A
SR 238 (Mission) - SB	Tamarack	Nursery	UC	2.07	I	3	2								29.8	B	29.0	B
SR 238 (Mission) - SB	Nursery	Stevenson	Fre	2.57	I	3	2								25.1	B	21.8	D
SR 238 (Mission) - SB	Stevenson	680 NB Rmp	Fre	2.46	I	3	2								28.7	B	29.0	B
SR 260 (Tubes) - NB	Atlantic	7th/Web	Oak	1.31	I	1	2								---	A	---	A
SR 260 (Tubes) - SB	7th/Web	Atlantic	Oak	1.31	I	1	2	•							---	B	---	B
SR 262 (Mission) - EB	I-880 NB	I-680 NB	Fre	1.32	I	3	2								15.9	E	20.4	D
SR 262 (Mission) - WB	I-680 NB	I-880 SB	Fre	1.11	I	3	2								19.5	D	23.7	C

Note: SR 84 between SR 238 in Fremont and Holmes in Livermore had consistently operated at LOS A or B in previous surveys, and therefore it has not been surveyed for two years. Because of increases in traffic on I-680 over the Sunol Grade in the last several years, it is likely that the service levels on this roadway are worse than LOS B, particularly near the interchange with I-680. This roadway will be divided into smaller segments and surveyed for the next LOS Monitoring report.

Ramps and Special Segments - PM Peak Hour

CMP Route	Segment Limits From:	To:	Juris	Plan Area	Length (miles)	No of Lanes	Free Flow Speed	Prior LOS "F" 91	92	93	94	95	96	97	1997 Results Speed	LOS	1998 Results Speed	LOS
I-80/I-580 Interchange	I-80 SB	I-580 EB	Oak	1	0.30	1	38.0	•	•					•	10.0	•(F)•	18.6	•(F)•
I-80/I-580 Interchange	I-580 WB	I-80 NB	Oak	1	0.41	1	40.0	•	•						20.9	E	19.4	•(F)•
SR 24 WB/I-580 WB	SR 24 On	I-580 Off	Oak	1	0.69	2	Weaving					•			28.7	E	63.6	A
I-580/SR 24 Interchange	I-580 WB	SR-24 EB	Oak	1	0.51	2	45.0								34.8	C	33.8	C
I-580/SR 24 Interchange	SR-24 WB	I-580 EB	Oak	1	0.74	2	51.0								47.7	A	45.5	B
SR 13/SR 24 Interchange	SR-13 NB	SR-24 EB	Oak	1	0.32	1	40.0		•	•	•	•	•	•	11.8	•(F)•	6.0	•(F)•
SR 13/SR 24 Interchange	SR-24 WB	SR-13 SB	Oak	1	0.16	1	31.0								24.9	B	28.5	A
I-880/I-238 Interchange	I-880 SB	I-238 EB	San L	2	0.74	2	47.0			•	•	•		•	18.3	•(F)•	32.6	D
I-880/I-238 Interchange	I-238 WB	I-880 NB	San L	2	0.54	1	54.0								37.1	D	37.7	D
I-880/I-238 Interchange	I-880 NB	I-238 EB	San L	2	0.33	1	32.0			•	•				21.5	D	13.9	•(F)•
I-880/I-238 Interchange	I-238 WB	I-880 SB	San L	2	0.76	1	53.0								35.2	D	43.8	B
I-580/SR 238 Interchange	I-580 SB	I-238 EB	Hay	2	0.35	1	37.0								27.6	C	31.0	B
I-580/SR 238 Interchange	I-238 WB	I-580 NB	Hay	2	0.32	1	38.0								30.4	B	25.2	D
I-580/I-680 Interchange	I-580 EB	I-680 NB	Pleas	4	0.46	1	35.0								25.0	C	20.6	E
I-580/I-680 Interchange	I-580 EB	I-680 SB	Pleas	4	0.28	1	42.0								27.7	D	26.7	D
I-580/I-680 Interchange	I-680 NB	I-580 EB	Pleas	4	0.32	1	40.0			•					25.0	D	28.6	C
I-580/I-680 Interchange	I-680 NB	I-580 WB	Pleas	4	0.66	1	41.0								33.7	B	39.9	A
I-580/I-680 Interchange	I-580 WB	I-680 NB	Pleas	4	0.43	1	41.0								41.5	A	42.3	A
I-580/I-680 Interchange	I-580 WB	I-680 SB	Pleas	4	0.66	1	39.0								31.0	C	32.7	B
I-580/I-680 Interchange	I-680 SB	I-580 EB	Pleas	4	0.48	1	35.0		•						30.2	B	19.3	E
I-580/I-680 Interchange	I-680 SB	I-580 WB	Pleas	4	0.35	1	41.0								33.3	B	35.9	B
I-880/SR 260 Connection	I-880 SB	SR-260 WB	Oak	1	0.99	1	32.0								26.4	B	18.1	E
I-880/SR 260 Connection	SR-260 EB	I-880 NB	Oak	1	0.36	1	35.0								24.1	D	15.3	•(F)•

1998 Level of Service Results

AM Peak Travel Time Results

CMP Route	Segment Limits From:	To:	Jurisdiction	Plan Area	Length (miles)	No of Lanes	1994 ADT	Prior "F" 96	Prior "F" 97	1997 Results Speed	1997 Results LOS	1998 Results Speed	1998 Results LOS
I-80 WB	Central (On)	University	Alb/Berk	1	2.48	8	239,000		•	13.9	•(F)•	51.2	C
I-80 WB	University	I-80/I-580 Split	Alb/Berk	1	2.43	8	246,000		•	12.1	•(F)•	39.6	E
I-80 WB	I-80/I-580 Split	Toll Gate	Oak	1	1.20	8	280,000		•	10.0	•(F)•	5.6	•(F)•
I-80 WB	Toll Gate	SF County Line	Oak	1	2.00	8	280,000		•	16.9	•(F)•	17.2	•(F)•
I-880 NB	High/42nd St	I-980 (Off)	Oak	1	3.70	8	161,000			47.4	D	31.5	E
I-880 SB	Marina	A St	Unin/Hay	2	4.44	8	191,000			40.1	D	57.4	B
I-880 SB	A St	RT 92/Jackson	Hay	2	1.81	8	210,000	•	•	29.3	•(F)•	58.1	B
I-880 SB	Rt92/Jackson	Tennyson	Hay	2	0.96	8	166,000			54.1	C	53.6	C
I-880 SB	Tennyson	Alvarado-Niles Rd	Hay/Unin	2	2.59	8	160,000			31.0	E	36.3	E
I-880 NB	Alvarado-Niles Rd	Tennyson Rd	UC/Hay	2	2.65	8	160,000			47.7	D	42.3	D
I-880 NB	Tennyson Rd	SR 92/Jackson	Hay	2	1.14	8	166,000			47.0	D	49.6	C
I-880 NB	SR 92/Jackson	A St	Hay	2	1.52	8	210,000			51.1	C	55.3	B
I-880 NB	A St	Marina	Unin	2	4.48	8	191,000			55.8	B	52.7	C
I-238 WB	I-580 WB/SR 238 W	I-880 NB/SB (Split)	Unin	2	1.70	6	135,000	•	•	20.5	•(F)•	20.6	•(F)•
I-880 SB	RT 262/Mission	Dixon Landing (Off	Fre	3	1.27	6	135,000	•	•	13.5	•(F)•	9.6	•(F)•
I-680 SB	Alcosta	I-580	Dub	4	1.84	6	115,000			48.3	D	65.3	A
I-680 SB	I-580	Bernal Ave	Plea	4	3.30	6	92,000			58.3	B	67.2	A
I-680 SB	Bernal Ave	Rt 84 (Niles Canyo	Unin	4	5.12	6	87,000			59.4	B	40.3	E
I-680 SB	Rt 84 (Niles Canyo	Rt 238/Mission	Unin	3	4.60	6	108,000	•	•	18.6	•(F)•	12.9	•(F)•
I-580 WB	Portola Ave	Tassajara Rd	Unin	4	4.70	8	122,000			44.6	D	43.5	D
I-580 WB	Tassajara Rd	I-680	Plea	4	2.87	8	140,000			53.3	B	60.6	A
I-580 WB	I-680	San Ramon (On)	Plea	4	0.69	8	135,000			44.1	D	45.6	D

APPENDIX J

A Traffic Study of the Proposed Pacific East Mall (TJKM Transportation Consultants, March 22, 1996)

TJKM Transportation Consultants

DRAFT

FINAL

A Traffic Study of the Proposed Pacific East Mall

In the City of Richmond

MARCH 22, 1996

FINAL

A Traffic Study of the Proposed Pacific East Mall

In the City of Richmond

March 22, 1996

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022-019R.1K2

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INTRODUCTION AND SUMMARY

Introduction

This report presents the results of TJKM's traffic impact analysis of the proposed Pacific East Mall to be located at the existing Breuner's site east of Pierce Street and south of Central Avenue in the City of Richmond. The study area is illustrated in Figure 1.

The study was conducted in accordance with the requirements set by the City of Richmond and the Contra Costa Transportation Authority (CCTA).

The traffic analysis focused on the impact generated by the project on the nearby roadway system. Off-site traffic impacts were evaluated at seven study intersections, listed below (and illustrated in Figure 1):

1) Central Avenue/Pierce Street
2) Central Avenue/Carlson Boulevard
3) Central Avenue/San Pablo Avenue
4) Pierce Street/Solano Avenue
5) Pierce Street/Buchanan Avenue
6) Central Avenue/I-80 Southbound Ramps
7) Central Avenue/I-80 Northbound Ramps

Three scenarios were addressed in the study,

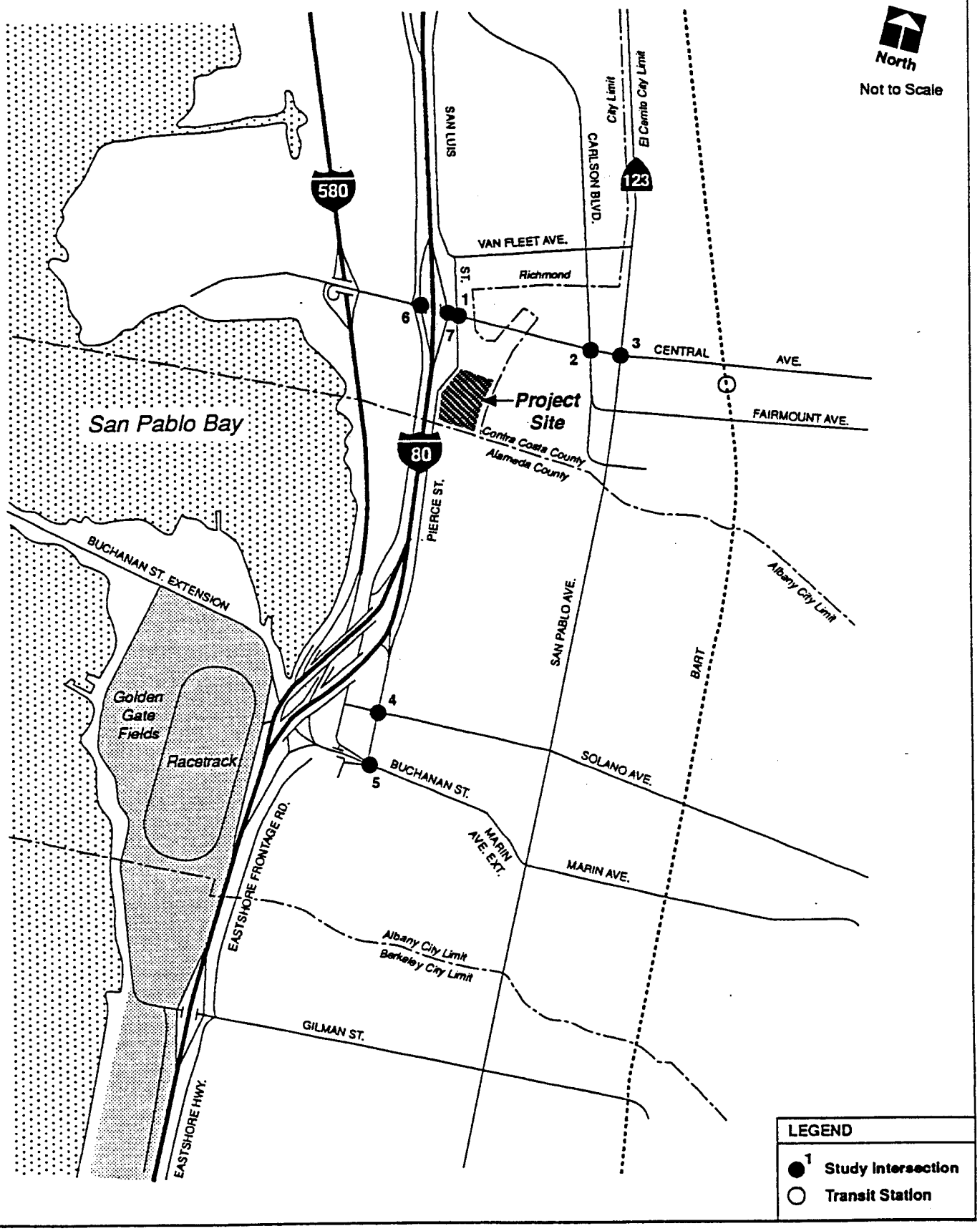
- *Existing* - Current traffic volumes and roadway conditions for a typical weekday peak hour.

- *Existing plus Proposed Project* - Identical to Existing conditions, but with traffic from development of the Pacific East Mall.

These scenarios were evaluated once at all intersections to determine weekday p.m. peak hour conditions. The potential impacts were also evaluated for Sunday peak hour conditions at Intersections 1, 3, and 7. In addition to these two scenarios traffic conditions were evaluated for potential impacts due to development of the proposed project in combination with closure of the Pierce Street hook-ramps.

Summary

No significant off-site traffic impacts were identified in conjunction with the proposed projects. Notably, substantial volumes of traffic on San Diego and Belmont Streets do result from the project (relative to existing levels), however, on weekdays this will be offset by a substantial, if not even greater, decrease in cut through traffic from what exists now. Recommendations were made to alter the site plan to better discourage patrons from accessing the site via San Diego Street. Furthermore it is recommended that reasonable measures be taken to prevent truck traffic from accessing the project from San Diego Street.



City of Richmond
Traffic Impact Study - Breuner's Site

Vicinity Map

Figure **1**

TJKM

22-019 - 10/94 - K2

EXISTING CONDITIONS

Roadway Network

The proposed project and the surrounding area are illustrated in Figure 1. Important roadways serving the project area are discussed below.

Interstate 80 is an east-west freeway spanning the state of California. In the vicinity of the proposed project, I-80 is a north-south facility providing access to San Francisco to the southwest. Regional access to the site is provided by an interchange at Central Avenue. I-580 and I-80 merge in the vicinity of the proposed project. North of the merge point, I-80 carries 140,000 to 160,000 vehicles per day. South of the merge point, the merged facilities carry 230,000 to 250,000 vehicles per day.

Interstate 580 is an east-west freeway spanning Contra Costa, Alameda and San Joaquin Counties. In the vicinity of the proposed project, I-580 is a north-south facility. As mentioned above, I-580 and I-80 merge in the vicinity of the proposed project. North of the merge point, I-580 carries 70,000 to 80,000 vehicles per day.

San Pablo Avenue (State Route 123) is a four-lane north-south arterial roughly parallel to I-80 and I-580 in the vicinity of the proposed project, carrying approximately 23,000 to 30,000 vehicles per day. In the vicinity of the proposed project, the posted speed limit on San Pablo Avenue is 35 miles per hour (mph).

Central Avenue is a two-lane east-west arterial connecting the Cities of Richmond and El Cerrito with I-580 and I-80. In the vicinity of the proposed project, the posted speed limit on Central Avenue is 30 mph.

Pierce Street is a north-south collector/frontage road that parallels I-80 on the east side. Pierce Street provides the primary access to the project site with three driveways. South of the project site are two "hook ramps" which provide access to and from northbound I-80. In the vicinity of the proposed project, the posted speed limit on Pierce Street is 25 mph.

Solano Avenue is a hilly two-lane residential collector street with STOP controls at intersections. The posted speed limit on Solano Avenue near Pierce Street is 15 mph.

Buchanan Street is a four-lane arterial that provides access to I-580 for much of the City of Albany. West of I-580, Buchanan Street is the primary access to the Golden Gate Fields race track. The posted speed limit on Buchanan Street is 25 mph.

San Diego Street is a minor two-lane residential street which runs between the project site and San Pablo Avenue to the east. San Diego Street is used by approximately 1,150 vehicles per day on weekdays and 710 vehicles on Sunday. The speed limit on San Diego Street is 25 mph.

Belmont Street is a minor two-lane residential street which runs from San Diego Street to Central Avenue. Traffic volumes on Belmont Street vary from 700 on weekdays to 520 on Sunday. The speed limit on Belmont Street is 25 MPH.

Level of Service Analysis Methodology

Richmond's level of service standard is Level of Service (LOS) D. Therefore, LOS D is used as the standard of significance in this traffic study. The operating conditions at signalized study intersections were evaluated using the signalized intersection operations method adopted by the Contra Costa Transportation Authority (CCTA). Appendix A contains a detailed description of the methodology. Peak hour intersection conditions are reported in terms of volume-to-capacity ratio (V/C) with a corresponding level of service. Level of service ratings are qualitative descriptions of intersection operations reported using an A through F letter rating system to describe travel delay and congestion. Level of Service A indicates free flow conditions with little or no delay and LOS F indicates jammed conditions with excessive delays and long back ups.

One- and two-way unsignalized study intersections were analyzed using the unsignalized intersection analysis method described in the 1994 *Highway Capacity Manual (HCM)*. The methodology evaluates level of service for an intersection in terms of overall average delay (measured in seconds per vehicle). Appendix A contains a detailed description of the unsignalized intersection methodology.

All-way STOP-controlled intersections were evaluated using the methodology described in the Transportation Research Board (TRB) *Circular 373*. The methodology correlates the average delay per vehicle entering the intersection with an A through F level of service rating scale similar to that described above.

Results of Level of Service Analysis

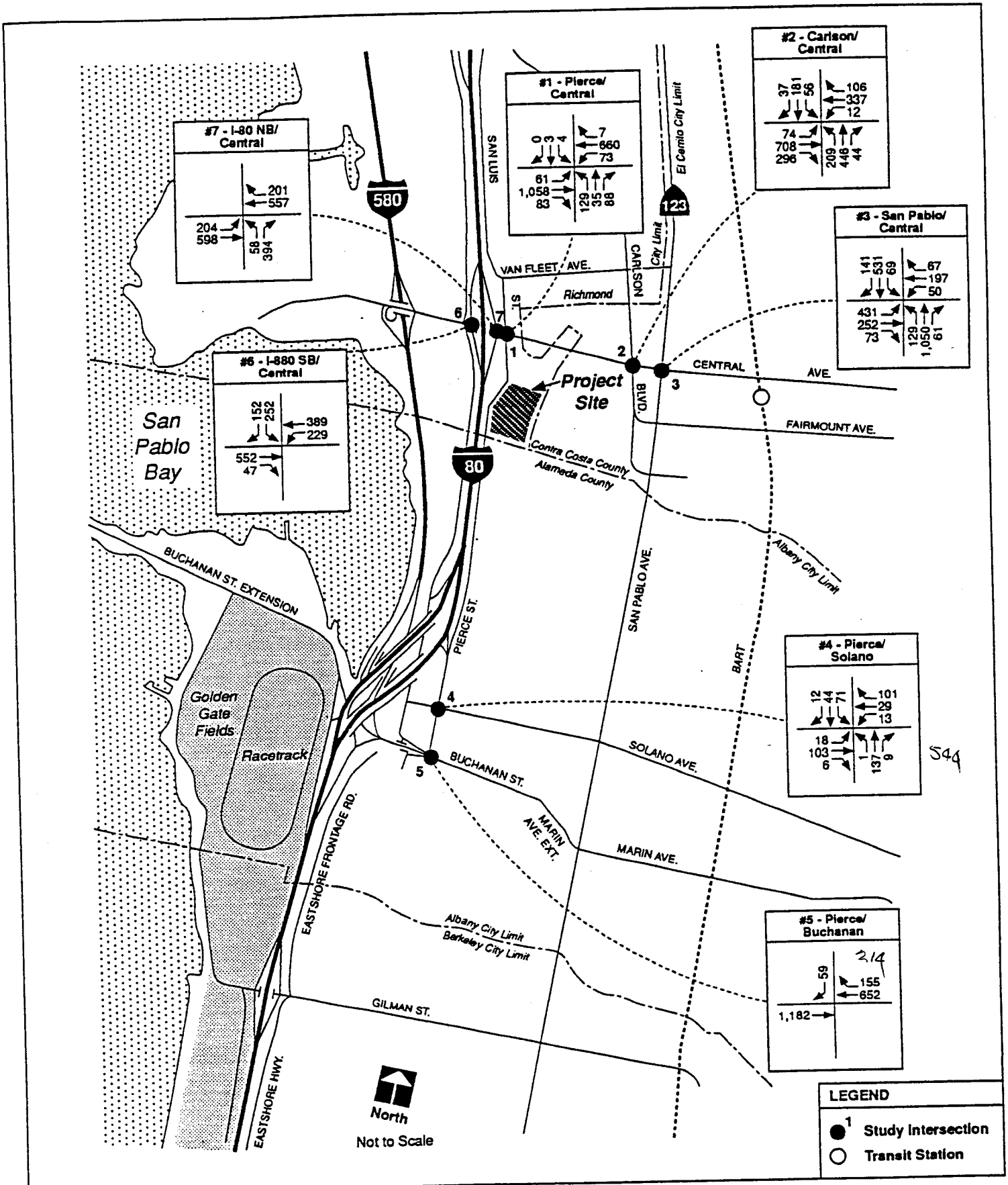
TJKM conducted peak hour turning movement counts at the five study intersections during the week of July 11, 1994. Figure 2 illustrates the existing weekday p.m. peak hour turning movements for the seven study intersections. Figure 2b illustrates the existing Sunday peak hour turning movements.

The intersection analysis revealed that all study intersections are currently operating at acceptable levels of service. Appendix B contains the detailed results of the level of service analysis. The results of the intersection analysis are summarized in Table I for existing conditions.

Table I:Peak Hour Intersection Levels of Service - Existing Conditions

	Intersection	Control	P.M. Peak Hour		Sunday Peak Hour	
			*	LOS	*	LOS
1	Pierce Street/Central Avenue	Signal	0.52	A	0.31	A
2	Carlson Boulevard/Central Avenue	Signal	0.53	A	-	-
3	San Pablo Avenue/Central Avenue	Signal	0.73	C	0.55	A
4	Pierce Street/Solano Avenue	4-Way STOP	3.0	A	-	-
5	Pierce Street/Buchanan Street	1-Way STOP	0.1	A	-	-
6	I-80 SB Ramps/Central Avenue	Signal	0.47	A	-	-
7	I-80 NB Ramps/Central Avenue	Signal	0.49	A	0.42	A

NOTE: * = Volume-to Capacity Ratio for signalized intersections; delay for 1-way and 4-way STOP-controlled intersections



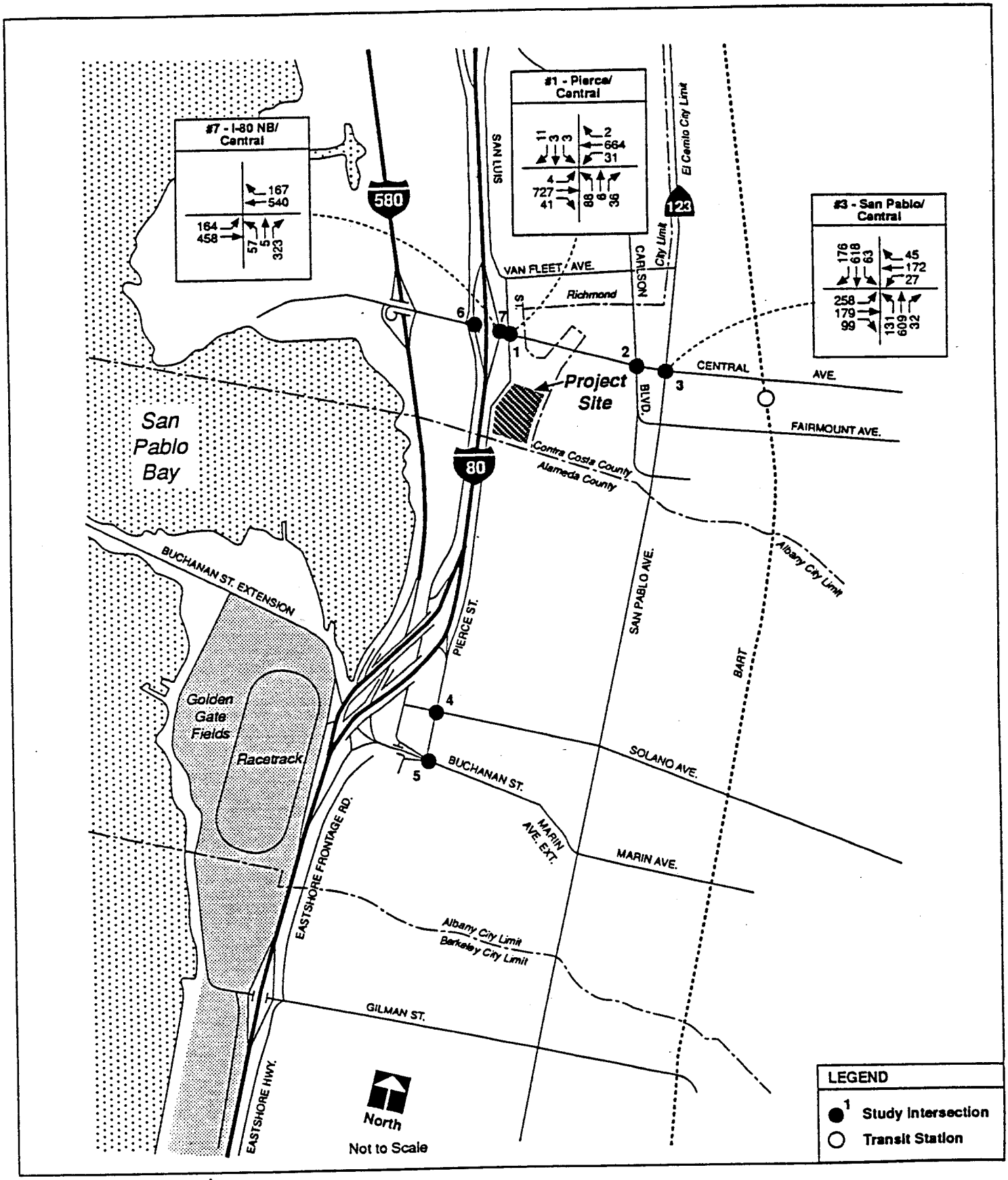
City of Richmond
Traffic Impact Study - Breuner's Site

Existing P.M. Peak Hour Turning Movement Volumes

Figure **2**

TJKM

22-019 - 10/94 - K2



City of Richmond
Traffic Impact Study - Breuner's Site

Existing
Sunday Peak Hour Turning Movement

Figure **2b**

TJKM

22-019 - 3/96 - K2

Transit Service

Currently, the AC Transit G, L and 43 routes, providing service to the El Cerrito del Norte BART station and the El Cerrito Plaza BART station, respectively, travel on Pierce Street with stops near the proposed project. The 43 route in particular is expected to provide access for patrons of the proposed project, especially given that it also serves a large complex of University of California Student housing nearby in Albany. The western portion of the parking lot on the project site is currently dedicated as a Park 'n' Ride facility for casual carpool riders and for users of these transit routes but this will cease when the proposed project is implemented.

"Cut-Through" Traffic

The driveway of the proposed project provides a connection between Pierce Street on the west side of the project and San Diego Street on the northeast side. Concern has been expressed regarding the use of the parking lot as a short cut for local residents to get to and from both the downtown area and the freeway. To assess the impact of these vehicles, counts of "cut-through" vehicles were conducted during both the a.m. and p.m. peak hours. It was found that 54 vehicles use the parking lot as a short-cut during the a.m. peak hour (predominantly in the westbound direction) and 73 make the short cut during the p.m. peak hour (nearly equally divided between eastbound and westbound). Table II summarizes the results of the "cut-through" observations.

Table II: Existing On-site "Cut-Through" Traffic

Peak Hour	Eastbound	Westbound	Total
A.M.	12	42	54
P.M.	37	36	73

The majority of the vehicles use the northernmost (and most direct) driveway; a small amount of vehicles use the next driveway to the south (most likely due to the lack of pavement near the driveway); the remainder of the traffic is nearly equally divided between the two southern driveways. While these movements may not be desired by the City or the property owner, the parking lot design allows these maneuvers to be made safely. This weekday "cut-through" activity will be significantly altered once the site is re-developed and operational. The presence of parked vehicles and pedestrian activity will lessen the attractiveness of the route. Other site design measures can also be made to further discourage this travel pattern as will be discussed later in this report.

PROJECT IMPACTS

Project Description

The existing 138,800square foot building is currently occupied by a 78,000 square foot Breuner's furniture store and a 40,000 square foot area used by the U.S. Postal Service. The existing structure is to be renovated to create an indoor mini-mall with a distinct Asian theme. This will consist of a 34,600 square foot Ranch 99 food market, 37,700 square feet of restaurants and bakeries and 33,800 square feet of retail, service and office and office space all directly accessible from 32,700 square feet of interior circulation and common space. As part of the project significant renovations are also being planned for the parking lot. These will include repairs to pavement deficiencies and improvements to on site circulation.

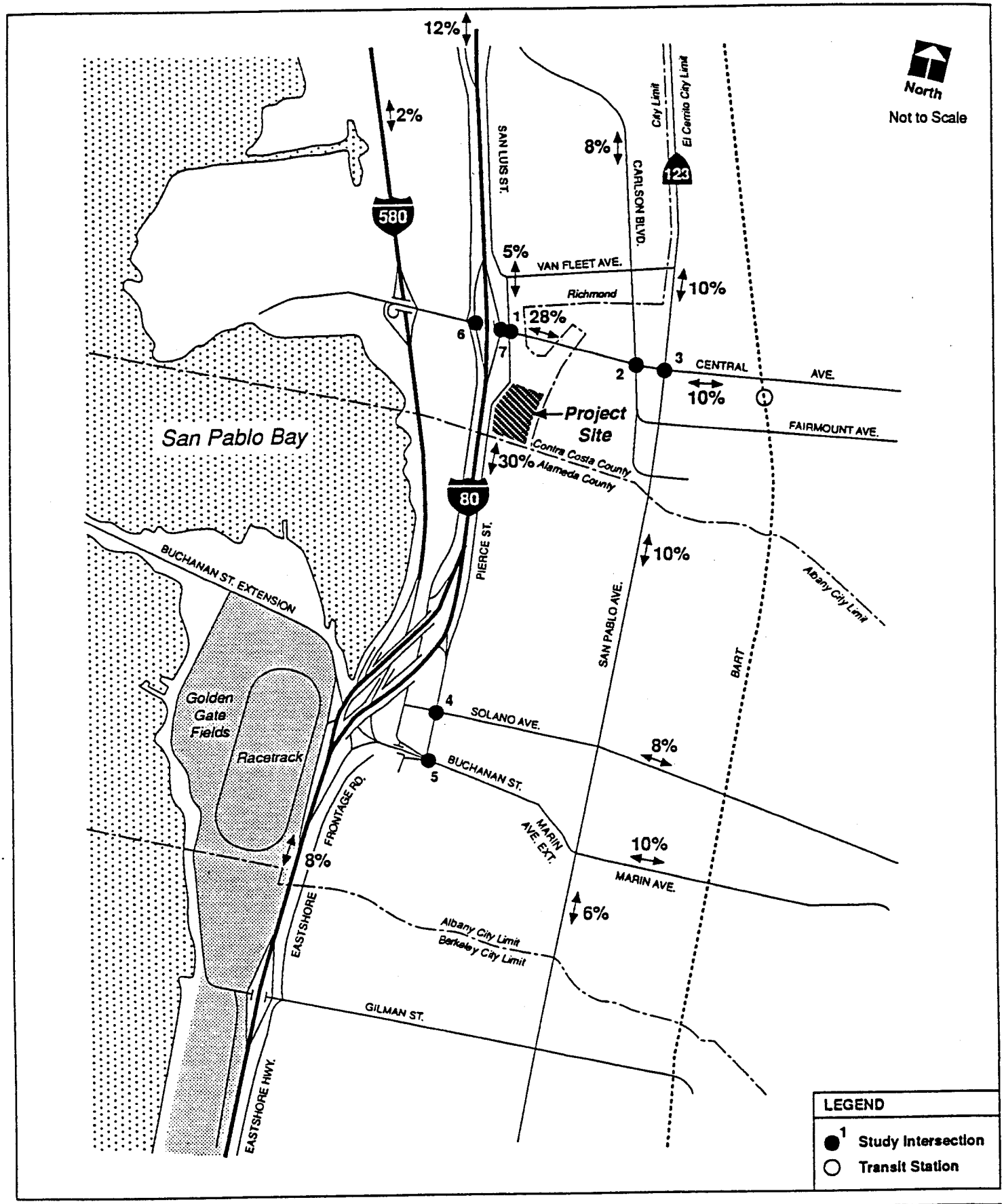
Trip Generation and Assignment

The trip generation assumptions for the proposed project are based on information contained in ITE's *Trip Generation* (Fifth Edition, ITE). The estimates include "pass-by " assumptions which quantify the amount of vehicles already travelling on adjacent roadways that will access the project (in contrast to completely new trips). The project is expected to generate 847 new p.m. peak hour trips during weekdays, and 966 new Sunday peak hour trips. Table III illustrates the estimated trip generation for the proposed projects.

Project trip distribution assumptions were developed based on existing travel patterns and knowledge of the study area, and discussions with the applicant about targeting of market areas. Figure 3 illustrates the trip distribution assumptions for the proposed project.

Table III: Project Trip Generation

Use	Size	P.M. Peak Hour					Sunday Peak Hour				
		Rate	In:Out	In	Out	Total	Rate	In:Out	In	Out	Total
Ranch 99 Supermarket	34.61 ksf	15.0	50:50	260	260	520	22.9	50:50	396	396	793
Restaurants	37.70 ksf	15.0	64:40	339	226	565	14.1	60:40	314	209	523
Retail/Service/Office	33.81 ksf	4.0	50:50	68	68	136	2.4	60:40	49	32	81
SUBTOTAL				667	554	1,221			759	637	1,397
Pass-by Trips				*-178*	*-155*	*-333*			*-227*	*-204*	*-431*
Reduction in Existing Traffic				*-17*	*-29*	*-41*			*0*	*0*	*0*
TOTAL NET INCREASE				472	370	847			532	433	966



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Traffic Impact Study - Breuner's Site

Project Trip Distribution

Figure 3

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22-019 - 3/96 - K2

Level of Service Analysis

Based on the project trip distribution assumptions, project trips were assigned to the local roadway network. Figures 4 and 4b illustrate the projected study intersection turning movements under the Existing plus Project weekday and Sunday scenarios respectively. The level of service analysis for the Existing plus Project scenarios revealed that all study intersections are projected to continue to operate at acceptable levels of service on weekdays and on Sundays. Therefore, no mitigations are required. Table IV summarizes the results of the level of service analysis. Detailed calculations are contained in Appendices C (weekday p.m. peak) and D (Sunday peak).

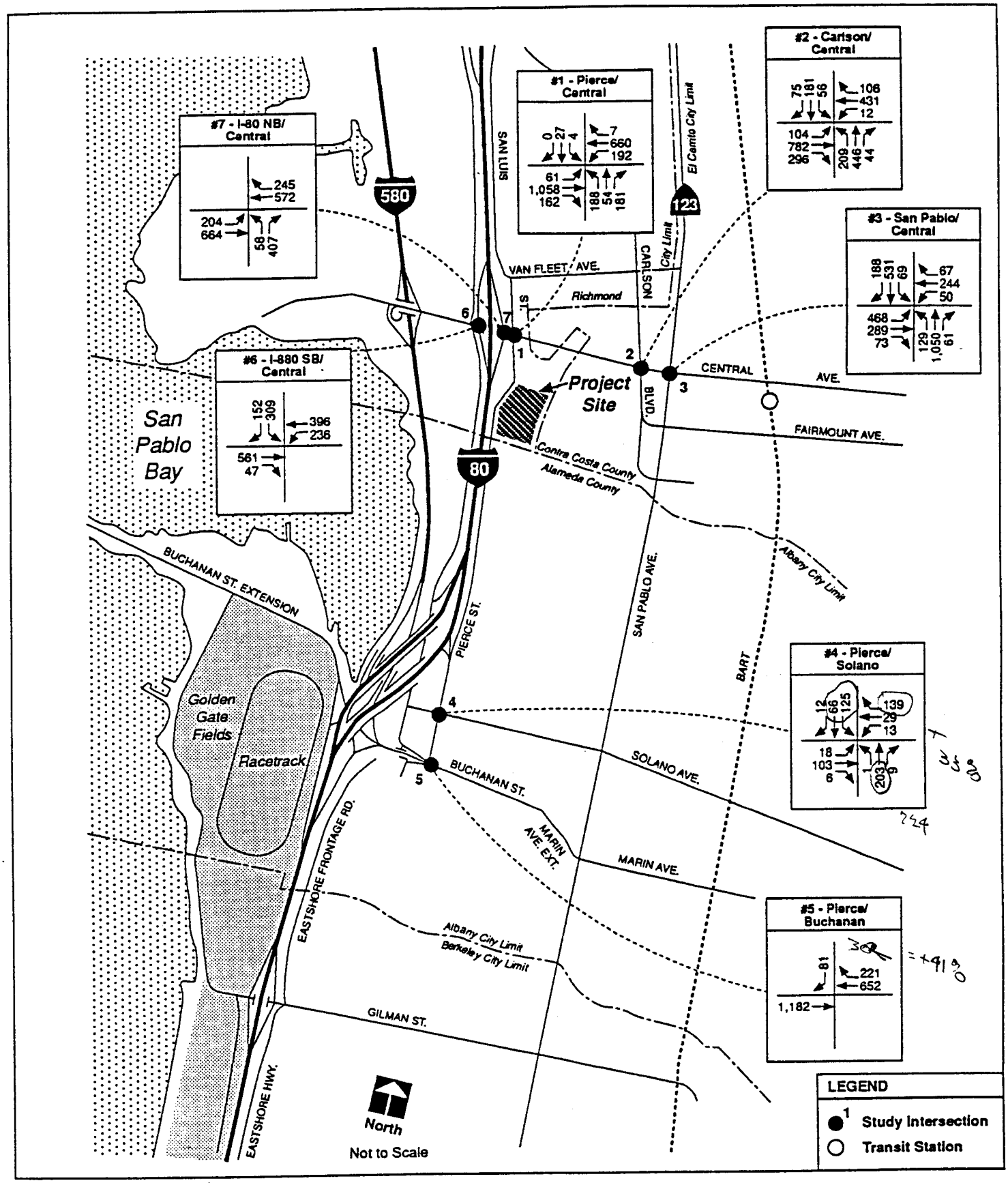
Table IV: Peak Hour Intersection Levels of Service - Existing plus Project

		Existing				Existing plus Project			
		P.M. Peak		Sunday Peak		P.M. Peak		Sunday Peak	
		*	LOS	*	LOS	*	LOS	*	LOS
1	Pierce/Central	0.52	A	0.31	A	0.70	B	0.52	A
2	Carlson/Central	0.53	A	-	-	0.57	A	-	-
3	San Pablo/Central	0.73	C	0.55	A	0.77	C	0.61	B
4	Pierce/Solano	3.0	A	-	-	5.1	B	-	-
5	Pierce/Buchanan	0.1	A	-	-	0.2	A	-	-
6	I-80 SB/Central	0.47	A	-	-	0.51	A	-	-
7	I-80 NB/Central	0.49	A	0.42	A	0.54	A	0.45	A

NOTE: * = Volume-to Capacity Ratio for signalized intersections;
Delay for 1-way and 4-way STOP-controlled intersections

Effect of Pierce Street Ramp Closure

Caltrans, in cooperation with the City of Albany, is currently planning to reconfigure the I-80/I-580/ Buchanan Street interchange as part of a project to add a High Occupancy Vehicle (HOV) lane on I-80. The project will result in a modified diamond-type interchange configuration with the eastbound I-80 to westbound I-580 connector relocated to the opposite side of the freeway. As part of the project, the existing I-80 "hook" ramps at Pierce Street will be closed, resulting in a redistribution of the ramp traffic to the Central Avenue and Buchanan Street interchanges. Although recent funding changes may delay the project, it is likely to be constructed in the near future.



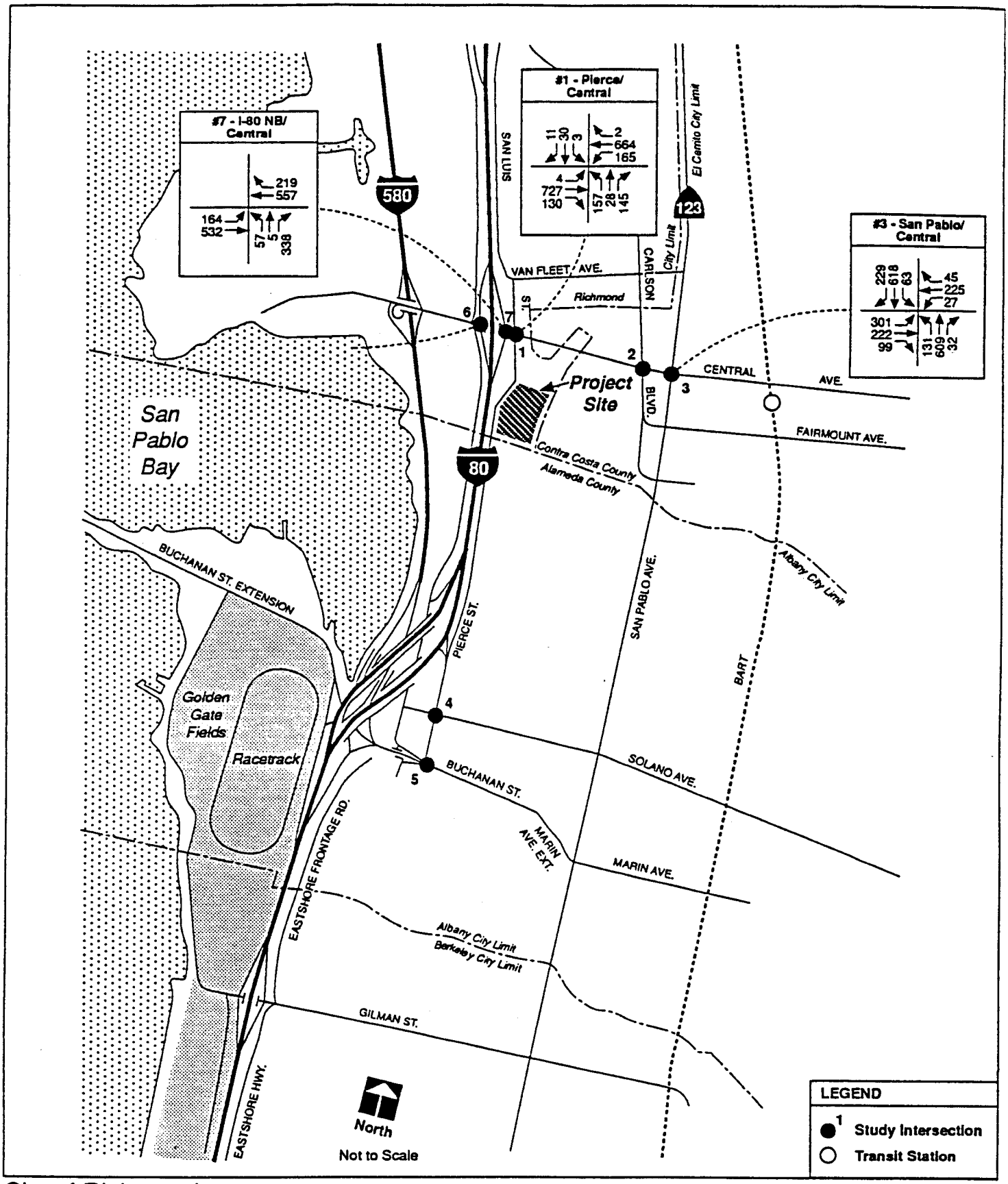
City of Richmond
Traffic Impact Study - Breuner's Site

Existing + Project
P.M. Peak Hour Turning Movement Volumes

Figure
4

TJKM

22-019 - 3/96 - K2



City of Richmond
Traffic Impact Study - Breuner's Site

Existing + Project
Sunday Peak Hour Turning Movement

Figure **4b**

TJKM

22-019 - 3/96 - K2

Therefore, the effects of the Pierce Street ramp closure are considered under the Existing plus Project scenarios. According to the most recent available count data[1], 340 vehicles enter the freeway at Pierce Street during the p.m. peak hour and 300 exit. These assumptions are applied to traffic conditions on Sundays as well, although doing so is conservative because in reality freeway volumes on Sundays are probably lower. It was also assumed that, with the Pierce Street ramps closed, 40 percent of the vehicles bound for the freeway would use the Buchanan Street interchange; the remaining 60 percent would use the Central Avenue interchange. Furthermore, it was assumed that 60 percent of the vehicles leaving the freeway would use the Buchanan Street interchange; the remaining 40 percent would use the Central Avenue interchange.

Level of service analysis revealed that there were no impacts that resulted from a combination of Existing plus Project scenario traffic and closure of the Pierce Street ramps. This was the case for both the weekday p.m. peak and for the Sunday peak, therefore, no mitigations are required as a result of ramp closure.

Truck Traffic

It is expected that the project would generate a substantial amount of truck traffic on a daily basis. This does not account for any decrease in truck traffic which will occur with the elimination of U.S. Postal Service Bulk Mail activity on the project site. Table V shows a summary of anticipated truck traffic which is expected to total approximately 10 to 12 trucks daily.

Table V: Anticipated Truck Traffic

Type of Establishment	No. of Establishments	Truck Type	Frequency	Time of Delivery
Restaurant	1 or more	5 ton	2-3/day	8-11 a.m.; 3-4 p.m.
Bakery	2-3	2-3 ton	2/day	10 a.m.-3 p.m.
		40 footer	3/week	10 a.m.-3 p.m.
Market	1	5 ton	2/day	8 a.m.-7 p.m.
		40 footer	1/day	8 a.m.-7 p.m.
Service/Retail/Office	up to 51	2-5 ton	intermittent	8 a.m.-7 p.m.

Note that this traffic would be oriented towards Pierce Street only. Adherence to an explicit policy which restricts trucks form using San Diego Street will be expected of each tenant leasing space in the proposed development as well as service and utility providers for the project as whole. Furthermore, it is anticipated that trucks will utilize Central Avenue to access either the I-80 Freeway or San Pablo Avenue.

Traffic on San Diego Street and Belmont Street

It is expected that some of the patrons of the Pacific East Mall will access the site via Belmont and San Diego Streets. To determine the impact of this, 24-hour traffic volume counts were conducted on these streets from Thursday, March 14 through Sunday, March 17. Table VI summarizes existing traffic and traffic due to the proposed project on a typical weekday and on Sunday.

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[1]Source: Barton Aschman Associates, March 1991 counts.

Table VI: Daily Traffic on Residential Streets

Street	Weekday			Sunday		
	Existing	Project	Existing plus Project	Existing	Project	Existing plus Project
San Diego Street	1,127	910	2,037	715	896	1,611
Belmont Street	701	307	1,008	520	310	830

Note that an evaluation of 24 hour Existing plus Project traffic on these streets would indicate LOS A using capacity analysis alone. However as Table VI indicates, the relative increase in traffic on these streets is substantial and there would be a pronounced difference to neighborhood residents living nearby. This observation is partially mitigated by the fact that with renewed activity on the project parking lot cut-through traffic would be reduced and perhaps even eliminated during certain times of day. Referring back to Table II, during the weekday p.m. peak the potential reduction in cut through traffic (73 vehicles per hour) is almost as great as the increase due to project traffic (88 vehicles per hour).

However, weekend traffic from the project is expected to roughly double the current volumes on these residential streets. This pronounced change will be especially noticeable because there is no offsetting reduction in "cut-through" traffic as will occur during weekdays. As a result, even though there is no impact as defined by applicable capacity standards, it is suggested that measures be taken on-site to reduce the attractiveness of San Diego Street as an access point to the project site. Although this entrance has been reconfigured and landscaping has been planned which would partially obscure this access point, more aggressive treatments may be desirable.

It is recommended that westbound vehicles traveling on the traffic aisle that runs along the north edge of the project site be prevented from taking a direct path along this access to San Diego Street. One alternative for accomplishing this would be to physically obstruct movement along this aisle by extending landscaping across it. Another less drastic option would be to produce two one-way aisles immediately to the west of the San Diego Street access point by using narrow aisles on either side of a landscaped island in combination with a small amount of diagonal parking.

CONCLUSIONS

Because no off-site impacts were identified in the analysis, no off-site mitigation measures are recommended in conjunction with the proposed project. However, even though the project itself will discourage cut-through traffic, the potential increase in traffic on San Diego Street and Belmont Street warrants attention. It is recommended therefore that minor modifications to the site plan be undertaken to reduce the attractiveness of San Diego Street access and to further reduce cut through traffic.

STUDY REFERENCES

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APPENDIX A

Description of Intersection Capacity Analysis CCTA Signalized Methodology Unsignalized Method

.60 DESCRIPTION OF INTERSECTION CAPACITY ANALYSIS
CCTA SIGNALIZED METHODOLOGY

Background

The CCTA intersection capacity analysis methodology is described in detail in the Technical Procedures Manual of the CCTA, January, 1991. It is identical to the Circular 212 Planning methodology except that the lane capacity has been increased from 1500 vph to between 1650 to 1800 vph based on saturation flow measurements taken at four intersections in Contra Costa County. (See following Table 9 from the Technical Procedures Manual.)

On average, saturation flow rates for left-turn lanes were over ten percent lower than for through lanes. However, insufficient data was collected to provide statistical accuracy for the averages. Thus, saturation flow rates for through lanes are equal to those for turn lanes.

This methodology determines the critical movement for each phase of traffic. It then sums the critical volume-to-capacity ratio by phase to determine the intersection volume-to-capacity ratio. Circular 212, on the other hand, sums the critical movement volumes themselves and compares them to the total capacity of the intersection to determine, in effect, the volume-to-capacity ratio of the intersection as a whole.

Level of Service

The volume-to-capacity ratio is related to level of service (LOS). The following level of service for Signalized Intersections depicts the relationship between the volume-to-capacity ratio and level of service. An intersection operating at capacity would operate at LOS E. Level of Service F is not possible for existing conditions, but can be forecasted for future conditions when volume projections exceed existing capacities.

Input Data

The intersection capacity work sheets use a code to identify different lane configurations. This nomenclature is described on the following Description of Lane Configurations. Right turn on red adjustments are accounted for as well as unequal distribution of turn volumes in double turn lanes. For more information, see Circular 212 and the CCTA Technical Procedures Manual.

LEVEL OF SERVICE RANGES

LOS	VOLUME TO CAPACITY RATIO	MAXIMUM SUM OF CRITICAL VOLUMES		
		2-Phase	3-Phase	4+-Phase
A	≤ 0.60	1,080	1,030	990
B	0.61 - 0.70	1,260	1,200	1,160
C	0.71 - 0.80	1,440	1,380	1,320
D	0.81 - 0.90	1,620	1,550	1,490
E	0.91 - 1.00	1,800	1,720	1,650
F	----------Not Applicable----------			

Source: Contra Costa County Growth Management Program, Technical Procedures, Table 9.

Level of Service for Signalized Intersections

Level of Service	Type of Flow	Delay	Maneuverability	V/C Ratio
A	Stable Flow	Very slight or no delay. If signalized, conditions are such that no approach phase is fully utilized by traffic and no vehicle waits longer than one red indication.	Turning movements are easily made, and nearly all drivers find freedom of operation.	0.00-0.60
B	Stable Flow	Slight delay. If signalized, an occasional approach phase is fully utilized.	Vehicle platoons are formed. Many drivers begin to feel somewhat restricted within groups of vehicles.	0.61-0.70
C	Stable Flow	Acceptable delay. If signalized, a few drivers arriving at the end of a queue may occasionally have to wait through one signal cycle.	Back-ups may develop behind turning vehicles. Most drivers feel somewhat restricted.	0.71-0.80
D	Approaching Unstable Flow	Tolerable delay. Delays may be substantial during short periods, but excessive back ups do not occur.	Maneuverability is severely limited during short periods due to temporary back ups.	0.81-0.90
E	Unstable Flow	Intolerable delay. Delay may be great—up to several signal cycles.	There are typically long queues of vehicles waiting upstream of the intersection.	0.91-1.00
F	Forced Flow	Excessive delay	Jammed conditions. Back ups from other locations restrict or prevent movement. Volumes may vary widely, depending principally on the downstream back-up conditions.	Varies[1]

Notes: 1. In general, volume-to-capacity ratios cannot be greater than 1.00, unless the lane capacity assumptions are too low. Also, if future demand projections are considered for analytical purposes, a ratio greater than 1.00 might be obtained, indicating that the projected demand would exceed the capacity.

References: *Highway Capacity Manual, Special Report No. 209*, Transportation Research Board, 1985.
Highway Capacity Manual, Special Report No. 87, Highway Research Board, 1965.
TJKM.

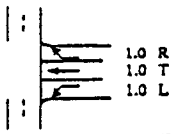
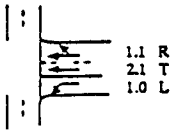
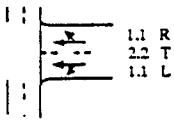
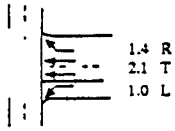
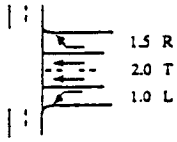
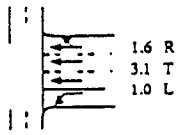
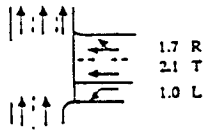
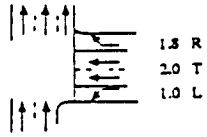
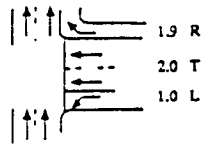
los_desc.tab

DESCRIPTION OF LANE CONFIGURATION FORMAT

The number of lanes and the use of the lanes is denoted with a special nomenclature described below:

Lane Nomenclature

X.Y Where X Denotes the total number of lanes available for a particular movement.
Y Denotes how the lanes are used.

When Y is . . .	. . . The following applies:
0 	A lane used exclusively for a particular movement (i.e. exclusive left-turn lane).
1 	A lane which is shared, that is, either of two different movements can be made from a particular lane (i.e. a lane which is shared by through and right-turn traffic).
2 	Denotes two or more through lanes in which two lanes are shared, one with left-turn traffic, the other with right-turn traffic.
3	Denotes an expressway through movement.
4 	Denotes a right-turn movement from a wide outside lane where right-turn vehicles can bypass through traffic sharing the lane to make a right-turn on red.
5 	Denotes a right-turn movement from an exclusive right-turn lane with a right-turn arrow and prohibition on the conflicting U-turn movement.
6 	Denotes a right-turn movement from a shared lane with a right-turn arrow and prohibition on the conflicting U-turn movement.
7,8,9	Denotes a turning movement which has a separate lane to turn into, as shown below:
7 	Turn lane which is shared with a through lane or left-turn lane and under signal control, and which has its own lane to turn into. There must be at least two through lanes.
8 	Exclusive turn lane which is under signal control, and which has its own lane to turn into.
9 	Exclusive turn lane not under signal control and which has an exclusive lane to turn into, often referred to as a "free" turn. Since the volumes in this lane do not conflict with other intersection movements, the V/C ratio of the free right-turn movement is not included in the sum of critical V/C ratios.

DESCRIPTION OF INTERSECTION CAPACITY ANALYSIS UNSIGNALIZED 1994 METHOD

Background

The method of unsignalized intersection capacity analysis used in this study is from Chapter 10, "Unsignalized Intersections" of the *Highway Capacity Manual, Special Report No. 209*, Transportation Research Road, Updated October 1994

This method applies to two-way STOP sign or YIELD sign controlled intersections (or one-way STOP sign or YIELD sign controlled intersections at three-way intersections). At such intersections, drivers on the minor street are forced to use judgment when selecting gaps in the major flow through which to execute crossing or turning maneuvers. Thus, the capacity of the controlled legs of an intersection is based on two factors:

1. The distribution of gaps in the major street traffic stream.
2. Driver judgment in selecting gaps through which to execute their desired maneuvers.
3. Follow-up time required to move into the front-of-queue position

It is assumed that gaps in the traffic stream are randomly distributed. For this reason, the methodology will be less reliable in situations in which the conflicting flows are strongly platooned, as would be the case at many urban intersections where the major street is part of a signalized network.

This method assumes that major street traffic is not affected by minor street flows. This assumption is generally good for periods when the operation is smooth and uncongested. (When congestion occurs, it is likely that major street traffic will experience some impedance due to minor street traffic.) Left turns from the major street are assumed to be affected by the opposing major street flow, and minor street traffic is affected by all conflicting movements.

Input Data

The general procedure to calculate the level of service is as follows:

1. Define existing geometric and volume conditions for the intersection under study.
2. Determine the conflicting traffic through which each minor street movement and the major street left-turn must cross.
3. Determine the size of the gap in the conflicting traffic stream needed by vehicles in each movement crossing the conflicting traffic stream.
4. Determine the capacity of the gaps in the major traffic stream to accommodate each of the subject movements that will utilize these gaps.
5. Adjust the capacities found to account for impedance and the use of shared lanes.

DESCRIPTION OF TRB ALL-WAY STOP CONTROLLED INTERSECTION CAPACITY ANALYSIS

This method is described in the Transportation Research Board's Circular number 373. The methodology reports level of service results in terms of average delay per vehicle. Delay is reported per approach as well as intersection-wide. Table I summarizes the relationship between approach delay and LOS for this methodology.

Table I

TRB All-Way STOP Method LOS Ranges

LOS	Average Stopped Delay, sec
A	< 5
B	5 - 10
C	10 - 20
D	20 - 30
E	30 - 45
F	> 45

The approach delay is calculated by the following equation:

$$Delay = e^{\frac{3.8}{v/c}}$$

where:

v = Approach volume, vph;
c = Approach capacity, vph; and
e = Base of natural logarithms.

The approach capacity, *c*, is calculated as follows:

$$c = 1000V_{ps} + 700V_{po} + 200L_s - 100L_o - 300LT_{po} + 200RT_{po} - 300LT_{pc} + 300RT_{pc}$$

where:

V_{ps} = Proportion of the intersection volume on the subject approach;
V_{po} = Proportion of the intersection volume on the opposing approach;
L_s = Number of Lanes on subject approach;
L_o = Number of Lanes on opposing approach;
LT_{po} = Proportion of volume on the opposing approach turning left;
RT_{po} = Proportion of volume on the opposing approach turning right;
LT_{pc} = Proportion of volume on conflicting approaches turning left;
RT_{pc} = Proportion of volume on conflicting approaches turning right.

The model from which this method is derived predicts most effectively when the input volumes and geometrics fall within a certain range of parameters relating to evenly balanced flow throughout the intersection and on each individual approach. Table II indicates the parameter ranges considered acceptable.

Table II

Range of Valid Input Conditions

Parameter	Subject Approach	Opposing Approach	Conflicting Approach
Volume distribution (proportion)	0.20 - 0.50	0.00 - 0.50	0.20 - 0.50
Number of Approach Lanes	1 - 3	0 - 3	1 - 5
Proportion of Left Turns	---	0.00 - 0.35	0.00 - 0.35
Proportion of Right Turns	---	0.00 - 0.35	0.00 - 0.35

APPENDIX B

Results of the Intersection Capacity Analysis
Existing Conditions

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing Conditions 03/19/96

INTERSECTION 1 Pierce Street/Central Ave Richmond
Count Date 7/12/94 Time 4:00-6:00 pm Peak Hour 5:00-6:00 pm

CCTA METHOD 2-PHASE SIGNAL

RIGHT THRU LEFT
0 3 4

LEFT 61 --- 1.1 1.1 1.1 1.1 1.1 --- 7 RIGHT
Split? N

THRU 1058 ---> 2.2 (NO. OF LANES) 2.2<--- 660 THRU

RIGHT 83 --- 1.1 1.1 1.1 1.1 1.1 --- 73 LEFT

N
W + E
S

129 35 88
LEFT THRU RIGHT Split? N

STREET NAME: Central Ave

SIG WARRANTS: Urb=Y, Rur=Y

STREET NAME: Pierce Street

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	88	88	1800	0.0489	
	THRU (T)	35	35	1800	0.0194	
	LEFT (L)	129	129	1800	0.0717	
	T + R		123	1800	0.0683	
	T + L		164	1800	0.0911	
	T + R + L		252	1800	0.1400	0.1400
SB	RIGHT (R)	0	0	1800	0.0000	
	THRU (T)	3	3	1800	0.0017	
	LEFT (L)	4	4	1800	0.0022	0.0022
	T + R		3	1800	0.0017	
	T + L		7	1800	0.0039	
	T + R + L		7	1800	0.0039	
EB	RIGHT (R)	83	83	1800	0.0461	
	THRU (T)	1058	1058	3600	0.2939	
	LEFT (L)	61	61	1800	0.0339	
	T + R		1141	3600	0.3169	
	T + L		1119	3600	0.3108	
	T + R + L		1202	3600	0.3339	0.3339
WB	RIGHT (R)	7	7	1800	0.0039	
	THRU (T)	660	660	3600	0.1833	
	LEFT (L)	73	73	1800	0.0406	0.0406
	T + R		667	3600	0.1853	
	T + L		733	3600	0.2036	
	T + R + L		740	3600	0.2056	

TOTAL VOLUME-TO-CAPACITY RATIO: 0.52
INTERSECTION LEVEL OF SERVICE: A

* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing Conditions 03/18/96

INTERSECTION 2 Carlson Blvd/Central Ave Richmond
Count Date 7/12/94 Time 4:00-6:00 pm Peak Hour 5:00-6:00 pm

CCTA METHOD 5-PHASE SIGNAL

RIGHT THRU LEFT
37 181 56

Split? N

LEFT	74	---	1.1	1.1	2.1	1.0	1.1	---	106	RIGHT
THRU	708	--->	2.2	(NO. OF LANES)			2.2	<---	337	THRU
RIGHT	296	---	1.1	1.0	2.1	1.1	1.1	---	12	LEFT

STREET NAME: Central Ave

N
W + E
S

209 446 44
LEFT THRU RIGHT Split? N

SIG WARRANTS: Urb=Y, Rur=Y

STREET NAME: Carlson Blvd

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	44	44	1650	0.0267	
	THRU (T)	446	446	3300	0.1352	
	LEFT (L)	209	209	1650	0.1267	0.1267
	T + R		490	3300	0.1485	
SB	RIGHT (R)	37	37	1650	0.0224	
	THRU (T)	181	181	3300	0.0548	
	LEFT (L)	56	56	1650	0.0339	
	T + R		218	3300	0.0661	0.0661
EB	RIGHT (R)	296	296	1650	0.1794	
	THRU (T)	708	708	3300	0.2145	
	LEFT (L)	74	74	1650	0.0448	
	T + R		1004	3300	0.3042	
	T + L		782	3300	0.2370	
	T + R + L		1078	3300	0.3267	0.3267
WB	RIGHT (R)	106	106	1650	0.0642	
	THRU (T)	337	337	3300	0.1021	
	LEFT (L)	12	12	1650	0.0073	0.0073
	T + R		443	3300	0.1342	
	T + L		349	3300	0.1058	
	T + R + L		455	3300	0.1379	

TOTAL VOLUME-TO-CAPACITY RATIO: 0.53
INTERSECTION LEVEL OF SERVICE: A

* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing Conditions 03/18/96

INTERSECTION 3 San Pablo Ave/Central Ave Richmond
Count Date 7/12/94 Time 4:00-6:00 pm Peak Hour 5:00-6:00 pm

CCTA METHOD 6-PHASE SIGNAL

RIGHT THRU LEFT
141 531 69

							Split? N		
LEFT	431	---	1.1	1.1	2.1	1.0	1.1	--- 67	RIGHT
THRU	252	--->	2.1	(NO. OF LANES)			2.2	<--- 197	THRU
RIGHT	73	---	1.0	1.0	2.1	1.1	1.1	--- 50	LEFT

STREET NAME: Central Ave

SIG WARRANTS: Urb-Y, Rur-Y

N
W + E
S

129 1050 61
LEFT THRU RIGHT Split? N

STREET NAME: San Pablo Ave

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	61	61	1650	0.0370	
	THRU (T)	1050	1050	3300	0.3182	
	LEFT (L)	129	129	1650	0.0782	
	T + R		1111	3300	0.3367	0.3367
SB	RIGHT (R)	141	141	1650	0.0855	
	THRU (T)	531	531	3300	0.1609	
	LEFT (L)	69	69	1650	0.0418	0.0418
	T + R		672	3300	0.2036	
EB	RIGHT (R)	73	0 *	1650	0.0000	
	THRU (T)	252	252	3300	0.0764	
	LEFT (L)	431	431	1650	0.2612	0.2612
	T + L		683	3300	0.2070	
WB	RIGHT (R)	67	67	1650	0.0406	
	THRU (T)	197	197	3300	0.0597	
	LEFT (L)	50	50	1650	0.0303	
	T + R		264	3300	0.0800	
	T + L		247	3300	0.0748	
	T + R + L		314	3300	0.0952	0.0952

TOTAL VOLUME-TO-CAPACITY RATIO: 0.73
INTERSECTION LEVEL OF SERVICE: C

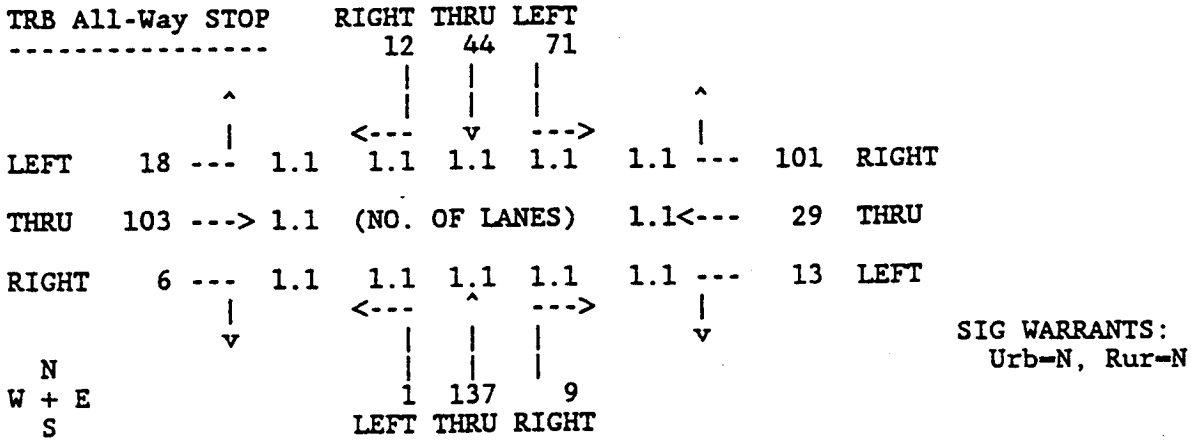
* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing Conditions 03/18/96

INTERSECTION 4 Pierce Street/Solano Avenue Richmond
Count Date 7/13/94 Time 4:00-6:00 PM Peak Hour 5:00-6:00 PM

TRB All-Way STOP



SIG WARRANTS:
Urb-N, Rur-N

RANGE CHECK VALUE	MIN	MAX	NB	SB	EB	WB
VOLUME PROPORTION	0.20	0.50	0.27	0.23	0.23	0.26
APPROACH LANES	1	3	1	1	1	1
LEFT TURN PROPORTION	0.00	0.35	0.01	0.56*	0.14	0.09
RIGHT TURN PROPORTION	0.00	0.35	0.06	0.10	0.05	0.70*

* - VALUE LIES OUTSIDE VALID INPUT RANGE. USE RESULTS WITH CAUTION.

APP	ORIGINAL VOLUME	PEAK HOUR FACTOR -LT-	-TH-	-RT-	ADJUSTED VOLUME	CAPACITY	V/C	DELAY	LOS
NB	147	0.95	0.95	0.95	154	468	0.33	3.5	A
SB	127	0.95	0.95	0.95	134	616	0.22	2.3	A
EB	127	0.95	0.95	0.95	133	574	0.23	2.4	A
WB	143	0.95	0.95	0.95	151	437	0.35	3.7	A

DELAY= 3.0 SEC/VEH LOS= A

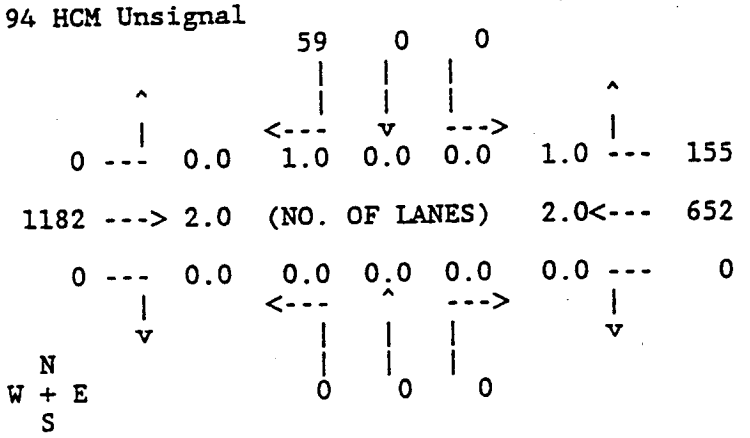
INT-BRL-EX.INT,VOL-BRL-EX.PMV,CAP-C:..LOSCAP.TAB

LOS Software Licensed to by TJKM

Condition: PM PEAK - Existing Conditons 03/21/96

INTERSECTION 5 Pierce Street/Buchanan Street Richmond
Count Date 7/13/94 Time 4:00-6:00 PM Peak Hour 5:00-6:00 PM

94 HCM Unsignal



N/S CONTROL: STOP
E/W CONTROL: NONE
MAJ ST SAT FLOW:
Th= 0, Rt= 0

CRITICAL GAP ADJUST

	LEFT	THRU	RIGHT
SB	---	---	0.0
EB	---	---	---
WB	---	---	---

SIGNAL WARRANTS:
Urb=N, Rur=N

ACCEL LANE FOR LT	% SU/RV	% COMBO VEH	% MOTOR CYCLE	PEAK HOUR FACTOR LEFT	PEAK HOUR FACTOR THRU	PEAK HOUR FACTOR RGHT
N	0	0	0	0.95	0.95	0.95
-	0	0	0	0.95	0.95	0.95
-	0	0	0	0.95	0.95	0.95

MOVEMENT	ORIG VOL	ADJ VOL	ADJ GAP	CONFL VOL	POT CAP	ACT CAP	MVMT DELAY	MVT LOS	APP DELAY	APP LOS	
SB R	59	68	5.5	326	947	947	4.1	A	4.1	A	A
EB T	1182	1369					0.0	A	0.0	A	A
WB T	652	755					0.0	A	0.0	A	
R	155	179					0.0	A			

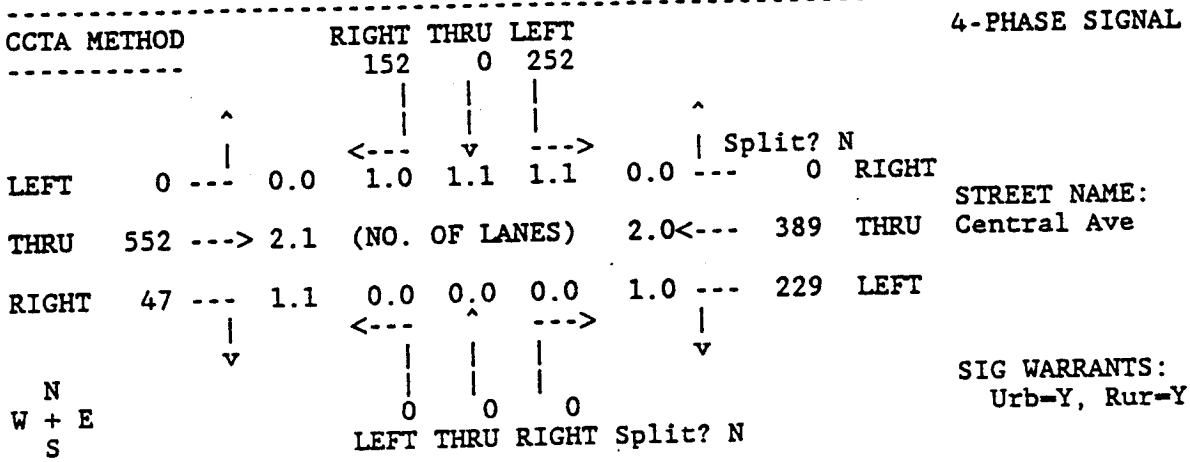
DELAY= 0.1 SEC/VEH LOS=A

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing Conditions 03/18/96

INTERSECTION 6 I-80 SB Ramps/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 4-PHASE SIGNAL



STREET NAME: Central Ave

SIG WARRANTS: Urb=Y, Rur=Y

STREET NAME: I-80 SB Ramps

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
SB	RIGHT (R)	152	152	1650	0.0921	
	THRU (T)	0	0	1650	0.0000	
	LEFT (L)	252	252	1650	0.1527	0.1527
	T + L		252	1650	0.1527	
EB	RIGHT (R)	47	47	1650	0.0285	
	THRU (T)	552	552	3300	0.1673	
	T + R		599	3300	0.1815	0.1815
WB	THRU (T)	389	389	3300	0.1179	
	LEFT (L)	229	229	1650	0.1388	0.1388

TOTAL VOLUME-TO-CAPACITY RATIO: 0.47
INTERSECTION LEVEL OF SERVICE: A

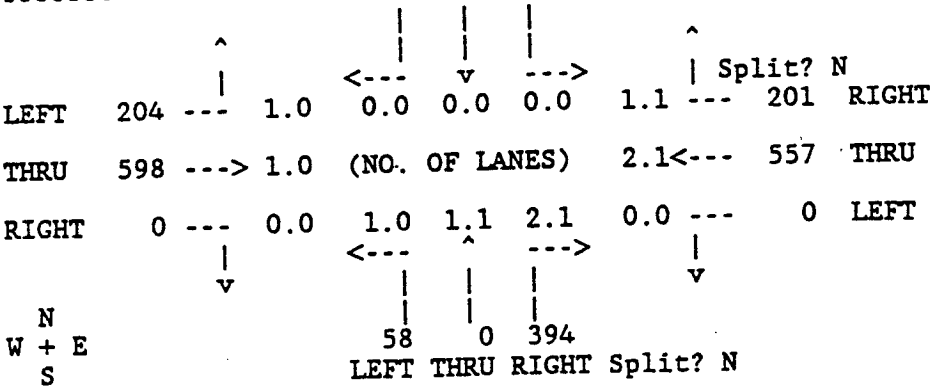
* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing Conditions 03/19/96

INTERSECTION 7 I-80 NB Ramps/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 4-PHASE SIGNAL



STREET NAME: Central Ave

SIG WARRANTS: Urb=Y, Rur=Y

STREET NAME: I-80 NB Ramps

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	394	394	3000	0.1313	0.1313
	THRU (T)	0	0	1650	0.0000	
	LEFT (L)	58	58	1650	0.0352	
	T + R		394	3000	0.1313	
EB	THRU (T)	598	598	1650	0.3624	0.3624
	LEFT (L)	204	204	1650	0.1236	
WB	RIGHT (R)	201	201	1650	0.1218	
	THRU (T)	557	557	3300	0.1688	
	T + R		758	3300	0.2297	

TOTAL VOLUME-TO-CAPACITY RATIO: 0.49
INTERSECTION LEVEL OF SERVICE: A

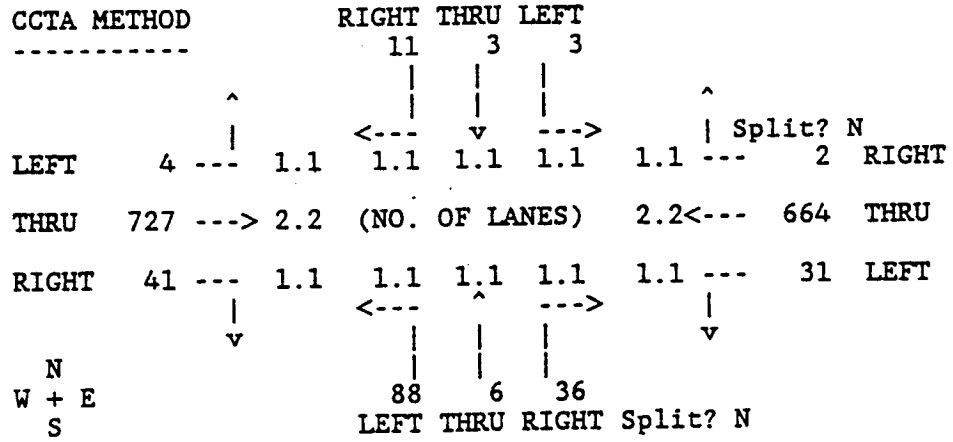
* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: SUNDAY PEAK - Existing Conditions 03/19/96

INTERSECTION 1 Pierce Street/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 2-PHASE SIGNAL



STREET NAME: Central Ave

SIG WARRANTS: Urb=N, Rur=Y

STREET NAME: Pierce Street

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	36	36	1800	0.0200	
	THRU (T)	6	6	1800	0.0033	
	LEFT (L)	88	88	1800	0.0489	
	T + R		42	1800	0.0233	
	T + L		94	1800	0.0522	
	T + R + L		130	1800	0.0722	0.0722
SB	RIGHT (R)	11	11	1800	0.0061	
	THRU (T)	3	3	1800	0.0017	
	LEFT (L)	3	3	1800	0.0017	0.0017
	T + R		14	1800	0.0078	
	T + L		6	1800	0.0033	
	T + R + L		17	1800	0.0094	
EB	RIGHT (R)	41	41	1800	0.0228	
	THRU (T)	727	727	3600	0.2019	
	LEFT (L)	4	4	1800	0.0022	
	T + R		768	3600	0.2133	
	T + L		731	3600	0.2031	
	T + R + L		772	3600	0.2144	0.2144
WB	RIGHT (R)	2	2	1800	0.0011	
	THRU (T)	664	664	3600	0.1844	
	LEFT (L)	31	31	1800	0.0172	0.0172
	T + R		666	3600	0.1850	
	T + L		695	3600	0.1931	
	T + R + L		697	3600	0.1936	

TOTAL VOLUME-TO-CAPACITY RATIO: 0.31
INTERSECTION LEVEL OF SERVICE: A

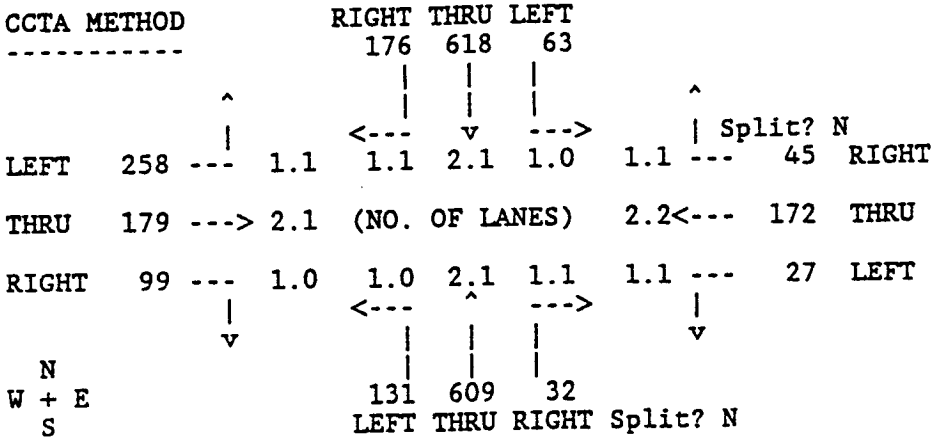
* ADJUSTED FOR RIGHT TURN ON RED
INT-BRL-EX.INT,VOL-BRU-EXSU.MMV,CAP-C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: SUNDAY PEAK - Existing Conditions 03/19/96

INTERSECTION 3 San Pablo Ave/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 6-PHASE SIGNAL



STREET NAME: Central Ave

SIG WARRANTS: Urb=Y, Rur=Y

STREET NAME: San Pablo Ave

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	32	32	1650	0.0194	
	THRU (T)	609	609	3300	0.1845	
	LEFT (L)	131	131	1650	0.0794	0.0794
	T + R		641	3300	0.1942	
SB	RIGHT (R)	176	176	1650	0.1067	
	THRU (T)	618	618	3300	0.1873	
	LEFT (L)	63	63	1650	0.0382	
	T + R		794	3300	0.2406	0.2406
EB	RIGHT (R)	99	0 *	1650	0.0000	
	THRU (T)	179	179	3300	0.0542	
	LEFT (L)	258	258	1650	0.1564	0.1564
	T + L		437	3300	0.1324	
WB	RIGHT (R)	45	45	1650	0.0273	
	THRU (T)	172	172	3300	0.0521	
	LEFT (L)	27	27	1650	0.0164	
	T + R		217	3300	0.0658	
	T + L		199	3300	0.0603	
	T + R + L		244	3300	0.0739	0.0739

TOTAL VOLUME-TO-CAPACITY RATIO: 0.55
INTERSECTION LEVEL OF SERVICE: A

* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRU-EXSU.MMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: SUNDAY PEAK - Existing Conditions 03/19/96

INTERSECTION 7 I-80 NB Ramps/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 4-PHASE SIGNAL

RIGHT THRU LEFT
0 0 0

| | |
<--- v --->

LEFT 164 --- 1.0 0.0 0.0 0.0 1.1 --- 167 RIGHT
Split? N

THRU 458 ---> 1.0 (NO. OF LANES) 2.1<--- 540 THRU

RIGHT 0 --- 0.0 1.0 1.1 2.1 0.0 --- 0 LEFT

<--- ^ ---> |
| | | v
| | |

N
W + E 57 5 323
S LEFT THRU RIGHT Split? N

STREET NAME: Central Ave

SIG WARRANTS: Urb-Y, Rur-Y

STREET NAME: I-80 NB Ramps

MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB RIGHT (R)	323	323	3000	0.1077	
THRU (T)	5	5	1650	0.0030	
LEFT (L)	57	57	1650	0.0345	
T + R		328	3000	0.1093	0.1093
EB THRU (T)	458	458	1650	0.2776	
LEFT (L)	164	164	1650	0.0994	0.0994
WB RIGHT (R)	167	167	1650	0.1012	
THRU (T)	540	540	3300	0.1636	
T + R		707	3300	0.2142	0.2142

TOTAL VOLUME-TO-CAPACITY RATIO: 0.42
INTERSECTION LEVEL OF SERVICE: A

* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRU-EXSU.MMV,CAP=C:..LOSCAP.TAB

APPENDIX C

Results of the Intersection Capacity Analysis
Existing plus Project Conditions (Weekday P.M. Peak)

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project 03/19/96

INTERSECTION 1 Pierce Street/Central Ave Richmond
Count Date Time Peak Hour 5:00-6:00 pm

CCTA METHOD RIGHT THRU LEFT 2-PHASE SIGNAL

0 27 4

Split? N

LEFT	61	---	1.1	1.1	1.1	1.1	1.1	---	7	RIGHT
THRU	1058	--->	2.2	(NO. OF LANES)			2.2	<---	660	THRU
RIGHT	162	---	1.1	1.1	1.1	1.1	1.1	---	192	LEFT

STREET NAME: Central Ave

N
W + E
S

188 54 181
LEFT THRU RIGHT Split? N

SIG WARRANTS: Urb=Y, Rur=Y

STREET NAME: Pierce Street

MOVEMENT		ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	181	181	1800	0.1006	
	THRU (T)	54	54	1800	0.0300	
	LEFT (L)	188	188	1800	0.1044	
	T + R		235	1800	0.1306	
	T + L		242	1800	0.1344	
	T + R + L		423	1800	0.2350	0.2350
SB	RIGHT (R)	0	0	1800	0.0000	
	THRU (T)	27	27	1800	0.0150	
	LEFT (L)	4	4	1800	0.0022	0.0022
	T + R		27	1800	0.0150	
	T + L		31	1800	0.0172	
	T + R + L		31	1800	0.0172	
EB	RIGHT (R)	162	162	1800	0.0900	
	THRU (T)	1058	1058	3600	0.2939	
	LEFT (L)	61	61	1800	0.0339	
	T + R		1220	3600	0.3389	
	T + L		1119	3600	0.3108	
	T + R + L		1281	3600	0.3558	0.3558
WB	RIGHT (R)	7	7	1800	0.0039	
	THRU (T)	660	660	3600	0.1833	
	LEFT (L)	192	192	1800	0.1067	0.1067
	T + R		667	3600	0.1853	
	T + L		852	3600	0.2367	
	T + R + L		859	3600	0.2386	

TOTAL VOLUME-TO-CAPACITY RATIO: 0.70
INTERSECTION LEVEL OF SERVICE: B

* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV+BRUASIA.PMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project w/CLOSURE 03/19/96

INTERSECTION 1 Pierce Street/Central Ave Richmond
Count Date Time Peak Hour 5:00-6:00 pm

CCTA METHOD RIGHT THRU LEFT 2-PHASE SIGNAL

0 27 4

Split? N

LEFT 66 --- 1.1 1.1 1.1 1.1 1.1 --- 7 RIGHT

STREET NAME:

THRU 1151 ---> 2.2 (NO. OF LANES) 2.2<--- 660 THRU Central Ave

RIGHT 194 --- 1.1 1.1 1.1 1.1 1.1 --- 192 LEFT

N
W + E
S

331 37 131

LEFT THRU RIGHT Split? N

SIG WARRANTS:
Urb-Y, Rur-Y

STREET NAME: Pierce Street

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	131	131	1800	0.0728	
	THRU (T)	37	37	1800	0.0206	
	LEFT (L)	331	331	1800	0.1839	
	T + R		168	1800	0.0933	
	T + L		368	1800	0.2044	
	T + R + L		499	1800	0.2772	0.2772
SB	RIGHT (R)	0	0	1800	0.0000	
	THRU (T)	27	27	1800	0.0150	
	LEFT (L)	4	4	1800	0.0022	0.0022
	T + R		27	1800	0.0150	
	T + L		31	1800	0.0172	
	T + R + L		31	1800	0.0172	
EB	RIGHT (R)	194	194	1800	0.1078	
	THRU (T)	1151	1151	3600	0.3197	
	LEFT (L)	66	66	1800	0.0367	
	T + R		1345	3600	0.3736	
	T + L		1217	3600	0.3381	
	T + R + L		1411	3600	0.3919	0.3919
WB	RIGHT (R)	7	7	1800	0.0039	
	THRU (T)	660	660	3600	0.1833	
	LEFT (L)	192	192	1800	0.1067	0.1067
	T + R		667	3600	0.1853	
	T + L		852	3600	0.2367	
	T + R + L		859	3600	0.2386	

TOTAL VOLUME-TO-CAPACITY RATIO: 0.78
INTERSECTION LEVEL OF SERVICE: C

* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV+BRUCLOSD.PMV+CLOSURE.PMV,CAP=C:..LOSCAP.

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project 03/19/96

INTERSECTION 2 Carlson Blvd/Central Ave Richmond
Count Date Time Peak Hour 5:00-6:00 pm

CCTA METHOD 5-PHASE SIGNAL

RIGHT THRU LEFT
75 181 56

| | | |
v v v

LEFT 104 ---> 1.1 1.1 2.1 1.0 1.1 ---> 106 RIGHT
Split? N

THRU 782 ---> 2.2 (NO. OF LANES) 2.2<--- 431 THRU

RIGHT 296 ---> 1.1 1.0 2.1 1.1 1.1 ---> 12 LEFT
| ^ | ^
v | v |

N | | |
W + E 209 446 44
S LEFT THRU RIGHT Split? N

STREET NAME: Central Ave

SIG WARRANTS: Urb-Y, Rur-Y

STREET NAME: Carlson Blvd

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	44	44	1650	0.0267	
	THRU (T)	446	446	3300	0.1352	
	LEFT (L)	209	209	1650	0.1267	0.1267
	T + R		490	3300	0.1485	
SB	RIGHT (R)	75	75	1650	0.0455	
	THRU (T)	181	181	3300	0.0548	
	LEFT (L)	56	56	1650	0.0339	
	T + R		256	3300	0.0776	0.0776
EB	RIGHT (R)	296	296	1650	0.1794	
	THRU (T)	782	782	3300	0.2370	
	LEFT (L)	104	104	1650	0.0630	
	T + R		1078	3300	0.3267	
	T + L		886	3300	0.2685	
	T + R + L		1182	3300	0.3582	0.3582
WB	RIGHT (R)	106	106	1650	0.0642	
	THRU (T)	431	431	3300	0.1306	
	LEFT (L)	12	12	1650	0.0073	0.0073
	T + R		537	3300	0.1627	
	T + L		443	3300	0.1342	
	T + R + L		549	3300	0.1664	

TOTAL VOLUME-TO-CAPACITY RATIO: 0.57
INTERSECTION LEVEL OF SERVICE: A

* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV+BRUASIA.PMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project w/CLOSURE 03/19/96

INTERSECTION 2 Carlson Blvd/Central Ave Richmond
Count Date Time Peak Hour 5:00-6:00 pm

CCTA METHOD 5-PHASE SIGNAL

RIGHT THRU LEFT
75 181 56

LEFT	104	--->	1.1	1.1	2.1	1.0	1.1	---	106	RIGHT
THRU	782	--->	2.2	(NO. OF LANES)			2.2	<---	431	THRU
RIGHT	296	---	1.1	1.0	2.1	1.1	1.1	---	12	LEFT

Split? N

STREET NAME: Central Ave

N
W + E
S

209 446 44
LEFT THRU RIGHT Split? N

SIG WARRANTS: Urb-Y, Rur-Y

STREET NAME: Carlson Blvd

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	44	44	1650	0.0267	
	THRU (T)	446	446	3300	0.1352	
	LEFT (L)	209	209	1650	0.1267	0.1267
	T + R		490	3300	0.1485	
SB	RIGHT (R)	75	75	1650	0.0455	
	THRU (T)	181	181	3300	0.0548	
	LEFT (L)	56	56	1650	0.0339	
	T + R		256	3300	0.0776	0.0776
EB	RIGHT (R)	296	296	1650	0.1794	
	THRU (T)	782	782	3300	0.2370	
	LEFT (L)	104	104	1650	0.0630	
	T + R		1078	3300	0.3267	
	T + L		886	3300	0.2685	
	T + R + L		1182	3300	0.3582	0.3582
WB	RIGHT (R)	106	106	1650	0.0642	
	THRU (T)	431	431	3300	0.1306	
	LEFT (L)	12	12	1650	0.0073	0.0073
	T + R		537	3300	0.1627	
	T + L		443	3300	0.1342	
	T + R + L		549	3300	0.1664	

TOTAL VOLUME-TO-CAPACITY RATIO: 0.57
INTERSECTION LEVEL OF SERVICE: A

* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV+BRUCLOSD.PMV+CLOSURE.PMV,CAP=C:..LOSCAP.

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project 03/19/96

INTERSECTION 3 San Pablo Ave/Central Ave Richmond
Count Date Time Peak Hour 5:00-6:00 pm

CCTA METHOD 6-PHASE SIGNAL

RIGHT THRU LEFT
188 531 69

LEFT 468 --- 1.1 1.1 2.1 1.0 1.1 --- 67 RIGHT
Split? N

THRU 289 ---> 2.1 (NO. OF LANES) 2.2<--- 244 THRU

RIGHT 73 --- 1.0 1.0 2.1 1.1 1.1 --- 50 LEFT

N
W + E
S

129 1050 61
LEFT THRU RIGHT Split? N

STREET NAME: Central Ave

SIG WARRANTS: Urb=Y, Rur=Y

STREET NAME: San Pablo Ave

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	61	61	1650	0.0370	
	THRU (T)	1050	1050	3300	0.3182	
	LEFT (L)	129	129	1650	0.0782	
	T + R		1111	3300	0.3367	0.3367
SB	RIGHT (R)	188	188	1650	0.1139	
	THRU (T)	531	531	3300	0.1609	
	LEFT (L)	69	69	1650	0.0418	0.0418
	T + R		719	3300	0.2179	
EB	RIGHT (R)	73	0 *	1650	0.0000	
	THRU (T)	289	289	3300	0.0876	
	LEFT (L)	468	468	1650	0.2836	0.2836
	T + L		757	3300	0.2294	
WB	RIGHT (R)	67	67	1650	0.0406	
	THRU (T)	244	244	3300	0.0739	
	LEFT (L)	50	50	1650	0.0303	
	T + R		311	3300	0.0942	
	T + L		294	3300	0.0891	
	T + R + L		361	3300	0.1094	0.1094

TOTAL VOLUME-TO-CAPACITY RATIO: 0.77
INTERSECTION LEVEL OF SERVICE: C

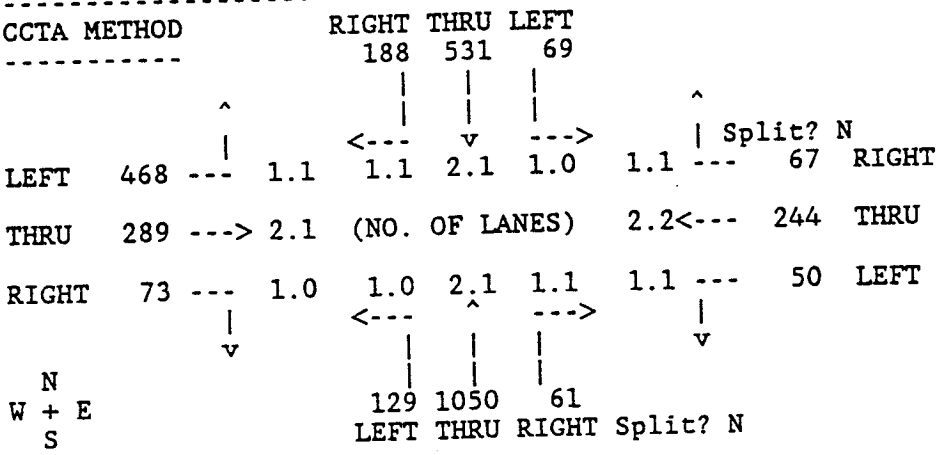
* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV+BRUASIA.PMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project w/CLOSURE 03/19/96

INTERSECTION 3 San Pablo Ave/Central Ave Richmond
Count Date Time Peak Hour 5:00-6:00 pm

CCTA METHOD 6-PHASE SIGNAL



STREET NAME: Central Ave

SIG WARRANTS: Urb=Y, Rur=Y

STREET NAME: San Pablo Ave

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	61	61	1650	0.0370	
	THRU (T)	1050	1050	3300	0.3182	
	LEFT (L)	129	129	1650	0.0782	
	T + R		1111	3300	0.3367	0.3367
SB	RIGHT (R)	188	188	1650	0.1139	
	THRU (T)	531	531	3300	0.1609	
	LEFT (L)	69	69	1650	0.0418	0.0418
	T + R		719	3300	0.2179	
EB	RIGHT (R)	73	0 *	1650	0.0000	
	THRU (T)	289	289	3300	0.0876	
	LEFT (L)	468	468	1650	0.2836	0.2836
	T + L		757	3300	0.2294	
WB	RIGHT (R)	67	67	1650	0.0406	
	THRU (T)	244	244	3300	0.0739	
	LEFT (L)	50	50	1650	0.0303	
	T + R		311	3300	0.0942	
	T + L		294	3300	0.0891	
	T + R + L		361	3300	0.1094	0.1094

TOTAL VOLUME-TO-CAPACITY RATIO: 0.77
INTERSECTION LEVEL OF SERVICE: C

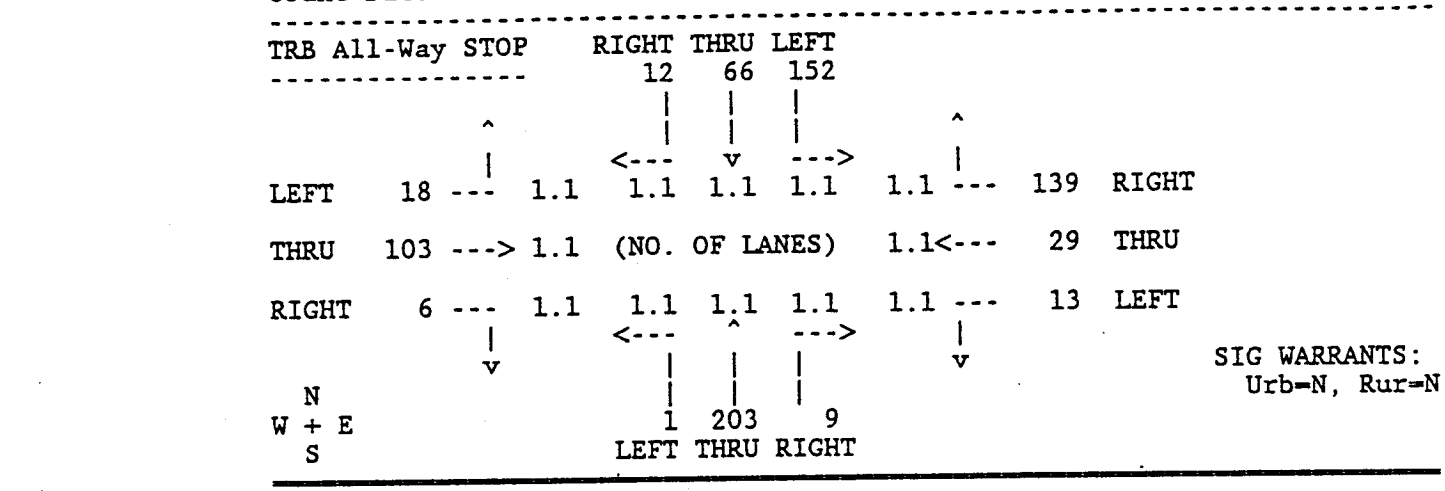
* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV+BRUCLOSD.PMV+CLOSURE.PMV,CAP=C:..LOSCAP.

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project 03/19/96

INTERSECTION 4 Pierce Street/Solano Avenue Richmond
Count Date Time Peak Hour 5:00-6:00 PM

TRB All-Way STOP



SIG WARRANTS:
Urb=N, Rur=N

RANGE CHECK VALUE	MIN	MAX	NB	SB	EB	WB
VOLUME PROPORTION	0.20	0.50	0.28	0.31	0.17*	0.24
APPROACH LANES	1	3	1	1	1	1
LEFT TURN PROPORTION	0.00	0.35	0.00	0.66*	0.14	0.07
RIGHT TURN PROPORTION	0.00	0.35	0.04	0.05	0.05	0.76*

* = VALUE LIES OUTSIDE VALID INPUT RANGE. USE RESULTS WITH CAUTION.

APP	ORIGINAL VOLUME	PEAK HOUR FACTOR -LT-	-TH-	-RT-	ADJUSTED VOLUME	CAPACITY	V/C	DELAY	LOS
NB	213	0.95	0.95	0.95	224	521	0.43	5.1	B
SB	230	0.95	0.95	0.95	242	722	0.34	3.6	A
EB	127	0.95	0.95	0.95	133	479	0.28	2.9	A
WB	181	0.95	0.95	0.95	191	336	0.57	8.7	B

DELAY= 5.1 SEC/VEH LOS= B

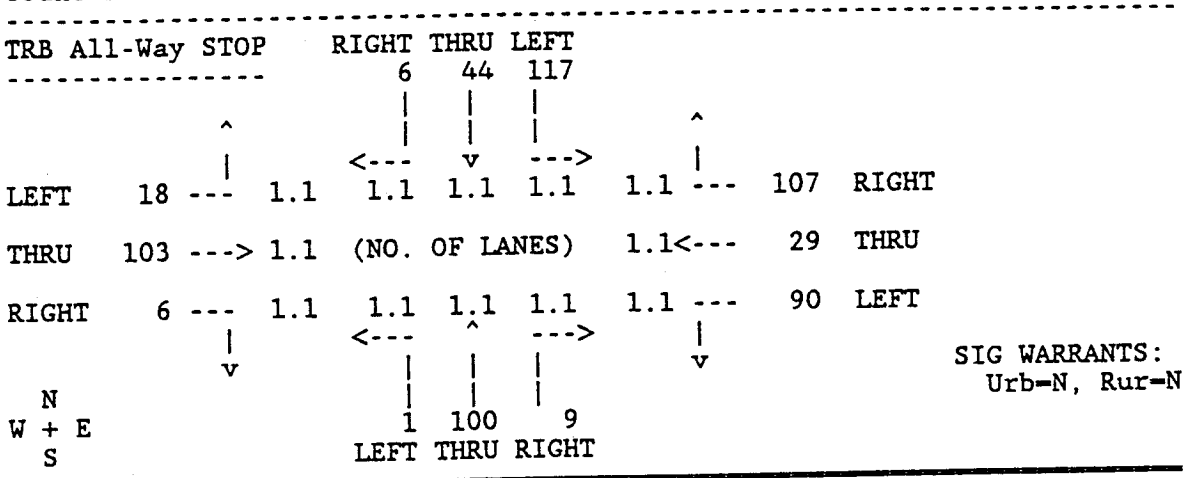
INT=BRL-EX.INT,VOL=BRL-EX.PMV+BRUASIA.PMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project w/CLOSURE 03/19/96

INTERSECTION 4 Pierce Street/Solano Avenue Richmond
Count Date Time Peak Hour 5:00-6:00 PM

TRB All-Way STOP



SIG WARRANTS:
Urb=N, Rur=N

RANGE CHECK VALUE	MIN	MAX	NB	SB	EB	WB
VOLUME PROPORTION	0.20	0.50	0.17*	0.26	0.20	0.36
APPROACH LANES	1	3	1	1	1	1
LEFT TURN PROPORTION	0.00	0.35	0.01	0.70*	0.14	0.40*
RIGHT TURN PROPORTION	0.00	0.35	0.08	0.03	0.05	0.47*

* = VALUE LIES OUTSIDE VALID INPUT RANGE. USE RESULTS WITH CAUTION.

APP	ORIGINAL VOLUME	PEAK HOUR FACTOR -LT-	-TH-	-RT-	ADJUSTED VOLUME	CAPACITY	V/C	DELAY	LOS
NB	110	0.95	0.95	0.95	115	259	0.44	5.4	B
SB	167	0.95	0.95	0.95	175	503	0.35	3.8	A
EB	127	0.95	0.95	0.95	133	416	0.32	3.4	A
WB	226	0.95	0.95	0.95	239	455	0.53	7.4	B

DELAY= 5.3 SEC/VEH LOS= B

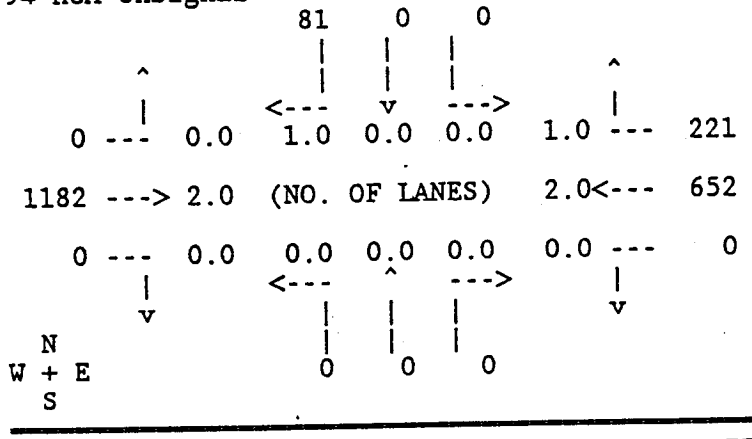
INT=BRL-EX.INT,VOL=BRL-EX.PMV+BRUCLOSD.PMV+CLOSURE.PMV,CAP=C:..LOSCAP.

LOS Software Licensed to by TJKM

Condition: PM PEAK - Existing plus Project 03/21/96

INTERSECTION 5 Pierce Street/Buchanan Street Richmond
Count Date Time Peak Hour 5:00-6:00 PM

94 HCM Unsignal



N/S CONTROL: STOP
E/W CONTROL: NONE
MAJ ST SAT FLOW:
Th= 0, Rt= 0

CRITICAL GAP ADJUST

	LEFT	THRU	RIGHT
SB	---	---	0.0
EB	---	---	---
WB	---	---	---

SIGNAL WARRANTS:
Urb=N, Rur=B

ACCEL LANE FOR LT	% SU/RV	% COMBO VEH	% MOTOR CYCLE	PEAK HOUR FACTOR LEFT	PEAK HOUR FACTOR THRU	PEAK HOUR FACTOR RGHT
N	0	0	0	0.95	0.95	0.95
-	0	0	0	0.95	0.95	0.95
-	0	0	0	0.95	0.95	0.95

MOVEMENT	ORIG VOL	ADJ VOL	ADJ GAP	CONFL VOL	POT CAP	ACT CAP	MVMT DELAY	MVT LOS	APP DELAY	APP LOS	
SB R	81	94	5.5	326	947	947	4.2	A	4.2	A	A
EB T	1182	1369					0.0	A	0.0	A	A
WB T	652	755					0.0	A	0.0	A	
R	221	256					0.0	A			

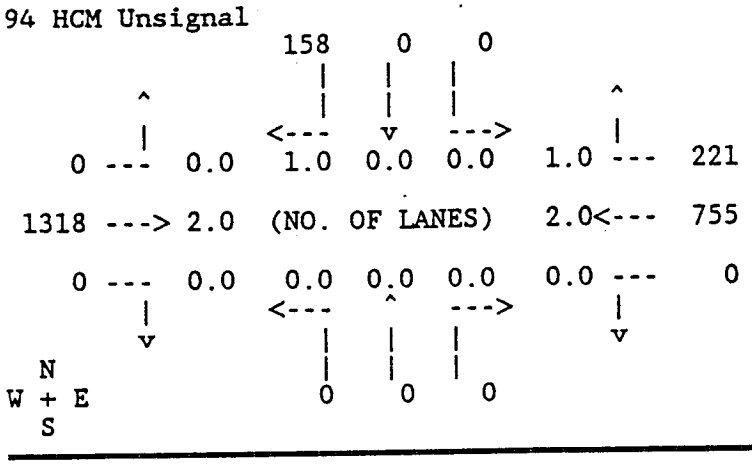
DELAY= 0.2 SEC/VEH LOS=A

LOS Software Licensed to by TJKM

Condition: PM PEAK - Existing plus Project w/Closure 03/21/96

INTERSECTION 5 Pierce Street/Buchanan Street Richmond
Count Date Time Peak Hour 5:00-6:00 PM

94 HCM Unsignal



N/S CONTROL: STOP
E/W CONTROL: NONE
MAJ ST SAT FLOW:
Th= 0, Rt= 0

CRITICAL GAP ADJUST

	LEFT	THRU	RIGHT
SB	---	---	0.0
EB	---	---	---
WB	---	---	---

SIGNAL WARRANTS:
Urb=Y, Rur=Y

ACCEL LANE FOR LT	% SU/RV	% COMBO VEH	% MOTOR CYCLE	PEAK HOUR FACTOR LEFT	PEAK HOUR FACTOR THRU	PEAK HOUR FACTOR RGHT
N	0	0	0	0.95	0.95	0.95
-	0	0	0	0.95	0.95	0.95
-	0	0	0	0.95	0.95	0.95

MOVEMENT	ORIG VOL	ADJ VOL	ADJ GAP	CONFL VOL	POT CAP	ACT CAP	MVMT DELAY	MVT LOS	APP DELAY	APP LOS	
SB R	158	183	5.5	378	891	891	5.1	B	5.1	B	B
EB T	1318	1526					0.0	A	0.0	A	A
WB T	755	874					0.0	A	0.0	A	
R	221	256					0.0	A			

DELAY= 0.3 SEC/VEH LOS=A

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project w/CLOSURE 03/19/96

INTERSECTION 6 I-80 SB Ramps/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 4-PHASE SIGNAL

RIGHT THRU LEFT
152 0 309

| | |
v v v

<--- ---> Split? N

LEFT 0 ---> 0.0 1.0 1.1 1.1 0.0 <--- 0 RIGHT

THRU 561 ---> 2.1 (NO. OF LANES) 2.0 <--- 411 THRU

RIGHT 47 ---> 1.1 0.0 0.0 0.0 1.0 ---> 236 LEFT

| ^ |
v | v

<--- ---> Split? N

0 0 0

LEFT THRU RIGHT

STREET NAME: Central Ave

SIG WARRANTS: Urb=Y, Rur=Y

N
W + E
S

STREET NAME: I-80 SB Ramps

MOVEMENT		ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
SB	RIGHT (R)	152	152	1650	0.0921	
	THRU (T)	0	0	1650	0.0000	
	LEFT (L)	309	309	1650	0.1873	0.1873
	T + L		309	1650	0.1873	
EB	RIGHT (R)	47	47	1650	0.0285	
	THRU (T)	561	561	3300	0.1700	
	T + R		608	3300	0.1842	0.1842
WB	THRU (T)	411	411	3300	0.1245	
	LEFT (L)	236	236	1650	0.1430	0.1430

TOTAL VOLUME-TO-CAPACITY RATIO: 0.51
INTERSECTION LEVEL OF SERVICE: A

* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV+BRUCLOSD.PMV+CLOSURE.PMV,CAP=C:..LOSCAP.

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project 03/19/96

INTERSECTION 6 I-80 SB Ramps/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 4-PHASE SIGNAL

```
                        RIGHT THRU LEFT
                          152    0  309
                           |     |   |
                           |     |   |
                          <---   v  --->
LEFT      0 ---  0.0      1.0  1.1  1.1   0.0 ---    0  RIGHT
                                                      STREET NAME:
THRU    561 ---> 2.1   (NO. OF LANES)     2.0<---  396  THRU   Central Ave

RIGHT    47 ---  1.1      0.0  0.0  0.0   1.0 ---  236  LEFT
                 |        <---   ^   --->    |
                 v           |   |   |      v
  N                          |   |   |                        SIG WARRANTS:
W + E                        0   0   0                          Urb-Y, Rur-Y
  S                      LEFT THRU RIGHT Split? N
```

STREET NAME: I-80 SB Ramps

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
SB	RIGHT (R)	152	152	1650	0.0921	
	THRU (T)	0	0	1650	0.0000	
	LEFT (L)	309	309	1650	0.1873	0.1873
	T + L		309	1650	0.1873	
EB	RIGHT (R)	47	47	1650	0.0285	
	THRU (T)	561	561	3300	0.1700	
	T + R		608	3300	0.1842	0.1842
WB	THRU (T)	396	396	3300	0.1200	
	LEFT (L)	236	236	1650	0.1430	0.1430

TOTAL VOLUME-TO-CAPACITY RATIO: 0.51
INTERSECTION LEVEL OF SERVICE: A

* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV+BRUASIA.PMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project 03/19/96

INTERSECTION 7 I-80 NB Ramps/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 4-PHASE SIGNAL

RIGHT THRU LEFT
0 0 0

| | |
v v v

<--- ---> | Split? N

LEFT 204 --- 1.0 0.0 0.0 0.0 1.1 --- 245 RIGHT

STREET NAME:

THRU 664 ---> 1.0 (NO. OF LANES) 2.1<--- 572 THRU Central Ave

RIGHT 0 --- 0.0 1.0 1.1 2.1 0.0 --- 0 LEFT

| ^ | ^
v | | v

<--- ---> |

N | | |
W + E 58 0 407 SIG WARRANTS:
S LEFT THRU RIGHT Split? N Urb-Y, Rur-Y

STREET NAME: I-80 NB Ramps

MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB RIGHT (R)	407	407	3000	0.1357	0.1357
THRU (T)	0	0	1650	0.0000	
LEFT (L)	58	58	1650	0.0352	
T + R		407	3000	0.1357	
EB THRU (T)	664	664	1650	0.4024	0.4024
LEFT (L)	204	204	1650	0.1236	
WB RIGHT (R)	245	245	1650	0.1485	
THRU (T)	572	572	3300	0.1733	
T + R		817	3300	0.2476	

TOTAL VOLUME-TO-CAPACITY RATIO: 0.54
INTERSECTION LEVEL OF SERVICE: A

* ADJUSTED FOR RIGHT TURN ON RED
INT-BRL-EX.INT,VOL-BRL-EX.PMV+BRUASIA.PMV,CAP-C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: PM PEAK - Existing plus Project w/CLOSURE 03/19/96

INTERSECTION 7 I-80 NB Ramps/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 4-PHASE SIGNAL

RIGHT THRU LEFT
0 0 0

| | |
v v v

| Split? N
LEFT 204 ---> 1.0 0.0 0.0 0.0 1.1 <--- 485 RIGHT

STREET NAME:
THRU 664 ---> 1.0 (NO. OF LANES) 2.1 <--- 572 THRU Central Ave

RIGHT 0 ---> 0.0 1.0 1.1 2.1 0.0 <--- 0 LEFT

| | |
v v v

N
W + E
S

SIG WARRANTS:
Urb=Y, Rur=Y

73 0 537
LEFT THRU RIGHT Split? N

STREET NAME: I-80 NB Ramps

MOVEMENT		ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	537	537	3000	0.1790	0.1790
	THRU (T)	0	0	1650	0.0000	
	LEFT (L)	73	73	1650	0.0442	
	T + R		537	3000	0.1790	
EB	THRU (T)	664	664	1650	0.4024	
	LEFT (L)	204	204	1650	0.1236	0.1236
WB	RIGHT (R)	485	485	1650	0.2939	
	THRU (T)	572	572	3300	0.1733	
	T + R		1057	3300	0.3203	0.3203

TOTAL VOLUME-TO-CAPACITY RATIO: 0.62
INTERSECTION LEVEL OF SERVICE: B

* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRL-EX.PMV+BRUCLOSD.PMV+CLOSURE.PMV,CAP=C:..LOSCAP.

APPENDIX D

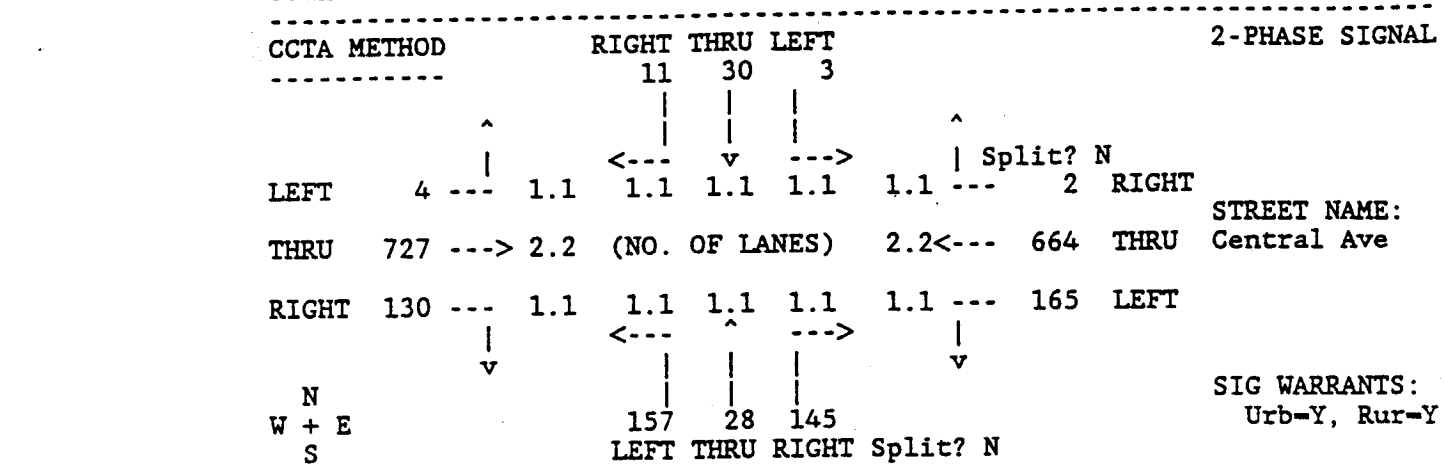
Results of the Intersection Capacity Analysis Existing plus Project Conditions (Sunday Peak)

LOS Software by TJKM Transportation Consultants

Condition: SUNDAY PEAK - Existing plus Project 03/19/96

INTERSECTION 1 Pierce Street/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD RIGHT THRU LEFT 2-PHASE SIGNAL



STREET NAME: Central Ave

SIG WARRANTS: Urb-Y, Rur-Y

STREET NAME: Pierce Street

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	145	145	1800	0.0806	
	THRU (T)	28	28	1800	0.0156	
	LEFT (L)	157	157	1800	0.0872	
	T + R		173	1800	0.0961	
	T + L		185	1800	0.1028	
	T + R + L		330	1800	0.1833	0.1833
SB	RIGHT (R)	11	11	1800	0.0061	
	THRU (T)	30	30	1800	0.0167	
	LEFT (L)	3	3	1800	0.0017	0.0017
	T + R		41	1800	0.0228	
	T + L		33	1800	0.0183	
	T + R + L		44	1800	0.0244	
EB	RIGHT (R)	130	130	1800	0.0722	
	THRU (T)	727	727	3600	0.2019	
	LEFT (L)	4	4	1800	0.0022	
	T + R		857	3600	0.2381	
	T + L		731	3600	0.2031	
	T + R + L		861	3600	0.2392	0.2392
WB	RIGHT (R)	2	2	1800	0.0011	
	THRU (T)	664	664	3600	0.1844	
	LEFT (L)	165	165	1800	0.0917	0.0917
	T + R		666	3600	0.1850	
	T + L		829	3600	0.2303	
	T + R + L		831	3600	0.2308	

TOTAL VOLUME-TO-CAPACITY RATIO: 0.52
INTERSECTION LEVEL OF SERVICE: A

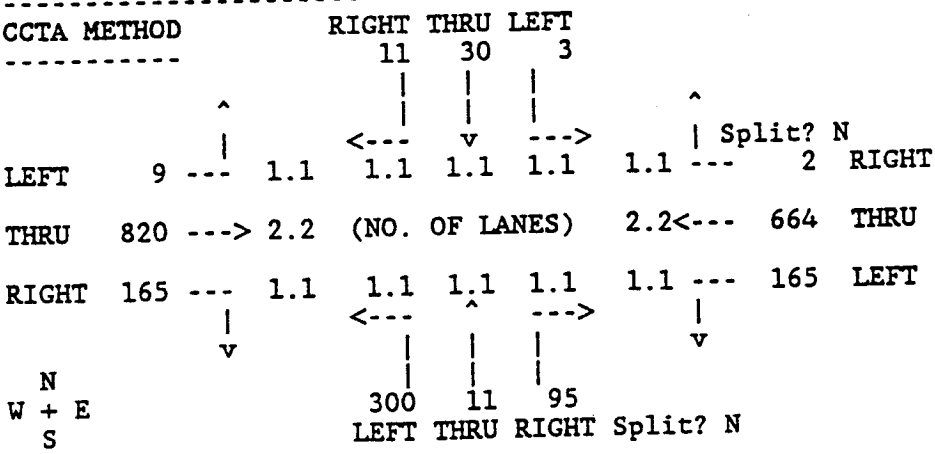
* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRU-EXSU.MMV+BRUSUND.PMV,CAP=C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: SUNDAY PEAK - Existing plus Project w/CLOSURE 03/19/96

INTERSECTION 1 Pierce Street/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 2-PHASE SIGNAL



STREET NAME: Central Ave

SIG WARRANTS: Urb-Y, Rur-Y

STREET NAME: Pierce Street

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	95	95	1800	0.0528	
	THRU (T)	11	11	1800	0.0061	
	LEFT (L)	300	300	1800	0.1667	
	T + R		106	1800	0.0589	
	T + L		311	1800	0.1728	
	T + R + L		406	1800	0.2256	0.2256
SB	RIGHT (R)	11	11	1800	0.0061	
	THRU (T)	30	30	1800	0.0167	
	LEFT (L)	3	3	1800	0.0017	0.0017
	T + R		41	1800	0.0228	
	T + L		33	1800	0.0183	
	T + R + L		44	1800	0.0244	
EB	RIGHT (R)	165	165	1800	0.0917	
	THRU (T)	820	820	3600	0.2278	
	LEFT (L)	9	9	1800	0.0050	
	T + R		985	3600	0.2736	
	T + L		829	3600	0.2303	
	T + R + L		994	3600	0.2761	0.2761
WB	RIGHT (R)	2	2	1800	0.0011	
	THRU (T)	664	664	3600	0.1844	
	LEFT (L)	165	165	1800	0.0917	0.0917
	T + R		666	3600	0.1850	
	T + L		829	3600	0.2303	
	T + R + L		831	3600	0.2308	

TOTAL VOLUME-TO-CAPACITY RATIO: 0.60
INTERSECTION LEVEL OF SERVICE: A

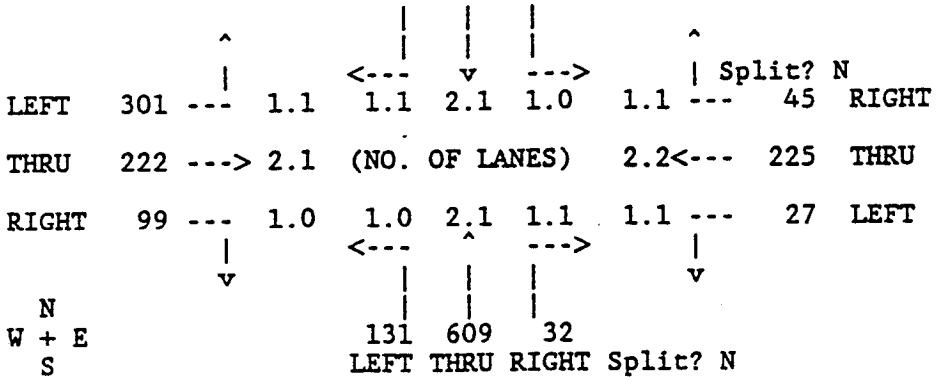
* ADJUSTED FOR RIGHT TURN ON RED
INT-BRL-EX.INT,VOL-BRU-EXSU.MMV+BRUCLSUN.PMV+CLOSURE.PMV,CAP-C:..LOSCA

LOS Software by TJKM Transportation Consultants

Condition: SUNDAY PEAK - Existing plus Project 03/19/96

INTERSECTION 3 San Pablo Ave/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 6-PHASE SIGNAL



STREET NAME: Central Ave

SIG WARRANTS: Urb=Y, Rur=Y

STREET NAME: San Pablo Ave

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	32	32	1650	0.0194	
	THRU (T)	609	609	3300	0.1845	
	LEFT (L)	131	131	1650	0.0794	0.0794
	T + R		641	3300	0.1942	
SB	RIGHT (R)	229	229	1650	0.1388	
	THRU (T)	618	618	3300	0.1873	
	LEFT (L)	63	63	1650	0.0382	
	T + R		847	3300	0.2567	0.2567
EB	RIGHT (R)	99	0 *	1650	0.0000	
	THRU (T)	222	222	3300	0.0673	
	LEFT (L)	301	301	1650	0.1824	0.1824
	T + L		523	3300	0.1585	
WB	RIGHT (R)	45	45	1650	0.0273	
	THRU (T)	225	225	3300	0.0682	
	LEFT (L)	27	27	1650	0.0164	
	T + R		270	3300	0.0818	
	T + L		252	3300	0.0764	
	T + R + L		297	3300	0.0900	0.0900

TOTAL VOLUME-TO-CAPACITY RATIO: 0.61
INTERSECTION LEVEL OF SERVICE: B

* ADJUSTED FOR RIGHT TURN ON RED
INT-BRL-EX.INT,VOL-BRU-EXSU.MMV+BRUSUND.PMV,CAP-C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: SUNDAY PEAK - Existing plus Project w/CLOSURE 03/19/96

INTERSECTION 3 San Pablo Ave/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 6-PHASE SIGNAL

RIGHT THRU LEFT
229 618 63

LEFT 301 --- 1.1 1.1 2.1 1.0 1.1 --- 45 RIGHT
THRU 222 ---> 2.1 (NO. OF LANES) 2.2<--- 225 THRU
RIGHT 99 --- 1.0 1.0 2.1 1.1 1.1 --- 27 LEFT

Split? N

STREET NAME: Central Ave

SIG WARRANTS: Urb-Y, Rur-Y

N
W + E
S

131 609 32
LEFT THRU RIGHT Split? N

STREET NAME: San Pablo Ave

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	32	32	1650	0.0194	
	THRU (T)	609	609	3300	0.1845	
	LEFT (L)	131	131	1650	0.0794	0.0794
	T + R		641	3300	0.1942	
SB	RIGHT (R)	229	229	1650	0.1388	
	THRU (T)	618	618	3300	0.1873	
	LEFT (L)	63	63	1650	0.0382	
	T + R		847	3300	0.2567	0.2567
EB	RIGHT (R)	99	0 *	1650	0.0000	
	THRU (T)	222	222	3300	0.0673	
	LEFT (L)	301	301	1650	0.1824	0.1824
	T + L		523	3300	0.1585	
WB	RIGHT (R)	45	45	1650	0.0273	
	THRU (T)	225	225	3300	0.0682	
	LEFT (L)	27	27	1650	0.0164	
	T + R		270	3300	0.0818	
	T + L		252	3300	0.0764	
	T + R + L		297	3300	0.0900	0.0900

TOTAL VOLUME-TO-CAPACITY RATIO: 0.61
INTERSECTION LEVEL OF SERVICE: B

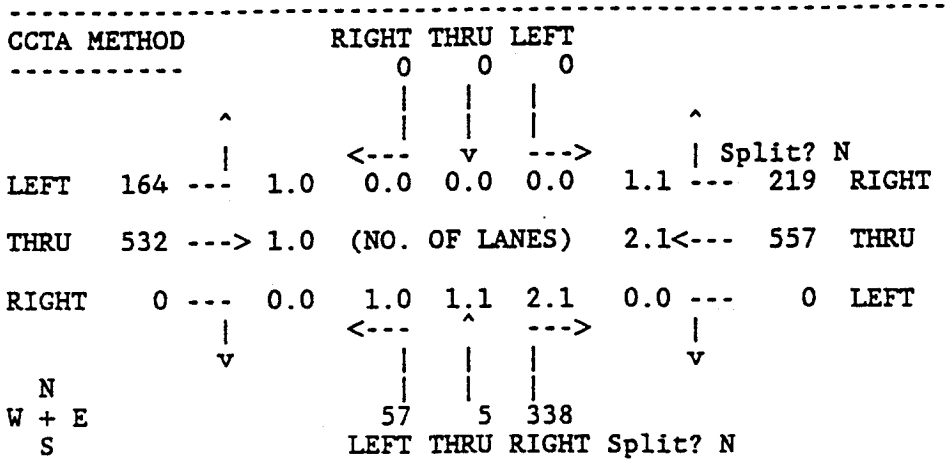
* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRU-EXSU.MMV+BRUCLSUN.PMV+CLOSURE.PMV,CAP=C:..LOSCA

LOS Software by TJKM Transportation Consultants

Condition: SUNDAY PEAK - Existing plus Project 03/19/96

INTERSECTION 7 I-80 NB Ramps/Central Ave Richmond
Count Date Time Peak Hour

CCTA METHOD 4-PHASE SIGNAL



STREET NAME: Central Ave

SIG WARRANTS: Urb-Y, Rur-Y

STREET NAME: I-80 NB Ramps

	MOVEMENT	ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	338	338	3000	0.1127	
	THRU (T)	5	5	1650	0.0030	
	LEFT (L)	57	57	1650	0.0345	
	T + R		343	3000	0.1143	0.1143
EB	THRU (T)	532	532	1650	0.3224	
	LEFT (L)	164	164	1650	0.0994	0.0994
WB	RIGHT (R)	219	219	1650	0.1327	
	THRU (T)	557	557	3300	0.1688	
	T + R		776	3300	0.2352	0.2352

TOTAL VOLUME-TO-CAPACITY RATIO: 0.45
INTERSECTION LEVEL OF SERVICE: A

* ADJUSTED FOR RIGHT TURN ON RED
INT-BRL-EX.INT,VOL-BRU-EXSU.MMV+BRUSUND.PMV,CAP-C:..LOSCAP.TAB

LOS Software by TJKM Transportation Consultants

Condition: SUNDAY PEAK - Existing plus Project w/CLOSURE 03/19/96

INTERSECTION 7 I-80 NB Ramps/Central Ave Richmond
Count Date Time Peak Hour

```
CCTA METHOD              RIGHT THRU LEFT                          4-PHASE SIGNAL
-----------                0    0    0
                           |    |    |
           ^               |    |    |       ^
           |             <---   v   --->     | Split? N
LEFT   164 ---  1.0      0.0  0.0  0.0  1.1 ---  459  RIGHT
                                                            STREET NAME:
THRU   532 ---> 1.0     (NO. OF LANES)  2.1<---  557  THRU  Central Ave

RIGHT    0 ---  0.0      1.0  1.1  2.1  0.0 ---    0  LEFT
           |             <---   ^   --->     |
           v               |    |    |       v
                           |    |    |                      SIG WARRANTS:
   N                                                          Urb-Y, Rur-Y
 W + E                    72    5  471
   S                     LEFT THRU RIGHT Split? N

              STREET NAME: I-80 NB Ramps
```

MOVEMENT		ORIGINAL VOLUME	ADJUSTED VOLUME*	CAPACITY	V/C RATIO	CRITICAL V/C
NB	RIGHT (R)	471	471	3000	0.1570	
	THRU (T)	5	5	1650	0.0030	
	LEFT (L)	72	72	1650	0.0436	
	T + R		476	3000	0.1587	0.1587
EB	THRU (T)	532	532	1650	0.3224	
	LEFT (L)	164	164	1650	0.0994	0.0994
WB	RIGHT (R)	459	459	1650	0.2782	
	THRU (T)	557	557	3300	0.1688	
	T + R		1016	3300	0.3079	0.3079

TOTAL VOLUME-TO-CAPACITY RATIO: 0.57
INTERSECTION LEVEL OF SERVICE: A

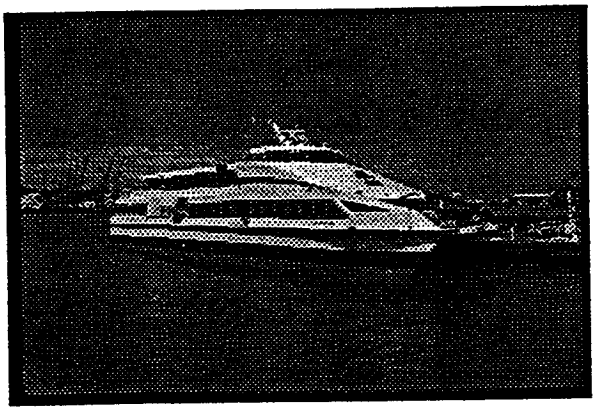
* ADJUSTED FOR RIGHT TURN ON RED
INT=BRL-EX.INT,VOL=BRU-EXSU.MMV+BRUCLSUN.PMV+CLOSURE.PMV,CAP=C:..LOSCA

APPENDIX K

Task 3 Working Paper: Immediate-Term Ferry Service Improvement Recommendations (Pacific Transit Management Corporation and Associated Consultants, August, 1998)

SAN FRANCISCO BAY AREA

1998 REGIONAL FERRY PLAN UPDATE



Task 3 Working Paper
Immediate-term Ferry Service Improvement Recommendations

Prepared for

Metropolitan Transportation Commission

Prepared by

Pacific Transit Management Corporation
and Associated Consultants

August 1998

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3.0 IMMEDIATE-TERM FERRY SERVICE IMPROVEMENT RECOMMENDATIONS

3.0 INTRODUCTION

This is the second of a series of working papers for the *1998 Regional Ferry Plan Update*. It contains a set of recommendations for immediate priority projects to enhance regional ferry service. As immediate-term projects, they consist of projects to increase the capacity, reliability, and safety of existing ferry services. Several of the projects are already committed and programmed for funding, but the majority of the capital projects are new projects that are not presently programmed. In addition to new capital expenditures, the recommendations include several suggestions for further analysis, as well as creation of a "High-Speed Commercial Craft Safety Board", to comprehensively plan for increasing volumes of high-speed ferry operations, particularly along the San Francisco waterfront.

3.1 SUMMARY OF IMMEDIATE-TERM PROJECTS

Table 3.1 summarizes the recommended immediate-term capital needs to further Bay Area ferry service during the next few years. The recommended improvements would improve access to the Larkspur Ferry Terminal, make the Sausalito ferry terminal accessible, and provide for the programmed replacement for the M.V. Golden Gate which provides service between Sausalito and the Ferry Building. Vallejo has several projects, the most critical of which is upgrading the performance of the M.V. Jet Cat Express to approach that of the new vessels. At present, the speed of this seven year old, 365 passenger vessel degrades substantially under heavy load conditions. This upgrade will provide more adequate back-up service while still maintaining the schedule, and also allow seasonal addition of a third vessel to cope with current overloads on both AM and PM commute trips. Another priority project is further investment in Vallejo's Mare Island maintenance facility, to provide the necessary facilities and equipment to protect and maintain the current three vessels. Finally, additional seats are needed to marginally increase the passenger capacity of the M.V. Intintoli and M.V. Mare Island.

The Alameda/Oakland service needs to have a larger and faster second vessel than the M.V. Ohlone Express. The second vessel also provides back-up service to the M.V. Encinal when it is out of service. Another investment in back-up vessels would be the re-engining and modification of the M.V. Harbor Bay Express II which is currently out of service.

There are several important projects for the Port of San Francisco that will facilitate use of the Pier 1/2 facility and provide for ferry service to China Basin and Pacific Bell Park when the Giants use the facility starting in 2000. The current Ferry Building improvement project provides a new south basin docking facility designed to accommodate a variety of vessel sizes and freeboards. Improvements to facilitate use of the existing north docking float are needed to ensure flexibility to accommodate all vessels, including vessels with two doors. Another recommended project for passenger comfort not included in the current project is weather protection awnings for gangways and floats.

TABLE 3.1
FERRY IMPROVEMENTS: RECOMMENDED IMMEDIATE CAPITAL NEEDS - 1998-1999

Applicant/ location	Project	Description	Estimated Cost	Primary Funding Strategy
GGBH&TD/Sausalito Sausalito	float modification	2nd level gangway for ADA access on GGT vessels	$ 250,000	TEA-21, Section 5307 or Section 1207 (2000)
GGBH&TD/ Larkspur	replacement vessel	replace Larkspur vessel which replaces existing Sausalito vessel	$ 8.3 million	TEA-21, Section 5307 (programmed 99)
GGBH&TD/ Larkspur	access improvements	road, signal, and bicycle improvements to facilitate access & egress	$ 1.5 million	STIP
City of Vallejo/ Vallejo	1)back-up vessel 2)maintenance facility 3)additional vessel seating	upgrade performance of back-up vessel facility and equipment upgrades 60 seats - increase capacity	$ 2 million $ 1 million $ 100,000	TEA-21, Section 1207 (99) TEA-21, Section 1207 (99) TEA-21, Section 1207 (99)
City of Alameda/ Alameda/Oakland Alameda	1)Alameda/Oakland backup vessel 2)Harbor Bay/Alameda backup vessel	needed to have more adequate replacement vessel repair unusable vessel (pending review of plan & impact on operating cost)	$ 2 million $ 300,000	TEA-21, Section 1207 (99) STIP
Port of San Francisco/ Ferry Building	1)upgrade existing Pier 1/2 float 2)gangway covers	needed to accommodate variety of vessels, including two door Vallejo vessels weather protection for patrons	$ 300,000 $ 450,000	TEA-21, Section 1207 (99) TEA-21, Transportation Enhancement Fund (TE) (99)
Port of San Francisco/ China Basin	China Basin ferry terminal	permanent two vessel float required to serve ballpark, Mission Bay, & emergency facility	$ 2 million	TEA-21, Section 1207 (99)

Source: Pacific Transit Management Corporation

20% local match

3.2 CRITERIA FOR PROJECT RANKING

All of the projects and service modifications meet the criteria listed in Working Paper 2. However, several additional criteria were utilized to measure the relative effectiveness of projects considered important for the immediate term:

- Does the project fulfill a safety or reliability requirement?
  Safety is the most important consideration. Any safety related proposal should be considered as a high priority. Reliability of service is also essential. To the maximum degree possible, back-up vessels should be available that provide reasonably similar service.

- Is the project important to sustain a current level-of-service?
  Without this project, comfort and safety would be compromised.

- Does the project fulfill a current capacity shortage?
  Passengers are being left at the dock. At what cost is the proposed capacity being provided?

- Does the project fulfill a program to increase capacity?
  The project meets an overall, long-term plan to increase capacity is a certain corridor.

- Is the project mandated by law (such as an accessibility project)?
  Without this funding, the service provider would be in non-compliance with a certain mandate.

- Does the project accommodate emergency services?
  The project will be useable during emergencies.

- Can the project be completed in a timely manner?
  The project has few if any environmental clearances and can readily be completed by the service sponsor.

With these criteria, the projects listed have been ranked by operator for inclusion in an immediate-term ferry system improvement program.

In addition, projects recommended for Transportation Equity Act for the 21st Century (TEA-21) Section 1207 funding must be supported by an operating plan, meet the specific program criteria, and be capable of project obligation by 1999.

3.3 CAPITAL PRIORITY PROJECTS

The following capital projects are deemed the highest priority to enhance Bay Area ferry service. If possible, they should be completed within the immediate-term, the next two years.

3.3.1 Sausalito

The M.V. Golden Gate is due to be replaced within the next few years. It contains an elevator to allow disabled access to both decks. At present, the GGBH&TD (GGT) intends to replace it by shifting one Larkspur vessel to Sausalito service. These vessels load on the second deck in San Francisco. The new float in Sausalito is low and provides first deck access to both Golden Gate and Blue and Gold vessels. In order to provide ADA compliance, either an elevator is required on each GGT vessel used in Sausalito service, or the Sausalito float should be modified to allow second deck access to the Golden Gate vessels. The M.V. Del Norte high-speed catamaran is only configured for second deck boarding, so it cannot be used to serve Sausalito unless the float is modified.

The recommended improvement to the new Sausalito float is to add a ramp to allow second deck boarding/disembarking for Golden Gate Transit ferry vessels. This is required to provide accessible access to all Golden Gate vessels. This project is not programmed and is estimated to cost less than $250,000.

The City of Sausalito expressed concern about a two deck float when plans were developed for the recent project. Because this project needs City and BCDC approval, it is designated for FTA Section 5307 funding or Section 1207 funding in the year 2000.

3.3.2 Larkspur

The purchase of a second high-speed vessel is required to replace the current Larkspur vessel that will be shifted to Sausalito to replace the M.V. Golden Gate. Estimated cost for a 35-knot, 350 passenger vessel is approximately $8.3 million, according to the District's Short-Range Transit Plan, and is programmed for about $6 million FTA Section 5307 (replacement for Section 9) funding in the 1998/99 fiscal year.

Phase II landside access improvements are needed to improve traffic and pedestrian circulation around the Larkspur Ferry Terminal. Additional on-site parking and an extra westbound lane on East Sir Francis Drake Boulevard between the terminal exit and Route 101 northbound on-ramp have been completed. Remaining priority projects identified in the District's *Larkspur Ferry Terminal Access Improvement Study* include:

- signalization of East Sir Francis Drake Boulevard (ESFDB) intersection with Andersen Drive;
- geometric improvements to the terminal exit/entrance with Larkspur Landing Circle and ESFDB;

- coordination of traffic signals along ESFDB;
- a bicycle bridge over Corte Madera Creek; and
- placement of a ferry service variable message sign on Route 101.

These projects are not programmed at this time, and are estimated to cost $1.5 million. Given that they are primarily roadway projects, STIP funding is recommended rather than dedicated ferry funding sources.

3.3.3 Tiburon

There are no immediate needs beyond the replacement of the existing float which is already planned and programmed for Proposition 116 funding.

3.3.4 Vallejo

With the replacement of the M.V. Jet Cat Express by two faster vessels in 1997, the Vallejo ferry service is filling the 300 passenger vessels and leaving people behind on a regular basis. This service needs a third vessel of comparable performance to provide both comparable back-up service and sufficient commute capacity. Alternatives are either to procure a new 325-350 passenger catamaran, modify and re-engine the seven year-old M.V. Jet Cat Express to allow 30-32 knot speeds with full loads, or procure two smaller vessels that would be used to supplement the two vessel service. The advantage of the latter could be reduction of operating costs per trip for midday service, particularly during the winter season.

A new vessel would cost approximately $9-10 million, while a substantial upgrade to the Jet Cat Express would cost approximately $2 million. Preliminary engineering analysis and lack of funding suggests the M.V. Jet Cat Express upgrade is the most cost-effective strategy for back-up and extra commute service at this time.

At a minimum, the current terminal parking lot needs to be paved and lit. This project is programmed but awaiting a City decision on a waterfront plan. Improvements are required to the maintenance facility as well. Projected total cost of facility improvements is approximately $1,00,000 which includes layberths, shop and office facilities, crew facilities, and a small workboat. A final project is the addition of 30 seats to the M.V. Intintoli and M.V. Mare Island, which would provide for 305 interior seats. With U.S. Coast Guard certification, these vessels could be approved to carry 330 passengers instead of the current capacity of 300 which includes 25 exterior seats. This project is recommended at $100,000 in Section 1207 funding.

3.3.5 Alameda Main Street/Oakland

An improved second vessel is required to back-up the M.V. Encinal and to provide supplemental commute trips - if sufficient funding can be procured to maintain 30 minute service during commute periods. Alternatives are to modify and re-engine the M.V. Ohlone Spirit, or to purchase another 200-300 passenger vessel. If funding is limited, purchase of a used vessel should be considered. An acquisition and upgrade of the Ohlone Spirit would be a $2-3 million

project. A used vessel, such as a used Washington State ferry which was acquired with federal assistance could be potentially acquired for less than $1 million. A $2 million allocation is suggested for current Section 1207 funding.

3.3.6 Alameda Harbor Bay Island

The M.V. Harbor Express II, a 149 passenger catamaran, was purchased for this service using California Proposition 116 funds. Because of frequent engine problems, it was withdrawn from service. An estimate for $300,000 in engine and other improvements that would increase reliability has been submitted by a shipyard. Pending review of the plans, this project is listed for potential STIP funding. If completed, this vessel could be used as a back-up vessel; become the primary Harbor Bay vessel, allowing the use of the M.V. Bay Breeze to back-up the Encinal; or be available for another public service that could use a 26 knot, 149 passenger vessel.

3.3.7 Port of San Francisco

As part of the Ferry Building docking facilities, there needs to be proper accommodation to move patrons most efficiently on and off vessels. The current north float is not efficiently configured for its current vessels, for example the ability to use both doors on the Vallejo ferries. This causes delay in the loading and unloading movements. It needs to be modified, but done so in a manner which does not preclude other vessels with differing freeboards from using the side of the float. This is recommended for Section 1207 funding for $300,000.

Gangways to both floats should have weather protection which is not included in the currently funded ferry improvements. This is recommended for federal Transportation Enhancement funds at an estimated cost of $450,000.

A China Basin ferry terminal will be required to facilitate service to the ballpark and Mission Bay. Because of peaked demand patterns, the facility should be able to accommodate two vessels concurrently. It may be utilized as well for potential service to the Mission Bay district of San Francisco, as well as an overflow facility during emergency periods when facilities at the Ferry Building are unable to meet the demand for berths. Estimated cost is approximately $2 million and it is recommended as an immediate Section 1207 project.

3.4 Operating Priority Projects

3.4.1 Service Modifications

Golden Gate Transit

The 1992 Plan called for two new high speed catamarans for Golden Gate Transit. The Plan recommended that these two vessels operate an interlined Larkspur — San Francisco — Sausalito route, with hourly midday service to San Francisco from both locations using only two vessels.

The consultants continue to advocate this proposal as the most cost-effective and most marketable operating scheme available. Golden Gate Transit has purchased one new fast ferry, the M.V. Del Norte, and will have funding to build another vessel in 1999. When this second vessel is operational, the interlined schedule should be utilized. Analysis indicates that such a schedule would allow for hourly service and additional peak period service — vessel hours are estimated to be about 40 daily. This compares to the current adopted schedule requiring about 42 hours and providing less than hourly service — in most cases, service about every hour and a half to two hours. The benefits of improved patronage during midday periods from clock headways and marketable and understandable schedules should translate into increased revenues at no increase in operating costs.

To accomplish this change, Golden Gate requires a high level boarding at Sausalito (to accommodate the restrictions on the Del Norte), but no other capital requirements, other than boats, are required.

Access improvements would also benefit the Sausalito Ferries — in the proposed half cent Marin transportation tax are proposals to provide "jitney" type connection services to the Sausalito ferry dock from relatively inaccessible areas in the hills above the city.

3.5 EVALUATION OF FUTURE PROJECTS

3.5.1 Vessel Size and Performance

The primary determinants of operating and capital cost of ferries are vessel size and speed. Vessels of 149 passengers or less have lower construction costs because of less rigorous U.S. Coast Guard construction standards. Larger vessels not only are more expensive to build but are required to carry larger crews, impacting on-going operating cost. For any given vessel size, substantial increases in engine size are required for higher speed, affecting both capital and operating (fuel consumption) costs.

Analysis was conducted to consider the alternative future vessel strategies recommended for Vallejo. Beyond the upgrading of the 28-knot Jet Cat Express, short-term improvements for the Vallejo Ferry should be focused on the provision for additional capacity. This requires additional vessels operating at peak periods. There are two alternatives: purchase of two 149 passenger vessels, at about $4 million each, or the purchase of one 325 passenger vessel at about $8-9 million. There are advantages and disadvantages to each alternative. The smaller vessels would allow midday service to be operated at lower cost. However, the difference in operating costs between the large vessel and smaller ones is only about $75 - $100 per hour. However, assuming that between five and 10 hours of service now provided with the larger vessels could be operated with the smaller vessels, the weekday savings would fall between $100,000 and $200,000 annually. In addition, smaller vessels would allow for more service during the peak periods, and would be especially useful during the "shoulders" of the peak when service is required, but the capacity of a large vessel is not.

On the other hand, Vallejo already operates two 300+ passenger catamarans and the provision of new smaller vessels would complicate maintenance and parts storage. In addition, ride quality of the larger vessel will be superior compared to smaller ones. However, peak period service frequency will be less than with two smaller vessels.

In addition to these service improvements, the Vallejo Ferry service also requires additional facilities at the Ferry Building to board and alight passengers quickly. Dwell time is essentially wasted peak period capacity, and the ability to alight passengers as quickly as possible allows more service to be operated at no increase in labor costs.

3.5.2 Terminal and Maintenance Location

The Oakland/Alameda Ferry Service operates between Oakland, the east side of Alameda, and then to San Francisco and Fisherman's Wharf. In addition, the Harbor Bay Isle Ferry operates to San Francisco — both services are subsidized.

The City of Alameda has proposed to develop a new storage and maintenance base for ferry servicing directly across from Jack London Square and has considered relocating the Main Street ferry terminal to the FISC parcel. The City also proposed a ferry fueling facility on the west side of the island. In addition, Red & White fleet has proposed to operate ferry service to the USS Hornet museum into the Inner Harbor on the west side.

Alameda/Oakland needs to examine a variety of issues, including the operating costs and subsidies required for the two services and two contractor operation. The duplication of contractor administrative functions appears excessive for the service level, and the desire for maintenance and fueling facilities needs to be related to the future operational model. These projects and services require coordination and analysis to ensure that they are supportive of each other and of overall service objectives. This plan recommends that the City of Alameda, in conjunction with the Port of Oakland, prepare an overall Short-Range Transit Plan for the Oakland/Alameda ferry services to ensure coordination of equipment, facilities, and operation; elimination of duplication; and enhanced marketing and service. The plan should consider which facilities should be owned and operated by the City and which by the operator(s) of the service.

3.5.3 Vessel Safety

In 1992 there were two fast ferries on the Bay — the Dolphin and the Catamarin. In 1998 there are seven fast ferries operating — the Encinal (nee Catamarin), the Zelinsky (nee Dolphin), the Bay Breeze, the Mare Island, the Intintoli, the JetCat, and the Del Norte. There are now more than 125 arrivals and departures from the Ferry Building every weekday.

This level of activity will require changes in operating procedures, communications and traffic control. Currently, maritime traffic operates under voluntary advisories — the vessel tracking service (VTS) only issues warnings but does not police or control traffic. However, as speed increases, and as vessel and engine technology allows greater increases in vessel speed, operating procedures will require adjustment. Just as aviation took a "quantum leap" in the

jump from propeller propulsion to jet engines — a leap which required new control measures, fast ferries will require a "quantum leap" in traffic control to ensure continued safe operation.

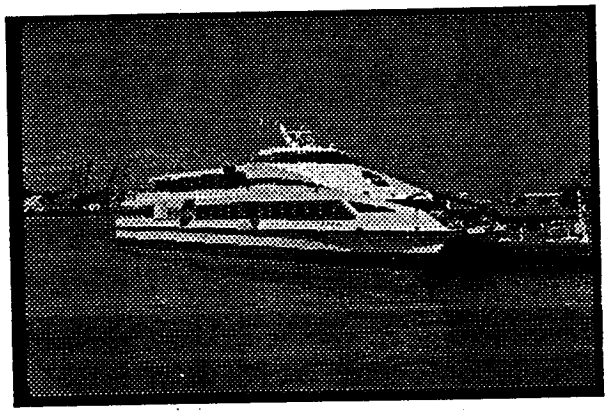
Among the procedures that should be studied are positive vessel traffic *control*, high speed ferry lanes, and electronic monitoring of vessel operation. With increasing numbers of high-speed craft operating in the Bay, vessel operators, the Coast Guard, and Port of San Francisco need to establish more formalized procedures to ensure vessel safety. A "High Speed Commercial Craft Safety Board (HSCCSB) was established in New York in 1997 to develop procedures to reduce risks associated with operations. This represents a good model which should be duplicated in the Bay Area.

APPENDIX L

Task 4 Working Paper: Short-Term Ferry Service Improvement Plan (Pacific Transit Management Corporation and Associated Consultants, October, 1998)

SAN FRANCISCO BAY AREA

1998 REGIONAL FERRY PLAN UPDATE



Task 4 Working Paper
Short-term Ferry Service Improvement Plan

Prepared for

Metropolitan Transportation Commission

Prepared by

Pacific Transit Management Corporation
and Associated Consultants

October 1998

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4.0 SHORT-TERM FERRY SERVICE IMPROVEMENT PLAN

4.0 INTRODUCTION

This working paper, part of the *1998 Regional Ferry Plan Update*, contains a review of operating and capital improvements for the existing ferry operators, and re-evaluates the potential new routes identified in the 1992 plan. The analysis prioritizes capital improvement plans for the existing operators, lays out recommended operational enhancements, and indicates the order of magnitude capital and operating investment required to initiate ferry service from Berkeley, Martinez/Benicia, and Port Sonoma.

4.1 PROJECTS TO ENHANCE EXISTING FERRY SERVICES

This section details projects that will enhance existing ferry services, including capital investments and operational changes that will make ferry services more productive. These projects include existing planned and/programmed projects reflected in Short-Range Transit plans, and additional projects not currently included in plans that are recommended for serious consideration. Table 4.1 provides financial operating statistics for the current subsidized ferry services in the Bay Area for the 1996-97 and 1997-98 fiscal years.

4.1.1 Sausalito.

Ridership on the Golden Gate Transit (GGT) service to the Ferry Building has averaged about 1,400 -1,500 passengers a day, with a single trip peak of about 160 passengers on the 5:30 PM weekday departure from San Francisco. Weekend ridership fluctuates greatly depending on season, weather, and special events, but on average is comparable to weekday patronage. Since only seven round trips are operated on weekends (10 on weekdays), the per trip average ridership is greater on weekends. The Labor Day weekend Sausalito Art Fair attracts the largest single day crowds, and GGT supplements service for special events. Approximately 45 percent of operating costs are covered by fare revenues, with bridge tolls and transit subsidy sources used to cover remaining expenses.

Capital Improvements

1. Accessible ADA Boarding Facility. As cited in previous working papers, an unprogrammed priority project for Sausalito is the modification of the new floating dock to accommodate second deck boarding and disembarking for GGT's vessels. This is necessary to maintain full accessibility to the GGT vessels which will serve this facility once the M.V. Golden Gate is retired within the next three years. Installing elevators on the current Larkspur vessels is not recommended because of the added weight and cost. It is not possible to add an elevator to the M.V. Del Norte, the new high-speed catamaran that sets the standard for future vessel purchases. Estimated capital cost of the facility would be $250,000-$350,000.

TABLE 4.1

ANNUAL OPERATING COSTS AND REVENUES: BAY AREA SUBSIDIZED FERRY SERVICES

Route	operating cost	cost/hour[1]	fare/other revenue	operating subsidies	farebox ratio	patronage	subsidy/ passenger	subsidy/ pass. mile
Sausalito								
- FY 1996	$3,196,000	$1,010	$1,424,000	$1,772,000	45%	473,179	$3.75	$.59
- FY 1997	$3,373,000	$1,048	$1,492,000	$1,858,000	44%	495,336	$3.75	$.59
Larkspur								
- FY 1996	$8,177,000	$1,010	$2,047,000	$6,130,000	25%	956,329	$6.41	$.49
- FY 1997		$1,048	$2,227,000	$6,427,000	26%	1,014,547	$6.33	$.48
Vallejo								
- FY 1997	$2,757,000	$700	$1,507,000	$1,251,000	55%	269,731	$4.64	$.19
- FY 1998	$4,500,000	$595	$2,373,000	$2,127,000	53%	545,000	$3.90	$.16
Alameda/Oakland								
- 1996	$1,720,000	$334	$1,148,000	$625,000	65%	410,708	$1.52	$.25
- 1997	$2,320,000	$437	$1,382,000	$634,000	60%	506,693	$1.25	$.21
Alameda/Harbor Bay								
- FY 1997	$1,583,000	$512	$339,000	$1,218,000	21%	100,268	$12.15	$1.52
- FY 1998	$1,250,000	$405	$361,000	$909,000	28%	99,066	$9.17	$1.15

1. Golden Gate Bridge, Highway, and Transit District does not disaggregate hourly cost between Sausalito and Larkspur service.

Source: Pacific Transit Management Corp. from Ferry Operators

Sausalito has opposed a two level platform because of concern about view blockage. There are relatively low profile ramps or elevators on the float that could accommodate the disabled without substantial interruption of the view.

2. Improvements to Landside Access. At present, there are neither direct kiss-ride nor bus transfer facilities adjacent to the dock. Relocation of parking spaces is recommended to accommodate a well signed one-way northbound vehicular loop in closer proximity to the newly designed passenger waiting area and float. Given the current parking shortage, high cost of parking, and urban design in downtown Sausalito, a dedicated parking lot or structure is not recommended for this facility.

3. Passenger Shelter. A sheltered waiting area and gangway should be provided to facilitate passenger comfort in inclimate weather.

Operating Improvements

1. Higher-speed ferry service. GGT plans to utilize a 20 knot Larkspur vessel on this route when the M.V. Golden Gate is retired. Travel time will be reduced from 30 minutes to approximately 20 minutes. The current hour and 10 minute or hour and 20 minute cycle time will be reduced to one hour. This would allow an increase from 10 round trips a day to 13 round trips with the same number of labor hours - but would require additional fuel. An hourly schedule would be beneficial for ridership, as would the faster travel time. Increasing vessel speed to 25 knots would allow reducing the cycle time to 50 minutes during commute periods. This would allow up to 15 round trips a day for a single vessel within the 13-14 hour scheduled operating hours.

   See Larkspur discussion with respect to interlining Larkspur and Sausalito service.

2. Shuttle feeder service. Given the lack of dedicated parking for this facility, new shuttle service should be provided linking Sausalito neighborhoods with commute trips. Additional shuttle service should also be provided from Mill Valley and the current park-and-ride facility under Route 101.

4.1.2 Larkspur

Ridership on the Golden Gate Transit service to the Ferry Building has averaged about 3,700 to 3,900 patrons per weekday, and about 1,100 - 1,200 on an abbreviated five round trip weekend schedule. Thirteen round trips were operated until September 1998 when the number of daily trips increased to 20 concurrently with the introduction of the M.V. Del Norte, a 35 knot, high-speed ferry. Like other routes, there is approximately a 20 - 25 percent fluctuation in weekday ridership, with July and August typically the peak and January/February ridership the lowest. Very initial results suggest the introduction of the Del Norte and reduction of travel time from 45 to 30 minutes will stimulate ridership. Results from the first week suggest an increase of 20-30 percent in peak period ridership (this travel time/patronage elasticity was predicted in the *1992 Regional Ferry Plan*).

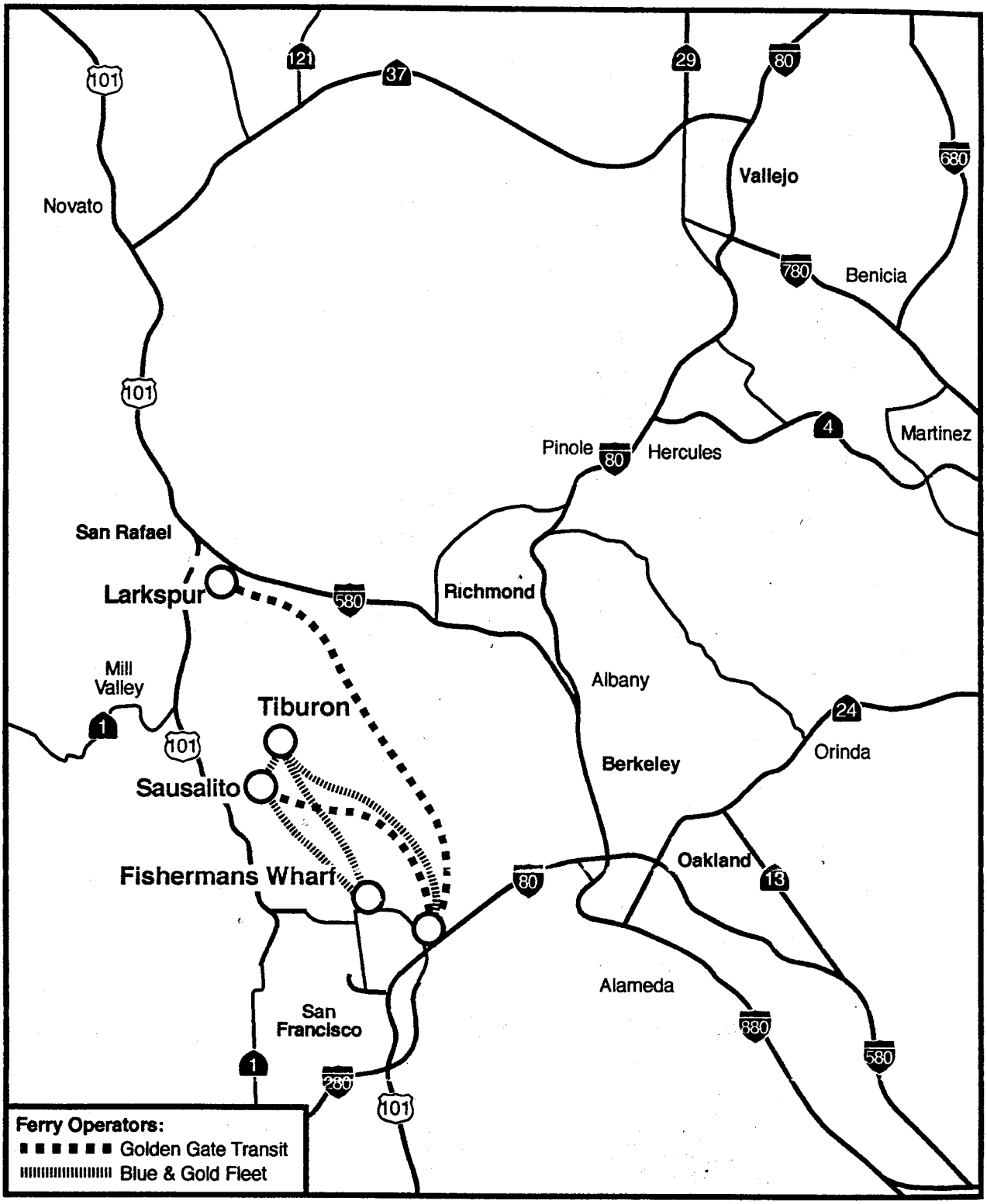

FIGURE 4.1 MARIN COUNTY FERRY ROUTES

Because of the extensive facilities and staffing involved in the Larkspur ferry operation, its farebox recovery ratio, at approximately 25 percent, is not as high as might be expected given its strong patronage. It is comparable, however, to that of the District's Bus Division.

Capital Improvements

1. Two additional high-speed vessels. Currently, the District operates one high-speed and three conventional 20 knot vessels on this route. As cited above, a second high speed vessel is expected to enter service within two-three years, which would result in two high speed and two conventional vessels. Two replacement vessels are currently programmed for FY2006 and FY2007. Earlier acquisition of a third vessel would reduce the need to operate four vessels on this route (see operating section). Given Vallejo experience and preliminary results with full loads on the 325 passenger Del Norte, the District should consider vessels with 375 to 400 seats. Each new ferry is projected to cost $8-9 million.

2. Phase 2 Larkspur Landside Access Improvements. Some access improvements were implemented prior to introduction of additional ferry service. Remaining elements include: "signalization of the intersection of East Sir Francis Drake Boulevard and Andersen Drive; geometric improvements to the intersection of East Sir Francis Drake, Larkspur Landing Circle and the Larkspur Ferry Terminal entrance/exit drive; coordinating traffic signals along East Sir Francis Drake Boulevard; a bicycle bridge over Corte Madera Creek; and a variable message sign on U.S. Highway 101 providing motorists with information about ferry services at Larkspur" (GGBHTD, Short-Range Transit Plan, page 120). Estimated cost is approximately $2 million. A garage to accommodate additional vehicles at Larkspur needs further consideration although environmental and traffic concerns may preclude it.

3. Equipment and Facility Upgrades. As the Larkspur and San Francisco terminals approach 25 years of age, rehabilitation of equipment and facilities, such as the hydraulic ramps, the maintenance facility, Larkspur berths, ferry radar, and parking lot repaving will be required. Estimated cost of such projects is approximately $3 million.

Operating Improvements

1. Operation of Three Vessels on Route. With acquisition of a third high-speed vessel, it should be possible to provide sufficient capacity and number of schedules with three vessels, slightly reducing operating costs compared to the current four vessel operation.

   Passenger capacity is not an issue for the current vessels which rarely carry more than 350 to 400 passengers (one trip per day - 5:20 PM departure from San Francisco - averaged 389 passengers per trip in FY1997). With three high-speed vessels, the District should be able to carry 2,600 - 3,000 passengers during the 4 PM to 7 PM peak period operating a trip in the peak direction every 25 minutes. Current demand averages 1,350 to 1,600 during this period, so three high-speed vessels should accommodate potential

demand. Thus, a third high speed vessel should allow the elimination of one vessel from the schedule.

2. Interlining Midday Service. As cited in previous analysis, an interlined two vessel midday service would allow the District to provide hourly service to San Francisco from both Sausalito and Larkspur with two high-speed vessels. Hourly schedules would boost ridership, and operating such a frequency with two vessels would provide better midday service with two vessels than the District presently provides with three vessels.

3. Marketing midday service. There is considerable excess capacity during midday periods, so the District needs to develop and implement a marketing strategy to encourage greater midday ridership.

4. Additional Feeder Bus Service. The feeder bus network to the Larkspur Ferry Terminal was modified in September 1998 with the introduction of new ferry service and expected parking demand in excess of available supply. New routes were created and midday bus service to the San Rafael Transit Center was introduced. Additional high-speed vessels will increase ferry travel demand further, and new connecting service will be required to alleviate parking congestion.

4.1.3 Tiburon.

With the programmed replacement dock and re-engining of the M.V. Zelinsky, no additional capital or operating projects are needed for this unsubsidized service.

4.1.4 Vallejo

Ridership on the Vallejo ferry service continues to grow. More than 14 months of data is available since the acquisition of two high-speed vessels and initiation of an 11 round trip schedule - replacing the former five round trip schedule. Approximately 69,000 passengers used the service in July 1998, compared to 50,000 in July 1997, a month after the new service was initiated, and 33,000 in July 1996. Average July 1998 ridership on weekdays was 2,350, on weekends 1,925.

A full load of 300 passengers was carried 14 times during July 1998, representing two percent of all trips. Twenty-seven trips, or approximately four percent of trips for the month, carried 275 passengers or more, the interior seating capacity of the vessels. Supplemental bus service has been introduced to accommodate the number of patrons left behind because of ferry capacity. This occurs most frequently on the 5:30 PM departure from San Francisco, when there is not another ferry departure for an hour (the earliest the 4:30 PM departure can return from Vallejo to make another trip).

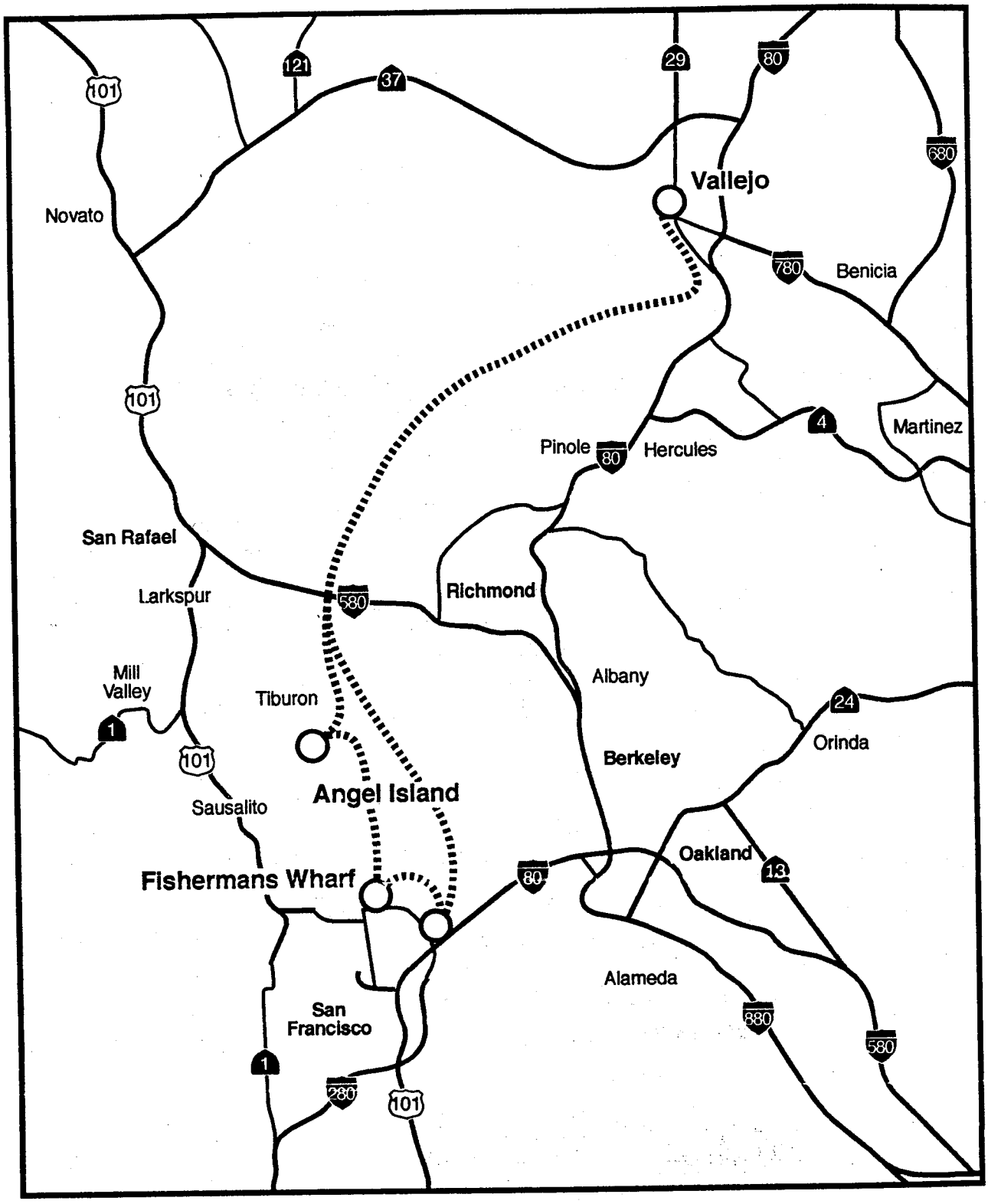

FIGURE 4.2 VALLEJO FERRY ROUTE

The Vallejo ferry service operating budget increased by approximately 60 percent with the introduction of two vessel service in May 1997. Ridership increased by 102 percent during the same time frame. With start-up expenses affecting operating costs for 1996-97, the cost declined to approximately $600 per hour for the 1997-98 fiscal year and farebox recovery remained more than 50 percent. The subsidy per passenger mile decreased to $.16, the lowest of Bay Area ferry services. However, the 25 mile route length contributes to the low cost per mile.

Capital Improvements

Vallejo is in the process of developing a new Short-Range Transit Plan. The following capital projects are expected to be included:

1. Additional 350-400 passenger High-Speed Ferry. Given the number of trips operating at capacity and inability of two vessels to make more than three peak direction commute trips on this 55 minute route, a third 35 knot vessel is required to meet the commute period demand. A third high-speed vessel could increase the number of commute trips from three to five, allowing an increase from a maximum of 900 commute trips to as many as 1,500. This vessel would cost $8.5 to $9 million.

2. M.V. Jet Cat Express Rehabilitation/Enhancement. This 368 passenger, 28 knot vessel provided the Vallejo ferry service prior to acquisition of new vessels in 1997. It is used as a back-up vessel and operates supplemental seasonal ferry services. This eight year-old vessel needs rehabilitation and modifications to allow it to maintain speed with full passenger loads - at present a trip with 300 passengers or more takes up to one and a half hours, 30 minutes behind schedule. Hull lengthening, new engines, and a fantail bicycle platform will allow the vessel to provide adequate back-up and supplemental service. Estimated project cost is $2.5 million.

3. Multimodal Transportation Facility at Vallejo Ferry Terminal. Current and anticipated passenger loads on this service are overwhelming the available 700-800 spaces currently available in an unpaved lot adjacent to the ferry terminal. Increasing demand and City desire to allow development on a portion of the existing parking area require development of a parking structure and improved facilities for bus to ferry and kiss-ride connections. Space for a future Napa County rail linkage is another potential aspect of the project.

   A 1,200 space garage and intermodal space for eight to 10 local and regional bus connections (Benicia, Napa, Fairfield, Vacaville, Sacramento, Napa winery charters, etc.) are required to facilitate the continued growth of this ferry service. Estimated cost is $15 million, including the garage, bus facilities, and street modifications. The project may be expanded with developer contributions for additional parking linked to proposed adjacent commercial development.

4. Maintenance Facility Phase 2 Improvements. The Vallejo Ferry service has developed an interim maintenance facility on Mare Island within one half mile of the terminal. The

improvement would construct permanent office space to replace trailers, and expand heavy maintenance shop space. The project could include up to 100,000 gallons of above ground fuel storage. Estimated project cost is $2 million. This facility could become a regional, North Bay ferry maintenance base if additional services are initiated from Martinez, Benicia, or Port Sonoma.

Operating Improvements

1. Supplemental feeder service. With considerable excess capacity in the reverse peak and midday market, Vallejo has initiated feeder transit service from Sacramento, Davis, Vacaville, and Fairfield. In addition, Benicia and Napa Transit systems provide links to some Vallejo ferry trips. These services need to be expanded to meet more ferry trips. Sacramento service does not connect to the 6 and 6:30 AM ferries from Vallejo to San Francisco and the 5:30 PM ferry from San Francisco because these ferries already operate near or at capacity. When a third vessel is brought into peak service, it should be possible to provide more feeder transit service to all ferry trips.

2. Marketing Midday Service. Further work needs to be developed to market midday ferry service, including the available connecting destinations (see #1 above). More marketing for destination such as Marine World, the Wine Train, winery tours, Vacaville outlet stores, the Golden Gate National Recreation Area, etc. should be linked with ferry service.

4.1.5 Alameda Main Street (West End)/Oakland

Ridership on this route has grown steadily, and demonstrates strong midday as well as peak ridership. For example, recent weekday surveys in August and September 1998 indicated that 47 percent of ridership on this route was on non-peak trips, compared to 27 percent for the Vallejo service and only 15 percent for Larkspur service. With the replacement of the 250 passenger M.V. Bay Breeze by the 400 passenger M.V. Encinal, capacity is not an issue for this route (except for occasional special event oriented weekend service).

Financial performance is very good, with fares contributing 60-65 percent of operating costs, and low subsidies per passenger. A Short-Range Transit Plan needs to be developed for both this route and the Alameda-Harbor Bay route, so the potential project list for this route needs further refinement.

Capital Improvements

1. Replacement/Second Vessel. At present, a second vessel is used for two supplementary trips during the AM peak period, and one trip during the PM peak period. This allows 30 minute headways during peak periods, as a single vessel is only capable of an hour or hour and five minute cycle time (i.e. departing Oakland at 6 AM and then again at 7:05 AM). The M.V. Ohlone Spirit, used for these supplemental trips, as well as for

replacement service when the M.V. Encinal is out of service, is too slow and not publicly owned. It should be replaced by a 200-300 passenger, 22-25 knot vessel. Projected cost is $2 million.

2. Maintenance/Fueling Facility. At present, these services are provided by the contract service operator at a facility in San Francisco. Fueling is done by truck and no fuel storage capacity exists for this service at present. Unlike Vallejo, the deadhead time and fuel consumption involved in berthing and maintaining the vessel in San Francisco is relatively insignificant.

   A publicly owned facility in Alameda or Oakland would provide more flexibility in selecting an operator, but may not be cost effective unless the scale of the operation increases (three or more vessels used for multiple East Bay routes). Cost of a maintenance/fueling facility could cost $1-2 million depending on available of existing facilities at Alameda Point and extent of required rehabilitation.

3. Third Vessel. With development of new ferry destinations (Treasure Island, China Basin Ferry Terminal, etc.), a third vessel may be required to provide service on an additional route. Given the existing route which includes stops at Oakland, Alameda, the San Francisco Ferry Building (and Pier 39 on midday trips), there is no capacity to add additional destinations to the existing route without adverse impacts on travel time -which would diminish ridership. The vessel should probably be a 350-400 passenger, 25-28 knot vessel, which would cost $5-6 million.

4. Alameda-Main Street Terminal Parking. If ridership continues growth, and particularly if a new route is developed, additional paved parking will be required at the Alameda terminal. A total of 500-700 spaces may be required, compared to 350 paved spaces at present. Other terminal upgrades and passenger amenities will be needed.

Operating Improvements

1. Supplemental Feeder Service. Redevelopment of sites along the waterfront in both cities (new housing and commercial development at or near Jack London Square, the Navy FISC property, and Alameda Point (formerly NAS Alameda) will generate potential new patrons for this service. Shuttle routes should be developed to link these sites to the ferry terminals.

2. Linkage of Alameda/Oakland, Alameda-Harbor Bay, and Potential U.S. Hornet Recreational Service. There are two San Francisco routes serving Alameda presently, and consideration of a third midday/weekend only route to the seaplane harbor at Alameda Point. Economies of scale would be achieved if a single operator provided multiple services, allowing better utilization of vessels, crews, facilities, etc.

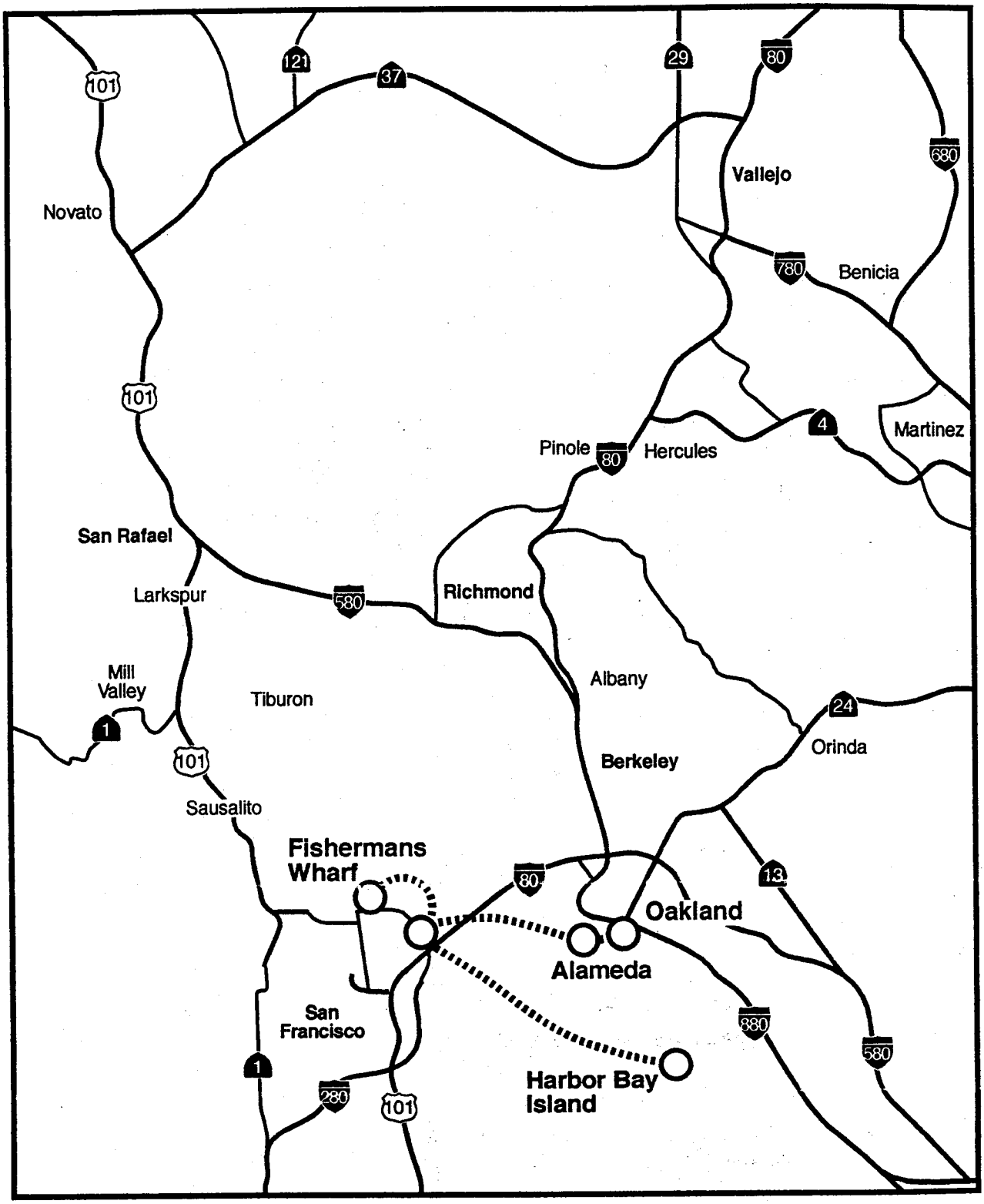

FIGURE 4.3 ALAMEDA COUNTY FERRY ROUTES

4.1.6 Alameda-Harbor Bay Island (East End)

At present, this service only operates to the Ferry Building during peak periods. It also provides special service to Giants and 49er games at Candlestick Point/3-Com Park for weekend day games. This latter service diminishes the subsidy required to operate the basic weekday service.

Because of operational difficulties, ridership and financial performance on this route is relatively weak compared to other Bay Area ferry routes. With a consistent service pattern by a reliable vessel, further development of the Harbor Bay Business Park, additional new houses, and completion of the cross-airport roadway (direct connection to the Oakland International Airport), this route has the potential to generate stronger ridership.

No capital improvements are anticipated for this service during the next three-seven years.

Operating Improvements

1. Linkage with Alameda/Oakland Service. Operation of this route separately from the Alameda/Oakland service has resulted in redundant overhead and maintenance expenses. Linking these routes would provide efficiencies of scale and better utilization of vessels. A linkage with the Alameda/Oakland service would also provide for joint utilization of a back-up vessel.

2. Linkage with Potential Alameda Point/U.S. Hornet Ferry Service. A recreational service has been proposed between San Francisco and the new U.S. Hornet Museum (World War II vintage aircraft carrier). Because the Harbor Bay service operates from the Bay side of Alameda, it could provide the best linkage to this potential future route. Recreational service to the Hornet could serve as another potential cross subsidy for the commute period service.

4.1.7 Port of San Francisco

The ferry docks at the Ferry Building represent the single most critical element in the Bay Area ferry network. The majority of trips and ridership are to and from this location. Golden Gate Transit has a two berth facility that is functional and very efficient in passenger movement on and off vessels. Its connection to the Embarcadero and downtown San Francisco is less successful. All other ferry services use the Pier 1/2 facility which has inadequate capacity as well as operational constraints. The Port has designed a two phase downtown ferry terminal project, that would ultimately result in 10 operational vessel berths. Only Phase 1 is funded and ready for construction. This will result in six berths compared to four at present.

Capital Improvements

1. Phase 2 Downtown Ferry Terminal. With incremental expansions of ferry service underway and several larger scale expansions possible, it is important that the Phase 2

expansion to 10 berths proceed so that to eliminate congestion-related constraints to ferry system expansion. This project would include two additional floating docks (and gangways) that could accommodate an additional four vessels. Landside modifications are necessary to have a kiss-ride and bus waiting area for the south basin area, where the expansion docks will be located. A 200 foot extension of the planned breakwater may be desirable, as is a public access pier on the primary breakwater. Estimated cost of these improvements is $6-10 million, depending on the scope of new decking required for landside access, and whether the breakwater is required.

2. China Basin Ferry Terminal. With the impending completion of the ballpark and anticipated development of Mission Bay and the UCSF campus, it is important to have a two vessel ferry terminal at China Basin. This will provide a direct ferry connection to the ballpark, access to Mission Bay employment centers, and an emergency alternative or expansion terminal for the Ferry Building. Estimated cost is $2-3 million.

Operating Improvements

1. Terminal Management. With expansion of ferry service, the Port needs to assign a terminal manager to be responsible for day by day operations of the facility. Coordination of operator scheduling, maintenance, information and ticketing services, planning special events, etc., all will require a greater level of attention than has been devoted to the ferry service to date.

4.1.8 Treasure Island

Although no specific long-term uses are proceeding to development at this time, it is clear that any development scenario, whether special-event activities or permanent land use development, will require ferry access as a significant element. Further analysis is required to develop a long-term ferry plan for the island, but an initial investment is required to accommodate interim uses.

Capital Improvements

1. A permanent, accessible two vessel float should be provided. It should be located at or near Pier 1 at the entrance to Clipper Cove. The facility needs an ADA accessible gangway, protective dolphins, and a float that can accommodate a variety of vessel freeboards. Based on engineer's estimate for new floats at the Ferry Building and the cost of the new ferry float in Vallejo, budget required is $2-2.5 million. This would not include permanent shoreside improvements.

TABLE 4.2
REGIONAL FERRY PLAN CAPITAL PROGRAM AND PRIORITIES

Sponsor/ Operator	Project Description	Estimated Cost by Priority		
		1999-2000	2001-2002	2003-2004
Sausalito/ GGBHTD	accessible ADA compliant dock		$350,000	
Sausalito	passenger shelter	$200,000		
Sausalito	landside access improvements			$1 million
GGBHTD	two 400 passenger, 35 knot ferries	$18 million		
Larkspur/ GGBHTD	landside access improvements		$ 2 million	
GGBHTD	equipment/facility upgrades			$3 million
Vallejo	400 passenger, 35 knot ferry	$9 million		
Vallejo	Jet Cat Express rehabilitation	$2.5 million		
Vallejo	multi-modal transportation facility		$15 million	
Vallejo	maintenance facility upgrades	$1 million		
Alameda/Oakland	replacement/back-up 250 passenger, 25 knot vessel	$2 million		
Alameda/ Oakland	maintenance/fueling facility			$2 million
Alameda/ Oakland	400 passenger, 28 knot vessel		$6 million	
Alameda/ Oakland	Main Street terminal parking/upgrades		$1 million	
Port of San Francisco	phase 2 Downtown Ferry Terminal (Ferry Building)		$6-10 million	
Port of San Francisco	China Basin ferry terminal	$3 million		
Treasure Island Development Authority	permanent dock	$2.5 million		
Totals		$38.2 million	$30-35 million	$6 million

Source: Pacific Transit Management Corporation

4.2 RE-EVALUATION OF NEW ROUTES RECOMMENDED IN 1992 FERRY PLAN

The 1992 Ferry Plan evaluated 17 potential new ferry routes throughout the Bay Area. Routes were evaluated based on past service proposals and MTC's Bay Crossing Study. Four routes were recommended for further consideration; not necessarily implementation but more detailed engineering and planning analysis. The Alameda/Harbor Bay service has been implemented. The following updates analysis of the other three sites considered to have the highest potential success for new service. Other potential new routes and terminals, such as Treasure Island or China Basin, described in a previous working paper, were not under consideration at the time of the 1992 analysis.

4.2.1 Berkeley/Albany

The *1992 Regional Ferry Plan* recommended a Berkeley/Albany ferry terminal at the foot of Gilman Street in the City of Berkeley. In 1993, the City of Berkeley requested $220,000 in Transportation Enhancement Activities (TEA) funding to provide for planning and environmental review of the project. However, these funds were not granted. With increasing regional interest in ferry service, increasing congestion, and enthusiasm by the Berkeley and Albany City Councils, further planning and engineering of this route is warranted, both for regular service and as a site for potential emergency ferry service.

Route and Distance

The proposed route would operate between Berkeley and San Francisco. The Regional Ferry Plan investigated three sites: the Berkeley Pier, the Berkeley Marina, and the foot of Gilman Street near Golden Gate Fields on land owned by Ladbroke. Distance is about six nautical miles from the pier, six plus miles from the marina, and just under seven nautical miles from Gilman Street. All terminals will require a dredged channel for approximately two nautical miles.

Terminal Location, Access, and Facilities

Each of the terminal options described in the *1992 Regional Ferry Plan* are reconsidered in relation to the City of Berkeley's adopted Waterfront Plan, the existing traffic conditions to and from the Berkeley waterfront, and the waterside constraints and opportunities.

Dredging would be needed for each option, to create a channel 10 feet deep at mean lower low water and about 75 feet wide. Dredging would be required from Gilman Street to a point about three miles off-shore (approximately 2-5 feet to achieve 10 foot minimum depth), a total of about 170,000 cubic yards of dredging. A marina terminal would require about 2.5 miles of dredging approximately 2-3 feet (dredging would have to occur within the Marina, in addition to the channel), about 15 to 20 percent less than Gilman. A terminal at the Pier would require about half of the dredging required of Gilman Street. Dredging requirements have been reviewed with Bay Conservation and Development Commission staff who did not foresee conceptual problems.

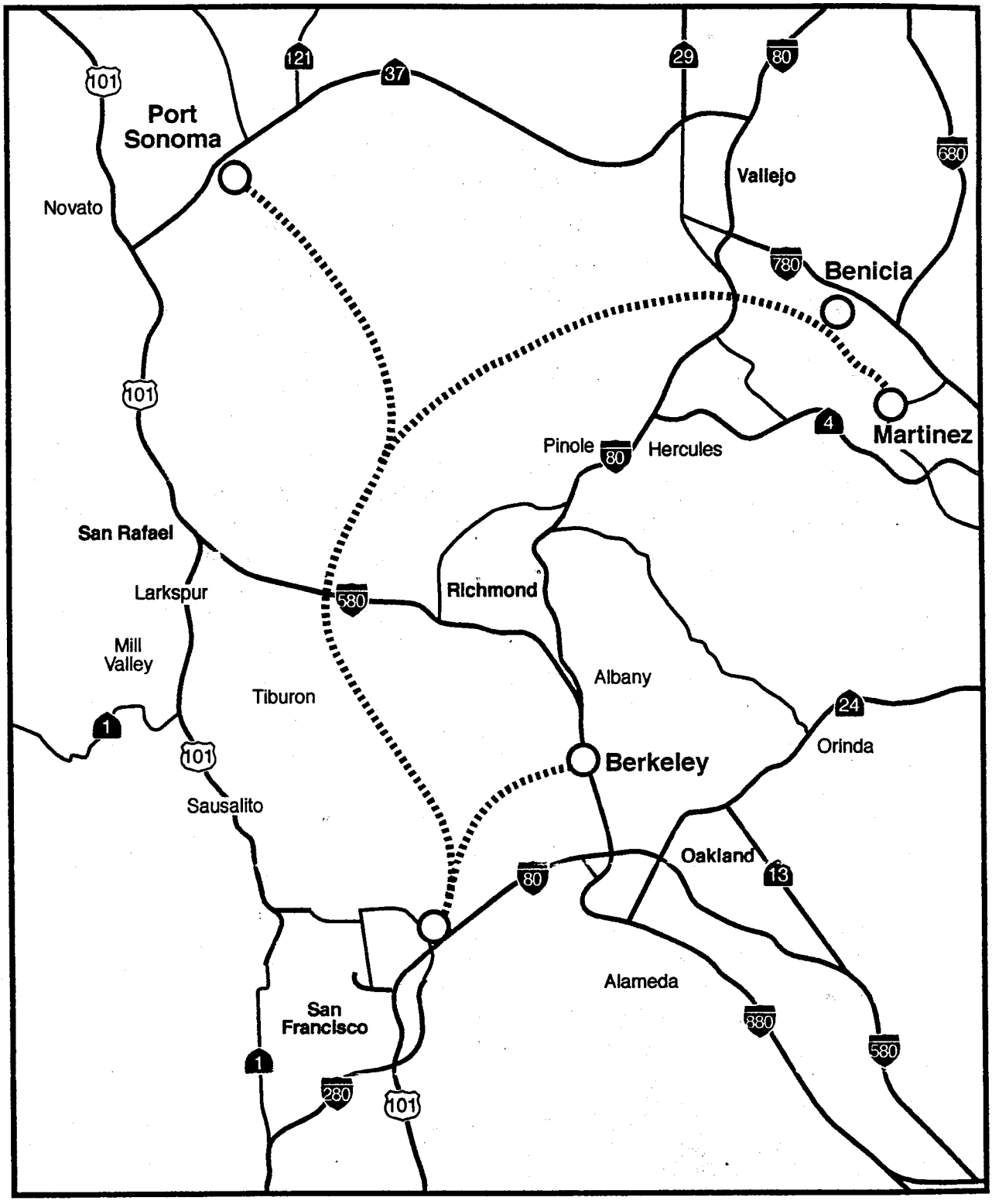

FIGURE 4.4 POTENTIAL NEW FERRY ROUTES RECOMMENDED IN 1992 REGIONAL FERRY PLAN

Some amount of maintenance dredging would be required, which would constitute an ongoing maintenance expenditure.

In 1978-79 and 1989, emergency ferries operated from a terminal in the southeast corner of the marina -- at the intersection of University Avenue and Marina Boulevard. This terminal has parking limitations, with much of the paved area used for parking for existing uses. Operationally, ferries operate slowly within the marina to prevent damage to other vessels and to limit wake.

While the Berkeley Pier was historically used for ferry service, it is now used for fishing and recreational uses which would be incompatible with ferry service. The distance from available parking would also be more than 500 yards. At Gilman Street, automobile parking could be accommodated on the existing "overflow" parking for Golden Gate Fields, south of Gilman. Each of the sites would require a new floating dock and gangway to operate ferry service.

Waterfront Plans. Berkeley is currently updating its Marina Master Plan. The new plan will reevaluate existing land uses and will also analyze appropriate new uses at the site. The document will also recommend and plan for upgrading and enhancing existing facilities, trails, signage and boating facilities. The current Berkeley Waterfront Plan calls for limited development throughout the area. Specifically, the policy calls for development only in parcels adjacent to Gilman Street. The site immediately north of Gilman (now the horse barns) is designated as the site for a 250 room hotel, while the site immediately south of Gilman is planned for 50,000 square feet of retail. The plan also recommended a 450 room hotel and conference center immediately south of the Cedar Street right-of-way. However, it should be noted that the latter site is being purchased by the East Bay Regional Park District on behalf of the State Park System. The balance of the waterfront property — about 85 acres — owned by Catellus Corporation, is being purchased by the Park District for the Eastshore State Park.

The Berkeley Waterfront Commission has indicated a desire to update the city's Waterfront Plan, which is now more than 10 years old. The Park District expects to also develop a master plan for the property it is purchasing from Catellus but has not yet initiated such a study due to a lack of funding.

Traffic and Access Issues. Of the three sites, the Berkeley Pier and the marina have the same access routes, while Gilman Street serves a slightly different catchment area and has different access.

- *Marina/Pier Access* — Primary access is via University Avenue and West Frontage Road, and the I-80 interchanges at University and Ashby Avenues. The University Avenue on and off-ramps provide direct access between I-80 westbound and the terminal site, but not eastbound. This means that automobile traffic arriving from north of Berkeley can directly access University Avenue to the marina, but traffic returning from the proposed terminal cannot directly access I-80. The alternative is to make a U-turn at Sixth Street, or use the Frontage Road to the Gilman Street eastbound on-ramp.

Local access from the Berkeley hills and Albany would be via Marin Avenue to San Pablo Avenue and then to University. Access from North Berkeley would primarily be via Hopkins Street to San Pablo Avenue or Sixth Street and then to University. From Albany Hill and El Cerrito, the primary access routes would be Pierce Street and San Pablo Avenue to Buchanan, and then the I-80 freeway. The marina is well served by AC Transit with Line 51M operating every 20 minutes during weekdays.

Both field investigations and analysis of existing documents (EIRs, traffic studies, etc.) were used to analyze existing traffic conditions on the main access routes leading to a marina/Berkeley Pier ferry terminal. I-80 traffic conditions are characterized as generally congested during both the morning and evening commute periods. The primary direction of travel is westbound in the morning commute and eastbound in the afternoon. During peak periods, level of service (LOS) varies between E and F, representing congested and oversaturated conditions. Even in the non-peak directions, LOS D, representing heavy traffic flows and some congestion, is predominant.

University Avenue, the primary access route to a marina/pier terminal, has generally poor levels of service in both peaks, but the afternoon period is worse than the morning. University Avenue westbound traffic on weekends exhibits especially poor conditions. The following indicates LOS for University Avenue weekday traffic conditions:

Intersection	AM	PM
University/I-80/West Frontage Road	F	F
University/Sixth Street	na	D/E
University/San Pablo	na	C/D

- *Gilman Street Access.* Primary access is via Gilman Street. The Gilman Street I-80 interchange provides direct access from vehicles entering and exiting I-80 in both directions. Local access from the Berkeley hills and Albany would be via Marin Avenue to San Pablo Avenue and then to Gilman Street. Access from North Berkeley would primarily be via Hopkins Street to Gilman. From Albany Hill and El Cerrito, the primary access routes would be Pierce Street and San Pablo Avenue to Buchanan, and then the I-80 freeway.

  There is currently no transit service to the proposed Gilman Street ferry terminal, although AC Transit Lines 9 and 52 operate within a few blocks of the site.

  I-80 traffic conditions are the same as noted for Marina/Pier access. Gilman Street, the primary access route to a Gilman terminal, is somewhat less congested than University Avenue, although vehicles experience significant delays at a number of intersections. These delays are due to left turns, particularly at the intersection with San Pablo Avenue. East of San Pablo on Gilman Street, slower street speeds and stop signs can cause some delay. However, Gilman Street traffic is not as congested as University Avenue. On

weekends it operates much more smoothly than University. As shown, the highest level of congestion in terms of level of service is at the intersection of Gilman and San Pablo.

Intersection	AM	PM
Gilman/I-80/West Frontage Road	C	C
Gilman/I-80/East Frontage Road	B	F
Gilman/6th Street	B	D
Gilman/San Pablo	E	E/F

Market Potential

The modeling effort used in the *1992 Regional Ferry Plan* estimated that hourly service from Berkeley would capture about 280 peak period passengers. Additional midday patronage was estimated to elevate all-day use to between 800 and 1,200 passengers daily. The patronage range resulted from an additional 300 to 400 Golden Gate Fields-bound passengers on 110 racing days; this increase can only be expected from a ferry terminal which is adjacent to the racetrack (i.e. only at the Gilman site).

The model, when analyzing other routes, predicted a 25 percent increase in patronage as service levels doubled, and 50 to 60 percent patronage increase as service levels tripled. Using these same formulas results in the patronage shown in Table 4.3.

TABLE 4.3
PATRONAGE FORECASTS FOR BERKELEY/ALBANY FERRY TO SAN FRANCISCO

Service frequency	peak period passengers	midday passengers	total passengers
Hourly	280	300	860
30 minute	360	350	1,070
20 minute	420	350	1,190

Source: DHS and PTM, Regional Ferry Plan, Sept. 1992.

On racetrack days, total patronage could be 1,500 to 1,600 passengers with peak trips every 20 minutes. The basis for the model's predictions is the 1990 census data, which while several years old is still the most useful information available and is consistent with MTC's current Berkeley to San Francisco work trip estimates. Peak period patronage is assumed to be primarily composed of North Berkeley and Albany origins, with some Richmond and El Cerrito residents also likely to use the service. Census data indicates that about 5,000 people commute daily from North Berkeley and Albany to downtown San Francisco. BART and bus are the mode of choice of about 35 percent, the remainder drive alone or carpool. MTC is projecting about a 25 percent increase in work trips between the Berkeley-Albany area and San Francisco

in the next 20 years. In the ferry's catchment area, the total work trip market could increase to about 6,300 trips.

It would appear that based on the existing transportation market, ferry service could be competitive. Ferries would travel to San Francisco in about 20 minutes, compared to 25 minutes from North Berkeley BART and 29 minutes from El Cerrito Plaza. Bus travel times range from about 25 to 30 minutes from various areas of Albany and North Berkeley. When access times are included, all the modes have about the same travel time to San Francisco.

After the Loma Prieta earthquake, the Berkeley ferry carried up to 500 passengers during the morning commute period and about 1,600 passengers daily with a 22 trip schedule. However, when the Bay Bridge reopened, patronage fell to about 500 to 700 trips daily, and then to 400 to 500 trips daily. As a result, the Berkeley ferry was eventually discontinued. The slow speed of the emergency service (12 knots) and travel time (45 minutes) provided a poor model of what ferry service could be with high-speed vessels and a visible terminal.

A great attraction of a Berkeley/Albany Ferry Terminal is its ability to provide for recreational and tourist service. The Eastshore State Park, located on the Emeryville, Berkeley and Richmond waterfronts, is in the process of being assembled and developed. The terminal would be available to serve ferries linking the Eastshore State Park with the Golden Gate National Recreation Area at the Presidio, Fort Baker and perhaps Alcatraz. Service could be operated to Sausalito and Angel Island.

With its outstanding freeway access and potential large parking lot, a Gilman Street ferry terminal could also be used to provide service to Treasure Island for both the permanent development at the site and for special events, and to China Basin for Giants baseball games and special events. Recent special event ferry service to Treasure Island overwhelmed parking capacity at Jack London Square, so a second convenient ferry terminal in the inner East Bay with parking capacity would be beneficial.

Vessel Type

The short six to seven mile route length between Berkeley and San Francisco requires a vessel to travel at approximately 25 knots (about 29 mph). Increasing speed to a 30 knot vessel (35 mph) would only shorten the sailing time by about three minutes. There is a large fuel consumption penalty associated with higher speed vessel operation which is not warranted given the small time differential associated with higher speed on this potential route.

There are several satisfactory vessel types and the vessel selected depends upon service frequency and demand. Should an hourly service be recommended, then one 250 passenger catamaran would be an appropriate selection. This could be a vessel such as the M.V. Bay Breeze, a 29 meter 25 knot vessel now used on the Harbor Bay Isle route. This vessel would consume about 70 gallons of fuel hourly on a Berkeley-San Francisco route. Such a vessel would cost about $4-4.5 million. Another alternative is the purchase of several 149 passenger vessels. This would allow more frequent service. Under this scenario, either catamarans or fast

monohull vessels could be purchased. Several manufacturers have off-the-shelf plans for such vessels including International Catamaran Designs and FBM Marine. Either of these vessels would cost about $3-3.5 million. Another alternative is the Westport Shipyard 30 meter monohull vessel, which has good experience in service to Santa Catalina Island in southern California. These vessels would cost about $3 million each, but use slightly more fuel per hour than a catamaran.

Financial Analysis

Different service alternatives were considered for a Berkeley/Albany ferry. One scenario anticipates one 250 passenger vessel providing hourly service to San Francisco. Another scenario anticipates 30 minute service frequencies using two 149 passenger boats. A third scenario anticipates 20 minute service in the peak periods, with 30 minute service in the off-peak. As service increases, patronage increases, but so do costs. Table 4.7 summarizes the capital costs associated with a three vessel service while Table 4.8 indicates associated operating costs and subsidies required for these scenarios.

While the project planning stage would determine the appropriate level of service, for this analysis it is assumed that the most expensive capital plan would be used, requiring the purchase of three 25 knot, 149 passenger vessels costing $3-3.5 million each. In addition, terminal facility costs, including dredging, docks, gangways and parking, are projected at about $4 million. Approximately $1.5 million is allocated for planning, design, and contingency. Thus, total capital costs would be approximately $15.5 million.

This analysis assumes a fare of $3.50 and hourly operating costs ranging between $325 and $400 (crew, fuel, insurance, management, etc.). The results, as shown in Table 4.8, indicate that hourly service would require a subsidy of about $590,000 annually, 30 minute service would require a subsidy of about $1.3 million annually, and peak service every 20 minutes would require a subsidy of about $1.6 million annually.

Sponsor

Both the Berkeley and Albany City Councils have expressed interest in planning, developing, and implementing ferry service. This route has the potential to be one of the most used maritime services on the Bay with 1,200-1,600 passengers daily (weekdays) if it is provided with a visible location, good access and supportive adjacent land uses. While there is currently no operating funding available, current Bay Area initiatives may result in more funding opportunities. Since the Berkeley project is planning intensive, work should start immediately on all the planning aspects that are required.

An early key step is the nomination of a project sponsor, which could include the City of Berkeley, AC Transit, the East Bay Regional Park District, or some other entity.

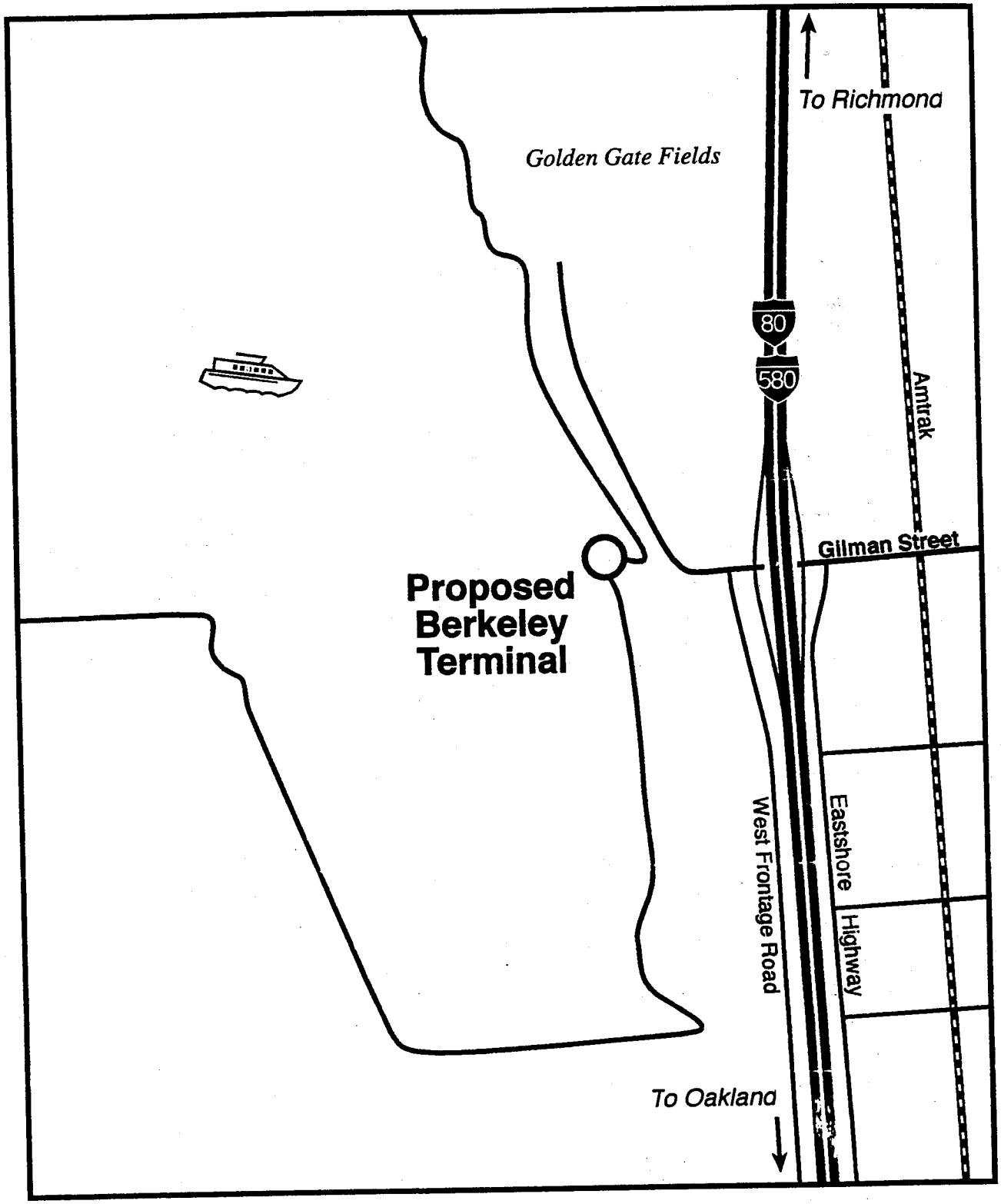

FIGURE 4.5 PROPOSED BERKELEY FERRY TERMINAL LOCATION

Recommendation

Terminal Location. Gilman Street is the preferred site for a Berkeley/Albany ferry terminal. While traffic conditions can be congested both on University Avenue and Gilman, the latter provides better access, serves a catchment area that is not well-served by BART. While there is some concern among residents and decisionmakers that a Gilman ferry terminal could increase traffic on the residential section of Gilman Street between San Pablo and Hopkins, it is also likely that much of the ferry-related traffic will simply be diverted from current drivers, with little net increase in overall traffic.

In addition, the Gilman site is the only area of the Berkeley Waterfront available for any type of development. All other uses within the area are primarily recreational and may not be compatible with an intensive ferry transit operation. Ferry riders would probably be equally split between BART users and drive alone automobile users. At the terminal, parking would need to be provided for about 80 percent of the peak period passengers. This demand results in a range between 350 and 450 parking spaces.

A Gilman Street ferry terminal could be served by several reroutings and extensions of AC Transit service. Among the options are a rerouting of Line 9 from Sixth Street to a terminal at Gilman. Line 52 could be rerouted to serve the ferry terminal by operating between University Village and the Berkeley campus via Gilman and the terminal. Line 43 trips could also be modified to serve the ferry terminal.

Next Tasks. This analysis indicates that ferry services from the Berkeley/Albany area could be successful with the implementation of supporting developments in the waterfront area (e.g. hotel and commercial development proposed for the Gilman Street area) and with the expansion of recreational docking facilities and destinations to boost overall ridership.

Therefore, it is recommended that the Cities of Berkeley and Albany and East Bay Regional Park District jointly integrate their waterfront planning (including Berkeley's Waterfront Plan update and the EBRPD's Eastshore State Park Plan) with implementation planning for ferry service at the Gilman Street location. With regard to the ferry service, the planning should at a minimum address the following:

- compatibility of ferry service (terminal facilities, parking, etc.) with planned developments in the waterfront area;
- landside access improvements to the Gilman Street location, including parking facilities and improved circulation;
- provision of connecting bus service;
- environmental impacts on the waterfront area, including dredging impacts

The planning should be sufficiently comprehensive to determine the feasibility and compatibility of ferry service with other land uses. Funding for all three planning efforts, estimated at $600,000, should be primarily from transportation sources to support the transportation-land use nexus.

4.2.2 Martinez

Following completion of the Regional Ferry Plan, the City of Martinez prepared a new Marina Master Plan, prepared a conceptual engineering and planning study for a ferry terminal, and successfully obtained a $250,000 FWHA Section 1064 grant for ferry facilities. With planning complete, this route is ready to move into implementation (including final design, construction and vessel acquisition, and operations) once capital and operating funding is procured. To date, no funding has been available for this ferry service. At a minimum, an interim or permanent dock should be developed as an emergency contingency facility.

Route and Distance

The proposed route would operate between Martinez and San Francisco, as shown in Figure 4.---. The route is approximately 28 nautical miles, following Carquinez Straits to San Pablo Bay, and then across San Pablo and San Francisco Bay following the route of the Vallejo ferry. Once leaving the marina or its vicinity, the channel is wide with few navigational impediments.

Terminal Location, Access, and Facilities

The proposed terminal would be at the foot of North Court Street, accessed from downtown via the railroad crossing on Ferry Street. Highway access would be approximately 2.5 miles to Highway 4 via Alhambra Avenue, or about 1.7 miles to I-680 via Marina Vista. As part of the Martinez Intermodal project, Joe DiMaggio Drive will be realigned and widened to accommodate a Class II bicycle lane on both sides of this street which connects the railroad crossing at Ferry Street to North Court Street, providing the linkage to the Martinez Marina. An additional access road will be constructed to and from the parking lots of the Intermodal Terminal from Ferry Street. No other roadway changes are anticipated at this time.

The key access roads and intersections to the Intermodal facility (and ferry site) operate at excellent conditions (LOS A in 1993) and are projected to operate at excellent conditions in year 2010 (LOS C or better). The intersection level of service would not deteriorate to unacceptable levels with an additional 150-200 vehicles inbound to a ferry terminal (maximum number projected per trip) in the AM peak hour or outbound in the PM peak hour. However, operations analysis should be conducted in the future to identify potential friction and conflicts between the vehicles accessing the ferry terminal and the Intermodal station at the intersection of Ferry Street and the new access road being designed to serve the Intermodal facility.

Investigation of docking facility needs in Martinez suggest a location either adjacent to the Harbor Master's office in the Martinez marina or using a portion of the historic ferry slip outside the existing marina. The concept level engineering and cost analysis favored the development of the ferry terminal at the historic ferry slip. In addition to cost, the fundamental difference between the ferry docking alternatives inside the marina and those outside is the relatively crowded conditions in the marina for ferry vessels of the length now designed for high speed travel in San Francisco Bay. Maneuvering a 30 to 40 meter vessel will be extremely tight inside the marina given the existing alignments of docks. It is feasible to locate the ferry dock

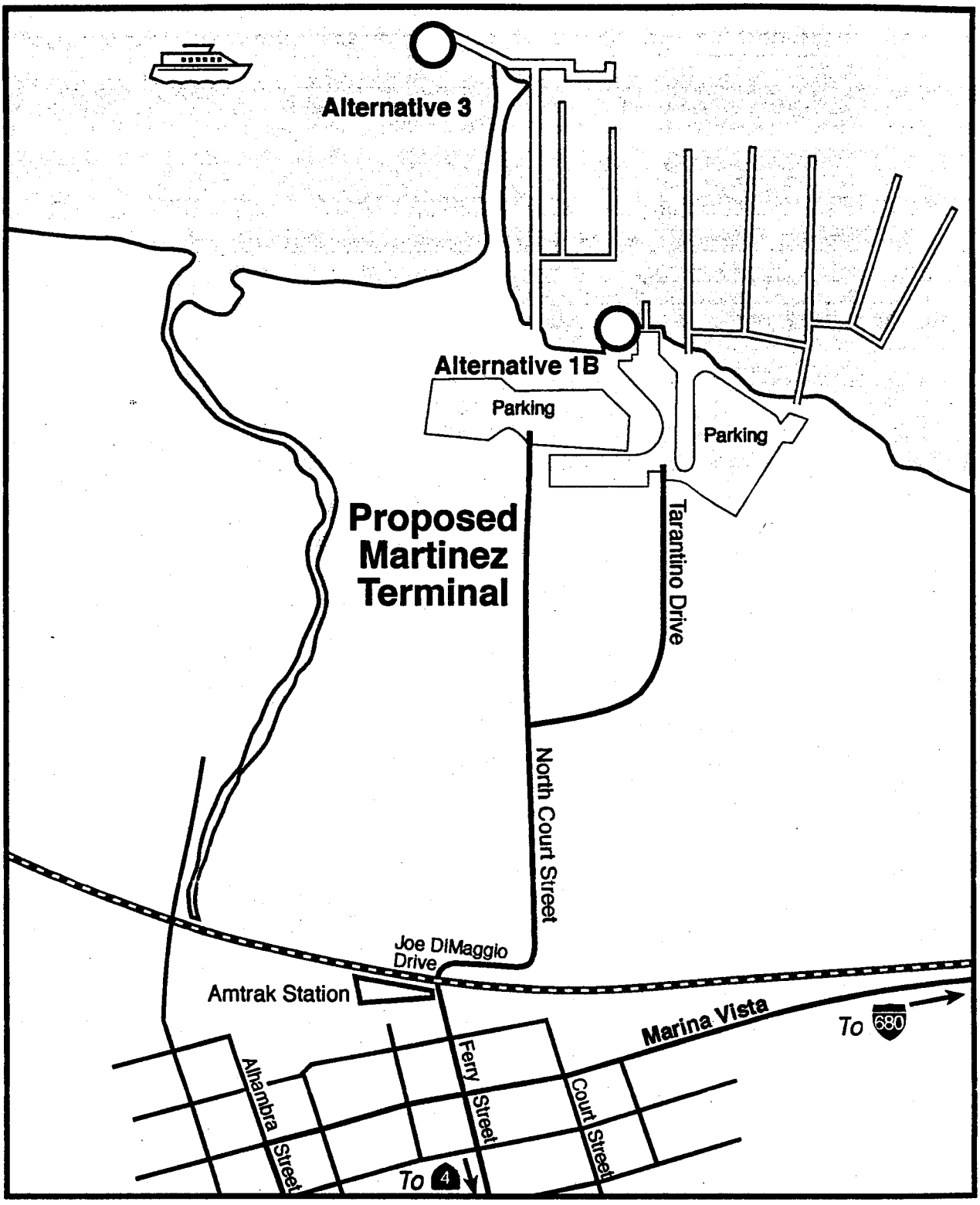

FIGURE 4.6 PROPOSED MARTINEZ FERRY TERMINAL ALTERNATIVES

in the marina by reorienting the corner of A dock and relocating the fuel and visitor docks. However, conditions will be constrained, maneuvering will be tight, and other boats, including those being launched, will not be able to pass in and out of the marina through the main channel while the ferry is underway. There is also increased risk of damage to other vessels or more likely perception of damage to other vessels as a result of operation of large ferries inside the marina.

Another fundamental element in the engineering analysis is the amount of on-going dredging that will be required inside the marina versus that at the historic ferry dock. Dredging a channel three to four feet deeper than the surrounding vessel berthing area may create a "sediment trap" that will require more frequent dredging to remain open for ferries and other large vessels. Besides the cost implications of dredging, the permitting and disposal requirements for dredging makes it difficult to do on a one-time or repetitive basis.

The disadvantage of utilizing the historic ferry slip for ferry service is the long walking distance from the parking lot and proposed ferry plaza. It is not possible to create a natural linkage or flow between the pedestrian areas of the marina and the dock. While comparable to a walk from parking to the platform at a BART Station, the approximately 750 to 800 foot walking distance to the end of the mole would diminish the visibility of the service and the marketing impact of ferry service relative to locating the vessel dock near the shore inside the marina. Although increasing pedestrian access time, it may not in fact increase the total journey time, since the ferry trip will be shorter. The extremely slow vessel speed required inside the marina would extend vessel travel time relative to docking at the historic ferry slip. It is also not feasible to fuel a ferry or pump out sewage at the historic slip unless expensive lines are installed in the mole.

Table 4.4 below summarizes the cost estimates for the two most feasible alternatives. The cost for the site at the historic ferry slip (alternative 3) is estimated at approximately $400,000 less than the best alternative inside the marina (alternative 1B). Without a breakwater at the alternative 3 location, there will be very occasional conditions when it is not possible to use the facility.

Table 4.4
Comparative Development Cost for Alternative Martinez Ferry Terminal Locations

Alternative	Location	Cost Estimate (1997)
1B	Diagonal to shore close to pedestrian plaza & Harbormaster's Office	$1.75 million
3	At historic ferry slip at end of mole (outside the marina)	$1.38 million

Source: Moffatt & Nichol Engineers (1997)

With engineering and environmental analysis, an appropriate dock in Martinez is likely to cost $2-2.4 million.

As the evaluation has indicated the potential of a joint Martinez-Benicia ferry service, alternative ferry docking locations in Benicia were considered as well. From east to west, these are the City dock at the foot of Fifth Street, in the Benicia marina, or at the foot of First Street. Advantages and disadvantages of each site are summarized below:

- Fifth Street. Advantages of the site are an existing pier which will be available in early 1999, sufficiently deep water, and good freeway access via the East 5th Street interchange. Adding a float and gangway would be relatively easy and permitting to upgrade an existing pier should be an easier regulatory problem than a new pier. There is also space for parking several hundred cars in this vicinity if Benicia Industries property to the east can be utilized. The primary disadvantage of this site is distance from downtown and the commercial district. Development cost is likely to be $1-1.5 million.

- Benicia Marina. The main advantage of this location is the infrastructure of the marina and the fact that the channel is already dredged, probably to sufficient depth for modern waterjet propelled ferries. A permit already exists for a potential ferry dock adjacent to the fuel dock, including an accessible gangway. Disadvantages of this site are the relatively congested space within the marina for vessel turning (approximately 220 foot square turning basin), the potential problem of ferry induced wash causing damage to vessels in the marina, and relatively constrained parking availability. Given the proposed location closest to the mouth of the marina, a vessel could back out into the channel without turning in the marina. The cost of facility improvements for docking at this location are likely to run $125-150,000[1]. About 40 to 50 parking spaces are presently available along B Street and several hundred additional spaces are available, but at greater distance.

- First Street. The foot of First Street was identified in the Benicia Urban Waterfront Restoration Plan as the desired site of a Marsh Overlook/Pier that "will provide opportunities to access the downtown from small boats or from a local water taxi or excursion boats" (Page 28). This site is adjacent to the "Historic Triangle" which was the site of the railroad station which connected to the ferry terminal which was on the spit. There are remnants of a historic pier at the proposed location at the foot of First Street which may provide some benefits in terms of the regulatory process. However, the site has several potential disadvantages or constraints to its use as a ferry terminal. First, it is adjacent to small islands, so it can only be approached from the south or east, not the west. Second, it is the most exposed to the strong winds which often blow in the Carquinez Strait, particularly in summer afternoons. Finally, the Benicia marina breakwater has reportedly caused significant siltation in the area, which means the pier will either need to extend farther into the channel or an approach channel will need to be dredged and maintained for the use of ferries and other craft. Parking for ferry patrons may be located at some distance along B Street.

---

[1]. according to estimates by John Ash, manager of the Benicia Marina.

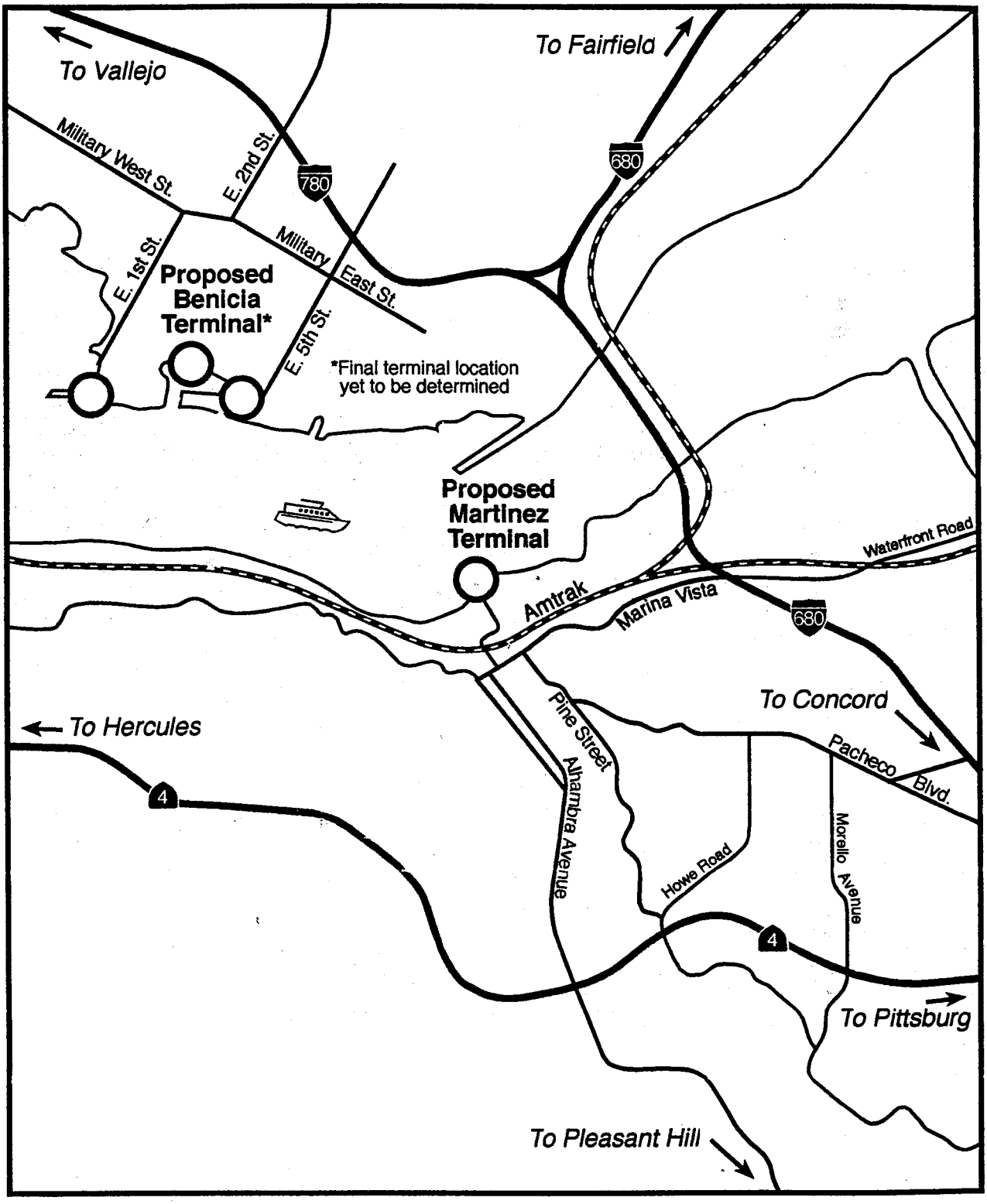

FIGURE 4.7 PROPOSED BENICIA FERRY TERMINAL ALTERNATIVES

Not including potential dredging, the cost of restoring a dock at the foot of First Street, purchase and installation of a pile supported float suitable for ferries, lighting, gangways, and other infrastructure, is likely to cost approximately $2-2.5 million.

Market Potential

Martinez. The modeling effort developed for Martinez in the *1992 Regional Ferry Plan* estimated that a peak period, one trip each direction Martinez to San Francisco service would attract about 250 passengers each direction (or about 500 daily). Although this seems somewhat optimistic, most Ferry Plan forecasts which have been implemented have met or exceeded projections. Furthermore, from a special survey conducted the week of the September 1997 BART strike, more than 200 people from Central or North Contra Costa used the Vallejo Ferry, despite considerable "out-of-direction" travel required to do so.

An alternative service option which would provide a two trip commute service, with one trip in conjunction with service from another city, such as Vallejo or Benicia. The model estimated that a two trip service could result in about 340 passengers in each peak period, and three-trip service would generate 390 passengers.

For commute travel, a Benicia stop would add 7-10 minutes to a Martinez-San Francisco route, which could diminish ridership potential by about 20% for that segment. Table 4.5 illustrates the Martinez based ridership demand for one-two or three trips with a Benicia stop. A Benicia-Martinez to San Francisco service loop should be considered as well, as such service could provide a morning connection from Benicia to downtown Martinez for County employees and vice versa at night. This might diminish Benicia ridership while increasing Martinez ridership.

Benicia. According to the Regional Ferry Plan, about 60% of 177 peak period riders that would be attracted to a single trip Benicia-San Francisco ferry would be current riders of the Vallejo ferry that would switch if a new service were created, thus netting only about 70 new riders. However, given high levels of ridership on Vallejo commute services, a slight reduction of demand from Benicia residents may be desirable.

According to Census data, approximately 1,100 Benicia residents, or 8.7% of the Benicia resident workforce, worked in San Francisco in 1990. Based on the nine percent population growth from 1990 to 1997 and relatively stable workforce participation, the number of Benicia residents working in San Francisco may have increased to approximately 1,200 to 1,300 persons. Because of diverse workplaces within San Francisco and work schedules, it is unlikely that ferries could attract more than 10-15% of the potential market, or 120 to 160 persons. This is slightly higher than the proportion of Vallejo residents working in San Francisco who commute by ferry. Attracting more riders for a Benicia ferry would require capturing riders from Fairfield and points up the I-80 corridor, markets which Vallejo is already penetrating (about 13-15% of Vallejo ferry ridership). The forecast of 120 to 200 Benicia riders reduces the 1992 Ferry Plan forecasts to reflect the strong draw Vallejo has at present among "upcounty" residents.

A survey of Vallejo ferry patronage during the September 1997 BART strike indicated that approximately 13 percent of regular Vallejo commute ferry riders were Benicia residents. A September 1998 survey indicated 16 percent were Benicia residents. This would translate to about 75 to 100 persons of the 700 daily commuters. About 10% of new riders on the system the week of the BART strike were Benicia residents.

Table 4.5 summarizes the commute demand for a joint Benicia-Martinez ferry. The 320 riders for single trip service would match the capacity of a 300-350 passenger vessel. Two trip patronage would be approximately 450 or 225 per trip, but such service would require two vessels to make one trip each since the two hour cycle time would prevent a single vessel from operating a convenient commute schedule.

Table 4.5
Patronage Forecasts for Commute Martinez-Benicia Ferry Service to San Francisco

number of commute trips	Martinez (with stop in Benicia)	Benicia	Total/ per trip
1	200	120	320
2	275	175	450/ 225
3	312	200	512/ 171

Source: DHS and PTM, Regional Ferry Plan, Sept. 1992.

Vessel Type

The 28 mile length of the route requires vessels comparable to the new Vallejo and Golden Gate ferries, capable of 33-35 knots, to provide the competitive travel times that will generate the projected ridership. There are several designs available for 300-400 passenger vessels that will achieve such performance. Such vessels would cost $8.5-9 million each including tax. An alternative strategy would be the acquisition of two 149 passenger vessels for $3.5 to $4.5 million each, or one large and one small. While operating costs would be somewhat lower for a smaller vessel than for a larger one, and multiple vessels would offer greater schedule flexibility, passenger comfort would not be as great as on a larger vessel, and the cost of operating two smaller vessels is higher than the cost of operating one larger vessel. One smaller and one larger vessel might be the ideal combination to provide flexibility for this route, although patronage forecasts suggest this might result in inadequate capacity.

Financial Analysis

A minimum of approximately $12-13 million would be required to purchase a single 35 knot, high-speed, 325-350 passenger vessel and create docking facilities in Martinez and Benicia.

Capital costs for a dedicated two vessel service would be about $21-23 million for two large vessels, as shown in Table 4.7, or $16 million for one large and one smaller vessel. An annual operating subsidy of about $1.2 million would be required to operate three commute trips and limited midday service. Not providing midday service would reduce the annual operating subsidy to approximately $570,000. A single vessel, two trip commute service could be operated at an annual subsidy of approximately $365,000 if other midday service could be provided by the vessel and crew. These operating costs are illustrated in Table 4.8.

No local or regional funding source is readily available at this time. The proposed Solano County sales tax measure could contribute to Benicia improvements, and a future re-authorization of the Contra Costa transportation sales tax could provide local funding for Martinez. Other possible capital funding sources would include state STIP or federal STP/CMAQ funds programmed by MTC in conjunction with county Congestion Management Agencies (CMAs) and transit operators. Other alternative funding sources could include a proposed regional gas tax or dedicated funding source for ferry capital and operating that may be sought by the Bay Area Council Water Transit Task Force. The 5% Bridge Toll Funds presently allocated to support of ferry services are already fully utilized by existing ferry services.

Sponsor

Both the cities of Martinez and Benicia have expressed interest in ferry service. The transit operators serving Martinez are BARTD and the Central Contra Costa Transit Authority. The latter has followed the analysis of feasibility and expressed some interest in sponsorship. The City of Benicia operates its own transit system and is a funding claimant for state and regional funding. A management and operational linkage with the nearby Vallejo ferry service would offer economies of scale, a potential maintenance facility, experience, and potential for some joint recreational services.

Recommendation

Further planning and engineering work is required to determine which of several alternative sites in Martinez and Benicia should be selected for docking sites. Even before funding is identified for full ferry service implementation, docks in these locations should be a high priority for emergency facilities because of the critical Bay Area to Solano County and Sacramento linkage across the Carquinez Straits.

4.2.3 Port Sonoma

At the time of the *1992 Ferry Plan*, a development firm proposed a Port Sonoma - San Francisco ferry route as a traffic mitigation and marketing plan for a planned 1,200 residential unit expansion of Bel Marin Keys in Novato. The proposed development was not approved, and plans for the ferry service have lapsed for lack of a sponsor. The service appears technically and financially feasible but is unlikely to proceed because of the lack of interested sponsor.

Route and Distance

The route is approximately 22 miles, approximately one half mile in the Petaluma River, four miles in the Petaluma Channel dredged in San Pablo Bay, and the remainder across San Pablo and San Francisco Bays. Apart from weekend marina traffic, there is little conflicting traffic and a vessel should be able to maintain speed on route except within the marina, under the railroad bridge, and in the Petaluma River which does have several homes along its banks. Estimated travel time at 32-35 knots would be 45 to 47 minutes.

Terminal Location, Access, and Facilities

The Port Sonoma Marina, presently owned by a subsidiary of Granite Construction Company, is on the south side of Highway 37 just east of the Petaluma River. It is located on the Sonoma County side of the river; Marin County jurisdiction and the City of Novato are on the west bank of the river. Vehicular access for this terminal site would branch from the existing entrance to the Port Sonoma Marina, approximately one quarter mile east of the Highway 37 bridge over the Petaluma River. The entrance is controlled by stop sign at the present time. In order to accommodate ferry service, a traffic signal would be required to allow incoming left turns and all exiting traffic to flow safely and efficiently through the intersection.

The marina is approximately four miles from the intersection of Highway 101 and Highway 37, five miles from Novato, 13 miles from Petaluma via Lakeville Road, and 14 miles from Sonoma via Highways 121 and 12. According to the "Sears Point Raceway Master Plan DEIR", there is sufficient capacity on Highway 37 and other access routes to accommodate potential ferry induced traffic. The Lakeville Highway/Highway 37 intersection presently operates at level of service (LOS) B during both AM and PM peak periods. However, the present PM peak period Lakeville Road level of service is at the D/E threshold although it has additional capacity for 900 vehicles per hour, more than sufficient capacity to serve as one of three primary access corridors to a ferry terminal - eastbound on Route 37, southbound on Lakeville Road, or westbound on Route 37. The widening of Route 101, a project on the November Marin and Sonoma transportation sales tax measure, would alleviate the current traffic level of Lakeville Road.

The proposed site for a ferry terminal would be on the south side of the marina, adjacent to the main access channel to the River. This would minimize ferry maneuvering during ingress and egress, thus reducing maintenance dredging needs to permit safe navigation in the channel. Although the access channel and river are routinely dredged, there have been recent periods when the marina was not consistently dredged. At present, all marina parking is located between Highway 37 and the boat basin - to the north of the marina. A parking lot for up to 700 cars could be accommodated adjacent to the proposed docking site. A roadway branch from the existing access roadway would be needed - this would extend up to a quarter mile to the southwest corner of the marina.

Required landside facilities would include a parking lot, covered waiting area, utilities, and passenger amenities (restroom, phones, information kiosk, etc.). Waterside requirements should include a riprap or bulkhead shoreline treatment, 10 foot deep dredged navigation channel and

turning basin, a barge type dock for the vessel, and covered gangway from shore to dock. Compatibility of land use has been identified as a serious issue for this terminal site, as the surrounding area is an agricultural use and supports a large wildlife habitat. The only "urban" site with water access is the Petaluma Marina, which is considerable distance "up river" and not accessible to the Sonoma and Novato markets.

Market Potential

The demand forecasts in the *1992 Ferry Plan* projected a ridership of 250 passengers for a single trip 45-minute service, 340 passengers on two trips, or 385 with three trips. These assumed 1992 fares of $7 round trip. Current vehicular travel time from Novato to downtown San Francisco is approximately 60 to 75 minutes during commute periods. Bus commute time between the two points is 75 minutes at present, although it may improve by 10-15 minutes when the Route 101 HOV lane is eventually extended from Larkspur through San Rafael. Thus, ferry service would offer a 10-20 minute travel time savings compared to bus, even with access time to Port Sonoma.

Table 4.6 illustrates current MTC forecasts for travel and mode split from Novato and Sonoma County to the San Francisco Financial District. Total travel in the corridor is approximately 7,000 daily trips, about 60-70 percent of the travel between Solano County and San Francisco. The majority of travel in the corridor is already on transit. A one-way demand of 340-385 passengers would only represent six percent of the market, which should be easily achievable. A good quality three peak trip service might generate 500 to 600 trips, particularly if the Petaluma - Novato segment of Route 101 remains congested. The projection of 385 trips represents an achievable, conservative projection. Based on experience in Vallejo combined with the current high transit mode share, ferry patrons are likely to represent both current auto and bus patrons.

Table 4.6
MTC Travel Demand: Novato/Sonoma to Downtown San Francisco

Novato/Sonoma to San Francisco CBD	auto person trips	transit person trips	total person trips	percent transit trips
1995	2,794	4,257	7,051	60%
2015	3,198	4,304	7,502	57%

Source: Korve Engineering from MTC

Only one bus route presently passes the Port Sonoma Marina, Golden Gate Transit Route 90 from Sonoma to San Francisco. It only makes one commute schedule run daily. In addition, Golden Gate Transit Route 71 provides four commute trips daily from Santa Rosa with ferry connections at the Larkspur Ferry Terminal, with stops in Rohnert Park, Petaluma, and Novato freeway bus pads. However, there is no assurance that feeder service would be provided to a Port Sonoma ferry terminal.

Vessel Type

The 22 mile length of the route requires the speed of the Vallejo or new Golden Gate ferry, 33-35 knots, to provide the competitive travel times that will generate the projected ridership. As cited previously, there are several designs available for 300-400 passenger vessels that will achieve such performance. Such vessels would cost $8.5-9 million each including tax. An alternative strategy would be the acquisition of two 149 passenger vessels for $3.5 to $4.5 million each, or one large and one small vessel.

Financial Analysis

A minimum of approximately $11 million would be required to purchase a single 35 knot, high-speed, 325-350 passenger vessel and create docking and parking facilities at Port Sonoma. Capital costs for a dedicated two vessel service, as shown in Table 4.7, would be about $20 million for two large vessels or $15 million for one large and one smaller vessel. Table 4.8 summarizes the subsidy per passenger trip and annual subsidy required for a Port Sonoma service. A single vessel, two commute trip service (for example, leaving Port Sonoma at 6 AM and again at 7:45 AM) would require a minimal subsidy, approximately $150,000 per year if cost could be kept to $600 per operating hour - approximately the cost of the current Vallejo ferry service. A two vessel, three trip commute schedule would require an annual operating subsidy of approximately $400,000.

No local or regional funding source is readily available at this time. Possible capital funding sources would include state STIP or federal STP/CMAQ funds programmed by MTC in conjunction with county Congestion Management Agencies (CMAs) and transit operators. Other alternative funding sources could include a proposed regional gas tax or dedicated funding source for ferry capital and operating that may be sought by the Bay Area Council Water Transit Task Force. Developer contributions could possibly generate part of the required capital funding. The 5% Bridge Toll Funds presently allocated to support of ferry services cannot fund this service because the Golden Gate Bridge is not part of the Caltrans toll bridge system.

Sponsor

Port Sonoma is within the regional transit service jurisdiction of the Golden Gate Bridge, Highway, and Transportation District. At this point, the District is working on plans to enhance Larkspur service, and has no plans in initiating service from the Port Sonoma Marina. However, the District's 1997/98 Short-Range Transit Plan does indicate that "should funds be available, GGBHTD would consider participating in an augmented water transit system in the North Bay" (page 108).

Until local or sub-regional support occurs and a potential sponsor comes forward, no action is likely to occur on this route. Since the service could operate with such a small operating subsidy, it could be a candidate route for a public-private partnership. With the cost of high-speed vessels, it is unlikely that a private operator could afford the capital costs of the vessels.

If future improvements in vessel speed occur as they have in recent years, it may be possible to operate this service on a break-even or small profit basis excluding the capital costs.

Recommendation

The analysis indicates that ferry service from Port Sonoma could generate enough ridership to be a successful operation. A major issue in the *1992 Regional Ferry Plan* was the adequacy of the access roads to handle auto traffic generated by a ferry service operating from the Port Sonoma Marina. This re-assessment indicates that the current road network has adequate capacity to accommodate traffic accessing such a terminal.

There are several remaining issues that needed to be addressed in implementation planning for this potential service. First, the landside and waterside impacts (e.g. shoreline impacts, waterfowl impacts, etc.) need to be analyzed as part of environmental analysis. Second, rail service in the Northwestern Pacific right-of-way and a Route 101 High Occupancy Vehicle (HOV), supported by many Marin and Sonoma County officials, are on the November ballot in both counties. If these projects are approved and implemented, a significant increase in Larkspur ferry service connecting the rail corridor with San Francisco may be a higher priority than establishing ferry service from Port Sonoma.

TABLE 4.7
CAPITAL COSTS FOR POTENTIAL NEW FERRY ROUTES

Route		Capital Costs ($000)			
	# of vessels	vessels	facilities	planning/ engineering/ contingency	Total
Berkeley - San Francisco	3	$10,000	$4,000	$1,500	$15,500
Martinez/ Benicia - San Francisco	2	$18,000	$1,400-1,800 $500-2,500	$600 $200-800	$20,700-23,700
Port Sonoma - San Francisco	2	$18,000	$1,400	$500	$19,900
Total	7	$46,000	$9,700	$3,400	$59,100

Assumptions: two large high-speed vessels for Martinez/Benicia and Port Sonoma. One vessel or two vessels with one large and one smaller would cost less. Planning, engineering, and contingency at 35% of facility costs.

Source: Pacific Transit Management Corporation

TABLE 4.8
OPERATING COSTS AND REVENUES FOR POTENTIAL NEW FERRY ROUTES

Route & frequency San Francisco -	# vessels/ vessel hrs.	hourly cost	daily cost	daily passengers	passenger revenue[1]	daily net operating revenue	farebox ratio	subsidy/ passenger trip	annual subsidy
Berkeley[2]									
- hourly	1/14 hrs.	$400	$5,600	950	$3,425	($2,275)	58%	$2.39	$592,000
- 30 minute	2/28 hrs.	$325	$9,100	1,200	$4,200	($4,900)	46%	$4.08	$1,274,000
- 20/30 minute	3/33 hrs.	$325	$10,720	1,310	$4,585	($6,135)	43%	$4.68	$1,595,000
Martinez/Benicia									
- no midday/1 boat[3]	1/9 hrs.	$600	$5,400	800	$4,000	($1,400)	74%	$1.75	$364,000
- no midday service	2/12 hrs.	$600	$7,200	1,000	$5,000	($2,200)	69%	$2.20	$572,000
- midday service	2/17.5 hrs.	$600	$10,500	1,200	$6,000	($4,500)	57%	$3.75	$1,170,000
Port Sonoma									
- one boat service	1/6 hrs.	$600	$3,600	600	$3,000	($600)	83%	$1.00	$156,000
- two boat service	2/9 hrs.	$600	$5,400	770	$3,850	($1550)	71%	$2.01	$403,000

1. average one way fares of $3.50 for Berkeley, $5 for other routes. These are consistent with current fares for comparable services.
2. patronage increased 10% for impact of racetrack demand.
3. slightly less than modelled 2 trip service, since 1 boat/2 trip would provide early and late commute schedules but not peak commute trip.

Source: Pacific Transit Management Corporation

APPENDIX M

Historic Speed Surveys at Solano Crest

omni·means
ENGINEERS · PLANNERS

July 26, 1990

Mr. Evan Flavell
P. O. Box 6397
Albany, CA 94706

Subject: 1990 Updated Traffic Speed Surveys for Solano Avenue

Dear Mr. Flavell:

This letter provides a summary of the 1990 updated speed surveys by Omni-Means for Solano Avenue. Specifically, we have compared the recent vehicle speed survey data with prior data for the crest area of the Solano Avenue hill. The new data was needed to test the effectiveness of an increased enforcement program.

Speed surveys were again conducted for westbound and eastbound traffic on Solano Avenue at the crest of the hill (surveys are attached). These surveys were conducted during the morning commute period (7:00-9:00 a.m.) and the early afternoon period (1:00-2:00 p.m.) to determine if there were substantial differences between previous travel speeds and speeds with increased enforcement. As shown in Table 1, the critical speeds and average speeds were all very comparable. (By definition 85% of surveyed vehicles travel at or below the "critical" speed.)

As the information in Table 1 indicates, the increased enforcement program has not measurably changed the vehicle speeds.

We trust that this data addresses your most recent traffic concerns for Solano Avenue. Please contact our office should you have further questions or comments.

Sincerely,

George W. Nickelson

George W. Nickelson, P.E.
Branch Manager

GWN:cgo

Enclosure

WALNUT CREEK
2500 Camino Diablo, Ste. 220
Walnut Creek, CA 94596
(415) 935-2230

SACRAMENTO
2240 Douglas Boulevard, Ste 260
Roseville, CA 95661
(916) 782-8688 / 969-8688

RENO
6121 Lakeside Drive, Ste 100
Reno, Nevada 89511
(702) 825-1223

TABLE 1
SUMMARY OF SPEED SURVEYS

	Speeds Before Signing		Speeds After Signing		Speeds With Increased Enforcement	
Time Period	Average	Critical	Average	Critical	Average	Critical
AM Peak						
Westbound	23 mph	25 mph	25 mph	27 mph	25 mph	28 mph
Eastbound	24 mph	27 mph	24 mph	26 mph	25 mph	28 mph
Afternoon						
Westbound	26 mph	27 mph	25 mph	28 mph	24 mph	27 mph
Eastbound	23 mph	25 mph	25 mph	27 mph	24 mph	27 mph
$\bar{x}$	24	26	26	27	24.5	27.5

(1) Speed Surveys by OMNI-MEANS, on February 16, 1988.

(2) Speed Surveys by OMNI-MEANS, on November 2, 1988.

(3) Speed Surveys by OMNI-MEANS on July 12-13, 1990.

RADAR SPEED SURVEY

OMNI-MEANS LTD.

Solano Ave East side of crest

DATE: 7/13/90 TIME START: 7:30 TIME END: 8:40 WEATHER: Clear ROAD TYPE: Residential

DIRECTION: Westbnd. SPEED LIMIT: 15 OBSERVER: M. Donnelly CALIBRATION TEST: Yes

SPEED	FREQUENCY	ACUM %	PERCENTAGE BREAKDOWN
15	3	3.0	¦***
16	0	3.0	¦***
17	1	4.0	¦****
18	0	4.0	¦****
19	1	5.0	¦****5
20	2	7.0	¦****5**
21	7	14.0	¦****5****¦****
22	7	21.0	¦****5****¦****5****2*
23	7	28.0	¦****5****¦****5****2****5***
24	9	37.0	¦****5****¦****5****2****5****3****5**
25	14	51.0	¦****5****¦****5****2****5****3****5****4****5****5*
26	16	67.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5**
27	15	82.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5****7****5****8**
28	3	85.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5
29	7	92.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9**
30	2	94.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****
31	2	96.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5*
32	2	98.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5***
33	0	98.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5***
34	1	99.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****
35	0	99.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****
36	0	99.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****
37	1	100.0	¦****5****¦****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****0
	100		

AVERAGE SPEED = 25.1
50th PERCENTILE = 24.9
85th PERCENTILE = 28
90th PERCENTILE = 28.7
95th PERCENTILE = 30.5

PACE = 20 - 29
% IN PACE = 87
VEHICLES IN PACE = 87

SAMPLE VARIANCE = 13.33373737335205
STANDARD DEVIATION = 3.651539087295532
RANGE 1*S = 71
RANGE 2*S = 94
RANGE 3*S = 99

RADAR SPEED SURVEY

OMNI-MEANS LTD.

Solano Ave. East side of crest

DATE: 7/13/90 **TIME START: 7:30** **TIME END: 8:00** **WEATHER: Clear** **ROAD TYPE: Residential**

DIRECTION: Eastbnd **SPEED LIMIT: 15** **OBSERVER: M. Donnelly** **CALIBRATION TEST: Yes**

SPEED	FREQUENCY	ACUM %	PERCENTAGE BREAKDOWN
			0--------10--------20--------30--------40--------50--------60--------70--------80--------90-------100
17	1	1.0	|*
18	2	3.0	|***
19	4	7.1	|****5**
20	4	11.1	|****5****1*
21	3	14.1	|****5****1****
22	7	21.2	|****5****1****5****2*
23	9	30.3	|****5****1****5****2****5****3
24	19	49.5	|****5****1****5****2****5****3****5****4****5****
25	9	58.6	|****5****1****5****2****5****3****5****4****5****5****5***
26	8	66.7	|****5****1****5****2****5****3****5****4****5****5****5****6****5*
27	5	71.7	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7*
28	9	80.8	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8
29	9	89.9	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****
30	5	94.9	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****
31	3	98.0	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5**
32	0	98.0	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5**
33	2	100.0	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****0
			0--------10--------20--------30--------40--------50--------60--------70--------80--------90-------100
	99		

AVERAGE SPEED = 25
50th PERCENTILE = 24
85th PERCENTILE = 28.4
90th PERCENTILE = 29
95th PERCENTILE = 30

PACE = 21 - 30
% IN PACE = 83.8
VEHICLES IN PACE = 83

SAMPLE VARIANCE = 12.10039138793945
STANDARD DEVIATION = 3.478561639785767
RANGE 1*S = 66.66666412353516
RANGE 2*S = 94.94949340820312
RANGE 3*S = 100

RADAR SPEED SURVEY

OMNI-MEANS LTD.

Solano Ave. [redacted] side of trest

DATE: 7/12/90 TIME START: 1:55 TIME END: 2:45 WEATHER: Clear ROAD TYPE: Residential

DIRECTION: [redacted]bnd. SPEED LIMIT: 15 OBSERVER: M. Donnelly CALIBRATION TEST: Yes

SPEED	FREQUENCY	ACUM %	PERCENTAGE BREAKDOWN
15	2	2.0	|**
16	1	3.0	|***
17	0	3.0	|***
18	2	5.0	|****5
19	2	7.0	|****5**
20	4	11.0	|****5****|*
21	12	23.0	|****5****|****5****2***
22	6	29.0	|****5****|****5****2****5****
23	16	45.0	|****5****|****5****2****5****3****5****4****5
24	7	52.0	|****5****|****5****2****5****3****5****4****5****5**
25	17	69.0	|****5****|****5****2****5****3****5****4****5****5****5****6****5****
26	7	76.0	|****5****|****5****2****5****3****5****4****5****5****5****6****5****7****5*
27	11	87.0	|****5****|****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5**
28	6	93.0	|****5****|****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9***
29	2	95.0	|****5****|****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5
30	4	99.0	|****5****|****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****
31	0	99.0	|****5****|****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****
32	0	99.0	|****5****|****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****
33	0	99.0	|****5****|****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****
34	0	99.0	|****5****|****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****
35	1	100.0	|****5****|****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****0

0--------10--------20--------30--------40--------50--------60--------70--------80--------90-------100

100

AVERAGE SPEED = 24
50th PERCENTILE = 23.7
85th PERCENTILE = 26.8
90th PERCENTILE = 27.5
95th PERCENTILE = 29

PACE = 19 - 28
% IN PACE = 88
VEHICLES IN PACE = 88

SAMPLE VARIANCE = 11.26010131835938
STANDARD DEVIATION = 3.355607509613037
RANGE 1*S = 76
RANGE 2*S = 96
RANGE 3*S = 99

RADAR SPEED SURVEY

OMNI-MEANS LTD.

Solano Ave. [illegible] of crest ?

DATE: 7/12/90 **TIME START: 1:55** **TIME END: 2:45** **WEATHER: Clear** **ROAD TYPE: Residential**

DIRECTION: [illegible]bnd. **SPEED LIMIT: 15** **OBSERVER: M. Donnelly** **CALIBRATION TEST: Yes**

SPEED	FREQUENCY	ACUM %	PERCENTAGE BREAKDOWN
			0--------10--------20--------30--------40--------50--------60--------70--------80--------90-------100
17	2	2.0	|**
18	2	4.0	|****
19	3	7.0	|****5**
20	4	11.0	|****5****1*
21	10	21.0	|****5****1****5****2*
22	12	33.0	|****5****1****5****2****5****3***
23	8	41.0	|****5****1****5****2****5****3****5****4*
24	11	52.0	|****5****1****5****2****5****3****5****4****5****5**
25	15	67.0	|****5****1****5****2****5****3****5****4****5****5****5****6****5**
26	12	79.0	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****
27	7	86.0	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5*
28	5	91.0	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9*
29	3	94.0	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****
30	4	98.0	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5***
31	0	98.0	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5***
32	2	100.0	|****5****1****5****2****5****3****5****4****5****5****5****6****5****7****5****8****5****9****5****0
			0--------10--------20--------30--------40--------50--------60--------70--------80--------90-------100
	100		

AVERAGE SPEED = 24.1
50th PERCENTILE = 23.8
85th PERCENTILE = 26.8
90th PERCENTILE = 27.7
95th PERCENTILE = 29.2

PACE = 19 - 28
% IN PACE = 87
VEHICLES IN PACE = 87

SAMPLE VARIANCE = 10.1559591293335
STANDARD DEVIATION = 3.186841487884521
RANGE 1*S = 75
RANGE 2*S = 96
RANGE 3*S = 100

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ENGINEERS · PLANNERS

November 8, 1988

Mr. Evan Flavell
P. O. Box 6397
Albany, CA 94706

Subject: Updated Traffic Data Collection for Solano Avenue

Dear Mr. Flavell:

This letter provides a summary of the updated traffic data collected by OMNI-MEANS for Solano Avenue. Specifically, we have compared the recent vehicle speed survey data with prior data for the crest area of the Solano Avenue hill. The new data was needed to test the effectiveness of 15 mph speed limit signs installed about one month ago.

Speed surveys were again conducted for westbound and eastbound traffic on Solano Avenue at the crest of the hill (surveys are attached). These surveys were conducted during the morning commute period (7:00-9:00 a.m.) and the early afternoon period (1:00-2:00 p.m.) to determine if there were substantial differences between previous travel speeds and speeds after sign installation. As shown in Table 1, the critical speeds and average speeds were all very comparable. (By definition 85% of surveyed vehicles travel at or below the "critical" speed.) In fact, slight increases were measured in certain speeds.

WALNUT CREEK
2500 Camino Diablo, Ste. 220
Walnut Creek, CA 94596
(415) 935-2230

SACRAMENTO
2240 Douglas Boulevard, Ste. 260
Roseville, CA 95661
(916) 782-8688 / 969-8688

RENO
6121 Lakeside Drive, Ste. 100
Reno, Nevada 89511
(702) 825-1223

TABLE 1
SUMMARY OF SPEED SURVEYS

TIME PERIOD	SPEEDS BEFORE SIGNING		SPEEDS AFTER SIGNING	
	AVERAGE	CRITICAL	AVERAGE	CRITICAL
AM Peak				
Westbound	23 mph	25 mph	25 mph	27 mph
Eastbound	24 mph	27 mph	24 mph	26 mph
Afternoon				
Westbound	26 mph	27 mph	25 mph	28 mph
Eastbound	23 mph	25 mph	25 mph	27 mph

(1) Speed surveys by OMNI-MEANS, on February 16, 1988

(2) Speed surveys by OMNI-MEANS, on November 2, 1988

As the foregoing information indicates, the installation of 15 mph speed limit signs has not measurably reduced the vehicle speeds. The speed surveys indicate that only 2% of the vehicles are traveling at speeds of 15-16 mph or less.

We trust that this data addresses your most recent traffic concerns for Solano Avenue. Please contact our office should you have further questions or comments.

Sincerely,

George W. Nickelson, P.E.
Branch Manager

GWN:cgo

Enclosure

MOTOR VEHICLE SPEED

SEQ: .....

ROAD: SOLANO RD. (EAST OF TOP OF HILL)

LOCATION: .....

WEATHER .....

OBSERVER: .....

CALC. BY: .....

ROAD CONDITION: .....

FILE NO.: .....

DATE: 11/2/88

TIME: ~7-8 AM ...STAR

CHECKED BY: .....

...FINIS

DIRECTION: E TO W (UPHILL)

Mph	VEHICLES	NO. VEH.	TOTAL SPEED
32	X	1	
30	X	1	
28	XXXXXXX	7	
26	XXXXXXXXXXXXXXXXXX	18	
24	XXXXXXXXXXXXXXXXXXXX	20	
22	XXXXXXXXXXXXXXXXXXXXXXX	23	
20	XXXXXXXXXXXXXXXXXXXXXXXXXXX	27	
18	XXXX	4	

DIRECTION: W TO E (DOWNHILL)

Mph	VEHICLES	NO. VEH.	TOTAL SPEED
30	XXXXXXX	7	
28	XXXXXXXXXX	10	
26	XXXXXXXXXXXXXXX	15	
24	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	32	
22	XXXXXXXXXXXXXXXXXXXXXXXX	24	
20	XXXXXXXXXXXXXXX	15	
18	XXXXX	5	
16	X	1	
14	X	1	

LEGEND

X = PASS CAR
P = PICKUP
B = BUS
2 = 2 AXLES
3 = 3 AXLES
4 = 4 AXLES
5 = 5 AXLES

ODD SPEEDS ARE ROUNDED UP.

TOTALS 110 VEHICLES

Average Speed 24.53 = 25 mph

Critical Speed 27

Pace Speed .....to.....

% Over Pace .....

% In Pace .....

TOTALS 110

Average Speed 23.60 = 24 mph

Critical Speed 26

Pace Speed .....to.....

% Over Pace .....

MOTOR VEHICLE SPEED

SEQ: .....

ROAD: Solano Rd (West of Top of Hill)

LOCATION: .....

WEATHER: .....

OBSERVER: .....

CALC. BY: .....

ROAD CONDITION: .....

CHECKED BY: .....

FILE NO.: .....

DATE: 11/2/88

TIME: 2:1-2 PM ... START

... FINISH

DIRECTION: E TOW (Downhill)

Mph	VEHICLES	NO. VEH.	TOTAL SPEED
32	X	1	32
30	XXX	3	90
28	XXXXXXXXXXXXX	13	364
26	XXXXXXXXXXXXXX	14	364
24	XXXXXXXXXXXXXXXXXXXXXXXX	24	576
22	XXXXXXXXXXXXXXXXXXXXXXXXX	25	550
20	XXXXXXXXXXXXXXXX	16	320
18	XXXXXXXXXXXX	12	216
16	XXXX	4	64
14	X	1	14

DIRECTION: W TOE (UPHILL)

Mph	VEHICLES	NO. VEH.	TOTAL SPEED
34	XXX	3	102
32	XXX	3	96
30	XXXXXXXXX	9	270
28	XXXXXXXXXXXXX	13	364
26	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	31	806
24	XXXXXXXXXXXXXXXXXXXXXXXXX	25	600
22	XXXXXXX	7	154
20	XXXXXXX	7	140
18	XXXXXX	6	108
16	XXXXX	5	80
14	X	1	14

LEGEND

X = PASS CAR

P = PICKUP

B = BUS

2 = 2 AXLES

3 = 3 AXLES

4 = 4 AXLES

5 = 5 AXLES

ODD NUMBERS ROUNDED UP

TOTALS 110. VEHICLES

Average Speed 24.85 = 25 mph

Critical Speed 28

Pace Speed ..... to .....

% Over Pace .....

% In Pace .....

TOTALS 110

Average Speed 24.85 = 25 mph

Critical Speed 27 mph

Pace Speed ..... to .....

% Over Pace .....

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ENGINEERS · PLANNERS

February 23, 1988

Mr. Evan Flavell
P. O. Box 6397
Albany, CA 94706

Subject: Traffic Data Collection for Solano Avenue

Dear Mr. Flavell:

This letter provides a summary of the traffic data collected by OMNI-MEANS for Solano Avenue. Specifically, we will outline the vehicle speed survey and sight distance data for the crest area of the Solano Avenue hill.

Speed surveys were conducted for westbound and eastbound traffic on Solano Avenue at the crest of the hill (surveys are attached). These surveys were conducted during the morning commute period (7:00-9:00 a.m.) and the early afternoon period (1:00-2:00 p.m.) to determine if there were substantial differences between peak and off-peak travel speeds. As shown in Table 1, the critical speeds and average speeds were all very comparable. (By definition 85% of surveyed vehicles travel at or below the "critical" speed.) The majority of all vehicles (65-70%) travel in the 22-24 mph range.

Sight distances were measured at a number of points on the crest of the Solano Avenue hill. Sight distance is basically the distance measured on a line of sight between a vehicle driver and an obstruction in the roadway. In the case of this segment of Solano Avenue, the sight distances are reduced by the acute vertical curve at the crest of the hill. As shown in Table 2, the available sight distance is very limited along the entire crest of the hill.

WALNUT CREEK
2500 Camino Diablo, Ste. 220
Walnut Creek, CA 94596
(415) 935-2230

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Roseville, CA 95661
(916) 782-8688 / 969-8688

RENO
6121 Lakeside Drive, Ste. 100
Reno, Nevada 89511
(702) 825-1223

TABLE 1

SUMMARY OF SPEED SURVEYS[1]

TIME PERIOD	SPEEDS AVERAGE	CRITICAL
AM Peak		
Westbound	23 mph	25 mph
Eastbound	24 mph	27 mph
Afternoon		
Westbound	26 mph	27 mph
Eastbound	23 mph	25 mph

(1) Speed surveys by OMNI-MEANS, Ltd. on February 16, 1988.

TABLE 2

SIGHT DISTANCE MEASUREMENTS[1]

LOCATION	SIGHT DISTANCE
Westbound Solano Avenue to driveway at #841 Solano	67 feet
Westbound Solano Avenue to driveway at #837 Solano	103 feet
Westbound Solano Avenue to driveway at #835 Solano	115 feet
Westbound Solano Avenue to Taylor/Solano intersection	86 feet
Eastbound Solano Avenue to Polk/Solano intersection	120 feet
Eastbound Solano Avenue to driveway at #848 Solano	72 feet

(1) Sight distance measured by OMNI-MEANS, Ltd. on February 16, 1988.

If the available sight distances are considered "stopping sight distances," appropriated vehicle speeds can be identified. Stopping sight distance is the distance at which a motorist can observe a roadway obstruction (such as a car backing out of a driveway), react and bring their vehicle to a complete stop. The sight distances available over the crest of the hill translate into appropriate speeds in the 15-20 mph range.

As the foregoing information indicates, the limited sight distance over the crest of the Solano Avenue hill reduces the appropriate vehicle speeds to the 15-20 mph range. The speed surveys indicate that 96% of the vehicles are traveling at speeds of 20 mph or greater. Thus, only a small percentage of the vehicles are actually traveling at speeds commensurate with the available stopping sight distance.

We trust that this data addresses your traffic concerns for Solano Avenue. Please contact our office should you have further questions or comments.

Sincerely,

George W. Nickelson

George W. Nickelson, P.E.
Branch Manager

GWN:ms

Enclosure

SIGHT DISTANCE OF 125' = 30 MPH

MOTOR VEHICLE SPEED

SEQ: .....

ROAD: Solano (West of Crest)

LOCATION: .....

WEATHER: .....

OBSERVER: .....

CALC. BY: .....

ROAD CONDITION: .....

CHECKED BY: .....

FILE NO.: .....

DATE: 2/16/88

TIME: ≈7-9am

START: .....

FINISH: .....

DIRECTION: West to East

Mph	VEHICLES	NO. VEH.	TOTAL SPEED
34	XXX	3	
32	X	1	
30	XXXXXXXX	9	
28	XXXXXXXXXXXXXXXXXX	19	
26	XXXXXXXXXXXXXXXXXXXXXXXX	24	
24	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	29	
22	XXXXXXXXXXXXXXXXXX	18	
20	XXXX	4	
18	XX	2	
16	X	1	

DIRECTION: East to West

Mph	VEHICLES	NO. VEH.	TOTAL SPEED
34	X	1	
32	X	1	
30	XXXXXXXX	8	
28	XXX	3	
26	XXXXXXXXXXXXXXXXXXXXXXXXX	25	
24	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	30	
22	XXXXXXXXXXXXXXXXXXXXXXX	23	
20	XXXXXXXXXXX	11	
18	XXXXXXX	7	
16	X	1	

LEGEND

X = PASSCAR

P = PICKUP

B = BUS

2 = 2 AXLES

3 = 3 AXLES

4 = 4 AXLES

5 = 5 AXLES

all speeds ranked 42

TOTALS .....

Average Speed 24

Critical Speed 27

Pace Speed 30

% Over Pace .....

% In Pace .....

TOTALS .....

Average Speed 23

Critical Speed 25

Pace Speed 28

% Over Pace .....

MOTOR VEHICLE SPEED

SEC: _____

ROAD: Solano Rd. (East of crest)

LOCATION: _____

WEATHER: _____ ROAD CONDITION: _____

FILE NO.: _____

OBSERVER: _____

CALC. BY: _____

CHECKED BY: _____

DATE: 2/16/88

TIME: ~1-2 pm START

FINIS

DIRECTION: W to E

Mph	VEHICLES	NO. VEH.	TOTAL SPEED
30	X	3	
28	XXXXXXXXXXX	11	
26	XXXXXXXXXXXXXXXXXXXXXX	22	
24	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	32	
22	XXXXXXXXXXXXXXXXXXXXXXXXXXX	28	
20	XXXXXXXXXXXXX	13	
18	X	1	

DIRECTION: E to W

Mph	VEHICLES	NO. VEH.	TOTAL SPEED
36	XX	2	
34	XX	2	
32	XX	1	
30	XXXXX	5	
28	XXXXXXXXXXXXXXXX	16	
26	XXXXXXXXXXXXXXXXXXXXXXXXXXX	27	
24	XXXXXXXXXXXXXXXXXXXXXXXXX	25	
22	XXXXXXXXXXXXXXXXXXX	19	
20	XXXXXXX	7	
18	XXXXXX	6	
16	X	1	

LEGEND

X = PASS CAR

P = PICKUP

B = BUS

2 = 2 AXLES

3 = 3 AXLES

4 = 4 AXLES

5 = 5 AXLES

All speeds are rounded up.

Σ=110

TOTALS

Average Speed 23

85% - Critical Speed @ 25

10 mph range that most cars travel in

Pace Speed 20

% Over Pace

% In Pace

Σ=110

TOTALS

Average Speed 26

85% Critical Speed 27

Pace Speed 22

% Over Pace