Applying Analysis Tools in Planning for Operations

Case Study #3 – Using Archived Data As a Tool for Operations Planning

U.S. Department of Transportation
Federal Highway Administration

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16. Abstract

More and more, transportation system operators are seeing the benefits of strengthening links between planning and operations. A critical element in improving transportation decision-making and the effectiveness of transportation systems related to operations and planning is through the use of analysis tools and methods. This brochure is one in a series of five intended to improve the way existing analysis tools are used to advance operational strategies in the planning process. The specific objective of developing this informational brochure series was to provide reference and resource materials that will help planners and operations professionals to use existing transportation planning and operations analysis tools and methods in a more systematic way to better analyze, evaluate, and report the benefits of needed investments in transportation operations. This particular case study focused on the application of archived data as a tool for operations planning. This case study summarizes an effort involving the use of archived data for operations planning conducted for the Metropolitan Transportation Commission (MTC) in the San Francisco Bay Area.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

Applying Analysis Tools in Planning for Operations

Case Study #3 – Using Archived Data As a Tool for Operations Planning

More and more, transportation system operators are seeing the benefits of strengthening links between planning and operations. A critical element in improving transportation decision-making and the effectiveness of transportation systems related to operations and planning is through the use of analysis tools and methods. This brochure is one in a series of five intended to improve the way existing analysis tools are used to advance operational strategies in the planning process. The specific objective of developing this informational brochure series was to provide reference and resource materials that will help planners and operations professionals to use existing transportation planning and operations analysis tools and methods in a more systematic way to better analyze, evaluate, and report the benefits of needed investments in transportation operations.

The series of brochures includes an overview brochure and four case studies that provide practitioners with information on the feasibility of these practices and guidance on how they might implement similar processes in their own regions. The particular case studies were developed to illuminate how existing tools for operations could be utilized in innovative ways or combined with the capabilities of other tools to support operations planning.[1] The types of tools considered when selecting the case studies included:

- Sketch planning tools;
- Travel demand forecasting models;
- Deterministic models;
- Traffic signal optimization tools;
- Simulation tools;
- Archived operations data;
- Operations-oriented performance measures/metrics; and
- Combinations of these tools and methods.

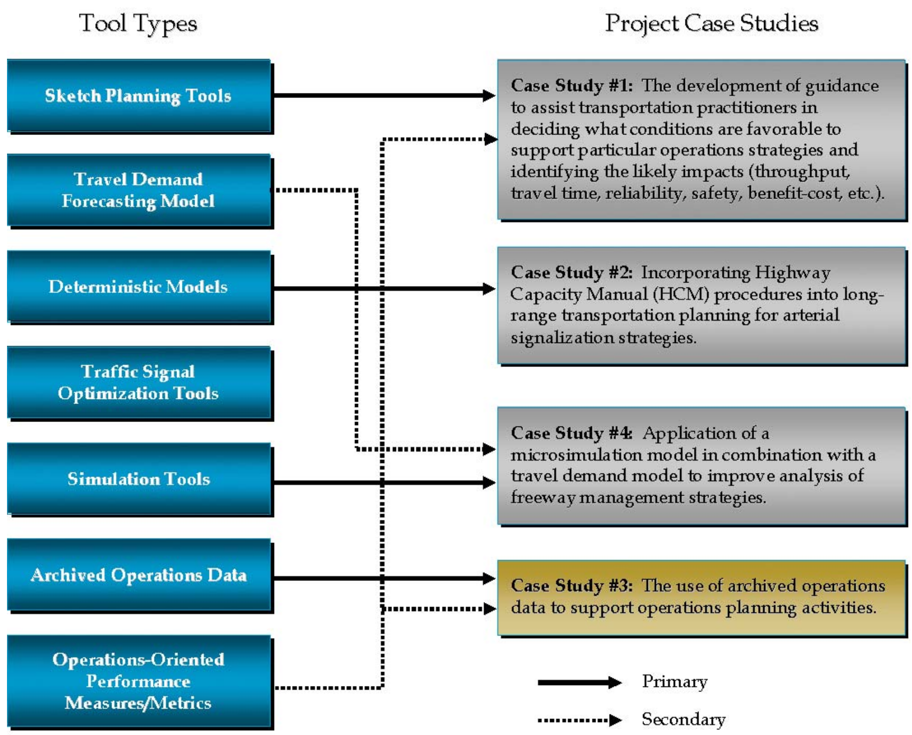
Additional information on these existing tool types is presented in the overview brochure to this series.

In selecting the case studies to highlight in this brochure series, a number of innovative analysis practices and tool applications were considered. Ultimately, four different case studies were selected from among many worthy candidates. Each of these case studies represents an innovative

1 The use of the term "Tools" in this context is meant not only to include physical software and devoted analytical applications, but is also intended to encompass more basic analysis methods and procedures as well.

use of one or more of the tool types listed above. Figure 1 presents the topics of the case studies and maps them to the related tool. Although individual case studies were not developed for each tool category, this should not be considered as a measure of indictment of the ability of any tool type to be used in innovative ways to support operations planning – there simply weren't project resources to identify and document all of the innovative practices being used. Likewise, the selection of a particular case study representing a specific tool should not be construed as the only manner in which to apply the particular tool. Instead, the case studies represent a sampling of the many innovative ways planners and operations personnel are applying these tools currently.

Figure 1. Analytical Methods/Tools and Related Case Studies Developed Under this Project



Case Study Introduction

This particular case study focused on the application of archived data as a tool for operations planning. Using archived data to conduct transportation operations analysis has multiple advantages, including the following:

• **Cost effectiveness –** It conserves resources that would otherwise be required for field data collection;

• **Time savings –** Archived data are readily available, which saves tremendous time that otherwise would be spent on field data collection;

• **Seasonal and daily variations –** Archived data are typically continuous with a long time span, which enables analysis of seasonal and daily variations;

• **Analysis of traffic trends –** The large amount of archived data make it feasible to understand traffic trends; and

• **Identification of both recurrent and nonrecurrent congestion –** Archived data make it possible to identify not only recurrent congestion but also nonrecurrent.

This case study summarizes an effort involving the use of archived data for operations planning conducted by the Metropolitan Transportation Commission (MTC) in the San Francisco Bay Area.

Case Study Objectives

The objective of this case study was to document the findings and results of an effort to use archived data for operations planning, and to summarize the successes and challenges associated with the work. The project used for this case study was MTC's Freeway Performance Initiative (FPI), corridor studies that will be used to develop a roadmap for the selection of the best projects and operational strategies in the region based on performance and cost-effectiveness. The focus of the case study was on the use of archived data for the existing conditions portion of the FPI analyses. The results of this case study indicate opportunities in the use of archived data and how existing conditions analysis has been enhanced by the use of the data.

Participating Agency and Project Background

The participating agency for this case study was the Metropolitan Transportation Commission (MTC), the regional planning agency for the San Francisco Bay Area in California. MTC is responsible for planning, financing, and coordinating transportation projects for the nine counties in the Bay Area, including Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma Counties.

MTC launched the Freeway Performance Initiative (FPI) project in 2006 with the objective of developing a roadmap for the selection of the best projects and operational strategies based on performance and cost-effectiveness. The FPI project includes traffic analysis on major San Francisco Bay Area freeway corridors; a quantitative assessment of existing freeway conditions; and development and assessment of short–term and long–term congestion relief strategies and projects.

Figure 2 shows the FPI corridors with six primary corridors being analyzed first:

1. Marin/Sonoma U.S. 101;

2. San Mateo/Santa Clara U.S. 101;

3. Solano I-80;

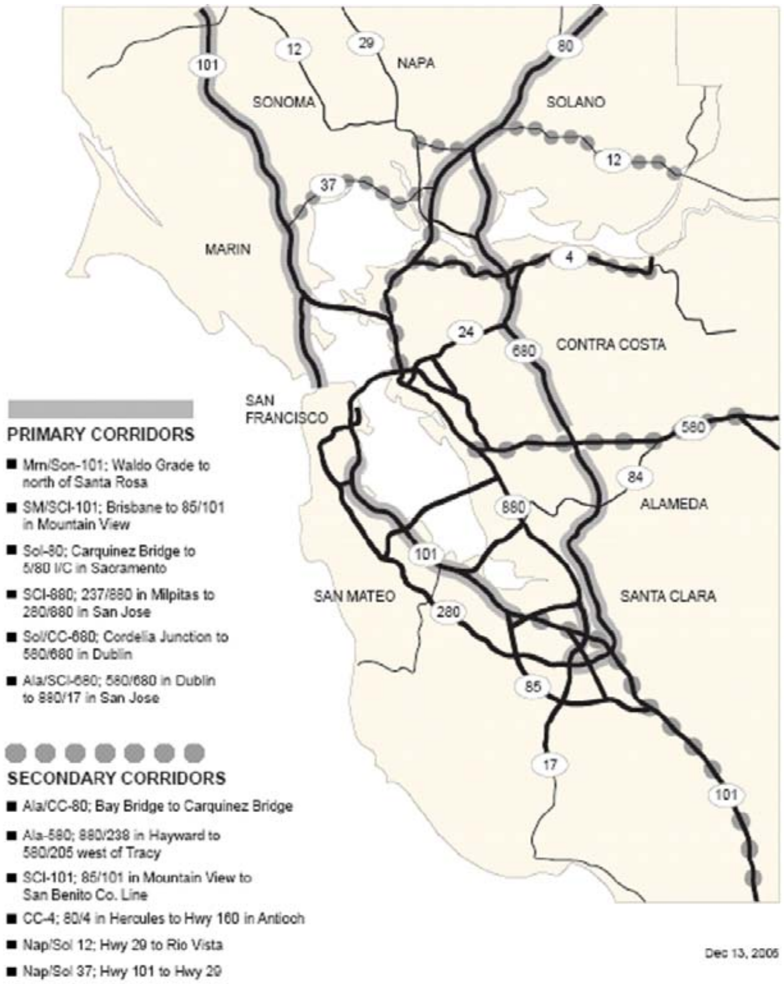
4. Santa Clara/Alameda I-880;

5. Solano/Contra Costa I-680; and

6. Alameda/Santa Clara I-680.

This case study includes findings on the use of archived data for the existing conditions analyses for these six corridors. The analyses were performed by four different consultant teams, with varying levels of archived data available, each extracting, compiling, and producing measures using different approaches. This provided MTC with the ability to obtain a variety of tabular and graphical representations of the results to determine which works best for their purposes.

Figure 2. FPI Study Corridors



Case Study Procedures

This case study focused on the quantitative assessment of existing conditions in the corridors using archived data to the extent possible. Due to time and budget constraints, the existing conditions analysis relied extensively on archived data. An overview of the existing conditions analysis, types of archived data used, and results generated are highlighted in the following sections.

Overview of Existing Conditions Analysis

The goal of the existing conditions analysis was to perform a comprehensive assessment of the existing traffic performance in the corridor, including the following:

- **Mobility –** How well the corridor moves people and freight;
- **Reliability –** The relative predictability of the public's travel time;
- **Safety –** The safety characteristics in the corridor including crashes (fatality, injury, property damage); and
- **Other –** Other measures of interest such as productivity, vehicle hours traveled (VHT), person hours traveled (PHT), transit, and park-and-ride capacity, etc.

Archived data were used for assessing the traffic performance in the existing conditions analyses on the FPI corridors to varying extents. The following summarizes the sources of archived data used.

Archived Data Types

Several types of archived data were used in the FPI project. They include the following:

- Freeway Performance Monitoring System (PeMS);
- MTC 511 system;
- Caltrans Highway Congestion Monitoring Program (HICOMP);
- Caltrans Traffic Accident Surveillance and Analysis System (TASAS); and
- Historical probe vehicle runs and traffic counts.

Freeway Performance Monitoring System (PeMS)

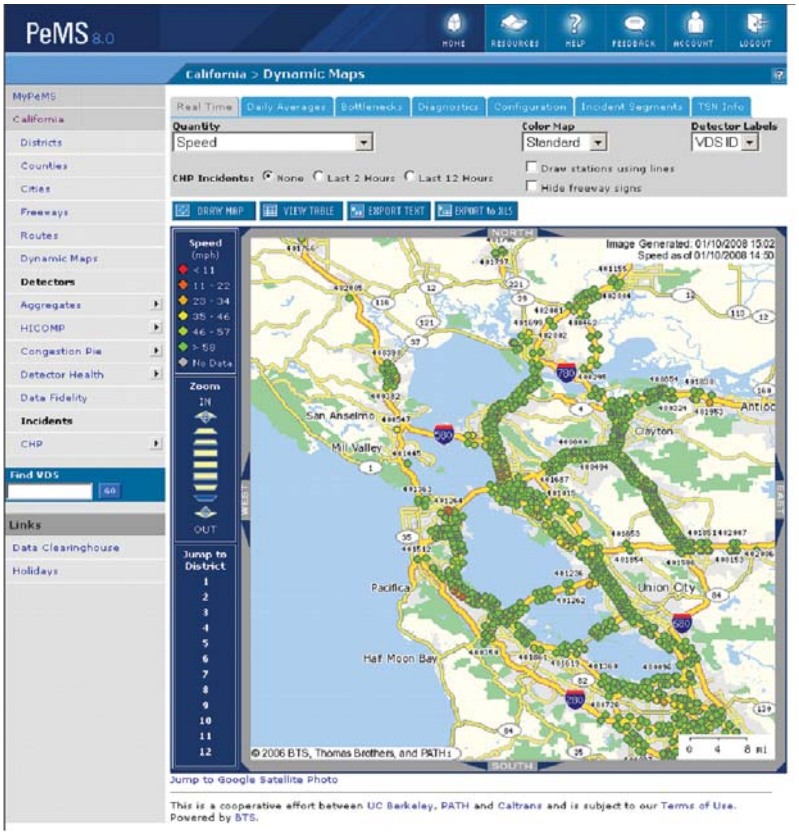
The Freeway Performance Monitoring System (PeMS)[2] is an Internet-based data archive system that collects historical and real-time freeway traffic data in California in order to compute freeway performance measures. It collects traffic data from freeway detectors such as counts and occupancies, and can automatically compute speeds, vehicle miles traveled (VMT), vehicle hours traveled (VHT), delay, travel time index, and productivity for every detector location every five minutes. Using the five-minute raw data of flow and occupancy, and the calculated values of speed and other performance measures, PeMS also aggregates several of the performance measures in time and space. Figure 3 presents a screenshot of the PeMS on-line system. Users can retrieve data using the standard query forms within the system.

MTC 511 System

The MTC's 511 system[3] gathers traffic information from several data sources such as FasTrak toll tag transponders, PeMS, and fixed radar sites. 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 to provide traveler information to Bay Area travelers. This data source is good for obtaining supporting or reference information for other data sources. Figure 4 presents a screenshot of the 511 system.

2 University of California, at Berkeley, California Department of Transportation, California Partners for Advanced Transit and Highways, and Berkeley Transportation Systems, 2008, Performance Measurement System, PEMS–available at https://pems.eecs.berkeley.edu/.
3 Metropolitan Transportation Commission, 2008, 511 San Francisco Bay Area [on-line] available at http://www.511.org.

Figure 3. PeMS On-line System



Source: PeMS, http://pems.eecs.berkeley.edu/.

Figure 4. MTC 511 System

The "Predict-a-Trip[SM]"[4] feature of the 511 system provides "typical" travel time and speed information for user-selected routes based on historical information. 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. 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.

Caltrans Highway Congestion Monitoring Program (HICOMP)

The Highway Congestion Monitoring Program (HICOMP)[5] report has been produced by Caltrans since 1987. The HICOMP report is produced annually and contains a compilation of measured congestion data reflecting conditions on urban freeways in California. Over the past few years, MTC has been producing the *State of the System Report*[6] and sharing this data with Caltrans for the HICOMP report. The data is collected by driving specially equipped vehicles along congested freeway segments during peak travel periods. Two times per year in the Bay Area, teams of drivers perform data collection runs along congested freeways. Because of budget constraints MTC has not been collecting data on all congested corridors. However, MTC has prioritized congestion monitoring corridors, so the segments with the most delay are those that continue to be monitored annually. In addition, Caltrans continues to perform floating car runs at least twice per year on freeway segments with high-occupancy vehicle (HOV) lanes.

Figure 5 shows congested segments on the San Mateo/Santa Clara U.S. 101 corridor between San Francisco and San Jose during the morning peak period. The HICOMP report includes maps illustrating the congested locations, the duration of congestion, and the hours of delay for each congested segment.

Caltrans Traffic Accident Surveillance and Analysis System (TASAS)

The Traffic Accident Surveillance and Analysis System (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 nonstate highways are not included (e.g., local streets and roads).

Table 1 shows the number of accidents and accident rate information obtained from a TASAS report for the San Mateo/Santa Clara U.S. 101 corridor.

4 Metropolitan Transportation Commission, 2008, 511 San Francisco Bay Area Predict-a Trip – available at http://traffic.511.org/his_traffic_text.asp.
5 California Department of Transportation, 2008, Caltrans Highway Congestion Monitoring Program (HICOMP) – available at http://www.dot.ca.gov/hq/traffops/sysmgtpl/HICOMP/index.htm.
6 Metropolitan Transportation Commission, 2008, State of the System – available at http://www.mtc.ca.gov/library/state_of_the_system/index.htm.

Figure 5. HICOMP Congestion Map

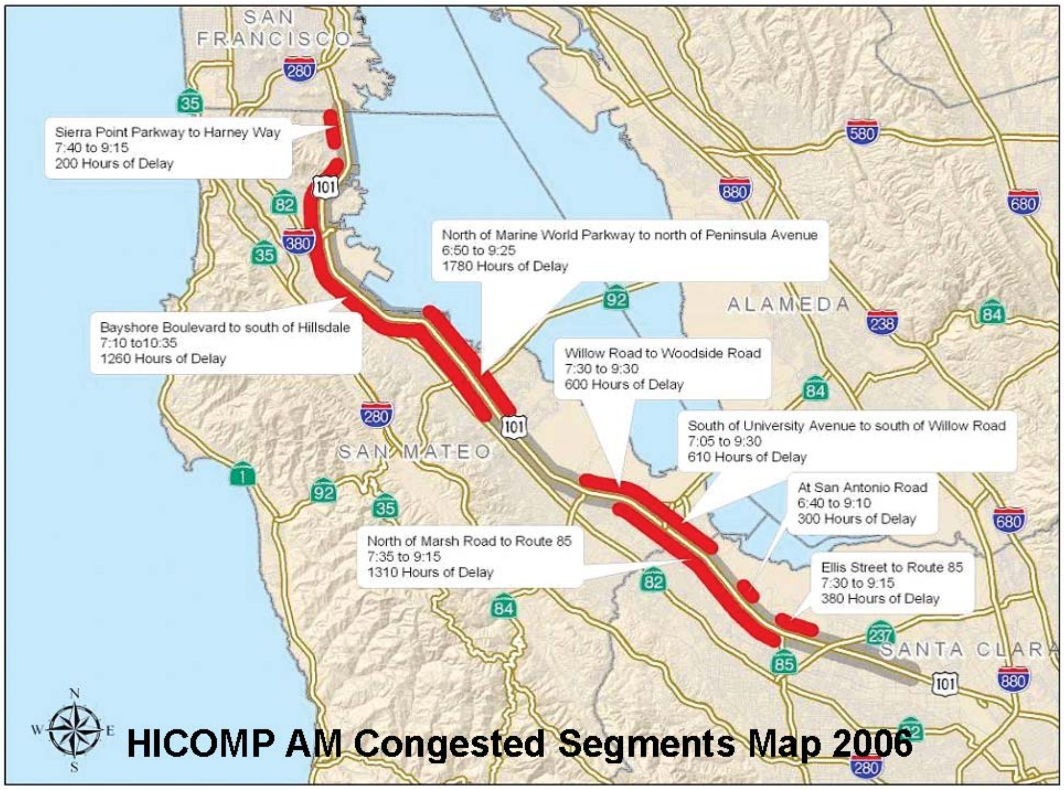


Table 1. TASAS–Accidents and Accident Rate

From	To	Number of Accidents				MVMT	Accident Rate (per MVMT)			
		Fatalities	Injuries	PDO	Total		Fatalities	Injuries	PDO	Total
Northbound										
On-Ramp from SB Great America (SCL 42.947)	SM/SCL County Line (SCL 52.550)	2	225	696	923	928.13	0.002	0.242	0.750	0.994
SM/SCL County Line (0.000)	On-Ramp from WB Whipple Ave (SM 6.666)	4	169	508	681	708.99	0.006	0.238	0.717	0.961
On-Ramp from WB Whipple Ave (SM 6.666)	North of Fashion Island Bl (SM 12.108)	2	154	499	655	660.45	0.003	0.233	0.756	0.992
North of Fashion Island Bl (SM 12.108)	On-Ramp from Old Bayshore (SM 16.790)	2	125	324	451	617.88	0.003	0.202	0.524	0.730
On-Ramp from Old Bayshore (SM 16.790)	SF/SM County Line (SM 26.106)	2	119	353	474	1071.65	0.002	0.111	0.329	0.442
Southbound										
SF/SM County Line (SM 26.107)	Off-Ramp to Millbrae (SM 18.151)	3	151	365	519	901.2	0.003	0.168	0.405	0.576
Off-Ramp to Millbrae (SM 18.151)	Between Harbor Bl and Holly St (SM 8.703)	4	213	565	782	1213.97	0.003	0.175	0.465	0.644
Between Harbor Bl and Holly St (SM 8.703)	SM/SCL County Line (0.000)	6	241	673	919	943.68	0.005	0.255	0.713	0.974
SM/SCL County Line (SCL 52.550)	Off-Ramp to SB Great America (SCL 43.034)	2	196	610	808	920.77	0.002	0.213	0.662	0.878

Performance Measures

In order to compare different investments within a corridor and among the various FPI corridor studies conducted by different consulting teams, a performance and analysis framework was established by MTC to enable consistent performance measurement for all FPI corridors. The framework established traffic analysis goals, set performance measures, and described expected output. As described previously, the performance measures used in the analysis included mobility, reliability, safety, and other measures appropriate for the corridor.

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 also are forecastable, making them useful for future comparisons. Three primary measures are typically used to quantify mobility: *travel time, speed,* and *delay*. The FPI analysis also involved a focus on *bottlenecks* and their extent as a proxy for delay. Bottleneck identification and identifying the causes of the bottlenecks are critical components in determining appropriate congestion relief strategies.

Travel time is reported as the amount of time for a vehicle to travel between two points on a corridor. Figure 6 shows the peaking characteristics of travel along the San Mateo/Santa Clara U.S. 101 corridor. The blue line is northbound and orange southbound. The green dashed line shows the travel time at 60 mph and the red line at 35 mph. According to this chart, the AM peak period can be described as beginning at 7:00 a.m., and ending at 11:00 a.m. The PM peak period effectively ends at around 7:30 p.m. However, the southbound PM period start time is around 2:30 p.m., while the northbound PM peak starts two hours later. The peak PM travel time also shows dramatic differences from the AM travel times. This figure was prepared using data from PeMS.

Speed across the study corridor can be presented using speed contour plots which are essentially the compilation of speed plots across the corridor at a certain time interval (e.g., five minutes). Figure 7 presents a typical speed contour plot generated using PeMS data for the San Mateo/Santa Clara U.S. 101 freeway corridor in the northbound direction (traffic moving left to right on the plot) on a typical weekday in the month of August 2006. Along the vertical axis is the time period from 6:00 a.m. to 9:00 p.m. Along the horizontal axis is the corridor segment from SR 87 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 blotch represent controlling bottleneck areas, where speeds pickup after congestion, typically from 30 to 50 miles per hour in a very short stretch. The horizontal length of each blot is the congested segment, or queue extents. The vertical length is the congested time period. In this plot, 82 percent of the detector data was observed (actual data from good detectors), and 18 percent were imputed (calculated due to defective detection data). Since the defective detector stations were distributed among the good stations, the PeMS imputed algorithm is expected to be effective and provide reasonably accurate results.

Figure 6. Mobility–Travel Time

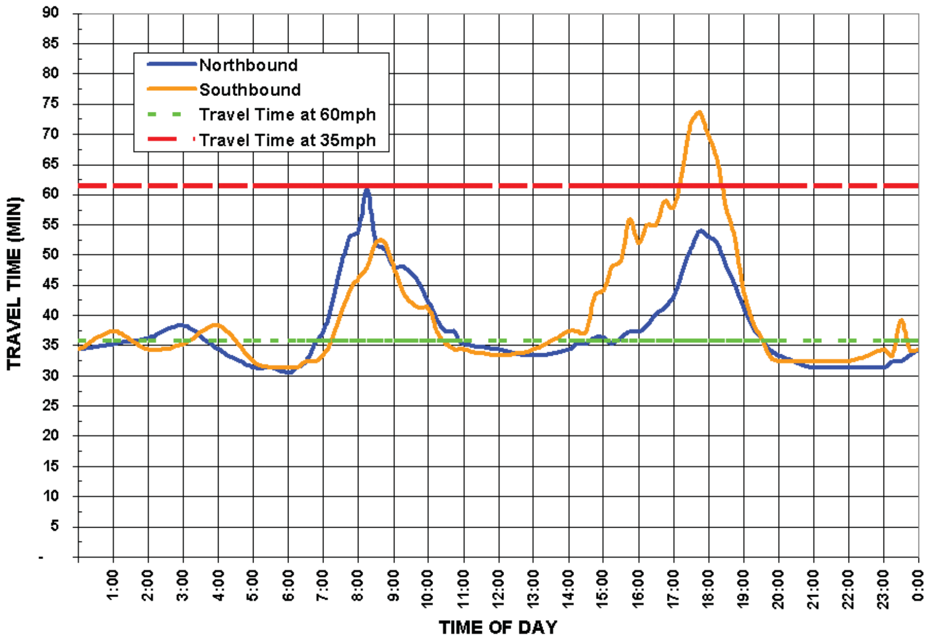
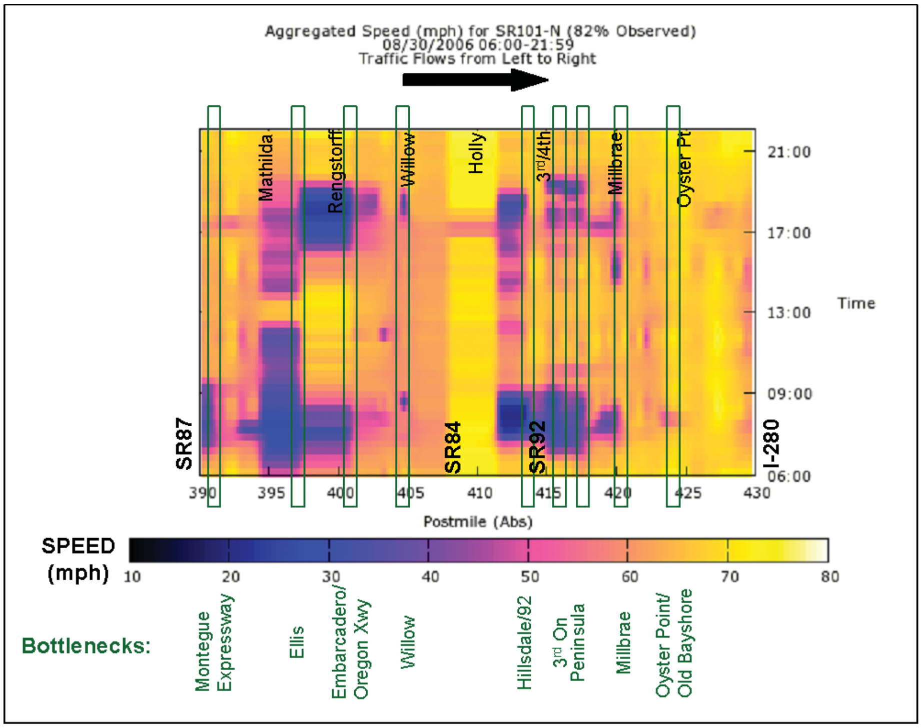


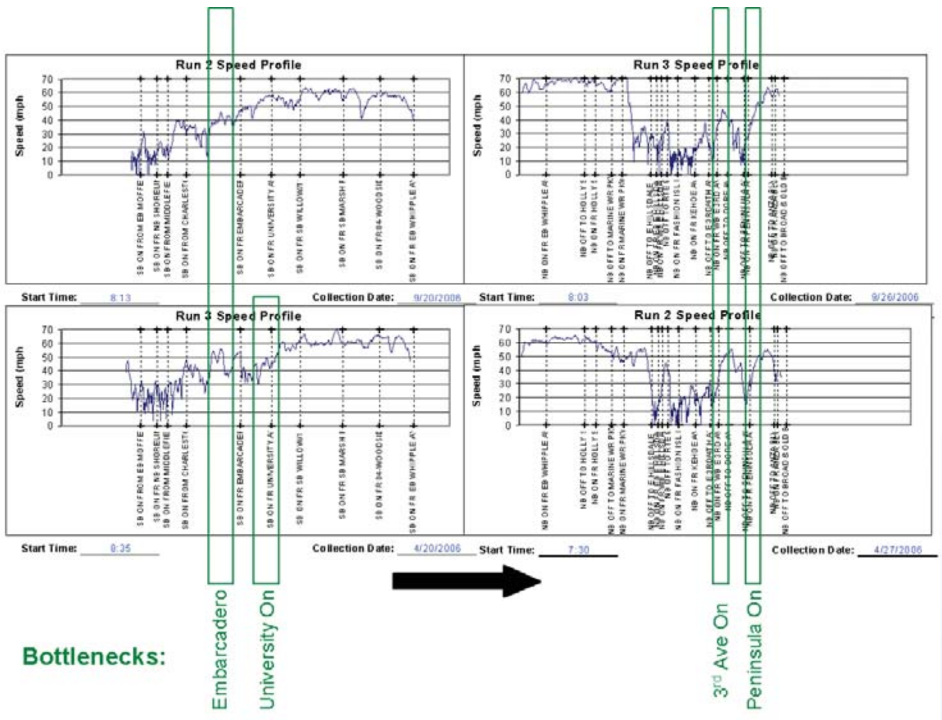
Figure 7. Mobility–Speed Contour Plot



Speed across the study corridor can also be assessed using probe vehicle runs, or tachometer (tach) runs. Similar to speed contour plots, controlling bottlenecks can be found at the end of a congested speed location where speeds pick up from about 30 to 50 miles per hour in a very short distance. Figure 8 illustrates typical runs for the San Mateo/ Santa Clara U.S. 101 freeway corridor in the northbound direction in the

AM peak conducted in 2006. As shown, the same bottlenecks appeared on each run: at Embarcadero, University, 3rd Avenue, and Peninsula. These bottleneck locations were also verified by field observations. It should be noted that there may also be other minor bottlenecks, often hidden behind major ones, as evident from these probe vehicle runs, at locations such as Middlefield and Kehoe.

Figure 8. Mobility–Probe Vehicle Runs



Delay is defined as the total observed travel time less the travel time under noncongested conditions, and is typically reported as vehicle-hours of delay. Both Figures 9 and 10 present delay for the San Mateo/Santa Clara U.S. 101 corridor using data from PeMS. Figure 9 presents a summary of the northbound average weekday hourly delay for the three years analyzed, 2004 to 2006. This exhibit is useful in that it shows the peaking characteristics of congestion and how the peak period is changing over time. It shows that the peak periods are shifting toward the midday period and that average delay is increasing. Figure 10 shows the three-year trend in overall weekday delay, excluding weekends and holidays, for the northbound direction. Gray is for the morning peak, light yellow is midday, orange is afternoon peak, and blue is night. Delay is in terms of vehicle hours at 60 mph.

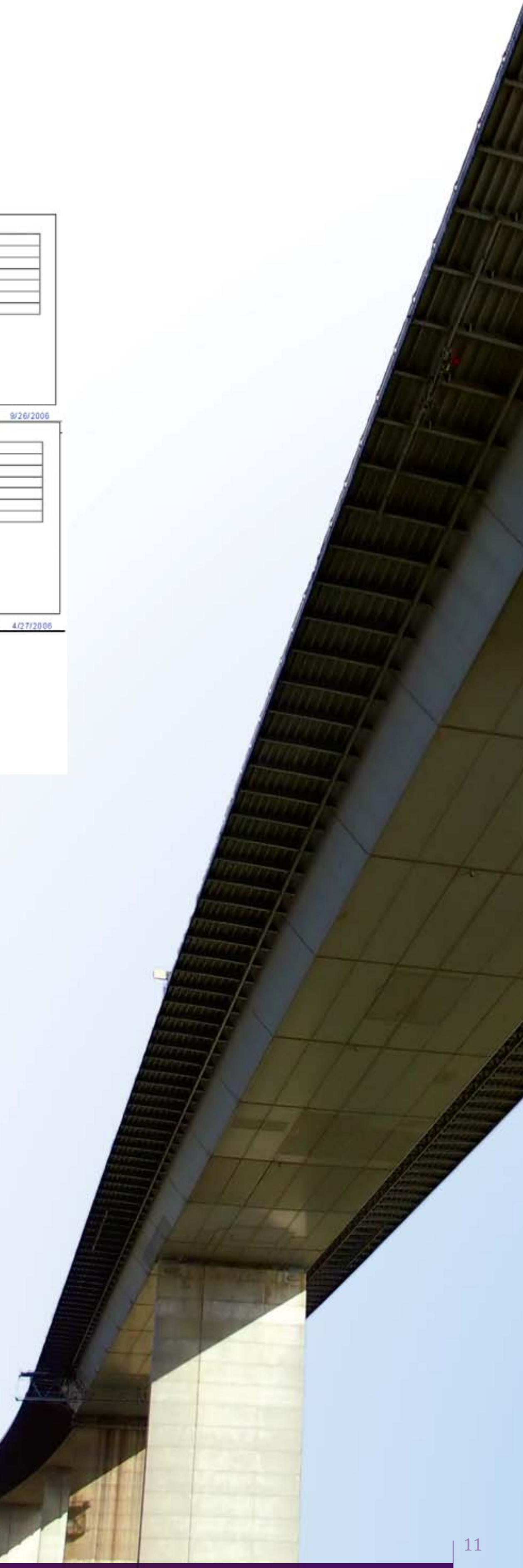


Figure 9. Mobility–Average Weekday Hourly Delay

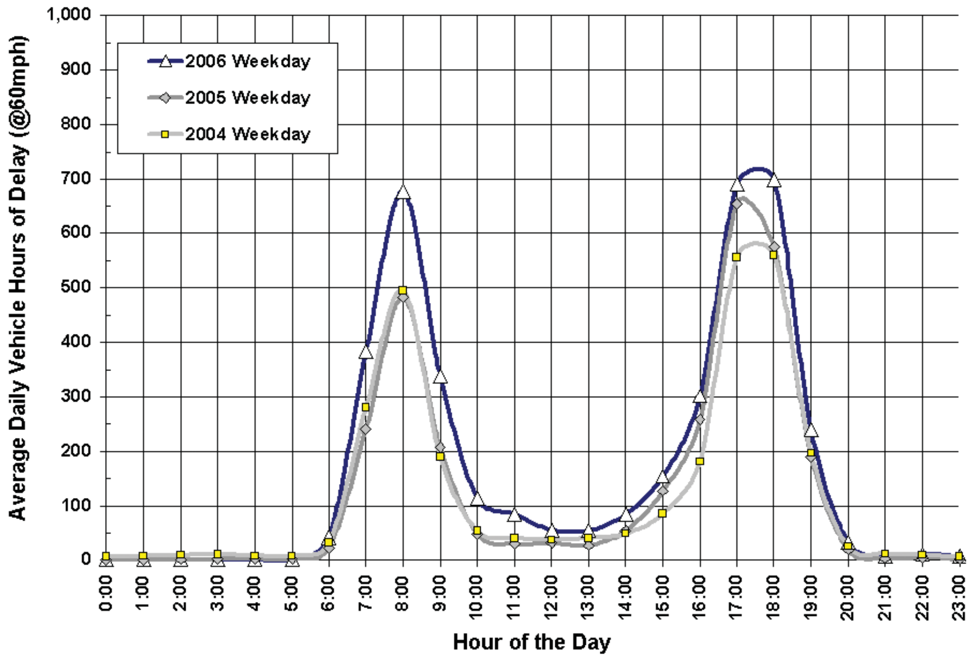
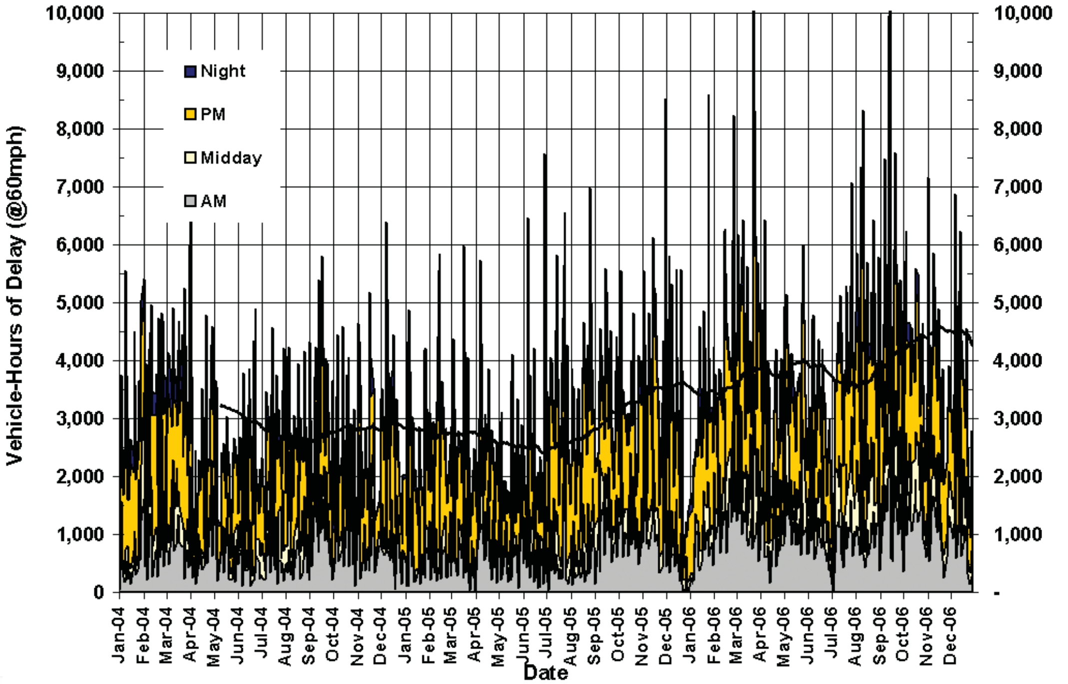
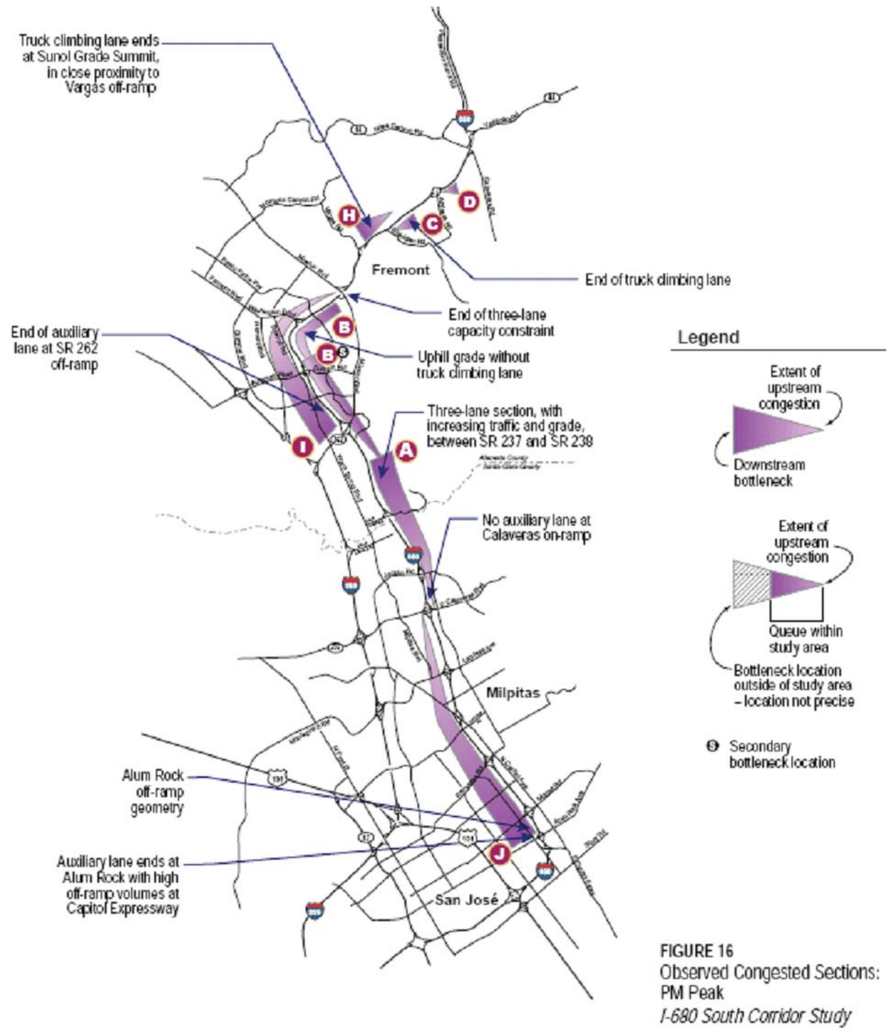


Figure 10. Mobility–Average Daily Delay



As an important part of the FPI studies, freeway *bottlenecks* that create mobility constraints were identified and the causes were analyzed. Figure 11 presents an example showing bottlenecks identified on the Alameda/Santa Clara I-680 corridor during the PM peak period using a variety of data sources such as PeMS, HICOMP, tach runs, and field observations.

Figure 11. Bottleneck Locations

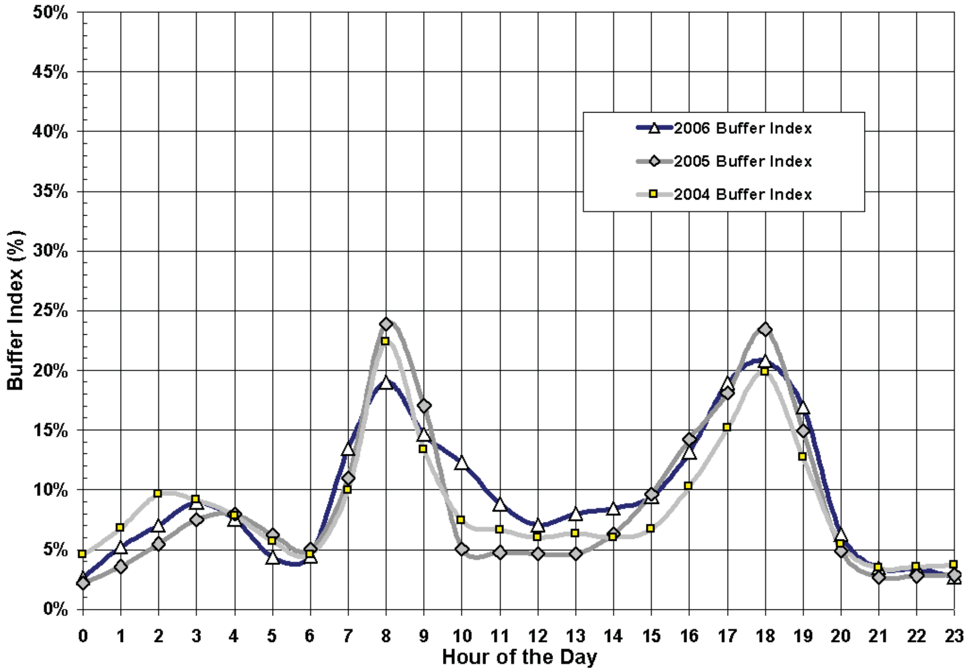


Reliability

Reliability captures the relative predictability of 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* is often used to estimate reliability. 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 is presented as a percentage, which makes it comparable among the different corridors and modes. Figure 12 shows the buffer index for years 2004 through 2006 for the northbound direction of San Mateo/ Santa Clara U.S. 101 corridor. It shows the additional time needed (in percentage) during each hour to ensure that a person is on time at least 95 percent of the time. As can be expected, the peak periods require the most additional time. This graphic was generated using data from PeMS and the 511 "Predict-a-Trip" tool. Knowing that the buffer index is a percentage of additional time needed to ensure that a person is on time for 95 percent of trips made, the percentages in Figure 12 can be converted into an additional travel time needed.

Figure 12. Reliability-Buffer Index



Safety

For the *safety* performance measure, the number of accidents and accident rates were generated from the Caltrans Traffic Accident Surveillance and Analysis System (TASAS). Figure 13 illustrates how one corridor presented the safety performance measure, the San Mateo/ Santa Clara U.S. 101 corridor. It shows northbound accidents by month for three years for the entire 36-mile corridor. The monthly accidents are broken down by weekday and weekend accidents. On average, more than 75 percent of all monthly accidents reported by California Highway Patrol (CHP) occur on weekdays and there are about 100 accidents on average per month. Figure 14 presents another safety measure, accidents by type over three years for the Solano I-80 corridor westbound, broken down by segment. Rear-end collisions are the predominant type, followed by hit object and sideswipe.

Figure 13. Safety–Accidents by Month

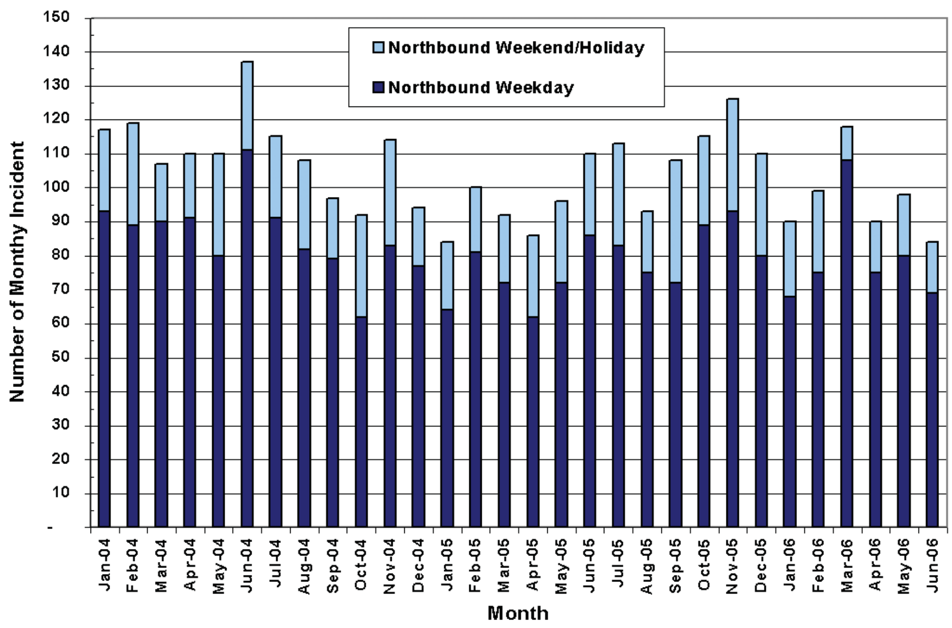
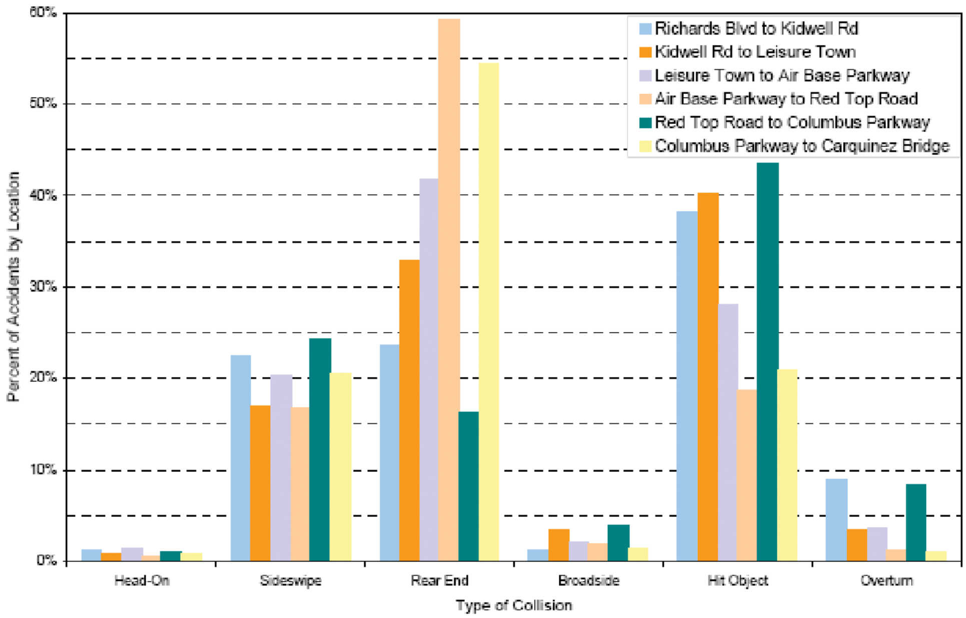


Figure 14. Safety–Accident Rates



Other Measures

Productivity is a system efficiency measure and, for corridor analysis, it is generally defined as the percentage of utilization of a facility or mode under peak conditions. 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 San Mateo/Santa Clara U.S. 101 during site visits, vehicles weaving and merging in and out of traffic caused slowing at major interchanges, which lead to significant reductions in capacity utilization. This loss in productivity is illustrated in Figure 15. As traffic flow increases to the capacity limits of a roadway, speeds decline rapidly and throughput drops dramatically. The productivity calculation requires good detection data and coverage, as was available for the corridor from PeMS.

This lost productivity can be converted into equivalent lost lane-miles as shown in Figure 16. These lost lane-miles represent a theoretical level of capacity that would have to be added in order to achieve maximum productivity. This figure summarizes the productivity losses on the San Mateo/Santa Clara U.S. 101 northbound for the three years analyzed. Strategies to combat such productivity losses are primarily related to operations and include building new or extending auxiliary lanes, implementing ramp metering or a more aggressive ramp metering strategy, and improving incident clearance times.

Figure 15. Productivity–Lost Productivity

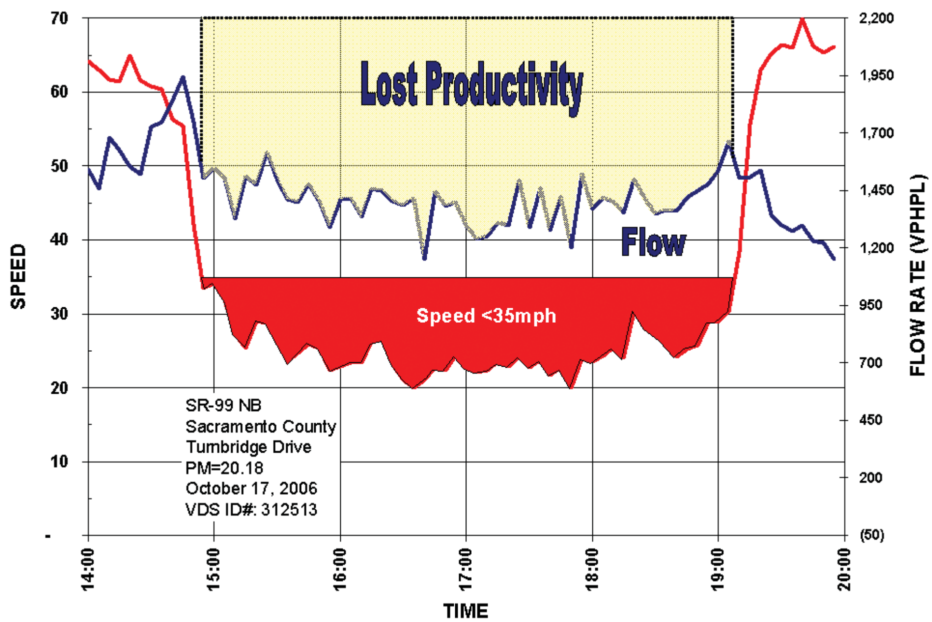
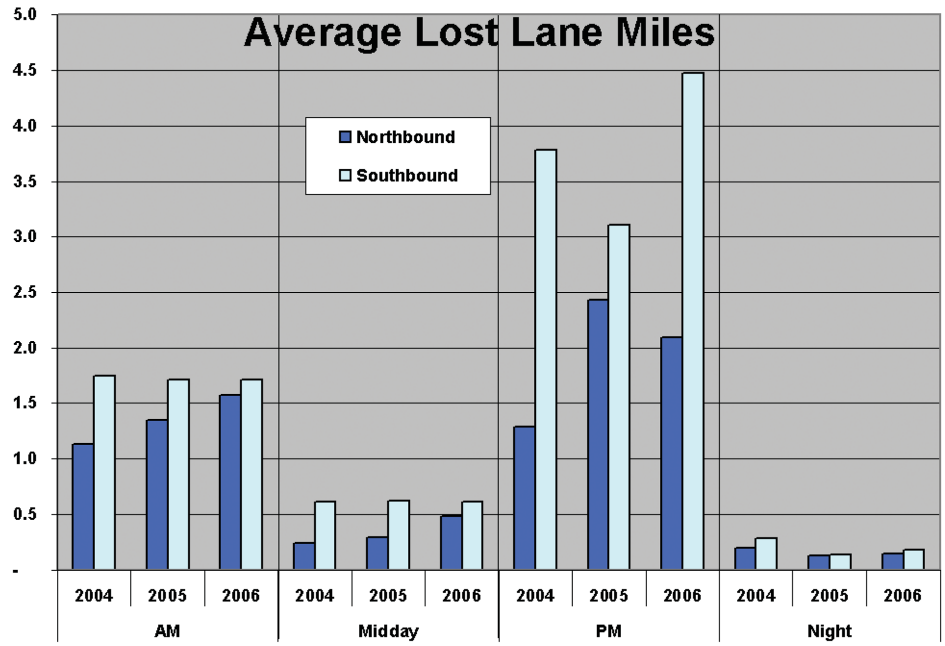


Figure 16. Productivity–Average Lost Lane Miles



Case Study Outcomes

Findings

Overall, the existing freeway conditions analysis for the MTC FPI project corridors were successfully completed under the constraints of limited time and budget through the use of archived data to the extent possible.

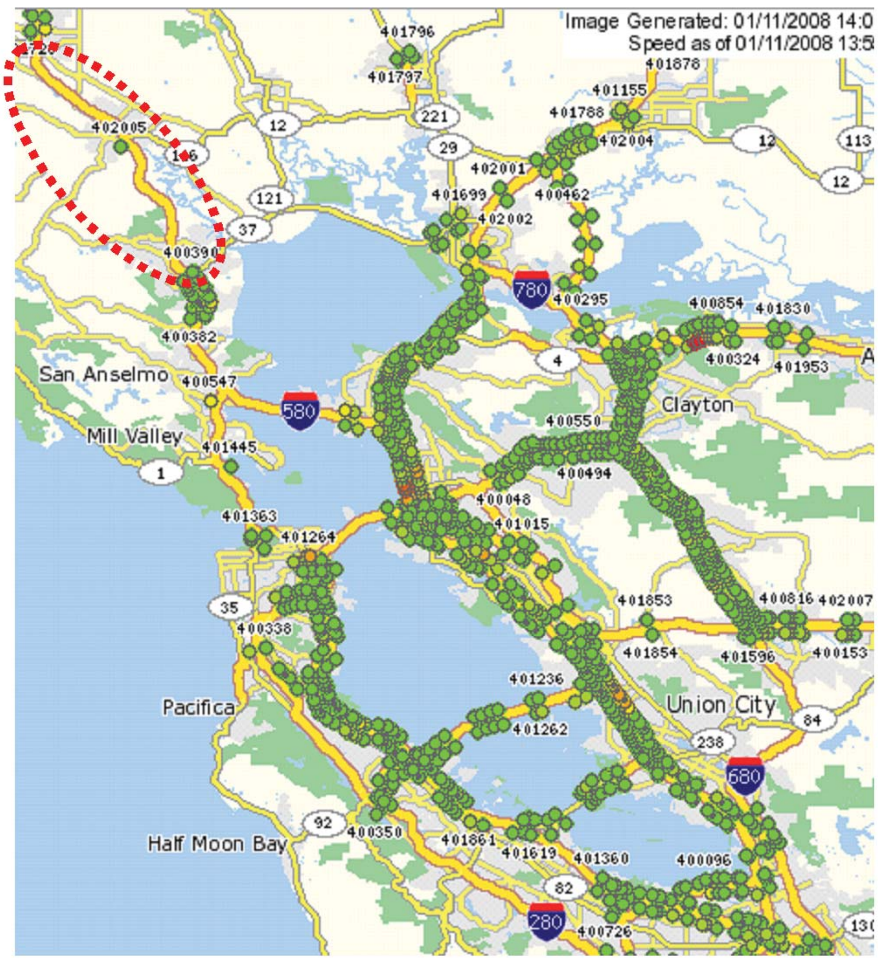
There were several findings from the use of archived data for the FPI analyses, summarized as follows:

- The archived data provided several advantages for the FPI analyses including the following:
    - — Availability of continuous data sets dating back to 2001;
    - — Existence of a large amount of historical data to understand traffic trends;
    - — Contribution of available data to reaching consensus among stakeholders regarding existing performance of the corridors;
    - — Ability to identify both recurrent and nonrecurrent congestion where adequate detector data were available;
    - — Use of archived data proved to be cost effective since data collection for the corridor studies would have been cost prohibitive, since most of the corridors were 30 to 60 miles in extent; and
    - — Significant time savings since data were readily available.
- The successful application of archived data, especially the PeMS data, depended on both the consulting team's ability to fully mine the data and the credible use of the data. If data were not analyzed, assessed for reasonableness, and compared against other sources, or if the data had been misinterpreted, the conclusions from the analysis could be unreliable.

• Low detector health rate on some segments affected the fidelity of the PeMS data. Detector data were imputed if the detector was defective based on historical data and neighboring detectors. If the defective detector stations were distributed among the good stations, the PeMS imputed algorithm is expected to be effective and provide reasonably accurate results; if not, the imputed data could be inaccurate and the results could be misleading.

• There were some segments on the FPI corridors without detection coverage. For example, Figure 17 shows a detection gap on the Marin/ Sonoma U.S. 101 corridor. Other data sources were needed in these cases or where there were significant gaps between detectors. Even where "good" detector coverage was available, consultant teams still would have preferred at least 50 percent greater coverage.

Figure 17. Detection Coverage



• There is a need to develop more methods and tools to capture nonrecurrent congestion. Traffic conditions between detectors are not captured in the PeMS data. Supplemental floating car runs can capture continuous traffic conditions along the corridor, but it is not an efficient method for capturing nonrecurrent congestion.

• In some corridors there were many data sources available for the analysis. In some cases, there were conflicting findings between the different data sources. The archived historical PeMS data provided a means to resolve some of the conflicting data by demonstrating conditions from a much larger data set. Resolving the conflicts required more analysis and, in some cases, additional field data collection.

• Stakeholders tend to remember traffic on "worst" days. This perception may not be consistent with analysis for "typical" days. Where available, archived data provided a means to better characterize "typical" days.

Next Steps

MTC is committed to advancing the use of archived data on for a variety of activities, including operations planning. This includes the following:

• Continuing to use archived data for planning studies, including bottleneck identification, queue length, delay, travel times, speed, volumes, accident analysis, etc.

• Exploring the use of archived data for regional congestion monitoring purposes, instead of the floating car method. Since floating car method is costly, usually only a few days worth of data are obtained. There is question of whether floating car runs are able to capture a "typical" day, whereas archived data sets are continuous and provide "24x7" coverage for the entire year.

• Improving detector coverage to minimize detection gaps, and enhancing detector maintenance to improve detector health and confidence in the data.

• Promoting improvements to PeMS by enhancing its usability, data extraction, and capability to analyze and quantify nonrecurrent congestion.

Conclusions

This case study met the goal of summarizing a successful effort of applying archived data for operations planning. The participating agency in this case study, MTC, launched an FPI program and, due to time and budget constraints, the existing conditions analysis relied heavily on archived data. A variety of archived data were used, including PeMS, the MTC 511 system, HICOMP, TASAS, historical probe vehicle runs, and traffic counts. The archived data sets were used to analyze multiple performance measures, which included travel time, speed, delay, travel time reliability, safety, and productivity. Those performance measures played a significant role in understanding the existing conditions on the FPI corridors. As an important part of the study, freeway bottlenecks that create mobility constraints were identified and the causes were analyzed.

Using archived data to conduct operations planning has its advantages, including cost effectiveness, time savings, capture of seasonal and daily variations, analysis of traffic trends, and ability to identify both recurrent and nonrecurrent congestion. This case study, however, also revealed several issues and challenges (e.g., ability to fully mine the archive data, low detector health rate, existence of detection gaps, weakness in capturing nonrecurrent congestion, especially in areas without adequate detector coverage, and conflicts between different data sets). MTC is planning to advance its efforts of applying archived data to operations planning by improving detector coverage, detector health, and PeMS usability. MTC will continue using archived data for planning studies, including bottleneck identification, queue length, queue duration, travel times, speeds, volumes, and accident analysis.

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