I-880

Interstate 880

Corridor System Management Plan

October 2010

appendices

csmp

CALTRANS DISTRICT 4

corridor system management plans

Caltrans


EXIT 12B
Warren Avenue
1/4 MILE
EXIT 12A
Mission Blvd
Sacramento
To
680
EXIT ONLY
EXIT
50
MPH

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Appendix I
(supporting documents)

A.1 INTELLIGENT TRANSPORTATION SYSTEMS

Statewide and Regional ITS Architectures

The California Statewide ITS Architecture (November 2004), along with its companion Regional ITS Architectures, are frameworks created to aid the deployment and integration of regional ITS systems and programs. These frameworks are intended to assist future larger scale integrations of transportation information systems. They are modeled after the National ITS Architecture (NITSA) and developed according to the Federal Highway Administration's (FHWA) "Final Rule on the National ITS Architecture" (23 CFR 940) and the Federal Transit Administration's (FTA) "Policy on the National ITS Architecture" (23 CFR 655). These frameworks identify project stakeholders and their roles in ITS deployments, functional requirements for ITS, standards to coordinate with other ITS deployments, and project sequencing. At the state level, the California Statewide ITS Architecture is used to guide the planning of transportation communication systems, equipment, and related facilities with a focus on interregional deployment and integration. The regional and statewide ITS architectures are required by federal regulations, and all major ITS projects must conform to the architecture as a condition of federal funding.

The MTC completed the *Regional ITS Architecture and Strategic Plan* in October 2004, and the Commission subsequently adopted it through the *Transportation 2030 Plan* in February 2005. The Regional ITS Architecture is an integrated part of the San Francisco Bay Area Regional ITS Plan, a roadmap for transportation systems integration in the Bay Area over the next ten years. The architecture is an important tool used by MTC and partner agencies to better reflect integration opportunities and operational needs into the transportation planning process.

This regional ITS architecture has a time horizon with a particular focus on those systems and interfaces that are likely to be implemented in the next ten years. The architecture covers the broad spectrum of ITS, including Traffic Management, Transit Management, Traveler Information, Emergency Management, and Emergency/Incident Management over this time horizon. The Bay Area Regional ITS Architecture is a living document with changes made based on recommendations of the Regional ITS Architecture Maintenance Committee members.

Caltrans District 4 Traffic Management Center (TMC)

The ITS infrastructure in the Bay Area includes deployment of ITS field elements (such as CCTV, CMS, Highway Advisory Radio [HAR], traffic detector stations, ramp metering) which enable traffic monitoring and management at the Caltrans District 4 TMC. The TMC is housed in the Caltrans District 4 office in downtown Oakland. The facility is co-staffed by Caltrans Maintenance and Operations workers, California Highway Patrol (CHP) officers, and operators for the 511 regional traveler information systems. The main software collects data from field devices and generates the speed map display, places dynamic icons on the map, supplies real-time data to external systems (such as 511, PeMS, TMC archives), emails detector station data to interested parties, and provides a user interface for ramp meters.

Existing and Planned Detection in the Corridor

The coverage and distribution of the sources of detection in the I-880 corridor varies. Most if not all of the detection in the I-880 corridor is paired in order to provide data for both the north and south directions. In the northern end of the corridor between SR-84 and I-980 the existing detection is separated by distances of no more then a half mile. Detection coverage gaps exist up to one mile along the corridor between Marina Boulevard and Washington Street, Lewelling Boulevard and A Street in Hayward and between 66th Street and High Street in Oakland. For those segments between I-280 and SR-84, distance between detection units increases up to a mile and a half. The gaps in the detection grow as large as two and half miles between Stevenson Boulevard, and Auto Mall Boulevard in Fremont, SR-84 and Thornton Boulevard, Fremont Boulevard and Dixon Landing and Great Mall Parkway and Old Bayshore in Milpitas. Existing and Planned Detectors are shown in Figure A.1.1.

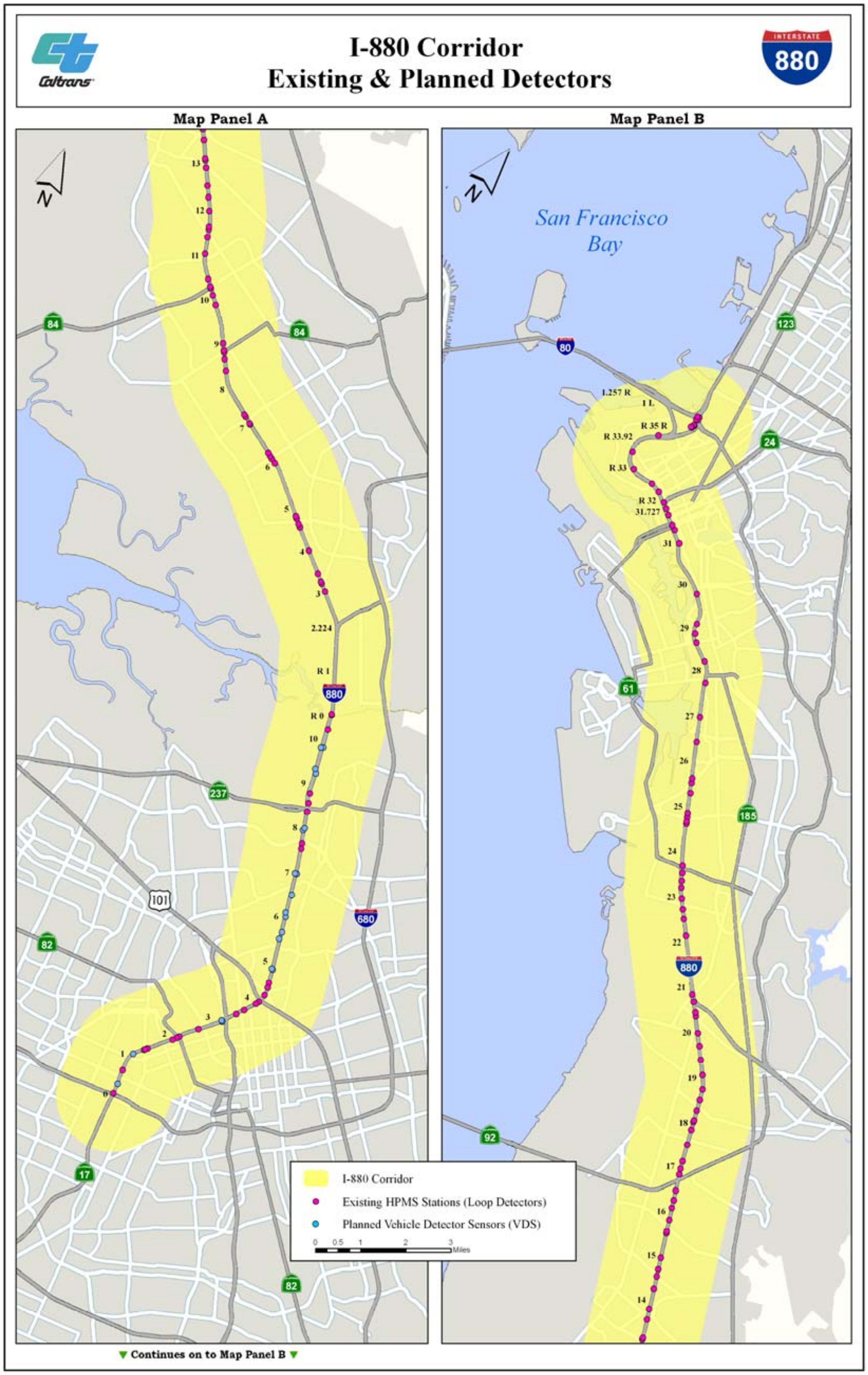


Figure A.1.1. I-880 Existing and Planned Detection

Bay Area 511

The Bay Area 511 Program (511) is a comprehensive, multI-modal traveler information service which makes traveler information accessible via phone and internet www.511.org. 511 operates 24 hours a day, seven days a week with free phone service available in the nine county Bay Area. 511 unifies several traveler information programs into a one-stop resource for transit, traffic, ride-share and bicycle information, and provides up-to-the-minute information on traffic conditions, incidents and driving times. 511 also provides schedule, route and fare information for the Bay Area's public transportation services. 511 is also a source of valuable transportation system data for public and private partner agencies. The Bay Area 511 Program is managed by a partnership of public agencies: MTC, CHP, and Caltrans.

A.2 FREEWAY AGREEMENTS

The Freeway Agreement documents the understanding between Caltrans and the local agency relating to the planned traffic circulation features of the proposed facility. It does not bind the State to construct on a particular schedule or staging. In the event that the freeway is fully constructed, it shows which streets may be closed or connected to the freeway; it shows which streets and roads may be separated from the freeway; it shows the location of frontage roads; and it shows how streets may be relocated, extended or otherwise modified to maintain traffic circulation in relation to the freeway. Locations of railroad and pedestrian structures, as well as those for other non-motorized facilities, should also be shown. Agreements are often executed many years before construction is anticipated and they form the basis for future planning, not only by Caltrans but by public and private interests in the community.

The California Freeway and Expressway System has a large financial investment in access control to insure safety and operational integrity of the highways. The legislative intent for requiring Freeway Agreements is to obtain the local agency's support of local road closures and changes to the local circulation system and to protect property rights and to assure adequate service to the community. Access control is necessary on the freeway or expressway so that current and future traffic safety and operations are not compromised. Freeway Agreements are used as the basis for establishment of Maintenance Agreements with local agencies, but are not used as Maintenance Agreements.

Because of its wide use, the freeway or controlled access highway agreement is an extremely important document. Care must be exercised in its preparation to insure accuracy. For the same reasons, this agreement should be kept current. It is recognized that during the design and construction phases of a project, it is sometimes necessary to make revisions that are not in conformance with the current agreement. It is also recognized that the revisions vary greatly in magnitude and importance. A history of freeway agreements in the I-880 CSMP corridor is provided in Tables A.2.1. (Santa Clara County) and A.2.2. (Alameda County).

Table A.2.1 Freeway Agreements from Santa Clara County PM 0.00 to 10.50.

County	Route	Post Mile	Agreement #	Approval Date	Stakeholders
SCL	880 280 17	0.00-0.30 3.5- 5.4 13.9	1203	10/14/69	Santa Clara County/Caltrans
SCL	880 280	0.30-0.70 4.6/7.4	1217	01/15/63	Santa Clara County/Caltrans/City of San Jose/ Dept of Transportation
SCL	880	1.30-1.40	1248	08/12/47	Santa Clara County/Caltrans/City of San Jose/ Dept of Transportation
SCL	880	1.40-2.70	1249	07/18/62	Santa Clara County/Caltrans/City of San Jose/ Dept of Transportation
SCL	880 237	2.70-3.60 6.5-9.4	1247	01/25/94	Santa Clara County/Caltrans City of San Jose/ Dept of Transportation
SCL	880	3.60-4.30	1250	10/27/52	Santa Clara County/Caltrans/City of San Jose/ Dept of Transportation
SCL	880	4.30-5.00	1251	10/27/52	Santa Clara County/Caltrans/City of San Jose/ Dept of Transportation
SCL	880	5.00-6.20	1252	01/22/51	Santa Clara County/Caltrans/City of San Jose/ Dept of Transportation
SCL	880	6.20-6.70	1253	03/16/71	Santa Clara County/Caltrans/City of San Jose Dept of Transportation
SCL	880	6.70-6.80	1254	02/02/71	City of Milpitas/Caltrans
SCL	880	6.70-7.20	1255	01/26/71	Santa Clara County/Caltrans
SCL	880 237	7.20-10.10 8.7-9.5	1212	09/16/97	City of Milpitas/Caltrans
SCL	880	10.10-10.50	1256	08/15/00	City of Milpitas/Caltrans

Table A.2.2 Freeway Agreements from Alameda County PM 0.00 to 34.37.

County	Route	Post Mile	Agreement #	Approval Date	Agreement(s) With
ALA	880	0/0.3	1059	06/13/00	City of Fremont/Caltrans
ALA	880	1.8/2.7	1027	01/10/56	Alameda County/Caltrans
ALA	880	2.7/5.2	1067	04/10/91	City of Fremont/Caltrans
ALA	880	5.2/10.7	1068	12/07/93	City of Fremont/Caltrans
ALA	880	6.3/10.5	1069	10/28/93	City of Newark/Caltrans
ALA	880	12.5/14.1	1071	10/24/95	City of Fremont/Caltrans
ALA	880	13.5/15	1072	01/22/91	City of Hayward/Caltrans
ALA	880	15/16.7	1073	07/06/54	City of Fremont/Caltrans
ALA	880	16.4/17	1074	02/09/51	N/A
ALA	880	17.1/19.8	1060	05/26/65	Alameda County/Caltrans
ALA	880	19.8/20.3	1061	03/11/86	Alameda County/Caltrans
ALA	880	24.2/27	1062	01/17/95	City of Oakland/Caltrans
ALA	880	27/27.8	1063	09/18/47	City of Oakland/Caltrans
ALA	880	27.7/28.1	1001	04/12/48	N/A
ALA	880	27.8/30.9	1064	09/28/48	City of Oakland/Caltrans
ALA	880	30.9/31	1065	04/24/53	City of Oakland/Caltrans
ALA	880 980	880-31/31.7 980-0/1.1	1066	02/26/80	City of Oakland/Caltrans
ALA	880 580 80	880-31.7/35.4 580-46.2/47 80-1.3/3.2	1049	07/27/93	City of Oakland/Caltrans

A.3 CORRIDOR MOBILITY IMPROVEMENT ACCOUNT (CMIA) PROJECT FACTSHEETS

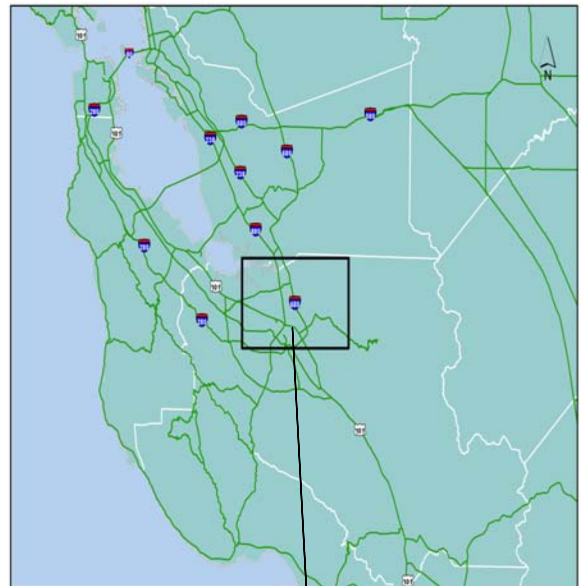
A.3.1. I-880 Widening Project, SR-237 to US-101

A.3.2. I-880 SB HOV Lane Extension, Hegenberger to Marina Boulevard

A.3.3. I-880 I-280 Stevens Creek Interchange Improvements

I-880 WIDENING – SR-237 TO US-101
FACT SHEET

The Project
This project will add over 4 miles of carpool (HOV) lane in each direction of I-880 in Santa Clara County, between State Route 237 in Milpitas and US 101 in San Jose. The project will extend the carpool system from northern Santa Clara County through Alameda County, a distance of about 20 miles.



The Need
The I-880 corridor is a significant route for commuters traveling between the Silicon Valley in the south and the Tri Valley Area and Central Valley in the north. Traffic has continued to increase along this route, primarily in the "Golden Triangle" area bounded by SR 237, Route 101, and I-880.

Benefits
The project will increase highway capacity, reduce congestion, enhance safety, and improve connectivity between I-880 and US-101, two critical elements of Santa Clara County's transportation network.

Partnership
This project is developed through a partnership among the Santa Clara Valley Transportation Authority (VTA), the Metropolitan Transportation Commission (MTC), and the California Department of Transportation (Caltrans). Project sponsors include local and state agencies.

Project Status
The environmental phase was completed on 6/26/09(A). The Draft Environmental Document (MND/FONSI) was approved on 1/23/09. The Final ED was approved on 6/5/09. The CTC approved the project for future funding consideration at its September 2009 CTC Meeting. The design phase is at 65% stage, and expected to be completed in early 2011.

Project Costs
The total project cost is estimated at $95 million ($71.6 million CMIA funds and $23.4 million local funds)

Project Schedule
Start Construction: Spring 2011
Finish Construction: Summer 2013

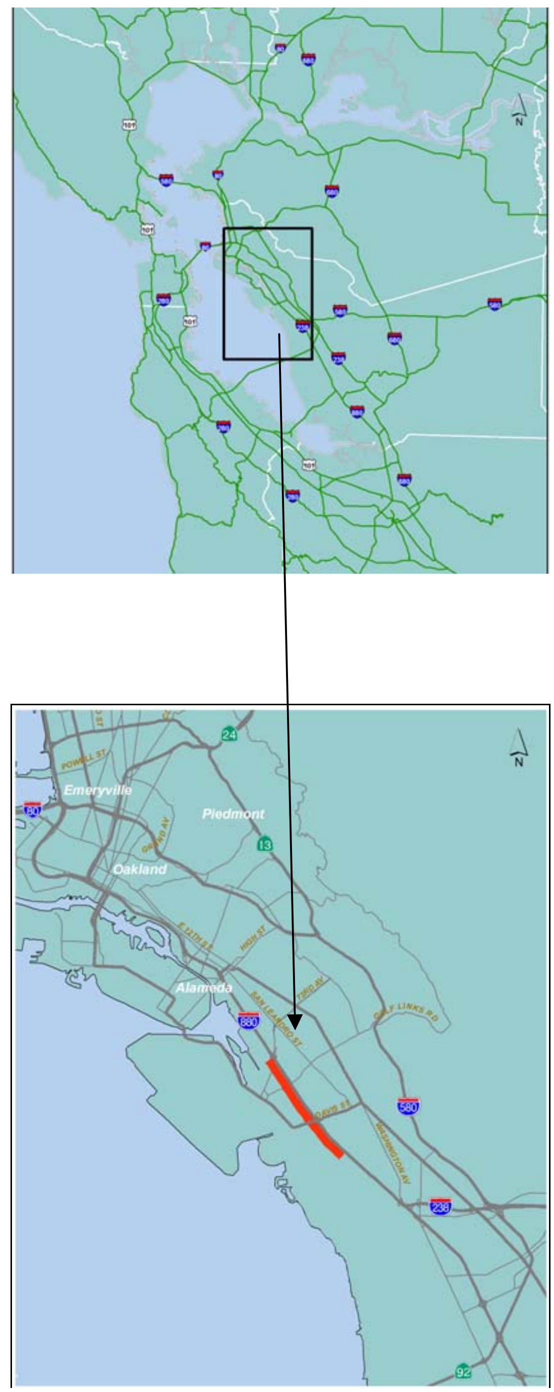
Summary
The I-880 Widening Project will close the carpool lane gap between SR 237 and US 101; the project will extend the carpool system from northern Santa Clara County through Alameda County, a distance of about 20 miles.

I-880 SB HOV LANE EXTENSION PROJECT

FACT SHEET

The Project

This is a Proposition 1B - Transportation Bond project funded by Corridoor Mobility Improvement Account program. This project will extend the HOV (High Occupancy Vehicle, or car-pool) lane on the southbound Nimitz Freeway (I-880) approximately 3 miles from the Hegenberger Road in Oakland to Marina Boulevard in San Leandro. When this project is completed, a continuous HOV lane will be provided in the southbound direction to Mission Boulevard (SR 262) in Fremont, a distance of over 20 miles.



The Need

The I-880 corridor is a major local and regional commute corridor and plays a key role in the movement of freight and goods. With high traffic volumes, a high percentage of trucks and non-standard freeway features, freeway congestion occurs on a daily basis during peak travel periods. The efficient operation of I-880 is of critical economic importance to the region and the state as well as the entire nation.

Benefits

This project will ease congestion, improve mobility by moving twice as many people as a regular use lane, decrease commute times for all drivers, enhance safety, reduce air pollution and promote ridesharing.

Partnership

This project is developed through a partnership between the Alameda County Congestion Management Agency (ACCMA) and the California Department of Transportation (Caltrans). The project has also been coordinated with the cities of Oakland and San Leandro.

Project Status

This project is in the environmental phase. DED approved 10/29/09(A). DPR approved 11/5/09(A). The environmental document is completed in early 2010. The design phase is expected to be complete in Summer 2011.

Project Costs

The total costs for the project are estimated at $108 million.

Project Schedule

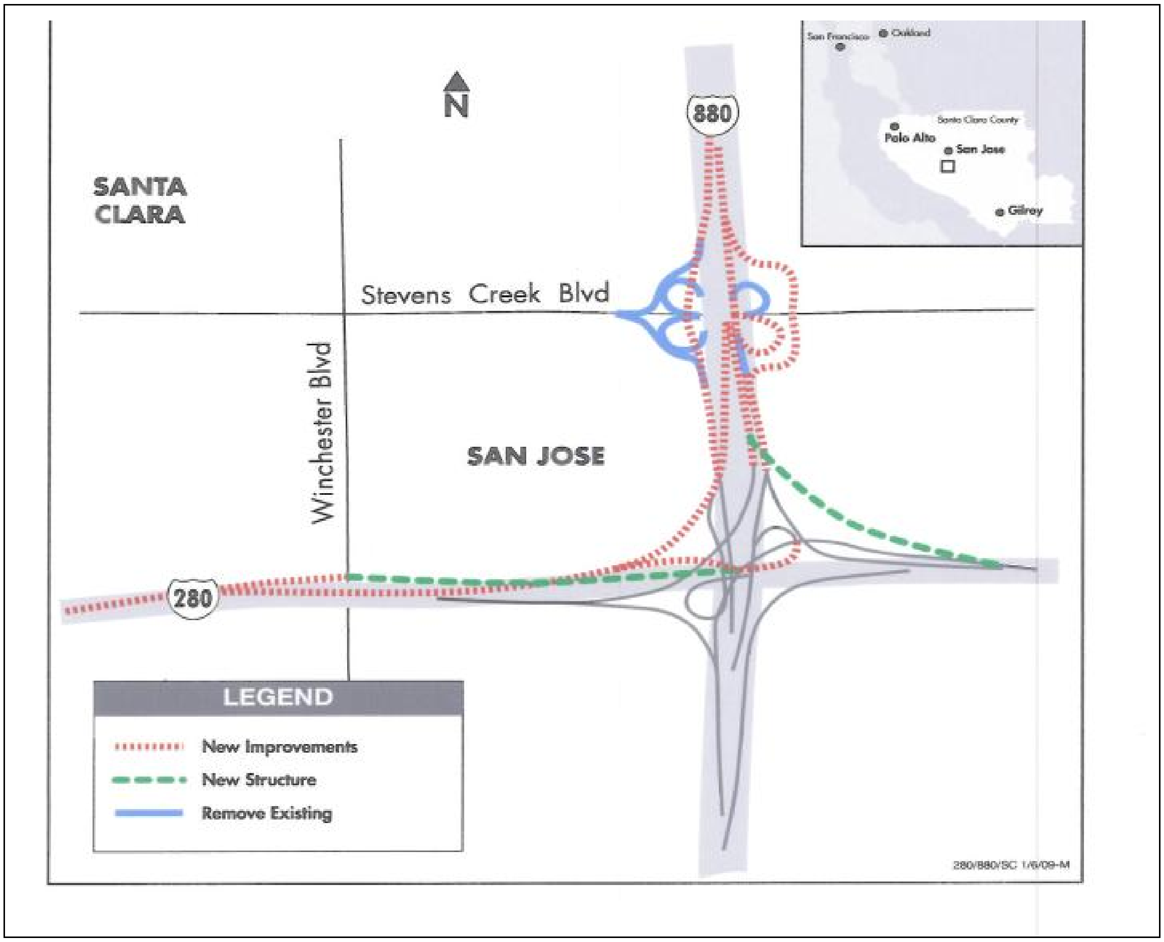
Start Construction: Winter 2012
Finish Construction: Spring 2014

Summary

The extended HOV lane will promote carpooling in the corridor, reduce delay for all drivers and help to complete the HOV lane network between Alameda and Santa Clara Counties. The project includes upgrading the freeway within the project's limits to provide better freeway safety and operation.

I-280/I-880/Stevens Creek Improvements Project
EA 44560

Location Map



LIMITS: On I-880 in City of San Jose, Santa Clara County, extend from Stevens Creek Boulevard to I-280, and on I-280 from I-880 to Winchester Boulevard.

PROGRAM/PROJECT SPONSOR: VTA

Overview

The project proposes to improve traffic flow, safety and access between the Interstate 280 (I-280) and Interstate 880 (I-880) freeway corridors near Stevens Creek Boulevard, including modifications to the freeway-to-freeway intersection of State Route 17 (SR-17)/I-280/I-880 freeway interchange, as well as the adjacent interchanges at I-880/Stevens Creek Boulevard and I-280/Winchester Boulevard.

Specific improvements include:

I-280/I-880/Stevens Creek Improvements Project
EA 44560

- Reconfiguring the existing full cloverleaf I-880/Stevens Creek Boulevard interchange to improve traffic flow in the surrounding interchange area by widening and realigning ramps, widening the overcrossing structure at Stevens Creek Boulevard over I-880, improving intersections and providing enhanced access for pedestrians and bicyclists.
- Separating freeway-to-freeway traffic from local traffic by constructing a new direct connector from northbound I-280 to northbound I-880.
- Providing new freeway access by constructing a new northbound I-280 off-ramp at Winchester Boulevard

Objective
To improve traffic flow, enhance pedestrian friendly features along Stevens Creek Blvd., separate regional freeway-to-freeway traffic from local traffic and reduce queuing and traffic backups onto northbound I-280 from I-880 and Stevens Creek Blvd.

Operations
Upon completion, Caltrans will operate and maintain the improved highway interchanges. The City of San Jose will operate and maintain the local streets.

PURPOSE AND NEED:
To improve traffic operations and minimize traffic delays along I-880 and I-280. It will relieve the merge and weave problems at the northbound I-880 and northbound I-280 collector-distributor ramp exiting to Stevens Creek Boulevard and improve traffic proceeding to northbound Route I-880. Traffic congestion at this location is due to the close proximity of major shopping destinations along Stevens Creek Boulevard.

Other operational benefits include enhanced overall traffic flow through the effective use of ramp metering, consistent with an Intelligent Transportation System focus. Enhanced safety will be another project benefit. The implementation of these improvements would result in a measurable reduction in the amount of congestion-related accidents.

PROGRAMMING
$130-$150 million (currently not fully funded) / $54 million in federal, CMIA funds, City of San Jose and VTA funds have been designated for an initial phase focused on the northbound I-280 to northbound I-880 connection and the I-880/Stevens Creek Boulevard interchange.

Available Funds:	($ thousands)
CMIA	$30,975
SAFTEA-LU Earmark	$19,549
Local/City of San Jose	$ 2,835
Federal STP	$ 1,000

I-280/I-880/Stevens Creek Improvements Project
EA 44560

PROJECT SCHEDULE (tentative):

PSR	10/01/10
PAED	03/30/11
RTL	07/31/12
Contract award	12/31/12

ISSUES:

- Geometric and safety concerns on the new proposed 280/Winchester Blvd connector.
- Continue discussion on the 880/Stevens off ramp direct connection to Monroe St.
- VTA plan to extend BRT to Stevens Creek.

PROJECT PARTNERS:

- Caltrans, VTA, and the City of San Jose.
- VTA - Project sponsor
- Caltrans - Oversight

A.4 CORRIDOR SEGMENT DATA SHEETS

A.4.1 Segment A – I-280 to Coleman Street

A.4.2 Segment B – Coleman Street to Old Bay Shore Highway

A.4.3 Segment C – Old Bay Shore Highway to Montague Expressway

A.4.4 Segment D – Montague Expressway to Dixon Landing Road

A.4.5 Segment E – Dixon Landing Road to Paseo Padre Parkway

A.4.6 Segment F – Paseo Padre Pkwy. to Alvarado Road

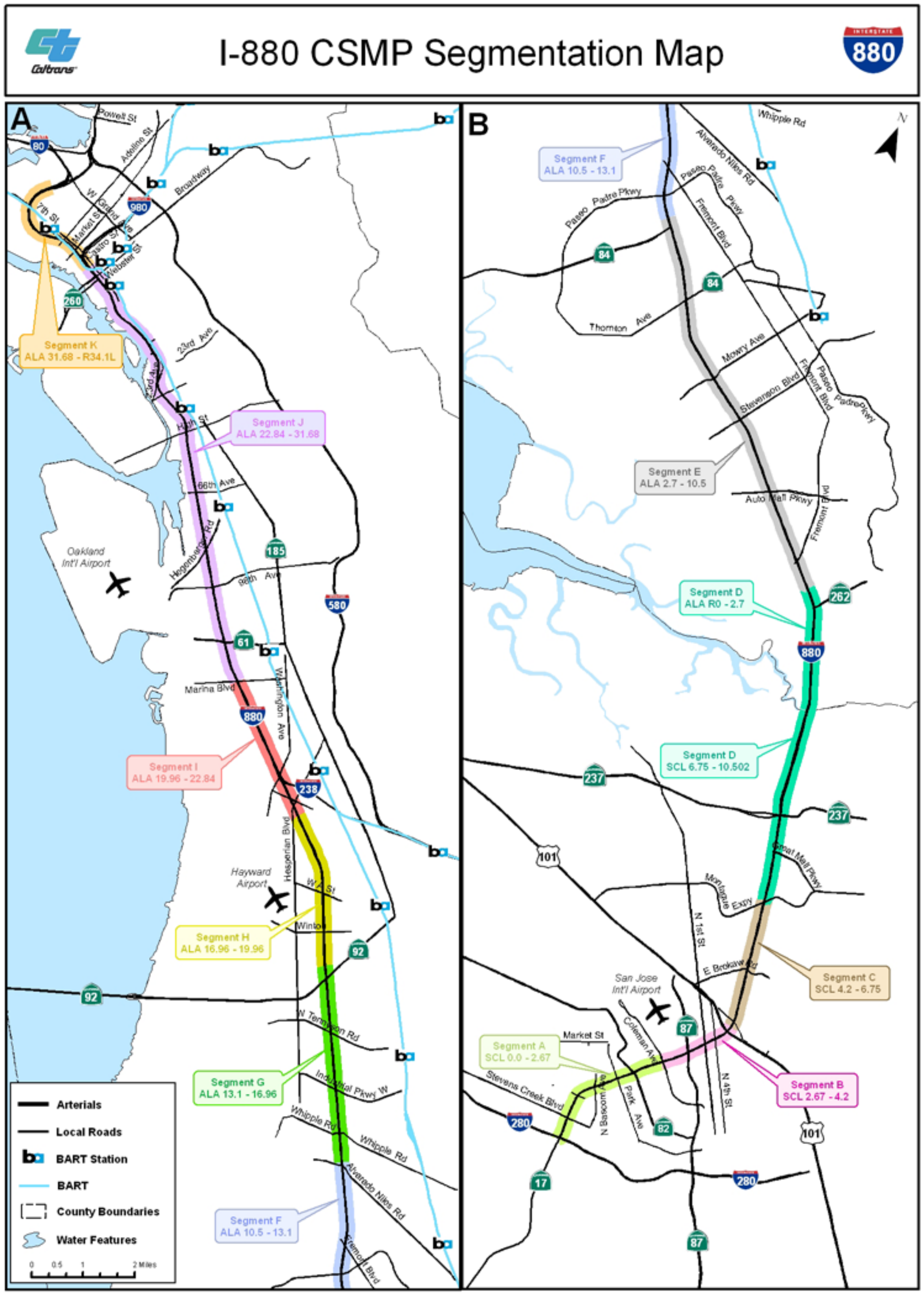
A.4.7 Segment G – Alvarado Road to Junction SR-92

A.4.8 Segment H – Junction SR-92 to Paseo Grande

A.4.9 Segment I – Paseo Grande to 98th Avenue

A.4.10 Segment J – 98th Avenue to Junction I-980

A.4.11 Segment K – Junction I-980 to 7th Street


I-880 CSMP Segmentation Map
880
Segment K
ALA 31.68 - R34.1L
Segment J
ALA 22.84 - 31.68
Segment I
ALA 19.96 - 22.84
Segment H
ALA 16.96 - 19.96
Segment G
ALA 13.1 - 16.96
Segment F
ALA 10.5 - 13.1
Segment E
ALA 2.7 - 10.5
Segment D
ALA R0 - 2.7
Segment D
SCL 6.75 - 10.502
Segment C
SCL 4.2 - 6.75
Segment B
SCL 2.67 - 4.2
Segment A
SCL 0.0 - 2.67
Oakland Int'l Airport
Hayward Airport
San Jose Int'l Airport
Arterials
Local Roads
BART Station
BART
County Boundaries
Water Features

Corridor System Management Plan I-880
Segmentation Data Summary

CSMP Segment	CO/RTE/PM Start	VHD (AM / PM)	Peak Period Demands		AADT (2007)	Truck %	Accident Rate (Actual / Statewide Average)	HOV	Aux	Bottleneck Location	
			Northbound Volume (2007/2030)	Southbound Volume (2007/2030)						NB	SB
A	SCL-880-0.57	300 / 960	6,930 / 8,220	6,700 / 7,950	75,000-77,000	2.83	.95 / .94	N	X	X	X
B	SCL-880--2.67	300 / 960	7,380 / 8,750	7,100 / 8,420	79,000-81,000	2.46	.97 / 1.17	X	X	X	X
C	SCL-880-4.20	30 / 960	6,950 / 8,240	7,250 / 8,600	78,000-82,000	3.18	.79 / 1.70	X	X		X
D	SCL-880-6.75/ALA-880-0.00	0 / 1,530	7,325 / 8,750	7,520 / 8,980	94,000-95,000	5.20	.64 / 1.19	X	X	X	
E	ALA-880-2.70	670 / 1,530	7,100 / 8,460	7,300 / 8,700	98,000-100,000	5.70	.79 / 1.27	X	X	X	X
F	ALA-880--10.50	1,600 / 2,650	6,980 / 8,320	6,840 / 8,150	115,000-118,000	4.80	.85 / 1.00	X	X	X	X
G	ALA-880-13.10	2,960 / 1,990	7,200 / 8,580	7,160 / 8,540	117,000-120,000	6.00	.79 / 1.09	X	X	X	X
H	ALA-880-16.96	1,760 / 420	8,270 / 9,800	8,840 / 9,940	131,000-134,000	7.00	1.26 / 1.11	X		X	X
I	ALA-880-19.96	2,890 / 290	7,603 / 9,020	7,200 / 8,540	128,000-130,000	8.50	1.06 / 1.20	X	X	X	X
J	ALA-880-22.84	1,130 / 1,210	7,000 / 9,340	6,600 / 7,870	110,000-112,000	8.70	0.96 / 1.12	N	X	X	X
K	ALA-880-31.68	0 / 0	6,000 / 7,150	5,900 / 7,030	68,000-69,000	10.70	1.29 / 1.14	N	X		

Sources: CO/RTE/PM Start: From CSMP segmentation modified from 2002 TCCR segments. Start of segment only.

VHD: MTC, State of the System report, 2008

Volumes, AADT, Truck %: http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/

Accident Rate: Traffic Accident Surveillance and Analysis System (TASAS) Table B (09-01-04 to 08-31-07)

HOV / Auxilliary lane: X in the box if present in the corridor

Bottleneck Location: X in the box per technical analysis report

I-880 **SEGMENT A** DATA

TITLE	DATA
Features	**Data**
County, City	Santa Clara County, City of San Jose
Facility type	Freeway
Existing Facility	6F
2035 Year Concept	8F(2H)
Segment Characteristics	
Segment Limits	I-280 - Coleman St.
Begin/ End Post Mile	SCL PM -0.57-2.67
Length	2.1
Terrain	Flat
Land Use	Urban
Grade % (Postmile to Postmile)	0-3%
Auxiliary Lanes: 3 NB, 3 SB (Postmile to Postmile)	NB: 0.57-1.06,1.30-1.93, 2.02-2.62 SB: 2.56-2.41, 2.22-1.48, 1.44-0.77
HOV lanes	No
Parallel Arterials	1st St., N. 13th St., Oakland Rd., S. Main St., N. Abel St., King Rd., Lindy Av.
Scenic Highway	No
Assembly District	9,10,13
Senate District	15,18,24,20
Multi Modal	
Bikeways/Bike lanes	None
Transit Provider	VTA,SJRTD, Santa Cruz Metro, Greyhound Lines
	VTA-140,180,181; SJRTD-(San Joaquin Commuter)-170, SCM-HWY 17 Bus
Rail Station(s)	San Jose Diridon Station- Amtrak, Caltrain, ACE Santa Clara- Caltrain/ACE (Amtrak in the future)
	VTA-Race St. Sta., Gish Sta., Metro Airport Sta., Katrina Sta., VTA-Diridon Sta.
Park and Ride	None
Traffic Information	
Actual Fatality + Injury Rate this segment (3-yr period)	0.95
Statewide Fatality + Injury Rate	0.94
Actual Total Accident Rate this segment (3-yr period)	0.26
Statewide Total Accident Rate	0.3
AADT 2007	75,000-77,000
AADT 2030	88,950-91,320
Vehicle Hours of Delay 2008 (AM Peak)	300
Vehicle Hours of Delay 2008 (PM Peak)	960
NB / SB Volumes 2007	6,930 / 6,700
NB / SB Volumes 2030	8,220 / 7,950
Truck Volumes 2007	4,300
Truck Traffic: Truck percentage of AADT	2.83-4.19
5+ Axle Truck Percentage of Truck AADT	22.3-29.12

Santa Clara I - 880 PM 0.57 - 2.67 Segment A

I-880 **SEGMENT B** DATA	
TITLE	**DATA**
Features	**Data**
County, City	Santa Clara County Cities: San Jose, Santa Clara, Milpitas
Facility type	Freeway
Existing Facility	8F
2035 Year Concept	10F(2H)
Segment Characteristics	
Segment Limits	Coleman St.-Old Bay Shore Hwy.
Begin/ End Post Mile	SCL PM -2.67-4.20
Length	1.53
Terrain	Flat
Land Use	Urban
Grade % (Postmile to Postmile)	0-3%
Auxiliary Lanes: 1NB, 0 SB (Postmile to Postmile)	NB: 3.69-4.10
HOV lanes	Yes
Parallel Arterials	1st St., King Rd, Lindy Av.
Scenic Highway	No
Assembly District	9,10,13
Senate District	15,18,24,20
Multi Modal	
Bikeways/Bike lanes	None
Transit Provider	VTA, SJRTD, Greyhound Lines
	VTA-140,180,181; SJRTD (San Joaquin Commuter)-170
Rail Station(s)	Santa Clara Great America sta.- Amtrak/VTA/ACE
Park and Ride	None
Traffic Information	
Actual Fatality + Injury Rate this segment (3-yr period)	0.97
Statewide Fatality + Injury Rate	1.17
Actual Total Accident Rate this segment (3-yr period)	0.26
Statewide Total Accident Rate	0.36
AADT 2007	79,000-81,000
AADT 2030	93,690-96,070
Vehicle Hours of Delay 2008 (AM Peak)	300
Vehicle Hours of Delay 2008 (PM Peak)	960
NB / SB Volumes 2007	7,380 / 7,100
NB / SB) Volumes 2030	8,750 / 8,420
Truck Volumes 2007	3,930
Truck Traffic: Truck percentage of AADT	2.46
5+ Axle Truck Percentage of Truck AADT	22.3-29.12

Santa Clara I - 880 PM 2.67 - 4.20
Segment B

I-880 **SEGMENT C** DATA

TITLE	DATA
Features	**Data**
County, City	Santa Clara County Cities: San Jose, Santa Clara, Milpitas
Facility type	Freeway
Existing Facility	8F
2035 Year Concept	10F(2H)
Segment Characteristics	
Segment Limits	Old Bay Shore Hwy.-Montague Expressway
Begin/ End Post Mile	SCL PM -4.20-6.75
Length	2.55
Terrain	Flat
Land Use	Urban
Grade % (Postmile to Postmile)	0-3%
Auxiliary Lanes: 1 NB, 0 SB (Postmile to Postmile)	NB: 4.20-4.33
HOV lanes	Yes
Parallel Arterials	1st. Street, O'toole/McCarthy Blvd., N.Abel St., King Rd, Lindy Ave.,SR-238-Mission Blvd
Scenic Highway	No
Assembly District	9,10,13
Senate District	15,18,24,20
Multi Modal	
Bikeways/Bike lanes	None
Transit Provider	VTA,SJRTD,, Greyhound Lines
	VTA-140,180,181; SJRTD-(San Joaquin Commuter)-170,
Rail Station(s)	
Park and Ride	None
Traffic Information	
Actual Fatality + Injury Rate this segment (3-yr period)	0.79
Statewide Fatality + Injury Rate	1.70
Actual Total Accident Rate this segment (3-yr period)	0.22
Statewide Total Accident Rate	0.62
AADT 2007	78,000-82,000
AADT 2030	92,510-97,250
Vehicle Hours of Delay 2008 (AM Peak)	30
Vehicle Hours of Delay 2007 (PM Peak)	960
NB / SB Volumes 2007	6,950 / 7,250
NB / SB Volumes 2030	8,240 / 8,600
Truck Volumes 2007	5,090
Truck Traffic: Truck percentage of AADT	3.18
5+ Axle Truck Percentage of Truck AADT	22.3-29.12

Santa Clara I - 880 PM 4.20 - 6.75
Segment C

I-880 **SEGMENT D** DATA	
TITLE	**DATA**
Features	**Data**
County, City	Santa Clara County, Alameda County Cities: San Jose, Santa Clara, Milpitas, Fremont
Facility type	Freeway
Existing Facility	10F(2H)
2035 Year Concept	10F(2H)
Segment Characteristics	
Segment Limits	Montague Expy.--Dixon Landing Rd.
Begin/ End Post Mile	SCL-6.75-10.50/ALA.0.0-2.70
Length	2.55
Terrain	Flat
Land Use	Urban
Grade % (Postmile to Postmile)	
Auxiliary Lanes: 4 NB, 1SB (Postmile to Postmile)	NB: 7.09-7.40, 7.69-7.97, 8.73-10.08, 2.45-2.70 SB: 7.91-7.18
HOV lanes	Yes
Parallel Arterials	O'Toole Av./McCarthy Bl., Milpitas Bl., Warm Springs Rd., Osgood Rd., SR-238 (Mission Bl.)
Scenic Highway	No
Assembly District	9,10,13
Senate District	15,18,24,20
Multi Modal	
Bikeways/Bike lanes	None
Transit Provider	VTA
Rail Station(s)	Santa Clara-Great America (Amtrak, ACE)
	VTA-Great America Sta., Lick Mill Sta., Champion Sta., Tasman Sta., Baypointe Sta., Cisco Way Sta., I-880/Milpitas Sta., Great Mall of America Sta.
Park and Ride	None
Traffic Information	
Actual Fatality + Injury Rate this segment (3-yr period)	0.64
Statewide Fatality + Injury Rate	1.19
Actual Total Accident Rate this segment (3-yr period)	0.18
Statewide Total Accident Rate	0.37
AADT 2007	94,000-95,000
AADT 2030	112,240-113,430
Vehicle Hours of Delay 2008 (AM Peak)	0
Vehicle Hours of Delay 2008 (PM Peak)	1,530
NB / SB Volumes 2007	7,325 / 7,520
NB / SB Volumes 2030	8,750 / 8,980
Truck Volumes 2007	SCL: 7,920 ALA: 9,830
Truck Traffic: Truck percentage of AADT	4.19—5.20
5+ Axle Truck Percentage of Truck AADT	22.3-29.12

Santa Clara I - 880 PM 6.75 - 10.50/Alameda I - 880 PM 0.0 - 2.7 Segment D

I-880 **SEGMENT E** DATA	
TITLE	**DATA**
Features	**Data**
County, City	Alameda County, Fremont, Newark, Union City
Facility type	Freeway
Existing Facility	10F(2H)
2035 Year Concept	10F(2H)
Segment Characteristics	
Segment Limits	Dixon Landing Rd.-Paseo Padre Pkwy.
Begin/ End Post Mile	ALA-2.70-10.50
Length	8.43
Terrain	Flat
Land Use	Urban
Grade % (Postmile to Postmile)	0-3%
Auxiliary Lanes: 5 NB, 2 SB (Postmile to Postmile)	NB: 3.50-3.71, 4.06-4.46, 6.46-6.98, 7.41-8.57, 8.98-10.06 SB: 4.68-4.38, 3.90-3.60
HOV lanes	Yes
Parallel Arterials	SR-238 (Mission Bl.)
Scenic Highway	No
Assembly District	9,10,13
Senate District	15,18,24,20
Multi Modal	
Bikeways/Bike lanes	None
Transit Provider	AC Transit/Greyhound Lines/Union City Transit
	AC Transit-801, Union City Transit-S,SA,SB,
Rail Station(s)	Fremont - Amtrak/ACE, BART Fremont, BART Union City
Park and Ride	Union City Bl. & Smith/Horner Sts., Union City(25)
Traffic Information	
Actual Fatality + Injury Rate this segment (3-yr period)	0.79
Statewide Fatality + Injury Rate	1.27
Actual Total Accident Rate this segment (3-yr period)	0.26
Statewide Total Accident Rate	0.39
AADT 2007	98,000-100,000
AADT 2030	116,820-119,200
Vehicle Hours of Delay 2008 (AM Peak)	670
Vehicle Hours of Delay 2008 (PM Peak)	1,530
NB / SB Volumes 2007	7,100 / 7,300
NB / SB Volumes 2030	8,460 / 8,700
Truck Volumes 2007	11,180
Truck Traffic: Truck percentage of AADT	4.8
5+ Axle Truck Percentage of Truck AADT	22.3-29.12

Alameda I - 880 PM 2.7 - 10.50
Segment E

I-880 **SEGMENT F** DATA	
TITLE	**DATA**
Features	**Data**
County, City	Alameda County, Fremont, Newark, Union City
Facility type	Freeway
Existing Facility	10F(2H)
2035 Year Concept	10F(2H)
Segment Characteristics	
Segment Limits	Paseo Padre Pkwy. to Alvarado Rd.
Begin/ End Post Mile	ALA-10.50-13.10
Length	2.6
Terrain	Flat
Land Use	Urban
Grade % (Postmile to Postmile)	
Auxiliary Lanes: 1NB, 0 SB (Postmile to Postmile)	NB: 10.68-11.26
HOV lanes	Yes
Parallel Arterials	Newark Ave. Ardenwood, Hesperian Blvd,SR-238-Mission Blvd, Industrial Blvd.
Scenic Highway	No
Assembly District	9,10,13
Senate District	15,18,24,20
Multi Modal	
Bikeways/Bike lanes	None
Transit Provider	AC Transit/Greyhound Lines
	AC Transit-S, SA, SB, 801
Rail Station(s)	Amtrak- Hayward, Hayward BART, S. Hayward BART
Park and Ride	Union City Blvd. & Smith/Horner Sts., Union City(25)
Traffic Information	
Actual Fatality + Injury Rate this segment (3-yr period)	0.85
Statewide Fatality + Injury Rate	1
Actual Total Accident Rate this segment (3-yr period)	0.33
Statewide Total Accident Rate	0.31
AADT 2007	115,000-118,000
AADT 2030	137,080-140,660
Vehicle Hours of Delay 2008 (AM Peak)	1,600
Vehicle Hours of Delay 2008 (PM Peak)	2,650
NB / SB Volumes 2007	6,980 / 6,840
NB / SB Volumes 2030	8,320 / 8,150
Truck Volumes 2007	11,180
Truck Traffic: Truck percentage of AADT	4.80
5+ Axle Truck Percentage of Truck AADT	40.3-48.57

Alameda I - 880 PM 10.50 - 13.10
Segment F

I-880 **SEGMENT G** DATA	
TITLE	**DATA**
Features	**Data**
County, City	Alameda County, Union City, Hayward
Facility type	Freeway
Existing Facility	8F-10F(2H)
2035 Year Concept	8-10F(2H)
Segment Characteristics	
Segment Limits	Alvarado Road--Jct. SR-92
Begin/ End Post Mile	13.10-16.96
Length	2.6
Terrain	Flat
Land Use	Urban
Grade % (Postmile to Postmile)	
Auxiliary Lanes: 2 NB, 2 SB (Postmile to Postmile)	NB: 13.10-14.23, 14.70-15.45 SB: 15.46-14.84, 13.49-13.36
HOV lanes	Yes
Parallel Arterials	Hesperian Blvd,SR-238-Mission Blvd.
Scenic Highway	No
Assembly District	9,10,13
Senate District	15,18,24,20
Multi Modal	
Bikeways/Bike lanes	None
Transit Provider	AC Transit/Greyhound Lines
	AC Transit-S,SA,SB,801
Rail Station(s)	None
Park and Ride	None
Actual Fatality + Injury Rate this segment (3-yr period)	0.79
Statewide Fatality + Injury Rate	1.09
Actual Total Accident Rate this segment (3-yr period)	0.29
Statewide Total Accident Rate	0.34
AADT 2007	117,000-120,000
AADT 2030	139,460-143,040
Vehicle Hours of Delay 2008 (AM Peak)	2,960
Vehicle Hours of Delay 2008 (PM Peak)	1,990
NB / SB Volumes 2007	7,200 / 7,160
NB / SB Volumes 2030	8,580 / 8,540
Truck Volumes 2007	14,220
Truck Traffic: Truck percentage of AADT	5.5-7
5+ Axle Truck Percentage of Truck AADT	40.3-48.57

Alameda I - 880 PM 13.10 - 16.96
Segment G

I-880 **SEGMENT H** DATA

TITLE	**DATA**
Features	**Data**
County, City	Alameda County, Hayward, San Lorenzo
Facility type	Freeway
Existing Facility	10F(2H)
2035 Year Concept	10F(2H)
Segment Characteristics	
Segment Limits	Jct. SR-92-Paseo Grande
Begin/ End Post Mile	ALA-16.96-19.96
Length	3
Terrain	Flat
Land Use	Urban
Grade % (Postmile to Postmile)	
Auxiliary Lanes: NB 0, SB 0 (Postmile to Postmile)	None
HOV lanes	Yes
Parallel Arterials	SR-185-/E.14th, International Blvd., Wicks Blvd., Merced St.
Scenic Highway	No
Assembly District	9,10,13
Senate District	15,18,24,20
Multi Modal	
Bikeways/Bike lanes	None
Transit Provider	AC Transit/Greyhound Lines
	AC Transit-S,SA,SB,801
Rail Station(s)	None
Park and Ride	Union City Blvd. & Smith/Horner sts., Union City(25)
Traffic Information	
Actual Fatality + Injury Rate this segment (3-yr period)	0.85
Statewide Fatality + Injury Rate	1
Actual Total Accident Rate this segment (3-yr period)	0.33
Statewide Total Accident Rate	0.31
AADT 2007	131,000-134,000
AADT 2030	155,370-158,920
Vehicle Hours of Delay 2008 (AM Peak)	1,760
Vehicle Hours of Delay 2008 (PM Peak)	420
NB / SB Volumes 2007	8,270 / 8,840
NB / SB Volumes 2030	9,800 / 9,940
Truck Volumes 2007	18,550
Truck Traffic: Truck percentage of AADT	7.0
5+ Axle Truck Percentage of Truck AADT	40.3-48.57

Alameda I - 880 PM 16.96 - 19.96
Segment H

I-880 **SEGMENT I** DATA	
TITLE	**DATA**
Features	**Data**
County, City	Alameda County, San Leandro, Oakland
Facility type	Freeway
Existing Facility	8F-9F(1H)
2035 Year Concept	10F(2H)
Segment Characteristics	
Segment Limits	Paseo Grande-98th. Ave.
Begin/ End Post Mile	ALA-19.96-22.84
Length	2.78
Terrain	Flat
Land Use	Urban
Grade % (Postmile to Postmile)	
Auxiliary Lanes: 2 NB, 0 SB (Postmile to Postmile)	NB: 20.41-20.65, 20.90-22.82
HOV lanes	Yes
Parallel Arterials	SR-185-/E.14th, International Blvd, SR-61-Doolite Dr., Washington Ave, San Leandro St., Bancroft Ave., Foothill Blvd.
Scenic Highway	No
Assembly District	9,10,13
Senate District	15,18,24,20
Multi Modal	
Bikeways/Bike lanes	None
Transit Provider	AC Transit/Greyhound Lines
	AC Transit -1R(Rapid),S, SA,SB,801
Rail Station(s)	Bay Fair BART,
Ferry	Bay Farm Island Ferry
Park and Ride	
Traffic Information	
Actual Fatality + Injury Rate this segment (3-yr period)	0.85
Statewide Fatality + Injury Rate	1.06
Actual Total Accident Rate this segment (3-yr period)	0.33
Statewide Total Accident Rate	0.31
AADT 2007	128,000-130,000
AADT 2030	151,810-154,180
Vehicle Hours of Delay 2008 (AM Peak)	2,890
Vehicle Hours of Delay 2008 (PM Peak)	290
NB / SB Volumes 2007	7,603 / 7,200
NB / SB Volumes 2030	9,020 / 8,540
Truck Volumes 2007	21,930
Truck Traffic: Truck percentage of AADT	8.50
5+ Axle Truck Percentage of Truck AADT	39.6-57.4

Alameda I - 880 PM19.96 - 22.84
Segment I

I-880 **SEGMENT J** DATA

TITLE	DATA
Features	**Data**
County, City	Alameda County, Oakland
Facility type	Freeway
Existing Facility	8F
2035 Year Concept	8F-10F(2H)
Segment Characteristics	
Segment Limits	98th. Ave.-Jct.I-980
Begin/ End Post Mile	ALA-22.84-31.68
Length	2.78
Terrain	Flat
Land Use	Urban
Grade % (Postmile to Postmile)	
Auxiliary Lanes: 5 NB, 2 SB (Postmile to Postmile)	NB: 23.11-23.52, 24.45-25.25, 25.48-25.94, 26.82-27.43,28.70-28.86 SB:: 25.37-25.12, 23.71-23.24
HOV lanes	No
Parallel Arterials	SR-185-/E.14th, International Blvd, SR-61-Doolite Dr., San Leandro St., Bancroft Ave., Foothill Blvd.
Scenic Highway	No
Assembly District	9,10,13
Senate District	15,18,24,20
Multi Modal	
Bikeways/Bike lanes	None
Transit Provider	AC Transit/Greyhound Lines
	AC Transit -1R(Rapid),S, SA,SB,801
Rail Station(s)	BART San Leandro, BART/Amtrak- Oakland Coliseum Station
Ferry	Bay Farm Island Ferry
Park and Ride	
Traffic Information	
Actual Fatality + Injury Rate this segment (3-yr period)	0.96
Statewide Fatality + Injury Rate	1.12
Actual Total Accident Rate this segment (3-yr period)	0.37
Statewide Total Accident Rate	0.35
AADT 2007	110,000-112,000
AADT 2030	131,120-133,500
Vehicle Hours of Delay 2008 (AM Peak)	1,130
Vehicle Hours of Delay 2008 (PM Peak)	1,210
NB / SB Volumes 2007	7,000 / 6,600
NB / SB Volumes 2030	9,340 / 7,870
Truck Volumes 2007	19,310
Truck Traffic: Truck percentage of AADT	8.70
5+ Axle Truck Percentage of Truck AADT	51.6-52

Alameda I - 880 PM 22.84 - 31.68 Segment J

I-880 **SEGMENT K** DATA	
TITLE	**DATA**
Features	**Data**
County, City	Alameda County, Oakland
Facility type	Freeway
Existing Facility	6F
2035 Year Concept	6F
Segment Characteristics	
Segment Limits	Jct. I-980 – 7th St.
Begin/ End Post Mile	31.68-34.11
Length	2.43
Terrain	Flat
Land Use	Urban
Grade % (Postmile to Postmile)	
Auxiliary Lanes: 1 NB, 0 SB (Postmile to Postmile)	NB: 31.36-31.68
HOV lanes	No
Parallel Arterials	International Blvd, SR-61-Doolite Dr., San Leandro St., Bancroft Ave., Foothill Blvd.,7th St., 8th St., 14th St., 12th St., W. Grand Ave., E. 12th St.
Scenic Highway	No
Assembly District	9,10,13
Senate District	15,18,24,20
Multi Modal	
Bikeways/Bike lanes	None
Transit Provider	AC Transit/Greyhound Lines
	AC Transit -1R(Rapid),S, SA,SB,801
Rail Station(s)	Amtrak Oakland Jack London Station - (Capitol Corridor & Coast Starlight, San Joaquins), Lake Merritt BART, Fruitvale BART
Ferry	San Francisco-Alameda-Oakland
Park and Ride	Linden(180)
Traffic Information	
Actual Fatality + Injury Rate this segment (3-yr period)	1.29
Statewide Fatality + Injury Rate	1.14
Actual Total Accident Rate this segment (3-yr period)	0.3
Statewide Total Accident Rate	0.36
AADT 2007	68,000-69,000
AADT 2035	81,060-82,250
Vehicle Hours of Delay 2008 (AM Peak)	0
Vehicle Hours of Delay 2008 (PM Peak)	0
NB / SB Volumes 2007	6,000 / 5,900
NB / SB Volumes 2030	7,150 / 7,030
Truck Volumes 2007	17,160
Truck Traffic: Truck percentage of AADT	10.7
5+ Axle Truck Percentage of Truck AADT	51.6-52

Alameda I - 880 PM 31.68 - 34.11
Segment K

A.5 PROGRAMMED/PLANNED IMPROVEMENT LIST

Table A.5.1: I-880 Programmed/Planned Improvement List

Rte	Post Mile	EA	T2035* Ref#	Project Description	Planned	Programmed
SCL	880	4.07-10.50	230668	Convert HOV lanes to express lanes US-101 to ALA/SCL line	X	
ALA	880	0.00-22.81	230669	Convert HOV lanes to express lanes ALA/SCL line to Ma-rina/Lewelling Blvd.	X	
ALA	880	22.81-25.61	230670	Convert HOV lanes to express lanes Marina/Lewelling to Hegenberger Road	X	
ALA	880	29.67-34.51	230671	Convert HOV lanes to express lanes 16th Avenue to SFOBB toll plaza. (No HOV yet to convert).	X	
ALA	880	31.67-34.51	22002	Extend I-880 NB HOV lane from Maritime St. to SFOBB toll plaza		RM2 Toll Bridge Program
ALA	880	30.94	22087	Reconstruct I-880/Oak St. interchange		X
ALA	880	23.77	22100	Replace overcrossing at I-880/Davis St. interchange		X
ALA	880	22.85-25.61	22670	Construct SB HOV lane from Hegenberger Rd. to Marina Blvd.		Prop. 1B CMIA
ALA	880	28.68-28.93	22769	Improve NB I-880 ramp geometrics at 23rd and 29th Avenues		Prop. 1B, TCIF
ALA	880	1.92	22779	Reconstruct SR-262/I-880 interchange and widen I-880		X
ALA	880	0.00-1.92	94030	Reconstruct SR-262/I-880 interchange and widen I-880 from 8 lanes to 10 lanes from SCL line to SR-262		X
ALA	880	16.69	94514	Reconstruct I-880/SR-92 interchange with direct connectors		RM2 Toll Bridge Program
ALA	880	31.39	98207	Improve I-880/Broadway-Jackson interchange, including new on/off ramps		X
ALA	880	18.22	230047	Reconstruct I-880/West A Street interchange, including new sidewalks		X
ALA	880	14.63	230053	Reconstruct I-880/Industrial Parkway interchange (Phase 1)	X	
ALA	880	14.53	230054	Construct auxiliary lanes at Industrial Parkway		X
ALA	880	14.72	230057	Reconstruct I-880/Industrial Parkway interchange, including new on-ramps (Phase 2)	X	

continues on next page

continued from previous page

Table A.5.1: I-880 Programmed/Planned Improvement List (cont)

Rte	Post Mile	EA	T2035* Ref#	Project Description	Planned	Programmed
ALA	880	22.83	230066	Improve I-880/Marina Blvd. interchange, including on-off ramp improvements		X
ALA	880	19.27-25.61	230088	Extend NB HOV lane from north of Hacienda Ave. to Hegenberger Road	X	
ALA	880	20.82	21466	Improve Washington Ave./Beatrice St. and I-880 inter-change		2000 Measure B COMPLETE)
ALA	880	17.60	230052	Construct auxiliary lanes on I-880 near Winton Ave. in Hayward	X	
ALA	880	27.63	230170	Improve access to I-880 from 42nd Ave. and High Street	X	
SCL	880	0.41	21719	Improve I-880/I-280/Stevens Creek Blvd. interchange		Prop. 1B CMIA
SCL	880	4.08-8.42	22944	Widen I-880 for HOV lanes in both directions from SR-237 to US-101		Prop. 1B CMIA
SCL	880	6.70	23063	Construct interchange at I-880 and Montague Expressway		X

A.6 10-YEAR PAVEMENT MANAGEMENT PLAN

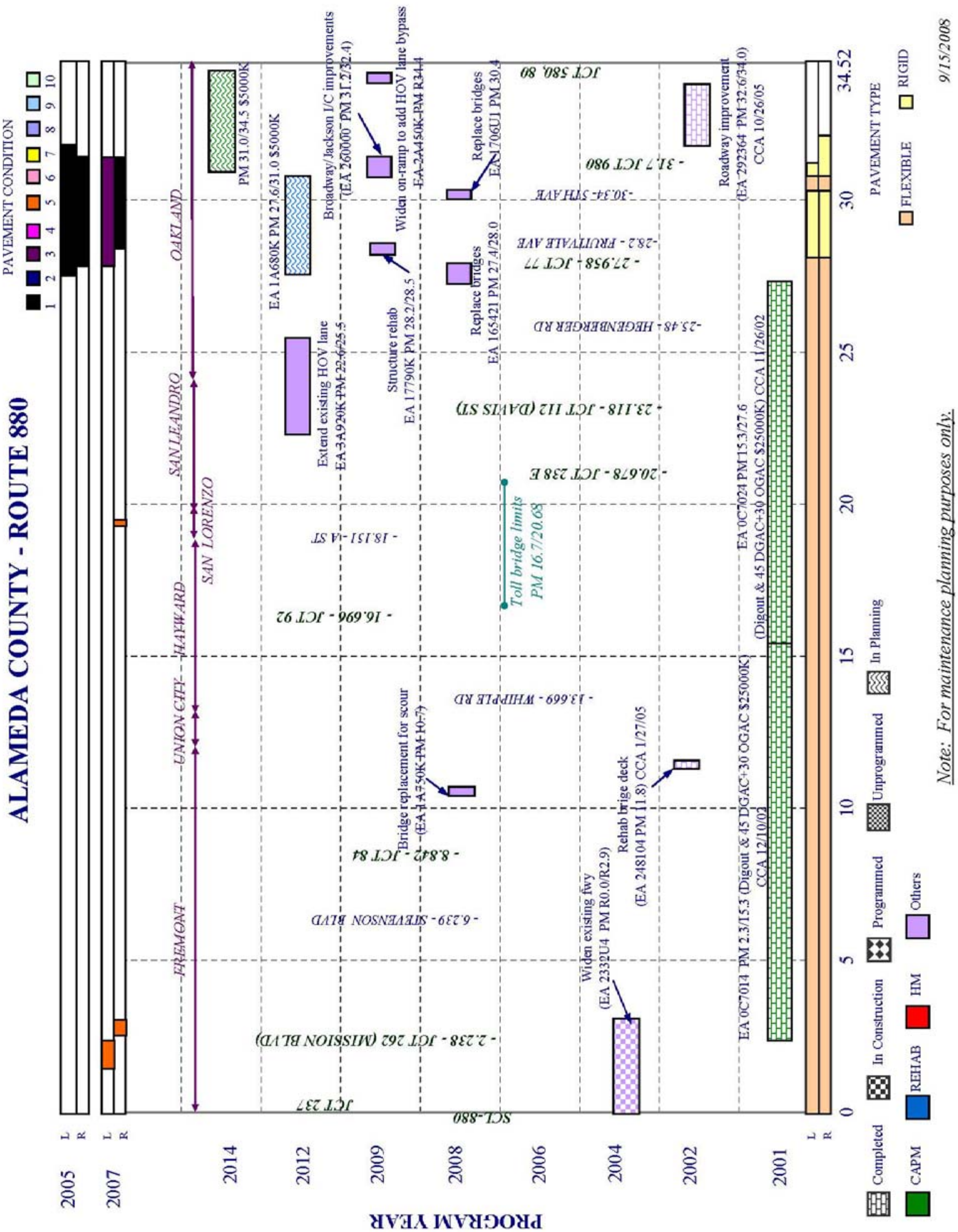


Figure A.6.1. I-880 Alameda County

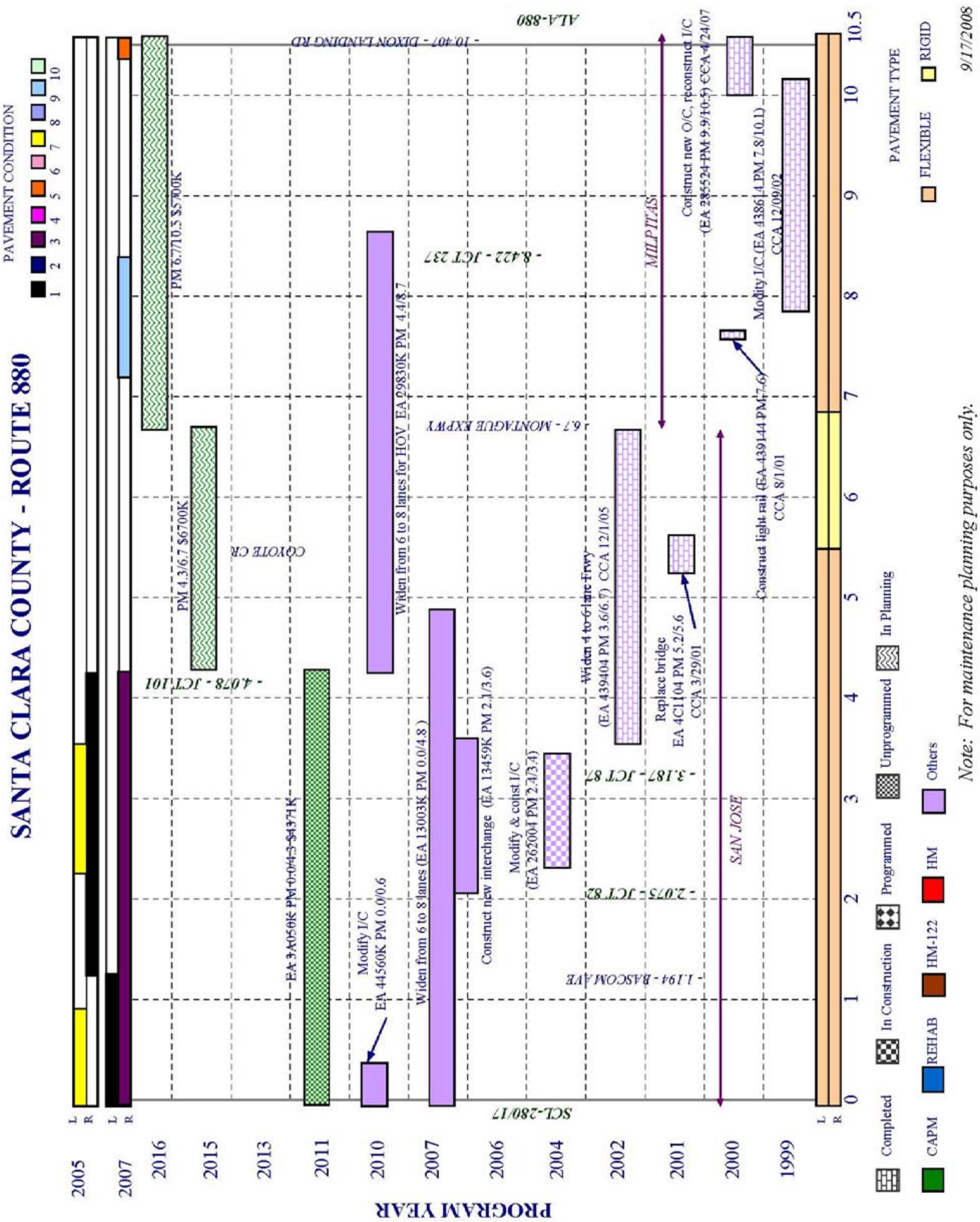


Figure A.6.2. I-880 Santa Clara County

A.7 METROPOLITAN TRANSPORTATION COMMISSION RESOLUTION NO. 3794

Date: February 28, 2007
W.I.: 1236
Referred by: Operations Comm.

ABSTRACT

Resolution No. 3794

This resolution authorizes the Metropolitan Transportation Commission (MTC) to enter into a cooperative agreement with the California Department of Transportation (DEPARTMENT) to provide supplemental funds for the Bay Area Freeway Performance Initiative Corridor Studies.

Attachment 1 – Scope of Work for the cooperative agreement

Date: February 28, 2007
W.I.: 1236
Referred by: Operations Comm.

RE: Authorizing a Cooperative Agreement with the California Department of Transportation

METROPOLITAN TRANSPORTATION COMMISSION
RESOLUTION NO. 3794

WHEREAS, the Metropolitan Transportation Commission (MTC) is the regional transportation planning agency for the San Francisco Bay Area pursuant to Government Code Section 66500 *et seq.*; and

WHEREAS, MTC has committed, as part of the agency strategic plan adopted on March 22, 2006 to the development of a strategic plan for the Bay Area freeway system, called the Freeway Performance Initiative; and

WHEREAS, as part of implementing the Freeway Performance Initiative, MTC is conducting a number of technical assessments of the major freeway corridors in the Bay Area called the Freeway Performance Initiative Corridor Studies (Corridor Studies).

WHEREAS, MTC, as part of its submittal of project nominations for the Corridor Mobility Improvement Account, committed to the development of corridor management plans in cooperation with the California Department of Transportation (DEPARTMENT); and

WHEREAS, MTC has historically worked collaboratively with the DEPARTMENT to plan for the effective management and expansion of the Bay Area freeway system; and

WHEREAS, the DEPARTMENT has allocated $1.5 million State Highway Account funds to supplement the Corridor Studies; and

WHEREAS, MTC now wishes to enter into a cooperative agreement with the DEPARTMENT to accept the supplemental funds; now, therefore, be it

MTC Resolution No. 3794
Page 2

RESOLVED, that MTC authorizes the Executive Director, or his designee, to enter into a cooperative agreement, based on the scope of work attached, with the DEPARTMENT to accept the aforementioned $1.5 million for the Corridor Studies, and

RESOLVED, that MTC commits to the completion of Corridor Studies plans consistent with guidance provided by the DEPARTMENT and the timely submittal of study results and recommendations.

METROPOLITAN TRANSPORTATION COMMISSION

Chair

The above resolution was entered into by the Metropolitan Transportation Commission at a regular meeting of the Commission held in Oakland, California, on February 28, 2007.

A.8 CORRIDOR CONCEPT

The Corridor Concept conveys Caltrans' vision for a route with respect to corridor capacity and operations for a 25-year planning horizon.

The Corridor Concept is derived from examination of strategies and projects recommended in the CSMP technical analysis report. The CSMP technical analysis was done with sensitivity to information contained in current approved planning documents and operations plans, local and regional input, and review of Freeway Agreements.

The Corridor Concept supersedes previous "route concepts" documented in District 4 (D4) 1980s Route Concept Reports (RCRs) and facility and operational concepts in the 2001-02 Transportation Corridor Concept Reports (TCCRs). Table A 8.1 shows the I-880 Corridor Concept by CSMP corridor.

Concept Rationale

Caltrans and its partners have strategies and projects to address poor performance within the I-880 CSMP corridor. Short-term improvements include operational, ITS and capacity increasing projects. Long-term improvements include enhanced HOV lanes.

Table A.8.1. 25-year I-880 CSMP Corridor Concept.

Segment	County	Segment Description	Existing Facility	25-Yr Concept
Segment A SCL 880: 0.57-2.67	SCL	I-280 to Coleman Street	6F	8F(2H)
Segment B SCL 880: 2.67-4.20	SCL	Coleman Street to Old Bayshore Highway	8F	10F(2H)
Segment C SCL 880: 4.20-6.75	SCL	Old Bayshore Highway to Montague Expressway	8F	10F(2H)
Segment D SCL 880: 6.75-10.50, ALA 880: 0.0-2.70	SCL ALA	Montague Expressway to Dixon Landing Road	10F(2H)	10F(2H)
Segment E ALA 880: 2.70-10.50	ALA	Dixon Landing Road to Paseo Padre Parkway	10F(2H)	10F(2H)
Segment F ALA 880:10.50-13.10	ALA	Paseo Padre Parkway to Alvarado Road	10F(2H)	10F(2H)
Segment G ALA 880:13.10-16.96	ALA	Alvarado Road to Junction 92	8-10F(2H)	8-10F(2H)
Segment H ALA 880:16.96-19.96	ALA	Junction 92 to Paseo Grande.	10F(2H)	10F(2H)
Segment I ALA 880:19.96-22.84	ALA	Paseo Grande to 98th Avenue	8F-9F(1H)	10F(2H)
Segment J ALA 880:22.84-31.68	ALA	98th Avenue to Junction I-980	8F	8F – 10F(2H)
Segment K ALA 880:31.68-34.11	ALA	Junction I-980 to 7th Street	6F	6F

F=Freeway, H=HOV, TCL=Truck Climbing Lane

A.9 ACRONYMS LIST

AADT—Annual Average Daily Traffic

AB—Assembly Bill

ABAG—Association of Bay Area Governments

AC Transit—Alameda-Contra Costa Transit

ACCMA—Alameda County Congestion Management Agency

ACE—Altamont Commuter Express

ACS—American Community Survey

ACTA—Alameda County Transportation Authority

ACTIA—Alameda County Transportation Improvement Authority

ALA—Alameda County

BAAQMD—Bay Area Air Quality Management District

BART—Bay Area Rapid Transit

BCDC—Bay Conservation and Development Commission

BNSF—Burlington Northern Santa Fe

BRT—Bus Rapid Transit

CALEPA—California Environmental Protection Agency

Caltrans—California Department of Transportation

CAPM—Capital Preventative Maintenance

CARB—California Air Resources Board

CC—Contra Costa County

CCBC—Cross County Bicycle Corridor

CCFS—Central Alameda County Freeway Study

CCIT—California Center for Innovative Transportation

CCTV—Closed Circuit Television

CEQA—California Environmental Quality Act

CHP—California Highway Patrol

CHSR—California High Speed Rail

CMIA—Corridor Mobility Improvement Account

CMS—Congestion Management System

CNDDB—California Natural Diversity Database

CO—Carbon Monoxide

CPAD—Carbon Monoxide

CSMP—Corridor System Management Plan

CTC—California Transportation Commission

CTP—California Transportation Plan

CZMA—Coastal Zone Management Act

DFG—Department of Fish and Game

DPG—Damage Priority Group

EA—Environmental Assessments

EIS—Environmental Impact Statement

EPA—Environmental Protection Agency

FED/CAL—Federal/California

FHWA—Federal Highway Administration

FOCUS—Focus Our Future

FPI—Freeway Performance Initiative

FTA—Federal Transit Administration

GHG—Greenhouse Gas

GMAP—Goods Movement Action Plan

HAR—Highway Advisory Radio

HICOMP—Statewide Highway Congestion Monitoring Program

HOT—High Occupancy Toll

HOV—High Occupancy Vehicle

ICM—Integrated Corridor Management

IRRS—Interregional Road System

ITS—Intelligent Transportation System

ITSP—Interregional Transportation Strategic Plan

LATIP—Local Alternative Transportation Improvement Program

LLM—Lost Lane Miles

LOS—Level of Service

MRN—Marin County

MTC—Metropolitan Transportation Commission

NAP—Napa County

NB—Northbound

NEPA—National Environmental Policy Act

NITSA—National ITS Architecture

NOx—Nitrogen Oxide

NPDES—National Pollutant Discharge Elimination System

NRCS—National Resource Conservation Service

NRHP—National Registry of Historical Places

O3—Ozone

PAED—Project Approval and Environmental Document

PDA—Planning Development Area

PeMS—Performance Monitoring System

PSR—Project Study Report

RCR—Route Concept Report

REB—Regional Express Bus

RTL—Ready to List

RTP—Regional Transportation Plan

RTPA—Regional Transportation Planning Agency

SAFTEA-LU—Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users

SB—Southbound

SCL—Santa Clara County

SCS—Sustainable Community Strategy

SGP—Strategic Growth Plan

SHELL—State Highway Extra Legal Load

SM—San Mateo County

SOL—Solano County

SON—Sonoma County

SOV—Single Occupancy Vehicle

SR—State Route

STAA—Surface Transportation Assistance Act

SVSC—Silicon Valley Smart Corridor

SWITSA—California ITS Architecture and System Plan

T/E—Threatened/Endangered

TAC—Technical Advisory Committee

TASAS—Traffic Accident Surveillance and Analysis System

TCCR—Transportation Corridor Concept Report

TCIF—Trade Corridors Improvement Fund

TDM—Transportation Demand Management

TMC—Transportation Management Center

TMS—Traffic Monitoring Station

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Interstate 880

Appendix II
(technical documents)

Attached Documents:

I-880 Corridor Management Plan Demonstration. UC Berkeley California Center for Innovative Transportation with System Metrics Group and Braidwood Associates. January 2010.

Freeway Performance Initiative (FPI) Santa Clara I-880 Existing Conditions Analysis. Metropolitan Transportation Commission with System Metrics Group and Cambridge Systematics. December 2007.

CALIFORNIA CENTER FOR INNOVATIVE TRANSPORTATION
INSTITUTE OF TRANSPORTATION STUDIES
UNIVERSITY OF CALIFORNIA, BERKELEY

I-880 Corridor Management Plan Demonstration

Thomas West
Director, California Center for Innovative Transportation

CCIT Research Report
UCB-ITS-CRR-2010-1

The California Center for Innovative Transportation works with researchers, practitioners, and industry to implement transportation research and innovation, including products and services that improve the efficiency, safety, and security of the transportation system.

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UNIVERSITY OF CALIFORNIA, BERKELEY

I-880 Corridor Management Plan Demonstration

Thomas West, Director, CCIT

CCIT Research Report
UCB-ITS-CRR-2010-1

This work was performed by the California Center for Innovative Transportation, a research group at the University of California, Berkeley, in cooperation with the State of California Business, Transportation, and Housing Agency's Department of Transportation, and the United States Department of Transportation's Federal Highway Administration.

January 2010

I-880 Corridor Management Plan Demonstration

Task Order 1015 - Final Report
January 2010

California Center for Innovative Transportation
System Metrics Group, Inc.
Braidwood Associates

Project Fact Sheet

Title:	I-880 Corridor Management Plan Demonstration
Sponsor:	Caltrans Division of Research and Innovation
Executing organization:	California Center for Innovative Transportation
	2105 Bancroft Way, Berkeley, CA 94720
	Phone: (510) 642-4522. Fax: (510) 642-0910
Execution period:	6/1/2006—9/30/2009
Contract amount:	$855,458
Principal Investigator:	Hamed Benouar, PhD
Center Director:	Thomas West
Project Manager:	Thomas West

Dedication

We dedicate this Corridor Management Plan Demonstration to the memory of Patricia “Pat” Weston (1951-2009), Chief, Caltrans Office of Advanced System Planning, whose seemingly limitless energy and passion for transportation system planning in California has been an inspiration to countless transportation planners and engineers within Caltrans and its partner agencies. Pat’s efforts elevated the importance of corridor-based system planning, performance measurement for system monitoring, and the blending of long-range planning with near-term operational strategies. This has resulted in stronger planning partnerships with Traffic Operations in Caltrans and led directly to the requirement to conduct comprehensive corridor planning through Corridor System Management Plan (CSMP) documents. This is but one of a long list of major achievements in Pat’s lengthy Caltrans career. She generously shared her knowledge, wisdom, and guidance with us over the years. She will be sorely missed as a planner, mentor, and friend.

Executive Summary

It is clear that transportation infrastructure expansion will continue to fall behind the pace of demand. If conditions are to improve, or at least not deteriorate as fast, a new approach to transportation decision making and investing is needed. The Corridor system Management Plan for the Nimitz (I-880) Freeway corridor in the Bay Area is a “first cut” template that integrates the overall concept of system management into Caltrans’ planning and decision-making process.

System Management is the wave of the future and is being touted at the federal, state, regional and local levels. Understanding how a corridor performs and why it performs the way it does is critical to crafting the appropriate strategies. From the research, it is found that congestion leads to lost productivity in the form of bottlenecks. Expanding existing infrastructure, however, is not always the best route to go, especially in today’s economic climate. The system management philosophy begins by defining how the system is performing, understanding why it is performing that way, and then evaluating different strategies to address deficiencies.

In 2004, under sponsorship from the California Department of Transportation, the California Center for Innovative Transportation (CCIT) at the University of California, Berkeley began the process to evaluate the performance of a heavily congested major urban transportation corridor in the San Francisco Bay Area and to model and assess the benefits of a variety of transportation investments upon the corridor. Systems Metrics Group (SMG), a subcontractor to CCIT and responsible party to conduct the overall evaluation, modeling, and investment review has returned with a comprehensive and scientifically justifiable assessment of Interstate 880, the selected corridor with boundaries that include the SR-237 interchange in Fremont to the Grand Avenue Interchange in Oakland. Through extensive performance monitoring, SMG was able to conduct and document a comprehensive performance assessment of the corridor and through the use of sophisticated microscopic traffic simulation modeling tools and techniques, to evaluate the validity of a variety of investment scenarios.

While not intended to replace other studies, this analysis represents the first attempt by the California Department of Transportation to address existing travel conditions and mobility challenges though the integration of operational analyses, traditional planning management strategies, and capital improvements all based upon a strong and scientific assessment of existing conditions and potential scenarios. In summary, results of this study produced a return-on-investment ranking for a variety of improvement opportunities for the Interstate 880 corridor, primarily located in bottle-neck related problem areas. In addition, the study identified advanced ramp metering as highest performing investment included in the study and proposes, among other recommendation, that Caltrans and its partners focus on a properly implemented advanced ramp metering systems along the Interstate 880 corridor.

Table of Contents

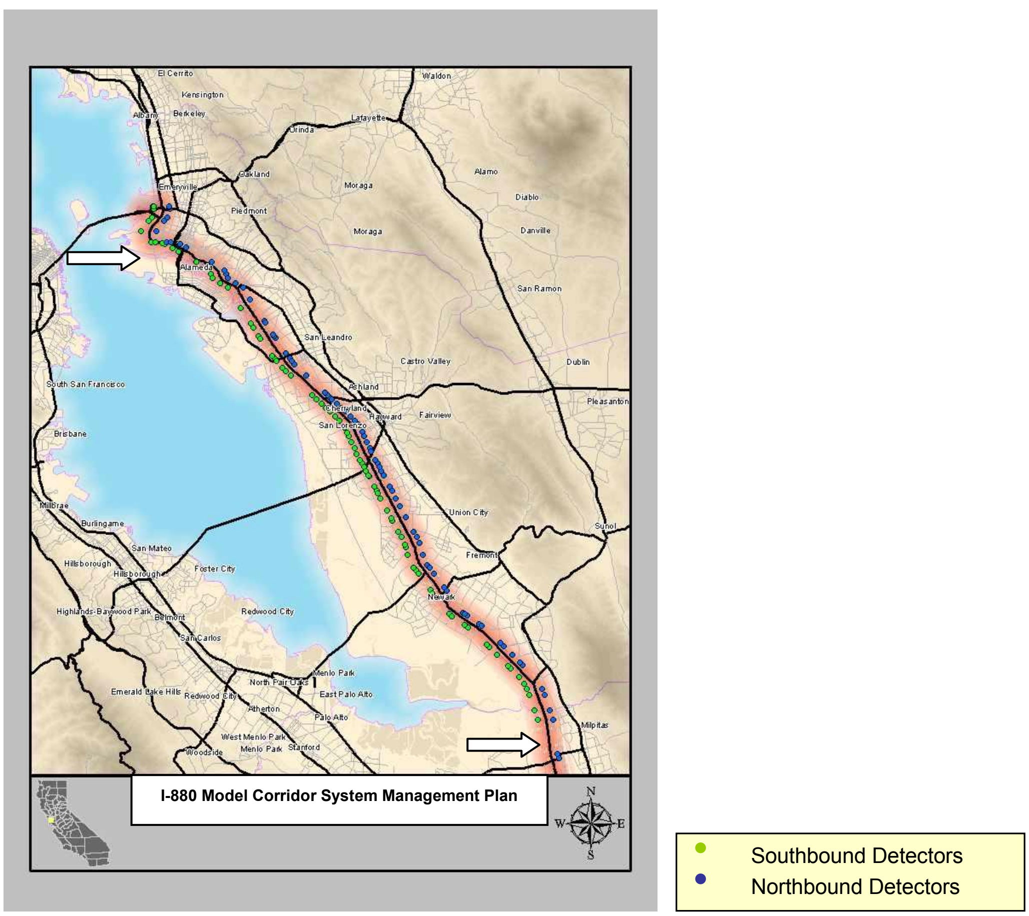
List of Exhibits

I. INTRODUCTION

This document presents the Model Corridor Management Plan for the Nimitz (I-880) Freeway corridor in the Bay Area from the SR-237 Interchange in Fremont to the Grand Avenue Interchange in Oakland. This project was intended to demonstrate the concept of corridor management, including conducting and documenting the comprehensive performance assessment and evaluating improvements. This was done by using advanced micro simulation tools to duplicate corridor performance conditions documenting and projecting the benefits of different improvement strategies on traffic flow and overall mobility on the corridor. The project was not intended to replicate or replace other studies or previous decisions.

This plan represents the first attempt by the California Department of Transportation (Caltrans) to develop a phased strategy that integrates operational analysis with more traditional system planning based on a foundation of comprehensive performance assessment and evaluation. The corridor was selected by Caltrans District 4 (Bay Area) and its stakeholders, partly based on the availability of detection data needed for the critical performance assessment efforts. Exhibit I-1 below shows the corridor boundaries (identified by the arrows) and its detection stations.

Exhibit I-1: 880 Corridor Study Boundaries and Detection Stations



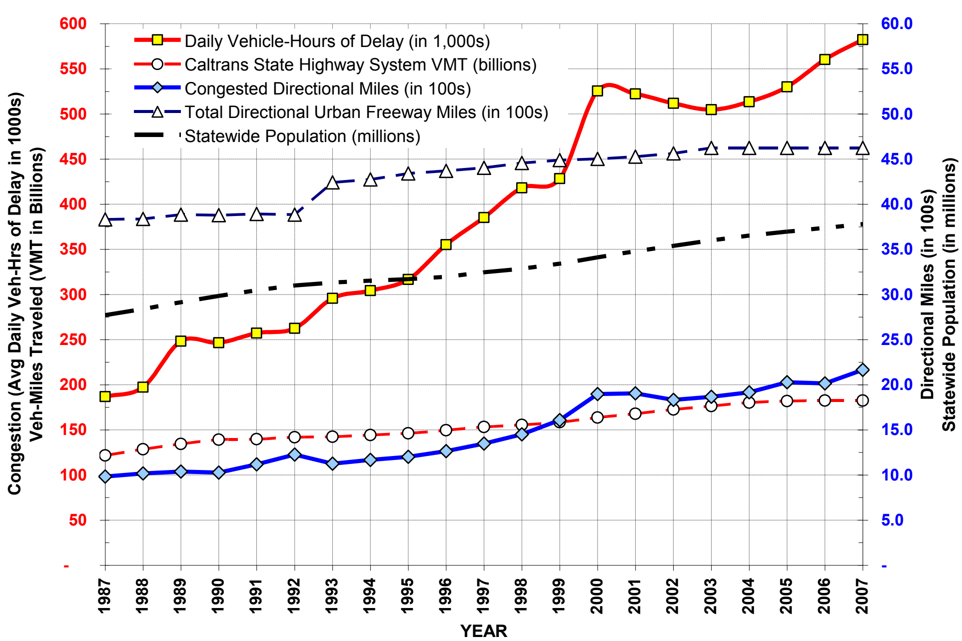
What is a Corridor Management Plan?

A Corridor Management Plan is a document that identifies the recommended system management strategies for a given State Highway System facility based on comprehensive performance assessment and evaluation. The strategies are phased and include both operational and more traditional longer range capital expansion strategies. The strategies take into account transit usage and projections and interactions with the arterial network. As such, this corridor management plan serves as a "first cut" template that integrates the overall concept of system management into Caltrans' planning and decision-making processes. Moving away from the traditional approach that often focuses on expensive capital improvements to localized freeway problem areas, this project follows a corridor management plan approach, which emphasizes performance assessments and operational strategies that yield higher benefit to cost results.

What is System Management?

With the rising cost and complexity of construction and right of way acquisition, the era of building new facilities is coming to an end. From 1998 through 2007, California, like so many other states, expanded its freeway transportation infrastructure by less than one half percent annually. However, demand for transportation during the same period, as measured by freeway vehicle miles traveled, rose by an average of 2.5 percent, which is five times the rate of infrastructure growth. As indicated in Exhibit I-2, congestion continues to generally increase at a rate higher than demand except during periods of economic stagnation

Exhibit I-2: California Freeway Traffic Congestion Growth Last 20 Years

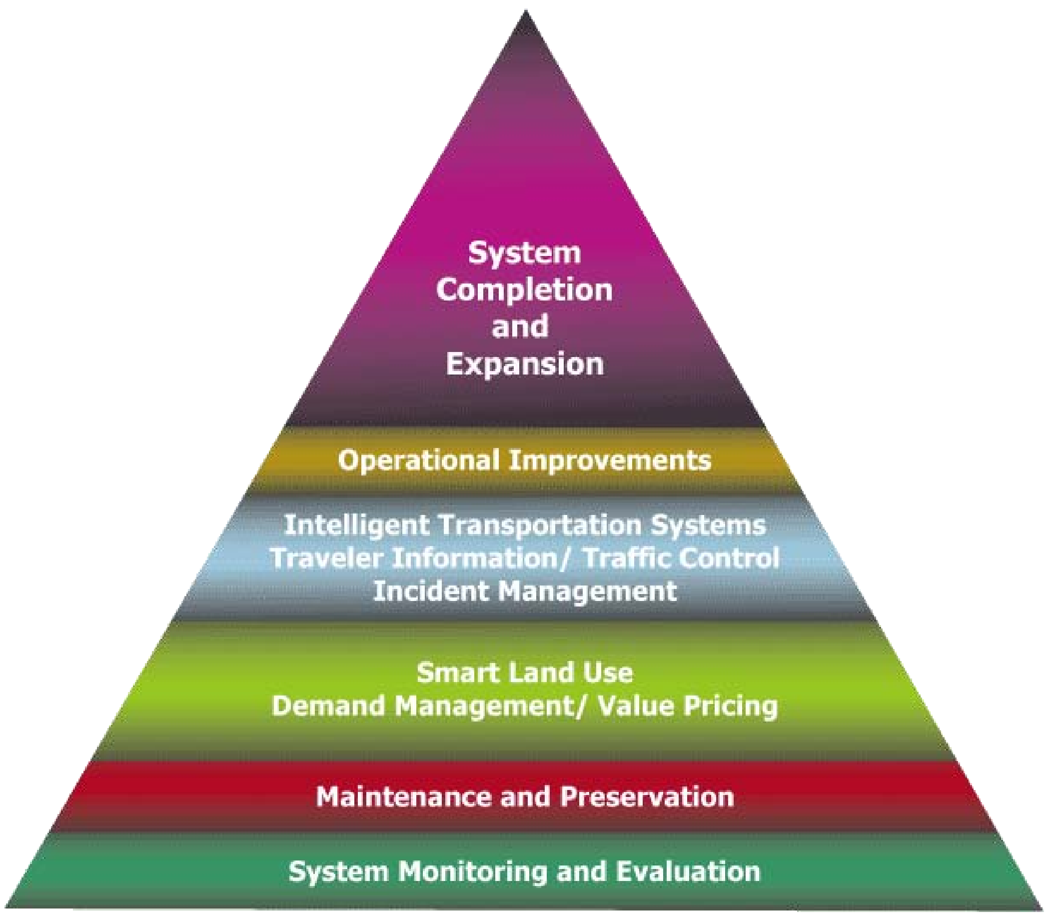


It is clear that infrastructure expansion will continue to fall behind the pace of demand. If conditions are to improve, or at least not deteriorate as fast, a new approach to transportation decision making and investing is needed.

Caltrans recognized this emerging need as it adopted a "One Vision/One Mission" statement to improve mobility across California. It specifies a revised set of goals to help guide the State towards that new approach: productivity, reliability, flexibility, safety, and performance. The first three goals are new and call for improving the efficiency of the transportation system, reducing traveler delays due to incidents and road work, and making transit a more practical travel option. The last two goals are traditional but critical, ensuring the public's safety and delivering the projects efficiently.

System Management (SM) is the wave of the future and is being touted at the federal, state, regional and local levels. The SM "pyramid" shown in Exhibit I-3 illustrates how we need to address both transportation demand and supply to maximize system performance. In the end, it is critical that the *productivity of our system increases* to make up with the past and likely future difference (deficiency) between supply and demand increases.

Exhibit I-3: System Management Pyramid



Ideally, Caltrans and its regional partners would develop a regional system management plan that addresses all components of the SM pyramid for an entire region comprehensively. However, because SM is new to Caltrans and its regional and local partners, it is prudent to practice SM at the corridor level first.

The foundation of system management is system monitoring and evaluation (the base of the pyramid) through comprehensive performance assessment and evaluation. Understanding how a corridor performs and why it performs the way it does is critical to crafting the appropriate strategies. Two entire sections of the appendix to this document (Sections A-2 and A-3) are dedicated to performance assessment. A relatively new, sometimes controversial measure merits a discussion here since it explains the increased emphasis on operational strategies. This measure is productivity.

What is Productivity?

A critical goal of System Management is to "get the most out" of the existing system, or maximize system productivity. One would think that a given freeway is most productive during peak commute times. This is true for freeways not experiencing congestion. However, for California's urban freeways which have been experiencing growing congestion, the opposite is true.

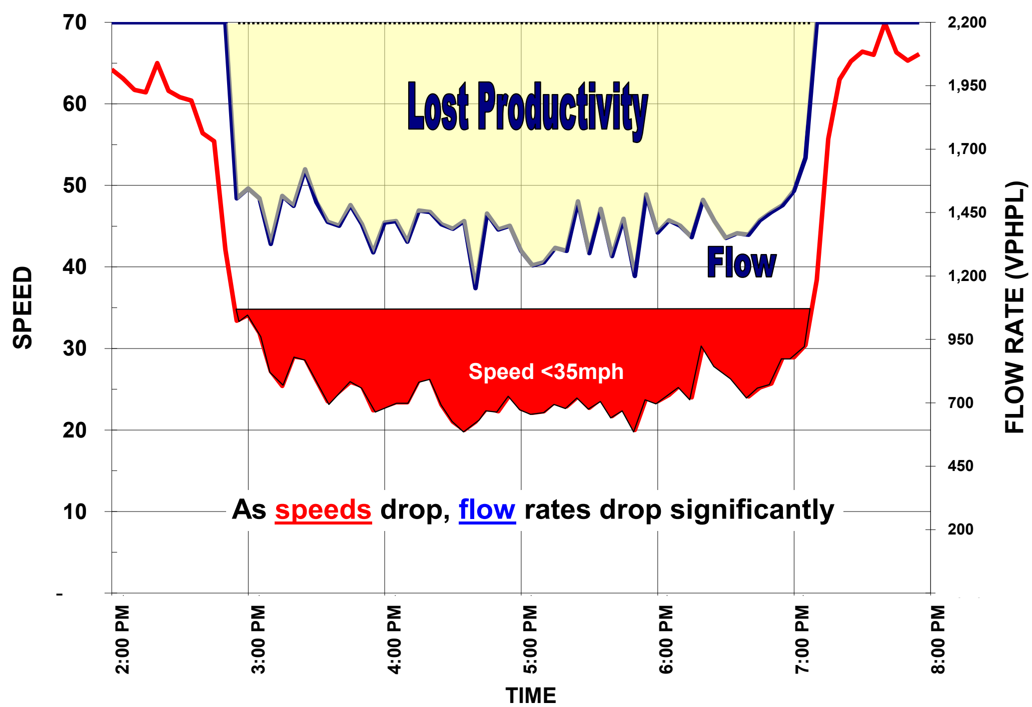
Exhibit I-4 illustrates how congestion leads to lost productivity. The exhibit represents speeds in red and flow rates in blue on one section of the 405 freeway in Los Angeles. It shows that once severe congestion starts (at around 2 pm) and speeds dip to 20 miles an hour, flow rates (the number of vehicles passing through the segment per hour) dip to below 750 per lane per hour. Given that design capacities for freeways are around 2,000 vehicles per hour per lane, actual flow rates during the congested period can represent a loss of more than 50 percent of this capacity (i.e., 750 actual flow rates versus 2,000 design capacity). This loss, shown as the shaded area in the exhibit, is referred to as lost productivity and can be presented in terms of "Lost Lane Miles".

The cause of lost productivity can almost always be linked to bottlenecks (or pinch points). These bottlenecks sometimes occur on a regular basis (e.g., at certain interchanges) and sometimes occur as a result of special circumstances (e.g., incidents).

In both cases though, bottlenecks occur when the overall demand at a particular location exceeds the effective capacity of that location. In this case, demand refers to vehicular demand that is actually either on the freeways or is allowed on the freeways (e.g., from on-ramps). It does refer to the total number of vehicles who want to get on the freeway, but may still be on the ramps or on the arterials. Conversely, effective capacity refers to the maximum throughput (e.g., number of vehicles per hour per lane) that can be sustained at a certain location.

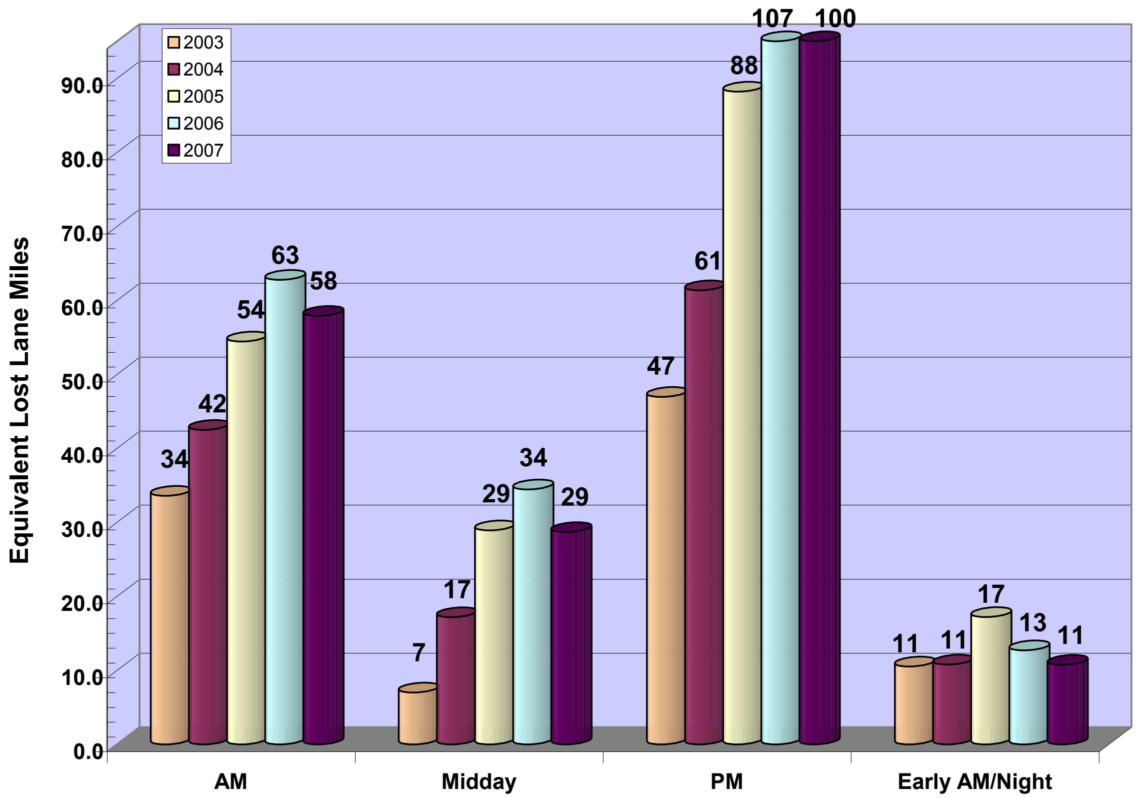
When demand exceeds the effective capacity, unstable traffic flow occurs and any additional merging and weaving lead to queues building behind the bottleneck. The flow rates are generally lower in bottleneck queues. This in turn leads to productivity losses. To the extent that operational strategies can be implemented to eliminate the bottleneck altogether or to reduce the severity of the bottlenecks and the queues, productivity can be increased without major facility expansion.

Exhibit I-4: Productivity Loss during Severe Congestion



As shown in Exhibit I-5, the lost productivity aggregated for District 4 was estimated to be equivalent to exceed 100 lane-miles during the afternoon peak commute periods in 2007. Total lost productivity for the district in 2007 (i.e., adding up lost lane miles for all time periods) added up to almost 200 lane-miles. Therefore, just when the region needed the most capacity, its freeways performed in a less productive manner.

Exhibit I-5: 2003-2007 Lost Productivity in District 4



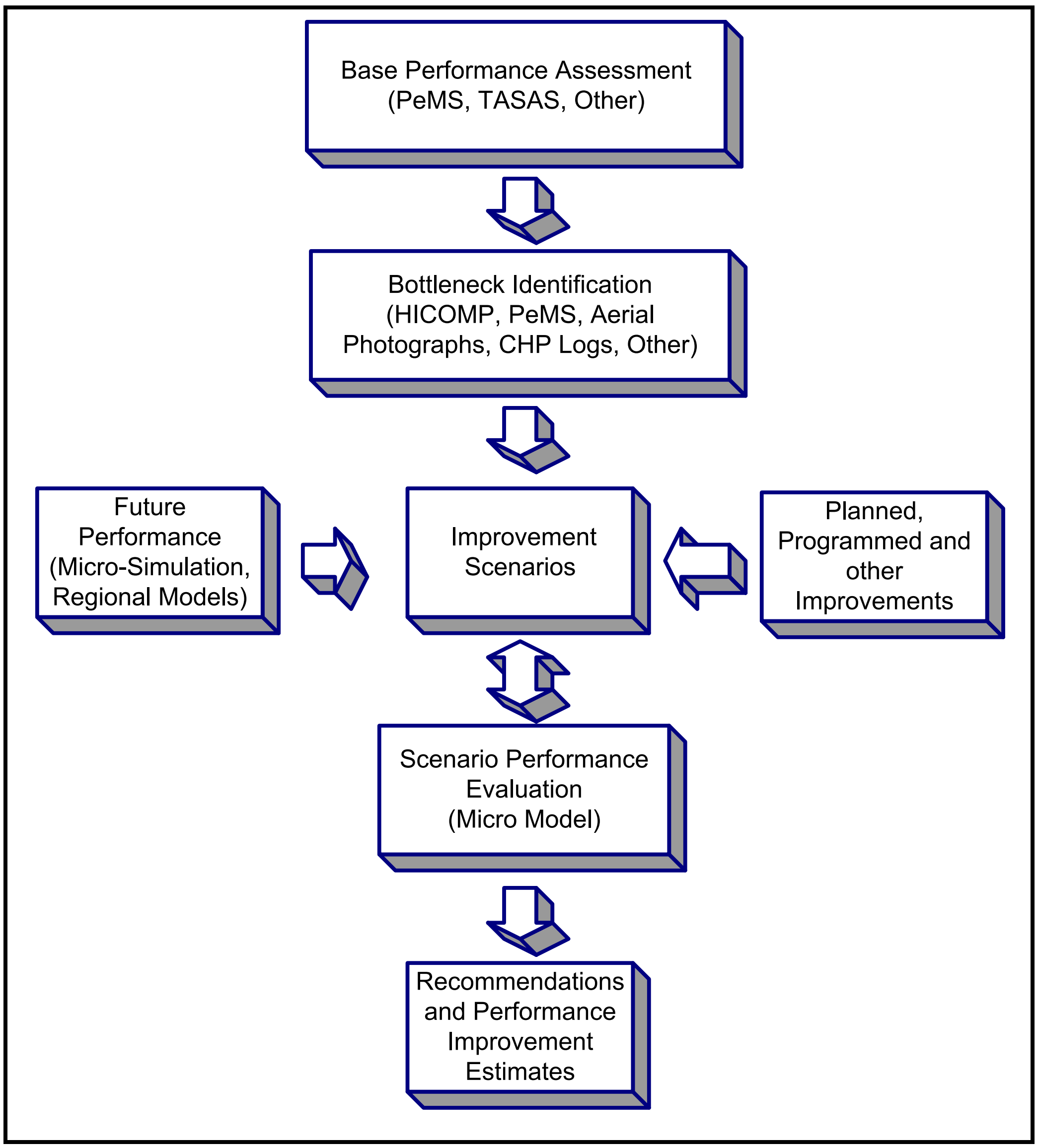
Losing 100 lane-miles in the afternoon peak periods effectively means that previous investments in the region were not fully productive when demand was at its highest. Clearly, the District and the State aim to leverage these past investments to the extent possible, which can be done to some extent by implementing targeted operational strategies.

Infrastructure expansion, although still an important strategy, cannot be the only strategy for addressing the mobility needs of Californians. System Management is needed to get the most out of the current system and must be an important consideration as we evaluate the need for facility expansion investments. Simply stated, the System Management philosophy begins by defining how the system is performing, understanding why it is performing that way, and then evaluating different strategies, including operations centric strategies, to address deficiencies. These strategies can then be evaluated using different tools to allow for estimation of the benefits and an evaluation of whether the benefits are worthy of the associated costs.

Study Approach

The study approach and its steps are shown in Exhibit I-6 and include the important data sources or tools used for each task (data needs and sources are discussed in the appendix section). Note that the base performance assessment relied on the Performance Measurement System (PeMS) developed by Caltrans and the Traffic Accident and Surveillance Analysis System (TASAS), also developed and maintained by Caltrans. These systems are invaluable for mobility, reliability, productivity, and safety analyses. Also note that throughout the study, stakeholders from all jurisdictions were involved to ensure acceptance of the final recommendations.

Exhibit I-6: Study Approach



Document Organization

This document focuses on the scenario development and evaluation process. However, for reference purposes, previous documents and sections thereof are included as an appendix section. The remainder of this final report is organized as follows (Section I is this Introduction):

- Section II – discusses the scenario development framework (i.e., how the scenarios where developed and why)
- Section III – presents the model results of the scenario performance evaluation process
- Section IV – presents the “post model” evaluation results, which include benefit cost analysis results as well as Green House Gas (GHG) emission reduction estimates
- Section V – outlines the conclusions of this study and how these conclusions may impact ongoing or future corridor management planning efforts.
- Appendix A
  - Section A1 – Presents the corridor description section
  - Section A2 – Presents the comprehensive performance assessment, including corridor-wide performance measures updated through 2007 and the bottleneck identification and causality findings
  - Section A3 – Presents exhibits with drawings of the different scenarios tested

Also note that there are two additional technical appendices under a separate cover. The first is the technical model calibration report and the second is the technical scenario analysis report. Both focus on the modeling aspects of the corridor. Electronic copies of all models (base year, horizon year, and scenarios) have been submitted to Caltrans and can be made available.

II. SCENARIO DEVELOPMENT FRAMEWORK

This section describes the logic behind developing the scenarios that were evaluated using the microsimulation model. Ideally, one would wish to evaluate each project on its own and in combination with others. Realistically, that is not possible due to resource and schedule constraints.

For instance, consider a case where 10 projects are candidates for evaluation. To evaluate each possible combination, one would need to run the microsimulation model over 1,000 times. Given the time it takes to run the model and check the results, this is not currently feasible. As computer power and the ability to streamline such testing improve, this may become possible. But for now and for the near future, this comprehensive evaluation approach is not pragmatic.

Therefore, projects have to be combined to the extent possible. This is why the study focused on developing scenarios that make logical sense. It is also important to note a couple of important factors upfront:

- Scenario testing in this study is different from traditional “alternatives evaluation” generally undertaken for Major Investment Studies (MIS) or Environmental Impact Reports (EIRs). The latter types of studies focused on identifying alternative solutions to addressing current and/or projected corridor problems. So each alternative is evaluated separately and results are compared. At the end, a locally preferred alternative is defined. For this study, scenarios build on each other (as detailed later). So a given scenario generally equates to a previous one plus one or more projects. This difference is important since corridor management studies are new and are often confused with alternative studies.

- For horizon year 2020, we started with a “do minimum” model which does not include any improvements scheduled to be delivered before 2020. This way, we could evaluate the expected benefits from fully programmed improvements as part of this study. This is somewhat different from other studies that start off with a “baseline” horizon year that includes all projects programmed and to be completed before the horizon year. These types of studies look for projects over and beyond the programmed ones. However, we wanted to evaluate programmed improvements first so we can estimate their benefits and then later on compare real benefits versus estimates ones.

Scenario Development Process

Developing the first set of scenarios involved several steps. First, a list of programmed and planned projects was compiled for the corridor. This was an iterative process partly due to the delays encountered in this study.

Using this list of programmed and planned projects, we identified all projects that were fully programmed and scheduled to be delivered in the short term (i.e., by 2012 or sooner). The reason we distinguished between projects to be delivered by 2012 and projects to be delivered afterwards is that the first group were candidates to be tested by both the 2006 Base Year Model and the 2020 Do Minimum Model. This would allow us to estimate the benefits expected from these projects in the near term as well as the longer term.

From that list, we then combined those projects related to our performance analysis, specifically to bottlenecks identified and discussed in the appendix section. Other projects, such as sound walls, were discarded since microsimulation models cannot evaluate them. The list of projects and selected ones for testing are shown in Exhibit II-1 below. Note only three projects met the two criteria (to be delivered by 2012 and related to mobility on the corridor). These three projects represented Scenario (1A).

Scenario 1A (2006) =	**Base Year 2006 + Mobility Related and Fully Funded Programmed Projects to be delivered by 2012**
Scenario 3AA (2020) =	**No Project Horizon Year - 2020 (also referred to by the modeling firm as the Do Minimum Horizon Year 2020)**
Scenario 4A (2020) =	**Scenario 3AA + Mobility Related and Fully Funded Programmed Projects to be delivered by 2012**

Exhibit II-1: Fully Funded Near Term Corridor Projects

	Work Description	Capital Cost (x1000)	2006	2007	2008	2009	2010	2011	2012
⇨	ALA 238 Widening	$ 85,772.00							
	880 Seismic Retrofit - 5th Avenue	$ 107,840.00							
⇨	92/880 Interchange Reconstruction	$ 110,994.00							
	ALA 880 Oakland High Street Retrofit	$ 84,994.00							
	ALA 580 Seismic Retrofit Phase II Bent	$ 1,110.00							
	ALA 580 MacArthur On-Ramp Partial Widening	$ 9,742.00							
	ALA 880 Interchange Improvement	$ 2,583.00							
	ALA 880 Structure Rehabilitation	$ 8,946.00							
⇨	ALA 880 Route 262/I-880 I/C Construction	$ 70,818.00							
	SCL 880/87 at Coleman Avanue	$ 59,700.00							
	ALA 580 Pavement Structure Rehabilitation	$ 35,742.00							
	ALA/SCA 880 Bridge Widening	$ 33,893.00							
	ALA 880 Improve Median for Relinquishment	$ 12,281.00							
	BART to Airport Connector	$ 50,000.00							
	SC 880 AC Overlay RT 280	$ 4,000.00							
	ALA 92 Rehabilitation of the Existing Roadway	$ 3,000.00							
	ALA 238 Roadway Rehabilitation	$ 19,522.00							

Note that all three projects relate to more than the I-880 Corridor. For instance the Alameda I-238 widening improves the I-880/I-238 Interchange, but also improves I-238 and I-580. So when evaluating these projects, especially in terms of benefit cost analysis, the benefits derived from microsimulation will understate total benefits since they represent the I-880 Corridor only.

Once scenario 1A was evaluated, the team looked for additional, inexpensive projects that could be implemented before 2012. The only realistic one was an improvement in ramp metering. Generally speaking, changes in ramp metering can be implemented reasonably quickly and inexpensively (at least compared to other physical improvements).

First, we tried to make manual adjustments to the ramp metering rates at specified bottleneck locations. However, the results from the microsimulation analysis showed increased congestion. Therefore, we discarded this scenario and looked for more advanced ramp metering as a substitute.

Scenario 2 (2006)	**=**	**Scenario 1A plus Selected Ramp Meter Rate Adjustments - discarded**

Next, we would have liked to test the Systemwide Adaptive Ramp Metering (SWARM) algorithm developed by Delcan Corporation and deployed on a test basis in Southern California. However, an application that emulates the current SWARM algorithm for the microsimulation model does not exist and the details of the algorithm were not readily available for the team. Therefore, another algorithm called ALINEA was used. ALINEA, is a more advanced adaptive ramp metering algorithm that has been deployed on many freeways internationally. We therefore used the available ALINEA API as a proxy for more advanced algorithms. ALINEA however, is locally adaptive and therefore its benefits probably understate the potential of a well calibrated corridor-wide ramp metering algorithm. This scenario therefore represented scenario 1A plus ALINEA and was tested for both the base year and the horizon year.

Scenario 3A (2006) =	**Scenario 1A plus ALINEA**
Scenario 5A (2020) =	**Scenario 4A plus ALINEA**

The next scenario attempted to evaluate improvements in traveler information by 2020 with en-route and pre-route applications that provide the traveler with real time traffic information. This proved to be very difficult. Microsimulation models sometimes have a variable called “familiarity” that attempts to represent how familiar drivers are with alternative routing. The higher the percent familiarity, the more knowledgeable the drivers are assumed to be in terms of alternative routing. By increasing the percent familiarity we could hypothetically simulate improved information provided to the traveler. However, as will be discussed in the next section, the study model was limited to the I-880 Corridor, major interchanges and a limited set of arterials.

As a result, this scenario led to degradation of performance as drivers tried to bypass one bottleneck only to create another one downstream. Therefore, although the results are shown in the next section, we believe them to be incorrect. Were the model significantly more extensive to allow for more re-routing, we believe the results would have been superior.

Scenario 6A (2020) = Scenario 5A + Traveler Information - discarded

Finally, three additional scenarios were tested. These built on priorities defined by the Alameda County Central Freeway Study (ACCFS), which all showed incremental improvement in performance. The three scenarios were defined as follows:

- **Scenario 7A** added to Scenario 5A the recently approved Trade Corridor Improvement Fund (TCIF) project. This project will remove and reconstruct the 29th Avenue overcrossing and the two 23rd Avenue overcrossings of I-880, which is the major truck route in the Bay Area. Reconstruction of the overcrossings will provide room to widen the existing I-880 mainline lanes to the Caltrans standard width of 12 feet. In addition, the proposed project will widen the mainline outside shoulders and lengthen existing auxiliary lanes.

  Note that our original bottleneck analysis did not identify the 29th Avenue overcrossing as a major mobility issue. The close proximity of the on-ramps is the main reason for this bottleneck. Nevertheless, we tested the entire project. Exhibits A3-1 and A3-2 in the appendix section illustrate the changes coded into the model for this scenario at 23rd and 29th Avenue respectively.

- **Scenario 8A** added to Scenario 7A a number of high priority projects identified by the ACCFS. These included a number of interchange improvements and auxiliary lanes as defined by Technical Memorandum: Task 8.2 by the ACCFS. Exhibits A3-3 through A3-7 in the appendix section illustrate the changes coded into the model for this scenario, including:

  - **I-880 Auxiliary Lanes, Paseo Grande to Winton Avenue** - This project would add auxiliary lanes in both the northbound and southbound directions between Winton Avenue and West A Street by widening the freeway and reconfiguring the lane layout. A northbound auxiliary lane would be added between West A Street and Paseo Grande to effectively extend the auxiliary lane to the south limit of the northbound auxiliary lane portion of the SR-238 Widening Project.

  - **I-880 Auxiliary Lanes, Whipple Road to Industrial Parkway West** - This project would add auxiliary lanes by widening the freeway and reconfiguring the lane layout to provide the minimum lane widths identified by Caltrans. This assumes the existing I-880 bridge over Alameda Creek would be widened to accommodate the new cross-section.

- **I-880/Whipple Road Interchange** - This project would expand the on ramp from Whipple Road to I-880 northbound to provide two lanes, including one HOV bypass lane. Construction of this project requires expanding the existing bridge over the Union Pacific Railroad and some right-of-way acquisition.

- **I-880/West A Street Interchange** - This project was defined in concept by the City of Hayward and would involve widening A Street between the foot-of-ramp intersections. This required reconstructing the I-880 overcrossing. This project would involve intersection and signalization modifications.

- **I-880/West Winton Avenue Interchange** - This project was defined in concept by City of Hayward and would involve reconstructing ramps to create a partial cloverleaf with signalized foot-of-ramp intersections. It would also include reconfiguration of the eastbound West Winton to southbound I-880 on-ramp and a new connection to Southland Mall Drive opposite the I-880 southbound off-ramp intersection with West Winton Avenue.

- **Scenario 9A** added to scenario 8A added an HOV extension from Hegenberger Street to Marina Boulevard. In addition to the HOV lane on the southbound mainline, a dedicated HOV on-ramp lane has been added at the 98th Avenue Interchange. . Exhibits A3-8 through A3-15 in the appendix section illustrate the changes coded into the model for this scenario.

Scenario 7A (2020)	**=**	**Scenario 5A + Trade Corridor Improvement Fund (TCIF)**
Scenario 8A (2020)	**=**	**Scenario 7A + Aux Lanes and Interchange Improvements defined in the ACCFS**
Scenario 9A (2020)	**=**	**Scenario 8A + HOV Extension and related Interchange Improvements**

It is certainly important to note that this study benefited from the ACCFS in several ways. First and foremost, it provided our modelers with specific details of all of the operational improvements tested (e.g., interchange modifications, auxiliary lanes). In other corridor studies, these details would not have been available and would have been left to the study team to draw conceptually.

Second, and as importantly, the conclusions of the ACCFS reflected local input and priorities. So even though some of the improvements would not have been critical from a bottleneck relief perspective, we believe the local consensus make these projects easier to implement. Without such input, we may have excluded one or two projects or changed the parameters of others from a pure technical perspective. But in the end, as can be seen in the next section, all of the ACCFS projects do indeed improve corridor performance (as shown in the next section) and the sometimes tough work of selling projects to the local stakeholders has already been done.

III. SCENARIO RESULTS

This section first discusses how scenarios were evaluated and then presents the model output summaries for the different scenarios.

Scenario Analysis Approach

For every model run, output statistics were provided and divided by major segment, direction, and time of day (i.e., AM Peak, PM Peak). An example of an output is shown below under Exhibit III-1. The statistics included Delay (measured as the difference between free flow and actual travel speeds), Vehicle Miles Traveled (VMT), and Vehicle Hours Traveled (VHT). Note that the statistics are also broken down by hour as well as by mainline, on-ramp, off-ramp, and arterial).

Exhibit III-1: Example Model Output

		Northbound Section 1 SR-237 to SR84 Directional freeway distance 13.1 miles			
		Freeway	On Ramp	Off Ramp	Arterial*
Delay					
	06:00 - 07:00	101.37	2.72	6.18	8.91
	07:00 - 08:00	175.48	14.14	12.68	23.28
	08:00 - 09:00	154.89	7.23	11.25	23.92
	Total Peak Period	431.74	24.08	30.11	56.12
VHT					
	06:00 - 07:00	924.82	42.00	30.71	37.30
	07:00 - 08:00	1203.41	75.81	50.92	76.44
	08:00 - 09:00	1185.43	69.15	51.73	76.55
	Total Peak Period	3313.66	186.96	133.36	190.29
VMT					
	06:00 - 07:00	50021.03	1959.09	1222.51	1050.59
	07:00 - 08:00	62502.24	2973.91	1857.46	1947.78
	08:00 - 09:00	62634.67	2993.49	1947.92	1927.42
	Total Peak Period	175157.93	7926.49	5027.89	4925.78

When such results were provided for the aforementioned scenarios, they were first evaluated for reasonableness. In several cases, the models had to be adjusted and rerun to address concerns voiced by reviewers.

Second, the results were compared to the appropriate base model results as well as preceding scenario results. For example, Scenario 1A (programmed projects to be delivered before 2012) were compared against the 2006 Base Year model. Scenario 3A (Scenario 1A plus ALINEA) was compared against Scenario 1A.

The results were then aggregated to derive overall congestion reduction. Then, these aggregated results were used to derive other benefits using the Caltrans Cal-B/C model[1]. GHG emissions were also estimated. Finally, we computed the benefit cost ratios of each scenario.

Model Output Summaries

This subsection presents the evaluation results of the different scenarios. First, Exhibit III-2 presents the delay comparisons of the different 2006 model runs and includes the Base Year 2006, Scenario 1A (the three programmed projects to be delivered by 2012), and Scenario 3A (Scenario 1A plus the implementation of the ALINEA ramp metering algorithm). The delay numbers are the sum of mainline, ramps, and arterial delays.

Exhibit III-2: 2006 Base Year Model Delay Scenario Results

(Daily Vehicle Hours of Delay)

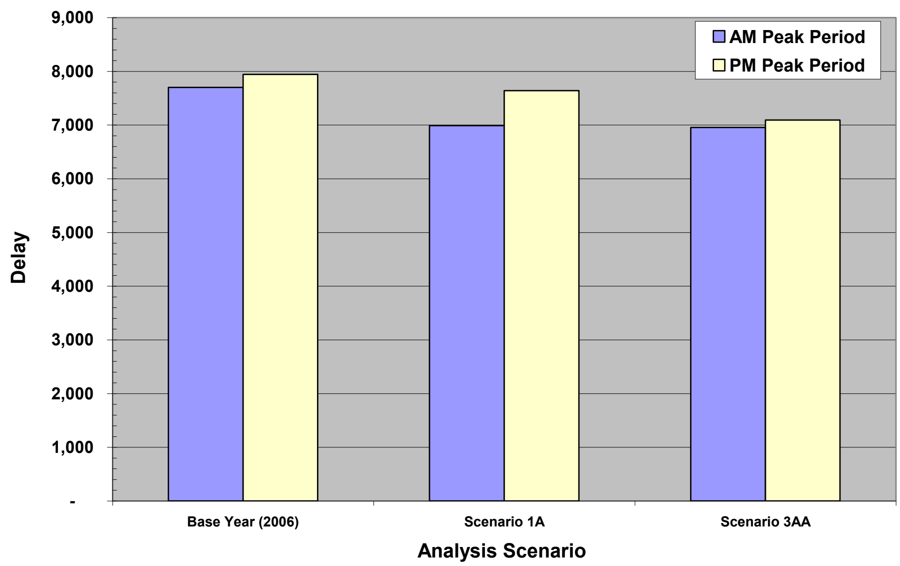


Exhibit III-3 shows the percent reductions in delay for the two peak periods and overall. Note that Scenario 1A reduces delay by more than nine (9) percent in the AM Peak period and by less than four (4) percent in the PM Peak period. However, Scenario 3AA (i.e., adding ALINEA) leads to almost equal delay reductions in both peak periods.

Exhibit III-4 presents the percent reductions in delay by direction. Note that Scenario 1A reduces delay more significantly in the southbound direction. Again, Scenario 3AA (i.e., adding ALINEA) leads to almost equal delay reductions in both directions.

[1] The Cal-B/C model is a PC-based spreadsheet model developed by the Office of Transportation Economics at Caltrans. It can be used to analyze many types of highway construction and operational improvement projects, as well as some Intelligent Transportation System (ITS) and transit projects. It can be accessed and downloaded via the web at: http://www.dot.ca.gov/hq/tpp/offices/ote/benefit.html

Exhibit III-3: Peak Periods Percent Delay Reductions Compared to 2006 Base Year

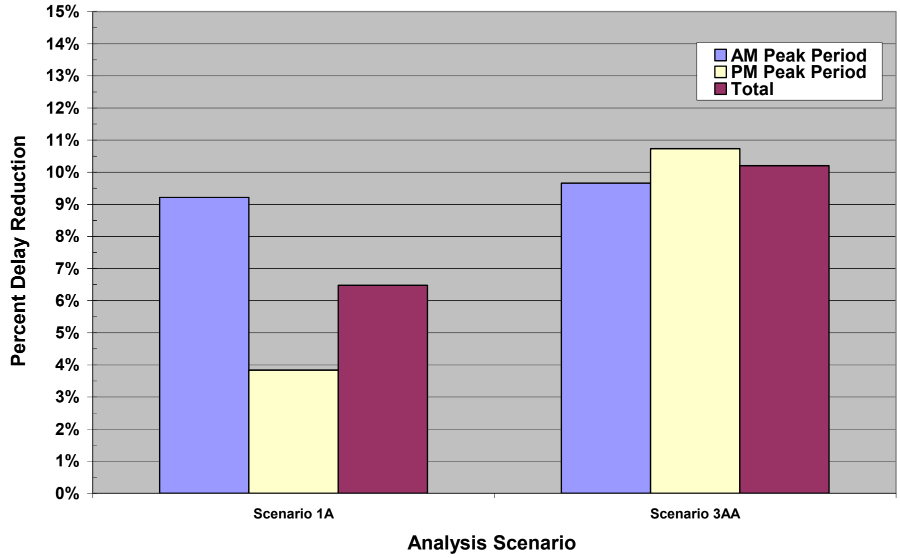
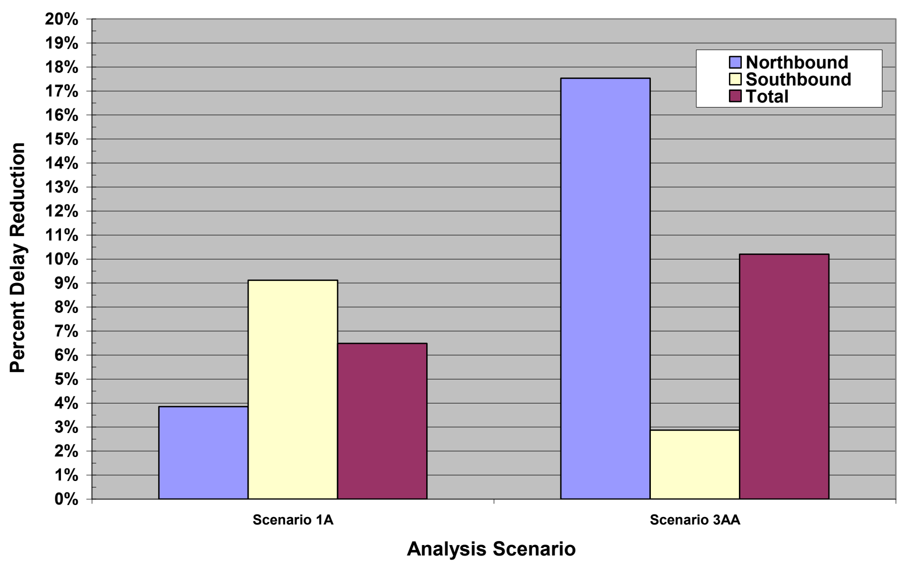


Exhibit III-4: Percent Delay Reductions by Direction Compared to 2006 Base Year



The following summarizes the results of the simulation using the Base Year Model:

1. The three programmed projects to be delivered in the short term representing Scenario 1A reduce overall delay on the corridor by almost seven (7) percent, which is significant for a congested urban corridor like I-880.
2. Adding advanced ramp metering such as ALINEA in the short term reduces delay further. At a minimum, the combination of the three programmed projects and ALINEA reduce delay by 10 percent.

In other words, this advanced ramp metering contributes more than three (3) percent of delay reductions over and beyond the three programmed projects. Note however that ALINEA significantly reduces northbound delays and actually increases southbound delays. Investigating this further, we found that the increase in delay southbound is primarily on the ramps and, to a lesser extent, arterials. Hypothetically, we could eliminate the ALINEA simulation in the southern direction and gain even more benefits. However, ALINEA, like other advanced metering systems (e.g., SWARM) requires multiple (perhaps) tens of simulations to optimize its settings. For instance, our first simulation using ALINEA led to increased delay overall on the corridor. We then changed parameters (e.g., the density threshold at which ALINEA gets activated) and the results improved. We could have gone back and forth several times to get the best results for each direction. However, due to resource constraints, this was not possible. We therefore believe that the results can be improved further with additional parameter optimization.

Moving on to the 2020 Horizon Year, Exhibit III-5 compares the 2006 Base Year with the 2020 Do Minimum Scenario (Scenario 3AA). Note that 2020 "Do Minimum" delays are projected to be double 2006 Base Year delays (southbound delays increase more). In total, corridor delay increases from about 15,500 hours to almost 31,000 hours during the two peak periods.

Exhibit III-5: Base Year 2006 and Do Minimum 2020 Horizon Year Corridor Delays

(Daily Vehicle Hours of Delay)

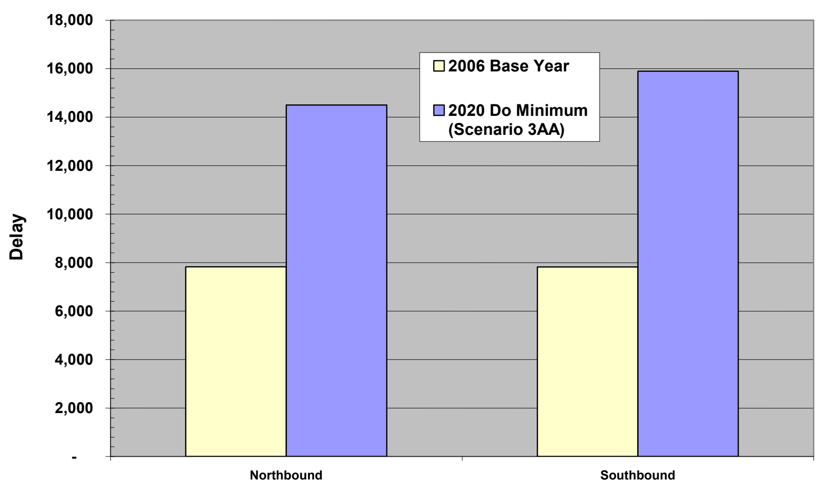


Exhibit III-6 presents the delay results for the scenarios tested on the 2020 horizon year model. The scenarios are compared against the "Do Minimum" Horizon Year. Scenario 4A includes the three programmed projects, Scenario 5A adds ALINEA to scenario 4A, Scenario 6A adds traveler information to scenario 5A (which is then dropped), Scenario 7A adds the TCIF project to Scenario 5A, Scenario 8A adds the multiple interchange improvements and auxiliary lanes to Scenario 7A, and finally, Scenario 9A adds the HOV extension to Scenario 8A. Exhibit III-7 presents the percent delay reductions for each of the scenarios when compared against the Do Minimum Scenario 3AA results.

Exhibit III-6: 2020 Horizon Model Scenario Results

(Daily Vehicle Hours of Delay)

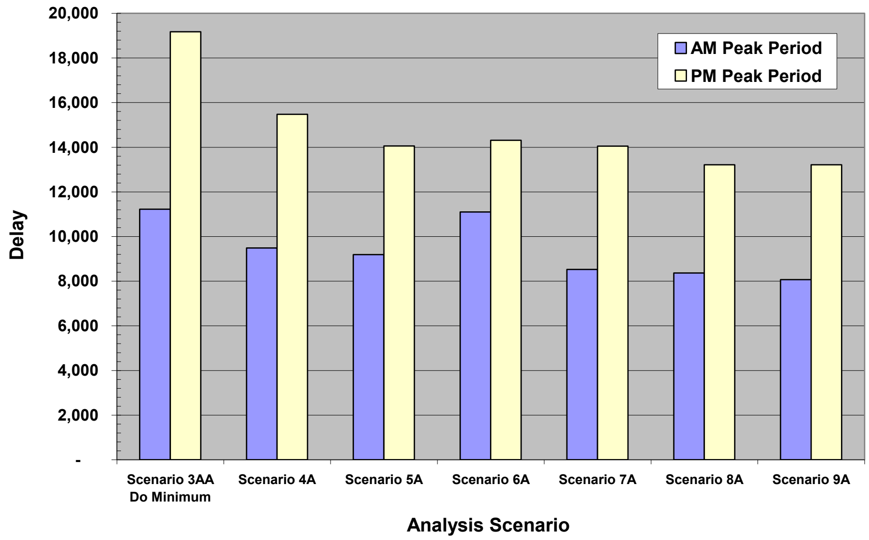
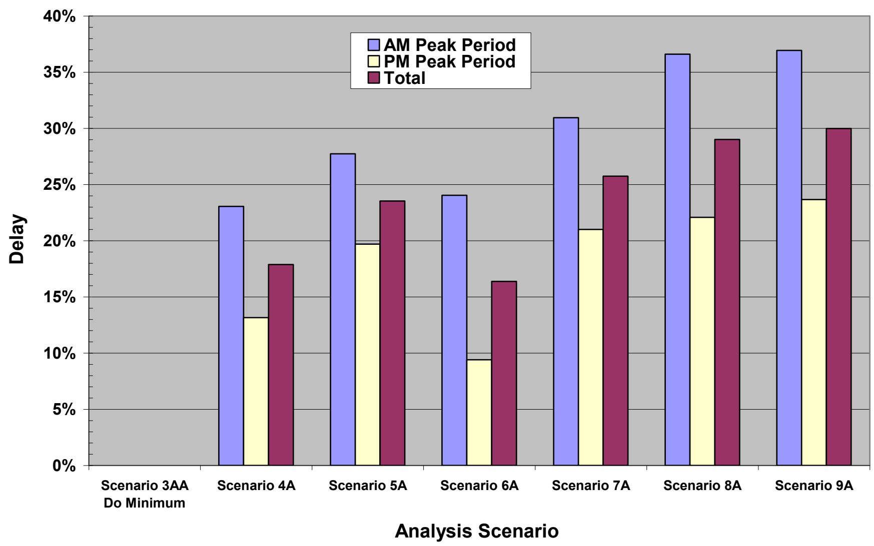


Exhibit III-7: Percent Delay Reductions Compared to 2020 Do Minimum Scenario

(Daily Vehicle Hours of Delay)



The following summarizes the results of the 2020 Horizon Year model results:

1. The three programmed projects (Scenario 4A) to be delivered by 2012 reduce delay in 2020 by 18 percent, much more than the 7 percent projected using the 2006 Base Year model. This means that the effectiveness of these projects increases as demand increases in the future.
2. Adding ALINEA to these three projects (Scenario 5A) reduces overall corridor delay by 24 percent. In other words, advanced ramp metering adds another 6 percent in delay reductions. Moreover, the delay reductions are projected in both

directions (as opposed to the 2006 Base Year). Again, increasing demand improves the effectiveness of advanced ramp metering.

3. The attempt at simulating traveler information by increasing driver familiarity (i.e., Scenario 6A) actually increases delay compared to Scenario 5A. Delay reductions are estimated to be 16 percent. Investigating this further, we found that many drivers diverted to bypass the I-238 freeway metering and other bottlenecks, and created new bottlenecks in both directions. We do not believe this result represents what would really happen. The reason is that the simulation network includes only limited arterials and therefore only permits limited diversion. As this diversion gets exaggerated due to these limits, corridor delay at arterials increases significantly. The driver familiarity increase was therefore dropped from subsequent scenarios.
4. Adding the TCIF project to the combination of the three programmed projects and ALINEA (Scenario 7A) reduces total corridor delay by 26 percent with the majority of the delay reductions in the northbound direction. This represents an additional two (2) percent reduction compared to Scenario 5A.
5. Scenario 8A, which added a number of interchange improvements and auxiliary lanes to Scenario 5A reduced delay by 29 percent, a further three (3) percent reduction from Scenario 7A. We suspect that many of the interchange improvements would improve delay on arterials not included in the model and were therefore not captured.
6. Finally, Scenario 9A, which adds the HOV extension to Scenario 8A only reduces delay by another one (1) percent. We believe this result to understate actual HOV benefits. However, microsimulation models do not have a mode shift component to estimate the additional carpooling that would take place as a result of the HOV extension. In other words, it assumed a constant number of carpools with and without the extension.

These results show that most of the congestion relief in the modeled network would be captured by the three short term programmed projects (Scenario 1A) and advanced ramp metering. The other projects do reduce delay further, and in many cases, the model probably understates these impacts. Hence, these projections should be considered to be conservative.

In summary, near term total delays are projected to be reduced by 10 percent (from 15,500 to around 14,000 daily peak period hours of delay), a significant achievement for a highly congested urban corridor. These near term results reflect current vehicular demand (based on the 2006 model). As demand increases over time, longer term (based on the 2020 model) delays are projected to be reduced by 30 percent (from 31,000 to 21,000 daily peak period hours of delay).

IV. POST MODEL ANALYSIS

The detailed results from the model as shown previously in Exhibit II-16 were further analyzed using the Caltrans Benefit Cost Model (Cal-B/C), which has recently been enhanced to allow for link by link analysis and to estimate green GHG emission reductions[2].

Note that the benefit cost computations take all the costs into account even though the benefits of several projects extend beyond the modeled I-880 corridor. Examples include, but are not limited to:

- Alameda I-238 Widening – The project cost was provided at almost $86 million. This project should improve mobility and reduce delay on I-580, I-238, and I-880. However, the microsimulation model does not include I-580 and only the I-238 Interchange. As such, benefit cost results would be significantly understated.
- The SR-92/I-880 and the SR-262/I-880 Interchange improvements do not show benefits or reductions on congestion for either SR-92 or SR-262. Again, the benefit cost ratios would be understated.
- The TCIF project (for 23th and 29th overcrossings and arterial improvements) will help congestion on I-880 and arterials. However, the model likely understates the arterial benefits. Nevertheless, the model estimates that the mobility benefits on the freeway will be relatively modest compared with other scenarios. This does not mean that it is not a good project as it is designed to provide additional benefits over and beyond the mobility benefits captured by modeling, such as safety improvements.
- The interchange improvements in Scenario 8A presumably improve mobility on several local arterials not included in the model. Again, the results of the benefit cost may be understated.
- The HOV lane extension modeling does not forecast additional mode shifts to carpooling which means that the reductions in delay are also likely understated.

The above caveats may lead the reader to believe that the model should have been extended to include other facilities (e.g., I-238, SR-92, SR-262, arterials). However, extending the model beyond its current limits would have been too complex for a microsimulation model and would have probably added hundreds of thousands of dollars to the cost. The best we can do is to understand the results and the limitations. Hypothetically, we could have only included a portion of the costs for each project or set of projects and made some assumptions as the percentage of the project that is applicable to the modeled corridor. However, after consulting with District project management, it was decided to keep the full costs and explain the associated limitations.

[2] Only Carbon Dioxide (CO_2) Green House Gas Emission reductions are estimated by Cal-B/C

Scenario Costs

Scenario component costs are presented in Exhibit IV-1 and were compiled from Caltrans and the ACCFS. The study team estimated the ALINEA implementation to cost $25 million which we believe to be more than adequate.

Exhibit IV-1: Scenario Component Costs as Provided (in mil. $)

	Project Costs
Short Term Programmed Projects	$ 267.60
ALINEA	$ 25.00
TCIF Projects	$ 85.00
Interchange and Auxiliary Lane Projects	$ 92.50
HOV Extension	$ 155.50

Exhibit IV-2 shows these initial component costs were then added for each scenario in constant $2007 dollars. Note that the short term projects $2007 costs are less than the ones originally provided since 2007 was one of the rare years when the construction costs index actually declined.

Exhibit IV-2: Scenario Costs Summary (in 2007 mil. $)

Benefit Category	Short Term Programmed Projects	+ ALINEA	+ TCIF Projects	+ Interchange and Auxiliary Lane Projects	+ HOV Extension
Life-Cycle Costs	$249.00	$274.00	$359.00	$451.50	$607.00

These costs were then used in the Cal-B/C model together with the microsimulation model results to derive monetized benefits which are discussed next.

Scenario Benefits

Benefits for the different scenarios can be divided into three categories:

- Travel Time Reductions
- Vehicle Operating Cost Savings
- Emissions

For more information on how the Cal-B/C computes these different benefits, please refer to the Caltrans web site at http://www.dot.ca.gov/hq/tpp/offices/ote/benefit.html.

Note that in this case, actual model speeds were used instead of having Cal-B/C estimate them. Also note that for scenarios that were tested on both the 2006 Base Year Model and the 2020 horizon year model, both model results were used to estimate life cycle cost benefits. Therefore, Scenario 1A and 4A were combined to estimate benefits for the three short term programmed projects. The same applies to Scenarios 3A and 5A, both of which added ALINEA to these three programmed projects.

Exhibit IV-3 presents the benefits for each scenario by category and in total in 2007. Note that the negative vehicle operating costs for the short term programmed project represents another microsimulation nuance where total VMT increases because the model can process more vehicles.

More VMT means more fuel utilization, for instance, which increases operating costs. However, this negative should be ignored to some extent since increased VMT means that shoulder hours would have reduced VMT (absent induced demand). By far the biggest benefit category is time savings (i.e., congestion reduction).

Exhibit IV-3: Monetized Delay Reductions Compared to 2020 Do Minimum Scenario

Benefit Category	Short Term Programmed Projects	+ ALINEA	+ TCIF Projects	+ Interchange and Auxiliary Lane Projects	+ HOV Extension
Travel Time Savings	$315	$440	$477	$535	$550
Veh. Op. Cost Savings	($20)	$14	$6	$17	$17
Emission Cost Savings	$5	$9	$8	$11	$12
TOTAL BENEFITS	$299	$464	$491	$563	$579

Benefits are in $2007 millions

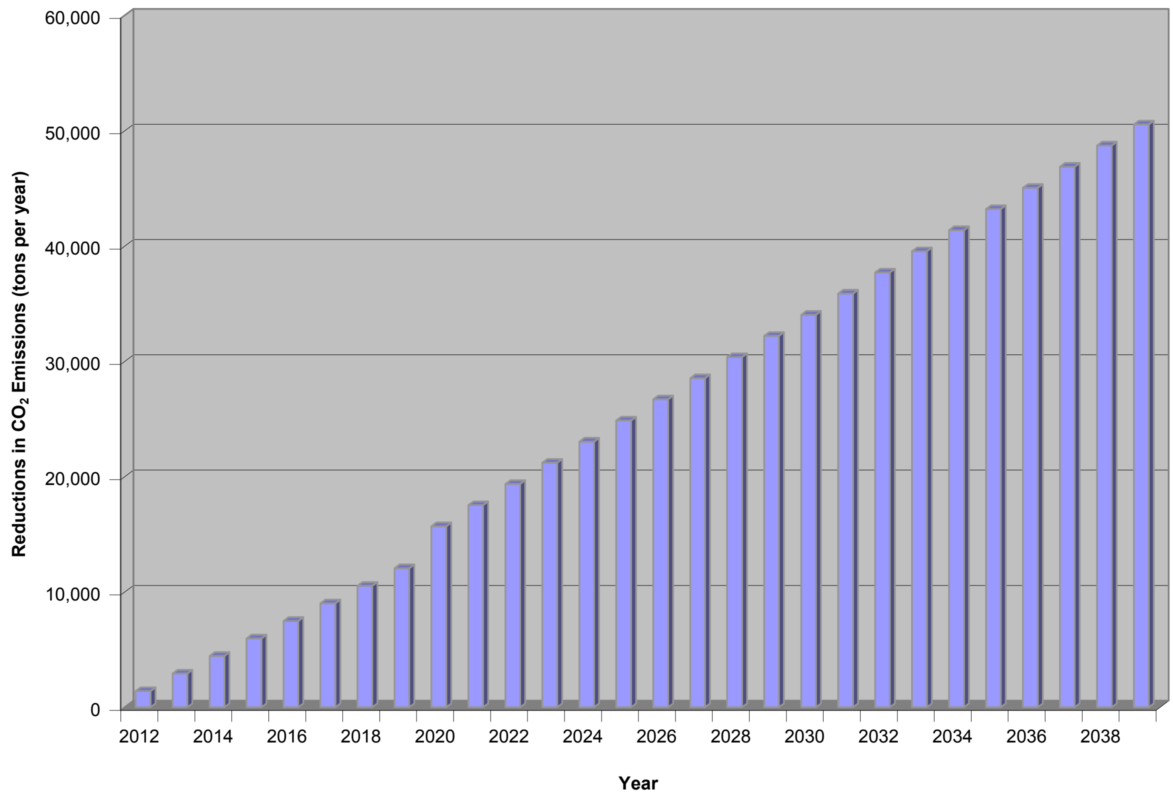
Given the increased focus on global warming, we have extracted GHG emission reduction results for the different scenarios. Exhibit IV-4 shows the additional benefits related to GHG emissions in aggregate. The results represent the additions of 20 years of reductions only.

Alternatively, Exhibit IV-5 shows annual reductions in GHG emissions starting in 2012 and going up to 2040 for Scenario 9A. Note that the reductions in GHG emissions start at 2012 for all near term projects, but extends these benefits through 2040. Reductions from longer term scenarios start at 2020. The graph goes through 2040 to maintain the overall trends. This is based on the results that show that the benefits of the projects increases as congestion levels increase (i.e., benefits for projects using the 2020 model are higher than the benefits for the same projects using the 2006 model).

Exhibit IV-4: Aggregated GHG Emission Benefits by Scenario

	Short Term Programmed Projects	+ ALINEA	+ TCIF Projects	+ Interchange and Auxiliary Lane Projects	+ HOV Extension
Additional CO_2 Emissions (tons)	186,911	317,112	293,577	398,916	419,163
Additional CO_2 Benefits (mil. $)	$4.8	$8.4	$7.8	$10.3	$10.7

Exhibit IV-5: Aggregated GHG Emission Reductions by Scenario



Scenario Benefit Cost Ratios

The final step was to combine the benefits and the costs and compute the benefit cost estimates for each scenario component, which are shown below. The useful life for all projects was assumed to be 20 years. Note that these ratios are fairly low except for the ALINEA component. This is partly due to the understatement of the benefits previously discussed and partly due to costs being relatively higher for some investments compared to projected benefits.

Exhibit IV-6: Benefit Cost Ratios for Scenario Components

	Short Term Programmed Projects	ALINEA	TCIF Projects	Interchange and Auxiliary Lane Projects	HOV Extension
BENEFIT COST RATIO (OVER 20 YEARS)	1.30	7.12	0.47	1.16	0.15

Note that the short term programmed projects would likely yield a cost benefit ratio of over three (3) if the benefits of SR-238 and I-580 were included. However, the TCIF projects would probably yield relatively low benefits regardless of model extent. The HOV extension benefit cost ratio would increase depending on the projected mode shift.

V. CONCLUSIONS

The projects evaluated in this study are summarized on Exhibit V-1, with evaluated projects limited to bottleneck-related problem areas. The three short-term programmed projects (i.e., Scenario 1A) should yield impressive benefits that will only grow in time.

In addition, the evaluation recommends that Caltrans and its partners focus on implementing more advanced ramp metering algorithms on the I-880 Corridor. If implemented correctly, this improvement will provide the highest benefits relative to its costs. The delay reductions projected for the ALINEA implementation are but a proxy of what can be attained with more advanced algorithms. As discussed earlier, with more testing and optimization, we believe these results can be improved.

The TCIF projects around 23rd and 29th provide geometric upgrades resulting primarily in safety benefits and slight mobility gains. These safety benefits cannot be quantified in a Paramics microsimulation model and as expected, the model results show only small improvements in mobility.

The large list of interchange improvements and auxiliary lanes that were combined and tested together provide for a reasonable return on investment along with delay reductions. Additional interchange by interchange modeling may be useful to delineate specific investment benefits. The HOV extension will provide a higher return on investment when significant shift to carpooling and transit takes place.

Finally, GHG emission reductions on this one network could add up to an average of 20,000 tons per year. This demonstrates that operational improvements can and should contribute to the attainment of GHG emission targets mandated by Assembly Bill 32 (AB 32) and Senate Bill 375 (SB 375).

Exhibit V-1: Summary of Planned and Recommended Projects Related to Corridor Bottlenecks

Project/Strategy	Scenario Package	Comments
Programmed/In Construction		
Alameda 238 Widening	1A	Project mostly complete. Addresses major interchange, requires implementation of freeway to freeway metering for full effectiveness.
92/880 Interchange Reconstruction	1A	In construction. Addresses major interchange, includes auxillary lane and freeway to freeway metering.
Alameda 880/262 Interchange Construction	1A	In construction. Addresses major bottleneck, includes HOV lane.
Short-Range Recommended (2012)		
Advanced Ramp Metering (e.g., ALINEA, SWARM)	5A	Not programmed. Very high benefits compared to cost. Could potentially exceed projected benefits with more calibration of metering variables.
Advanced Traveler Information	6A	Unable to analyze with microsimulation; generally favorably viewed by other research.
Long-Range Planned (2013-2020)		
TCIF Project (includes 23rd and 29th Overcrossings)	7A	Project provides upgrades to geometric standards with benefits primarily related to safety and some mobility benefits.
I-880 Auxiliary Lanes, Paseo Grande to Winton Avenue	8A	Increases merge limits, not tested separately.
I-880 Auxiliary Lanes, Whipple Road to Industrial Parkway West	8A	Increases merge limits, not tested separately.
I-880/West A Street Interchange	8A	Related to occasional bottleneck, not tested separately.
I-880/West Winton Avenue Interchange	8A	Related to occasional bottleneck, not tested separately.
I-880/Whipple Road Interchange	8A	Not directly related to existing bottleneck (Whipple used to be an occasional bottleneck in 2003 and 2004), not tested separately.
HOV extension from Hegenberger Street to Marina Boulevard	9A	Benefits will increase with expected increase in transit and ridesharing.

APPENDIX SECTION

A1. CORRIDOR DESCRIPTION

Within the Caltrans District 4 area and the Northern California Bay Area region, I-880 East Shore South corridor from the Grant Avenue to SR-237 was selected for this study based on a number of criteria:

- Serve significant inter-regional travel
- Multi-modal in nature
- Congestion is high and projected to grow
- High potential for benefits and B/C ratios
- Good detection infrastructure and data
- Serve the goods movement industry

Note that other corridors, especially the I-580 and the I-80 were originally preferred by the stakeholders. However, due to the lack of detection on these corridors and the need for the detection for a comprehensive performance assessment, I-880 was selected instead.

Freeway

The I-880 corridor selected for this study begins from the SR-237 interchange in Fremont to the Oakland to Grant Avenue. SR-237 runs in an east-west direction with connectors to the northbound and southbound segments of I-880. The eastbound SR-237 to northbound I-880 connector has three travel lanes with two metered single occupancy vehicle (SOV) lanes and one high occupancy vehicle (HOV). The right-most lane drops approximately 560 feet north of the merge providing a total of five travel lanes for northbound traffic.

Southbound traffic at this interchange provides three through lanes and two exit lanes to eastbound SR-237. Outside shoulders are approximately 8-feet wide while inside shoulders range from approximately 18- to 25-feet wide. A concrete median divides the freeway. North of the California Circle interchange, both the northbound and southbound directions are reduced to three through travel lanes.

A peak period HOV lane begins at the SR-262 interchange with an auxiliary lane that extends from SR-262 to the Fremont Boulevard interchange. In this segment, the freeway has three through travel lanes, one peak-period HOV lane in each direction, and intermittent auxiliary lanes to facilitate merging and diverging traffic.

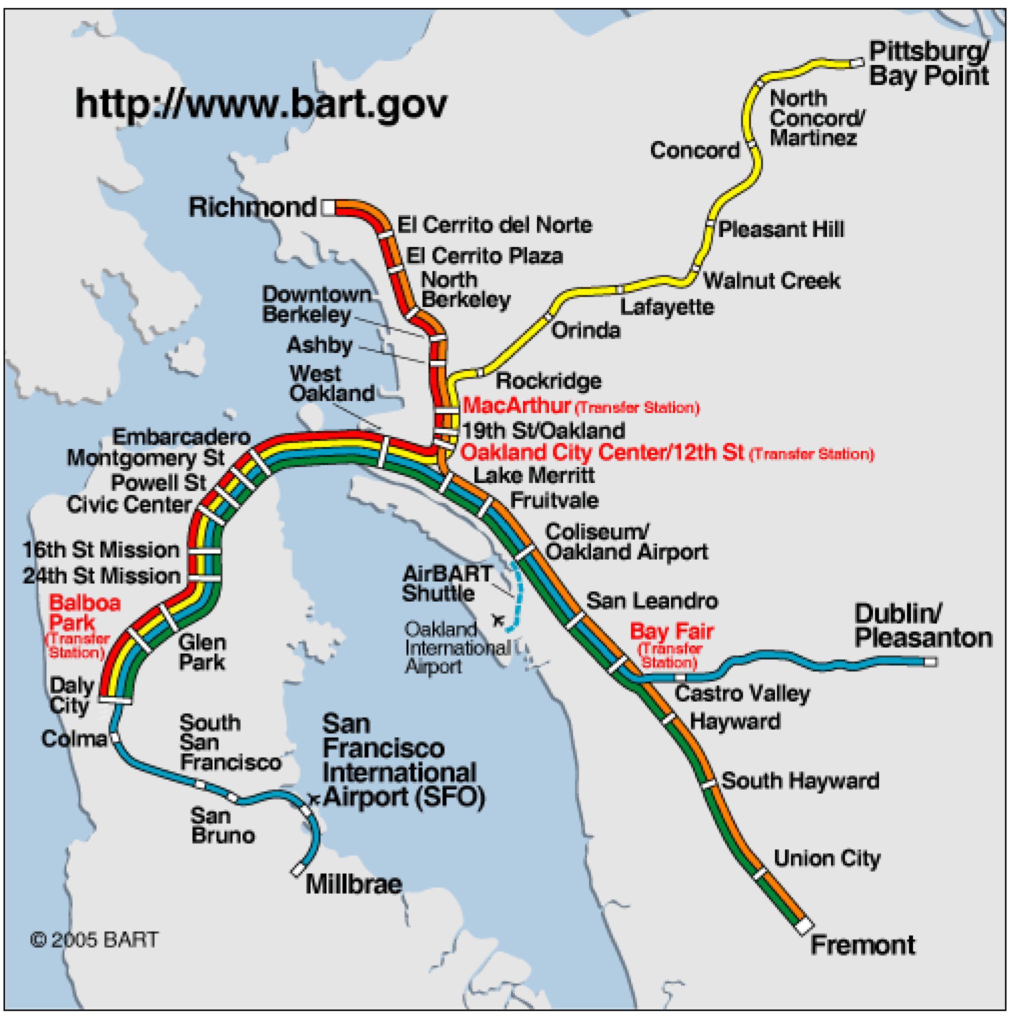
From the SR-92 to the I-238 interchange, both northbound and southbound lanes have four through travel lanes and one peak period HOV lane. From the I-238 interchange to the I-980 interchange, the number of total travel lanes varies from four to five in each direction. Major interchanges in this study corridor include the SR-237, SR-238, SR-84 (Dumbarton Bridge), and SR-92 (San Mateo-Hayward Bridge).

The I-880 corridor is a Surface Transportation Assistance Act (STAA) route and therefore large trucks are allowed to operate on it. The segment just south of the I-980 interchange to Alameda is a California Legal Advisory route. According to the 2004 Annual Average Daily Truck Traffic on the California State Highway System published by Caltrans in August 2005, this segment of the study corridor's 2004 daily truck traffic ranges from 4.4% to 10.7% of the total daily traffic.

Transit

Major transit operators within this regional corridor are the Bay Area Rapid Transit (BART) and the Alameda-Contra Costa Transit (AC Transit). Intercity rail service from Amtrak also offers service from Sacramento to the Bay Area region. The Fremont line, shown as part of the BART map on Exhibit A1-1 below, serves an almost parallel route to the I-880 corridor under study.

Exhibit A1-1: Bay Area Rapid Transit Map



BART service operates on Mondays through Fridays from 4 a.m. to midnight, on Saturdays from 6 a.m. to midnight, and on Sundays from 8 a.m. to midnight. In many cases, service extends beyond midnight depending upon the station coordination of the last running train. Based on the BART Station Profile Study conducted by San Francisco Bay Area Rapid Transit District in 1999, BART surveys show an average daily ridership of more than 300,000. Several million Bay Area residents take BART each year, often for occasional travel to events, shopping, or visiting friends and family.

On a typical weekday however, most of BART's customers are regular riders who use BART to commute to work. With regional population growth expected to grow to 7.8 million in 2020, a 22% increase from 1995, and the elderly population expected to also nearly double during this period, forecasts show that the BART ridership could potentially be affected by the growing population and changes in more flexible work schedules.

The BART Fremont service lines serve the I-880 corridor by providing connectivity to three end points:

- The Fremont to Richmond line provides connectivity between Fremont to Oakland, Berkeley, and Richmond.

- The Fremontline also allows transfers at the Oakland City Center/12 Street and MacArthur to provide a connection to the Pittsburg/Bay Point terminus

- The Fremont to Daly City line starts from Fremont with transfer stations at Bay Fair and Balboa Park where the connection provides access to San Francisco International Airport and Millbrae.

The BART Strategic Plan was adopted in 1999 and updated in 2003. The BART's system capacity goal is to create capacity for the BART core system to carry 500,000 average weekday riders by 2025. Subject to funding, the BART may be extended south of the Fremont terminal to Warm Springs, providing additional access to handle future increased ridership along the I-880 corridor.

The Alameda-Contra Costa Transit District (AC Transit) serves more than 100 local lines within the East Bay and more than 27 Transbay to San Francisco and the Peninsula. As the third largest all-bus system in California, AC Transit provides connection to 21 BART stations. AC Transit's strategic vision anticipates that ridership will be increased to approximately 100 million per year by 2010. A new Transbay Terminal in downtown San Francisco is expected to begin construction in 2008 and completed within five years. This rebuilt structure will be a modern and multimodal facility that would serve more than 100,000 passengers a day on Transbay buses, Muni, intercity buses and Caltrain and ultimately California High Speed Rail services.

AC Transit Line S West Hayward runs parallel to I-880 from Oliver Eden Shores Park to the San Francisco Transbay Terminal via I-880 with no stops. This line operates during the weekday directional commuting peak hours from 5:16 a.m. to 8:45 a.m. in the westbound direction and from 4:10 p.m. to 7:10 p.m. in the eastbound direction with frequencies ranging from 30 to 45 minutes. The Line SA Washington Manor runs south of I-880 starting from the San Lorenzo Village station to the San Francisco Transbay Terminal via I-880 with no stops. This line also operates during the weekday directly commuting peak hours from 5:20 a.m. to 8:45 a.m. in the westbound direction and from 4:00 p.m. to 7:45 p.m. with frequencies ranging from 20 to 45 minutes. The Line SB Newark runs south of I-880 from the Cedar Boulevard & Stevenson Boulevard intersection to the San Francisco Transbay Terminal also via I-880 with no stops. This line also operates during the weekday directional commuting peak hours from 5:17 a.m. to 8:40 a.m. in the westbound direction and from 4 p.m. to 9:15 p.m. in the eastbound direction with frequencies from 20 to 45 minutes.

The Line OX runs along the freeway from Park Street in Oakland to the San Francisco Transbay Terminal. This line operates during the weekday directional commuting peak hours from 5:30 a.m. to 9:00 a.m. in the westbound direction and from 4:10 p.m. to 8:39 p.m. in the eastbound direction with frequencies from 10 to 20 minutes. The Line O also runs along the freeway from the Posey and Webster Tube in Oakland to the San Francisco Transbay Terminal. Line O operates daily with frequencies from 10 to 45 minutes. In the westbound direction during the weekdays, it operates from 5:26 a.m. to 12:10 a.m. In the eastbound direction during the weekdays, it operates from 6:22 a.m. to 12:41 a.m. During the Saturdays, Sundays, and holidays, the westbound line operates from 6:01 a.m. to 11:29 a.m. and the eastbound line operates from 6:25 a.m. to 12:51 a.m.

The Line W runs along the freeway from the Oakland Posey and Webster Tube along the freeway to the San Francisco Transbay Terminal. This line operates during the weekday directional commuting peak hours from 5:46 a.m. to 9:00 a.m. in the westbound direction and from 4 p.m. to 8:49 p.m. in the eastbound direction with frequencies of 20 minutes.

The Amtrak Capitol Corridor (Auburn-Sacramento-Emeryville[San Francisco]-Oakland-San Jose) provides service between the Sacramento region and the Bay Area with many stops in between. It starts at Auburn, runs southwest to Emeryville and terminates south at the San Jose transfer station to Caltrain and motorcoach service lines south of San Jose. A station is available just south of the SR-237 and I- 880 interchange in Santa Clara and the line runs adjacent to I- 880 to north of Oakland and Sacramento.

Intermodal Facilities

The Port of Oakland is a major seaport facility that is growing and planning to capture a larger share of west coast maritime activities. The Port currently processes almost 1.7 Twenty-foot Equivalent Units (TEUs) annually. As such, the Port is a major origin and destination of significant truck trips. An aerial of the Port is shown in Exhibit A1-2.

Exhibit A1-2: Port of Oakland Aerial

Ten Container terminals and two intermodal rail facilities serve the Oakland waterfront. The Union Pacific and the Burlington Northern and Santa Fe Railway Company (BNSF) railroad facilities are located adjacent to the marine terminal area to provide a reliable and efficient movement of cargo between the marine terminals or transload facilities and the intermodal rail facilities.

Through its Vision 2000 Maritime Development Program, the BNSF and Port of Oakland reached an agreement in 2002 for BNSF to operate the Port's Joint Intermodal Terminal, known as Oakland International Gateway. BNSF will also be able to provide service to other third parties for this facility, which will also benefit the community by taking more than 20,000 truck moves a year off Interstate 80. Oakland International Gateway ties into BNSF's rail network by way of trackage rights and specific access conditions approved by the Surface Transportation Board (STB) to BNSF as part of the 1995 Union Pacific/Southern Pacific Merger Settlement Agreement.

I-880 also serves the Oakland Airport, which grew even after the 9/11. Exhibit A1-3 below presents the overall trend for passenger volumes over time. Note that in 2008, the airport passenger volumes exceeded dropped significantly back to 2001 levels. Exhibit A1-4 shows the overall trend for cargo volumes over time. Cargo volume also dropped in 2008, albeit by a smaller percentage than passenger volume.

Exhibit A1-3: Oakland Airport Passenger Volume Trends

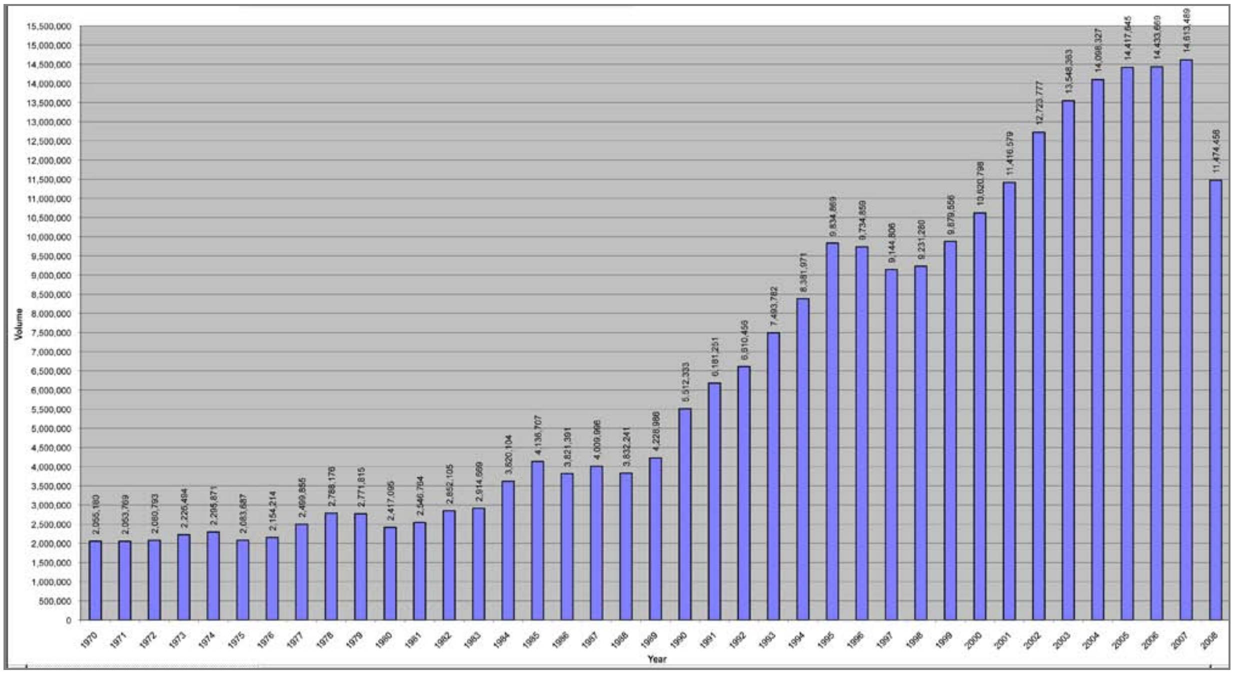
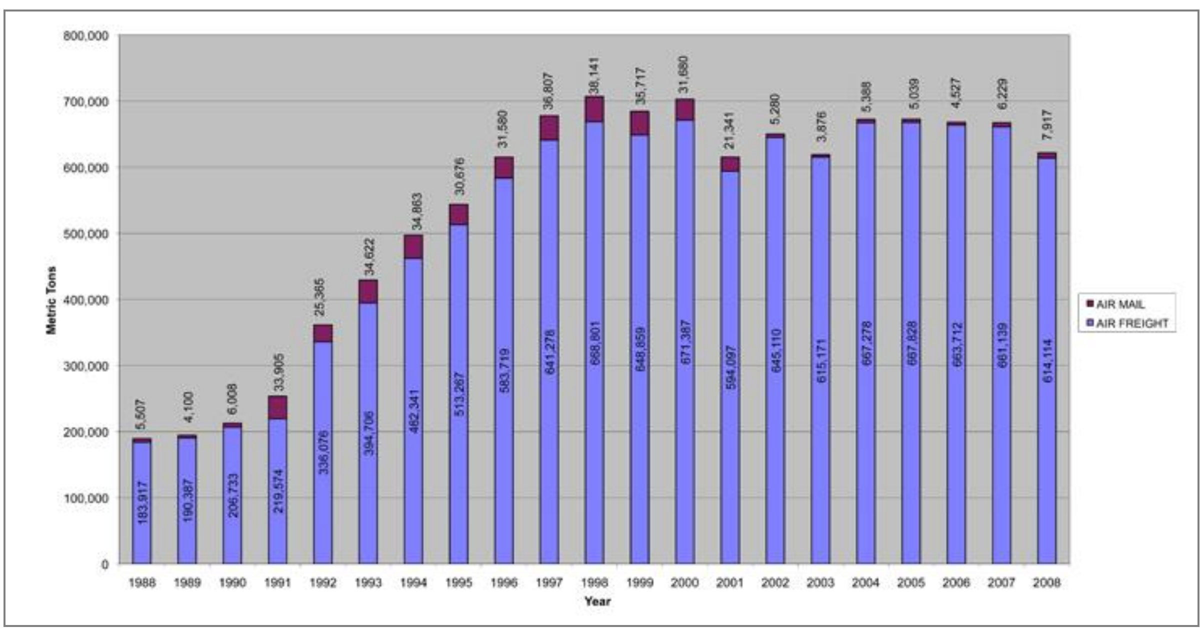


Exhibit A1-4: Oakland Airport Cargo Volume Trends



Special Event Facilities

I-880 corridor also serves the McAfee Coliseum, which is the home stadium for Major League's Baseball's Oakland Athletics and the National Football League's Oakland Raiders. Right next to it is the enclosed Sports Arena which is the home of the National Basketball Association's Golden State Warriors. Between these three professional franchises, there are more than 130 events that impact the mobility on I-880. Other events such as concerts also contribute to the transportation demand on I-880 corridor. An aerial of the McAfee Coliseum and the Sports Arena is shown on Exhibit A1-5 below.

Exhibit A1-5: McAfee Coliseum and Adjacent Sports Arena Aerial

Land Use

The Association of Bay Area Governments (ABAG) is a regional land use planning agency responsible for describing existing conditions, forecasting changes to the population and economy, and assisting local governments to identify policies that address a changing environment.

The traditional focus of ABAG's research and analysis has been its biennial long run forecast of the region known as Projections. The next forecast, Projections 2007, is

expected to be issued at the end of 2006. Projections 2007 will describe the changes in population, housing and employment within the region over the next 25 years.
ABAG also produces a short term forecast which identifies economic changes for the coming two years. This short term forecast is released each January at a special conference. The conference information includes a state-level forecast, regional retail sales forecast information and information on the regional housing situation.

The ABAG Projections 2005 forecasted population, housing, jobs, and income for the nine-county San Francisco Bay Region to year 2030. Comparing Projections 2005 to Projections 2002 extended to 2030, the newer forecast predicts 121,970 more housing units.

The additional housing would mean that almost 330,000 additional residents will live in the region by 2030. The additional housing is also expected to provide a home for approximately 180,000 more employed residents than forecasted by the Projections 2002 base-case forecast. The increase in employed residents is significant, when compared to the number of jobs in the region, because it gives a rough estimate of the net interregional commute.

Projections 2005 forecasts over 46,000 fewer jobs than Projections 2002. This is a result of the slow pace of job growth in the Bay Area during the early part of the forecast. With the forecasted increase in residents by 2030, the Construction and goods and services sector jobs are expected to increase while jobs in other economic sectors are expected to slow due to the slower economy of the last few years.

Projections 2005 also included forecasts based on implementation of Smart Growth policies. It assumes that state, local, or regional policy makers would change land use policies or other types of funding decisions in a way that would change regional development. This in effect results in a higher number of housing units produced than under previous forecasting assumptions. Although ABAG did not adopt the numerical values of the Smart Growth Vision, the Projections 2005 analysis included information from the Smart Growth Vision.

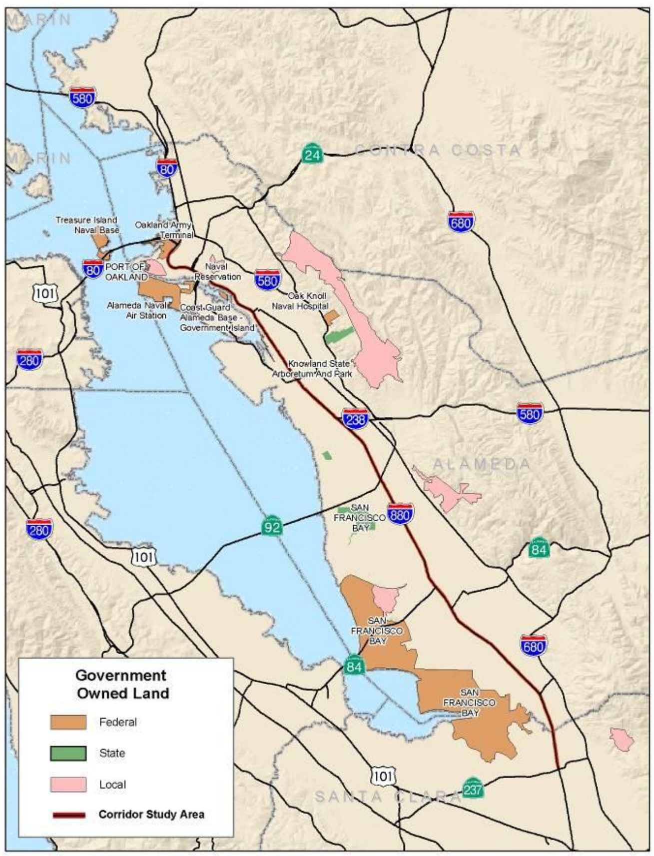
Government Lands

As shown in Exhibit A1-6, I-880 corridor includes an array of government-owned lands. Within three miles of the corridor nearly 50 square miles are owned by federal, state, or local governments. Most of the land consists of recreational areas and abandoned military bases, including:

- *Oakland Army Terminal*, which was closed as part of a 1993 government base closure program. The Oakland Base Reuse Authority approved plans for conversion to civilian use, involving creation of an industrial park and job-training center, with much of the waterfront being placed under control of the Port of Oakland

- *Alameda Naval Station*, which was the headquarters for Fleet Air Pacific, but closed as part of a 1993 government base closure program
- *Coast Guard Island*, which is the Northern California Headquarters for the US Coast Guard
- *Knowland Park*, which includes the Oakland Zoo
- *Garin Regional Park*, a recreation area built on former ranch lands containing a blacksmith shop and exhibits about ranching history
- *Ardenwood Regional Preserve*, which is part of the East Bay Regional Park District and includes the Patterson Ranch mansion and gardens as well as a working demonstration farm
- *San Francisco Bay National Wildlife Refuge*, which encompasses over 18,000 acres of estuarine habitat, including uplands, open water, mudflats, salt ponds, and salt marshes

Exhibit A1-6: Government-Owned Land



Parks and Recreational Areas

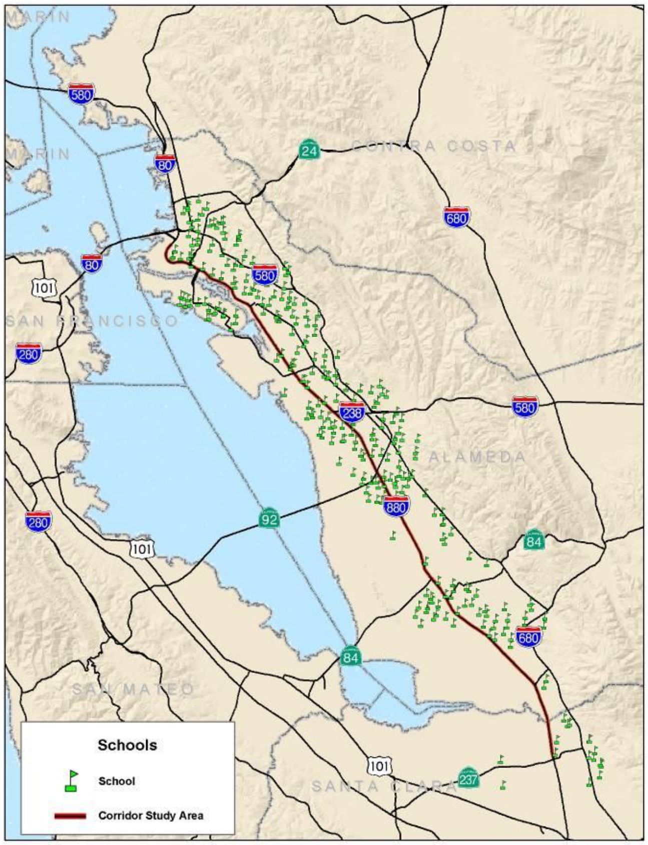
Exhibit A1-7 shows the location of 18 recreational areas along the I-880 corridor. Extensive recreational opportunities are available and a number of these are part of the East Bay Regional Park District. There are no public or private golf courses within three miles of the corridor.

Exhibit A1-7: Recreational Areas

Schools

I-880 corridor includes over 275 public and private elementary schools, middle schools, high schools, and public academies. Exhibit A1-8 shows the location of these educational facilities. These schools impact the traffic on the I-880 corridor both in the morning and afternoon.

Exhibit A1-8: Educational Facilities



Hazardous Material Sites

According to the hazardous waste sites database provided by Caltrans District 4, there are more than 44,000 sites within three miles of the corridor. These include sites identified by the State and the United States Environmental Protection Agency (US EPA) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). There are sites on the state priority list and two sites are on the national priority list (NPL).

Exhibit A1-9 shows the location of the seven largest sites:

- Site 1 the former Alameda Naval Air Station) includes underground linking storage tanks and is on the RCRA large generators lists and the state priority list.

- Site 2 is on the Department of Toxic Substances Control Hazardous Waste and Substances Sites (Cortese) List

- Site 3 is on the state list of underground storage facilities.

- Site 4 is on the state CERCLIS list.
- Site 5 is an RCRA small generator.
- Sites 6 and 7 are on the NPL, the state priority list, the regional priority list, and RCRA CERCLIS.

Exhibit A1-9: Primary Hazardous Waste Sites

Wetlands

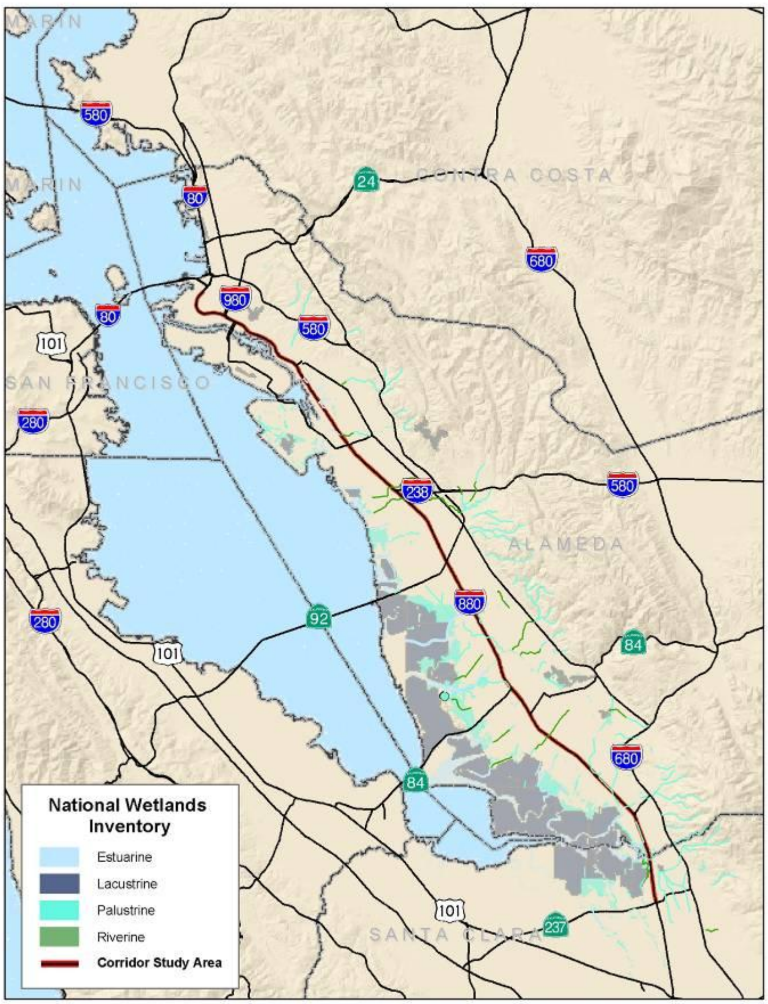
According to the US Fish and Wildlife Service's National Wetland Inventory (NWI), nearly 74,000 acres of wetlands are within three miles of I-880 corridor. The NWI groups wetlands into five major classes under the Cowardin system:

- Marine – open ocean overlying the continental shelf and coastline exposed to the open ocean

- Estuarine – deepwater tidal habitats and adjacent tidal wetlands semi-enclosed by land, but with access to the ocean
- Riverine – wetlands and deepwater habitats contained with a channel
- Lacustrine – wetland and deepwater habitats situated in a topographical depression or dammed river
- Palustrine – Nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens.

Since I-880 corridor parallels the San Francisco Bay coastline, much of the adjacent land west of the corridor consists of estuarine wetlands (approximately 47,000 acres), as shown in Exhibit A1-10. Most of the other wetlands are lacustrine (approximately 20,000 acres) or palustrine (less than 7,000 acres).

Exhibit A1-10: Wetland Locations



A2. COMPREHENSIVE PERFORMANCE ASSESSMENT

Comprehensive performance measurement and evaluation is the foundation for implementing the system management philosophy. Without understanding how any corridor performs and why it performs the way it does, it is impossible to truly practice system management. For the I-880 corridor, the performance assessment efforts included three critical steps as follows:

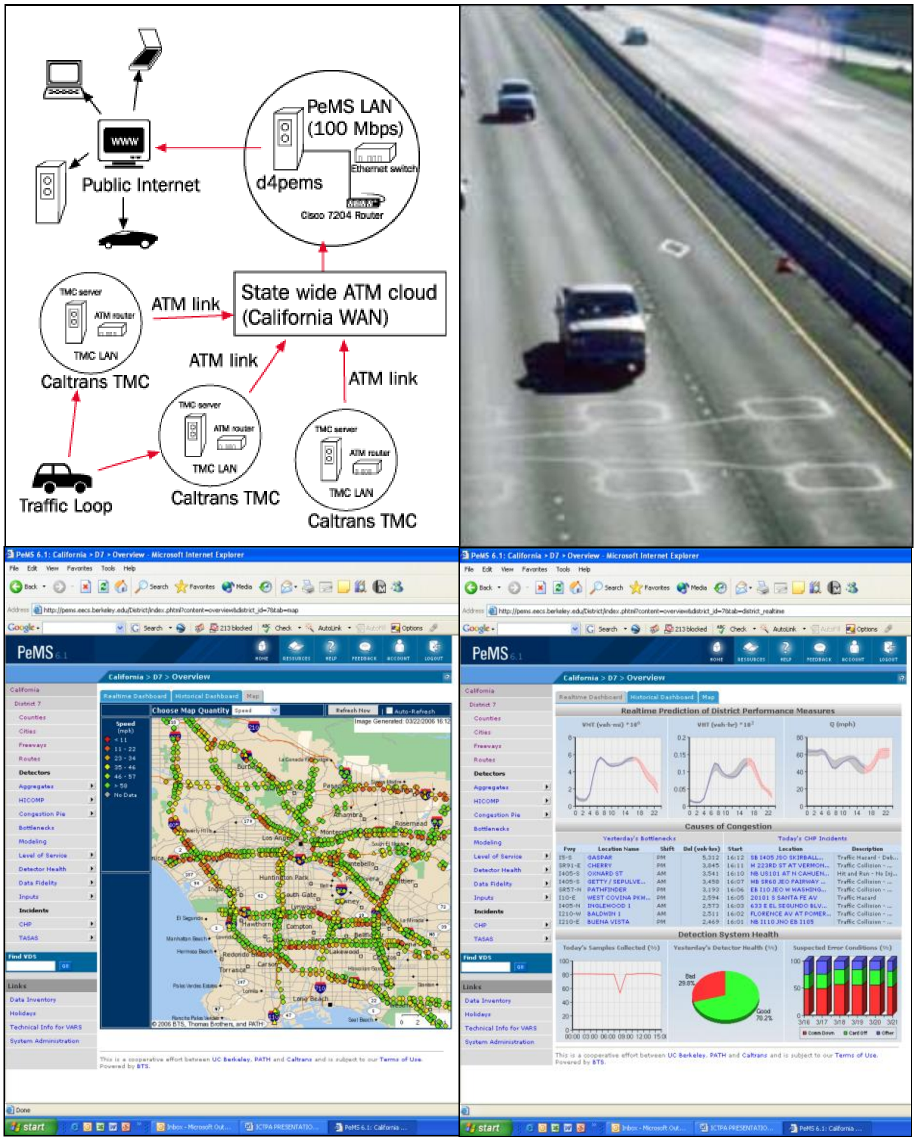
- Compute and evaluate corridor-wide performance and trends thereof
- Identify key bottlenecks
- Understand the relative contributions of each bottleneck to overall corridor performance

For this project, freeway performance was measured using the Performance Measurement System (PeMS), a software tool designed at the University of California, Berkeley to host, process, retrieve and analyze road traffic conditions information. The PeMS database logs data from California freeway traffic detectors, as well as incident-related data from the California Highway Patrol (CHP) and weather data. PeMS features a web-based Graphical User Interface (GUI) that provides the ability to extract various representations of the data. PeMS is a joint effort by Caltrans, the University of California, Berkeley, and the Partners for Advanced Transit and Highways (PATH) - a joint venture between Caltrans, the University of California, other public and private academic institutions, and private industry. PeMS is a traffic data collection, processing and analysis tool to assist traffic engineers in assessing the performance of the freeway system. PeMS extracts information from real-time and historical data and presents this information in various forms to assist managers, traffic engineers, planners, freeway users, researchers, and traveler information service providers. PeMS obtains 30-second loop detector data in real-time from each Caltrans District Transportation Management Center (TMC). The data are transferred through the Caltrans wide area network (WAN) to which all districts are connected. The 30-second data received by PeMS consist of counts (number of vehicles crossing the loop), and occupancy (the average fraction of time a vehicle is present over the loop). Exhibit A2-1 presents PeMS connectivity with the TMCs and two of its GUI screens.

PeMS processes the data in real-time and performs the following steps:

- Performs diagnostics on the data to determine if the loop detector is faulty;
- Aggregates 30-second values of counts and occupancy to lane-by-lane, 5-minute values
- Calculates the speed for each lane based on individual g-factors (which represent the average vehicle length) for each loop detector in the system
- Aggregates the lane-by-lane value of flow, occupancy, and speed across all lanes at each detector station
- Computes performance measures
- Aggregates across geographical boundaries.

Exhibit A2-1: PeMS Connectivity to TMCs and Example Screens



Corridor-wide Performance Measures and Trends

Corridor-wide performance measures were computed for five years (2003 through 2007) where data was available. A notable exception is safety performance results, which were computed using the Caltrans TASAS database from January 1999 through December 2006. The measures computed include:

- Mobility Measures – Delay, travel time
- Reliability Measures – Variability of travel time
- Safety Measures – Number of collisions, number of incidents
- Productivity – Lost Lane miles

Corridor-Wide Mobility Results - Delay

Delay was computed for four time periods: AM peak (from 6 am to 9 am), mid day (9 am to 3 pm), PM peak (3 pm to 7 pm), and evening/early am (from 7pm to 6 am). Delay is computed as the difference in travel time between actual congested conditions and freeway conditions (assumed to reflect speeds of 60 miles per hour). Exhibits A2-3 and A2-4 on the next page show the three-year trend in overall weekday delay (i.e., excluding weekends and holidays) for the three years analyzed for the northbound and southbound directions respectively. Note that the PM peak period generally has the highest delays, followed by the AM peak period.

It is evident from the two exhibits that the southbound travel experiences higher delays overall than the northbound direction. Finally, it is evident that delay varies significantly from day to day, week to week, and month to month. All the spikes on both exhibits show that using one or two days of data can lead to less than defensible conclusions. In 2006 for instance, some days experienced less than 5,000 hours of total delay, and others 10,000 hours or more. Clearly, to truly compute "average delays", the sample size of days must be quite large.

To compare, we averaged daily delay for each year using the same data that was used to develop the charts. The results are shown below in Exhibit A2-2. In the northbound direction, after a decline in average delay in 2004, delay in the PM peak period has been growing steadily since that time. Morning (AM Peak) and midday delays grew until the year 2006, and declined again in 2007. In the southbound direction, AM peak period delays have remained somewhat constant over the five year period, but midday and PM peak period average delays grew sharply until 2006. In the year 2007, these delays in the southbound direction declined slightly.

Exhibit A2-2: I-880 Study Area Average Daily Delay by Time Period

	Northbound Direction				
Year	AM Peak	Mid Day	Evening and Early AM	PM Peak	Total Daily
2003	1,499	1,237	552	2,547	5,835
2004	1,124	1,067	360	2,317	4,867
2005	1,331	1,434	285	2,351	5,402
2006	1,436	1,716	308	2,644	6,103
2007	1,251	1,533	335	2,804	5,922
	Southbound Direction				
Year	AM Peak	Mid Day	Evening and Early AM	PM Peak	Total Daily
2003	1,924	1,397	276	2,249	5,846
2004	1,728	1,427	291	2,375	5,821
2005	1,678	1,848	232	2,444	6,202
2006	1,988	2,766	277	3,367	8,398
2007	1,976	2,426	159	2,477	7,039
	Total Corridor				
Year	AM Peak	Mid Day	Evening and Early AM	PM Peak	Total Daily
2003	3,423	2,634	828	4,796	11,682
2004	2,852	2,494	651	4,691	10,688
2005	3,009	3,282	517	4,795	11,604
2006	3,425	4,482	584	6,010	14,501
2007	3,227	3,959	494	5,281	12,961

Exhibit A2-3: Northbound Average Daily Delay by Time Period

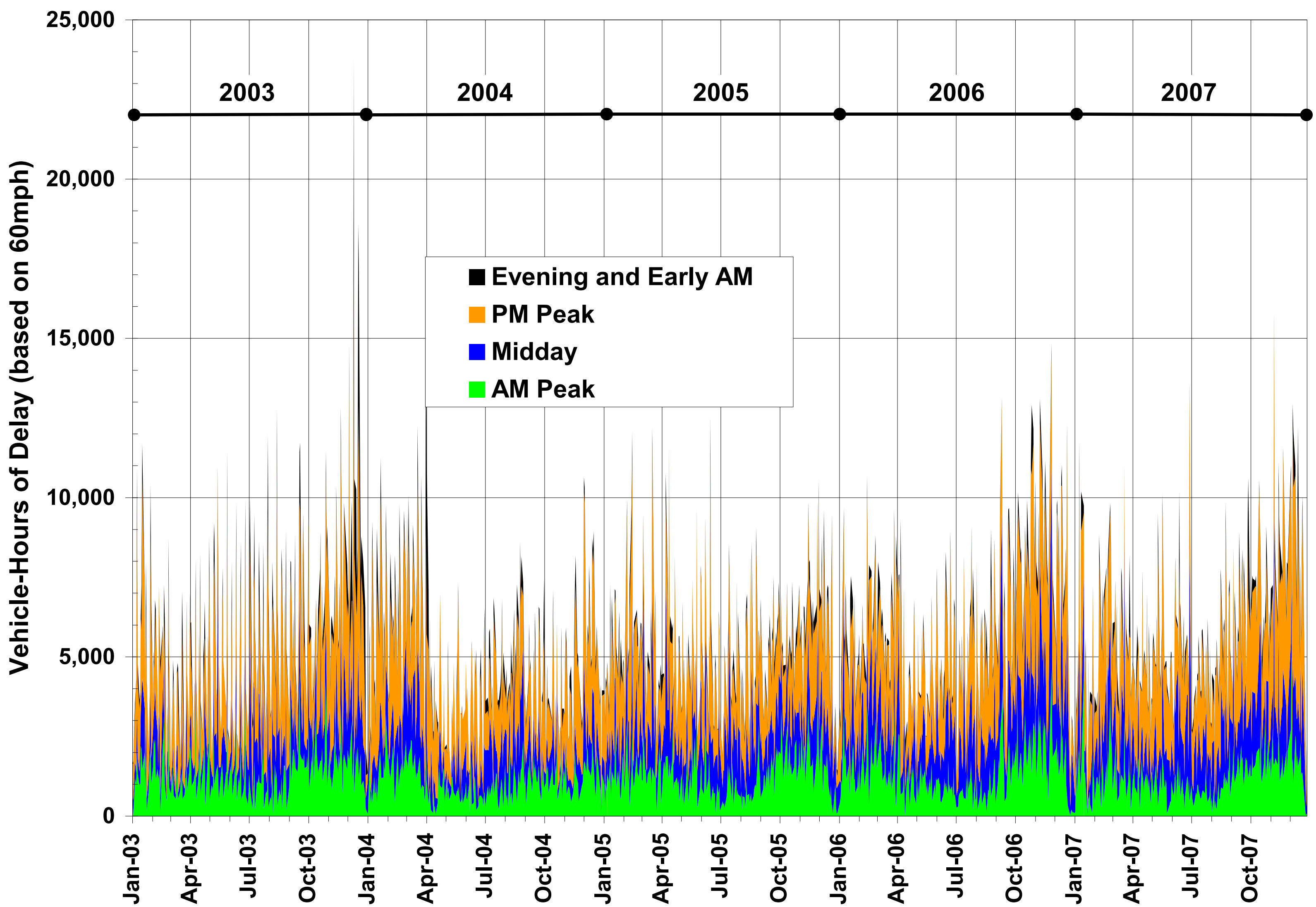
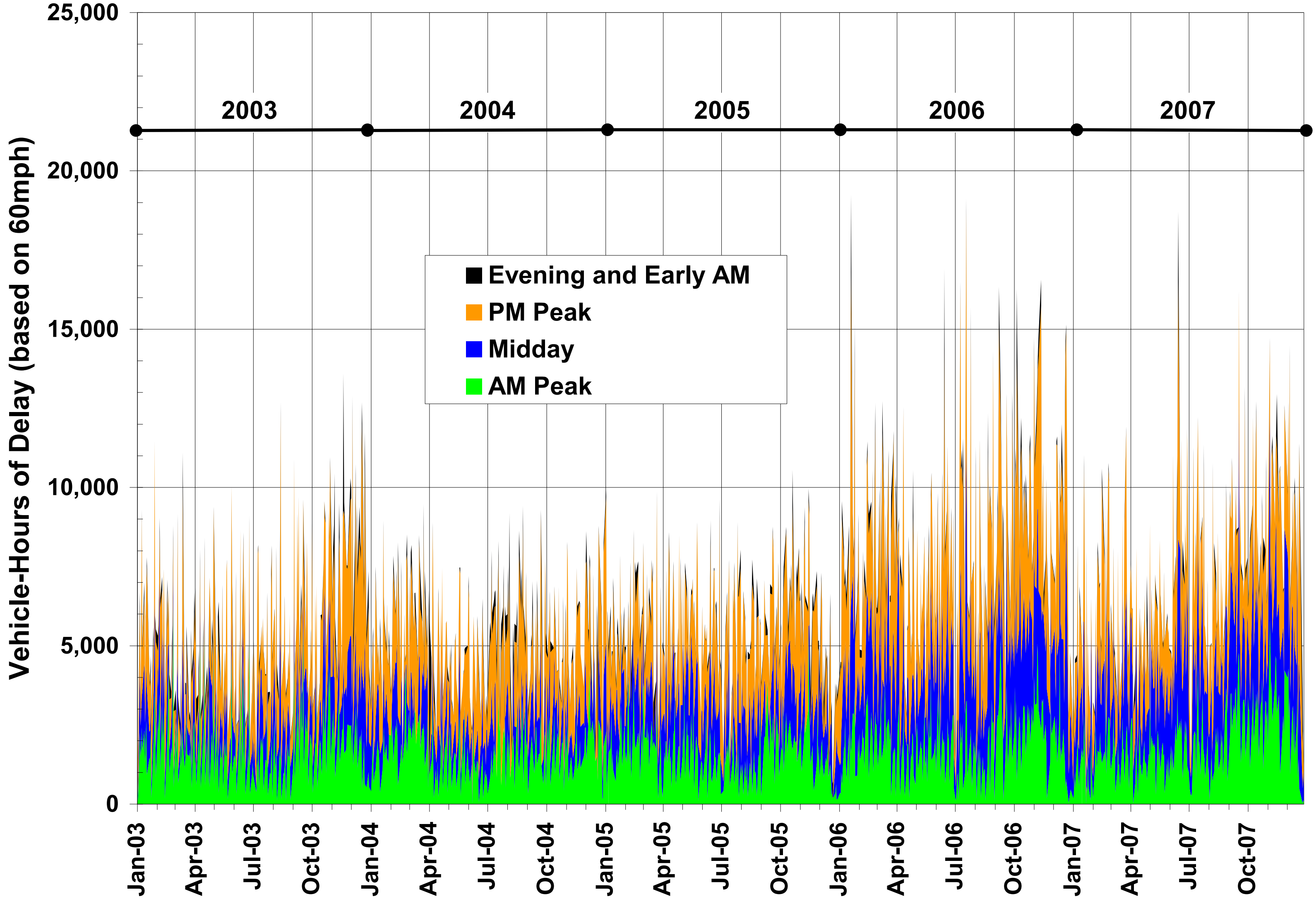


Exhibit A2-4: Southbound Average Daily Delay by Time Period



The next set of exhibits enables further understanding of delay characteristics and trends. Exhibits A2-5 and A2-6 below show the average daily delay by month for the northbound and southbound by time period respectively.

Exhibit A2-5: Northbound Average Monthly Daily Delay by Time Period

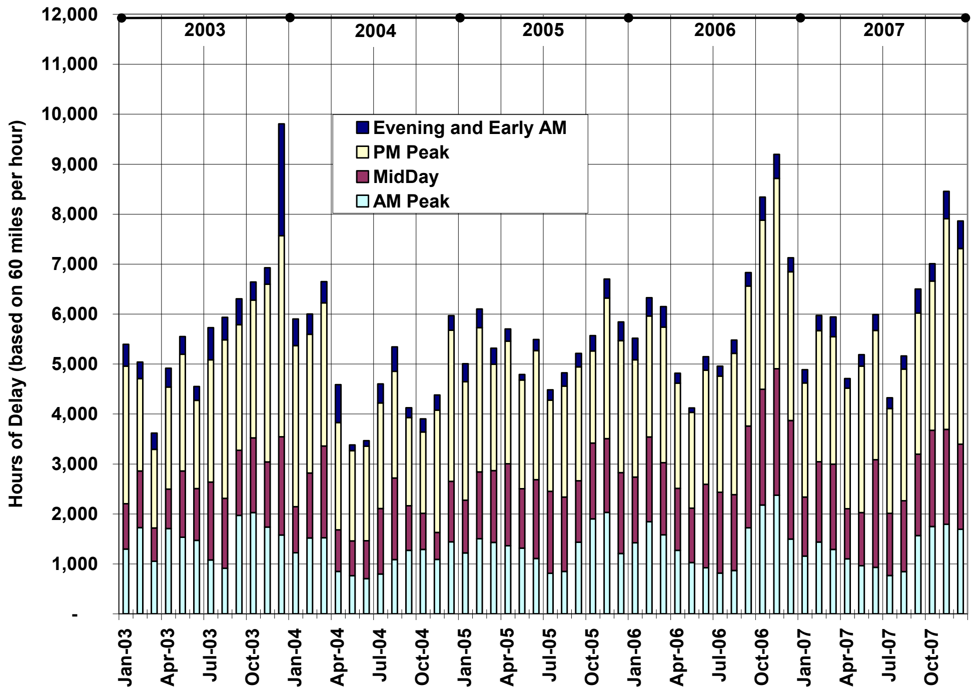
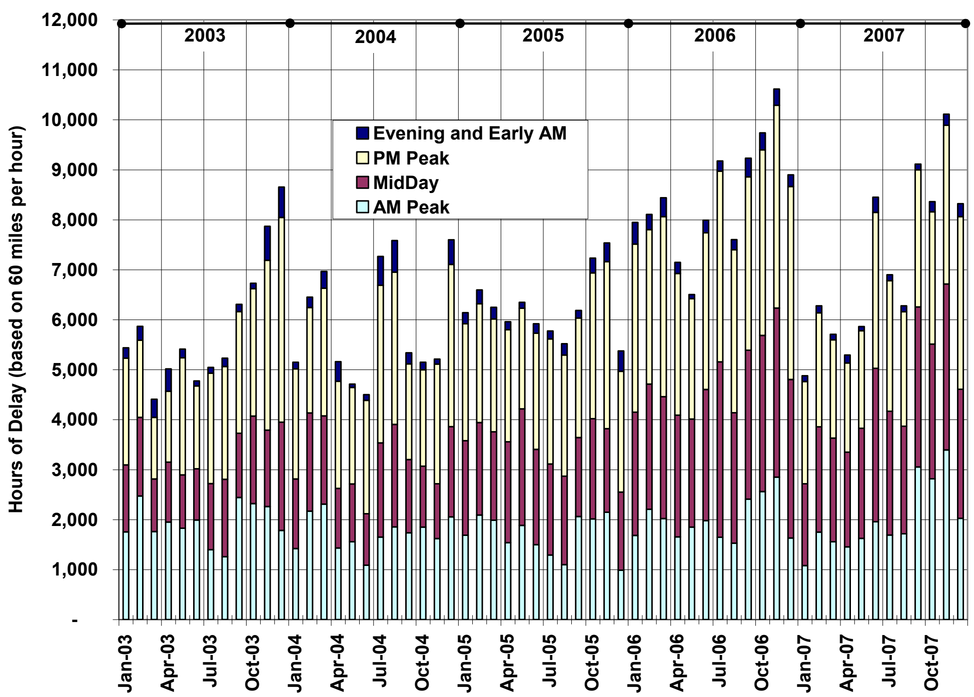


Exhibit A2-6: Southbound Average Monthly Daily Delay by Time Period



These two exhibits better reflect the higher PM peak delays, the trend of increasing delays in 2006, and the fact that southbound delays are higher than northbound delays. They also show the seasonality of delay during the year. At this point, the very high evening/early morning delays in the northbound direction in December, 2003 have not been explained. It may be related to construction and/or maintenance activities that were undertaken at night.

As mentioned earlier, delays presented to this point represent the different in travel time between actual conditions and free flow conditions at 60 miles per hour. This delay can be segmented into two components:

- Severe delay – delay that occurs when speeds are below 35 miles per hour
- Other delay – delay that occurs when speeds are between 35 miles per hour and 60 miles per hour

Severe delay represents breakdown conditions and is generally the focus of congestion mitigation strategies. On the other hand, "other" delay represents conditions approaching the breakdown congestion, leaving the breakdown conditions, or areas that do not cause wide-spread breakdowns, but cause at least temporary slowdowns. Although combating congestion requires the focus on severe congestion, it is important to review "other" congestion and understand its trends. This could allow for pro-active intervention before the "other" congestion turns into severe congestion.

Exhibit A2-7 shows the severe congestion related delay averages by year for both the northbound and southbound directions. Exhibit 24 presents the information for the non-severe or "other" congestion related delay.

With the exception of year 2003, Fridays have tended to be the most congested weekdays in both directions, although the difference between Friday and other weekdays is more noticeable in the northbound direction within a given year. In contrast, Mondays have tended to be the least congested weekdays in the northbound direction along with Tuesdays.

The significant spike in congestion in the year 2006 identified earlier is also noticeable in these exhibits. Most of this spike has been in the southbound direction. In 2007, most of this congestion appeared to have been alleviated, which could have been caused by construction activities on the southern end of the corridor.

Exhibit A2-8 shows non-severe congestion, and illustrates that slowing below between 35mph and 60mph only contributes around 30% to 35% to total delay, with severe delay contributing the remaining two-thirds.

Another way to understand the characteristics of congestion and related delays is shown on Exhibits A2-9 and A2-10, which summarize average weekday hourly delay for the three years analyzed.

Exhibit A2-7: Average Severe Congestion by Day of Week

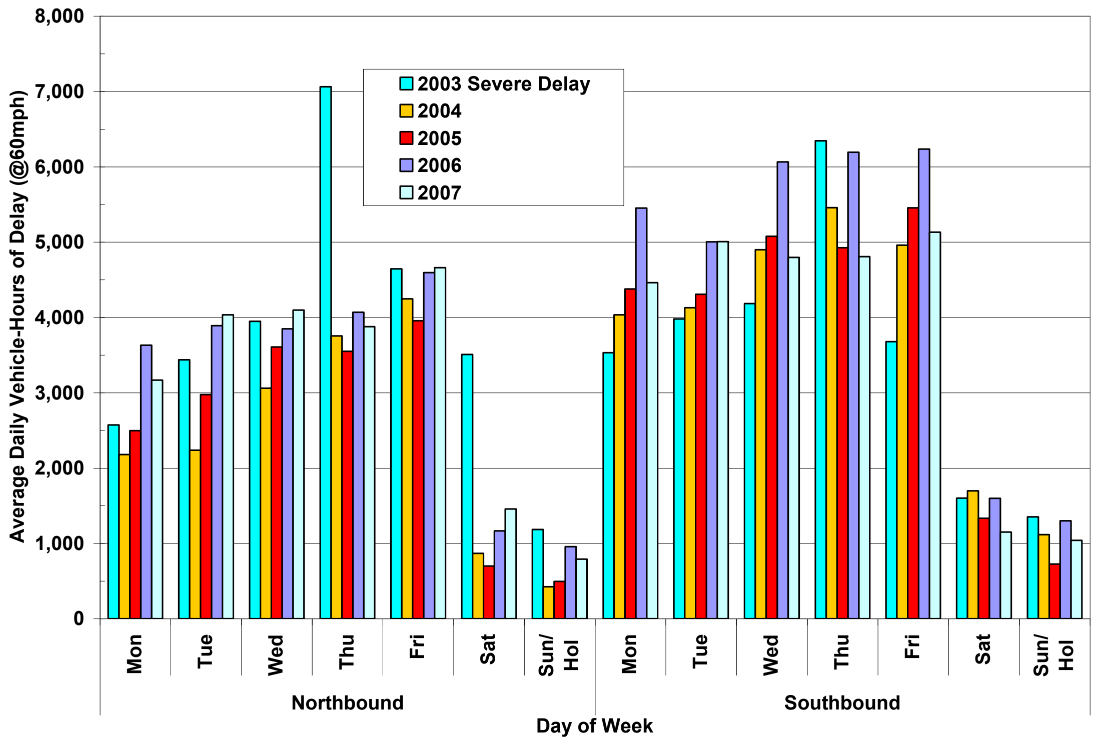


Exhibit A2-8: Average Non-Severe, Other Congestion by Day of Week

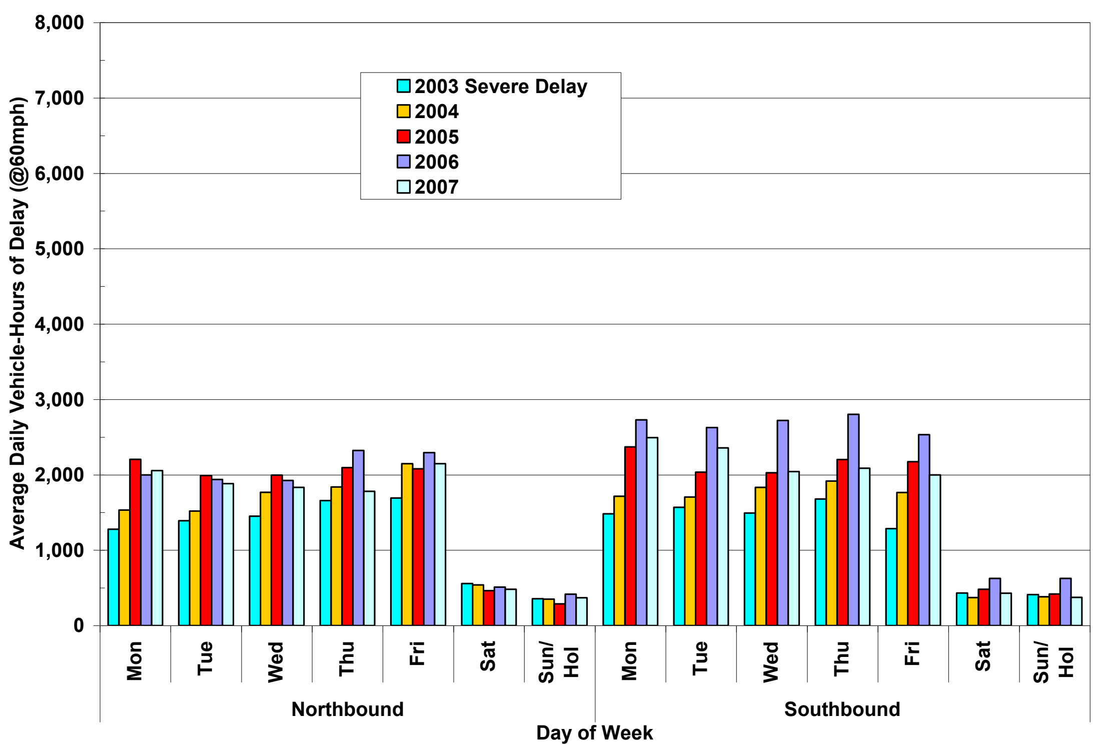


Exhibit A2-9: Average Northbound Weekday Hourly Delay

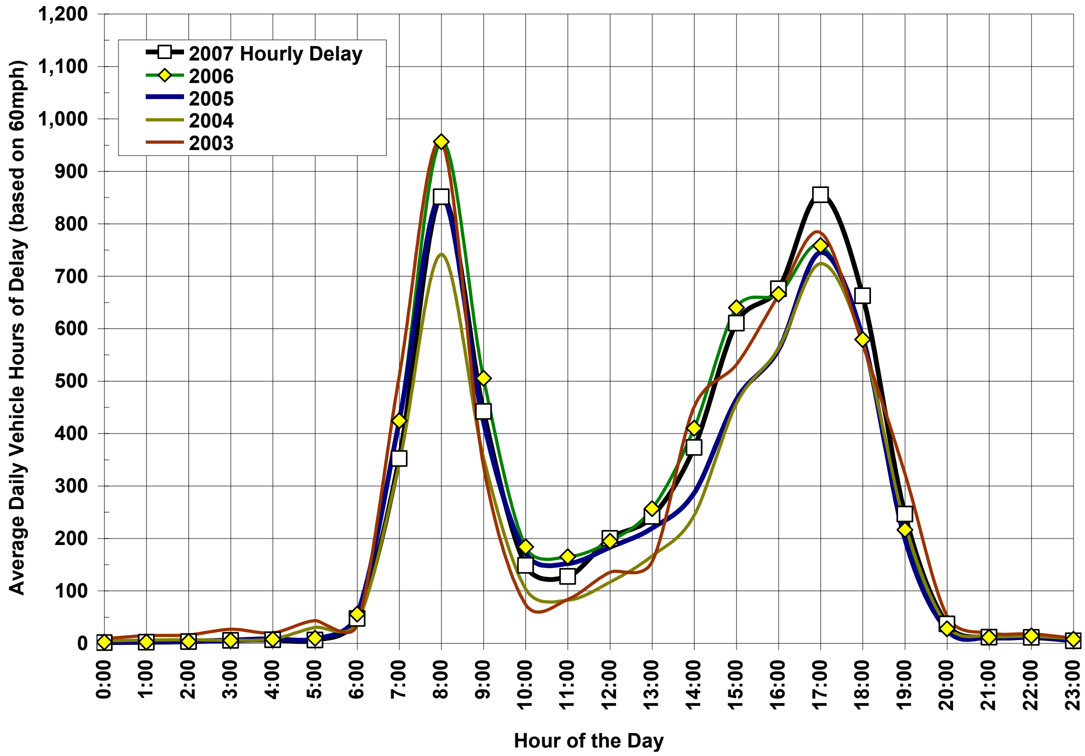
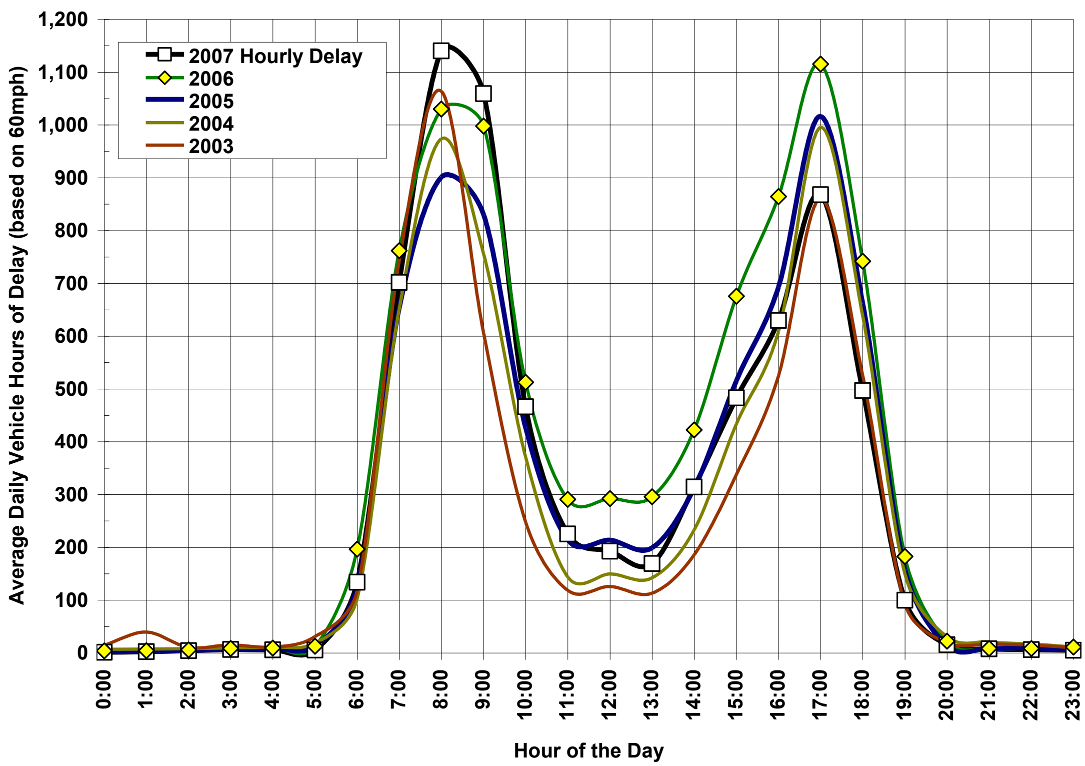


Exhibit A2-10: Average Southbound Weekday Hourly Delay



These two exhibits help identify the peak hour for congestion both in the AM and PM peak periods (8 to 9 am in the morning, and 5 to 6 pm in the afternoon). They also help review “peak spreading” trends, which reflect the extent to which congestion spreads (or compresses) during the peak commute periods.

The significant trend from these two charts is that the PM peak period in the northbound direction is spreading into the midday period. In the years 2004 and 2005 the PM peak actually got shorter and started nearly 45 minutes later in the afternoon. However, by the year 2006, the PM peak period started around 2:00 or 2:30 PM in the afternoon. The northbound AM peak period, though not spreading is becoming more intensely congested.

In the southbound direction, the spike in the year 2006 is very apparent in Exhibit A2-10 as that trend line stands out, particularly in the midday and PM peak periods. However, of note in the southbound direction is that the AM peak period intensity of congestion has grown in both 2006 and in 2007. Congestion in the southbound direction is more intense than in the northbound direction as illustrated by both the height of the peak periods in Exhibit A2-10 compared to Exhibit A2-9 and the widths of the peak periods.

Corridor-Wide Mobility Results – Travel Time and Reliability of Travel Time

In addition to understanding delay characteristics and trends, it is useful to understand the impacts of congestion on the traveler. The best mobility result the traveler relates to is travel time.

For the purposes of the I-880 corridor study area, the entire corridor delineates points A and B. Travel time statistics provided represent either an entire southbound trip (from Grand Avenue to SR-237) or an entire northbound trip (SR-237 to Grand Avenue).

Obviously, these travel times differ by time of day. Exhibits A2-11 and A2-12 show the average weekday travel times by time of day for the five years analyzed for the northbound and southbound directions respectively. Note that the hourly travel time trends are consistent with the hourly delay trends in Exhibits A2-9 and A2-10 (as should be expected).

Exhibit A2-11: Average Northbound Travel Times by Hour

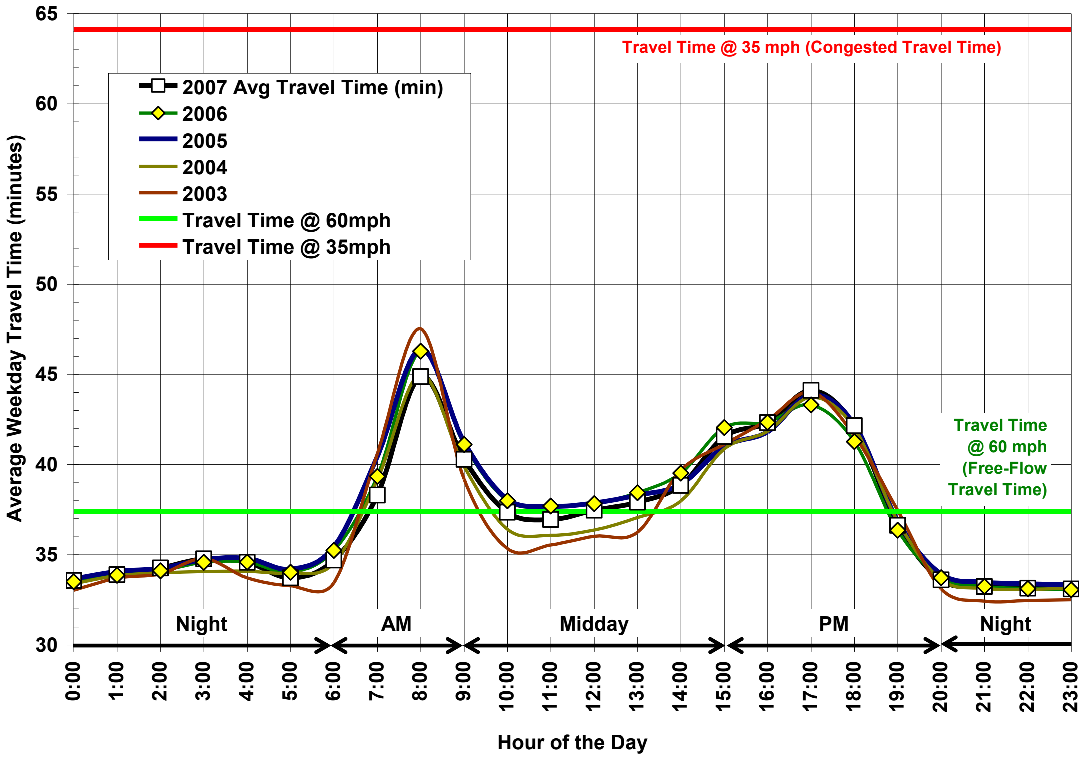
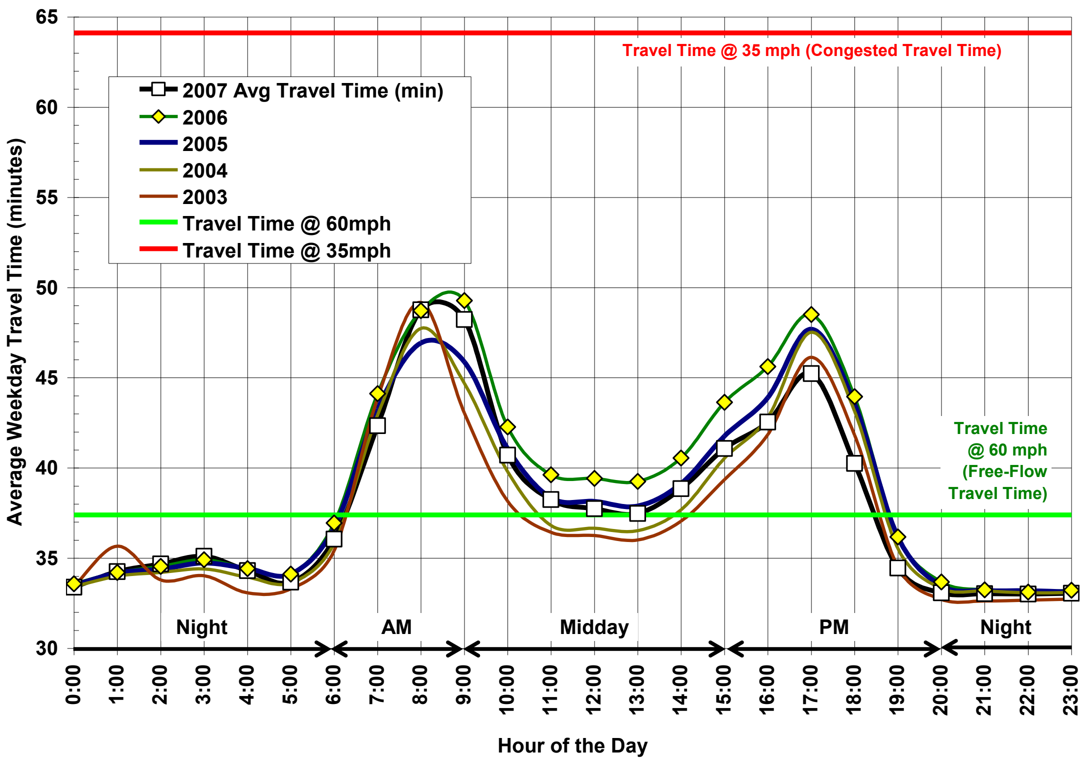


Exhibit A2-12: Average Southbound Travel Times by Hour



Despite the consistencies between delay and travel times, it is critical to understand that significant delay changes often mean small travel time changes. For instance, using the data from Exhibit A2-2, the most dramatic change in delay occurred in the AM peak period in the northbound direction from 2003 to 2004. Delay was reduced from 1,499 hours to 1,124 hours representing a decline of almost 25 percent. During that same time, the maximum reduction in average travel time was less than 3 minutes.

Decision makers are sometimes surprised when improvement strategies are predicted to reduce travel time by only two or three minutes. However, as was just shown, two to three minutes can mean a reduction of 25 percent in congestion related delay. Without these reduced few minutes, as demand increases, travelers face the compounded increase in congestion. Stated differently, small reductions in overall average travel times often relate to significant reductions in delay.

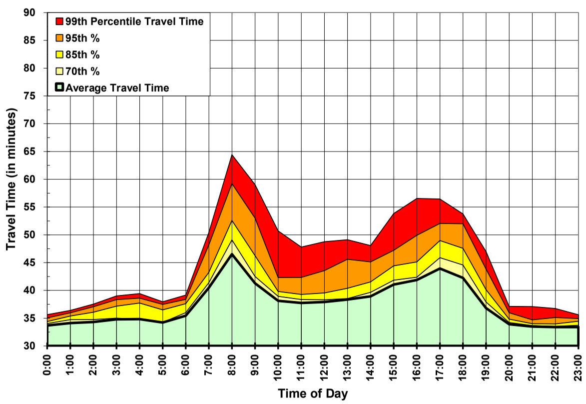
Another factor that is important to understand is the variation of travel time. Perhaps the single most frustrating aspect for the traveling public is the "not knowing" about how long a particular commute is going to take. Even though average travel times at 8 AM in the northbound direction are shown to be around 46 minutes in 2007 (as shown in Exhibit A2-11), few travelers experience the exact average travel time on a day to day basis. In fact, commuters experience a large variation in travel times due to seasonality, accidents, special events, road closures, and small changes in demand (among others). Understanding these variations are important to address the customers' frustrations and evaluate strategies meant to reduce these variations and thereby increasing the overall reliability of the trip.

Exhibits A2-12 through A2-17 illustrate this point. Exhibits A2-12 through A2-14 along the top row represent the northbound direction between 2005 and 2007 while Exhibits A2-15 through A2-17 on the bottom row show the southbound direction for the same years. The axes are the same as in Exhibits A2-12 and A2-13 with the x-axis representing the hour of the day and the y-axis showing the travel time. For each year and direction, the average travel time is shown (as in Exhibits A2-12 and A2-13), but in addition the travel time is shown for the following percentiles for the given year: 70th, 85th, 95th, and 99th. For example, the 70th percentile travel time is was the travel time for that hour of the day that a traveler would arrive within 70% of the days traveled on along the corridor in that year as measured by PeMS.

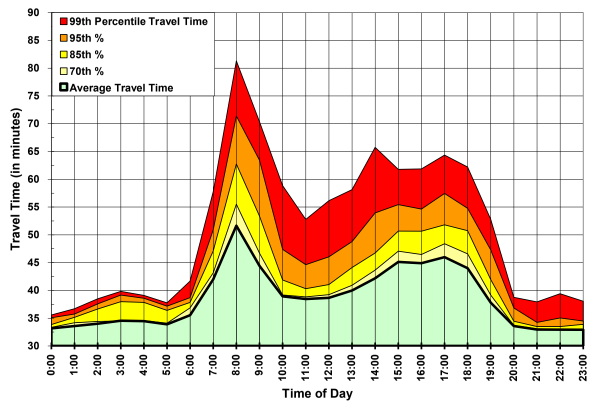
The key finding from these exhibits is that even though the average travel time did not vary much from one year to the next, the variability – particularly during the midday and PM peak periods – deteriorated dramatically between 2004 and 2007. As an example for the northbound direction. In 2006, a traveler in the 17:00 hour (5:00 PM) would have to add nearly 18 minutes to the 46-minute average travel time for a total of 65 minutes to ensure arrival with confidence at the 99th percentile. By 2007, this same traveler would have to add more than 24 minutes to the average travel time of 47 minutes, and would have to leave more than 71 minutes early to ensure arrival with 99% confidence.

Exhibit A2-13, A2-14, A2-15: Northbound Travel Time Variability

A2-12 – 2005 NB Travel Time Variability



A2-13 – 2006 NB Travel Time Variability



A2-14 – 2007 NB Travel Time Variability

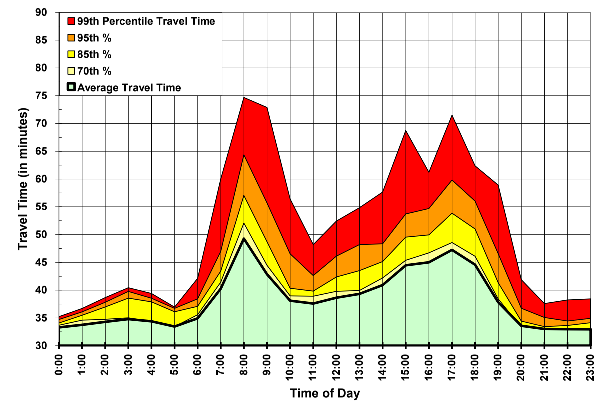
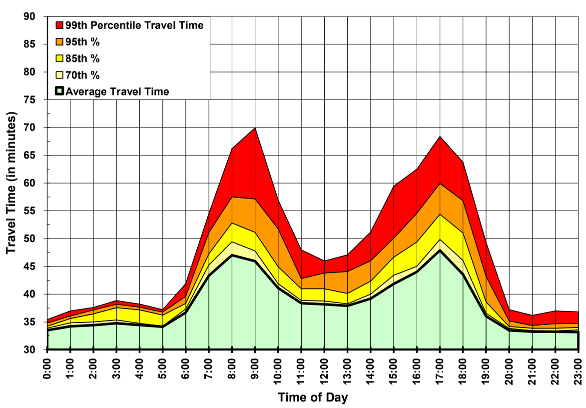
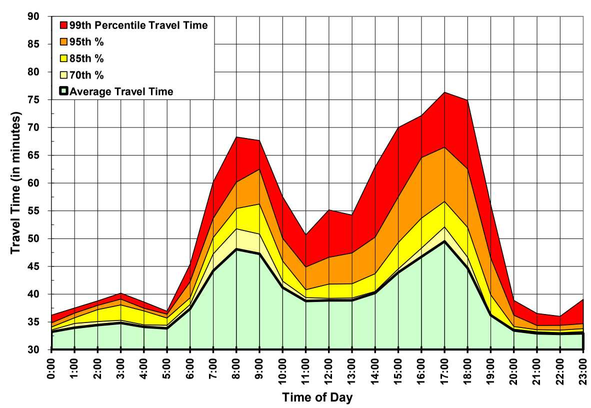


Exhibit A2-15, A2-16, A2-17: Southbound Travel Time Variability

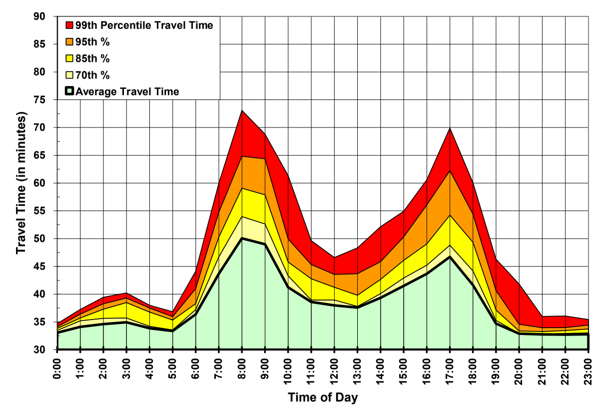
A2-15 – 2005 SB Travel Time Variability



A2-16 – 2006 SB Travel Time Variability



A2-17 – 2007 SB Travel Time Variability



Corridor-Wide Productivity Results

Productivity, defined as throughput during peak congestion conditions, can be represented by the "lost lane miles" measure discussed in the introduction section. As congestion occurs, flow rates on the freeway diminish due to merging, weaving, and queuing. Exhibits A2-18 and A2-19 summarize the productivity losses on I-880 for the five years analyzed for the northbound and southbound travel directions respectively. Similar to the delay results, productivity worsened steadily from 2003 to 2007 in the northbound direction. Southbound, productivity declined steadily for all years, with the exception of the year 2007, which showed an improvement over 2006.

Exhibit A2-18: Average Northbound Lost Lane Miles

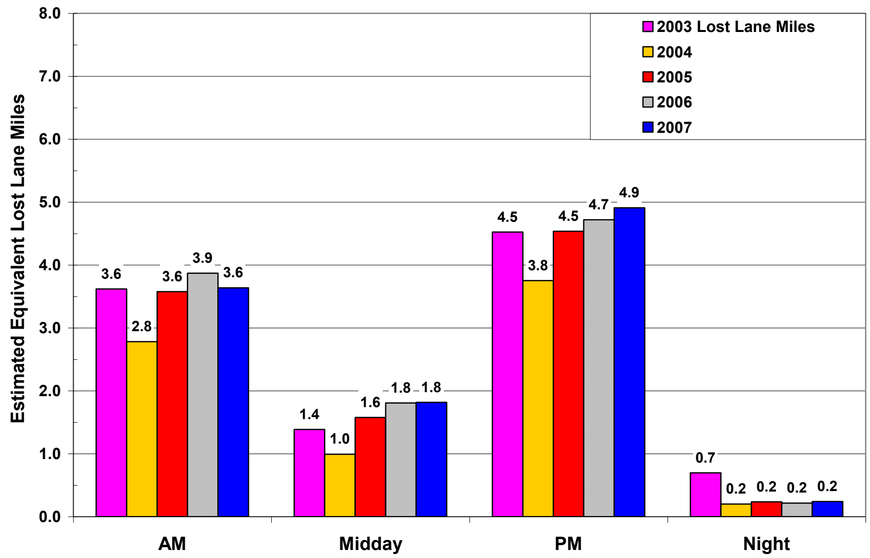
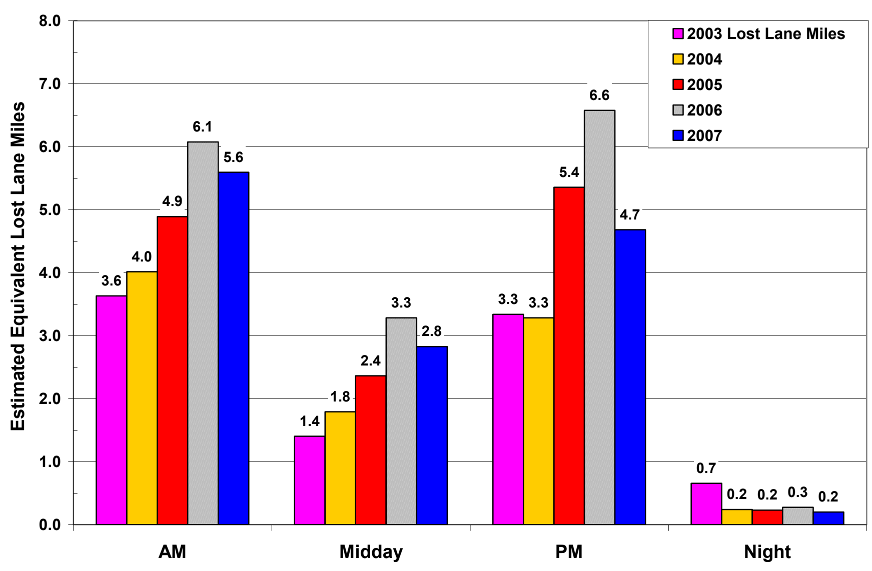


Exhibit A2-19: Average Southbound Lost Lane Miles



Strategies to combat such productivity losses are primarily related to operations and include building new or extending auxiliary lanes, developing more aggressive ramp metering strategies without negatively impacting the arterial network, improvements in incident clearance times. These types of improvements will be tested using the micro simulation models to identify the most promising and cost effective strategies.

Corridor-Wide Safety Results

Safety results are based on the TASAS database, which Caltrans maintains. It contains all collisions on the State Highway System. In addition, incident data (which includes collisions and other incidents) was collected from the California Highway Patrol (CHP) for a week to understand the relationship between incidents and collisions (e.g., how many non-collision incidents occur compared to collisions).

Exhibit A2-20 shows the results of synthesizing the incident data from CHP. The graph depicts daily number of incidents reported. Surprisingly, the number of incidents exceeded 100 every day analyzed. Next, incidents were discarded if their descriptions did not suggest a likely impact on congestion (e.g., changeable message sign malfunction). The remaining incidents that were likely to impact congestion were then divided by time period for the entire week. Exhibit A2-21 shows the results of this second step. These show that at least for the week analyzed, the highest number of incidents occurs between 3 pm and 6 pm (over 100 incidents during the week or over 15 per day) and between 6 pm and 9 pm (more than 90 incidents or 13 per day).

Exhibit A2-20: Daily CHP Incidents Reported

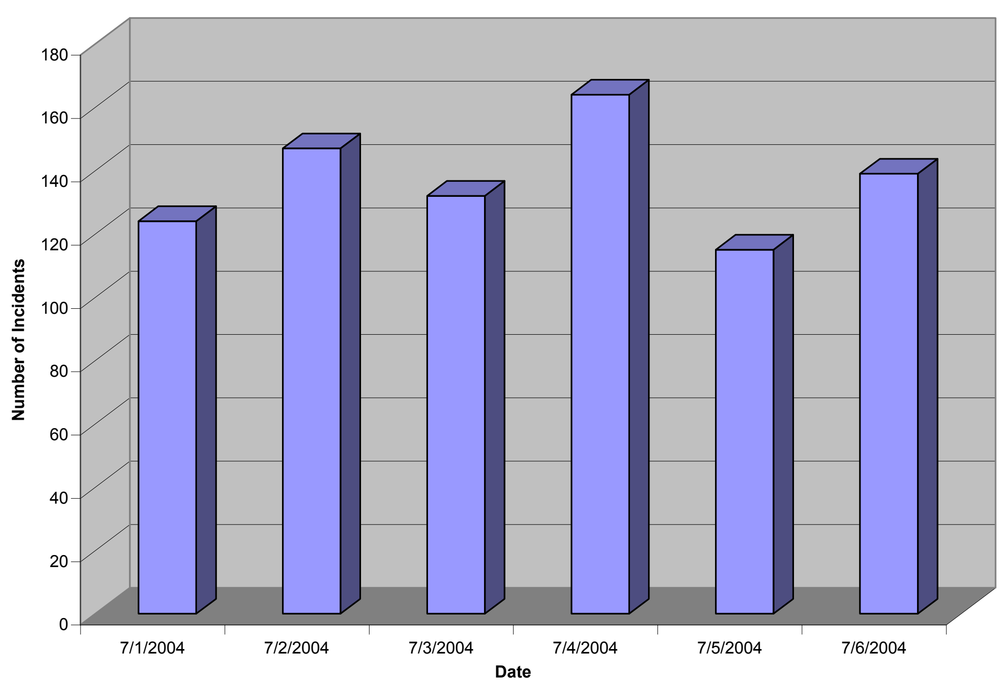
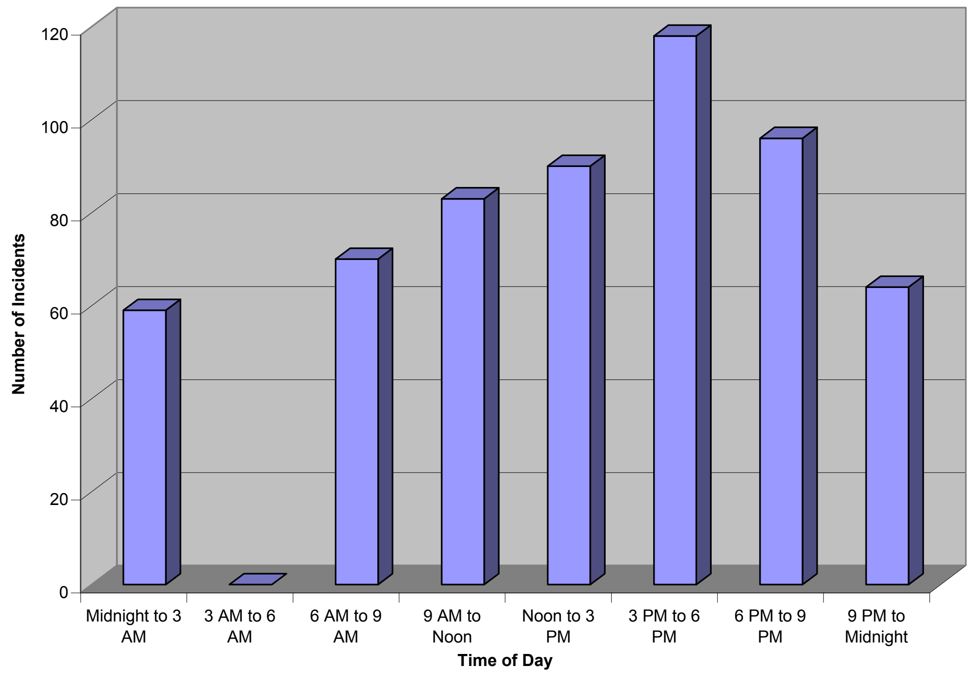


Exhibit A2-21: Week Total CHP Incidents Likely to Impact Congestion By Time Period



The results of the collision analysis are summarized in Exhibits A2-22 and A2-23. The first shows a daily count of collisions for the more than five years analyzed. The second shows average number of daily collisions by month to better understand the overall trend. Note that on a daily basis, the number of collisions generally ranges between 5 and 15. Obviously, these collisions add to the daily congestion, especially when they occur during peak commute periods.

Around the beginning of the year 2002, a downward trend in average number of collisions was established. Around that same time, Caltrans started metering the corridor after working with the local stakeholders to agree on the ramp metering approach. Although the data does not conclusively prove that metering was the direct cause of the reduction in the number of collisions, it is consistent with federal and state studies such as the Minnesota Ramp Metering Study that imply that such a correlation in fact exists.

Comparing the number of incidents to the number of collisions, one can deduce a rule of thumb that we have approximately five to six incidents for each collision. Of course, incidents in general do not contribute to congestion as much as collisions do. In subsequent discussions regarding bottlenecks, collisions will be discussed again to better understand where and when collisions do occur and how they relate to the major bottlenecks on the study corridor.

To properly understand congestion and resulting delay, it is imperative to understand its causes. Until recently, even with the detection data, it was impossible to divide congestion into components, each relating to a specific cause.

Exhibit A2-22: Daily CHP Collisions Reported

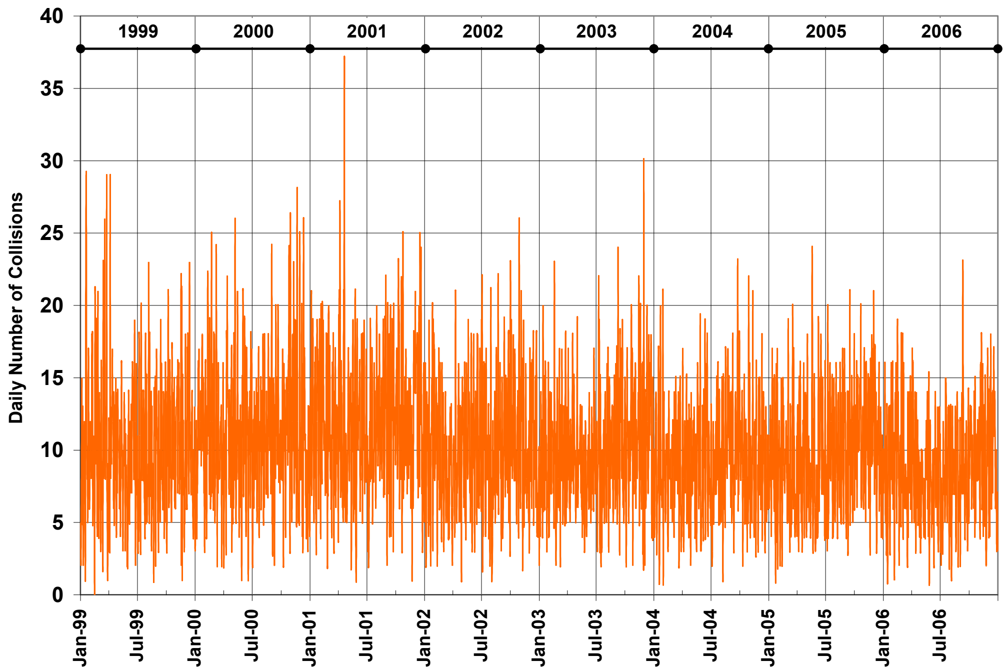
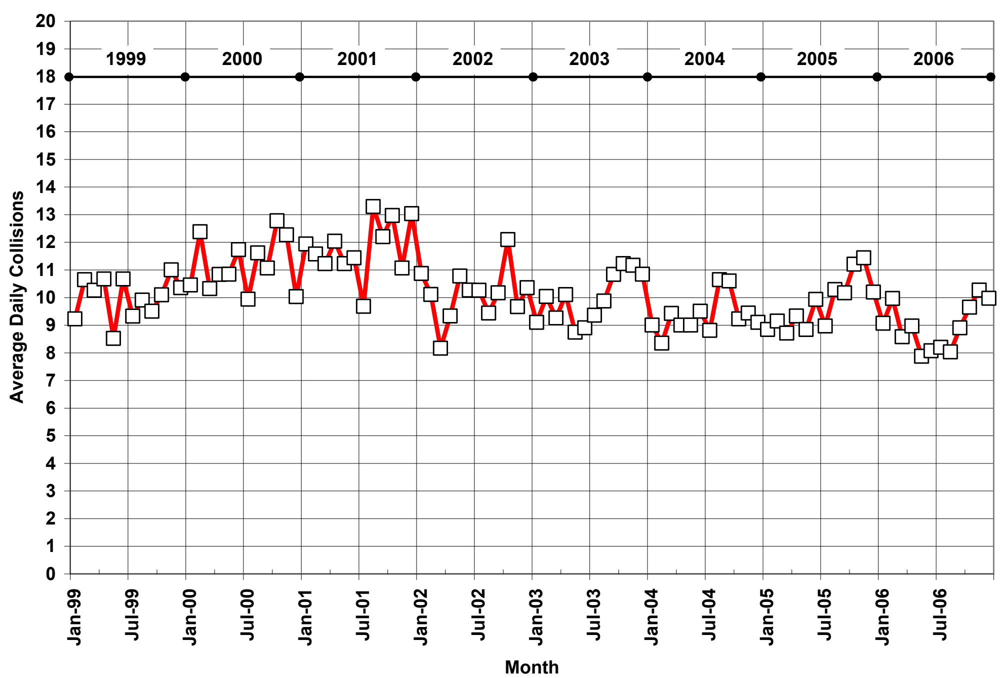


Exhibit A2-23: Average Daily CHP Collisions Reported by Month



Recently, Caltrans and UC Berkeley developed an algorithm that estimates the congestion by cause. Even though these algorithms are new and do not identify each cause, they present an approach to estimate the contributions of major causes of congestion. Exhibits A2-24 and A2-25 illustrate the results of these algorithms. They divide overall congestion into three components: collisions, excess demand, and potential reduction. The first two categories are self-explanatory. The third, "potential reduction", reflects the potential reduction in delay if it were possible to optimize operational strategies. Of course, it is almost impossible to fully optimize operational strategies. However, focusing on these strategies in conjunction with reducing collisions and/or removing them faster will have significant congestion-relief benefits.

Exhibit A2-24: AM Percent Delay Estimates by Cause in 2006

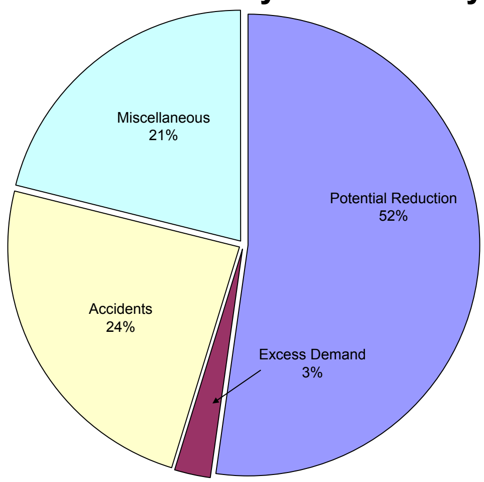
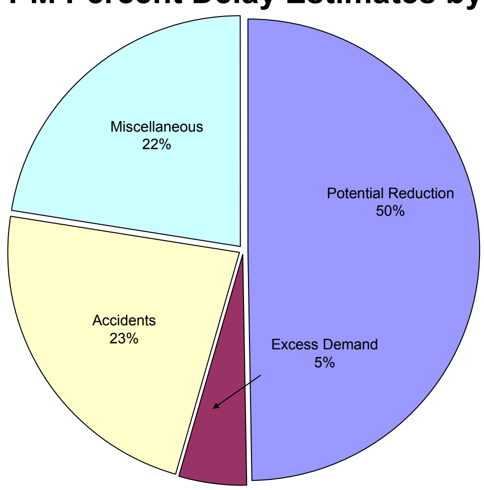


Exhibit A2-25: PM Percent Delay Estimates by Cause in 2006



Bottleneck Analysis

<u>The previous discussions focused on corridor-wide performance results and trends, as well as a corridor-wide causality analysis (i.e., the congestion pie). At this point, the aforementioned results established the following:</u>

- Corridor delays have increased through 2007, but have not reached the 2006 delay numbers. Non-severe delays, representing the delays associated for speeds above 35 miles per hour, spiked in 2006. This may be a prelude for increased severe delays in the future. Overall, daily delays on I-880 averaged approximately 12,950 hours in 2007, which was up from 11,700 in 2003.

- Overall, PM peak delays are larger than AM peak delays and PM peak congestion lasts longer. PM peak congestion lasts approximately four hours whereas AM peak congestion lasts around two hours. Overall, AM and PM daily delays averaged around 4,000 and 5,280 hours respectively in 2007.

- Travel times trends are similar to congestion delay figures. However, travel time variability spiked in 2006 during the PM peak period. So whereas the average travel time saw a small increase in 2006, reliability declined considerably.

- Safety collisions through 2006 showed a continuation of the decline that started in 2002, starting approximately after ramp metering was initiated.

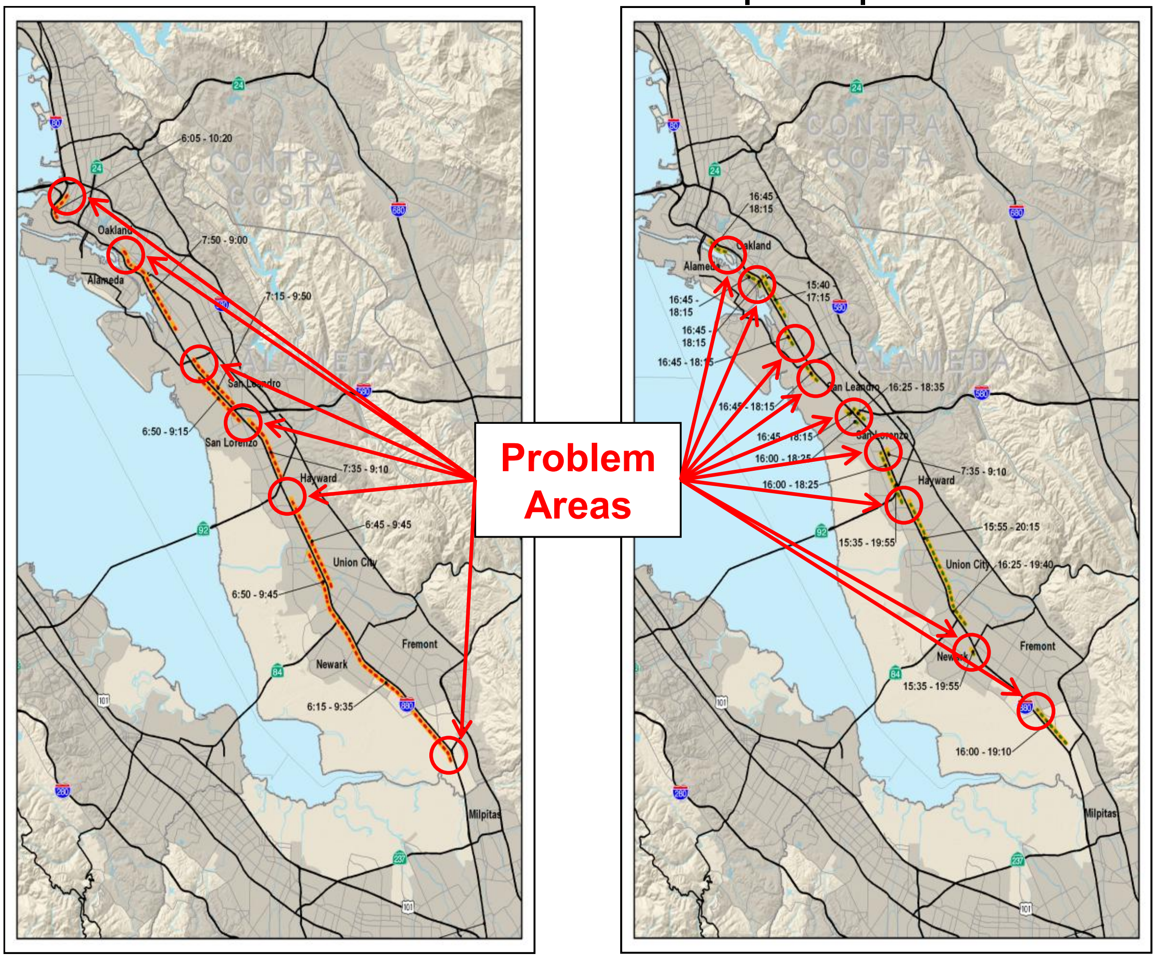
- Total delay can be roughly attributed to three factors (in 2006): collisions, excess demand, and lack of optimal corridor management. The latter represents the maximum potential improvements if the corridor can be managed optimally. According to the PeMS algorithm, this potential reduction can account for more than half of the delay along the corridor.

Although these findings are important, they do not lend themselves to identifying potential location-specific improvements. They do lend themselves to corridor-wide strategies, such as increased freeway service patrol during the PM peak period. But more is needed to start developing projects for addressing congestion.

Therefore, the second major step in performance measurement requires location specific analysis to identify bottlenecks that create the congestion in the first place. As a first step in this effort, it is useful to analyze the HICOMP report developed by Caltrans District 4 in coordination with MTC. The report includes maps identifying the locations and durations of severe congestion. The 2006 HICOMP report maps for the study corridor are shown on Exhibit 43 on the next page.

Note that these are useful in identifying the possible problem areas in both directions. Whenever there is a stretch of freeway experiencing severe congestion, the end point of the congested segment (e.g., the north end of a congested segment in the northbound direction) is a possible or likely bottleneck.

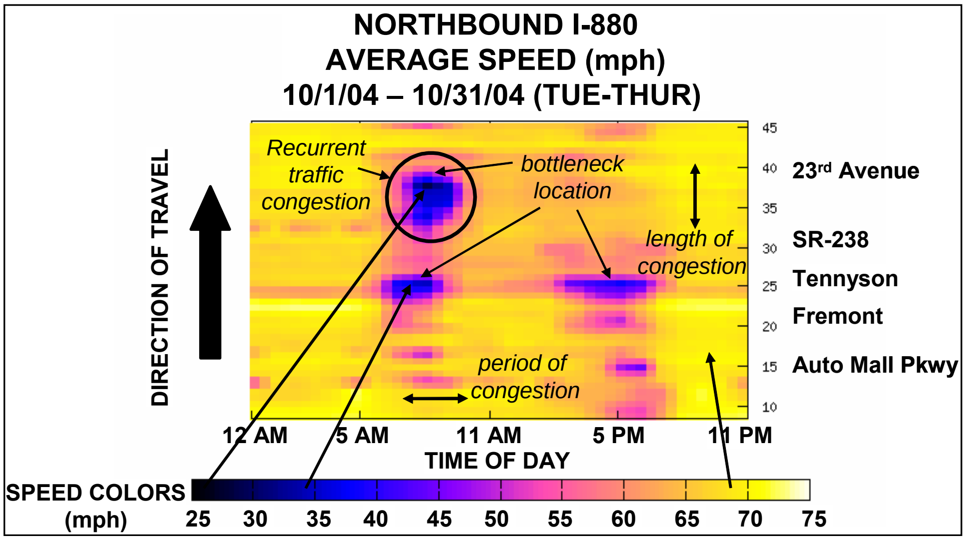
Exhibit A2-26: 2006 HICOMP Report Maps



As indicated in the map, there are six locations during the AM peak hours and nine locations during the PM peak hours. However, further analysis was needed to identify all bottlenecks and understand the associated causes.

In addition to HICOMP maps, the study team relied on speed contour plots that can be accessed using the PeMS web site. Exhibit A2-27 illustrates a typical speed contour plot generated by PeMS. It illustrates the average speed contour plot for the I-880 freeway corridor in the northbound direction in the month of October 2004. It represents the average speeds by time of day for mid-week days (Tuesdays through Thursday) from October 1, 2004 to October 31, 2004. Along the horizontal axis is the time period from 12 AM to 11 PM. Along the vertical axis is the corridor segment from milepost 10 to milepost 45. The various colors represent the average speeds corresponding to the color speed chart shown below the diagram. As shown, the dark blue blotches represent congested areas where speeds are reduced. The tops of each dark blotch represent bottleneck areas. The vertical length of each blotch represents the length of the congested segment. The horizontal length represents the duration of congestion.

Exhibit A2-27 – Example Speed Contour Plot



As indicated, the congestion occurs at different locations anywhere from approximately 6 AM to 10 AM during the morning commute hours and from 3 PM to 7 PM during the evening commute hours.

Northbound Bottlenecks

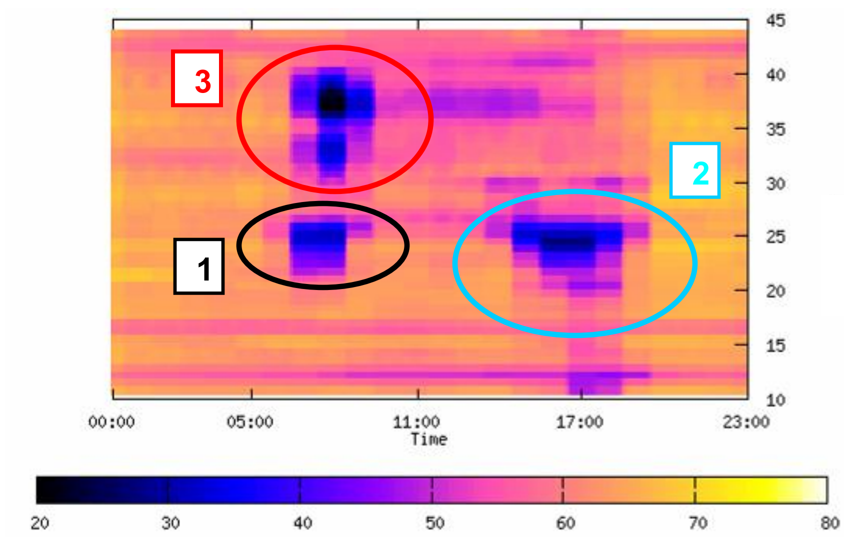
The preliminary identified major bottleneck areas are at the 23rd Avenue interchange and at Tennyson Road interchange. Smaller bottlenecks may also be present at SR-238 interchange, Fremont Boulevard interchange, and Auto Mall Parkway interchange. The highest congestion appears at the 23rd Avenue interchange with typical queues extending as long as 6 miles during the AM peak hours. However, the queues could be related to multiple bottlenecks. The congestion at the Tennyson Road interchange appears to be the second largest with congestion during both the AM and PM peak hours and with the queues extending to about 3 miles back. All of these preliminary findings were consistent with the HICOMP report.

More detailed analysis is required to “pin down” the locations of the bottlenecks and compare 2003 through 2005 bottlenecks. This detailed analysis focuses first on bottleneck trends and then adds precision to the speed contour plots by focusing on each major bottleneck separately. Following this analysis, it is imperative to conduct field observations to check on the findings and understand the reasons for the bottlenecks. A follow-up analysis was performed using 2006-2007 PeMS results, and similar findings were found.

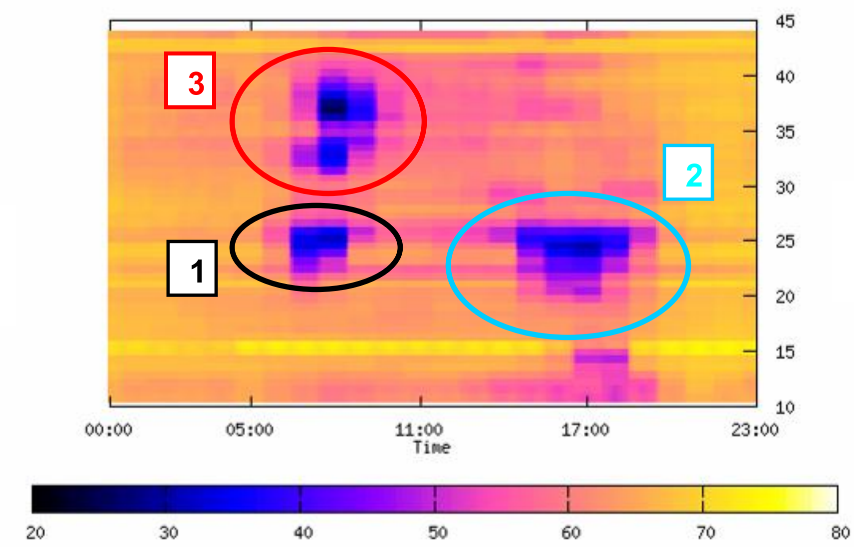
The northbound bottleneck trends are shown on the next page on Exhibits A2-28, A2-29, and A2-30 for the month of October in years 2003, 2004, and 2005 respectively.

Exhibit A2-28, A2-29, A2-30: Northbound Speed Contour Plots

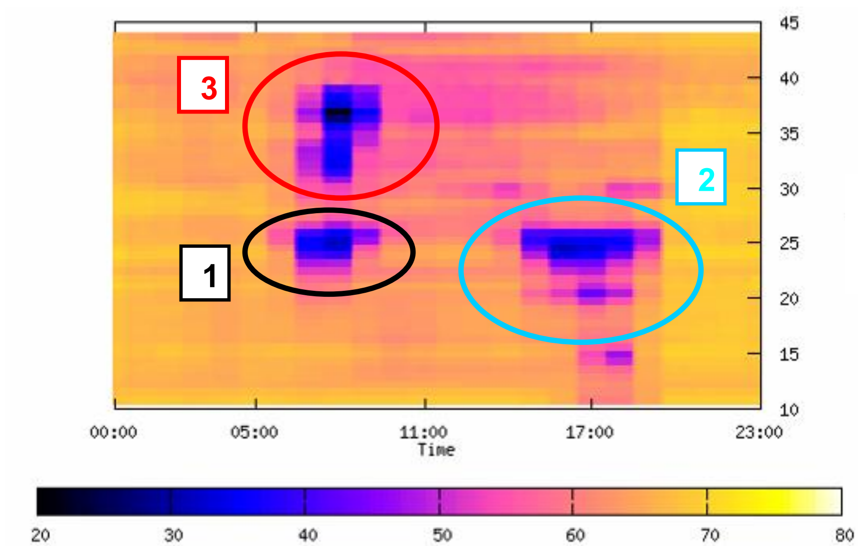
A2-28 - October 2003 NB Speed Contour Plot



A2-29 – October 2004 NB Speed Contour Plot



A2-30 – October 2005 NB Speed Contour Plot



- All three speed contour plots represent the monthly weekday averages for northbound direction.
- Areas denoted with 1 and 2 represent the aforementioned Tennyson bottleneck both in the AM and the PM peak periods
- Area denoted with 3 represents the aforementioned preliminary 23rd Avenue bottleneck.

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A few notes on these three exhibits:

- The 2003 northbound direction shows significantly slower speeds and severe congestion for bottleneck area (1). This can be observed by the darkness of the area, which reflects speeds at or below 20 miles per hour.

- The 2004 contour map suggests what was originally viewed as one bottleneck around 23rd Avenue may be two separate bottlenecks. This lightening of the color around post mile 35 shows higher speeds dividing the two slower speed areas.

- Both the 2003 and 2005 contour maps do not show this distinction. This could mean that the bottleneck at 23rd Street in fact extends all the way to the bottleneck upstream. .

- The queue behind the 23rd Avenue bottleneck grew in the AM peak period by 1-2 miles in 2005 compared to 2004.

- The Tennyson bottleneck denoted by (2) in the AM peak period grew in duration (i.e., the horizontal length of the dark area) in 2005 compared to 2004.

- The combination of the queue length growth at 23rd Avenue and the congestion duration at Tennyson are probably the main reasons why the AM peak congestion (in terms of hours of delay) increased between 2004 and 2005.

Before addressing the southbound direction, it is important to further analyze the AM peak 23rd Avenue bottleneck area to verify the existence of a second bottleneck and identify its location.

Exhibit A2-31 through A2-34 on the next page present daily speed contour plots zoomed to the specific bottleneck area in the AM peak period. Note that on some days (such as on October 17, 2005), it is impossible to distinguish between the two bottlenecks.

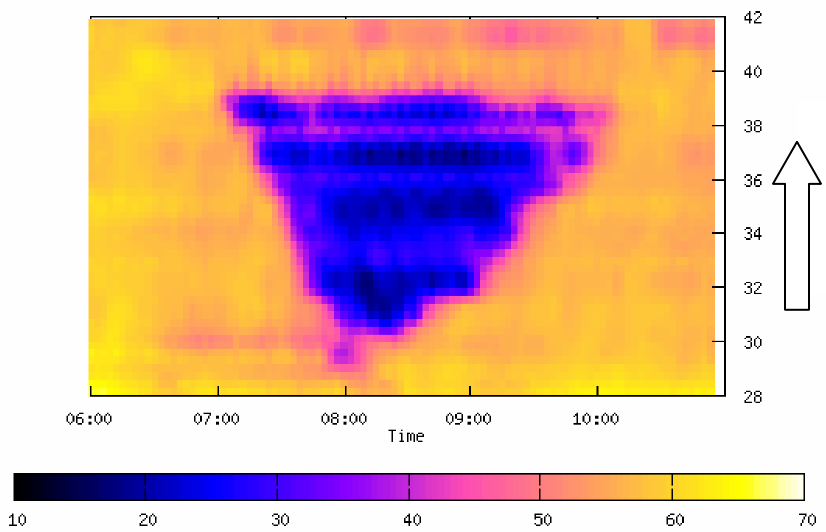
However, as different days are selected, a clearer pattern emerges that identifies two distinct bottlenecks:

- one is at 23rd Avenue (around absolute post mile 40)
- the other at Davis (around absolute post mile 34), which in effect is a hidden bottleneck when only analyzing monthly trends

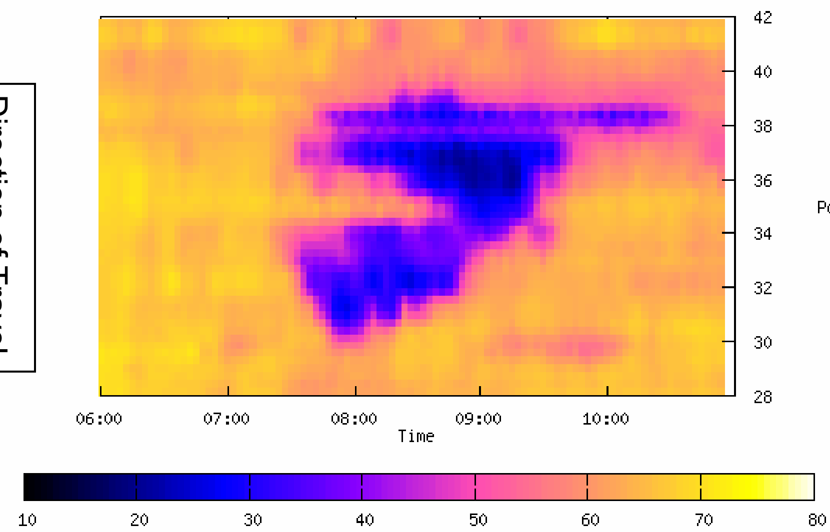
This determination needed to be confirmed with numerous field visits as mentioned before.

Exhibits A2-31, A2-32, A2-33, A2-34: Northbound AM Peak Speed Contour Plots

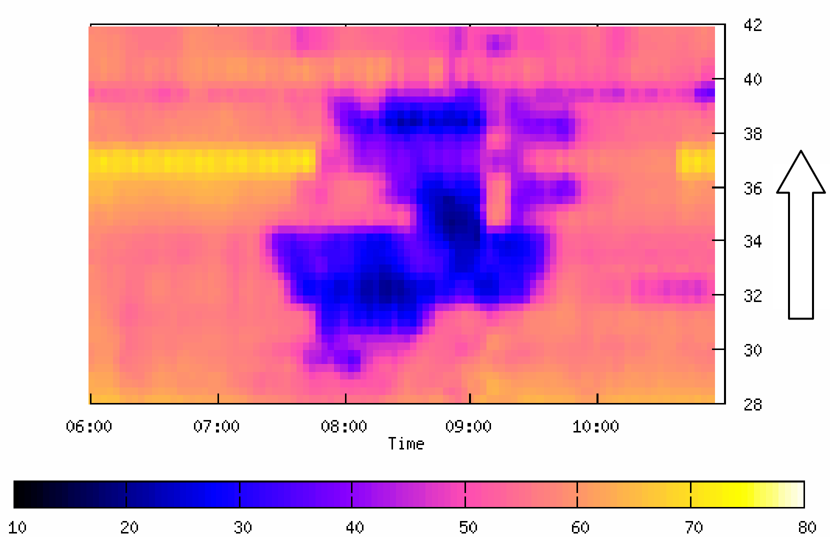
A2-31 – October 17, 2005 NB Speed Contour Plot



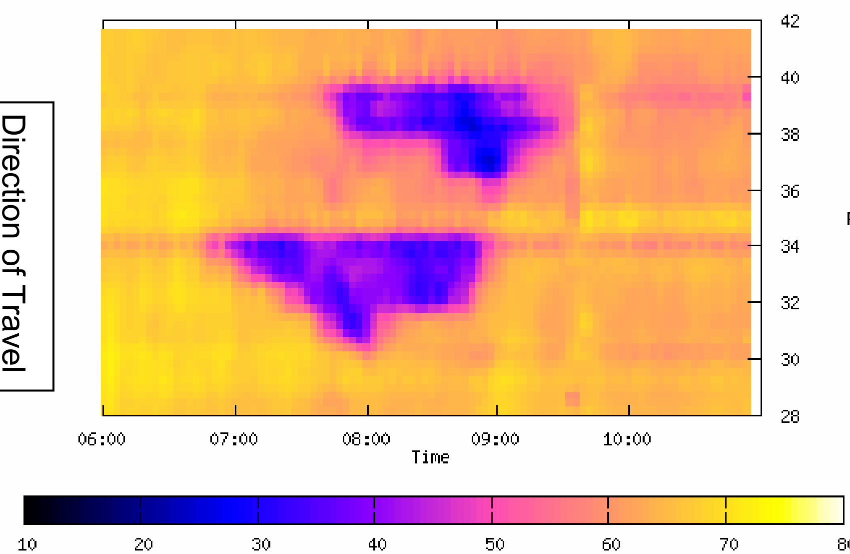
A2-32 – October 7, 2005 NB Speed Contour Plot

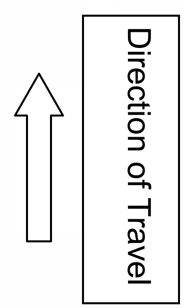


A2-33 – September 19, 2005 NB Speed Contour Plot



A2-34 – July 18, 2006 NB Speed Contour Plot





The next step is to verify these findings and determine the potential causes of these congested areas and its bottlenecks. By reviewing the aerial photographs of geometric layout and observing field traffic conditions during the congested hours several times, the specific locations of the bottlenecks can be verified and the potential causes can be investigated. Bottlenecks are discussed starting from the southern end of the study corridor and moving northbound.

Tennyson Interchange Bottleneck (Northbound AM and PM Peak around abs post mile 25)

The Tennyson bottleneck occurs both in the AM peak and the PM peak periods. In analyzing the Tennyson Road interchange, we again find two side-by-side on-ramps with high traffic volumes. However, unlike the Davis bottleneck, there is only a short on-ramp merge taper and split ramp metering systems that allows for platoons to occur at the merge. This is shown on Exhibit A2-35 below showing a photo taken during one of the field observation efforts.

Exhibit A2-35: Tennyson Merge Bottleneck

Again, during our field observations, we witnessed the speeds pick up after the merge congestion as shown on Exhibit A2-36.

Exhibit A2-36: Traffic Clearing after Tennyson On-ramps

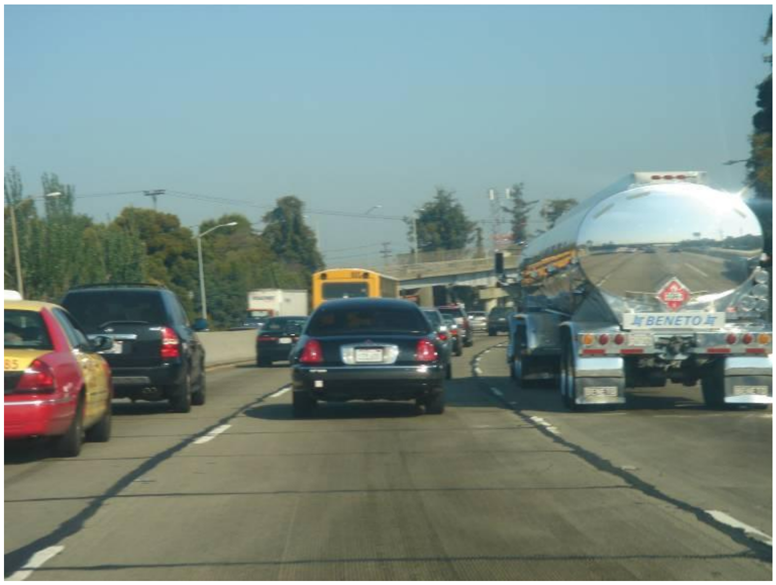
23rd Avenue Interchange Bottleneck (Northbound AM Peak at around abs post mile 40)

Investigating the 23rd Avenue interchange congestion, the aerial photograph on Exhibit A2-37 shows that the 23rd Avenue interchange is very "busy" with two closely spaced railroad overpass structures with sharp horizontal curves. There are two very close on-ramps with high volumes during the AM peak period.

Exhibit A2-37: Aerial of the 23rd Avenue Interchange

The high on-ramp merge traffic causes of the bottleneck and resulting congestion. Exhibit A2-38 is a photo taken during one of the field visits, and the photo shows that the traffic clears right after the on-ramps.

Exhibit A2-38: Traffic Clearing after 23rd Avenue On-ramps

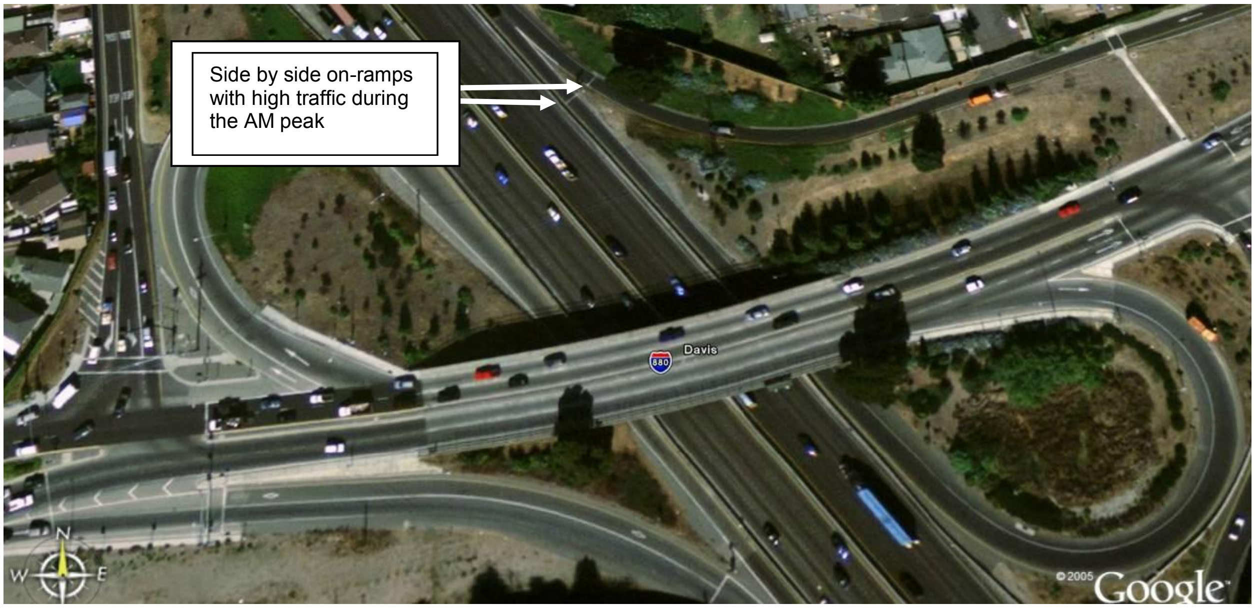


Davis Interchange Bottleneck (Northbound AM Peak at around abs post mile 34)

Identifying the location of this bottleneck was not easy. During several field visits, the 23rd Avenue bottleneck created queues that extended beyond the Davis interchange. As is the case with the some speed contour plots, when one bottleneck's queues extend back to another bottleneck location, the latter becomes "hidden".

After several field visits and reviewing aerials, the bottleneck was identified. The importance of identifying a "hidden" bottleneck must be emphasized. For if only the 23rd Avenue bottleneck were identified and a project were implemented that somehow relieves it, the Davis bottleneck would still cause congestion and become more visible. Exhibit A2-39 is an aerial of the Davis interchange.

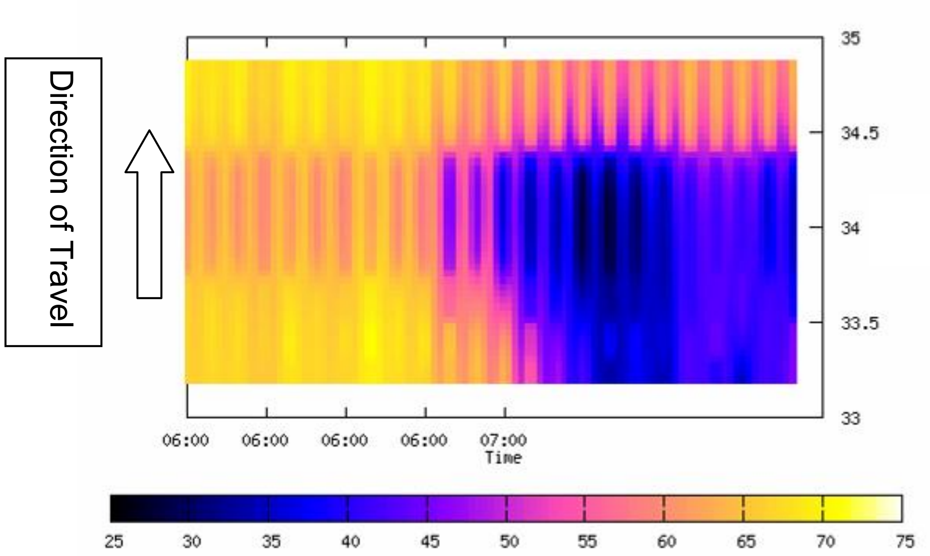
Exhibit A2-39: Davis Interchange Bottleneck (Northbound AM Peak)



Note that there are two on-ramps side-by-side at Davis with high traffic during the AM peak period. Generally speaking, one on-ramp with high traffic on a busy corridor can create slowdowns due to merging. With side-by-side on-ramps, despite a relatively long auxiliary lane to space the merging, the additional traffic creates the Davis bottleneck.

To check on the accuracy of our findings, a more detailed speed contour plot is shown below on Exhibit A2-40. Note that the speeds increase before absolute post mile 34.5. The Davis on-ramps are both at before 34.5. The speeds increase occurs past the auxiliary lane from which the merges occur.

Exhibit A2-40: Detailed Speed Contour Plot for Davis Bottleneck



Southbound Bottlenecks

Exhibits A2-41 through A2-43 show weekday speed contour plots for the month of November for years 2003, 2004, and 2005 in the southbound direction. From these plots, the preliminary identified major bottleneck areas are at the 98th and the Mission (SR-262) interchanges. A number of smaller bottlenecks are also present between absolute post mile 17 and 33 ending at around Tennyson.

The exhibits also show that the bottlenecks around the 98th and around Mission (SR-262) interchanges intensified in 2005 when compared to 2004 (note increased darkness denoting slower speeds for areas denoted as 1, 4, and 5). On the other hand, the bottlenecks between these two (i.e., the multiple bottlenecks between post mile 17 and 33) did diminish in 2005 compared to 2004 (note reduced dark areas in 2005 at these locations denoted by 2 and 3).

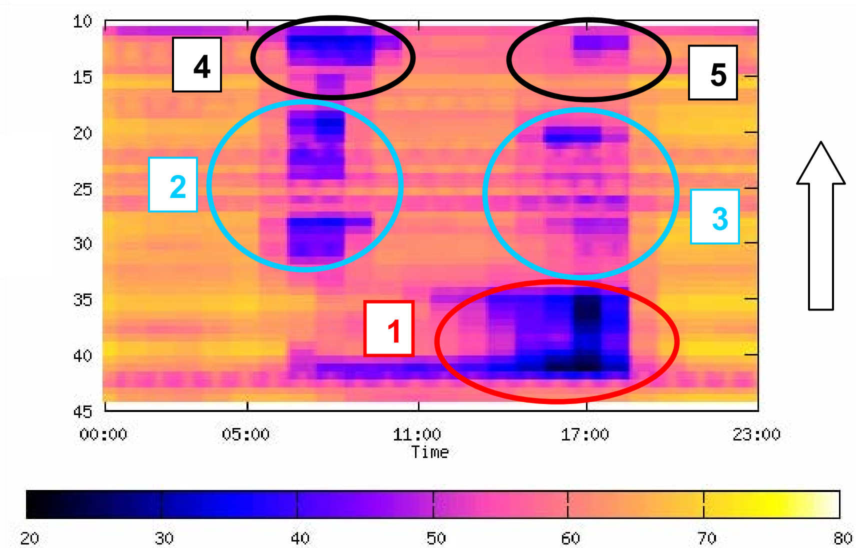
Analysis performed using 2006 and 2007 PeMS data indicates that improvements have mitigate some of the congestion for bottleneck number “1” described below.

As with the northbound bottlenecks, the southbound direction required further detailed analysis as well as numerous field observations to determine the specific locations of the bottlenecks, identify hidden bottlenecks if they do exist, and determine likely causes for these bottlenecks.

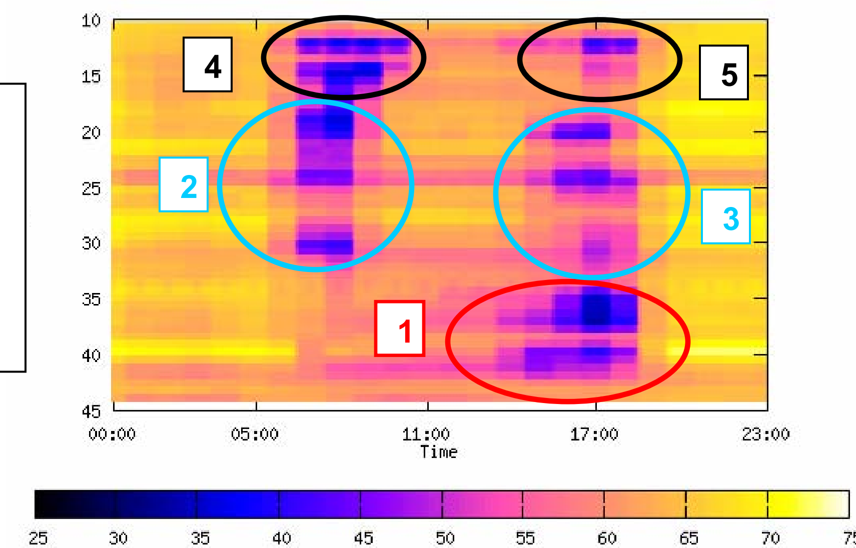
The results of these detailed analyses and field observations are shown following the speed contour plots on the next page starting from the north end of the study corridor and moving south.

Exhibits A2-41, A2-42, A2-43: Southbound Speed Contour Plots

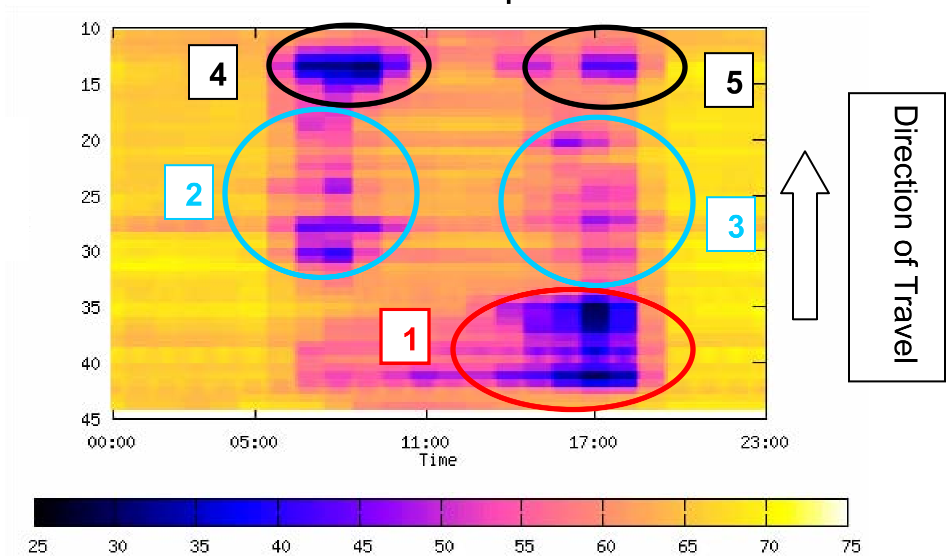
A2-41 – November 2003 SB Speed Contour Plot



A2-42 – November 2004 SB Speed Contour Plot



A2-43 – November 2005 SB Speed Contour Plot



- All three speed contour plots represent the monthly weekday averages for southbound direction.
- Areas denoted with 1 represents the preliminary 98th bottleneck in the PM peak period only
- Areas denoted with 2 and 3 represent the multiple smaller bottlenecks ending at Tennyson both in the AM and the PM peak periods
- Areas denoted with 4 and 5 represent the preliminary bottleneck at Mission Blvd – Rte 262

98th Avenue Bottleneck (Southbound PM Peak around abs post mile 34.5)

Originally, the study team believed this bottleneck to be at Marina/Davis on-ramps. However, after further review from the speed contour plots as well as field visits, it became evident that the bottleneck is actually at the 98th Avenue on-ramps. One way to ensure that the correct bottleneck has been identified is to look at speed data in 5-minute increments as shown in Exhibit A2-44 below. Note that the speeds start diminishing at 98th Street, not Davis or Marina (direction of travel is from bottom to top). By the time they get to Davis, speeds have already picked up. Also, note that the percentage of observed data is reasonable (i.e., more than 30 percent). Finally, note two separate speed reduction areas at 29th off-ramp to Fruitvale and at Oak. These locations and others (e.g., at Broadway) are occasional bottlenecks that do not always occur.

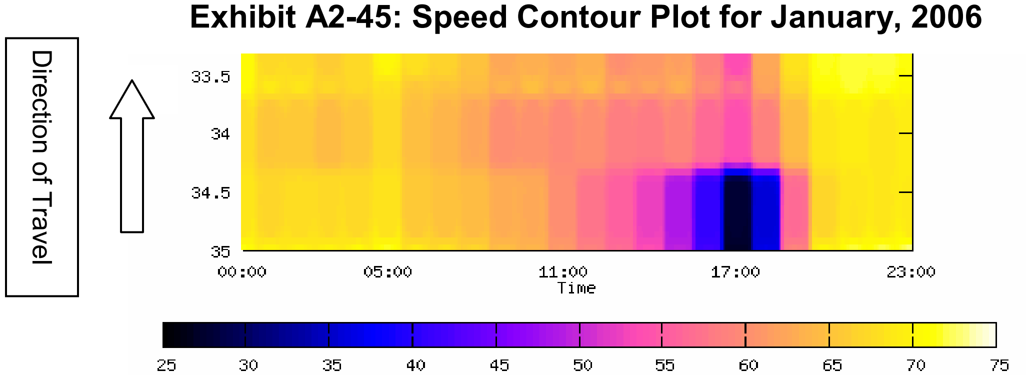
Exhibit A2-44: Five-Minute Speeds by Detector for January, 2006

Postmile (Abs)	Locattion	% Observed	15:30	15:35	15:40	15:45	15:50	15:55	16:00
30.187		39.8	54.7	55.1	54.8	54.2	53	52.8	52.3
30.557		80.4	59.2	59.2	59	58.6	57.9	57.1	56.8
30.877		0	59.4	59.3	59.3	58.8	58.1	57.4	57.2
32.357		0	61.7	61.9	61.7	62	62.4	62.5	62.9
32.727		77.5	59.1	59.6	59.7	60.6	60.6	60.6	60.8
32.947	Marina	71.1	57.8	57	56.2	55.4	54.9	54.5	55.8
33.427		77	60.7	60.3	59.2	57.6	56.7	56.3	57.9
33.577	Davis	44.2	61.3	61.6	60.6	59.7	59.6	59.2	60.5
34.827	98th	77.8	48.5	48.4	47.1	42.4	39.2	38	39.1
35.497		61.2	47.2	47.2	45.3	43.1	42	41	40.1
35.697		52.9	49.2	48.7	47	44.8	43.5	41.5	40.2
36.557		80.2	51.2	49.5	47.1	45.2	43	42.2	42.8
37.757		82.8	50.6	50	48.7	46.1	43.8	42.5	42.4
38.297		67.5	51.2	50.2	48.5	47.1	47.9	48	47.5
38.877	29th off-ramp to Fruitvale	91	47.1	47.4	43.9	42.8	42.9	42.7	41.8
39.107		71.1	50.8	50.5	48.1	46	46	44.9	44.1
39.327		35.6	54	53.8	52.5	52	51.8	51.6	51.8
39.977		38.5	59.9	59.9	59.3	59.7	59.8	60.2	60.7
41.187	Oak St	59	48	47.1	45.9	45.3	44.2	42.6	42.6
41.537		82.2	51.4	51	49.4	48.9	47.6	47.8	47.6
41.887		17.2	57.7	57.3	55.9	55.7	56.2	56.2	55.8
42.027		23.3	59.4	59.5	59	58.9	60	59.6	58.8
42.127		67.2	71.9	71.7	71.2	71.9	73.4	73.5	73.5
42.327		37.4	67	66.6	67	67.6	67.3	67.4	67.5

Direction of Travel

The 98th Street bottleneck can be further verified by the speed contour plot in Exhibit A2-45 below. Note that the darker areas denoting the slower speeds occur well before post mile 34, which means it cannot be at Davis (which is at around post mile 33.5).

Exhibit A2-45: Speed Contour Plot for January, 2006



Finally, Exhibits A2-46 and A2-47 show the likely cause of the bottleneck at 98th. The on-ramps from the eastbound and westbound directions are close to each other. In addition, the eastbound on-ramp includes two main lanes and one HOV lane. At peak demand, the high merge and weave activities cause the bottleneck.

Exhibit A2-46: 98th On-Ramp Bottleneck

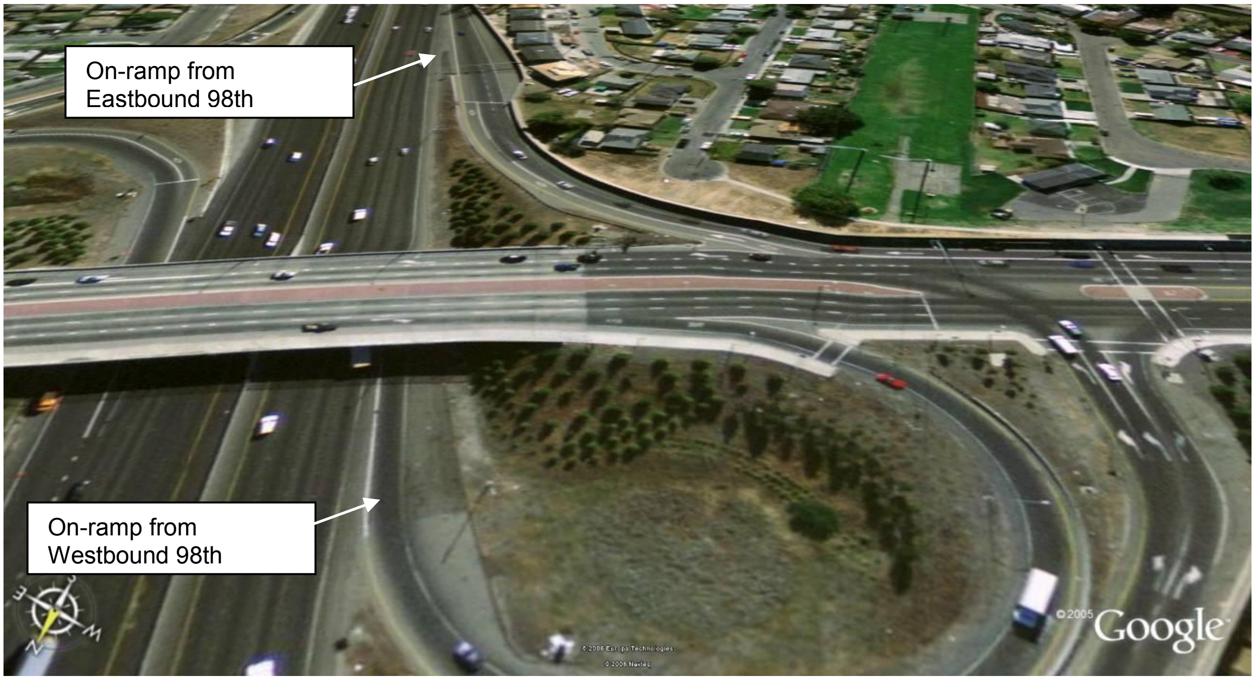
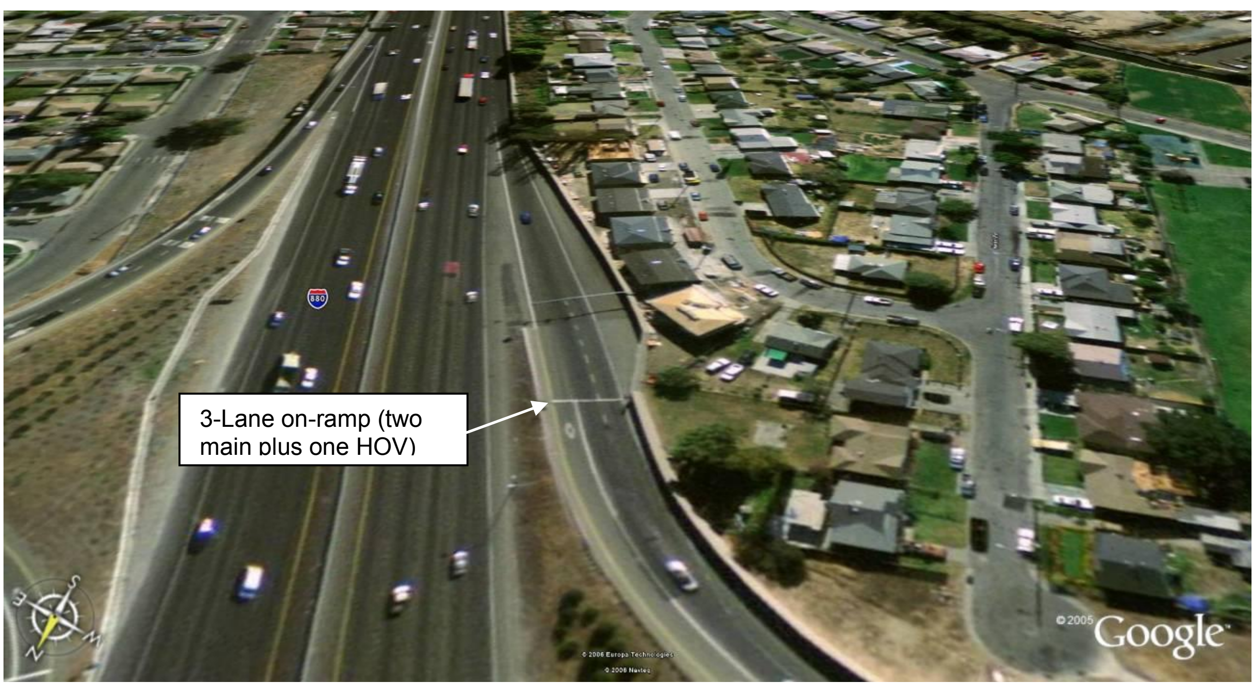


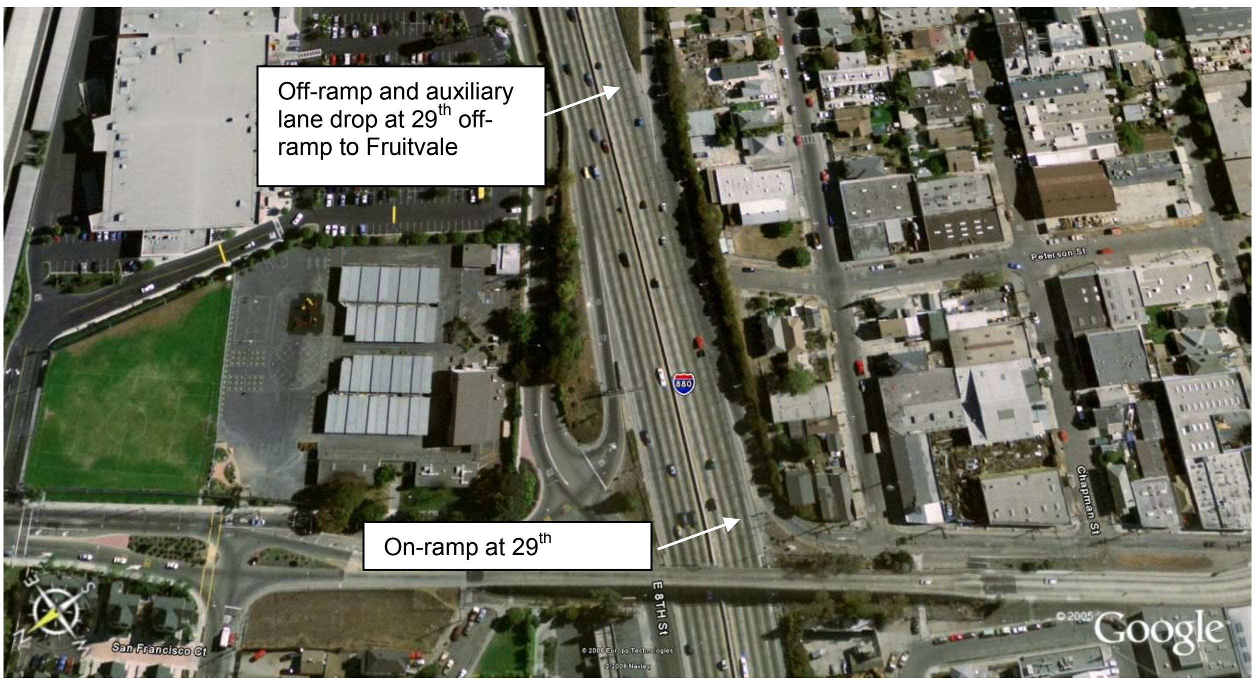
Exhibit A2-47: On-Ramp from Eastbound 98th



29th Avenue Off-Ramp Occasional Bottleneck (Southbound PM Peak at around abs post mile 38.8)

This occasional bottleneck is sometimes hidden by the queues from the 98th bottleneck. This off-ramp shown on Exhibit A2-48 allows travelers to exit I-880 and get to Fruitvale. The off-ramp includes an auxiliary lane drop, which contributes to the bottleneck and backs up traffic on I-880. In addition, the 29th on-ramp just north of the off-ramp forces drivers to merge left while drivers wishing to exit are forced to merge right. The combination and the demand during the peak period occasionally cause the bottleneck.

Exhibit A2-48: 29th Off-Ramp Bottleneck



Oak On-Ramp Bottleneck (Southbound PM Peak around abs post mile 41.2)

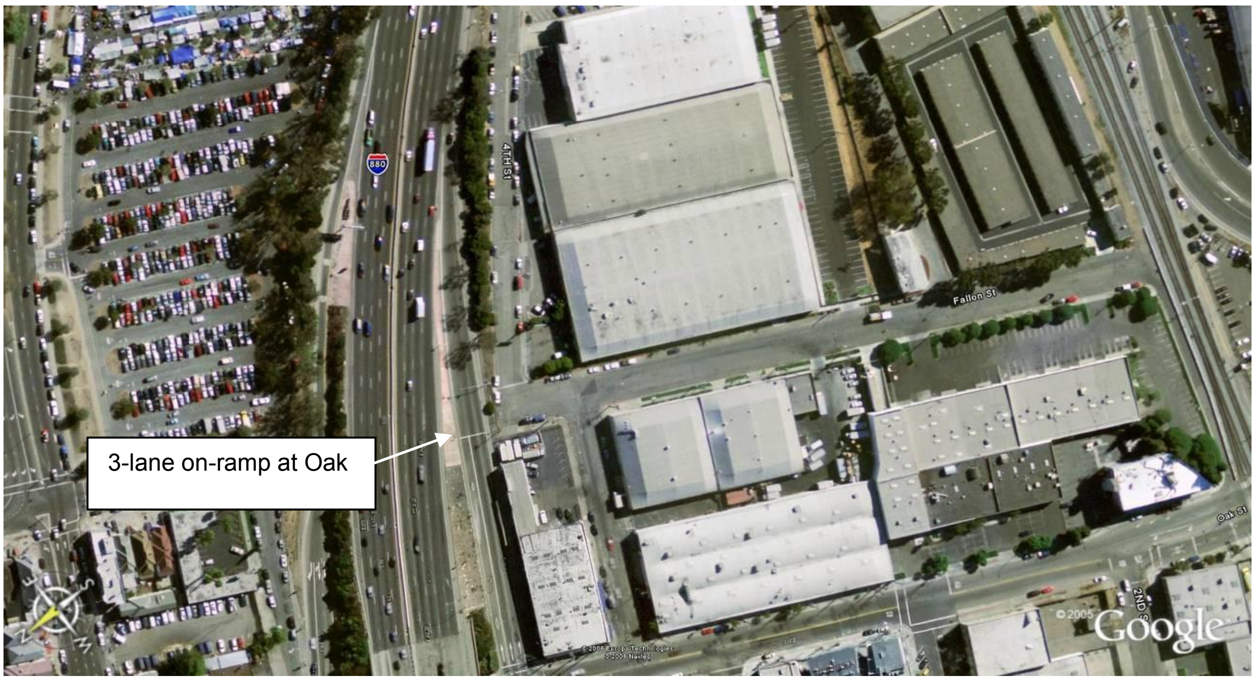
This occasional bottleneck is located is sometimes hidden by the combination of the 98th on-ramp and 29th off-ramp bottleneck queues. Exhibit A2-49 shows how the speeds drop at Oak and Broadway and the queue forms in the PM peak period.

Exhibit A2-50 shows the likely reason for this occasional bottleneck. Note the three lane on-ramp that merges into I-880 at Oak. When demand is already high, a three-lane on-ramp in total produces a high volume of vehicles which add merge and weave activities that sometimes produce the bottleneck.

Exhibit A2-49: 5-Minute Speeds for Oak On-Ramp Bottleneck

Postmile (Abs)	Postmile (CA)	Location	% Observed	16:00	16:05	16:10	16:15	16:20	16:25	16:30	16:35	16:40	16:45	16:50
38.877	28.65	29th off-ramp to Fruitvale	68.6	40.7	39.8	38.5	38.9	40	39.6	40	41.1	40.6	40	41.3
39.107	28.88		80.4	44.8	44.2	43.1	42	42.6	42	42.1	42.6	42.1	41.1	42.8
39.327	29.1		48.7	42.8	41.9	41.3	40.7	41.1	40.6	40.8	42	41.9	41.1	42.5
39.977	29.75		69.7	62.7	62.5	62.5	62.8	63	63.5	64.1	64.6	64.4	64.8	64.6
41.187	30.96	Oak	59.9	52.8	52.7	51.3	51.1	51.1	50.1	50.2	50.2	50.2	50.1	50.2
42.027	31.8		39.1	47.8	46.5	45.3	44.7	44.6	44.5	44.6	45.5	44.6	43.4	43
42.127	31.9		68.9	50.7	49.1	45.6	44.2	43.6	43.2	42.9	43.5	43.3	42.6	41.2
42.327	32.1		59.1	60.5	60.7	60.2	59.9	57.6	55.8	55.1	55.2	55.3	55.2	54.7

Exhibit A2-50: Oak On-Ramp Bottleneck



Multiple smaller bottlenecks ending at Marina (between abs post miles 33 and 17)

The next set of bottlenecks occurs in the morning and to a much lesser degree in the afternoon peak period. None of the bottlenecks is as severe as the previously discussed ones. However, they do occur on a regular basis. Exhibit A2-51 on the next page shows the 5-minute speeds for January, 2006 for that part of the corridor.

Note that speeds slow down considerably at Winton, West A Street, Hesperian, Tennyson, and up to Mowry. In 2003 and 2004, there were also considerable slowdowns at Whipple and Tennyson. Now only moderate slowdowns occur at Tennyson and Mowry during the AM peak.

These bottlenecks are generally caused by on-ramp traffic merges as shown on Exhibit A2-52 on the next page. The exhibit shows the Winton on-ramps (from both directions). Note that the eastbound on-ramp auxiliary lane ends and forces traffic to merge left, which causes the bottleneck during peak demand conditions.

Exhibit A2-51 – Smaller Bottlenecks (Southbound AM)

Postmile (Abs)	Postmile (CA)	Location	% Observed	07:30	07:35	07:40	07:45	07:50	07:55	08:00	08:05	08:10	08:15	08:20	08:25
17.337	7.11	EB Mowry	91.4	56.5	55.4	52.8	50.6	50.3	51.2	51.8	52.2	52.4	52.8	53.4	52.7
17.527	7.3		91.7	57.4	57.3	55.9	53.8	52.8	53.1	53.5	54	54.6	55.3	56.1	55.5
18.907	8.68		79.1	55	52.2	47.7	44.2	43.5	43	43.5	44.9	45	45.1	45.8	45.9
19.097	8.87		78.7	59.1	57.1	51.7	47.6	45.8	45.1	45.7	46.7	45.9	46	46.2	47.1
20.127	9.9		50.4	57.1	56.9	56.7	56.3	53.1	52.6	52.2	52.5	53.3	54.5	53.6	53.7
20.347	10.12		79.8	59.2	59.4	58.9	56.1	50.8	47.9	47.1	47.7	48.7	49.8	49.8	49
20.547	10.32		80.3	61.2	60.9	60.4	58.9	55.9	53.5	52.7	52.9	53.4	54.1	53.6	53.3
21.277	11.05		91.1	62.7	62.3	62.2	61.4	60.9	60.1	59.6	58.8	59.5	59.5	59.5	59.6
21.647	11.42		77.9	55.6	55	55.3	52.6	50.8	48.7	47.8	47	47.7	47.7	47.1	46.7
21.817	11.59		32.6	54.8	54.1	54	52.4	50.5	48.7	48.1	47.2	46.9	46.4	45.1	44.1
22.227	12		5.4	58.9	58.2	58	58.1	56.3	56.8	57.1	57.5	56.9	57.2	56.9	56.4
22.527	12.3		80.3	53.4	51.5	51.8	52.6	51.9	52.1	51.3	51.1	50.6	49.9	50.5	49.5
22.777	12.55		60.3	52.4	51.6	50.1	49.1	48.5	50.3	50.5	49.5	48	47.1	47.9	47.8
23.167	12.94		74.5	58.5	57.7	57.3	55	55.6	56.6	57.4	55.1	53.9	53.2	53.2	53.2
23.327	13.1		80.4	59.7	59	59.4	58.3	59.2	59.5	60.7	59.1	57.4	56.8	55.8	56.3
23.767	13.54		79.8	53.8	53.3	53.7	53.9	54.6	54.7	54.7	54	53.1	52.2	51.4	51.6
24.477	14.25		51.9	52.7	52.3	52.2	51.5	51.6	51.4	51.6	51.6	51.2	51	51.6	51.6
24.767	14.54		84	55	55.4	55.9	55.9	56.3	56.5	56.6	56.7	57.5	57.1	56.6	55.6
25.177	14.95		80.2	58.2	58.5	58.8	58.8	59.2	59.4	59.1	59	59.9	59.7	58.3	57.7
25.727	15.5	Tennyson	61.6	44.8	44.7	44.8	45	44.8	44.3	44.6	44.7	44.6	44.4	43.8	43.1
26.027	15.8		80	60.6	60.9	59.8	60.1	59.4	59.9	59.4	59.6	59.1	59	58.3	58.1
26.287	16.06		59.8	56.5	56.2	55.7	55.6	54.1	54.2	54.8	55.4	55.2	54.6	54.9	55
26.467	16.24		43.1	57.4	57.1	56.8	56.7	54.7	53.3	53.7	54.4	54.1	53.6	54.3	55.2
26.677	16.45		16.1	56.8	56.2	55.5	55.3	54.7	52.9	53.1	53.4	53.4	52.6	53.6	54.5
27.037	16.81	SR92/Jackson	73.3	53.7	54.2	53.3	53.1	53.4	53.4	53.6	53.2	52.9	52.4	52.8	53.3
27.337	17.11	Winton	70.4	38.2	38.4	38.1	38.1	40	41.3	41.6	41.3	40.4	39.6	39.3	39.4
27.707	17.48	Winton	89.9	39.7	38.6	38.5	38.9	40.3	42	42.3	41.5	41.5	41.4	41.2	40.8
28.047	17.82	Winton	71.3	49.8	48.1	48	48.5	49.4	51.1	51.4	51.2	51.2	50.8	51.2	50.9
28.217	17.99		41.2	58.2	57.9	57.4	57.8	57.8	58.1	58	58.1	57.8	56.9	57.6	57.5
28.477	18.25	West A Street	91.2	41.9	40	38.9	37.6	36.6	37.7	40.3	41.1	41.6	42	42.8	43
28.947	18.72		64.3	53.3	52.4	51.2	50.8	49.8	50.4	51.9	54	54.9	54.6	54.4	54.4
29.267	19.04		56.3	50.7	50.5	48.4	48.1	46.4	46.8	48	50.2	50.4	49.7	50.1	50.3
29.597	19.37	Hesperian	78.1	49.7	47.9	46.1	45.7	44.8	45.7	46.6	48.6	49.2	48.9	48.2	48.7
29.907	19.68	Hesperian	63.6	47.4	45.5	44.3	43.3	42.9	42.6	43	44.5	44.9	45.7	44.9	44.3
30.187	19.96	Hesperian	39.8	44	41.8	41.1	39.6	39.4	39.2	39.2	39.5	40	40.8	40	39.5
30.557	20.33		80.4	45.9	44	42.5	41.8	40.3	38.9	39.7	39.7	40.3	40.3	40.3	40.2
32.727	22.5	Marina	77.5	54.1	47.5	43.2	39.6	37.3	35.7	34.7	34.3	36.3	37.6	36.4	40.5
32.947	22.72	Marina	71.1	61.5	60.8	60.5	59.2	58	56.7	56.2	55.6	54.6	53.9	54.1	54.1

Exhibit A2-52 – Winton On-Ramp Occasional Bottleneck

Mission Blvd - Rte 262 Bottleneck (Southbound AM and PM Peak around abs post mile 12)

In further analyzing this bottleneck it becomes apparent that the darker area with slower speeds represents two separate bottlenecks. The first is indeed at Mission Blvd at the Rte 262 interchange. The second is at the Fremont interchange. Reaching this conclusion was somewhat challenging because of changes in detection data.

The next page explains these challenges and our conclusions, which were also verified with field observations:

- Exhibit A2-53 on the next page shows 5-minute speeds by detector for the month of October, 2004. For each detector, it also identifies the percentage of "observed" data. This refers to the percent of the data that was actually received from the detector station. So for instance, the detector at post mile 11.402 only had 15.8 percent of the data received from the field. PeMS does estimate the remainder, although when it estimates a high percentage, the results may not be correct. Note how there are two separate sets of detectors that report deteriorating speeds. The first set starts at absolute post mile 11.402. This detector represents the Mission Blvd interchange. The speeds diminish to below 30 miles per hour. However, at post mile 12.657, which has almost 80 percent observed data, speeds pick up again to above 60 miles per hour. Then at post mile 13.277, speeds diminish again. This detector represents the Fremont interchange. Clearly, speeds recover between the two bottlenecks.

- Exhibit A2-54 shows the same type of data for the month of March, 2005. The same trend is shown with two distinct bottleneck areas and speeds recovering between them.

- However, Exhibit A2-55 representing October, 2005 no longer shows any detection at post miles 11.402, 12.467, or 12.657. Furthermore, it shows that zero observed values for post mile 12.182. Hence, it appears that there is only one bottleneck since the Mission Blvd interchange no longer produces any data.

- Exhibit A2-56 further illustrates this point. The exhibit represents March, 2006 data and no longer shows any detection at post mile 12.182.

This analysis underscores the need to verify any detection related conclusions with observed data. If the study team had relied on 2005 and 2006 detection data, it is likely that it would have identified only the Fremont Blvd bottleneck.

But in fact, there are two separate bottlenecks. The Mission Blvd bottleneck queue sometimes (e.g., November 2003 on Exhibit A2-47) extended beyond the Fremont bottleneck. Also note from the Exhibits A2-47 through A2-49 that the bottleneck speeds at Fremont were lower (with darker color) in 2005 compared to 2004. This accounts for some of the delay increases reported as part of the corridor-wide results in this section.

Exhibit A2-53: 5-Minute Speeds by Detector Southbound at/near Mission Blvd - October 2004

Postmile (	Postmile (	VDS	% Observed	06:20	06:25	06:30	06:35	06:40	06:45	06:50	06:55	07:00	07:05	07:10	07:15	07:20	07:25	07:30	07:35	07:40
10.21	10.21	401642	0	64.5	64.1	64.2	63.9	64	64.3	64.4	64.1	64.2	64.1	63.8	63.8	64	63.9	63.7	63.5	63.1
10.542	0.04	401637	0	65.5	65.3	65	64.9	64.9	65	65	65.2	65.1	64.8	64.3	63.8	63.3	62.8	62.3	61.5	60.7
11.052	0.55	401647	0	64.2	64	63.3	62.6	62.5	62.4	62.4	62.5	62.2	62	61.9	61.6	61.4	60.8	60.3	59.7	59
11.402	0.9	401648	15.6	60.7	59.7	57	53.1	50	48	46.6	46.2	44.6	45.2	46	46.2	46.7	46.2	45.8	45.2	45.2
12.182	1.68	400371	84.8	58.7	56.5	53.8	48.9	40.5	35.2	29.6	29	29.1	29.7	29.2	28.9	28.2	27.2	25.9	23.1	22.9
12.467	2.24	400077	0	62.1	61.3	61	60.1	58.2	57.2	55.8	55.5	55.5	55.4	54.9	54.6	54.6	54.2	53.9	53.5	53.7
12.657	2.43	401080	83.7	65.6	64.7	64.7	64.5	65	65.1	65.3	65.7	66.1	65.8	65.3	65.3	65.8	65.3	65.2	65.8	65.3
13.277	3.05	400409	17.7	61.2	59.7	59.4	58.7	57	53.4	52.5	51.3	50.8	50.3	47	45.1	44	43.7	43.1	41.7	41.8
13.467	3.24	400941	28	62	61	60.1	57.6	55.3	51.7	50.5	49.2	48.9	48.4	42.7	39.5	37.1	36.1	35.2	32.5	31
14.257	4.03	400698	53.4	59.6	58.8	58.4	55.5	54.8	53.8	51.8	51.1	49.5	47.8	46.3	44.6	43.5	40.6	40.7	39	37
14.807	4.58	400363	40.9	59.8	58.8	58.1	57.5	56.3	55	54.1	52.4	52.1	50.2	50.4	49.7	44.8	42.3	38.7	36.7	34.9

Exhibit A2-54: 5-Minute Speeds by Detector Southbound at/near Mission Blvd - March 2005

Postmile (	Postmile (	VDS	% Observed	06:20	06:25	06:30	06:35	06:40	06:45	06:50	06:55	07:00	07:05	07:10	07:15	07:20	07:25	07:30	07:35	07:40
10.21	10.21	401642	39.8	78	77.8	77.6	77.7	77.5	76.9	77.5	78	78.3	78.3	78.2	77.9	77.6	77.7	77.7	77.8	78.1
10.542	0.04	401637	0	67.7	67.3	66.8	66.8	66.3	66	66.3	66.8	66.9	66.9	66.6	66.5	66.2	66.1	65.7	65.7	65.5
11.052	0.55	401647	0	62.9	62.1	61.4	60.5	59	58.2	57.2	57.6	57.9	58	57.8	58.1	58.7	58.6	57.7	58.2	58.3
11.402	0.9	401648	79.5	63	61.3	59.6	57.1	54.3	51.6	51.1	51.9	52.3	52.2	51.7	52.4	53.7	53.5	51.7	52.5	52.9
12.182	1.68	400371	77.5	60.7	58.2	55.4	51.7	45.8	38.3	32.3	32.4	31.8	30.7	30.7	30.7	30.8	30.4	29.1	27.9	27.8
12.467	2.24	400077	0	63	61.8	61.6	60.7	59.7	57.9	56.3	55.8	55.8	55	54.5	54.2	54.5	54.6	54.7	54.4	54.4
12.657	2.43	401080	79.7	67	66.8	66.8	66.6	67	66.5	67.1	67.4	67.8	67.8	67.1	66.6	66.5	66.3	66.3	65.9	65.6
13.277	3.05	400409	75.7	64.6	63.6	62.3	59.8	58.6	56.2	53.3	51.1	49.6	48.3	46	42.2	38.9	36.3	35.5	32.9	30.4
13.467	3.24	400941	80.5	65.9	64.8	63.6	62	60.1	58.8	57.2	55.4	53.4	51.6	49.2	46	42.7	39.8	37.4	34.3	32
14.257	4.03	400698	78.4	64.8	63.6	61.5	60.3	59.5	59.3	60	60.1	59.5	58.3	57.1	55.4	53.5	52.3	49.2	47	43.7
14.807	4.58	400363	82.1	64.8	63.5	60.9	59.9	58.8	58.4	58.9	59.9	59.6	58.1	57.4	57.4	56.2	54.6	52.1	50.8	49.7

Exhibit A2-55: 5-Minute Speeds by Detector Southbound at/near Mission Blvd - October 2005

Postmile (	Postmile (	VDS	% Observed	06:20	06:25	06:30	06:35	06:40	06:45	06:50	06:55	07:00	07:05	07:10	07:15	07:20	07:25	07:30	07:35	07:40
10.21	10.21	401642	92.7	61.7	61	60.3	60.3	60.4	60.8	60	59.7	58.9	57.9	57.5	57.9	58	57.7	57.7	57.5	57.7
10.542	0.04	401637	0	59.6	59.3	58.8	58.8	58.7	58.9	58.6	58.4	57.9	57.4	57	57.1	56.9	56.6	56.6	56.6	56.7
12.182	1.68	400371	0	63.2	62.8	61.6	58.5	54.7	51.2	48.9	47.9	48.6	48.3	48.5	48.5	49.1	48.2	47.2	44.6	43.5
13.277	3.05	400409	89.2	62.2	61	58.2	50.6	41.2	33.7	27.9	27	27.6	26.6	26.9	27	26.8	25.8	23.6	20.7	18.9
13.467	3.24	400941	87.8	63.9	62.7	60.1	55.2	47.4	40.1	35.2	32.4	32	30.8	30.6	30.5	30.3	28.4	26.4	24.1	22.5
14.257	4.03	400698	91.8	61.2	59.7	56.9	53.2	49.6	45.6	41.4	39.2	37.8	39.7	39	37	35.2	33.6	32.5	32.6	32.3
14.807	4.58	400363	92.9	62	60.2	57.6	55.5	54.1	51.3	48.3	46	46.3	48	49.4	48.4	44.9	42.6	39.9	37.7	36.4

Exhibit A2-56: 5-Minute Speeds by Detector Southbound at/near Mission Blvd – March 2006

Postmile (	Postmile (	VDS	% Observed	06:20	06:25	06:30	06:35	06:40	06:45	06:50	06:55	07:00	07:05	07:10	07:15	07:20	07:25	07:30	07:35	07:40
10.21	10.21	401642	86.3	70.7	70.2	70.1	69.7	69.5	69.4	69.6	69.5	68.9	68.3	67.6	67.6	67.5	67.4	67.8	67.2	67.1
10.542	0.04	401637	0	66.1	65.7	65.3	64.5	63.7	63	62.7	62.6	62.4	62.6	62.3	62	60.8	60.1	59.8	59.1	58.8
13.277	3.05	400409	73.6	59.6	58.4	55.7	52.1	47.7	42.7	40.3	41.3	40.5	41.4	41.6	39.2	35.8	33.1	29.8	26.9	25.1
13.467	3.24	400941	88.3	64.1	63.3	60.3	57.7	54	50.2	48.2	47.9	47.4	48.3	48.4	46.5	42.1	39.8	36	32.6	30.1
14.257	4.03	400698	73.3	63	62.3	60.8	59.5	59.2	58.8	56.4	56.7	57.5	58.2	59.1	57.7	54.5	52.1	50.1	48.1	46.3
14.807	4.58	400363	91.5	59.6	58.2	56.8	56	55.2	56	55.2	55.7	55.4	55.4	55.1	54.2	54	53.4	51.8	50.3	48.5

Traveling southbound, a traveler experiences the Fremont interchange first as in Exhibit A2-57. The on-ramp for this interchange is quite large with 3 lanes (2 SOV, 1 HOV). The merge from this on-ramp leads to the congestion with queues as long as 1-2 miles.

Exhibit A2-57 – Southbound Bottleneck at the Fremont Interchange

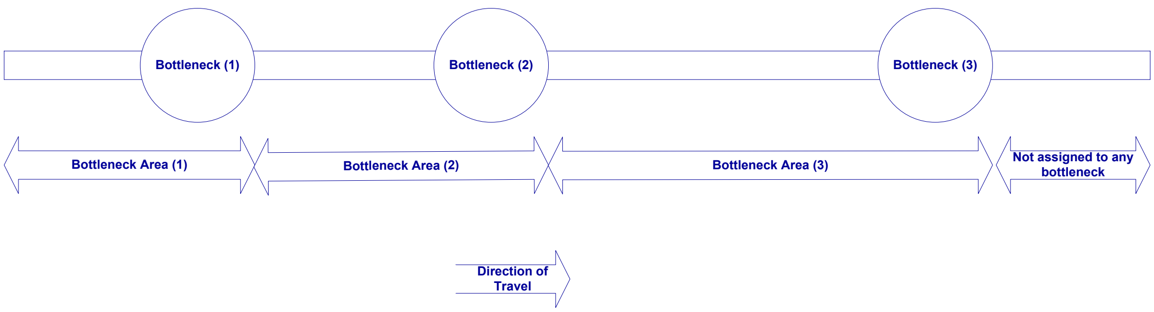
Around one mile after the Fremont interchange, the traveler arrives at the next bottleneck at the Mission/Rte-262 interchange. The reason for this bottleneck can be attributed to the merge activities from the Mission/Rte 262 on-ramp as well as another on-ramp just after it at Gateway Blvd as shown on Exhibit A2-58 below.

Exhibit A2-58: Southbound Bottleneck at the Mission/Rte 262 Interchange

Bottleneck Areas

In order to get a sense of priority among bottlenecks, the study team also re-analyzed the delay and collision data and divided them into “bottleneck areas”. Bottleneck area is a term used here to define a portion of the freeway from one bottleneck to another as depicted in Exhibit A2-59. Note that occasional bottlenecks (e.g., at Oak) have been included as part of the more severe bottlenecks. Also, the multiple, smaller bottlenecks between absolute post miles 25 and 33 are considered one single bottleneck area. Finally, when two bottlenecks are very close to each other such as the case with Fremont and Mission Blvd southbound in the AM, these were combined into one bottleneck area (since we do want to address them concurrently to the extent possible).

Exhibit A2-59: Dividing Corridors into Bottleneck Areas



Based on this approach, the following is a listing of bottleneck areas:

Northbound

From			To			Description	Designation	Bottleneck Period
Abs	CA	County	Abs	CA	County			
8.4	8.4	Santa Clara	26.5	16.3	Alameda	From 237 to Tennyson	Tennyson Bottleneck (N1)	AM and PM Peak
26.5	16.3	Alameda	34.0	23.8	Alameda	From Tennyson to Davis	Davis Bottleneck (N2)	AM only
34.0	23.8	Alameda	40.0	30.0	Alameda	From Davis to 23rd	23rd Bottleneck (N3)	AM only
40.0	30.0	Alameda	44.0	34.0	Alameda	From 23rd to 7th	Not a bottleneck at all (N4)	None

Southbound

From			To			Description	Designation	Bottleneck Period
Abs	CA	County	Abs	CA	County			
44.0	34.0	Alameda	34.8	24.6	Alameda	From 7th to 98th	98th Street Bottleneck Area (S1)	PM Peak Only
34.8	24.6	Alameda	17.0	6.8	Alameda	From 98th to Marina	Multiple Bottleneck Area (S2)	AM and PM Peak
17.0	6.8	Alameda	11.0	0.8	Alameda	From Marina to Dixon Landing (south of Mission/Rte 262)	Fremont and Mission/Rte 262 Bottleneck Area (S3)	AM and PM Peak
11.0	0.8	Alameda	8.4	8.4	Santa Clara	From Automall to SR 237	Not a bottleneck area at all (S4)	None

A3. SCENARIO DRAWINGS

The remainder of this section shows the coding changes incorporated into the microsimulation project scenarios 7A, 8A, and 9A as discussed in Section 2.

Exhibit A3-1: Scenario 7A Changes Coded at 23rd Avenue

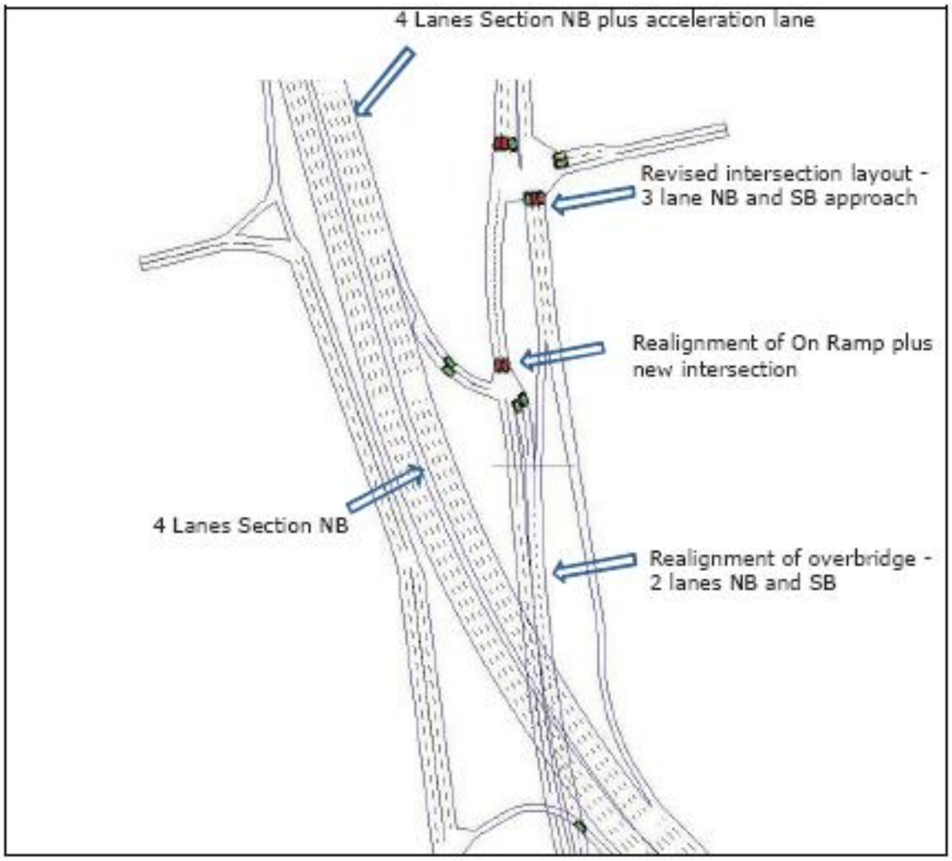


Exhibit A3-2: Scenario 7A Changes Coded at 29th Avenue

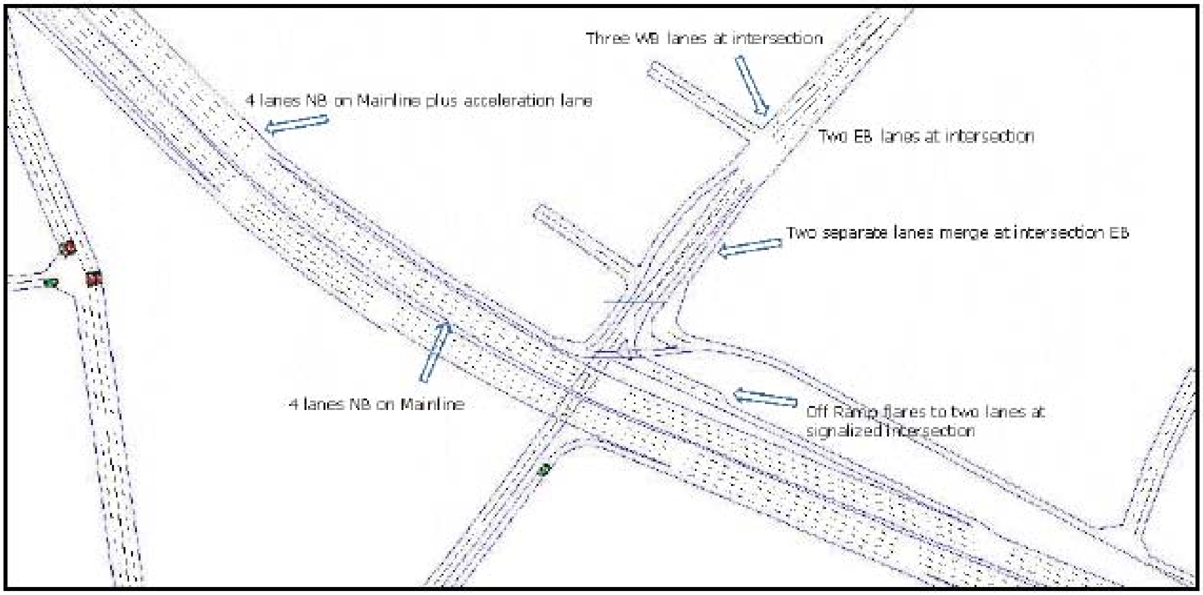


Exhibit A3-3: Scenario 8A Changes Coded - Auxiliary Lanes Paseo Grande to Winton Avenue

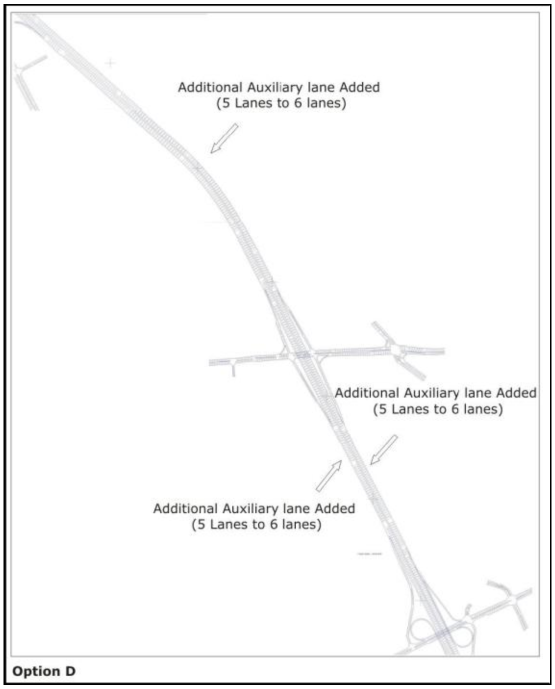


Exhibit A3-4: Scenario 8A Changes Coded - Auxiliary Lanes Whipple Road to Industrial Parkway West

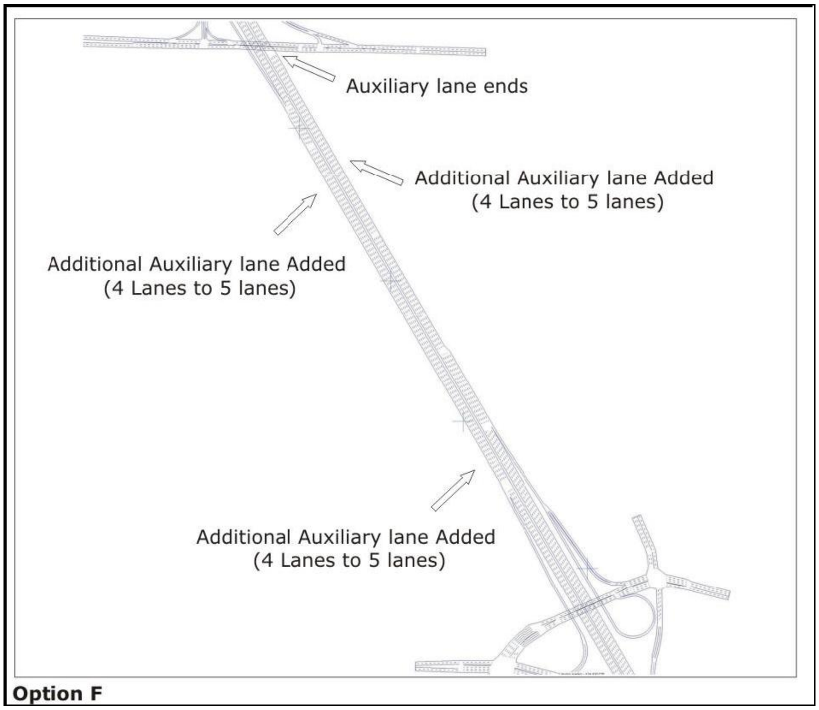


Exhibit A3-5: Scenario 8A Changes Coded - I-880/Whipple Road Interchange

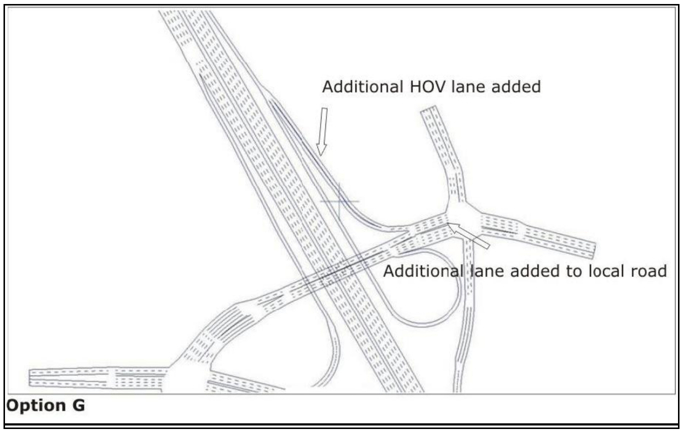


Exhibit A3-6: Scenario 8A Changes Coded - I-880/West A Street Interchange

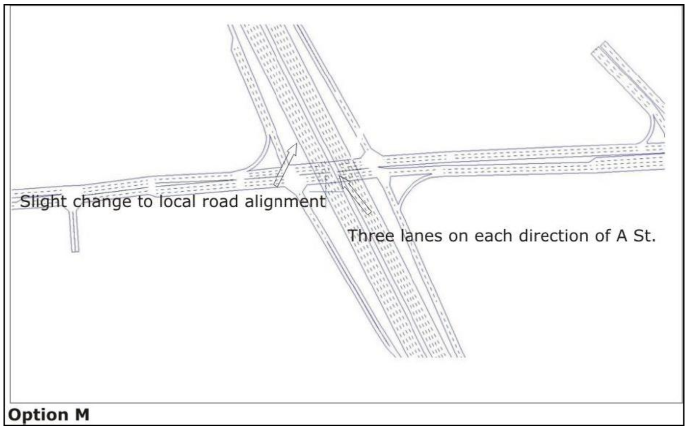


Exhibit A3-7: Scenario 8A Changes Coded - I-880/West Winton Avenue Interchange

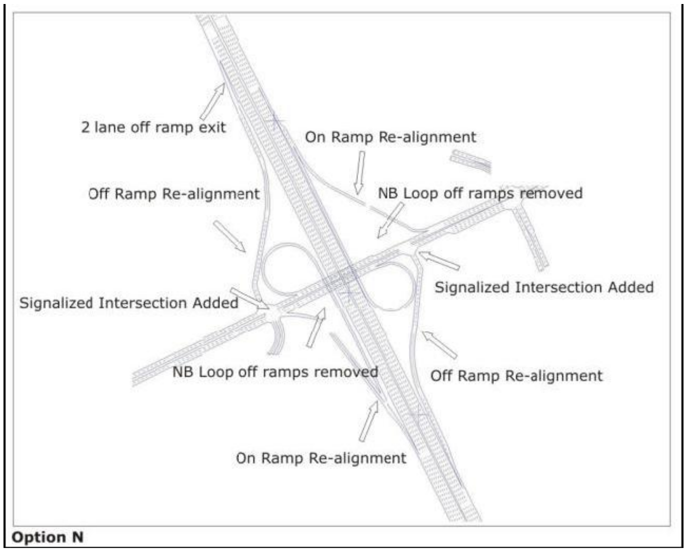


Exhibit A3-8: Scenario 9A Changes Coded - Hegenberger Street Interchange to 98th Avenue Interchange

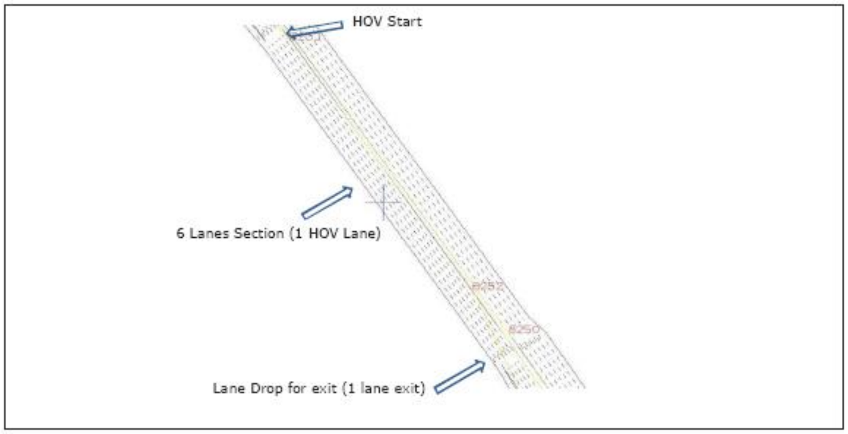


Exhibit A3-9: Scenario 9A Changes Coded - 98th Avenue Interchange

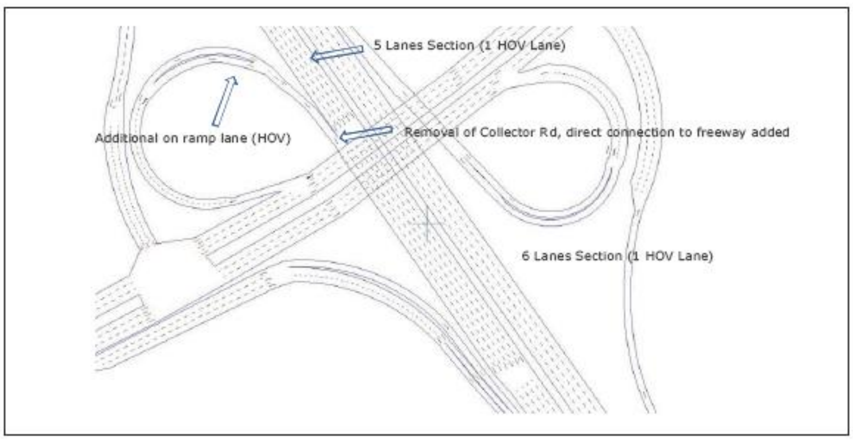


Exhibit A3-10: Scenario 9A Changes Coded - 98th Avenue Interchange to Davis Street Interchange

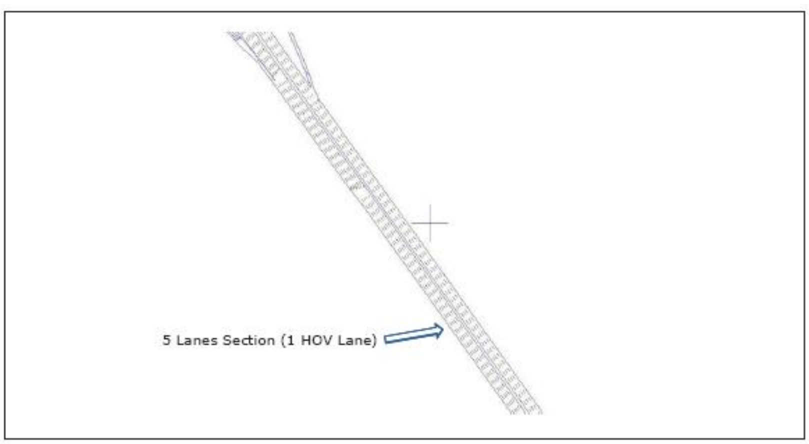


Exhibit A3-11: Scenario 9A Changes Coded - 98th Avenue Interchange to Davis Street Interchange

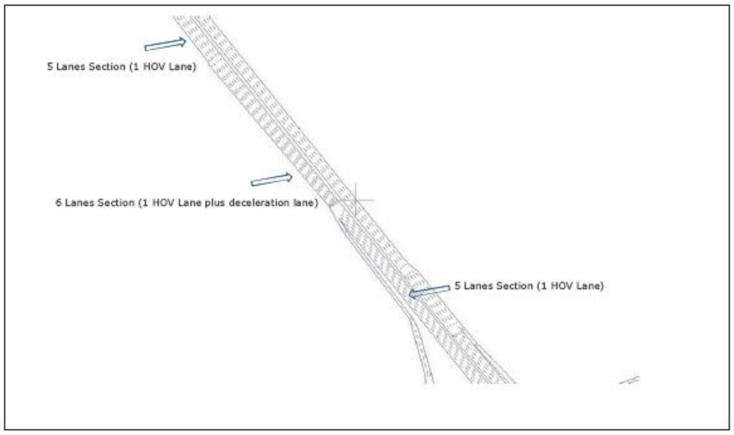


Exhibit A3-12: Scenario 9A Changes Coded - Davis Street Interchange

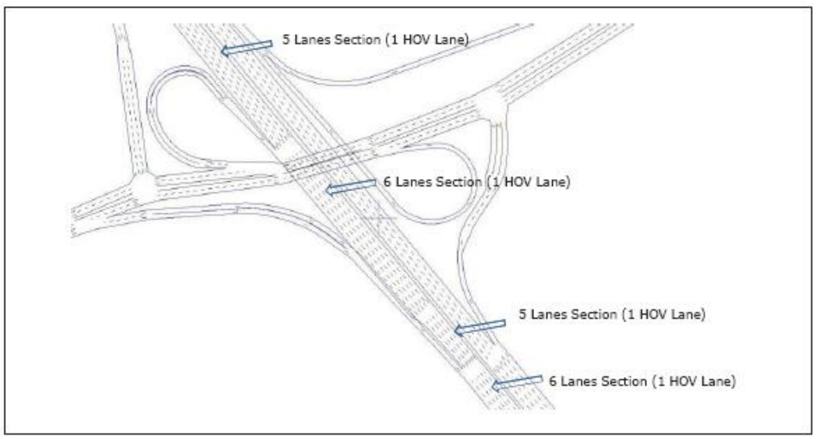


Exhibit A3-13: Scenario 9A Changes Coded - Davis Street Interchange to Marina Blvd Interchange

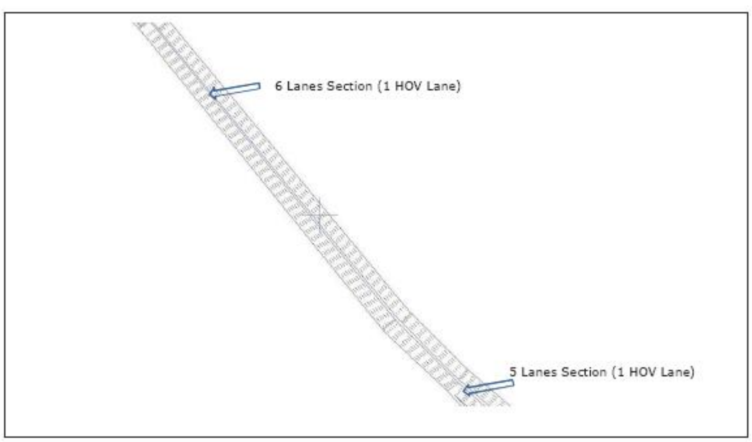


Exhibit A3-14: Scenario 9A Changes Coded - Marina Blvd Interchange

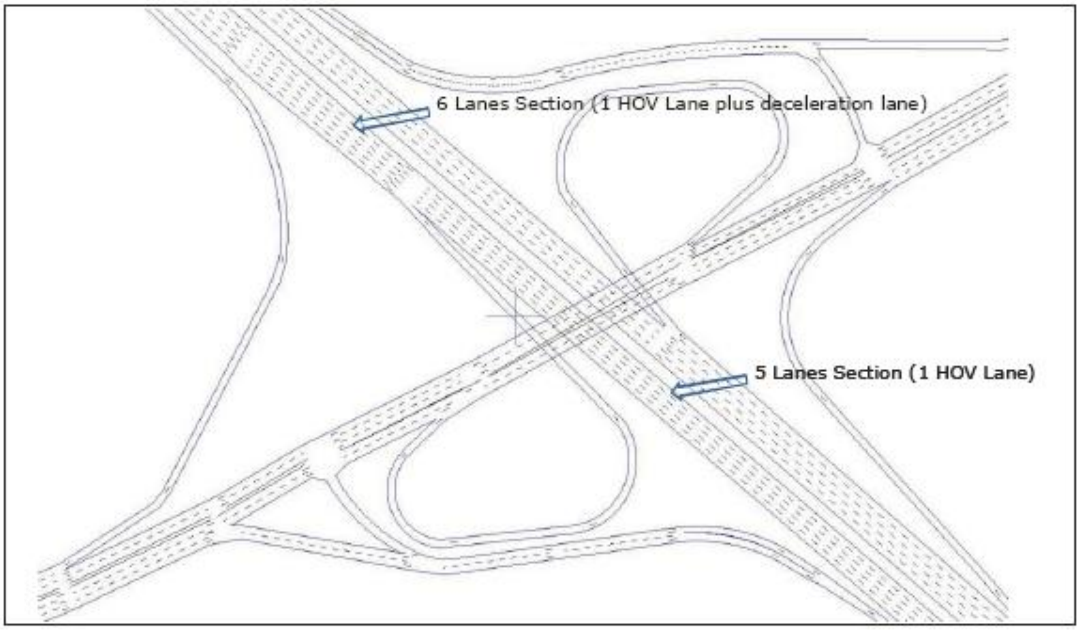
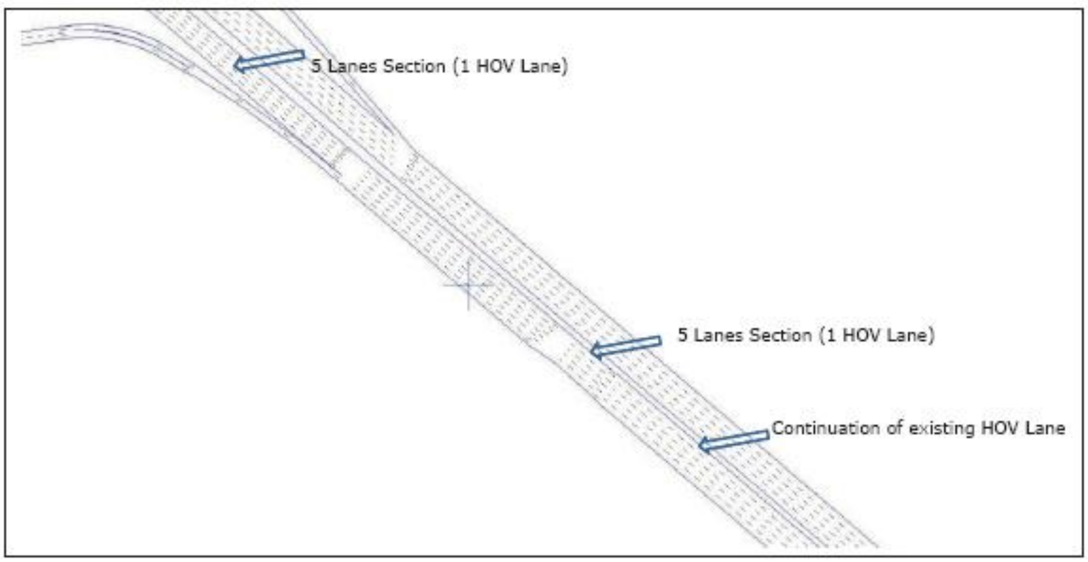


Exhibit A3-15: Scenario 9A Changes Coded - Marina Blvd Interchange to Continuation of Existing HOV Lane



System Metrics Group, Inc.

In association with Cambridge Systematics, Inc.

DRAFT FINAL

METROPOLITAN TRANSPORTATION COMMISSION (MTC)

FREEWAY PERFORMANCE INITIATIVE (FPI) SANTA CLARA I-880 EXISTING CONDITIONS ANALYSIS (TASK 2)

December 20, 2007

Contact:
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Tom_Choe@SysMetGroup.com

Table of Contents

List of Exhibits

System Metrics Group, Inc.

Memo

To: The Metropolitan Transportation Commission (MTC)

From: System Metrics Group, Inc.

CC: Cambridge Systematics, Inc.

Date: October 12, 2007

Re: **FPI ALA/SCL 880 Deliverable 1C: Draft Final Existing Conditions Technical Memorandum (ECT)**

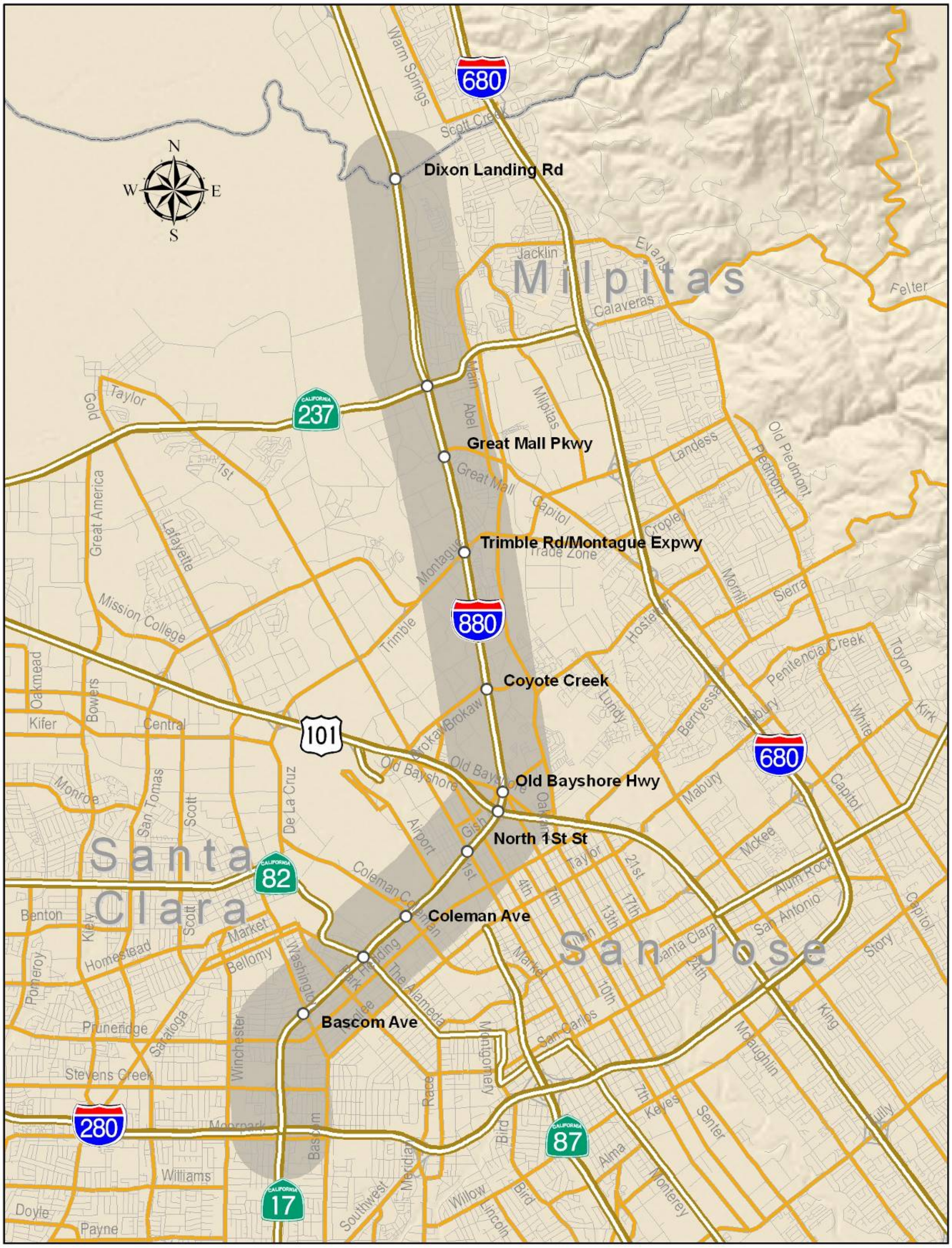
This memorandum represents the third deliverable for Task Order Number CS-880-ALA/SCL-#2 for the Metropolitan Transportation Commission (MTC) Freeway Performance Initiative (FPI) related to the Alameda/Santa Clara 880 Existing Conditions Analysis. System Metrics Group, Inc. (SMG), under contract to Cambridge Systematics, Inc. (CS) analyzed the available data, conducted field reviews, and developed this memorandum. This technical memorandum will refer to the corridor as the SCL/ALA 880 Corridor.

SMG followed the proposed approach documented in the combined deliverable 1A/1B, which identified available data, discussed the limitations of the data, and recommended the collection of additional data.

The results from this Existing Conditions Technical Memorandum (ECT) will be combined with the results of the California Center for Innovation in Transportation (CCIT) I-880 Corridor Template study currently underway to provide a review of the entire I-880 corridor in both Alameda and Santa Clara Counties.

This ECT will only cover the Santa Clara County portion of I-880 as shown in Exhibit 1. The limits of the study corridor are from I-280/SR-17 in San Jose at the southern end of the corridor to the Alameda/Santa Clara County Line near Dixon Landing Road in Milpitas at the northern end.

Exhibit 1: Map of Study Area



EXECUTIVE SUMMARY

For the purposes of this document, the SCL/ALA 880 Corridor refers to the Santa Clara County segment of I-880. When available, the Alameda segment extending up to 7th Street in Oakland will be incorporated into this document. The SCL/ALA 880 corridor, which extends about 10.5 miles, runs through the city of San Jose from the I-880/I-280/SR-17 interchange in Santa Clara County north to the Alameda County Line near Dixon Landing Road. According to Caltrans data, this corridor carries between 133,000 and 176,000 average annual daily traffic (AADT), which includes 2.8 to 4.2 percent trucks. For most of the corridor, it is a six-lane freeway with a paved median and concrete barrier separating the two travel directions with the following exceptions: high occupancy vehicle (HOV) lanes in both directions north of the SR-237 interchange to south of Marina Boulevard in Alameda County and auxiliary lane plus a HOV lane north of the SR-237 interchange to Dixon Landing Road.

Comprehensive performance measure analyses for this corridor were conducted. According to *Bay Area 511 Predict-a-Trip*, a feature of the 511 Traffic website, the peak travel time along this corridor is 16 minutes during the AM peak and 22 minutes during the PM peak. The following table is the complete list of congested segments reported by MTC between the years 2003 and 2006. The most congested segment on the corridor lies in the northbound direction in the PM peak period between Montague Expressway and the Santa Clara/Alameda County Line at Dixon Landing Road in Milpitas. Since 2003 – following the freeway widening – delay dropped by around 40 percent on this segment, but it continues to be the most congested segment on the SCL/ALA 880 corridor. In 2006, the congestion reported on this segment ended at Route 237, which is nearly two miles north of Montague Expressway where it was originally reported. Between 2003 and 2006, the second most congested segment was in the southbound PM direction between Montague Expressway and US-101. This segment also showed a downward trend in delay dropping from 1,510 DVHD in 2003 to 920 by 2006. This congestion, though much less in magnitude, appears to have grown in length. Prior to 2005, the congestion ended at Brokaw Road, but now it continues more than a mile further south to US-101.

Detailed results of the analysis of delay, travel time reliability, and lost productivity based on the Performance Measurement System (PeMS) data are presented in this report. As it relates to traffic safety, on average, the northbound direction experiences around 28 accidents per month and the southbound direction averages just over 25 accidents per month. In both directions, weekdays account for over 75 percent of all accidents per month.

Exhibit ES-1: MTC Congested Segments 2003-2006

Period	Dir	Generalized Congested Area	Specific Congested Segment	Generalized Area Congested				Specific Segment Congestion			
				2003	2004	2005	2006	2003	2004	2005	2006
AM	NB	Coleman Ave to Brokaw Rd	North 1st St to Brokaw Rd	1,030	90	160	330	1,030	90		
			North of Coleman Ave to north of Gish Rd								330
			South of US101 to Brokaw Rd							160	
	SB	Montague Expwy to Brokaw Rd	Montague Expwy to Brokaw Rd	50	50	50	50	50	50	50	50
AM PEAK PERIOD SUMMARY				1,080	140	210	380	1,080	140	210	380
PM	NB	Montague Expwy to Dixon Landing Rd	Montague Expwy to Dixon Landing Rd	2,450	1,400	900	1,480			900	
			Montague Expwy to north of Dixon Landing Rd					2,450	1,400		
			North of Rte 237 to north of Dixon Landing Rd								1,480
	SB	Montague Expressway to US101	Montague Expwy to Brokaw Rd	1,510	1,400	720	920	1,510	1,400		
			Montague Expwy to south of Old Bayshore Hwy							720	
			North of Montague Expwy to south of Old Bayshore Hwy								920
		US101 to 1st St & Rte82 to Bascom Ave	US101 to 1st St & Rte 82 to north of Bascom Ave	190	190	190	190	190	190	190	190
PM PEAK PERIOD SUMMARY				4,150	2,990	1,810	2,590	4,150	2,990	1,810	2,590
TOTAL CORRIDOR CONGESTION				5,230	3,130	2,020	2,970	5,230	3,130	2,020	2,970

In addition to the performance measures, a bottleneck analysis was also conducted to evaluate specific causes of existing recurrent traffic congestion in the corridor. Freeway bottleneck locations that create mobility constraints are identified and documented, and their relative contribution to corridor-wide congestion is reported. As a basic definition, a bottleneck is considered as a location where traffic demand exceeds capacity. It is important to note that a bottleneck location typically is over some distance or a segment, rather than a single spot. In the effort to understand the cause of a bottleneck and find potential solutions, it is important to know where the bottleneck terminates and free flow conditions are restored. This bottleneck section is typically found where low in-queue speeds increase to 30 to 50 miles per hour. As part of the bottleneck analysis, MTC probe vehicle runs (taken during spring and fall of 2006), PeMS speed contour plots, aerial photographs, the I-880 Corridor Study Draft Existing Conditions Report (October 2005), and field observations were used to identify bottleneck locations and determine the causes. The following table summarizes the results of the analysis. As indicated, the major bottlenecks in the northbound direction are the US-101 interchange (AM peak only), Brokaw interchange (AM peak only), and north of Dixon Landing Road interchange (AM and PM peak). In the southbound direction, the major bottlenecks were the US-101 interchange (PM peak only), 1st Street interchange (PM peak only), and Bascom Avenue Interchange (PM peak only). The causes were primarily due to demand exceeding capacity in areas where capacity is reduced due to roadway geometry, traffic weaving, or construction activity.

Exhibit ES-2: Bottlenecks Summary Table

BOTTLENECK LOCATION	**PeMS** [a] Speed Contours		**MTC** [b] Probe Vehicle Runs		**2005 DKS** [c] Associates Report		**Field** [d] Observations		**SUMMARY** [e]
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	
NORTHBOUND									
North of Dixon (Mission)	-	MAJOR	n/a	n/a	n/a	n/a	MAJOR	MAJOR	**Controlling bottleneck (AM/PM)**
Dixon On-ramp	-	-	n/a	MAJOR	n/a	n/a	-	-	Minor bottlenck (PM)
Brokaw Interchange	MAJOR	-	-	-	n/a	n/a	MAJOR	-	**Controlling bottleneck (AM)**
Gish On-ramp	-	-	minor	-	n/a	n/a	-	-	Minor bottleneck (AM)
US101 Interchange	-	-	MAJOR	-	MAJOR	-	minor	-	**Controlling bottleneck (AM)**
Coleman Interchange	-	-	n/a	n/a	MAJOR	-	-	-	Minor bottleneck (AM)
I-280 On-ramp	-	-	n/a	n/a	minor	-	-	-	Minor bottleneck (AM)
SOUTHBOUND									
US101 Interchange	-	MAJOR	-	-	-	MAJOR	-	MAJOR	**Controlling bottleneck (PM)**
1st Street Interchange	-	-	-	-	-	MAJOR	-	-	Minor bottleneck (PM)
Bascom Interchange	-	MAJOR	-	-	-	minor	-	MAJOR	**Controlling bottleneck (PM)**

NOTES:
[a] Based on Performance Measurement System (PeMS) sample daily speed contours taken from August 2006 and quarterly weekday averages from 2004 to 2007 data.
[b] Based on Metropolitan Transportation Commission (MTC) sample probe vehicle runs, as part of highway congestion monitoring program (HICOMP), taken in Spring & Fall 2006.
[c] Based on draft I-880 Corridor Study: Existing Conditions Report, DKS Associates, October 12, 2005.
[d] Based on field observations made by consultant staff, July and August 2007.
[e] Conclusive summary results include at least two sources confirming controlling bottleneck locations, otherwise considered minor bottlenecks.
MAJOR Major bottleneck locations where congestion was observed consistently most weekday peak hours from source.
minor Minor bottleneck locations where congestion was observed inconsistently on some weeday peak hours from source.
n/a Not available (probe vehicle runs did not cover this location).
\- No indication of bottleneck from this source.

1. INTRODUCTION

The purpose of this Existing Conditions Technical (ECT) memorandum is to collect and analyze all information necessary to understand existing traffic conditions along the Metropolitan Transportation Commission's (MTC) Freeway Performance Initiative (FPI) I-880 corridor extending from I-880/I-280/SR-17 interchange in Santa Clara County north to the Alameda County Line near Dixon Landing Road – a distance of approximately 10.5 miles. This corridor is shown in Exhibit 1, above, and will be referred to in this report as the SCL/ALA 880 corridor. At a later date when the data are available, this ECT will be expanded to include the Alameda County portion of the SCL/ALA 880 corridor up to 7th Street in Oakland.

This memorandum will detail the causes of traffic congestion along the corridor and identify existing freeway bottlenecks. The mobility, reliability, and safety implications of congestion caused by those bottlenecks will be estimated. The assessment of existing conditions will rely primarily on data compiled from the existing sources detailed in the *Draft Information and Data Collection Memorandum (IDC)*. The time frame for analysis will focus on weekday peak period conditions. This memorandum has three sections:

Corridor Description – describes the I-880 roadway and other transportation infrastructure along the SCL/ALA 880 corridor including:

- I-880 general description and geometrics;
- Transit network including Santa Clara Valley Transit Authority (VTA) bus and rail services as well as the Altamont Commuter Express (ACE) commuter rail service;
- Norman Y Mineta San Jose International Airport; and
- Adjacent sites and facilities that are relevant to the corridor.

Existing Conditions – comprehensively reviews existing traffic performance data to identify and analyze the causes of traffic congestion on the SCL/ALA 880 corridor.

Performance data for all modes are included. Peak period traffic (e.g., volumes, trucks, transit trips) on the freeway and major parallel arterials will be discussed, with a primary focus on four key areas:

- *Mobility* describes how well the corridor moves people and freight;
- *Reliability* captures the relative predictability of the public's travel time;
- *Safety* captures the safety characteristics in the corridor including crashes (fatality, injury, property damage); and
- *Other measures* of interest, specifically productivity.

Bottleneck Analysis – evaluates specific causes of existing recurrent traffic congestion in the corridor. Freeway bottleneck locations that create mobility constraints are identified and documented, and their relative contribution to corridor-wide congestion is reported.

2. CORRIDOR DESCRIPTION

The SCL/ALA 880 corridor runs thru the city of San Jose from the I-880/I-280/SR-17 interchange in Santa Clara County north to the Santa Clara County/Alameda County Line near Dixon Landing Road. Legislatively named the Nimitz Freeway, I-880 connects Silicon Valley with the East Bay Cities in Alameda County. I-680 runs parallel to I-880, which connects Silicon Valley with the Tri-Valley area in Alameda County.

Corridor Roadway Facility

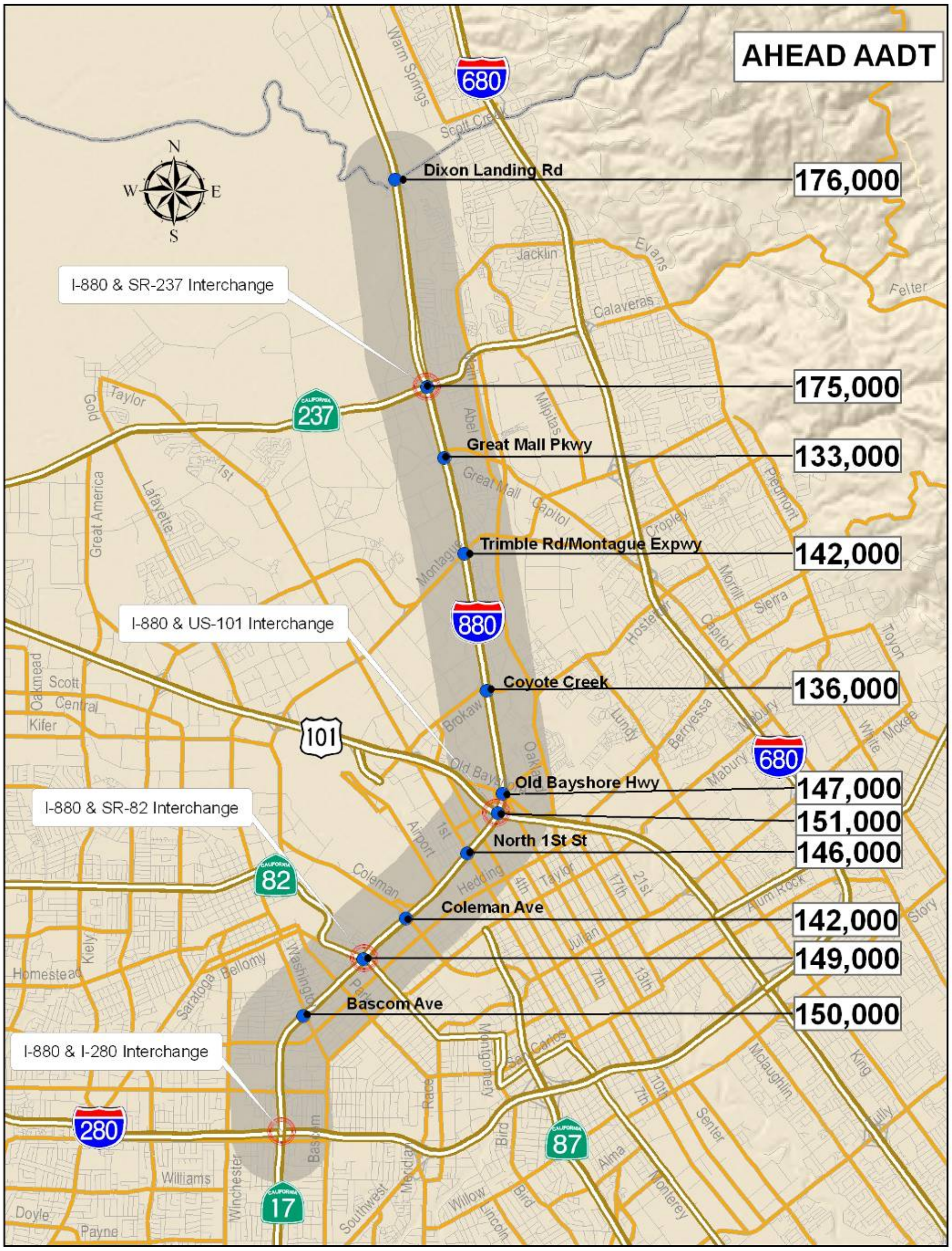
The SCL/ALA 880 Corridor extends about 10.5 miles from the I-880/I-280/SR-17 Interchange south of downtown San Jose to Dixon Landing Road near the Santa Clara/Alameda county line. As Exhibit 2-1 shows, the study corridor includes five major freeway-to-freeway interchanges:

- SR-237 provides access to Mountain View/Los Altos and Milpitas
- US-101 provides access to the peninsula cities to the north and Gilroy to the south
- SR-82 provides access to Mountain View at the north end and South San Jose/Morgan Hill at the south end
- I-280 provides access to Downtown San Jose on the east end and the peninsula on the west end
- I-680 provides access to Milpitas and the Tri-Valley Area.

According to the Caltrans Traffic and Vehicle Data Systems Unit annual traffic volumes reports, the SCL/ALA 880 corridor carries between 133,000 and 176,000 average annual daily traffic (AADT)[1] as shown in Exhibit 2-1. South of SR-237, the SCL/ALA 880 corridor carries up to 151,000 AADT, but volumes increase by about 1/3 at SR-237 to more than 175,000 AADT.

[1] AADT is the total annual volume of vehicles counted divided by 365 days.

Exhibit 2-1: Major Interchanges and AADT on the SCL/ALA 880 Corridor



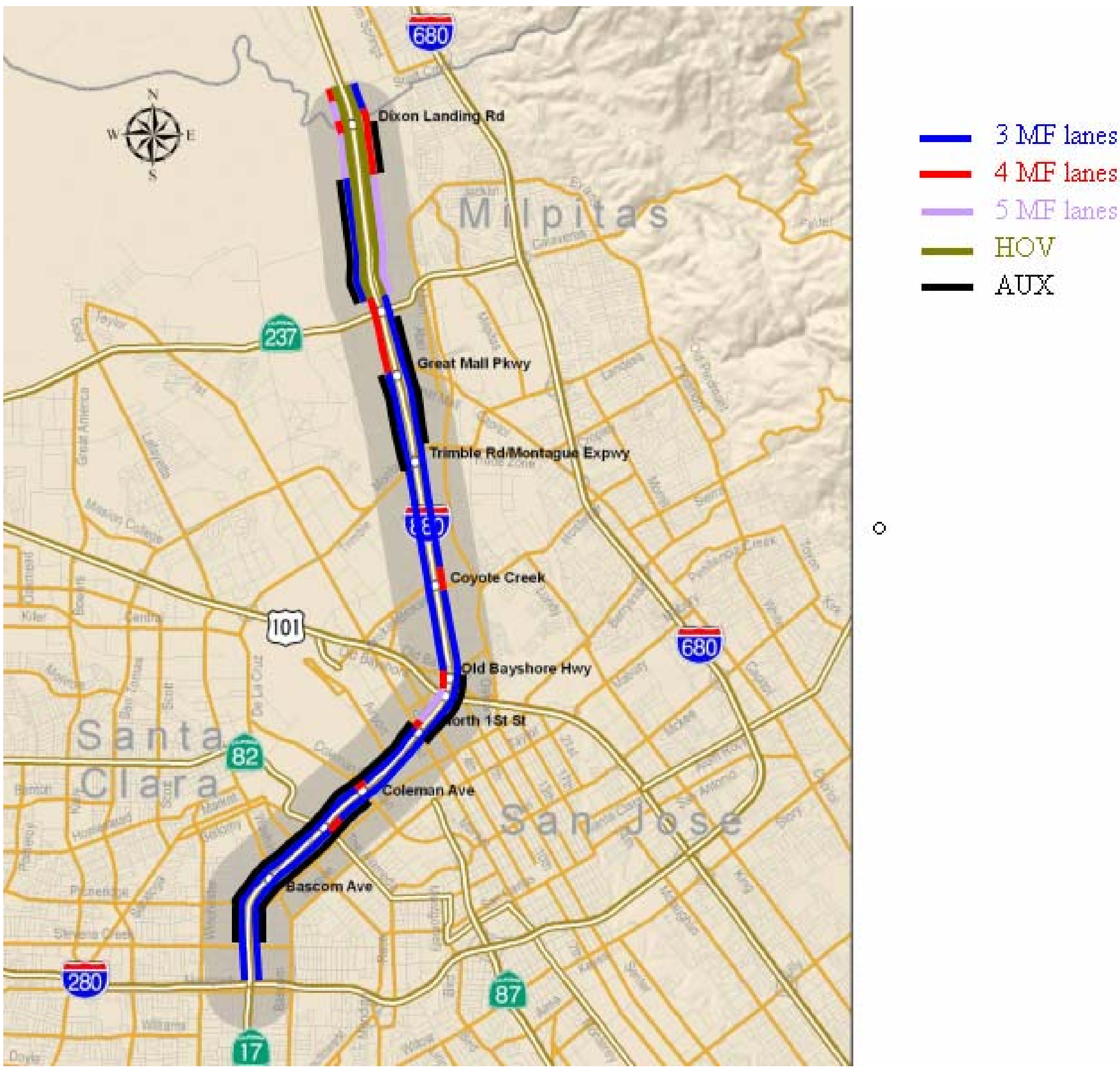
Source: Caltrans Traffic and Vehicle Data Systems Unit[2]

[2] http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/

For most of the SCL/ALA 880 corridor, I-880 is a six-lane freeway with a paved median and concrete barrier separating the two travel directions with a few exceptions (see in Exhibit 2-2. There are auxiliary lanes along several sections of the corridor. HOV lanes are available in the northern portion of the corridor starting from the SR-237 Interchange to Dixon Landing Road. The lanes operate as a 2+ facility from 5:00 AM to 9:00 AM and from 3:00 PM to 7:00 PM.

The corridor is a Surface Transportation Assistance Act (STAA) route, so large trucks are allowed to operate on it. According to the latest validated truck volumes from the 2005 Caltrans Annual Average Daily Truck Traffic data, trucks comprise 2.8 to 4.2 percent of total daily traffic along the corridor.

Exhibit 2-2: Lane Configurations on the SCL/ALA 880 Corridor



Transit

Three major public transportation operators provide service near the SCL/ALA 880 Corridor:

- Santa Clara Valley Transportation Authority (VTA) bus and light rail transit (LRT) services;
- Altamont Commuter Express (ACE) intercity commuter rail services; and
- Amtrak California Capitol Corridor train service.

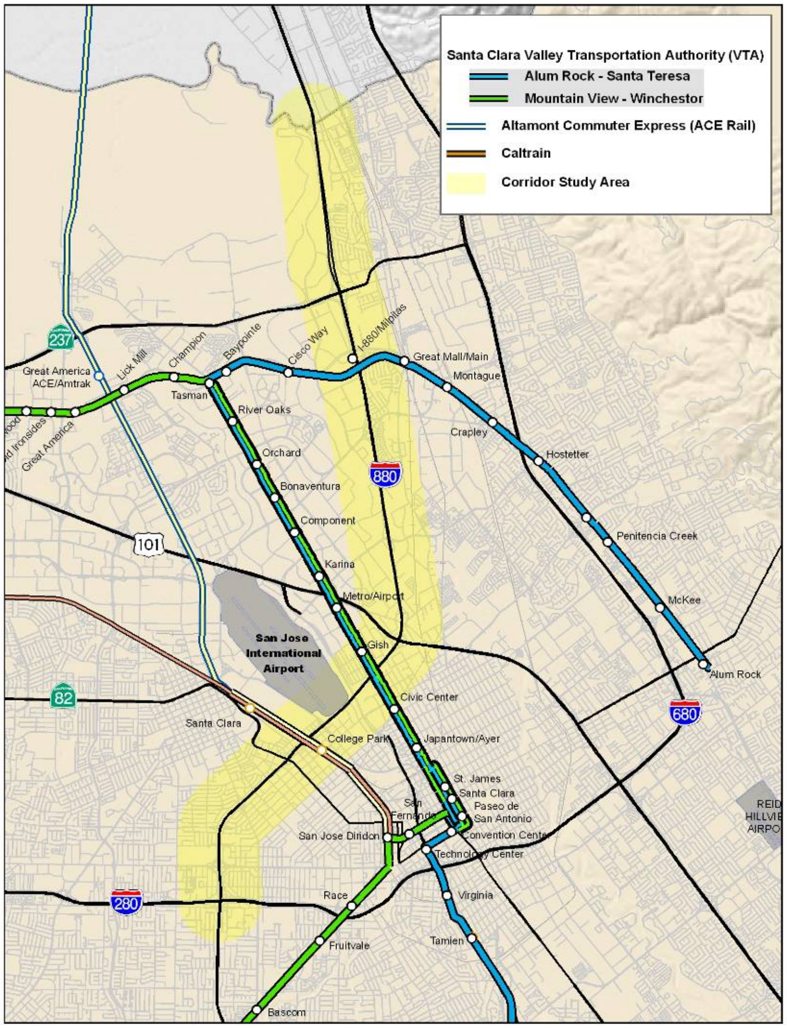
Caltrain, which serves the San Jose and Gilroy areas to San Francisco through San Mateo County, also provides service in the area. However, Caltrain does not parallel the SCL/ALA 880 corridor and is not considered a travel alternative for the SCL/ALA 880 corridor.

Amtrak's Coast Starlight train service provides one interstate train in each direction between Los Angeles, California and Seattle, Washington. This service is primarily interstate in nature and is not considered a travel alternative for commute period traffic on the SCL/ALA 880 corridor.

The Alameda Contra Costa Transit District (AC Transit) also operates one route (Rte 217) that terminates in the SCL/ALA 880 area at the Great Mall/Main Transit Center connecting with other bus and light rail transit services.

Exhibit 2-3 shows the primary rail services being offered near the SCL/ALA 880 corridor.

Exhibit 2-3: Rail Transit Services Along the SCL/ALA 880 Corridor



Santa Clara Valley Transportation Authority (VTA)

VTA provides service throughout Santa Clara County and partners with other systems for bus and rail service between Santa Clara County and the counties of Alameda, Santa Cruz, San Mateo, and San Francisco. VTA reported over 37 million passenger boardings in 2005, carrying over 120,000 passengers on an average weekday. The 42-mile LRT system carries approximately 22,000 weekday passengers between 62 stations. The two LRT routes are summarized as follows:

- LRT Route 901 (Alum Rock–Santa Teresa) operates between the Alum Rock Station in East San Jose and the Santa Teresa Station in South San Jose. It is approximately 27 miles long serving 38 stations.

- LRT Route 902 (Mountain View-Winchester) operates between the downtown Mountain View Multi-Modal Station and the Winchester Station in Campbell. It is approximately 22 miles long serving 37 stations, including the segment jointly served by the Alum Rock–Santa Teresa and Mountain View–Winchester Lines from the Convention Center Station in downtown San Jose to the Tasman Station in North San Jose.

Exhibit 2-4 is a table showing the average weekday ridership for several VTA bus routes and the two LRT lines. These routes were deemed by the project team to provide parallel service along significant portions of the SCL/ALA 880 corridor. Based on the ridership estimates, these routes account for approximately 30 percent of total VTA system ridership.

Exhibit 2-4: VTA Transit Route Ridership near SCL/ALA 880 Corridor

Route	Type	Route Description	Weekday Ridership (Oct 2005)
36	Local	Penitencia Creek Transit Center to Valley Fair/ Vallco Park	812
62	Local	Good Samaritan Hospital to Penitencia Creek Transit Center	3,225
66	Local	Santa Teresa Hospital to Milpitas/Dixon Rd	4,946
77	Local	Eastridge Transit Center to Great Mall/Main Transit Center	1,868
120	Express	Fremont BART Station to Lockheed Martin/ Moffett Park	65
140	Express	Fremont BART Station to Sunnyvale Caltrain Station	133
180	Express	Fremont BART Station to San Jose Diridon Station	1,673
901	Light Rail	Alum Rock to Santa Teresa	15,342
902	Light Rail	Mountain View to Winchester	6,734
		Total All FPI880 Corridor Routes	**34,798**
		All VTA Routes (Oct 2005)	**126,423**
		Pct of FPI880 of All VTA Routes	**28%**

Source: 2005-2006 On-Board Passenger Survey: Final Report. VTA. October 2006

Altamont Commuter Express (ACE)

The ACE service began in 1999 and runs between Stockton in San Joaquin County and San Jose with stations at Great America and Santa Clara in Santa Clara County. ACE operates four westbound AM peak period trains to San Jose and four eastbound PM peak period trains. In 2005, ACE carried more than 640,000 annual passengers averaging more than 2,500 passengers per weekday.

Amtrak California Capitol Corridor

California's Capitol Corridor runs 32 trains a day between Sacramento and the Bay Area, with 14 daily direct trains to San Jose. In fiscal year 2004/05 Amtrak reported that nearly 210,000 passengers boarded its trains in San Jose with 75,000 boardings at the Great America Station. Recent reports indicate that nearly 125,000 passengers per month take the Capitol Corridor trains, which is approximately 6,250 per average weekday.

Intermodal Facilities

Adjacent to the SCL/ALA 880 corridor on Coleman Avenue is the Norman Y Mineta San Jose Airport (SJC), shown in Exhibit 2-5. As of 2006, SJC recorded the 37th most enplanements in the United States and is ranked fifth in California behind the Oakland International Airport (OAK), also located on I-880 in Alameda County.

Exhibit 2-6 shows annual passenger enplanements and cargo weights for SJC. Since 2002, annual passenger boardings at the airport have ranged between 5.1 and 5.3 million annual enplanements. Though not shown in the exhibit, approximately the same number of passengers has disembarked in San Jose.

SJC is typically ranked in the top 50 to 60 airports nationally in terms of weight of cargo shipped. Exhibit 2-6 shows that the weight of goods shipped has declined from a high of nearly 360,000 tons in 2002 to just under 250,000 tons in 2006.

Exhibit 2-5: Norman Y Mineta San Jose International Airport (SJC)

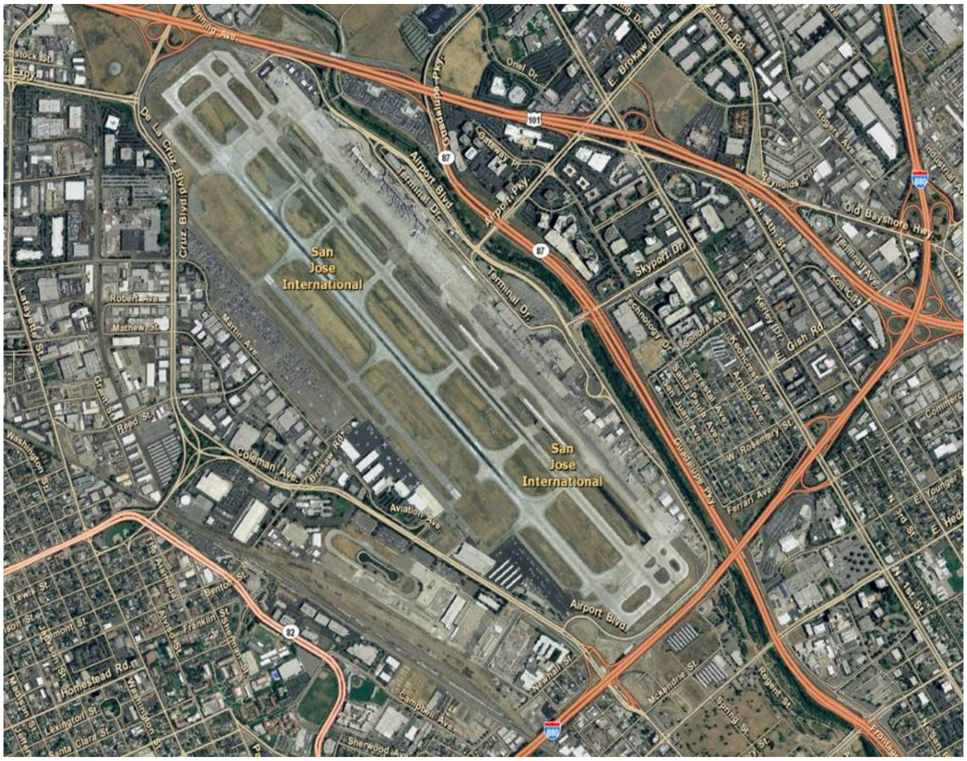


Exhibit 2-6: SJC Passenger and Cargo Statistics

	2002	2003	2004	2005	2006
Passenger Enplanements (millions)	5.25	5.10	5.27	5.31	5.28
Landed Weight of Cargo (1000s of tons)	358.4	282.4	276.0	244.5	246.3

Source: Federal Aviation Administration (FAA) Air Carrier Activity Information System (ACAIS).[3]

[3] http://www.faa.gov/airports_airtraffic/airports/planning_capacity/passenger_allcargo_stats/passenger/

Special Event Facilities/Trip Generators

Several major special event facilities may generate significant trips along the SCL/ALA 880 corridor. A number of the most significant ones are shown in Exhibit 2-7.

The most significant special event facility on the SCL/ALA 880 corridor is HP Pavilion. This arena is located in the downtown area of San Jose adjacent to the San Jose Diridon train station with provides rail service on Amtrak, Caltrain, and ACE. The Stadium seats 17,496 and is the home of the San Jose Sharks professional hockey team. It also serves as an indoor sports and entertainment stadium.

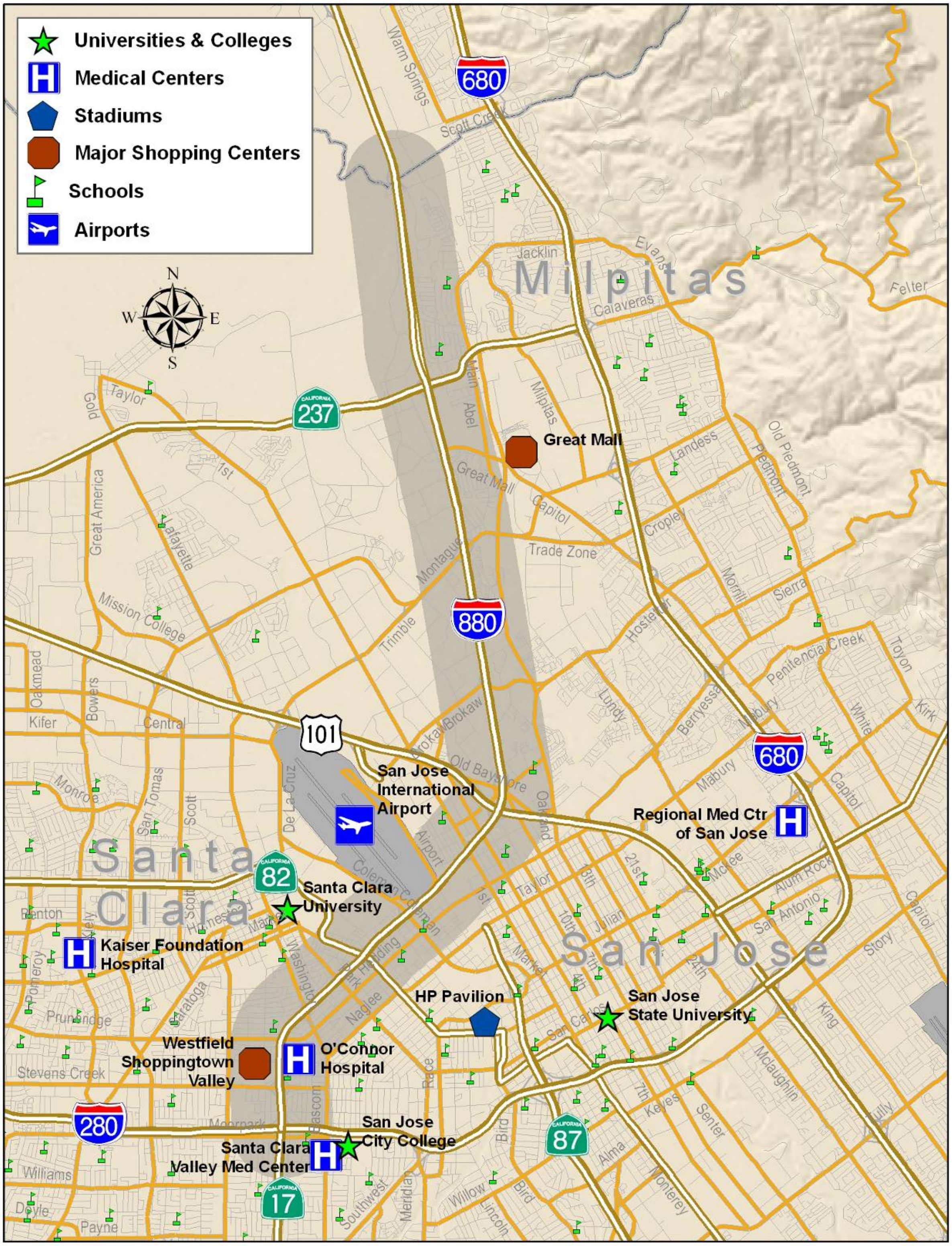
There are three major universities/colleges near the SCL/ALA 880 corridor. San Jose State University (SJSU) lies about two miles off of the corridor, but is a major traffic generator. SJSU is a four-year public university offering Bachelor and Masters Degree programs with an estimated enrollment of 30,000 students. San Jose City College lies off I-280 near the southern end of the SCL/ALA 880 corridor. It is a two-year community college and reports approximately 10,000 students and faculty. Finally, Santa Clara University lies on El Camino Real in Santa Clara near the Norman Y. Mineta San Jose Airport. It is also a four-year university with more than 8,300 students. In addition to these educational facilities, there are a number of secondary, middle, and elementary schools within a few miles of the corridor.

There are two major medical facilities on the corridor – both in San Jose near the southern end of the SCL/ALA 880 corridor. The Santa Clara Valley Medical Center in San Jose is located on Bascom Avenue near the I-280/I-880 interchange. This 524-bed hospital also houses several medical offices. It is adjacent to San Jose City College described above. Nearby O'Conner hospital has 358 beds and is located on Forest Avenue (near the Bascom Avenue interchange) in San Jose adjacent to I-880.

There are two major shopping malls on the SCL/ALA 880 corridor. The Great Mall of the Bay Area located off Great Mall Parkway in Milpitas has several dozen stores and restaurants and a 20-plex movie theatre. Westfield Valley Fair Mall on Steven's Creek Boulevard near the I-880/I-280 interchange in San Jose is another major shopping entertainment center.

Finally, downtown San Jose houses major Santa Clara County government offices including the office of the County Executive and Board of Supervisors near North 1st Street.

Exhibit 2-7: Major Special Event Facilities/Trip Generators



3. EXISTING CONDITIONS

This section summarizes the performance measures used to evaluate strategies for the SCL/ALA 880 study corridor. The primary objectives of the measures are to provide a sound technical basis for describing traffic performance on the corridor.

The performance measures focus on three key areas:

- **Mobility** describes how well the corridor moves people and freight;
- **Reliability** captures the relative predictability of the public's travel time; and
- **Safety** captures the safety characteristics in the corridor including crashes (fatality, injury, property damage).

MOBILITY

Mobility describes how well the corridor moves people and freight. The mobility performance measures are both readily measurable and straightforward for documenting current conditions and are readily forecast making them useful for future comparisons. Two primary measures are typically used to quantify mobility: travel time and delay.

Travel Time

Travel time is reported as the amount of time for a vehicle to traverse between two points on a corridor. For the SCL/ALA 880 corridor, this travel time is the time to traverse the 10.5-mile corridor. Travel time on parallel arterials is not included for this analysis.

There are three ways used to discuss travel time in this report:

*Bay Area 511 Predict-a-Trip*SM[4] – is a feature of the 511 Traffic website that provides "typical" travel time and speed information for user-selected driving times routes based on historical information. The typical travel time is the historical average driving time between a starting and ending point for a particular day of the week and time of day. Predict-a-Trip uses an averaging scheme that gives more weight to data that is current so that the "typical" values are representative of current, seasonal traffic patterns.

[4] http://traffic.511.org/his_traffic_text.asp

The 511 system gathers traffic information from several data sources including Fastrak toll tag transponders, PeMS, and fixed radar sites. Along the SCL/ALA 880 corridor, all three sensor technologies are deployed, with fixed radar sites and PeMS being the most prominent. This information is checked against several quality filters that help to ensure the data is as accurate as possible before it is used by the 511 system. The data is combined into 15-minute intervals for each day of the week and holiday defined in the system. For each 15-minute interval, a typical value is calculated based on historical information. The "typical" value is updated every day using the most recent data.

MTC State of the System Report/Statewide Highway Congestion Monitoring Program (HICOMP) – can be used to validate the 511 data described above. MTC has been collecting travel time and congestion data using probe vehicles driving on freeway mainline lanes over the past three years in coordination with Caltrans. The probe vehicle data was used to derive peak period travel times along the corridor. This estimate was used to validate the results of the 511 data.

Freeway Performance Measurement System (PeMS) – this internet-based data archive provides real-time and historical freeway traffic data such as speeds and volumes. Though limited in coverage along the SCL/ALA 880 corridor, this data source was also used to compare against the 511 data for validation purposes.

The travel time data used for the SCL/ALA 880 corridor comes primarily from the 511 Predict-A-Trip tool, specifically the travel time between I-280 in San Jose and Mission Boulevard in Fremont (Alameda County) for Tuesdays through Thursdays. Mission Boulevard lies less than two miles north of the SCL/ALA 880 northern limit of the Alameda/Santa Clara County Line near Dixon Landing Road in Milpitas.

According to Predict-A-Trip, this distance is 12.5 miles in the northbound direction and 12.6 miles in the southbound direction. The distance along the SCL/ALA 880 corridor is actually 10.5 miles (from I-280 to the Santa Clara/Alameda County Line near Dixon Landing Road). The Predict-A-Trip travel times were adjusted by a ratio of 10.5/12.5 (12.6 in the southbound direction to adjust the travel times to fit the corridor). This amounts to a 1.75 to four minute reduction in the travel time reported by Predict-A-Trip. Since the data is weighted toward more recent data, it may not reflect conditions during other seasons of the year.

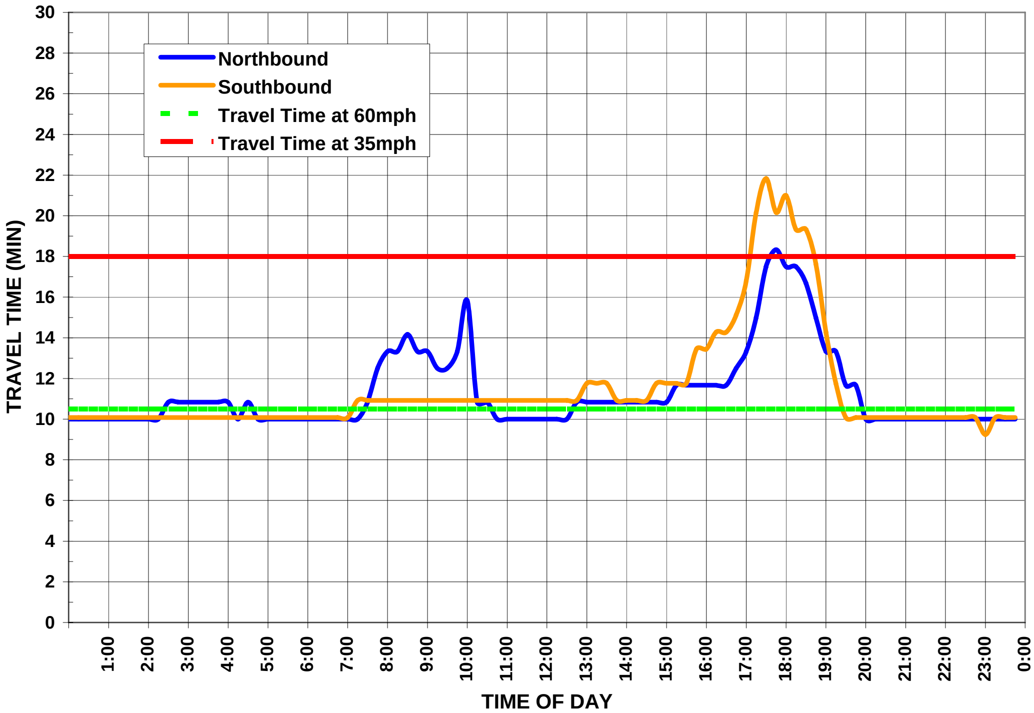
Exhibit 3-1 shows peaking characteristics of travel along the corridor. The AM peak period begins at 7:00 AM and ends around 10:15 AM for the northbound direction. There is no AM peaking for the southbound direction with travel speeds near free-flow during the entire morning commute. The northbound AM peak (16 minutes) occurs at 10:00 AM, which is atypical for commute corridors which tend to peak during the 8:00 to 9:00 AM hours. Since this 16 minute travel time is less than the travel time at 35mph (shown by the red line in Exhibit 3-1), the AM period is not considered to experience "severe" congestion. Severe congestion is discussed in more detail in the mobility delay section below, but is defined as the travel time delay that is experienced when speeds drop to 35mph or less.

The PM peak period begins around 3:30 PM (15:30 hours shown in the exhibit) and ends between 7:00 and 7:30 PM. The peak hour occurs between 5:00 PM and 6:00 PM. The maximum estimated travel time during the peak hour for the southbound direction is 22 minutes with a northbound time at 18 minutes. This is a typical PM peak period travel time profile. Severe congestion is experienced between 5:00 PM and 7:00 PM (speeds dropping below 35 mph as shown by the red line in Exhibit 3-1).

To validate these travel times, the study team conducted site visits on July 18, 2007, July 19, 2007, and on August 21, 2007. A review of PeMS accident data indicates that no major incidents took place along the corridor as reported by the California Highway Patrol.

The 511 data contradicts the delay estimates provided by the probe vehicle runs performed as part of the State of the System/HICOMP reporting done by MTC. This will be discussed in more detail in the Delay section of this report (see Exhibit 3-3). First, the 511 AM travel times in Exhibit 3-1 do not indicate any delay. In contrast, the probe vehicle data indicates small, yet measurable AM period delay. More importantly, the 511 data indicates that the southbound direction in the PM is more congested than the northbound direction, which is in contrast to the probe vehicle results in Exhibit 3-3. According to Exhibit 3-1, there should be little congestion associated with northbound travel since the peak travel time in the northbound direction rarely drops below the travel time for 35mph shown by the red line.

Exhibit 3-1: 511 Average Travel Time Estimates



Source: 511.org

Exhibit 3-2 presents the approximate travel times for various segments of the SCL/ALA 880 Corridor using the Predict-a-Trip tool. This table shows the estimated travel times a motorist should expect for various segments of the corridor at 15-minute intervals during the morning and afternoon peak periods on a typical weekday (Tuesday through Thursday). The segments used for this analysis includes:

- Mission Blvd (Fremont) to SR-237 (Milpitas) - 4.4 to 4.5 miles;
- SR-237 (Milpitas) to US 101 S (San Jose)- 4 miles;
- US 101 S to I-280 (San Jose) - 4.1 to 4.2 miles.

Similar to Exhibit 3-1, the longer travel times along the segments of the corridor occur during the PM peak period, mostly between 5:00 and 7:00 PM.

Exhibit 3-2: 511 Average Travel Time Estimates By Segment for the Peak Period

Time	Mission Blvd (Fremont) to SR-237 (Milpitas) 4.4-4.5 miles		SR-237 (Milpitas) to US 101 S (San Jose) 4 miles		US 101 S to I-280 (San Jose) 4.1-4.2 miles	
	SB	NB	SB	NB	SB	NB
AM Peak Period						
6:00	4	4	4	4	4	4
6:15	4	4	4	4	4	4
6:30	4	4	4	4	4	4
6:45	4	4	4	4	4	4
7:00	4	4	4	4	4	4
7:15	5	4	4	4	4	4
7:30	5	4	4	4	4	4
7:45	5	4	4	4	4	6
8:00	5	4	4	5	4	6
8:15	5	4	4	6	4	6
8:30	5	4	4	5	5	7
8:45	5	5	4	5	5	7
9:00	5	4	4	5	4	7
9:15	5	4	4	5	4	6
9:30	5	4	4	5	4	7
9:45	5	4	4	4	4	8
10:00	5	4	4	4	4	10
PM Peak Period						
3:00	5	5	6	4	4	4
3:15	5	5	6	5	4	4
3:30	5	5	6	5	4	4
3:45	5	6	7	4	5	4
4:00	5	7	7	4	4	4
4:15	5	7	8	5	5	4
4:30	5	7	8	4	5	4
4:45	5	8	9	4	5	4
5:00	5	8	9	5	6	4
5:15	5	9	12	5	8	5
5:30	5	10	12	6	8	5
5:45	5	11	12	6	9	4
6:00	5	11	11	6	8	4
6:15	5	10	9	6	8	4
6:30	5	10	9	6	8	4
6:45	4	9	7	5	7	4
7:00	4	7	5	4	6	4

Source: 511.org

Delay

Delay is defined as the total observed travel time less the travel time under non-congested conditions, and is reported as vehicle-hours of delay. Delay is calculated by using the following formula:

$$(\text{Vehicles Affect per Hour}) \times (Distance) \times (Duration) \times \left[\frac{1}{(\text{Congested Speed})} - \frac{1}{35\text{mph}} \right]$$

Where the "vehicles affected per hour" variable depends on the estimation method used to calculate delay.

Some methods assume a fixed flow rate (e.g., 2,200 vehicles per hour per lane), while others use a measured flow rate. For example, PeMS takes the number of vehicles counted from the sensors and uses that number as the number of vehicles affected. The distance is the length under which the congested speed prevails and the duration is the hours of congestion experience below the threshold speed. There are multiple ways used to discuss travel delay in this report:

MTC State of the System Report/Caltrans Statewide Highway Congestion Monitoring Program (HICOMP) – provides average daily recurrent congestion results for I-880 on mainline lanes only. MTC has been collecting and analyzing this data over the past three years in coordination with Caltrans. The results of the data collection are "recurrent" average daily vehicle-hours of delay (DVHD). Recurrent delay is the day-to-day congestion experienced by travelers when the number of vehicles traveling along a stretch of roadway exceeds the capacity of that roadway. Delay in the context of these reports occurs when travel speeds along the road decline below 35mph for a period of 15-minutes or more during a "typical" mid-week AM or PM commute period. The data is collected by driving specially equipped "probe" vehicles along congested freeway segments during peak travel periods. When speeds drop below 35mph, delay is recorded by the probe vehicle. Analysis procedures are used to aggregate this delay to an average DVHD for the corridor.

Freeway Performance Measurement System (PeMS) – this internet-based data archive provides real-time and historical freeway traffic data such as speeds and volumes. Though limited in coverage along the SCL/ALA 880 corridor, this data source provides both recurrent and non-recurrent vehicle-hours of delay statistics at any time scale, and can inform this study about congestion characteristics by hour, time period, day of week, and month of year. For this study, the PeMS data contains both HOV and mainline lanes combined into one result. The reason is that until recently PeMS had no way to distinguish between the two lane classes. Site visits indicate that HOV lanes in the corridor are not congested and maintain free-flow speeds. A review of the *Regional HOT Lanes Network Feasibility Study*[5] indicates that HOV facilities along the SCL/ALA 880 corridor are not approaching capacity.

<u>MTC State of the System Report/Caltrans HICOMP/VTA 2006 Monitoring and Conformance Report</u>

[5] *Regional HOT Lanes Network Feasibility Study: Task 3 – Initial Assessment Report. Parsons Brinkerhoff/ECO Northwest. February 2007.* http://www.mtc.ca.gov/planning/hov/

The HICOMP report has been published annually by Caltrans since 1987[6]. MTC, in coordination with Caltrans, presents detailed results based on the HICOMP processing methodology in the Bay Area "State of the System Report"[7]. Delay is presented as average daily vehicle-hours of delay (DVHD) and attempts to represent the sum of all the delay experienced by commuters on the corridor.

As discussed earlier, these results contradict the findings from the 511 travel time analysis. The differences may be explained in that probe vehicle runs are performed at most only two to four days during the entire year (ideally, two days of data collection in the spring and two in the fall of the year, but resource constraints may affect the number of runs performed during a given year.). Given the large resources required to monitor congestion, not every segment is monitored every year. In these cases, MTC staff use professional judgment about the level of delay, if any, to report. As will be discussed later in this section when discussing the PeMS data, congestion levels vary from day to day and depend on any number of factors including accidents, weather, and special events. Since the available 511 data provides a snapshot of travel times, this delay discussion will focus on trends, which will be reinforced by an additional congestion trend analysis provided by the PeMS data.

Exhibit 3-3 shows four-year delay trends (2003 to 2006) for the AM and PM peak travel period for both directions along the SCL/ALA 880 corridor. This chart reveals two salient trends: (1) Delay drops dramatically after the year 2003 (with a smaller, yet significant decline again in 2005), and (2) the PM peak period is significantly more congested than the AM period.

The decline in delay after 2003 may be due to a lane-widening project between North First Street and Montague Expressway, which added one lane in each direction. Completed at the end of 2003, this project added one 12-foot lane in each direction with a center barrier. The project also included a southbound auxiliary lane from US-101 to North First Street, and ramp improvements at the southbound Brokaw Road exit ramp.

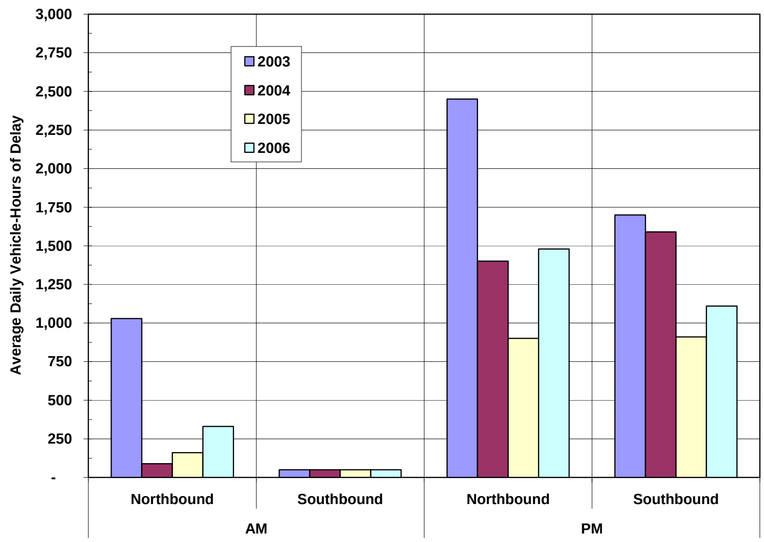
In the spring of 2005, the Route 237/I-880 HOV connector project was completed, which may be related to the decline in congestion in 2005. This project built the first direct high occupancy vehicle (HOV) connectors in the Bay Area from southbound I-880 to westbound Route 237 and from eastbound Route 237 to northbound I-880. In addition, a new exit ramp from I-880 to Tasman Drive was completed.

The PM peak period has significantly more delay than the AM peak period. Although, the northbound direction in the AM shows 330 DVHD, this is still many times lower than congestion in the PM peak. This low delay is supported by the travel time analysis in Exhibit 3-1 that shows relatively fast peak period travel times.

[6] Located at: http://www.dot.ca.gov/hq/traffops/sysmgtpl/HICOMP/index.htm
[7] Located at: http://www.mtc.ca.gov/library/state_of_the_system/index.htm

The PM peak period delay has ranged between 900 and 1,750 DVHD since 2004. Note that changes in delay from one year to the next may not be significant given the limited number of days on which data is collected. Trends over several years can be deemed significant. Given that in both directions delay drops between 2004 and 2005, then increases in 2006, no clear trend is evident.

Exhibit 3-3: Average Daily Vehicle-Hours of Delay 2003-2006



Source: MTC State of the System Report

Exhibit 3-4 shows the complete list of congested segments reported by MTC between the years 2003 and 2006. Exhibits 3-5 and 3-6 are maps showing the information from Exhibit 3-4 for the year 2006 during the two peak commute periods, respectively. The approximate locations of the congested segments, the duration of that congestion, and the reported recurrent daily delay are also shown on the maps.

Since a given congested segment may vary in distance from one year to the next as well as from day-to-day, more “generalized” congested segments have been created, so that segment comparisons can be made from one year to the next. The “specific” congested segments are the segments actually reported in the MTC produced “State of the System Report” report. On the SCL/ALA 880 corridor, one segment, the southbound AM period segment between Montague Expressway and Brokaw Road has not been monitored since 2003 and has continued to be reported as experiencing a very low 50 vehicle-hours of delay. PeMS, a 2005 DKS Associates study, nor field observations done in the summer of 2007 by the study team revealed any congestion in the southbound AM direction. Therefore, this segment was not considered a bottleneck for further analysis done in subsequent sections of this report.

The most congested segment on the corridor lies in the northbound direction in the PM peak period between Montague Expressway and the Santa Clara/Alameda County Line at Dixon Landing Road in Milpitas. Since 2003 – following the freeway widening – delay dropped by around 40 percent on this segment, but it continues to be the most congested segment on the SCL/ALA 880 corridor. In 2006, the congestion reported on this segment also ended at Route 237, which is nearly two miles north of Montague Expressway where it was originally reported.

Between 2003 and 2006, the second most congested segment, the southbound PM direction between Montague Expressway and US-101, also showed a downward trend in delay dropping from 1,510 DVHD in 2003 to 920 by 2006. This congestion, though much less in magnitude, appears to have grown in length. Prior to 2005, the congested ended at Brokaw Road, but now it continues more than a mile further south to US-101.

The Valley Transportation Authority's 2006 Monitoring and Conformance Report contains LOS information for the I-880 corridor. As shown in Figures 3-7 and 3-8, several segments of I-880 are currently operating at LOS F.

Exhibit 3-4: MTC Congested Segments 2003-2006

Period	Dir	Generalized Congested Area	Specific Congested Segment	Generalized Area Congested				Specific Segment Congestion			
				2003	2004	2005	2006	2003	2004	2005	2006
AM	NB	Coleman Ave to Brokaw Rd	North 1st St to Brokaw Rd	1,030	90	160	330	1,030	90		
			North of Coleman Ave to north of Gish Rd								330
			South of US101 to Brokaw Rd							160	
	SB	Montague Expwy to Brokaw Rd	Montague Expwy to Brokaw Rd	50	50	50	50	50	50	50	50
AM PEAK PERIOD SUMMARY				1,080	140	210	380	1,080	140	210	380
PM	NB	Montague Expwy to Dixon Landing Rd	Montague Expwy to Dixon Landing Rd	2,450	1,400	900	1,480			900	
			Montague Expwy to north of Dixon Landing Rd					2,450	1,400		
			North of Rte 237 to north of Dixon Landing Rd								1,480
	SB	Montague Expressway to US101	Montague Expwy to Brokaw Rd	1,510	1,400	720	920	1,510	1,400		
			Montague Expwy to south of Old Bayshore Hwy							720	
			North of Montague Expwy to south of Old Bayshore Hwy								920
		US101 to 1st St & Rte82 to Bascom Ave	US101 to 1st St & Rte 82 to north of Bascom Ave	190	190	190	190	190	190	190	190
PM PEAK PERIOD SUMMARY				4,150	2,990	1,810	2,590	4,150	2,990	1,810	2,590
TOTAL CORRIDOR CONGESTION				**5,230**	**3,130**	**2,020**	**2,970**	**5,230**	**3,130**	**2,020**	**2,970**

Source: MTC State of the System Report

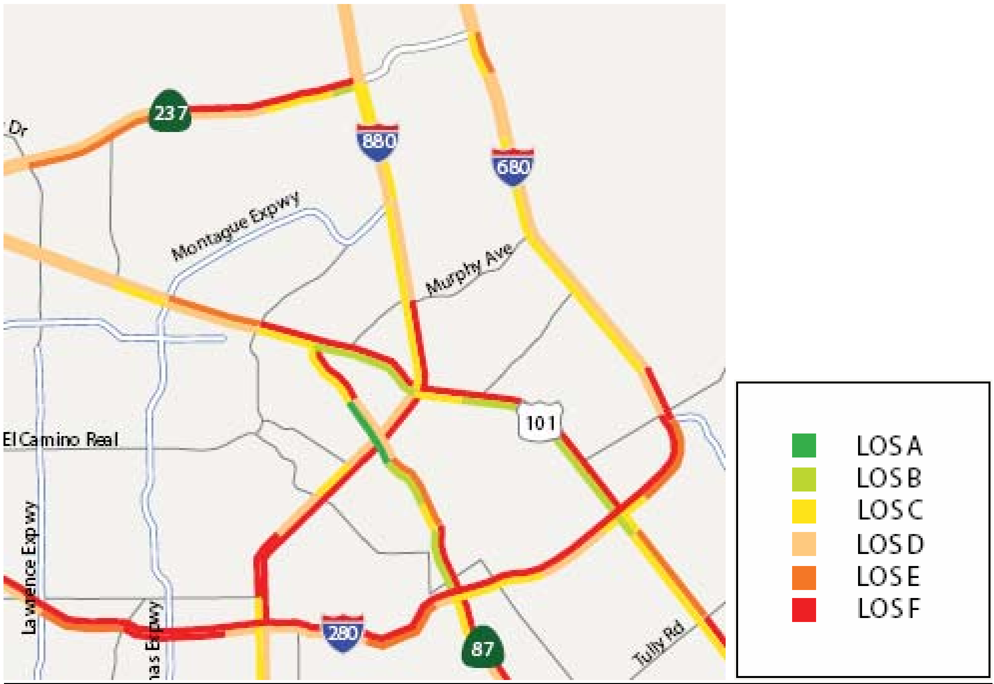
Exhibit 3-5: MTC Congested AM Peak Period Segments Map 2006

Source: SMG, Inc. based on MTC State of the System Report

Exhibit 3-6: MTC Congested PM Peak Period Segments Map 2006

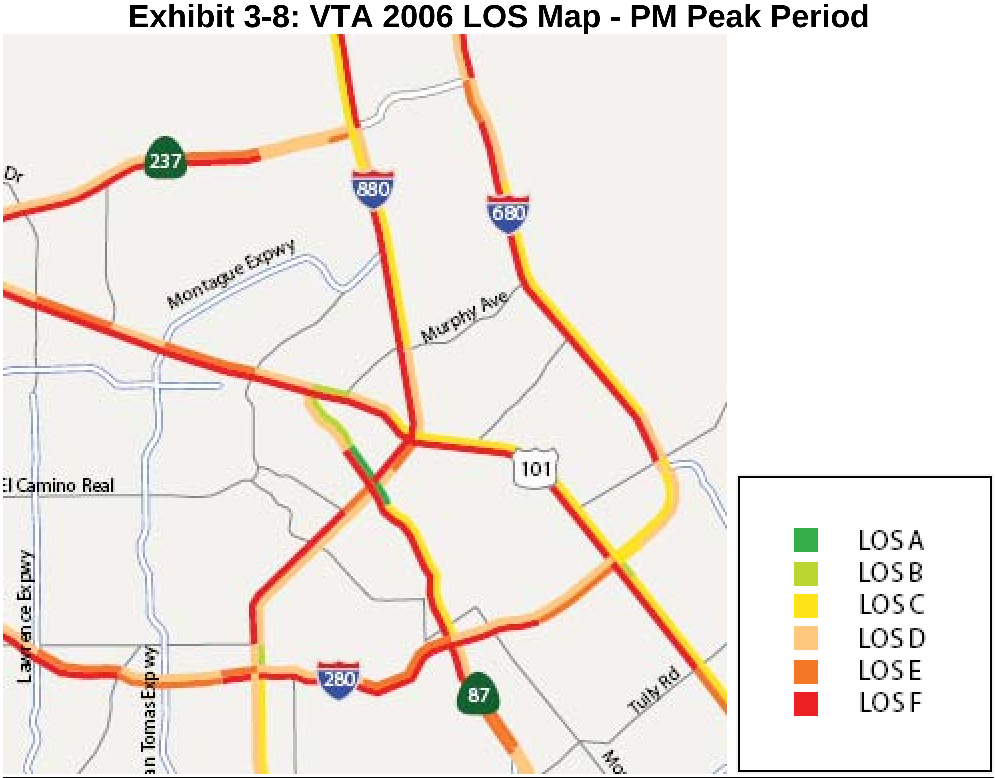
Source: SMG, Inc. based on MTC State of the System Report

Exhibit 3-7: VTA 2006 LOS Map - AM Peak Period



Source: Valley Transportation Authority 2006 Monitoring and Conformance Report

Exhibit 3-8: VTA 2006 LOS Map - PM Peak Period



Source: Valley Transportation Authority 2006 Monitoring and Conformance Report

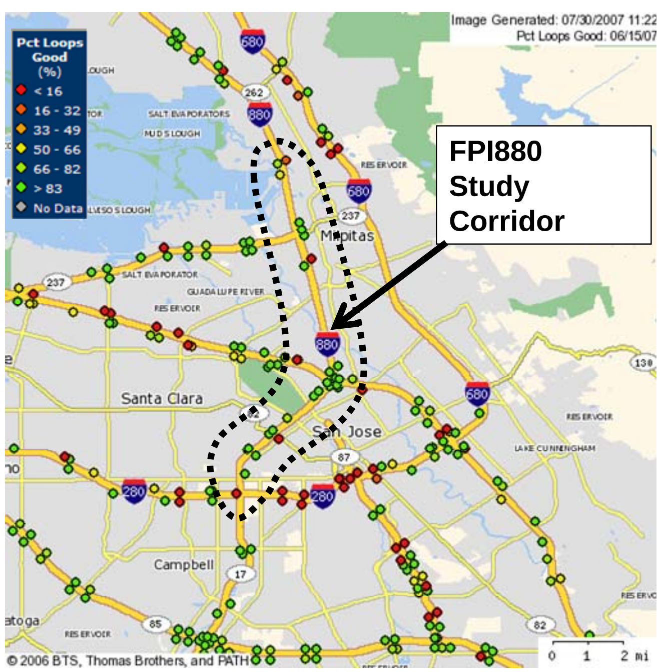
Freeway Performance Measurement System (PeMS)

The analysis of PeMS data indicates that PeMS covers between 20 and 25 percent of the SCL/ALA 880 study corridor depending on the time period under analysis and the travel direction being analyzed. Exhibit 3-9 is a graphic from PeMS showing the detection along the SCL/ALA 880 corridor and the percent of "good" data available for June 21, 2007, while Exhibit 3-10 is a table showing the percentage of "good" data for each month between 2004 and 2006. Exhibit 3-9 shows the location of gaps where there is no PeMS coverage at all. In addition, there are a number of sensors that are not producing "good" data (shown in red).

Exhibit 3-10 shows that data quality for working sensors varies by month and by location. However, it also reveals that there is "good" data at various points of the corridor, and the good detection is not completely located in one area. While not perfect, having detection covering a range of years, seasons, and locations on the corridor may help the study team by adding another dimension to the analysis, particularly concerning seasonal and time of day conditions.

Therefore, corridorwide data from PeMS may adequately reflect general trends along the corridor. If there is reasonable data from one or more detectors in the northern segment of the corridor, corridorwide peaking characteristics and travel time variations may be sufficiently estimated even though the results may be more heavily weighted toward conditions on the southern portion since there is more detection along the segment south of US-101.

Exhibit 3-9: PeMS Sensor Data Quality June 2007



Source: Freeway Performance Measurement System (PeMS)

Exhibit 3-10: PeMS Sensor Data Quality 2004-2006 by Location

Dir	Postmile (PeMS Absolute System)	Distance Monitored	Location	Co	City	Year and Month																																			
						2004-01	2004-02	2004-03	2004-04	2004-05	2004-06	2004-07	2004-08	2004-09	2004-10	2004-11	2004-12	2005-01	2005-02	2005-03	2005-04	2005-05	2005-06	2005-07	2005-08	2005-09	2005-10	2005-11	2005-12	2006-01	2006-02	2006-03	2006-04	2006-05	2006-06	2006-07	2006-08	2006-09	2006-10	2006-11	2006-12
Northbound	000.400	000.485		SCL	San Jose	92	95	85				9	-				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
	000.570	000.465	SB I-280	SCL	San Jose	83	92	92				82	18				71	76	75	83	95	92	80	42	53	84	94	84	76	6	-	-	-	26	53	53	15	65	90	94	86
	001.330	000.735	WB Bascom Ave	SCL	San Jose	67	67	92				82	18				78	83	82	80	94	90	73	37	82	97	95	80	86	7	47	80	61	75	73	96	92	58	94	91	97
	002.040	000.685	The Alameda/ SR-82	SCL	San Jose	34	-	8				-	-				-	-	-	-	-	-	-	-	-	-	6	-	-	31	29	31	27	31	18	14	33	6	-	-	-
	002.700	000.950		SCL	San Jose	84	91	87				-	-				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-										
	003.940	000.660	SB I-880 to SB US-101	SCL	San Jose	25	-	8				-	-				-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-									
	004.020	000.095	SB US-101 To NB I-880	SCL	San Jose	74	92	92				7	47				82	85	59	80	95	64	88	81	84	92	93	73	93	29	49	70	81	76	81	96	94	65	94	94	93
	004.130	000.095		SCL	San Jose	-	92	92				7	14				7	87	81	82	95	74	86	33	-	2	-	-	5	72	63										
	004.210	000.185	NB US-101 to NB I-880	SCL	San Jose	84	92	92				7	26				82	72	81	85	95	92	90	95	94	95	95	88	91	80	79	95	74	76	73	96	100	64	94	94	97
	004.500	000.645	Old Bayshore Highway	SCL	San Jose	39	-	26				98	97				88	87	83	30	-	-	4	71	94	95	94	88	82	93	71	95	81	81	81	71	48	66	94	94	100
	007.650	000.855	Great Mall Parkway	SCL	Milpitas	84	92	92				-	-				-	5	-	-	-	-	-	-	-	-	6	-	-	28	17	2	-	9	27	31	30	19	28	13	29
	008.360	000.450	SR-237 EB to I-880 NB	SCL	Milpitas	93	95	85				12	52				40	-	-	-	-	-	-	-	-	-	6	50	88	74	87	86	70	75	80	89	100	72	90	84	79
	008.550	000.205	SR-237 WB to I-880 NB	SCL	Milpitas	48	-	15				-	-				-	-	-	-	-	-	-	-	-	-	6	-	-	-	47	58	41	47	47	60	86	70	94	95	95
	008.770	001.001	SR-237 EB to I-880 NB	SCL	Milpitas	53	-	-				-	-				-	-	-	-	-	-	5	92	77	-	57	100			86	59	10	73	37	-	-	-	-	-	-
	010.552	001.706	Dixon Landing Rd	ALA	Fremont								-				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Southbound	000.030	000.640	Stevens Creek Blvd	SCL																			-	-	-	-	-	-	5	93	87	95	53	26	81	96	99	64	82	94	98
	001.250	000.625	Bascom Ave	SCL	San Jose	84	91	88				94	90				76	82	81	53	-	-	-	-	-	-	6	-	-	5	5	64	55	59	54	64	44	41	67	6	-
	001.280	000.345	Bascom Ave	SCL	San Jose	84	92	92				87	94				83	77	78	81	95	91	75	96	60	91	93	64	-	81	87	95	81	87	69	96	100	56	66	94	99
	001.940	000.410	NB SR-82	SCL	San Jose	84	92	92				94	93				78	87	80	89	95	92	91	90	92	95	95	80	93	92	81	85	67	40	81	96	100	64	85	94	100
	002.100	000.305	SR-82	SCL	San Jose	84	92	91				80	56				88	87	84	85	95	87	-	-	-	45	94	65	42	6	51	93	81	84	30	-	-	-	-	-	-
	002.550	000.670	Coleman Ave	SCL	San Jose	84	92	92				-	-				-	-	-	-	-	5	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	35
	003.440	000.480	WB North 1St	SCL	San Jose	28	-	8				95	67				88	90	80	89	95	92	96	96	95	96	95	82	92	84	76	91	81	76	77	96	100	77	93	92	81
	003.510	000.100	1st St	SCL	San Jose	13	-	8				-	-				-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-									
	003.640	000.215	1st St	SCL	San Jose	-	-	-				99	71				78	87	83	84	93	77	89	84	92	96	94	20	36	10	76	30	10	76	73	96	99	64	85	94	100
	003.940	000.245	SB US-101 To SB I-880	SCL	San Jose	-	42	84				83	92				7	84	80	63	90	77	91	74	94	96	94	79	97	85	66	91	62	76	56	65	81	60	86	76	81
	004.130	000.225		SCL	San Jose	-	50	92				7	14				-	-	-	-	-	31	9	-	-	-	-	-	-	67	63										
	004.390	000.185	Old Bayshore Highway	SCL	San Jose	-	-	-				97	93				88	62	83	90	95	91	91	93	33	42	95	87	94	94	70	95	81	75	32	-	-	-	-	-	-
	004.500	000.555	Old Bayshore Highway	SCL	San Jose	9	-	-				-	-				-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	
	007.530	001.000	Great Mall Parkway	SCL	Milpitas	22	-	8				24	54				53	38	-	-	-	-	-	-	-	-	67	87	83	92	84	9	-	27	77	95	98	66	72	94	100
	010.210	001.000	Dixon Landing Rd	SCL	Milpitas								-				-	-	68	41	-	-	-	-	29	64	92	88	98	68	60	91	71	76	86	89	100	72	94	95	99
	010.542	000.860	Dixon Landing Rd	ALA	Fremont								-				-	-	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-	-	-	-

Source: Freeway Performance Measurement System (PeMS)

With these caveats in place, it is still informative to review the PeMS data because there are still sensors that produce continuous high quality data. This data is deemed useful for performing global corridor wide analyses, and for detailed bottleneck analysis along sections with good quality data. In the bottleneck section below, a combination of probe vehicle data, PeMS data, and site visit results were used to identify and analyze bottlenecks.

To see how delay has changed between 2004 and 2006, the available PeMS data proves instructive. The study compiled three years of PeMS data and filtered out data that was deemed to be of poor quality (i.e., less than 75 percent observed). The study team did use estimated data in some instances where sufficient observed data was also available for the sensor to provide for a reasonable estimate. The total delay by time period for each direction is shown in Exhibits 3-11 and 3-12.

Total delay along the SCL/ALA 880 study corridor was computed for four time periods: AM peak (6:00 AM to 9:00 AM), Midday (9:00 AM to 3:00 PM), PM peak (3:00 PM to 7:00 PM), and evening/early AM (7:00 PM to 6:00 AM). Delay is computed as the difference in estimated travel time and a hypothetical travel time at a threshold speed of 60 miles per hour. This is different from the State of the System/HICOMP reporting methodology, which calculates delay using the “severe” threshold speed of 35 mph.

Exhibits 3-11 and 3-12 show the three-year trend in overall weekday delay (i.e., excluding weekends and holidays) for the three years analyzed for the northbound and southbound directions, respectively. There is also a 90-day moving average to “smooth” out the day-to-day variations and better illustrate the seasonal and annual changes in congestion over time.

The exhibits both illustrate that delay varies dramatically from day to day, which may have resulted in the contradictory results between the 511 and State of the System/HICOMP data. The 511 data is a snapshot average of all days available with the most recent travel times weighted more heavily in the calculation. The probe vehicle data from the State of the System/HICOMP reports is collected only a few days during the year.

Supporting the 511 data, the PM peak period in the southbound direction consistently has the highest delays on the corridor. In the AM northbound direction, the PeMS data supports both the 511 and State of the System/HICOMP data in that AM delay appears to be persistent over time as well as relatively constant in magnitude.

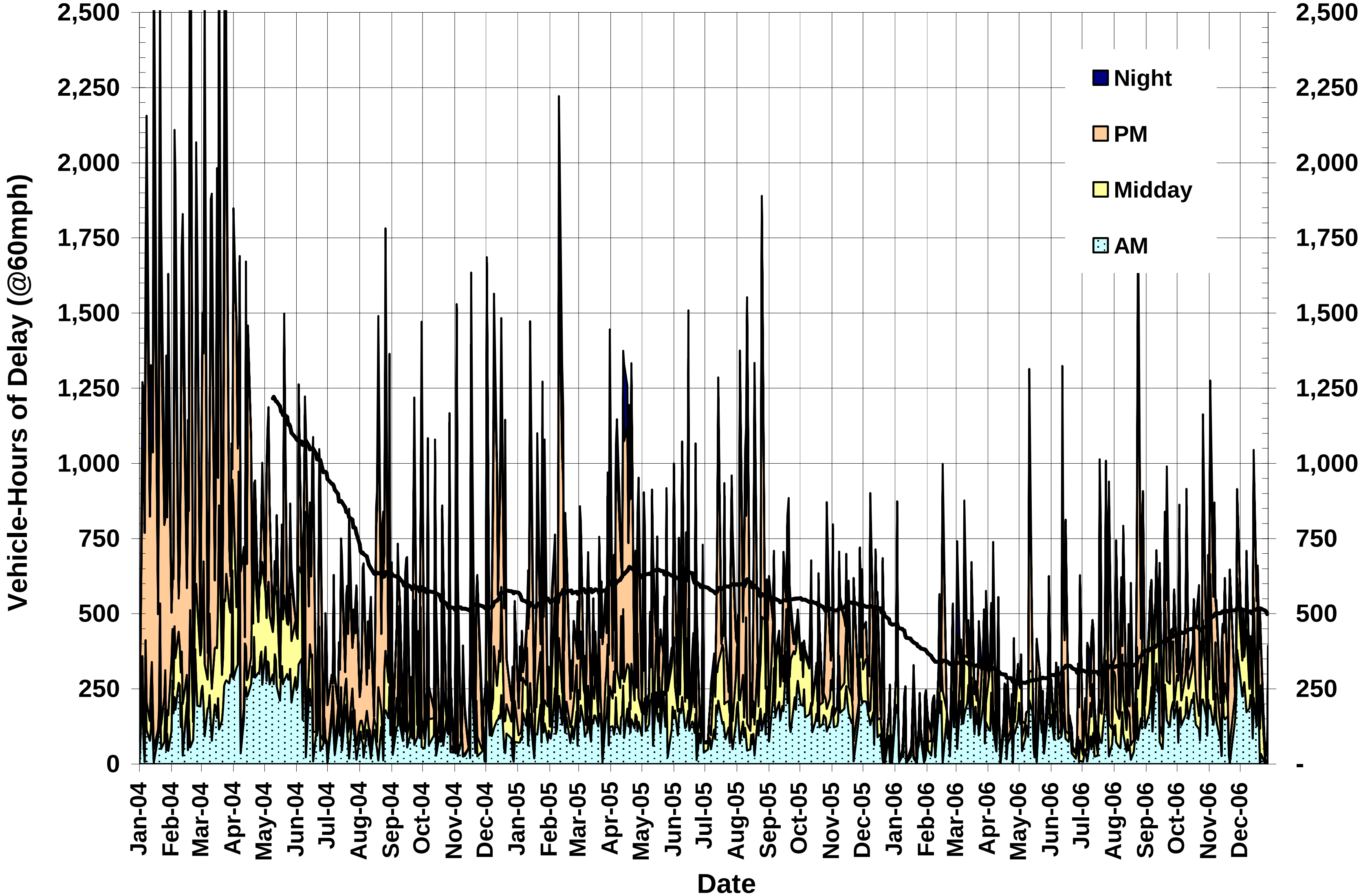
However, total congestion from PeMS is consistently lower overall than the HICOMP results by about two-thirds. The HICOMP delay along the corridor in both directions was about 2,970 DVHD for recurrent congestion in the fall and spring of 2006, while PeMS is reports no more than about 1,300 DVHD for total congestion during the same spring and fall periods.

There are a number of reasons for this difference. First, PeMS uses observed flows to estimate delay, while HICOMP uses a fixed 2,200 vphpl to calculate delay. Therefore, PeMS will report approximately 1/3 less delay than HICOMP. This is because under congested conditions, PeMS sensors typically report on the order of 1,500 vphpl which is approximately two-thirds of the flow rate used for the State of the System/HICOMP reporting (i.e., 2,200 vphpl).

PeMS also records congestion for all lanes, while the probe vehicles remain in a single lane (typically the second lane from the centerline or adjacent HOV lane) regardless of how well traffic flows on the adjacent lanes. The PeMS data also includes Mondays and Fridays, which may have lower delay than the mid-week days (discussed in more detail below). Finally, as mentioned previously, PeMS has coverage and data quality gaps, and even with “good” detection, PeMS will capture delay that occurs between detector locations. Therefore, the results that are based on PeMS are not capturing all the relevant traffic patterns on the corridor.

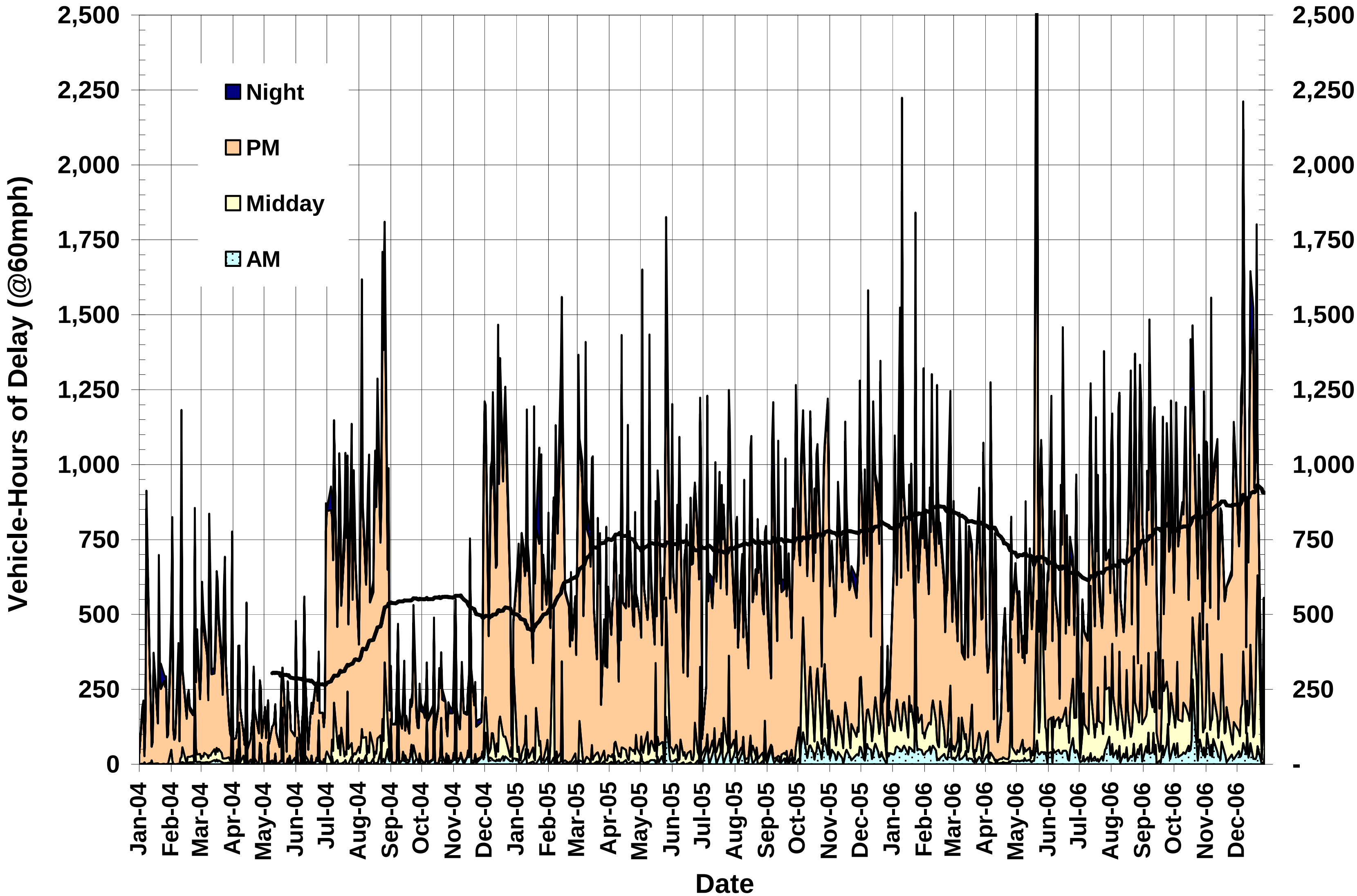
The southbound traffic experiences higher delays, particularly in the PM peak period and midday periods. Furthermore, the southbound direction has more weekdays with extreme delays. It is evident that delay varies significantly from day to day, week to week, and month to month, which points out a weakness of relying on a single day’s probe vehicle run to estimate annual delay.

Exhibit 3-11: Northbound Average Daily Delay by Time Period 2004-2006



Source: Freeway Performance Measurement System (PeMS)

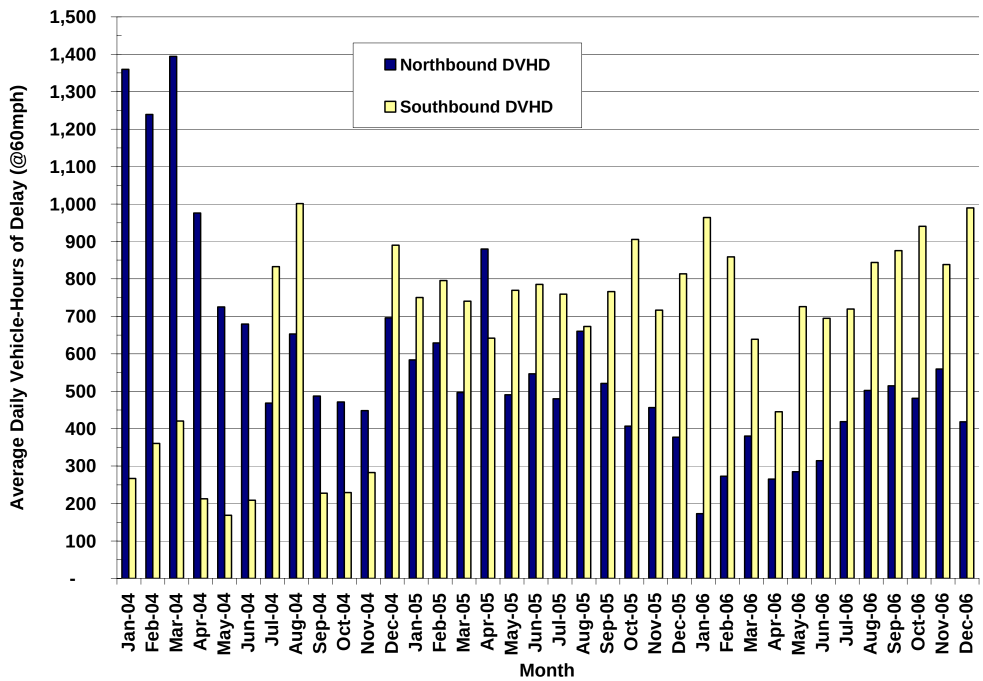
Exhibit 3-12: Southbound Average Daily Delay by Time Period 2004-2006



Source: Freeway Performance Measurement System (PeMS)

The next set of exhibits enables further understanding of delay characteristics and trends. Exhibit 3-13 shows the average daily weekday delay by month for the northbound and southbound directions. Similar to the discussion above, it is evident that since 2004, the southbound direction experiences more delay than the northbound direction. Moreover, northbound delay has declined since 2004, while southbound delay has grown dramatically.

Exhibit 3-13: Average Weekday Delay by Month 2004-2006



Source: Freeway Performance Measurement System (PeMS)

Delays presented to this point represent the difference in travel time between "actual" conditions and free flow conditions at 60 miles per hour. This delay can be segmented into two components as shown in Exhibit 3-14:

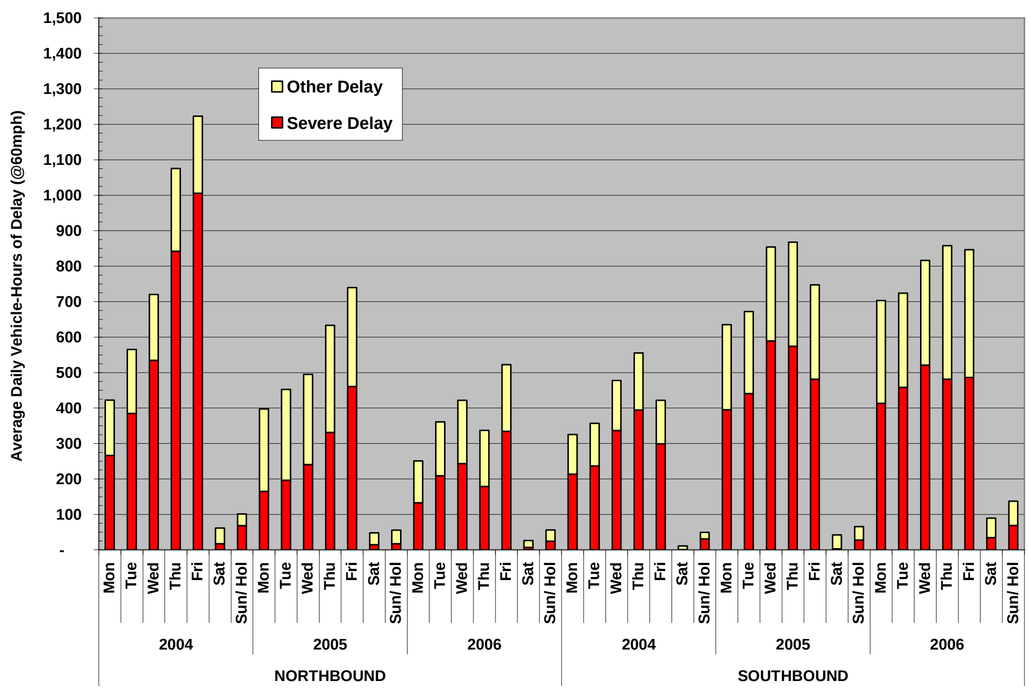
- Severe delay – delay that occurs when speeds are below 35 miles per hour; and
- Other delay – delay that occurs when speeds are between 35 miles per hour and 60 miles per hour.

Severe delay in Exhibit 3-14 represents breakdown conditions and is generally the focus of congestion mitigation strategies. On the other hand, "other" delay represents conditions approaching the breakdown congestion, leaving the breakdown conditions, or areas that do not cause widespread breakdowns, but cause at least temporary slowdowns. Although combating congestion requires the focus on severe congestion, it is important to review "other" congestion and understand its trends. This could allow for pro-active intervention before the "other" congestion turns into severe congestion.

This exhibit reveals that Wednesday, Thursdays, and Fridays are more congested than other days of the week. The exhibit also shows the trend described above where northbound delay has been declining over time while southbound delay appears to be growing.

On average, severe congestion (speeds below 35mph), contributes to just over 55 percent of total delay in 2006, ranging below 40 percent on Saturdays to around 64 percent on Wednesdays in the year 2006. Note also that northbound congestion has declined significantly since 2004, while southbound delay has grown consistently.

Exhibit 3-14: Average Delay by Day of Week by Severity 2004-2006



Source: Freeway Performance Measurement System (PeMS)

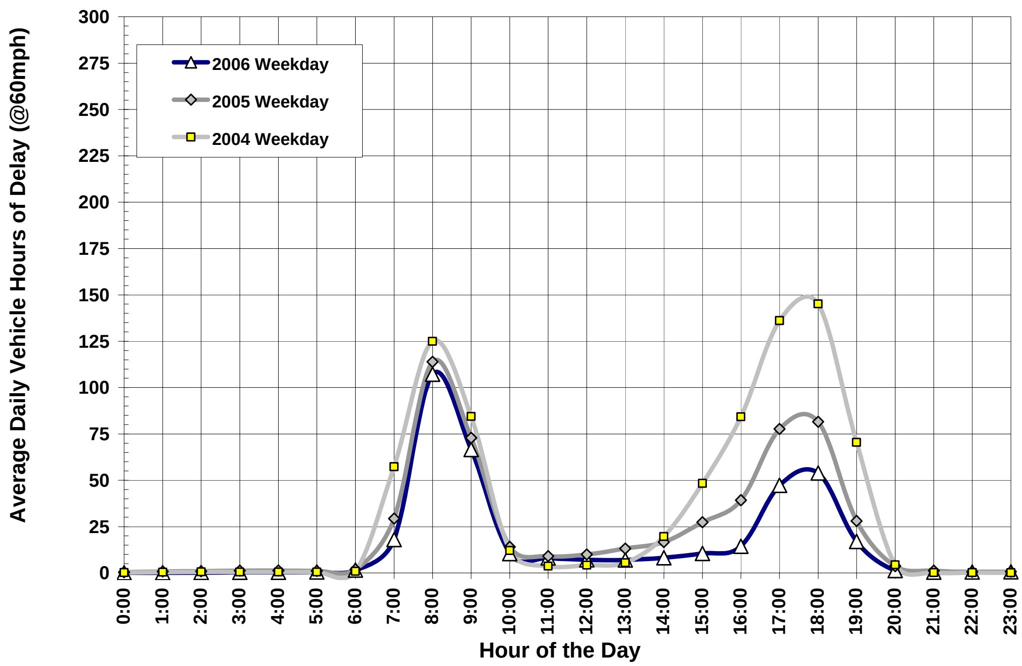
Another way to understand the characteristics of congestion and related delays is shown in Exhibits 3-15 and 3-16, which summarize average weekday hourly delay for the three years analyzed. Exhibit 3-15 shows in the northbound direction, while Exhibit 3-16 shows the southbound direction.

These exhibits show total delay by hour for the three years from 2004 through 2006. This exhibit is useful in that it shows the peaking characteristics of congestion and how the peak period is changing over time. As with the previous PeMS-based exhibits, delay has declined in the northbound direction since 2004, but has grown dramatically in the southbound direction. The AM peak period in the northbound direction lies between 6:30 AM and 10:00 AM, and there is no southbound AM peak. The PM peak period is approximately between 4:30 PM and 7:30 PM in both directions.

The northbound peak period has shrunk since 2004, most dramatically in the PM period where the midday side of the northbound PM peak period has shifted by nearly two hours and the evening side showing a shift of about one hour. The southbound PM peak period has shown no significant shifts in the congested period.

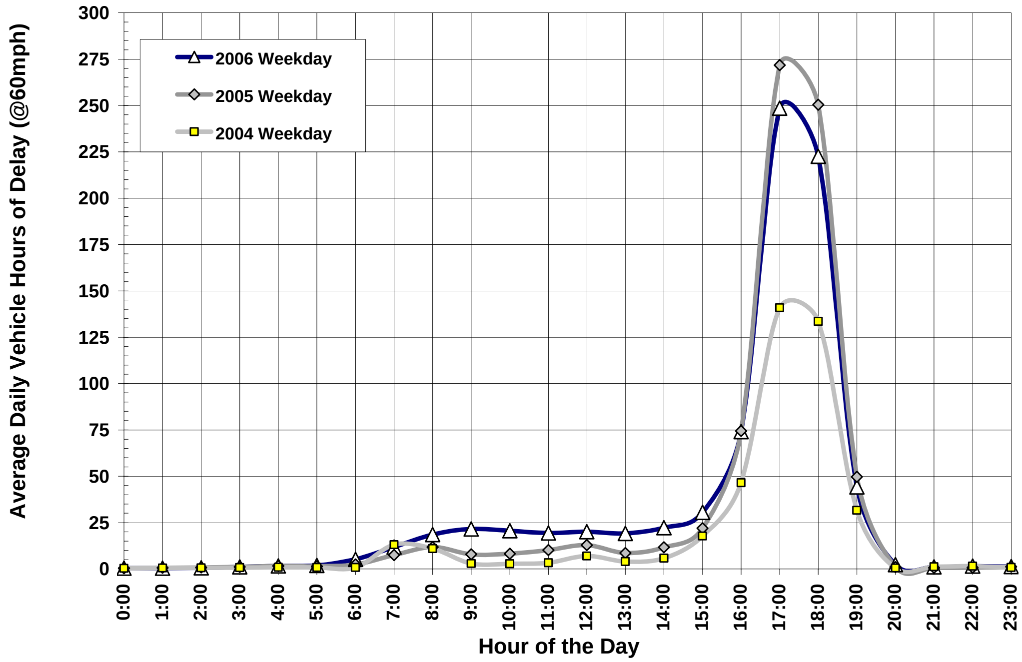
These exhibits compare favorably with the travel time analysis performed in Exhibit 3-1 in terms of the hours of the peak periods. The peak hour for the northbound AM in Exhibit 3-15 is at 8:00 AM while the 511 data shows the peak hour at 10:00 AM though the peak periods do coincide. The PM peak southbound peak hour in Exhibit 3-16 is during the 5:00 PM hour, while the peak in Exhibit 3-1 is one-half hour later at 5:30 PM.

Exhibit 3-15: Northbound Average Weekday Hourly Delay 2004-2006



Source: Freeway Performance Measurement System (PeMS)

Exhibit 3-16: Southbound Average Weekday Hourly Delay 2004-2006



Source: Freeway Performance Measurement System (PeMS)

RELIABILITY

Reliability captures the relative predictability of the public's travel time. Unlike mobility, which measures how many people are moving at what rate, the reliability measure focuses on how much mobility varies from day to day.

The "buffer index" was used to estimate reliability[8]. The buffer index is defined as the extra time (or time cushion) that travelers must add to their average travel time when planning trips to ensure on-time arrival. On-time arrival assumes the 95th percentile of travel time distribution. The buffer index is fairly easy to communicate to the general public. It can also be presented as a percentage, which makes it comparable among the different corridors and modes. To calculate and present the buffer index, two sources were used:

Bay Area 511 Predict-a-Trip℠[9] – described in detail in the travel time section above, this source was used to present the average travel time along the corridor.

Freeway Performance Measurement System (PeMS) – described in detail in the delay section of this report was used to calculate the buffer index.

Exhibit 3-17 shows the buffer index for years 2004 through 2006 for the northbound SCL/ALA 880. Exhibit 3-18 shows the same results for the southbound direction. Using the Predict-A-Trip data from Exhibit 3-1 along with the 2006 buffer index results from Exhibits 3-17 and 3-18, an estimate was made for the additional travel time needed to complete a trip. This assumes that the year 2006 buffer index results are compatible with the summer 2007 average travel time results from Predict-A-Trip. Since the Predict-A-Trip data is an average over the past year, this assumption may be valid. The results of this analysis are shown in Exhibits 3-19 and 3-20.

Although congestion worsened in 2006 in the northbound direction, reliability actually improved during the peak periods (though it worsened in the midday periods). This could be because as congestion worsens and becomes recurrent in nature, variations in travel time go down.

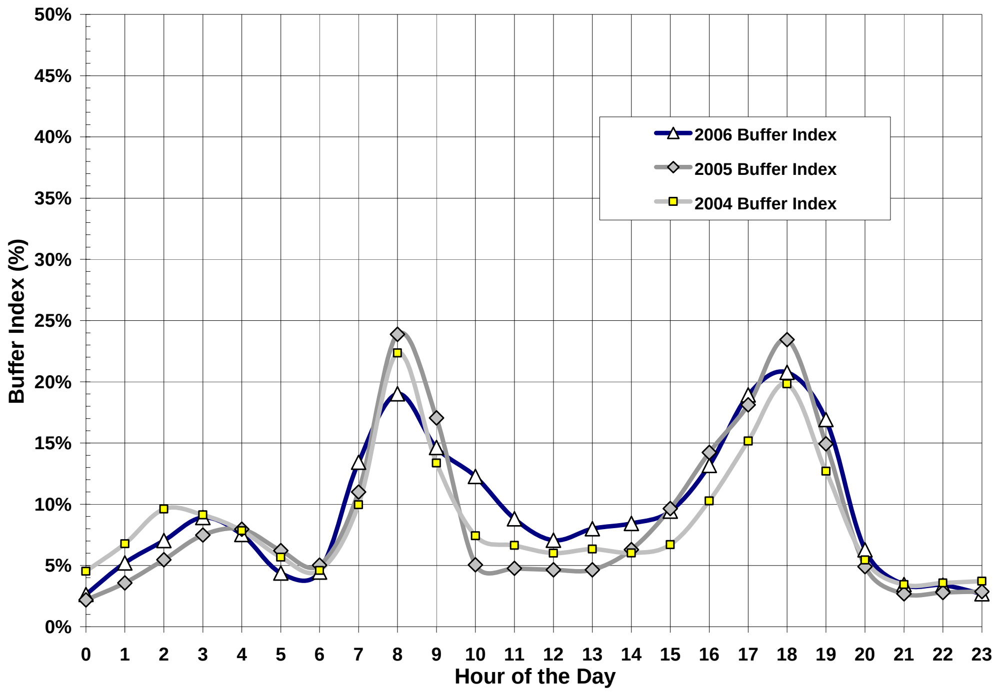
The advantage of using percentages is that a traveler can apply the percentage to any length of SCL/ALA 880 segment. In Exhibits 3-19 and 3-20, these percentages were applied to the average travel times for the entire corridor and the additional or "buffered" travel time to ensure an on-time arrival was calculated. As can be expected, the peak periods require more time with the PM peak northbound direction requiring a person to

[8] The Federal Highway Administration (FHWA) website (http://ops.fhwa.dot.gov/publications/tt_reliability/ has more information regarding the buffer index for planning purposes.
[9] http://traffic.511.org/his_traffic_text.asp

anticipate at least a 30-minute trip compared with the average time of approximately 22 minutes during the peak period around 6:00 PM.

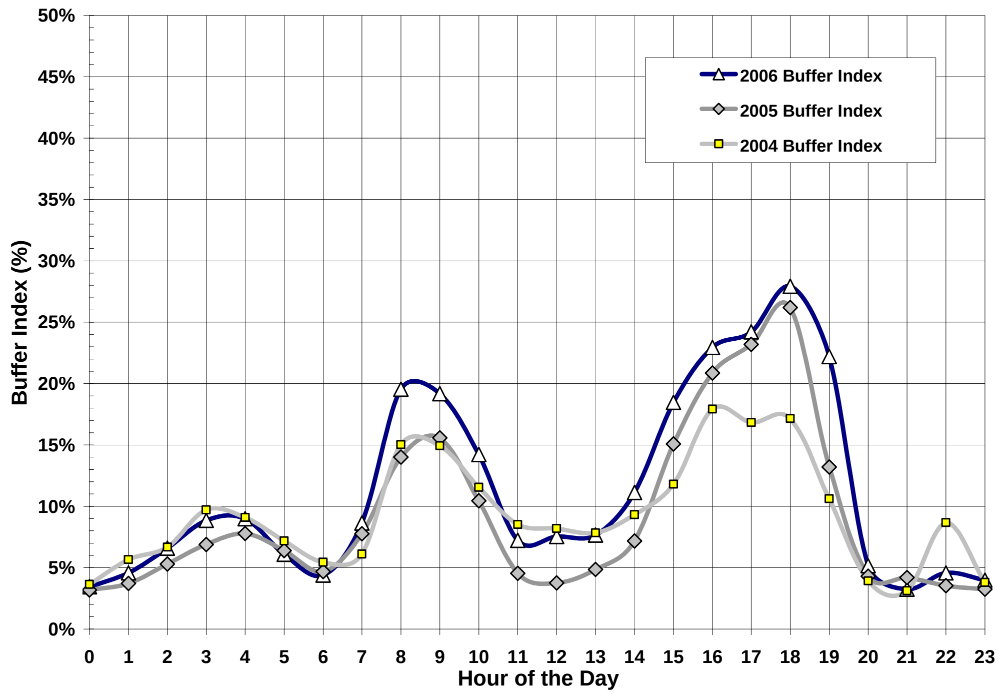
In the southbound direction, a traveler would need to anticipate an additional seven minutes to cover the corridor at 6:00 PM compared to an average travel time of 18 minutes to arrive on time at least 95 percent of the time that they travel this corridor.

Exhibit 3-17: Northbound Buffer Index by Time of Day 2004-2006



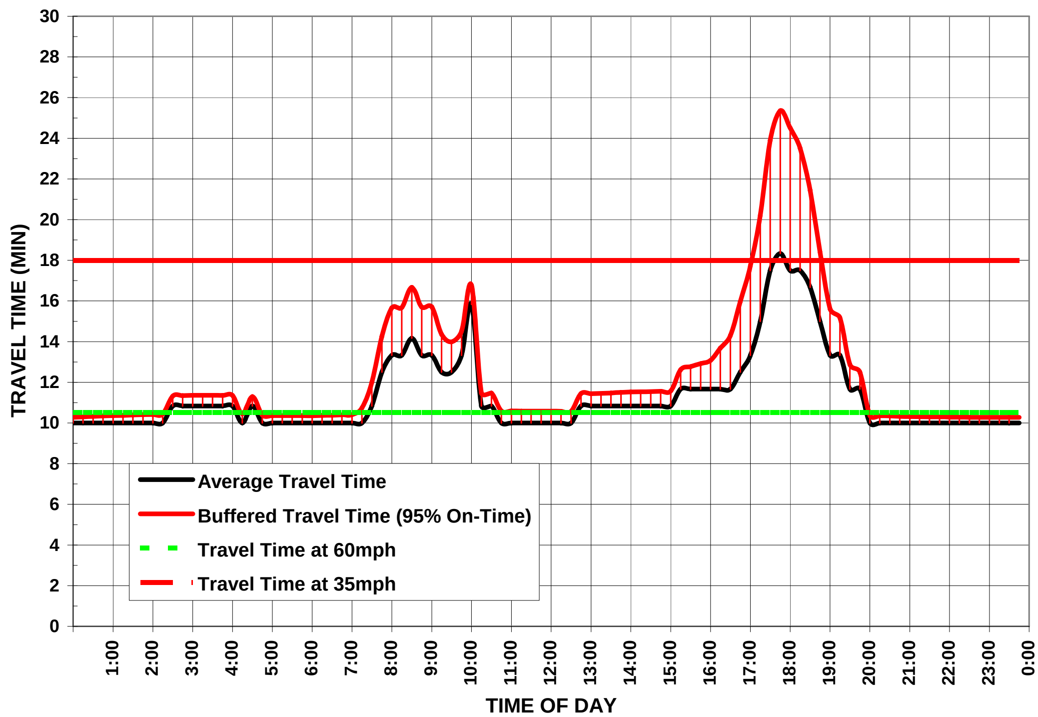
Source: PeMS

Exhibit 3-18: Southbound Buffer Index by Time of Day 2004-2006



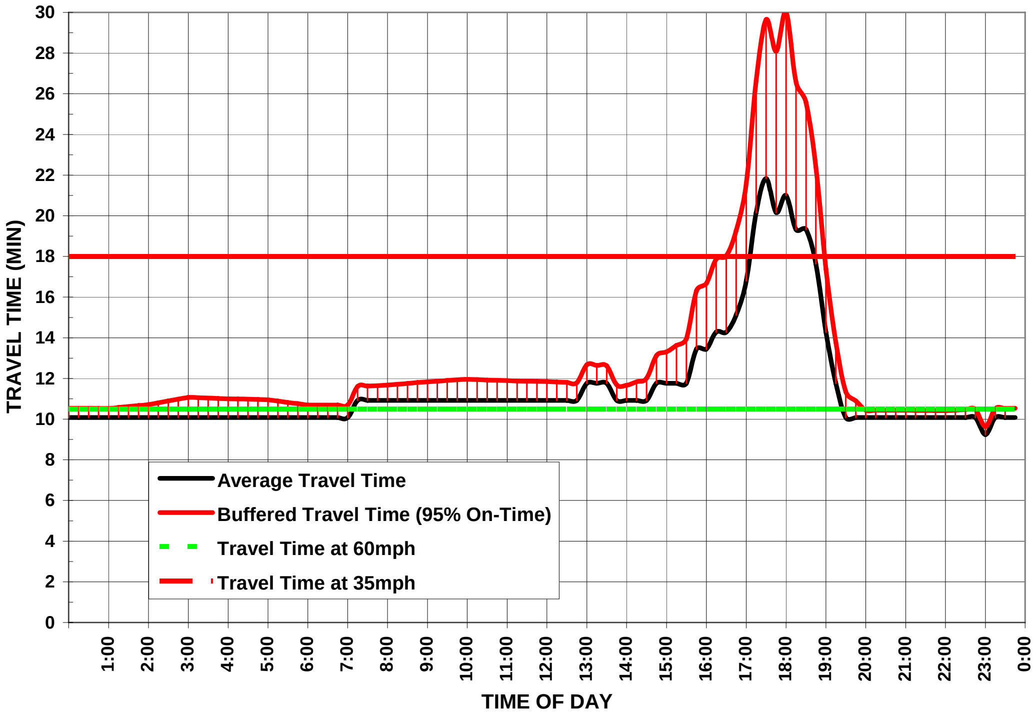
Source: PeMS

Exhibit 3-19: Northbound Travel Time Buffer 2007



Source: PeMS and 511.org

Exhibit 3-20: Southbound Travel Time Buffer 2007



Source: PeMS and 511.org

SAFETY

For the safety performance measure, the number of accidents and accident rates from the Caltrans Traffic Accident Surveillance and Analysis System (TASAS) were used. TASAS is a traffic records system containing an accident database linked to a highway database. The highway database contains description elements of highway segments, intersections and ramps, access control, traffic volumes and other data. TASAS contains specific data for accidents on State highways. Accidents on non-State highways are not included (e.g., local streets and roads).

The safety assessment in this report is intended to characterize the overall accident history and trends in the corridor, and to highlight notable accident concentration locations or patterns that are readily apparent. The FPI safety assessment is not intended to supplant more detailed safety investigations routinely performed by Caltrans staff.

Exhibits 3-21 and 3-22 show northbound and southbound accidents by month, respectively. The monthly accidents are broken down by weekdays and weekends and cover the 10.5 miles of the SCL/ALA 880 study corridor between I-280 to the south and the Santa Clara/Alameda County Line to the north. Monthly data from January 1, 2004 through June 30, 2006 is shown since the latest data available from 2006 is through

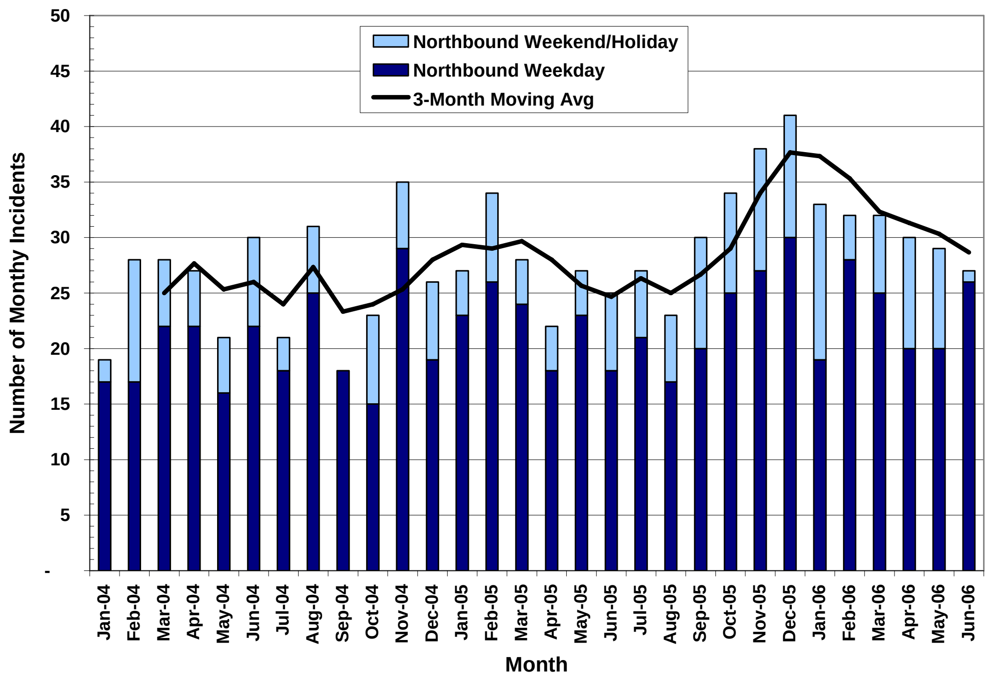
June of that year. The chart also shows the three-month moving average for total accidents on the corridor.

On average, the northbound direction experiences around 28 accidents per month and the southbound direction averages just over 25 accidents per month. In both directions, weekdays account for over 75 percent of all accidents per month. Assuming each month has approximately 20 workdays, this average accounts for approximately one incident per weekday in each direction.

In the northbound direction, there has been a clear increase in accidents since September 2005. Since that month, no month has reported fewer than 25 accidents and eight months of the ten months have reported more than 30 accidents. Prior to September 2005, only four of the 20 months had reported more than 30 accidents. Potential causes of accidents will be investigated as part of the bottleneck analysis, but more detailed safety analyses would have to be undertaken to determine whether this trend is atypical and not currently occurring or whether other conditions exist.

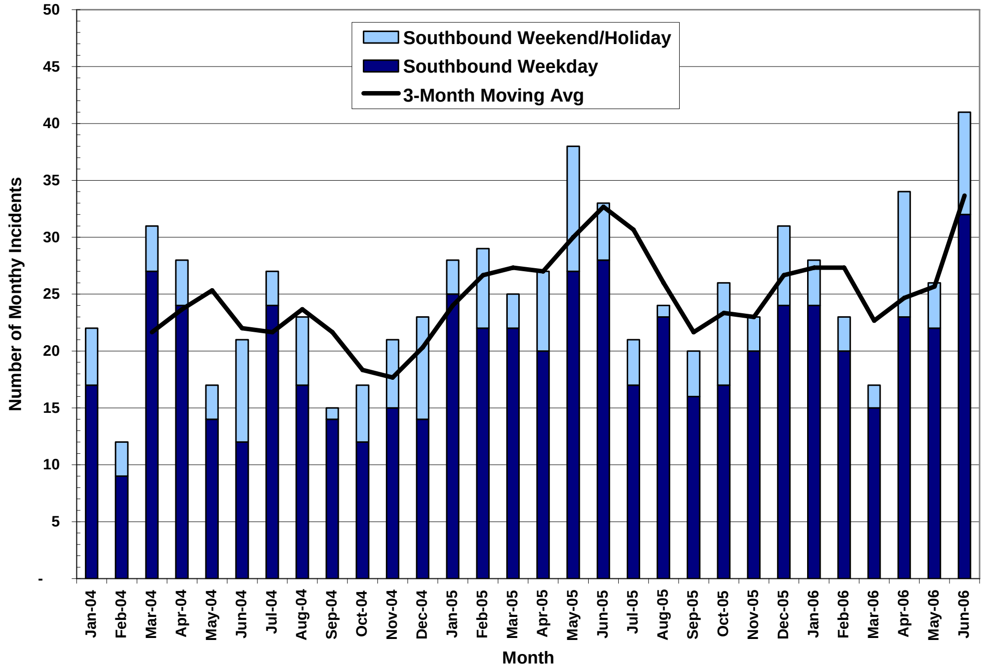
In the southbound direction, the number of accidents increased between November 2004 and June 2005, but dropped again following June 2005. June 2006 in the southbound direction is the highest month for accidents in the southbound direction, but may not be indicative of a future trend since no data is available after June 2006.

Exhibit 3-21: Northbound Monthly Accidents 2004-2006



Source: Caltrans Traffic Accident Surveillance and Analysis System (TASAS)

Exhibit 3-22: Southbound Monthly Accidents 2004-2006



Source: Caltrans Traffic Accident Surveillance and Analysis System (TASAS)

Exhibit 3-23 presents the TASAS three year accident data for 9/1/03 through 8/31/06 on I-880 both northbound and southbound. Total number of accidents by type (fatality, injury, and property damage only (PDO)), vehicle miles of travel, and the accident rate by type are provided. These accident rates are less than the statewide average accident rate for similar facilities in California.

Exhibit 3-23: Total Number of Accidents by Type and Accident Rate (2003-2006)

		Number of Accidents					Accident Rate (per MVMT)			
From	To	Fatalities	Injuries	PDO	Total	MVMT	Fatalities	Injuries	PDO	Total
Northbound										
I-280/SR-17 (SCL 0.000)	Near Mission Blvd (ALA 1.922)	3	236	568	807	1022.77	0.003	0.231	0.555	0.789
Southbound										
ALA/SCL County Line (SCL 10.502)	I-280/SR-17 (SCL 0.000)	3	174	542	719	848.53	0.004	0.205	0.639	0.847

Source: Caltrans Traffic Accident Surveillance and Analysis System (TASAS)

OTHER MEASURES

This section reports on the productivity measure that may help in informing decisions about the corridor. Productivity is a system efficiency measure used to analyze the capacity of the corridor, and is defined as the ratio of output (or service) per unit of input. In the case of transportation, it is the amount of people served divided by the level of service provided. Specific to highways, the input to the system is the capacity of the roadways; in transit, it is the number seats provided. For corridor analyses, productivity is defined as the percent utilization of a facility or mode under peak conditions. The highway productivity performance measure is calculated as actual volume divided by the capacity of the highway. Travel demand models do not generally project capacity loss for highways, but detailed micro-simulation tools can forecast productivity.

For highways, productivity is particularly important because where capacity is needed the most, the lowest “production” from the transportation system often occurs. In many locations on the SCL/ALA 880 corridor during the study team’s site visits, vehicles weaving and merging in and out of traffic caused slowing at major interchanges, which lead to significant reductions in capacity utilization. On some corridors throughput can decline as much as 50% during peak periods, and congested urban corridors typically lose 25% of their capacity during rush hour.

This loss in productivity is illustrated in Exhibit 3-24. As traffic flows increase to the capacity limits of a roadway, speeds decline rapidly and throughput drops dramatically. This loss in throughput is the lost productivity of the system. There are a few ways to estimate productivity losses. Regardless of the approach, productivity calculations require good detection or significant field data collection at congested locations. One approach is to convert this lost productivity into “equivalent lost lane-miles.” These lost lane-miles represent a theoretical level of capacity that would have to be added in order to achieve maximum productivity. For example, losing six lane-miles implies that adding a new lane along a six-mile section of freeway would improve productivity.

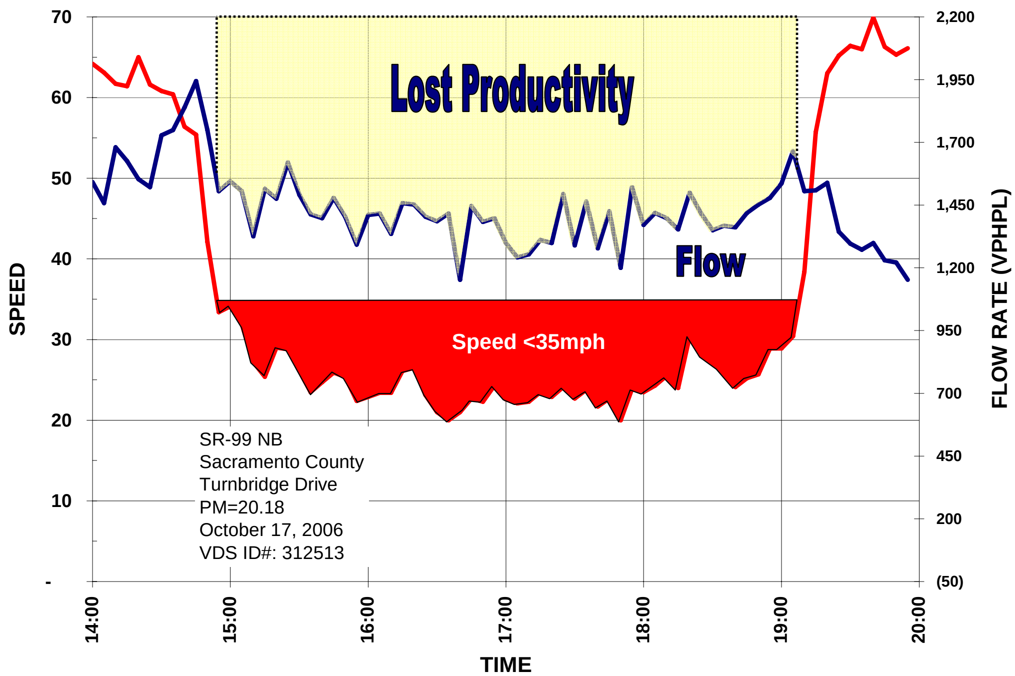
Equivalent lost lane-miles is computed as follows (for congested locations only):

$$LostLaneMiles = \left(1 - \frac{ObservedLaneThroughput}{2200vphpl}\right) \times Lanes \times CongestedDis\tan ce$$

Exhibit 3-24 summarizes the productivity losses on the SCL/ALA 880 study corridor for the three years analyzed for the northbound and southbound travel direction, respectively. Clearly, the PM peak period is where traffic congestion creates the most loss in productivity. Prior to 2006, the northbound direction experienced the highest losses, but in 2006, both directions experienced approximately the same level of productivity loss.

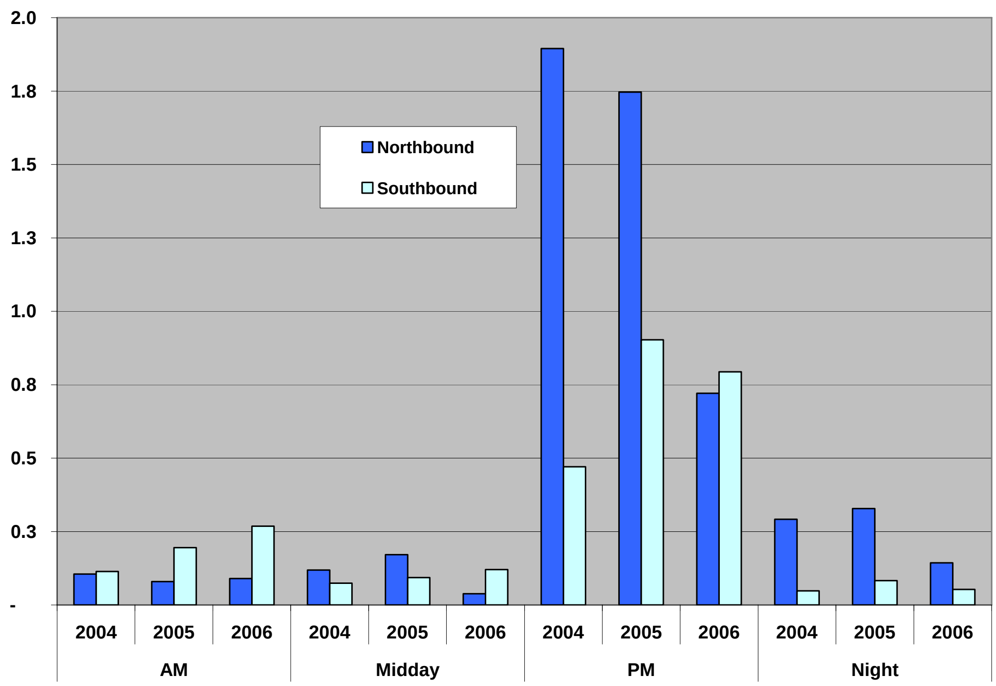
Strategies to combat such productivity losses are primarily related to operations and include building new or extending auxiliary lanes, developing more aggressive ramp metering strategies without negatively influencing the arterial network, and improvements in incident clearance times.

Exhibit 3-24: Lost Productivity Illustrated



Source: System Metrics Group, Inc.

Exhibit 3-25: Average Lost Lane Miles by Direction, Time Period, and Year

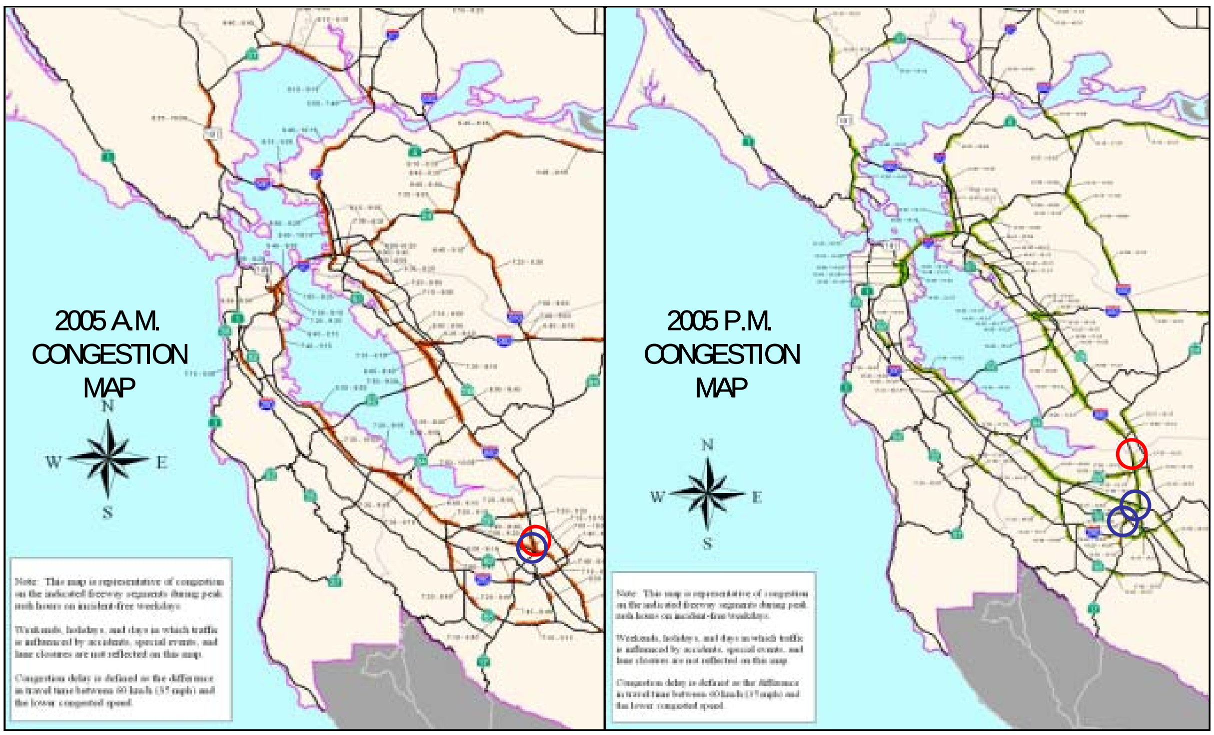


Source: PeMS

4. BOTTLENECK ANALYSIS

In review of the Caltrans Highway Congestion Monitoring (HICOMP) Report, potential problem areas are initially identified. Exhibit 4-1 illustrates the map of the SCL/ALA 880 Corridor congested freeway segments, along with the time period of congestion, obtained from the HICOMP Report. As shown, the downstream end of congested segments could potentially be bottleneck areas, illustrated in red and blue circles for northbound and southbound, respectively.

Exhibit 4-1: 2005 HICOMP Congestion Map



Source: Caltrans 2005 HICOMP Report

CHARACTERISTICS OF BOTTLENECKS

In order to establish a common understanding of bottlenecks in the context of this report, bottlenecks and their characteristics are defined as follows. Simply, a *bottleneck is a location where traffic demand exceeds capacity*. The 2000 Highway Capacity Manual defines it as “a road element on which demand exceeds capacity.” It is important to note, however, that a bottleneck does not necessarily refer to a physical location but rather a traffic condition that occurs at a particular location. Furthermore, a particular location, as it relates to bottlenecks, typically is over some distance, rather than a single spot. Depending on the bottleneck and situation, the length of the bottleneck segment will vary. In the effort to understand the cause of a bottleneck and find potential solutions, it is important to know where the bottleneck actually terminates and free flow conditions are restored. This bottleneck section is typically found where low in-queue speeds increase to 30 to 50 miles per hour.

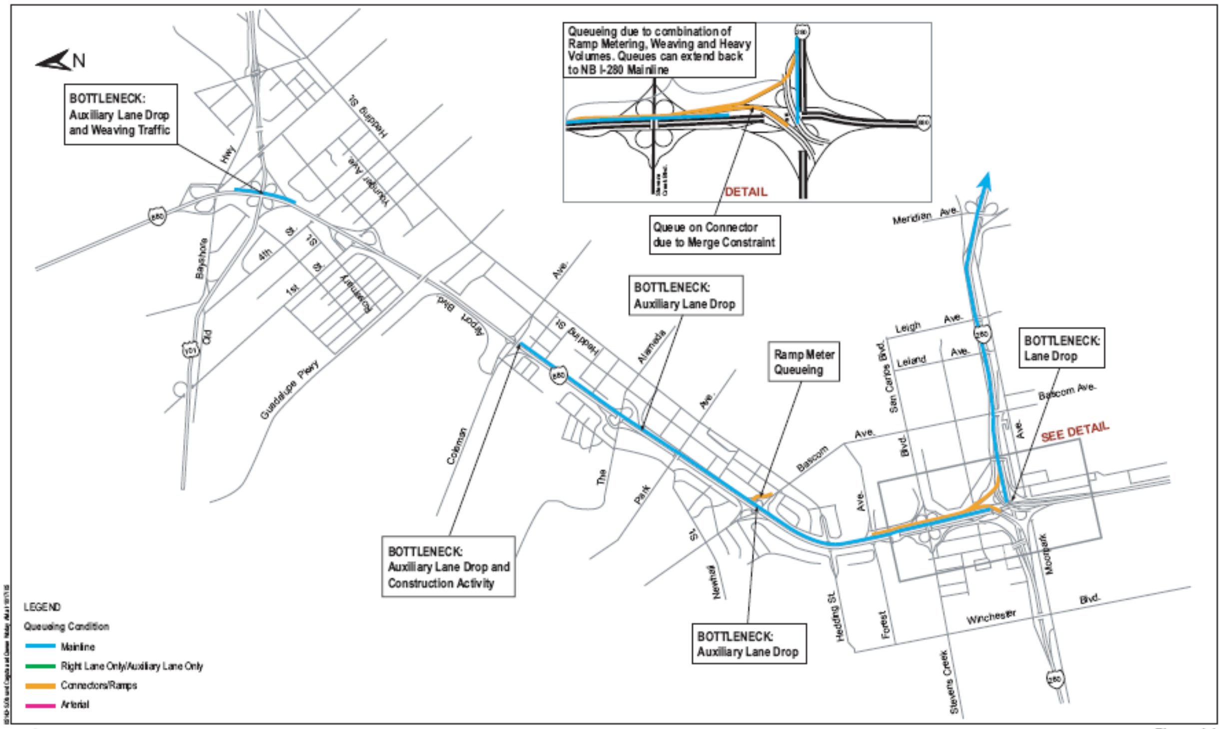
NORTHBOUND BOTTLENECKS

In review of the Caltrans Highway Congestion Monitoring (HICOMP) Report, potential problem areas are initially identified. As illustrated in Exhibit 4-1, the downstream end of congested segments could potentially be bottleneck areas in the northbound direction, as outlined in red circles. As indicated, in the northbound direction, there are potentially two major bottleneck locations, one in the AM, and another in the PM peak period. Further analysis would be needed, however, to determine their actual locations and possibly any other bottlenecks along the corridor not identified in the HICOMP. The review of the HICOMP provides a good starting point to keep in mind of the congested areas and possible bottleneck locations as more detailed analysis is conducted.

I-280 to US-101

The analysis of the I-880 freeway congestion and bottleneck locations along this segment was conducted by DKS Associates and detailed in their draft I-880 Corridor Study: Existing Conditions Report, October 12, 2005. As described in the report, bottlenecks in the northbound direction were observed only during the AM peak hours at the I-280 interchange due to the heavy I-280 on-ramp volume entering the freeway, at Coleman Avenue due to the auxiliary lane drop, and at the US-101 interchange due to the weaving of the traffic entering and exiting the interchange. Exhibit 4-2 illustrates the bottleneck and congestion location along this segment.

Exhibit 4-2: Observed Northbound Freeway Congestion Conditions



DKS Associates

Figure 4-1
I-880 Corridor Study
Observed Freeway Congestion and Queueing Conditions
Weekday AM Peak (7:00 – 10:00 AM)

US-101 to Santa Clara/Alameda County Line (Dixon Landing Road)

MTC Probe Vehicle Runs

Data from the MTC probe vehicle runs taken during spring and fall months of 2006 were used to determine the bottleneck and congestion locations along this corridor segment. The probe vehicle (electronic tachograph) runs provide speed plots across the corridor at various departure times. A vehicle equipped with an electronic tachograph device is driven along the corridor at various departure times, typically in a middle lane, during the peak period, at regular, 20 to 30 minute intervals. Actual speeds are recorded as the vehicle traverses the corridor length. From these plots, the locations where bottleneck terminates can be found at the downstream end of a congested speed location where speeds pick back up from about 30 miles per hour to free flow speeds in a very short distance. Exhibit 4-3 illustrates typical runs in the AM and PM peak conducted in April and September of 2006 with the bottlenecks identified. Additional runs during that time period did not reveal any new bottlenecks. The following are the bottleneck locations:

AM Peak:	North of US-101 Diagonal On-ramp
	North of Gish Road On-ramp
PM Peak:	North of Dixon Landing Road On-ramp

PeMS

With Performance Measurement System (PeMS), speed and speed contour plots are also used to identify potential bottleneck locations. Speed contour plots are essentially the compilation of speed plots across the corridor (similar to probe vehicle run graphs) at every five minutes. Unlike the probe vehicle runs, each 5-minute speed plot has universally the same time across the corridor. For example 7 AM plot includes the speed at one end of the corridor at 7 AM and the speed at the other end of the corridor also at 7 AM. With probe vehicle runs, the end time, or time at the end of the corridor, is the departure time plus the actual travel time.

Exhibit 4-4 illustrates a typical speed and speed contour plot generated by PeMS. It illustrates the typical speed and speed contour diagram for the I-880 freeway corridor in the northbound direction (traffic moving left to right on the plot) on a typical weekday in the month of August 2007. On the speed contour plot, along the vertical axis is the time period from 6 AM to 9 PM. Along the horizontal axis is the corridor segment from I-280 to Dixon Landing Road. The various colors represent the average speeds corresponding to the color speed chart shown below the diagram. As shown, the dark blue blotches represent congested areas where speeds are reduced. The ends of each dark blotches represent where controlling bottleneck terminates, where low in-queue speeds increase to 30 to 50 miles per hour. The horizontal length of each blot is the congested segment, queue lengths. The vertical length is the congested time period. As the exhibit illustrates, the likely bottlenecks in the northbound direction are at Brokaw Road interchange in the AM peak and north of Dixon Landing Road in the PM peak.

Exhibit 4-3: MTC Probe Vehicle Runs – AM & PM Peak, Spring & Fall 2006

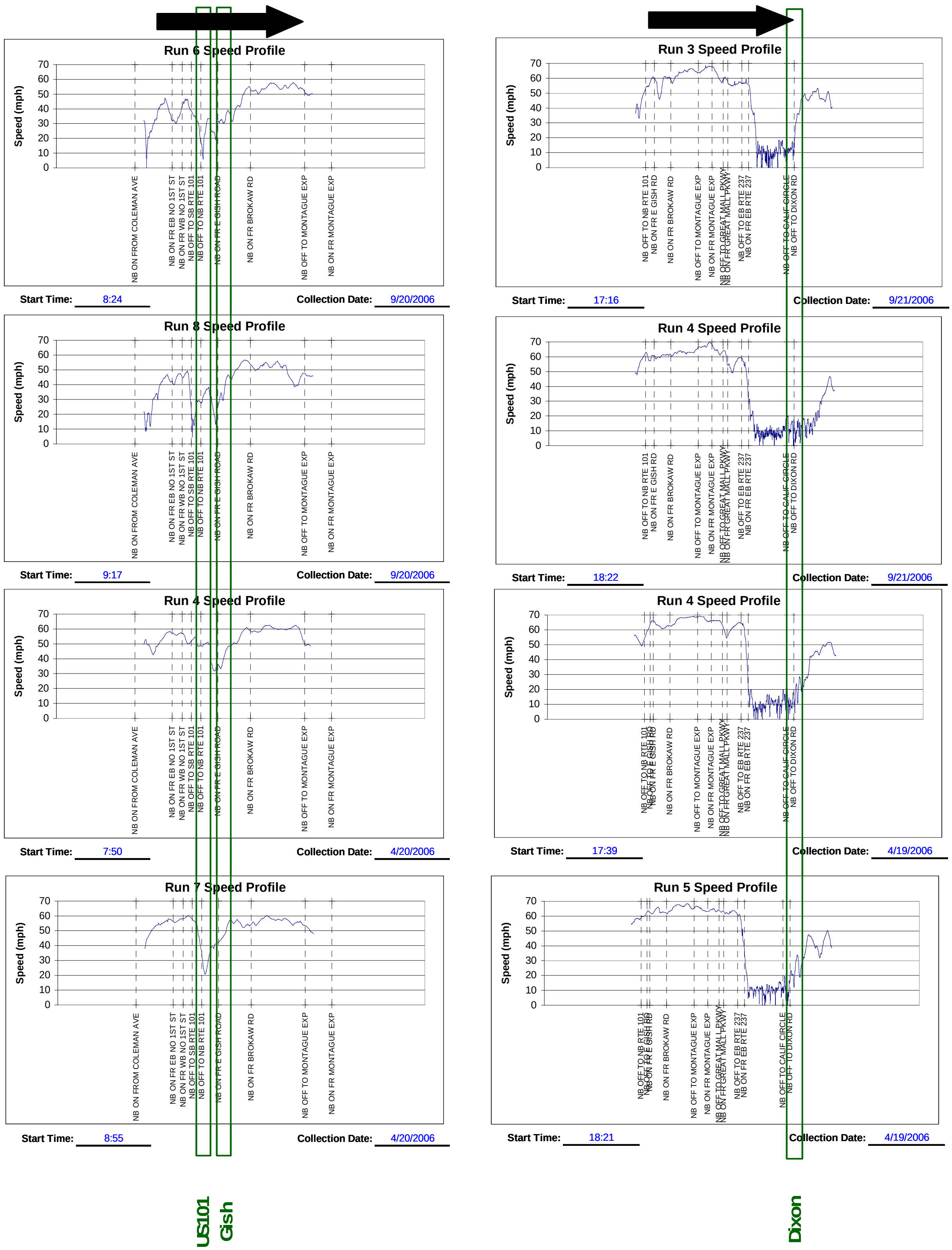
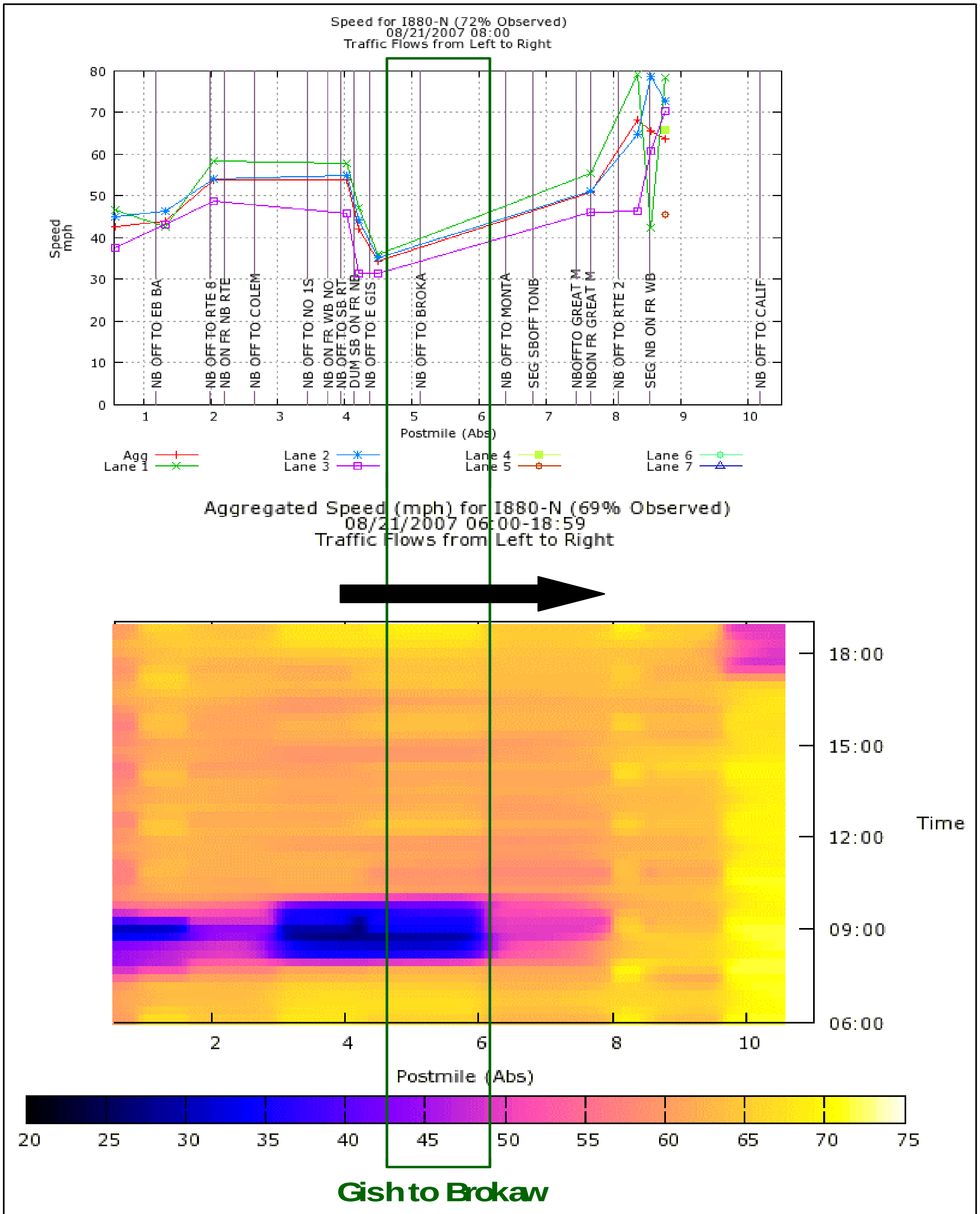


Exhibit 4-4: PeMS Speed and Speed Contour Plots – 8/21/07



Field Observations

Field observations were made on July 18 and 19, 2007 and again on August 21, 2007. Based on the field observations, bottlenecks in the northbound direction were identified at Brokaw Road interchange at the uphill grade during the AM peak and at the Mission Boulevard interchange construction area during the PM peak.

<u>Brokaw Road and Mission Blvd IC Bottlenecks</u>

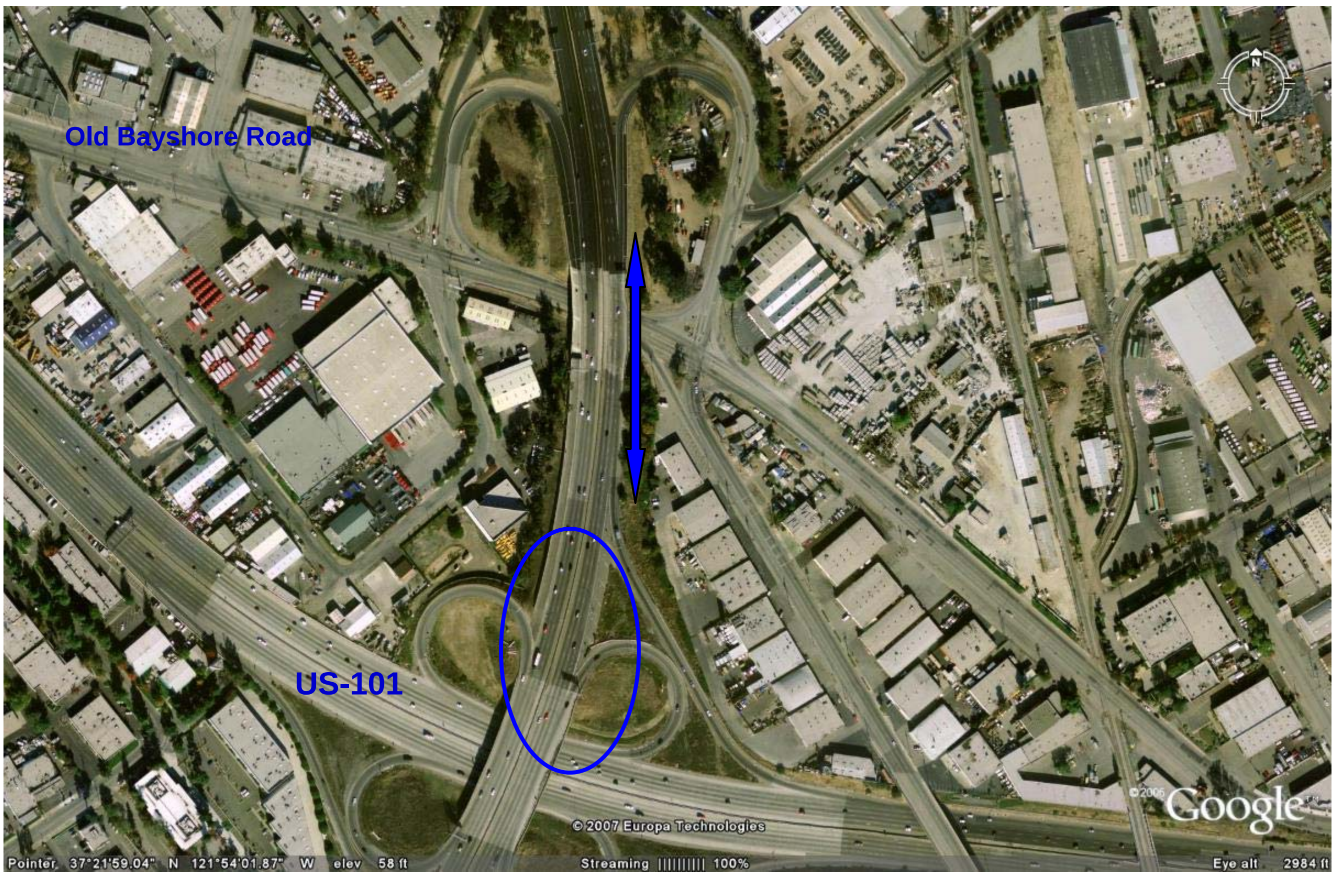
Exhibit 4-5 shows the approach to the Brokaw Road interchange. From the field observations, vehicles slowed down at the grade. When the mainline volumes are near the threshold levels, it could breakdown the freeway flow, creating congestion. The ramp volume is low and is currently metered; however, the ramp merge occurs at the crest of the grade, compounding the problem. North of Dixon Landing Road there is a construction project at Mission Boulevard with concrete rails adjacent to the roadway as shown on the exhibit that causes vehicles to slow and create congestion.

Exhibit 4-5: Northbound I-880 Approaching Brokaw Road and Mission Blvd IC

North of US-101 On-ramp Bottleneck

At the segment north of US-101 Off-ramp, there is a lane drop from four lanes to three. Just to the north of the lane drop is the US-101 On-ramp and a 700-feet merge/diverge segment to Old Bayshore/Gish Road Off-ramp. It is likely that the lane drop, US-101 ramp traffic merge, and weaving in and out of the very short merge/diverge lane that causes the bottleneck at this segment, as identified in the 2006 probe vehicle runs and in the 2005 study conducted by DKS Associates. The Exhibit 4-6 aerial photograph illustrates this location.

Exhibit 4-6: Northbound I-880 at US-101 Interchange



North of Gish Road On-ramp

At the segment north of Gish Road On-ramp, the bottleneck, as identified in the 2006 probe vehicle runs, is likely due to the ramp traffic merging onto the freeway such that the demand exceeds the capacity of the segment. However, based on the field site visits, this bottleneck was not observed.

SOUTHBOUND BOTTLENECKS

As illustrated in Exhibit 4-1, the downstream end of congested segments could potentially be bottleneck areas in the southbound direction, as outlined in blue circles. As indicated, in the southbound direction, there are potentially two major bottleneck locations, one in the AM and PM peak period and an additional location in the PM peak period. Again, the review of the HICOMP provides a good starting point to keep in mind of the congested areas and possible bottleneck locations as more detailed analysis is conducted.

I-280 to US-101

The analysis of the I-880 freeway congestion and bottleneck locations along this segment was conducted by DKS Associates and detailed in their draft I-880 Corridor Study: Existing Conditions Report, October 12, 2005. As described in the report, a bottleneck in the southbound direction was observed only during the PM peak hours at the 1st Street interchange, primarily due to the auxiliary lane drop. US 101 weaving traffic may also have contributed to the cause. Exhibit 4-7 illustrates the bottleneck and congestion location along this segment. Field observation made in July and August 2007 revealed that a significant and possibly a new bottleneck may have formed at Bascom Avenue interchange.

Exhibit 4-7: Observed Southbound Freeway Congestion Conditions

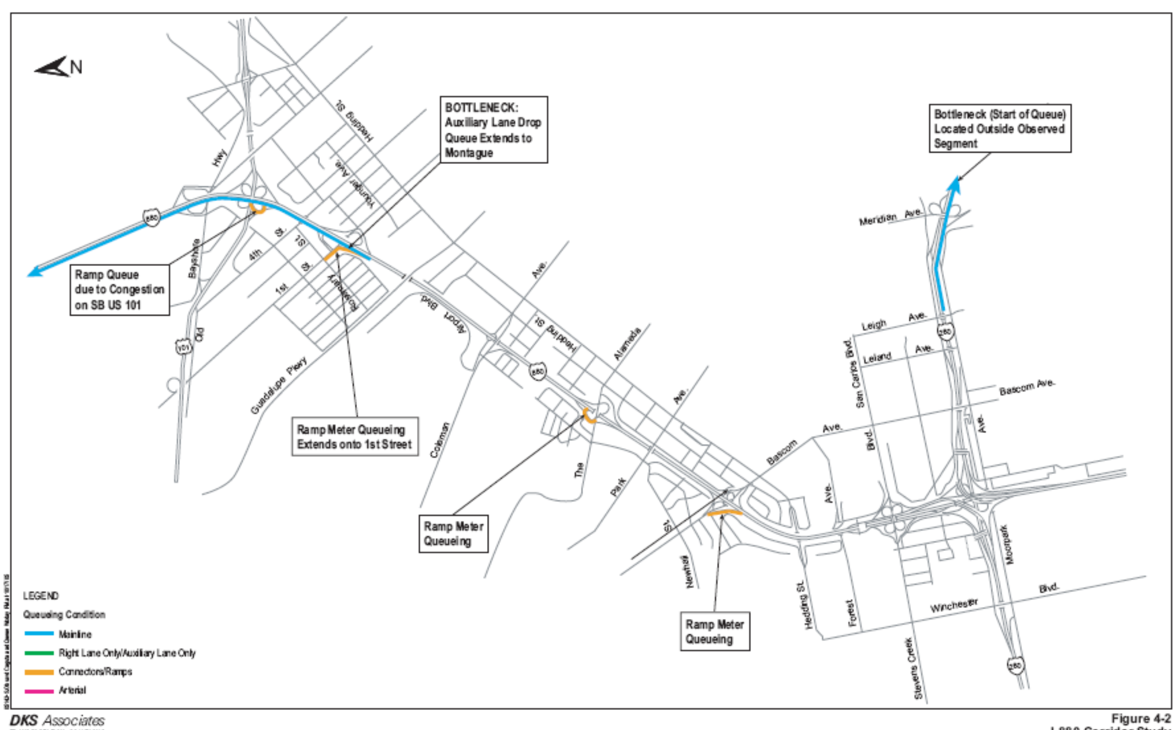


Figure 4-2
I-880 Corridor Study
Observed Freeway Congestion and Queueing Conditions
Weekday PM Peak (4:00 – 7:00 PM)

US-101 to Santa Clara/Alameda County Line (Dixon Landing Road)

MTC Probe Vehicle Runs

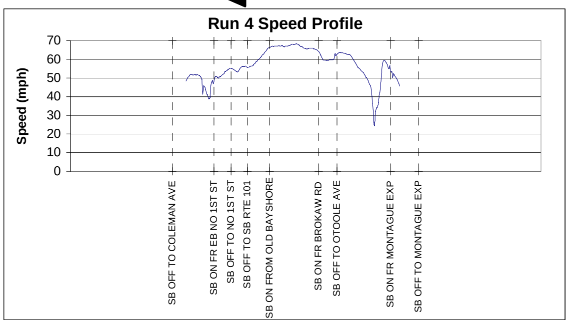
Again data from the MTC probe vehicle runs taken during the spring and fall months of 2006 were used to determine the bottleneck and congestion locations along this corridor segment in the southbound direction. Exhibit 4-8 illustrates typical runs in the AM and PM peak conducted in April and September of 2006 with the bottlenecks identified. Additional runs during that time period did not reveal any new bottlenecks. In the AM peak, no bottleneck or congestion is evident from the run samples. In the PM peak, a bottleneck at SR-237 is indicated in the spring 2006 runs only. Runs in the fall 2006 and spring and fall 2005 samples do not show the bottleneck at SR-237 to Montague Expressway. The bottleneck in the spring 2006 run could be from an incident or could be an anomaly.

PeMS

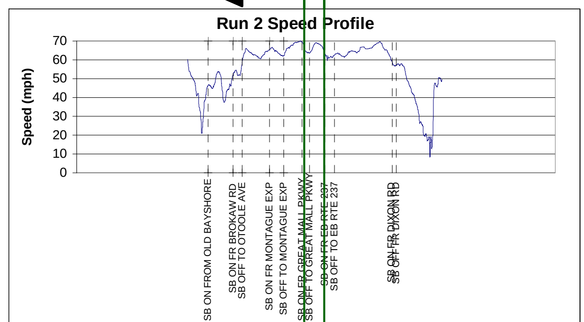
With Performance Measurement System (PeMS), speed and speed contour plots are again used to identify potential bottleneck locations. Exhibit 4-9 illustrates a typical speed and speed contour plot generated by PeMS. It illustrates the typical speed and speed contour diagram for the I-880 freeway corridor in the southbound direction (traffic moving left to right on the plot) on a typical weekday in the month of August 2007. On the speed contour plot, along the vertical axis is the time period from 6 AM to 9 PM. Along the horizontal axis is the corridor segment from Dixon Landing Road to I-280. The various colors represent the average speeds corresponding to the color speed chart shown below the diagram. As shown, the dark blue blotches represent congested areas where speeds are reduced. The ends of each dark blotches represent where controlling bottleneck terminates, where low in-queue speeds increase to 30 to 50 miles per hour. The horizontal length of each blot is the congested segment, queue lengths. The vertical length is the congested time period.

As the exhibit illustrates, the likely bottlenecks in the southbound direction are at the US-101 interchange and south of Bascom Avenue in the PM peak. No bottlenecks are indicated during the AM peak. Also, the PeMS data indicate that there are no bottlenecks between SR-237 and Montague Expressway.

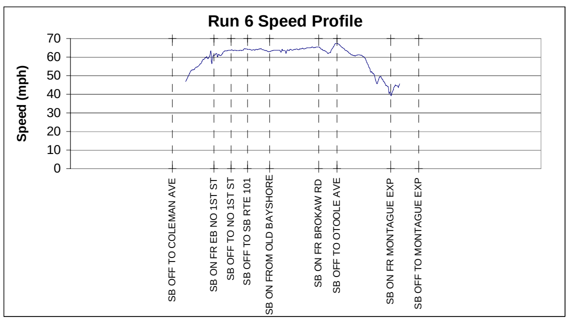
Exhibit 4-8: MTC Probe Vehicle Runs – AM & PM Peak, Spring & Fall 2006



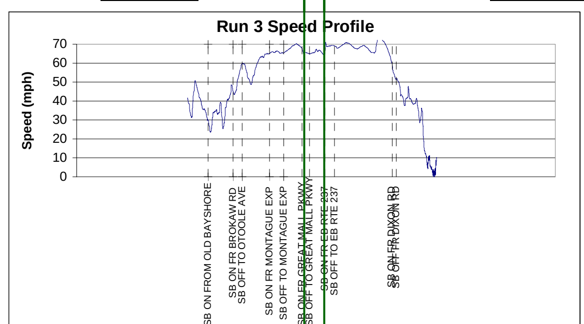
Start Time: 7:55 **Collection Date:** 9/20/2006



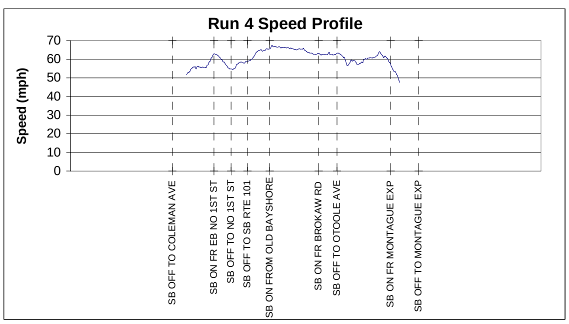
Start Time: 16:11 **Collection Date:** 9/21/2006



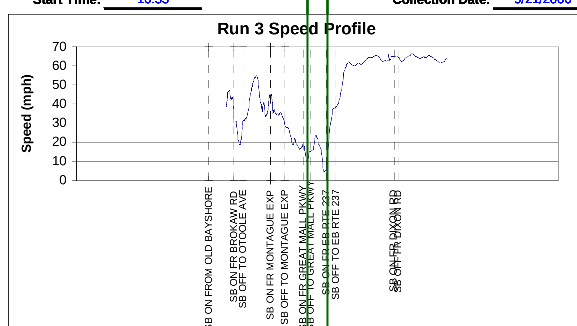
Start Time: 8:37 **Collection Date:** 9/20/2006



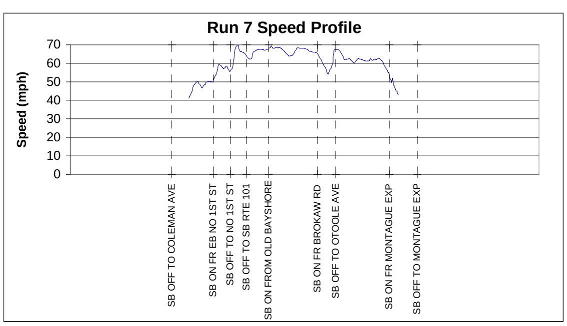
Start Time: 16:53 **Collection Date:** 9/21/2006



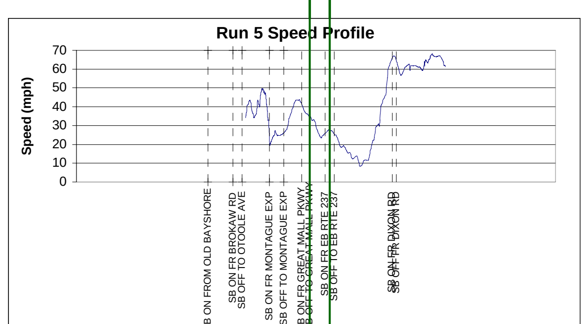
Start Time: 7:59 **Collection Date:** 4/20/2006



Start Time: 16:39 **Collection Date:** 4/19/2006



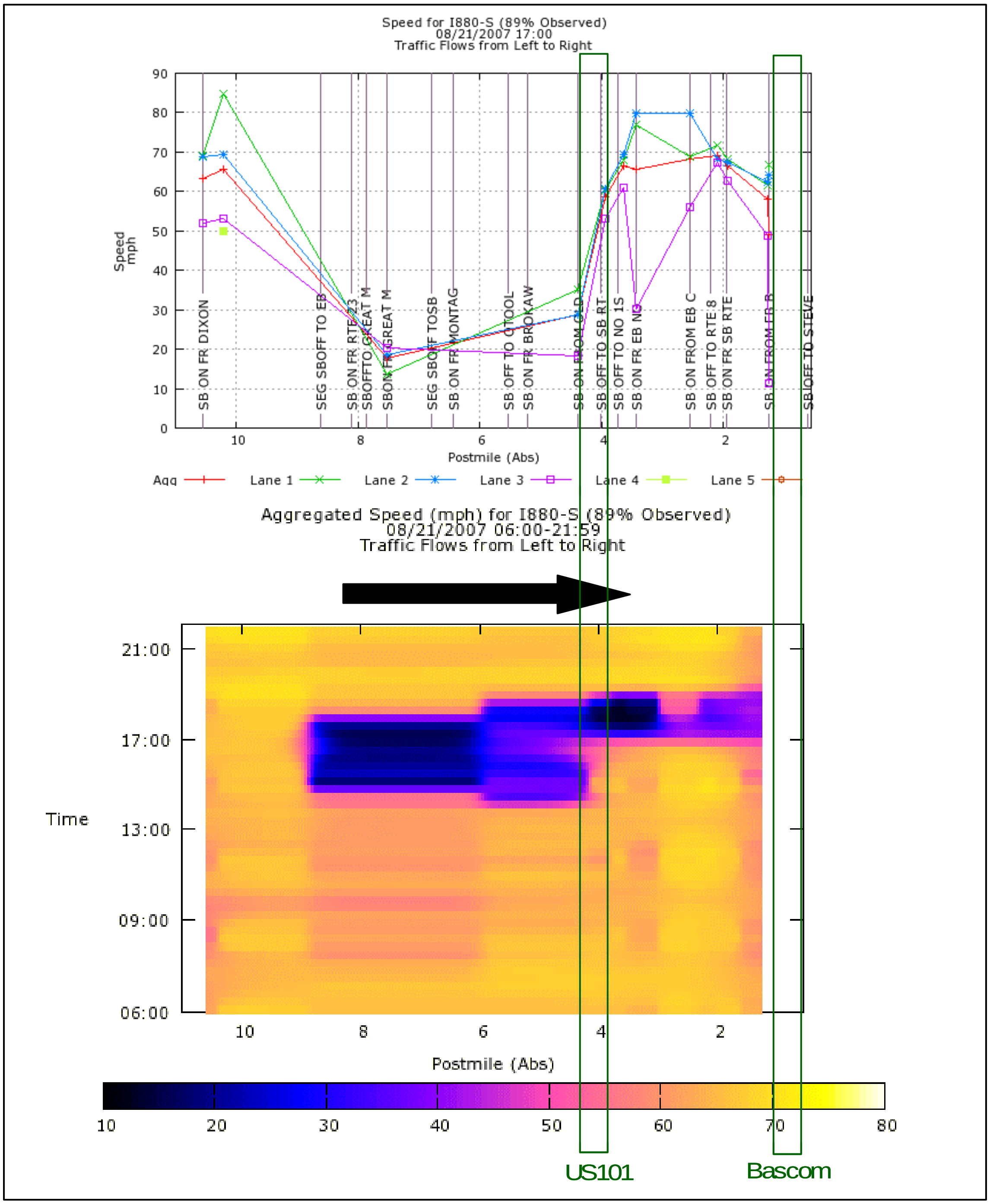
Start Time: 9:04 **Collection Date:** 4/20/2006



Start Time: 18:05 **Collection Date:** 4/19/2006

SR237

Exhibit 4-9: PeMS Speed and Speed Contour Plots – 8/21/07



Source: PeMS

Field Observations

Field observations made on July 18 and 19, 2007 and again on August 21, 2007, identified bottlenecks in the southbound direction at the US-101 interchange and at Bascom Avenue interchange during the PM peak. No bottlenecks or congestion were visibly evident during the AM peak; however, slowing in the outer lanes at the SR-237 and I-280 interchanges was also observed. The slowing was due to off-ramp traffic backing up onto the freeway mainline.

<u>US-101 Interchange Bottleneck</u>

Exhibit 4-10 shows the approach to the US-101 interchange. Considering the heavy traffic volume of the freeway to freeway interchange, the weaving distance provided by the full clover interchange is too short to handle the demand. As a result, congestion is created by this bottleneck location. The short weaving section between the ramps reduces the effective capacity such that the demand now exceeds this capacity. Exhibit 4-11 shows the dynamics of the traffic weaving through this interchange and the congestion that formed as a result. Speeds picking up to free flow were observed just past the off-ramp as indicated in the exhibit.

Exhibit 4-10: I-880 at US-101 Interchange

Source: Microsoft Virtual Earth

Exhibit 4-11: Southbound I-880 Approaching and At US-101 Interchange

Source: System Metrics Group, Inc.

<u>Bascom Avenue Bottleneck</u>

At the Bascom Avenue interchange, significant queuing and congestion was formed during the late evening hours. It is likely that the cause of the congestion is due to the auxiliary lane drop in the southbound direction and the merge of the on-ramp volume.

BOTTLENECKS SUMMARY

Exhibit 4-12 and outline below provide a summary of the bottlenecks for the SCL/ALA 880 Corridor. The outline summary list of bottlenecks represents those locations where traffic congestion is repeatedly formed.

Exhibit 4-12: Bottlenecks Summary Table

BOTTLENECK LOCATION	**PeMS** [a] Speed Contours		**MTC** [b] Probe Vehicle Runs		**2005 DKS** [c] Associates Report		**Field** [d] Observations		SUMMARY [e]
	AM	PM	AM	PM	AM	PM	AM	PM	
NORTHBOUND									
North of Dixon (Mission)	-	MAJOR	n/a	n/a	n/a	n/a	MAJOR	MAJOR	**Controlling bottleneck (AM/PM)**
Dixon On-ramp	-	-	n/a	MAJOR	n/a	n/a	-	-	Minor bottlenck (PM)
Brokaw Interchange	MAJOR	-	-	-	n/a	n/a	MAJOR	-	**Controlling bottleneck (AM)**
Gish On-ramp	-	-	minor	-	n/a	n/a	-	-	Minor bottleneck (AM)
US101 Interchange	-	-	MAJOR	-	MAJOR	-	minor	-	**Controlling bottleneck (AM)**
Coleman Interchange	-	-	n/a	n/a	MAJOR	-	-	-	Minor bottleneck (AM)
I-280 On-ramp	-	-	n/a	n/a	minor	-	-	-	Minor bottleneck (AM)
SOUTHBOUND									
US101 Interchange	-	MAJOR	-	-	-	MAJOR	-	MAJOR	**Controlling bottleneck (PM)**
1st Street Interchange	-	-	-	-	-	MAJOR	-	-	Minor bottleneck (PM)
Bascom Interchange	-	MAJOR	-	-	-	minor	-	MAJOR	**Controlling bottleneck (PM)**

NOTES:
[a] Based on Performance Measurement System (PeMS) sample daily speed contours taken from August 2006 and quarterly weekday averages from 2004 to 2007 data.
[b] Based on Metropolitan Transportation Commission (MTC) sample probe vehicle runs, as part of highway congestion monitoring program (HICOMP), taken in Spring & Fall 2006.
[c] Based on draft I-880 Corridor Study: Existing Conditions Report, DKS Associates, October 12, 2005.
[d] Based on field observations made by consultant staff, July and August 2007.
[e] Conclusive summary results include at least two sources confirming controlling bottleneck locations, otherwise considered minor bottlenecks.
MAJOR Major bottleneck locations where congestion was observed consistently most weekday peak hours from source.
minor Minor bottleneck locations where congestion was observed inconsistently on some weedday peak hours from source.
n/a Not available (probe vehicle runs did not cover this location).
\- No indication of bottleneck from this source.

Northbound AM

- North of Dixon Landing (Mission) Interchange
- Brokaw Interchange
- Gish On-ramp (minor)
- US-101 Interchange
- Coleman Interchange
- I-280 On-ramp

The US-101 Interchange and Mission Interchange are the two significant controlling bottlenecks in the northbound direction.

Northbound PM

- North of Dixon Landing (Mission) Interchange

Southbound AM

- None

Southbound PM

- US-101 Interchange
- 1st Street Interchange (minor)
- Bascom Interchange