HOV Performance Program

Evaluation Report

LOS ANGELES COUNTY
METROPOLITAN TRANSPORTATION AUTHORITY

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1.0 PURPOSE AND SCOPE OF THE STUDY

1.1 Introduction

For over 30 years, transportation professionals and policy-makers have supported High-Occupancy Vehicle (HOV) or carpool lanes as an effective means of increasing the person-carrying capacity of highly congested roadways. It was generally accepted that this capacity increase was achieved by providing incentives for travelers to use transit or carpool. For the most part, extensive monitoring of carpool lanes was only sporadically performed to evaluate the benefits and impacts of these new facilities.

Recently, the effectiveness of HOV lanes has been increasingly questioned both locally and statewide. A significant investment in carpool lane treatments has been made in Los Angeles County over the past decade, but there has not been a program audit to answer whether this investment has been a worthwhile expenditure of public funds. The California Legislative Analyst Office (LAO) published a report on January 7, 2000, titled *HOV Lanes in California: Are They Achieving Their Goals?* The LAO Report highlighted the inadequacy of existing HOV lane performance evaluation to determine how effectively carpool lanes achieve their intended goals. The LAO Report recommended the compilation of "a set of performance measures and cost-effective practices to increase carpool lane usage." In light of the recommendations of the LAO Report and increased local interest on the performance of carpool lanes, it has become evident that for Los Angeles County's HOV lane program to be effectively operated and expanded, data must be collected and evaluated on an ongoing basis to substantiate performance.

The Board of Directors of the Los Angeles County Metropolitan Transportation Authority (MTA) has taken a leadership role in recognizing the need to evaluate the performance of the Los Angeles County carpool lane system. In 2000, the MTA committed funding to conduct a robust, comprehensive evaluation of the Los Angeles County carpool lane system. This auditing function, called the HOV Performance Program, builds on past and existing California Department of Transportation (Caltrans) data collection and monitoring efforts to develop a more comprehensive and analytical approach to evaluating HOV system performance. The program also provides policy recommendations that outline steps to be taken to increase the productivity and effectiveness of Los Angeles County's carpool lanes. With these findings and recommendations staff and policy-makers can make more informed decisions regarding future carpool lane investments and possible changes in operational policies.

1.2 Project Purpose

Los Angeles County opened it's first HOV facility, the El Monte Busway, in 1973. Originally intended for buses only, carpools were permitted to use the facility starting in 1976. The El Monte Busway extends along Interstate 10 between El Monte and downtown Los Angeles. Since then, many more freeway carpool lanes, ramp meter bypass lanes, commuter park-and-ride lots, and other related HOV facilities have been built. There are over 383 lane miles[1] of carpool lanes operating along fourteen freeway corridors in Los Angeles County, making it the

[1] Source: 2001 HOV Annual Report, California Department of Transportation District 7, May 2002

largest operating HOV system in the nation, despite the fact that the portion of the Los Angeles County carpool lane system that exists represents only part of the system envisioned in the MTA Long Range Plan. With such a significant ongoing investment in carpool lane facilities, comprehensive monitoring and evaluation of the system's performance is critical.

Getting the most out of the region's highway system has been, and continues to be, a high priority. In Los Angeles County, the carpool lane system plays an important role in moving hundreds of thousands of people to and through the County on a daily basis. But are the carpool lanes working at peak performance? Are the carpool lanes performing as they should? Are there operational changes that would make them even more attractive to the traveling public? What if the region had no carpool lanes? What would happen to our freeways and adjacent highways? Would traffic congestion become worse, or would it improve? If it improved, how long would that improvement last? How have commute times been affected by the carpool lanes, and have the carpool lanes truly changed commute behavior?

The purpose of this study is to develop a comprehensive monitoring and evaluation program for the Los Angeles County HOV system to help answer some of the many questions relating to carpool lane performance. This program establishes a framework for performance monitoring that can be regularly reviewed and reported. The basis of this audit is to measure the impact of carpool lane use against a set of program goals and objectives that respond to the types of questions listed above. The five main objectives addressed by the HOV Performance Program include:

- Enhance existing HOV data collection;
- Analyze the travel impacts and user benefits of the HOV system;
- Provide policy-makers with information to enable them to make decisions about the future of HOV facilities;
- Sustain, market, and promote user and non-user acceptance of the HOV system; and
- Develop policy recommendations to help guide future HOV investments and operations.

Various suggested policies are developed as part of this program audit based on performance findings. These policies address steps to enhance productivity of the carpool lanes and ensure ongoing oversight for performance of future carpool lane investments. These policies have been adopted by the MTA Board of Directors for Los Angeles County, and may not be applicable to other area HOV systems.

1.3 Study Area

This HOV Performance Program examines 16 existing carpool lane study routes (typically referred to as "HOV Study Routes" or "Carpool Study Routes") in 13 of the 14 operational carpool lane corridors in Los Angeles County, as shown in **Table 1.3.1** and **Figure 1.3.1**. The study also includes five proposed carpool lane routes, or "Look-Ahead Routes", that are to be completed within the next five years. For the purpose of measuring carpool lane effectiveness to general-purpose lane operation, the study also incorporates two "Control Routes" where HOV facilities are not operational or planned for the next five years. A total of 23 corridors were evaluated as part of this program audit.

Table 1.3.1 HOV Performance Program Study Routes

Route	Study Route Limits	Post Miles		
		Start PM	End PM	Fwy. Miles
HOV STUDY ROUTES[a]				
10	Alameda St. to Baldwin Av.	17.0	28.0	11.0
14	San Fernando Rd. to Escondido Canyon Rd.	27.0	43.3	16.3
57	Orange County Line to Route 60	0.0	4.5	4.5
60	Brea Canyon Rd. to San Bernardino County Line	23.0	30.5	7.5
91	Route 110 to Orange County Line	6.4	20.7	14.3
105	Route 405 to Route 605	2.2	18.2	16.0
110	Route 91 to Route 105	9.8	13.8	4.0
	Route 105 to Adams Bl.	13.8	20.5	6.7
118	Ventura County Line to Route 5	0.0	11.4	11.4
134	Routes 101/170 to Route 210	0.0	13.3	12.9[b]
170	Routes 101/134 to Route 5	14.5	20.6	6.1
210	Route 134 to Sunflower Av.	25.0	43.5	18.5
405	Orange County Line to Route 110	0.0	13.0	13.0
	Route 110 to Century Bl.	13.0	22.2	9.2
	Route 101 to Route 5	38.5	48.6	10.1
605	South St. to Route 10	3.8	20.7	16.9
Subtotal	*16 HOV study routes*			*178.4*
FIVE YEAR LOOK AHEAD ROUTES[c]				
10	Baldwin Av. to Route 605	28.0	31.2	3.2
	Route 57 to San Bernardino County Line	42.4	48.3	5.9
60	Route 605 to Brea Canyon Rd.	11.7	23.0	11.3
405	Route 10 to Route 101	29.2	39.7	10.5
605	Orange County Line to South St.	0.0	3.8	3.8
Subtotal	*5 look ahead study routes*			*34.7*
FREEWAY CONTROL ROUTES[d]				
5	Route 605 to Route 710	6.9	13.8	6.9
101	Route 405 to Route 27	17.2	25.3	8.1
Subtotal	*2 control study routes*			*15.0*
Total	***23 total study routes***			***228.1***

Notes:

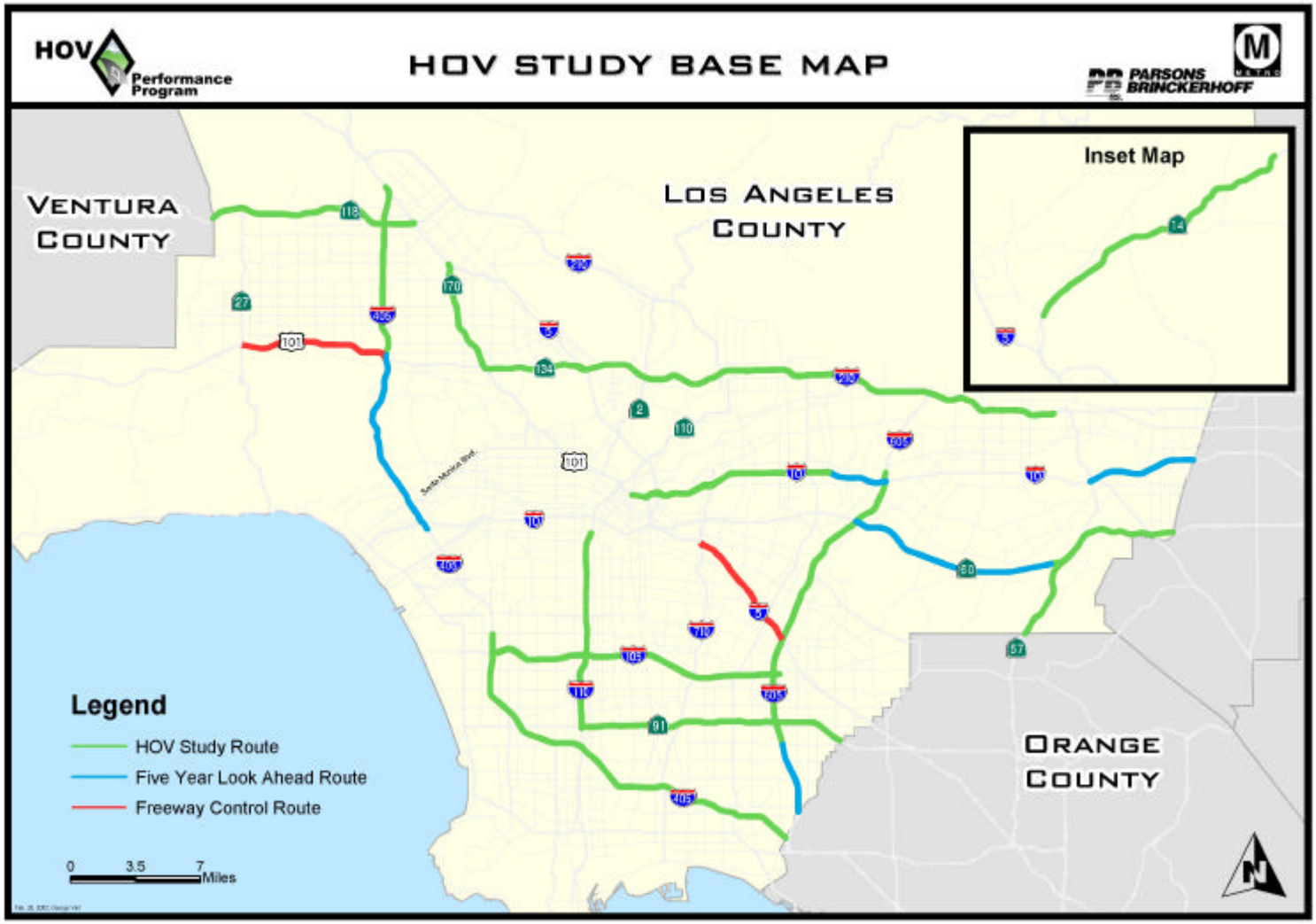
a - Represents routes and facilities that had operational HOV facilities in 2000 (current year of analysis for this iteration of HOV Performance Program).

b - Total mileage for Route 134 does not include 0.4 mile gap in HOV lanes at 5/134 interchange.

c - Represents routes and facilities that are prime candidates for "before" data collection.

d - Represents control routes and facilities that either had no improvement (i.e., Route 5) or were improved to provide additional mixed-flow lanes (i.e., Route 101).

Figure 1.3.1 HOV Performance Program Study Base Map



For analytical purposes, the Study Routes were further subdivided into "Analysis Segments". There are 38 Analysis Segments in total, including 30 Carpool Analysis Segments (which are subdivisions of Carpool Study Routes), six Look-Ahead Analysis Segments (which are subdivisions of the Look-Ahead Routes), and the two Control Analysis Segments (which are the same as the Control Routes). The analysis segments are listed in **Table 1.3.2**.

The HOV Performance Program does not examine all carpool lane facilities that currently exist in Los Angeles County. Route 30 from Sunflower to San Bernardino County was not evaluated due to the short length of this carpool facility and the unlikelihood that the analysis of this segment would yield meaningful results. The Route 30 carpool lane transitions from the Route 210 carpool lane to the San Bernardino County Line in anticipation of the extension of Route 30 in San Bernardino County.

Carpool lanes on Route 605 from Orange County to South, and on Route 405 southbound from the 101 to Waterford were also not evaluated as part of this study. These segments of carpool lanes were first opened in 2001 leaving insufficient time for the collection and analysis of appropriate data to support evaluation as part of this program audit. These segments were, however, included as Look-Ahead Routes to ensure appropriate data for "before" carpool lanes are collected to support the future comparative evaluation of these carpool lanes.

1.4 Agency Participation

This program audit represents a coordinated and cooperative effort involving multiple transportation and related public and private agencies. The MTA (http://www.mta.net) is the lead agency in the effort to complete the study with cooperative support and involvement from Caltrans (http://www.dot.ca.gov), and in particular Caltrans District 7 in Los Angeles.

The development of the HOV Performance Program has been guided by a Project Advisory Team (PAT) that is composed of stakeholders from various public and private agencies. The PAT generally met on a bi-monthly or as-needed basis to provide technical and policy guidance to the project team. Stakeholders involved in the PAT included (but was not limited to) the MTA, Caltrans, Southern California Association of Governments (SCAG) (http://www.scag.ca.gov), South Coast Air Quality Management District (AQMD) (http://www.aqmd.gov), the Federal Transit Administration/Federal Highway Administration (FTA/FHWA) (http://www.dot.gov), the City of Los Angeles (http://www.ci.la.ca.us), Los Angeles County (http://www.co.la.ca.us), the City of Long Beach (http://www.ci.long-beach.ca.us), Orange County Transportation Authority (OCTA) (http://www.octa.net), Foothill Transit (http://www.foothilltransit.org), the Automobile Club of Southern California (http://www.aaa-calif.com), the California Highway Patrol (CHP) (http://www.chp.ca.gov), and the University of California, Los Angeles (UCLA) (http://www.ucla.edu).

An important aspect of the HOV Performance Program was the utilization of a Peer Review Panel to provide an independent review of the project at three strategic milestones. The Peer Review Panel was composed of a diverse group of technical experts who shared their experience in carpool facility planning and operations from other carpool lane systems and projects around the country.

Table 1.3.2 HOV Performance Program Analysis Segments

Route	Study Route Limits	Analysis Segment Limits	Post Miles		
			Start PM	End PM	Fwy. Miles
HOV STUDY ROUTES					
10	Alameda St. to Baldwin Av.	Alameda St. to Route 710	17.0	21.4	4.4
		Route 710 to Baldwin Av.	21.4	28.0	6.6
		Subtotal:			*11.0*
14	San Fernando Rd. to Escondido Canyon Rd.	San Fernando Rd. to Sand Canyon Rd.	27.0	33.4	6.4
		Sand Canyon Rd. to Escondido Canyon Rd.	33.4	43.3	9.9
		Subtotal:			*16.3*
57	Orange County Line to Route 60	Orange County Line to Route 60	0.0	4.5	4.5
60	Brea Canyon Rd. to San Bernardino County Line	Brea Canyon Rd. to Route 57 N	23.0	25.4	2.4
		Route 57 N to San Bernardino County Line	25.4	30.5	5.1
		Subtotal:			*7.5*
91	Route 110 to Orange County Line	Route 110 to Route 710	6.4	11.7	5.3
		Route 710 to Route 605	11.7	16.7	5.0
		Route 605 to Orange County Line	16.7	20.7	4.0
		Subtotal:			*14.3*
105	Route 405 to Route 605	Route 405 to Route 110	2.2	7.4	5.2
		Route 110 to Route 710	7.4	13.5	6.1
		Route 710 to Route 605	13.5	18.2	4.7
		Subtotal:			*16.0*
110	Route 91 to Route 105	Route 91 to Route 105	9.8	13.8	4.0
	Route 105 to Adams Bl.	Route 105 to Adams Bl.	13.8	20.5	6.7
118	Ventura County Line to Route 5	Ventura County Line to Route 5	0.0	11.4	11.4
134	Routes 101/170 to Route 210	Routes 101/170 to Route 5	0.0	5.1	5.1
		Route 5 to Route 2	5.5	9.7	4.2
		Route 2 to Route 210	9.7	13.3	3.6
		Subtotal:			*12.9*
170	Routes 101/134 to Route 5	Routes 101/134 to Route 5	14.5	20.6	6.1
210	Route 134 to Sunflower Av.	Route 134 to Route 605	25.0	36.4	11.4
		Route 605 to Sunflower Av.	36.4	43.5	7.1
		Subtotal:			*18.5*
405	Orange County Line to Route 110	Orange County Line to Route 710	0.0	7.6	7.6
		Route 710 to Route 110	7.6	13.0	5.4
		Subtotal:			*13.0*
	Route 110 to Century Bl.	Route 110 to Century Bl.	13.0	22.2	9.2
	Route 101 to Route 5	Route 101 to Route 5	38.5	48.6	10.1
605	South St. to Route 10	South St. to Route 105	3.8	7.7	3.9
		Route 105 to Telegraph Rd.	7.7	10.8	3.1
		Telegraph Rd. to Route 60	10.8	17.4	6.6
		Route 60 to Route 10	17.4	20.7	3.3
		Subtotal:			*16.9*
Subtotal	*16 HOV study routes*	*30 HOV analysis segments*			*178.4*
LOOK-AHEAD ROUTES					
10	Baldwin Av. to Route 605	Baldwin Av. to Route 605	28.0	31.2	3.2
	Route 57 to San Bernardino County Line	Route 57 to San Bernardino County Line	42.4	48.3	5.9
60	Route 605 to Brea Canyon Rd.	Route 605 to Brea Canyon Rd.	11.7	23.0	11.3
405	Route 10 to Route 101	Route 10 to Waterford St.	29.2	31.9	2.7
		Waterford St. to Route 101	31.9	39.7	7.8
		Subtotal:			*10.5*
605	Orange County Line to South St.	Orange County Line to South St.	0.0	3.8	3.8
Subtotal	*5 look-ahead routes*	*6 look-ahead analysis segments*			*34.7*
CONTROL ROUTES					
5	Route 605 to Route 710	Route 605 to Route 710	6.9	13.8	6.9
101	Route 405 to Route 27	Route 405 to Route 27	17.2	25.3	8.1
Subtotal	*2 control routes*	*2 control analysis segments*			*15.0*
Total	***23 total study routes***	***38 total analysis segments***			***228.1***

The Peer Review Panel offered unbiased input, guidance, and technical objectivity on issues relating to study goals and objectives, evaluation methodology, and key findings. The panel included representatives of the Massachusetts Highway Department (MassHighway) (http://www.state.ma.us/mhd/home.htm), the Washington State Department of Transportation (WSDOT) (http://www.wsdot.wa.gov/), the New York State Department of Transportation (NYSDOT) (http://www.dot.state.ny.us), California Polytechnic State University (http://www.calpoly.edu), the San Diego Metropolitan Transit Development Board (MTDB) (http://www.sandag.cog.ca.us/sdmts/boards/mtdboard.htm), and the Dallas Area Rapid Transit (DART) (http://www.dart.org/home.htm). Eric Schreffler Transportation Consultant (ESTC) also participated in the Peer Review Panel in addition to contributing to the development of the Evaluation Plan and Evaluation Report.

The study team consisted of five local and national consulting firms specializing in various aspects of carpool lane facility planning, operations, performance monitoring and market research. The study team was lead by Parsons Brinckerhoff Quade and Douglas, Inc. (PBQD) (http://www.pbworld.com) and included Kaku Associates, Inc. (KA), Texas Transportation Institute (TTI) (http://tti.tamu.edu), Strategic Consulting and Research (SCR), and Heidi Stamm Public Affairs (HSPA).

1.5 Summary of Report Contents

The HOV Performance Program Evaluation Report is divided into six chapters according to topic and analysis organization. **Chapter 2.0** provides an overview of the Evaluation Plan, which established the framework for completing the study. This chapter explains the analysis methodology and Measures of Effectiveness (MOEs) developed for the study. This chapter also details the sources of data and provides a summary of the Data Management Plan that is the evaluation framework by which future monitoring and reporting can be performed.

Chapter 3.0 consolidates the findings of the extensive market research activities completed to support this program audit. The market research utilized five different techniques specifically designed to target different sectors of Los Angeles County's residents, commuters, transportation service providers and political representatives. This chapter summarizes the market research methodologies and key findings.

Chapter 4.0 highlights the results of the data analysis for MOEs addressing each of the following issue areas: travel demand, encouraging carpools, travel time savings, air quality and cost effectiveness. This chapter summarizes the analysis methodology for each MOE and the key results and findings. Where appropriate, the data analysis incorporates details of the market research efforts and performance evaluation results from other parts of the country to supplement the evaluation.

Chapter 5.0 of the report discusses policies adopted by the MTA Board of Directors with regards to carpool lane investment, design, operational rules, and agency involvement in carpool lane expansion. This chapter sets the stage for the review of carpool lane policy and establishes the context of the recommendations that follow.

Chapter 6.0 reviews performance and monitoring efforts based on the analysis results and provides recommendations for policies and planning to improve carpool lane performance throughout Los Angeles County.

The HOV Performance Program Evaluation Report consolidates the discussion and findings of the Technical Memoranda published previously as part of the study. A list of these previously published HOV Performance Program Technical Memoranda follows.

- Functional Requirements Document – Data Management Program (Technical Memorandum #1), January 2002
- Technical Memorandum (#2) – Preliminary Los Angeles Freeway HOV System Evaluation Plan, August 2000
- Technical Memoranda #3-6, 8-10 &14-17 – HOV Data Collection, Compilation and Analysis, March 2002
- Technical Memorandum #7 – HOV Safety Issues, September 25, 2001
- Technical Memorandum #11 – HOV Awareness and Attitude Study General Public Survey Summary, August 20, 2001
- Technical Memorandum #11 – Focus Group Meeting Summary, April 16, 2001
- Technical Memorandum #11A – Executive Interviews, December 17, 2001
- Technical Memorandum #12 – License Plate Survey, February 20, 2002
- Technical Memorandum #13 – HOV Transit Patronage Survey, February 20, 2002
- Education and Promotion Plan, January 4, 2002

An Executive Summary titled *"Eleven things you should know about the carpool lanes in Los Angeles County"* (July 2002) summarizes the key findings of the HOV Performance Program drawing from the information presented in this Evaluation Report. The Executive Summary was published as a stand alone ten page full color booklet in order to facilitate simplified reproduction and broad distribution of the key program findings.

2.0 EVALUATION PLAN

2.1 Introduction

This chapter presents the plan for monitoring and evaluating the performance of the HOV facilities in Los Angeles County. The chapter is divided into four sections following this introduction. The process followed to develop the performance evaluation plan is presented first. Second, the objectives and MOEs contained in the evaluation plan, which guide the performance assessment, are described. Third, the data sources used to analyze the MOEs are discussed. Fourth, the data management plan for the ongoing performance monitoring program is presented.

2.2 Performance Monitoring and Evaluation Plan Development Process

A number of activities were undertaken to develop the Los Angeles County freeway HOV system performance monitoring and evaluation plan. Existing agency goals and objectives for the HOV system and previous assessments of HOV facilities in the County and in Southern California were reviewed and the national experience with HOV project evaluations was examined. A workshop with participating agency staff was held to help identify key objectives and MOEs. An initial evaluation plan was developed based on the results of these tasks. The MOEs were then analyzed with available data collected, as some previously identified data was found not to be available. The MOEs and the performance evaluation plan were then revised based on this assessment. Each of these activities is briefly described.

Existing agency goals and objectives related to the HOV system were reviewed as the first step in developing the HOV performance monitoring and evaluation plan. The goals, policies, and objectives adopted by the MTA, SCAG, Caltrans, and other agencies and jurisdictions were examined. The results from the California HOV Summit held in Irvine in June 2000 were reviewed. National guidance in the collection and analysis of carpool lane performance data from the report *"Suggested Procedures for Evaluating Freeway HOV Facilities"*, developed through an FTA-sponsored research project, was used. Evaluation plans and findings from other metropolitan areas with HOV facilities were also reviewed.

A workshop was held with participating agency personnel on July 12, 2000, to review local policies and objectives, national experience, and a preliminary list of possible objectives and MOEs. This list was also intended to answer key questions raised by policy makers about the performance of Los Angeles County's existing carpool lanes. Input and comments were received through additional meetings with the Project Management Team, the PAT and the Project Peer Review Group. There was agreement from these groups that the following five objectives should guide the Los Angeles County performance monitoring and evaluation plan. The objectives are not presented in any priority order.

1. Manage Travel Demand by Increasing the Person Movement Capacity in Congested Freeway Corridors.
2. Encourage Carpooling, Vanpooling, and Bus Use by Providing Travel and Mobility Options.
3. Provide Travel Time Savings and Trip Reliability to Travelers Using the HOV Facilities.
4. Provide Air Quality Benefits.

5. Promote a Cost-Effective Transportation System.

Reducing congestion was not identified as a performance objective, since implementing carpool lanes is considered a congestion management tool, and not a congestion reduction measure. This is a common misperception regarding carpool lanes that was included in the LAO Report addressing carpool lane effectiveness in California.

MOEs were established for key elements of each objective. The data collection plan was then organized to ensure that the information needed to evaluate the MOEs was collected. Then a data collection and data reduction process was carried out. The MOEs were analyzed based on the available data and, as a result, the number of HOV Study Routes or Analysis Segments that were analyzed varies for each MOE. The results of this assessment are presented in **Chapter 4.0**. The performance monitoring and evaluation plan was modified based on the results of the initial assessment.

2.3 Measures of Effectiveness

The objectives and MOEs were initially detailed in the Preliminary Evaluation Plan that was published in August 2000 under the title of *"Technical Memorandum, Preliminary Los Angeles Freeway HOV System Evaluation Plan"*. The MOEs prescribed in the Preliminary Evaluation Plan have subsequently been refined based on the results of the data compilation and analysis efforts. Refinement was required because some of the desired data was not available, or not comprehensive enough to be adequate for system-wide reporting. Only the refined or final versions of the MOEs are described in this section. The objectives and MOEs are not presented in any priority order. Nor has any weighting or ranking been given to the various objectives or MOEs.

2.3.1 Objective 1: Manage Travel Demand by Increasing the Person Movement Capacity in Congested Freeway Corridors

This objective focuses on increasing the average vehicle occupancy (AVO) for the freeway and increasing the person trips, rather than vehicle trips, carried. Increases in AVO may result from both mode changes and spatial changes. Mode changes occur when individuals switch from driving alone to carpooling, vanpooling, or riding the bus. Spatial changes result when existing carpools, vanpools, or bus riders switch from traveling in the general-purpose lanes or parallel facilities to the HOV lane. In addition, new travelers in the corridor may use an HOV mode rather than driving alone. Attracting travelers to change from driving alone to forming carpools and vanpools, or riding the bus is critical to meeting this objective.

2.3.1.1 Measures of Effectiveness

- MOE 1A – Average Vehicle Occupancy. Actual number and percent change in the average vehicle occupancy (AVO) for the HOV lanes, the general-purpose lanes, and the total freeway.

- MOE 1B – Person Trips. Actual number and percent change in the person trips carried for the HOV lanes, the general-purpose lanes, and the total freeway.

- MOE 1C – Percent of Persons vs. Vehicles. Percent of persons carried in the HOV facility compared to percent of vehicles.

- MOE 1D – Carpools and Vanpools. Actual number and percent change in the number of carpools and vanpools; number of vehicles in HOV lane.

- MOE 1E – Buses and Bus Riders. Actual number of public transit buses and bus riders.

2.3.2 Objective 2: Encourage Carpooling, Vanpooling, and Bus Use by Providing Travel and Mobility Options

This objective supports elements of the MTA's vision and mission statement addressing mobility and quality of life in the County. Both quantitative and qualitative MOEs are used to measure changes and improvements in travel and mobility options. Some elements are more descriptive or qualitative in nature than those associated with other objectives. The MOEs focus on improving service to existing markets, serving new markets, and providing new connections to other HOV facilities, transit facilities, and major activity centers. The use of the HOV facilities by transit providers and the number of buses operating on the lanes depends on a number of factors. Elements influencing potential bus use include rail service in the corridor, travel patterns, route structures, and access points, which are factors not examined in this program audit. Not all HOV facilities are logical candidates for new or expanded bus services.

2.3.2.1 Measures of Effectiveness

- MOE 2A – Transit Operators Attitudes. Public and private transit operators attitudes toward HOV facilities.

- MOE 2B – Ridesharing Activities. Change in the nature and level of ridesharing program activities and services to existing and new markets.

- MOE 2C – System Connections. Change in connections with other HOV facilities, transit facilities, and major activity centers.

2.3.3 Objective 3: Provide Travel Time Savings and Trip Reliability to HOV Lane Users

Local and national experience indicates that the travel time savings and the trip time reliability offered by HOV facilities are key factors influencing individuals to change from driving alone to carpooling, vanpooling, or riding the bus. These same benefits also encourage use by taxis, airport shuttles, coaches, and other special user groups. As a result, HOV facilities should provide users with travel time savings over vehicles in the general-purpose lanes, as well as more reliable trip times. Although traffic congestion may occur at any time, these benefits are especially important during the morning and afternoon peak-periods when the greatest demands are placed on the freeway system. The MOEs under this objective focus on peak period travel time savings for vehicles in the carpool lane compared to those in the general-purpose freeway lane, and average travel speeds in the carpool lane.

2.3.3.1 Measures of Effectiveness

- MOE 3A – Travel Time Savings. Difference in the travel time for vehicles in the HOV lane from those in the freeway general-purpose lanes during the peak-period, in the peak direction.
- MOE 3B – Travel Speed. Average travel speed in the HOV lane.

2.3.4 Objective 4: Provide Air Quality Benefits

By carrying more people in fewer vehicles, HOV facilities should have a positive influence on air quality. HOV facilities are recognized by the United States Environmental Protection Agency (USEPA) and FHWA as transportation control measures (TCMs) and are one among a wide array of techniques for addressing air quality issues in non-attainment areas such as Los Angeles County. The exact influence of HOV facilities on air quality has been the subject of debate. Due to limitations associated with available data and analysis techniques, no comprehensive national study exists that addresses HOV facilities and air quality. Most MOEs used in other areas focus on changes in vehicle emissions and fuel consumption with the HOV facility compared to other alternatives and routes, and are based on calculations or simulation models using data generated from other objectives. Due to constraints in available data, the influence carpool lanes in Los Angeles County have on air quality was evaluated based on similar calculations. The MOEs for this objective focus on a comparison of vehicle emissions in corridors with carpool lane compared to those without carpool lanes, and on a comparison of carpool lanes to general-purpose lanes in the study corridors.

2.3.4.1 Measures of Effectiveness

- MOE 4A – HOV Corridor Vehicle Emissions. Comparison of vehicle emissions on HOV analysis segments compared to control routes.
- MOE 4B – HOV Lane Vehicle Emissions. Comparison of vehicle emissions in HOV lanes compared to adjacent general-purpose lanes.

2.3.5 Objective 5: Promote a Cost-Effective Transportation System

HOV facilities should be cost-effective elements of the overall surface transportation system. Six MOEs focus on different aspects of this objective. The first considers the influence of the HOV facility on transit operating efficiencies. Comments from transit personnel on the benefits of the lanes represent the measure to be used to evaluate the influence of HOV facilities on bus operating efficiencies. The multiple transit operators using the Los Angeles County HOV lanes makes obtaining the relevant cost information needed to quantitatively analyze this MOE more difficult than metropolitan areas with only one operator, and subsequently necessitates the qualitative assessment of this MOE. At least eight public transit operators currently use the Los Angeles HOV lanes, including the MTA, Foothill Transit, City of Los Angeles Department of Transportation (LADOT), Gardena, Antelope Valley, Torrance, OCTA, and Santa Clarita. The second MOE focuses on ensuring that an HOV lane has a positive benefit-cost ratio. The third MOE relates to changes in the accident rates for freeways with carpool lanes. The fourth and fifth MOEs address maintaining and increasing acceptance and support for HOV facilities among users, non-users, policy makers, and the general public. These two MOEs focus on perceptions related to use of the carpool lanes, acceptance of the carpool lanes as a good transportation investment, and violation rates. The final MOE focuses on monitoring violation

rates, which are vehicles using the HOV facility that do not meet the requisite occupancy requirement or other regulations.

2.3.5.1 Measures of Effectiveness

- MOE 5A – Transit Operations. Comments from transit personnel on benefits of HOV lanes for transit operations.

- MOE 5B – Benefit-Cost - Benefit-Cost Ratio (BCR), Net Present Value (NPV), Economic Rate of Return (ERR) and Year of Economic Feasibility (YEF) for the HOV facility.

- MOE 5C – Accidents. Accident rates for freeways with carpool lanes.

- MOE 5D – Public Perceptions – Adequate Use. Actual and percent of users, non-users, policy makers, and the public responding to questions on adequate use of the HOV facilities in surveys and other market research techniques.

- MOE 5E – Public Perceptions – Good Improvement. Actual and percent of users, non-users, policy makers, and the public responding to questions on HOV facilities as good transportation improvements in surveys and other market research techniques.

- MOE 5F – Violation Rates. Number and percent of vehicles in the HOV facility that do not meet the minimum occupancy requirement or other use regulations.

2.4 Data Sources

The MOEs described in the previous section were computed using the following types of data.

- Vehicular Volume Counts
- Travel Time and Speed Data
- Vehicle Occupancy Counts
- Accident Statistics
- HOV Project Facts (e.g., number of lanes, costs, opening dates, HOV system features)
- Transit Data
- Market Research Results

Through extensive efforts the study team determined the best available sources of this data for use in the HOV Performance Program. The team coordinated with multiple agencies via agency representatives on the PAT. Caltrans, MTA, SCAG, CHP, as well as a host of transit operators provided data to the study team. Also, the study team worked with Caltrans and the University of California (UC) Berkeley to investigate the potential use of the progressive Performance Monitoring System (PeMS) for volume and speed data.

The next few sections discuss the Evaluation Plan Objectives related to each data type, sources considered per data type, the data source used in the analysis, and data collection parameters.

2.4.1 Vehicular Volume Counts

Vehicular volume count data supported the analyses for Objectives 1, 4, and 5. Four potential sources were available:

- Caltrans District 7 Automated Traffic Monitoring System (ATMS).
- UC Berkeley PeMS.
- Caltrans District 7 Traffic Monitoring Group (TMG) Loop System.
- Caltrans District 7 Vehicle Occupancy Count data.

After considering the advantages and disadvantages of each source, TMG data was employed in the analysis.

ATMS data was not used because it was only available in hard-copy format that would have taken extensive effort to input into the project database. Also, historical data prior to 2000 is not available from this source.

PeMS data provided a similar alternative to ATMS data, given that the same underlying loop detection system supported both data sources. The main distinctions between the two data sources are:

- The two data sources use different algorithms to process the data.
- PeMS data was available electronically via the internet, rather than in hard-copy format as ATMS data was.

After several months of testing the available PeMS data, the study team concluded that PeMS was still too experimental for the analysis needs. Although PeMS does show promise of ultimately being utilized for future iterations of the HOV Performance Program, at the time of the current program audit (Summer 2000 to Fall 2001), the study team was not able to obtain a sufficiently comprehensive, consistent, and complete set of data for the study routes that met the evaluation needs. Because of delays that had already affected the project schedule, it was decided to rely on the Caltrans District 7 TMG Loop System for vehicle volume data.

Volume data from the Vehicle Occupancy Counts was not used due to disadvantages such as limited count locations, peak period/peak direction availability only, and the fact that it is conducted using a sampling method rather than a continuous count in all lanes.

2.4.1.1 Description of Caltrans District 7 TMG Volume Data Collection Parameters

Sources: Caltrans District 7 Traffic Monitoring Group loop data: Oracle database for recent years, Transportation System Network (TSN) database for older years

Locations: Selected loop stations on study routes (close to or at same locations as occupancy data whenever possible).
HOV and general-purpose lanes, separately when available.
Both directions, separately.

Months: One week each season (last full week in January, April, July and October).
If not available, alternate weeks used.

Days: All 7 days for each of the 4 sample weeks (Tuesday, Wednesday, Thursday used).

Time of Day: 24 hours.

Years: Current and historical as available (1990 through 2000).
Pre-1990 data not available.

Time Slice: 1-hour intervals (e.g. 7:00 to 8:00, 8:00 to 9:00, not 7:15 to 8:15).
Finer gradations not available.

Format: Varied electronic formats including speadsheet and text files.

In addition to basic volume count data from the TMG loops, fleet mix data was collected for use in Objective 4. Necessary fleet mix data was extracted from the Caltrans publication entitled *"Annual Average Daily Truck Traffic on the California State Highway System"*, December 2001.

2.4.2 Travel Time and Speed Data

Travel time data supported the analysis of three Objectives 3, 4, and 5. Three sources were potentially available:

- Caltrans District 7 ATMS.
- UC Berkeley PeMS.
- Caltrans District 7 Tachometer (tach) Runs.

The advantages and disadvantages associated with each source were considered. ATMS data, which was only available in hard-copy format, was not used because of the extensive effort required to input hard-copy data to the project database. PeMS data, a similar alternative, was considered based on the issues described in **Section 2.4.1**. Speed data from both ATMS and PeMS is computed via algorithms, not actually measured in the field. None of the sources provided historical speed data. Ultimately, it was decided that the tachometer (tach) runs provided the best data for the HOV Performance Program analysis.

2.4.2.1 Description of Caltrans District 7 Tach Run Data Collection Parameters

Source: Travel time runs conducted by Caltrans District 7 staff.
Travel time and delay data recorded automatically from the vehicle tachometer for each run.

Locations: All study routes.
HOV and general-purpose lanes separately.
Both directions of travel, separately.

Months: As available.

Days: Weekday, as available.

Time of Day: Data for runs conducted in the AM & PM peak periods were averaged. The AM peak period was defined as 6:00 a.m. to 9:00 a.m. and the PM peak period as 3:00 p.m. to 6:00 p.m.

Years: Current only (no historical data available).

Format: Caltrans Moving Vehicle Run Analysis Package (MVRAP) program, processed and extracted summary data in electronic text format that was translated into spreadsheet format for analysis.

2.4.3 Vehicle Occupancy Counts

Vehicle Occupancy Count data consisted of the following:

- AVO
- Percentage of carpools and vanpools
- Percentage of buses, and percentage of minimum occupancy violators.

Objectives 1, 4, and 5 used some or all of these data types. Caltrans District 7 Vehicle Occupancy Count data was the sole source of occupancy data available.

2.4.3.1 Description of Caltrans District 7 Vehicle Occupancy Data Collection Parameters

Locations: All available count locations on study routes.
HOV and general-purpose lanes, separately.
Directions, as available (off-peak direction generally not counted).

Months: As available.

Days: Focus on midweek (Tuesday, Wednesday or Thursday).
(Monday and Friday used as alternative where necessary.)

Time of Day: Focus on AM and PM peak periods (off-peak periods generally not counted).

Years: Current and historical as available.

Format: Electronic spreadsheet and hard-copy formats as available.

2.4.4 Accident Statistics

Objective 5 used accident data. Caltrans District 7 Traffic Accident Surveillance and Analysis System (TASAS) data and the original accident files were the two sources available. The accident files contain detailed records per accident. They are the only source that would accurately indicate if an accident occurred in a carpool lane or involved a vehicle exiting/entering a carpool lane. However, the amount of effort required to sort through these hard-copy files was beyond the scope and budget of this program audit, and therefore, TASAS data was used.

TASAS data was available in four forms:

- TASAS Table A (Cumulative Number of Accidents by PostMarker).
- TASAS Table B (Selective Accident Rate Calculation).
- TASAS Table C (High Accident Concentration Locations).
- TASAS Selected Accident Retrieval (TSAR).

Of the four types of TASAS outputs, TASAS Tables B and C were the most relevant for the analysis.

2.4.4.1 Description of Caltrans District 7 TASAS Tables B and C Collection Parameters

Locations: All study routes.
HOV and general-pupose lanes, combined (not available separately).
Both directions, separately.

Months: All months of the year.

Days: All days of the year.

Time of Day: 24-hours.

Years: Table B - 1990 through 2000 for all routes (pre-1990 not available).
Table C - 1st quarter 1996 through 2nd quarter 2000 for all routes (pre-1996 not available).

Format: Electronic text-dump of standard TASAS outputs.

2.4.5 Project Facts

Various types of project facts were collected from different data sources. Project facts and the corresponding analysis objective(s) and data sources are detailed in **Table 2.4.1**.

Table 2.4.1 Project Facts Data Sources

Data Item	Objective Number	Sources Used
Begin & End Mileposts, Length	Segment descriptor	MTA & Caltrans carpool project lists
Number of Lanes (Carpool & General Purpose)	General interest	Caltrans 1997 Highway Log, Caltrans staff
Carpool Lane Ingress/Egress Points	General interest	Caltrans freeway striping plans & as-builts; fieldchecks
Carpool Lane ROW & Construction Costs	5	MTA & Caltrans carpool project lists; MTA programming data; Caltrans project files
Carpool Lane Operations and Maintenance Costs	5	Caltrans
Carpool Lane Enforcement Costs	5	CHP
Carpool Lane Citations	5	CHP
Construction Start Date	1, 5	Caltrans project files
Carpool Lane Opening Date	1, 5	MTA & Caltrans carpool project lists
Park & Ride Lots (Locations, Size, Utilization)	2	Caltrans, MTA, SCAG
On-Line Transit Station Locations	2	Caltrans
Direct Carpool On/Off Ramp Locations	2	Caltrans
Direct Carpool Freeway-Freeway Connectors	2	Caltrans

2.4.6 Transit Data

Transit data was used for Objectives 1, 2, 4, and 5. These objectives used one or more of the following types of transit data:

- Number of buses on segment.
- Bus ridership on segment.
- Bus utilization of carpool lanes.
- Deadheading.
- Schedule adherence/on-time performance statistics.
- Productivity statistics (operating cost/vehicle mile, operating cost/passenger, operating cost/passenger mile).
- Fares.

Transit operators were the only source for most of the data items listed above. Although Caltrans District 7 vehicle occupancy counts provided an alternate source for the number of buses and ridership data, this source was not used due to data limitations such as limited count locations, peak period/peak direction availability only, and the fact that the surveyors cannot actually see the number of persons in each bus, so they estimate whether the bus is full, half-full, or empty.

The analysis employed transit data solely from transit operators who have bus routes traversing one or more study route. A comprehensive search for all bus routes running along study routes was conducted. Several transit operators, such as Culver City Transit, Long Beach Transit, and Santa Monica Municipal Bus, do not operate buses along any of the study routes.

The following transit operators do run buses along the study routes and data was requested from each of them: Antelope Valley Transit Authority, Foothill Transit, Gardena Transit, LADOT, Commuter Express, MTA, OCTA, Santa Clarita Transit, and Torrance Transit.

2.4.6.1 Description of Transit Operator Data Collection Parameters

Locations: All bus routes operating on study routes, if data available.
Bus routes operating in the carpool lanes and/or general-purpose lanes.

Months: As available. Varied by operator.

Days: Weekday with focus on midweek (Tuesday, Wednesday, Thursday) if available.
Varied by operator.

Time of Day: Peak hour, peak period, daily, and annual as available per operator.

Years: Year before carpool lane opening if available.
Year after carpool lane opening if available.
Current year if available.

Sources: Transit operators as listed above.

Format: Various formats - hard-copy, electronic text, spreadsheet file.

2.4.7 Market Research Data

Market Research data was used for Objectives 2, and 5. These objectives used market research data derived primarily from the five different market research activities conducted as part of the HOV Performance Program. These market research activities generally addressed the attitudes, awareness and behavior of Los Angeles County residents, commuters, transportation providers, and elected representatives with regard to the provision and use of carpool lanes in the county. These market research activities are described in **Chapter 3.0** and include Focus Group Meetings, Executive Interviews, a General Public Telephone Survey, a License Plate Mail-Out Survey, and an On-Board Transit Survey.

Results from the U.S. Decennial Census and transportation related surveys completed in various other parts of the country were also used to supplement and compare results obtained from the HOV Performance Program surveys of Los Angeles County. For the evaluation of Objectives 2 and 5, survey results from Orange County, California, Houston, Texas, Dallas, Texas, Minneapolis, Minnesota, Portland, Oregon, Seattle, Washington, and Northern Virginia/Washington, D.C., were utilized to provide a national context for local observations.

2.5 Data Management Program

Currently, the data required to effectively study the performance of carpool lane system is located in a myriad of public organizations and jurisdictions, offices, and file formats. The purpose and goal of the HOV Performance Program Data Management Program (DMP) is to provide an effective tool to organize, store, query, and retrieve all of this data, while serving as an analysis tool for future carpool lane monitoring and reporting.

The types of data that are served by the DMP include: carpool lane and connector physical characteristics, travel time runs, vehicle and vehicle-occupancy counts, and accident statistics. The DMP is designed as a tool to aid MTA staff in evaluating and monitoring the overall performance of the carpool lane system. It is not the intent of, nor feasible for, the DMP to replicate the detailed analysis and evaluation performed under each of the tasks of the HOV Performance Program. The DMP data specifications represent a fine balance between analysis flexibility, while maintaining data manageability.

The major features of the DMP include:

1. Development of a database and custom software application that will aid MTA staff in the electronic storage of historical, current, and future travel related data:
    a. Travel Time Data
    b. Vehicle Counts
    c. Vehicle Occupancy Counts
    d. Accident Statistics
    e. Transit Service and Ridership Data
2. Analysis and reporting of travel related data with customized queries, forms, and reports.
3. Mapping of travel related data by interfacing with Geographic Information System (GIS) technology.

The DMP has been developed using Microsoft® Visual Basic for Applications©[2] (VBA) as the application development environment. Since the DMP Application Layer is written in VBA, this allows additional software to interface to this layer through standard Component Object Model (COM), Object Linking and Embedding (OLE) or direct VBA procedure calls. The actual carpool data results are stored in a relational database using Microsoft Access©[3].

The DMP is setup and accessible on a stand-alone personal computer (PC) or over the client's internal local area network (LAN). No interface development is required in order to implement this communication. The DMP does not support any external communication interfaces (such as communicating DMP information over the internet or wide area network (WAN). No other communications interfaces are mandated.

MTA users are able to view, and perform "canned" queries on the DMP using the familiar Microsoft Windows©[4] operating environment. These users are assumed to have basic knowledge of the carpool lane data and are familiar and comfortable with basic software such

[2] Microsoft is a registered trademark of Microsoft Corporation. Visual Basic for Applications is a copyrighted product of Microsoft Corporation.

[3] Microsoft Access is a copyrighted product of Microsoft Corporation.

[4] Microsoft Windows is a copyrighted product of Microsoft Corporation.

as word processing and database querying tools. In addition to custom queries and reports, the DMP is designed to be queried by a GIS for further spatial analysis and mapping. The DMP provides the MTA a streamlined tool for the effective analysis of the carpool lane system.

The DMP contains very pertinent and useful information to Los Angeles County in regards to HOV transportation. A possible future enhancement may be to share this information over the Inter(ra)net in a web friendly format. Having the DMP or a subset of the data readily available through a web browser expands the possible access and use of this information, while saving time and energy for future planning projects. For example, most planning studies require the cooperation of many local and regional planning agencies such as MTA, Caltrans, SCAG, and various cities. Instead of having a user from particular planning agency request and wait for data to be supplied by each of these agencies, the user could log on and access the information using their PC's web browser. In a similar fashion, each of the agencies that have stewardship over the particular data in the DMP could use their web interface to perform the necessary updates.

Another possible future application may be tailored to public outreach. For example, if a citizen is interested in saving the most time on their daily trips they could simply type in their origin and destination trip information at the DMP website, and the DMP would then provide a map of their route along with the travel time savings typically realized using the HOV. A similar application has been implemented already in northern Virginia (http://www.hovcalculator.com). With a new and expanded development effort, the DMP could be enhanced to allow the end user to view both static and dynamic HOV data with any PC with web access.

3.0 MARKET RESEARCH

3.1 Introduction

Integral to the HOV Performance Program and the attainment of the study objectives was the need to develop a better understanding of the public's attitudes and perceptions towards carpool lane facilities in Los Angeles County. To accomplish this element of the study, extensive market research was conducted to determine the level of support for carpool facilities and to identify market factors that could influence carpool lane utilization. To assess public attitudes toward carpooling, the study invoked a comprehensive approach using five different nationally recognized market research techniques. Each technique allowed a slightly different sector of the public to be targeted for examination. These techniques included:

1. Focus Group Meetings
2. Executive Interviews
3. Awareness and Attitude Telephone Survey
4. License Plate Mail-out Survey
5. Transit On-Board Rider Survey

This Chapter provides an overview of each of the market research activities of the HOV Performance Program, including a brief explanation of the research methodology and a summary of key findings.

3.2 Focus Group Meetings

Focus group meetings provided the opportunity to discuss the awareness and attitude of the group members toward carpooling and the provision of carpool lanes. Focus groups do not represent a statistically significant portion of the general population so they did not provide a basis for drawing definitive conclusions from group comments. However, Focus Group Meetings provided an immediate and effective way to gauge general public attitudes and perceptions toward carpool lanes. The observations from the Focus Group Meetings offered important information to helped structure and refine subsequent quantitative survey activities, including the General Public Telephone Survey and License Plate Mail-Out Survey.

Focus Group Meetings helped accomplish the following market research objectives:

- Assess general knowledge and familiarity of public with different HOV terminology.
- Provide insight into motorist travel behavior and their attitudes and perceptions towards carpool facilities in Los Angeles County.
- Identify public preferences for improving availability and performance of carpool lane system.
- Identify factors that motivate motorists to rideshare and use carpool lanes.
- Assess public awareness and opinion of current and proposed HOV legislation and marketing strategies.
- Determine public awareness of what agencies are responsible for the various aspects of carpool lane system planning, development and operations.

3.2.1 Methodology

Three different focus group meetings were conducted as part of the HOV Performance Program marketing research. The three groups were composed of carpool lane "users" (drivers that use carpool lanes three or more times per week), "infrequent or non-users" (drivers that do not use carpool lanes more that twice per week), and Employee Transportation Coordinators (ETCs). Participants for the users and infrequent or non-users groups were recruited randomly by telephone. Known carpool lane users that had been identified by ETCs supplemented the users group. Participants in the ETCs group were recruited from a list of regional ETCs provided by the South Coast Air Quality Management District (AQMD).

The focus group meetings were held separately on the evening of September 12, 2000, September 13, 2000 and September 26, 2000, respectively. The focus group meetings were held at Assistance in Marketing LA (AIM) utilizing a specially designed facility. Mr. Peter Valk, a trained facilitator, led the group through a pre-determined list of questions. Although MTA staff and other project team members did observe the proceedings from the observation room, they did not participate in the discussions.

3.2.2 Key Findings

While each of the focus group meetings provided the opportunity to consider the awareness and attitudes of three distinctly different types of participants, the results of the group meetings indicate many common views and concerns regarding carpool lanes. In general, the focus group participants supported the continued development of the carpool lane system as an effective means of reducing travel times for carpool lane users. The lessons learned from the participants in all three Focus Group Meetings are summarized in the following sections. A detailed description of results from the Focus Group Meetings was presented in HOV Performance Program *"Technical Memorandum 11 – Focus Group Meeting Summary"* dated April 16, 2001.

3.2.2.1 Familiarity with HOV

The members of all three groups were familiar with the concept of HOV in relation to Los Angeles County freeways, and associated the terms "carpool" and "carpool lanes" with HOV. Participants generally considered the purpose of carpool lanes to be moving more people in fewer cars, improving mobility and providing travel-time savings.

3.2.2.2 Advantages and Disadvantages of Carpool Lanes

All participants felt that carpool lanes primarily benefit the users of the lanes, and do not necessarily manage overall freeway traffic congestion. Participants indicated that carpool lanes are very effective for reducing travel times, which was the primary motivation for using the lanes. Focus group participants also indicated that carpool lanes were an effective means of moving more people in fewer cars.

Participants identified several safety hazards felt to be associated with the operations of carpool lanes. The differential in traffic speed, congestion where carpool lanes abruptly end and congestion at carpool ingress and egress points were all identified as safety concerns.

3.2.2.3 Carpool Lane Utilization

Focus Group participants offered mixed opinions regarding perceived utilization of carpool lanes. Participants who perceived carpool lanes to be under-utilized generally based this perception on the appearance that the carpool lane was moving faster than the other lanes and therefore must be empty. Driver frustration was identified as a concern for those who perceived carpool lanes to be under-utilized.

3.2.2.4 Improving Carpool Lanes

All participants supported the provision of more carpool faciltities, including additional carpool lanes, new carpool lane interchanges (direct freeway-to-freeway carpool lane connectors) and new carpool lane on-ramps. A reduction in the number of carpool lane ingress and egress points was identified as a means of better serving longer carpool trips. Improved carpool lane markings and signage, and increased enforcement of carpool lane violations were also cited as being appropriate for improving carpool lanes.

None of the groups supported increasing the minimum occupancy of carpool lanes to 3+, unless there was clear evidence that the lanes have become over-utilized. Participants opposed allowing single-occupancy vehicles (SOV) to use carpool lanes at anytime.

3.2.2.5 Motivation for Using Carpool Lanes

Participants that used carpool lanes typically used the facilities to save time, save money and avoid stress, among other reasons. The need to maintain flexible working hours and not live near work colleagues were cited as the main reasons for not carpooling.

ETC Focus Group participants indicated that their companies all provided information on carpooling to employees and offered incentives to employees for carpooling or using transit services. Incentives included subsidies, preferential services, gift certificates and cash bonuses. Despite the availability of incentives, ETC's indicated that incentives had not had an effect on commuting as most employees that carpooled or used transit were already doing so.

ETC's generally felt that employers should not have the responsibility to push employees to rideshare. ETC's felt that the employees that do not carpool were unjustly penalized by employer incentives. They indicated that carpooling and the use of incentives elicits resentment from non-users and potentially could lead to conflict among employees.

3.2.2.6 Sources for Carpool Lane Information

The focus group participants indicated that they found newsradio, television and newspapers to be the good sources of traffic information. Caltrans, Southern California Rideshare, AQMD and 1-800-COMMUTE were identified as good sources of information specifically on carpool lanes and carpooling. Participants indicated a detailed map of carpool facilities in Los Angeles County would provide useful information. Participants generally felt that carpool lanes were effective at promoting themselves.

Participants in the focus group meetings were not aware of specific details regarding proposed legislation to change or close carpool lanes, although some participants recalled having heard something about it.

3.2.2.7 Responsibility for Carpool Lanes

The participants in all three focus groups were unclear about which agency was responsible for planning, designing and funding HOV projects in Los Angeles County. Caltrans was identified as the agency responsible for maintaining carpool lanes. The MTA was not associated with HOV lanes by any of the focus group participants.

3.3 Executive Interviews

The purpose of the Executive Interviews is to supplement the views and opinions of the general public with targeted input from elected officials and transit managers in both the private and public sectors. The Executive Interviews were completed specifically to supplement the information derived from the Focus Group Meetings described in **Section 3.2**.

The findings of the Executive Interviews are based on a limited number of interviews with individuals selected to be representative of the state legislature, private sector transit providers, and public sector transit providers. Given the small number of interviews, it is not possible to project results to any organization or group as a whole. The findings are qualitative and directional in nature, and are not supported by any level of statistical significance. As a result, the opinions expressed are those of the individuals interviewed, and not necessarily those of the organization or group they represent.

3.3.1 Methodology

A total of 13 one-on-one executive interviews were conducted in person at participants' offices. These interviews were conducted with Elected Officials, Private Sector Transportation Providers and Transit Agencies. The executive interviews included the following individuals:

- Elected Officials:
  - Assemblymember John Dutra's Aide, Ryan Spencer
  - Senator Betty Karnette
  - Senator Bob Margett
  - Assemblymember George Runner

- Private Sector Transportation Providers:
  - Greyhound – Craig Lentzch, Chief Executive Officer and
  - Jack Haugsland, Executive Vice President, Chief Operating Officer
  - Super Shuttle – Gene Hauch, President
  - Yellow Cab – Mesfin Shawel, Director of Communications for Administrative Services CO-OP

- Transit Agencies:
  - Foothill Transit – Juli Austin, Executive Director and George Karbowski, Director of Operations
  - LADOT – Haripal Vir, Principal Transportation Engineer; James Lefton, Chief of Transit Programs; and Philip Aker, Supervising Transportation Planner II
  - MTA – Ed Clifford, Director of Service Planning
  - OCTA – Kurt Brotcke
  - Santa Clarita Transit – Ronald Kilcoyne
  - Torrance Transit – Dennis Kobata and Eddie Harris

The elected officials were recruited based on having some familiarity of carpool lane issues. The transportation providers were selected based on the size of the organization they represented and the potential for their services to utilize carpool lanes in Los Angeles County. Peter Valk, a professional moderator specializing in transportation, interviewed each of the participants between November 3, 2000 and August 9, 2001.

3.3.2 Key Findings

The results of the Executive Interviews were presented in HOV Performance Program *"Technical Memorandum #11A – Executive Interviews"*, dated December 17, 2001. The following summary offers key findings for Executive Interviews with Elected Officials, Private Sector Transportation Providers and Transit Agencies, respectively.

3.3.2.1 Elected Officials

According to the elected officials interviewed, the purpose of carpool lanes is to change travel behavior by getting people to carpool instead of driving alone, thereby increasing vehicle occupancy. Only one participating elected officials aide mentioned reducing congestion and improving air quality as a primary purpose of carpool lanes.

Some elected officials were unsure about the effectiveness of carpool lanes due to the lack of documented research demonstrating their effectiveness. Despite the lack of appropriate information, none of the elected officials interviewed viewed carpool lanes as ineffective. All four of the elected officials felt that other transportation options, including transit and building more roads, may be a better long-term investment than building carpool lanes.

Three of the four elected officials interviewed indicated that their constituents generally support the provision of carpool lanes in their districts. The elected officials did, however, acknowledge that there is a vocal minority that opposes carpool lanes.

Relevant information that would be of interest to elected officials include demographics of carpool lane users, and the identification of ways to better manage carpool lanes to maximize usage. The elected officials also indicated they would like more information on the existing laws governing the provision and operation of carpool lanes.

3.3.2.2 Private Transportation Providers

Private transportation providers indicated that they are keenly aware of the location of carpool lanes. Two of the private providers indicated they specifically alter their routing to utilize the available carpool lanes. The private transportation providers group uniformly opposed any efforts to reduce the availability of carpool lanes.

Two of the three participants operate fleets that contain a significant percentage of Liquefied Petroleum Gas (LPG) vehicles that qualify for low emission vehicle (LEV) usage of the carpool lanes even when the driver is the only occupant. These respondents support LEV use of carpool lanes on the basis that they help support the investment in alternative fuel vehicles by making these vehicles capable of producing more revenue per hour.

3.3.2.3 Transit Service Providers

All of the interviewed transit agencies utilize carpool lanes in their delivery of services. All of the transit providers have altered their routing, at least to some extent, to use the carpool lanes in the delivery of service. Most public transit bus operators believe that carpool lanes save time for routes that utilize carpool lanes and provide a more reliable travel time thereby making transit a more attractive alternative to commuters. The transit providers indicated that carpool lanes provide lower costs as a result of better trip efficiency. The transit providers also indicated they felt that carpool lanes offered a safer alternative for freeway bus operators because they reduce opportunities for vehicles to swerve in front of the bus and cause an accident.

3.4 General Public Telephone Survey

Although the focus groups and executive interviews provided a rich and detailed discussion of individuals attitudes related to carpool lanes, these research techniques do not provide statistically significant, quantitative data that can be projected to the entire population or geographic subsections of Los Angeles County. The General Public Telephone Survey conducted with a random sample of Los Angeles County residents provided feedback from the general population that could serve this purpose. This survey provided information on public attitudes that can be extremely useful both for policy decisions and for use in future awareness and marketing programs about carpool lanes.

To measure the public's attitudes towards carpool lane facilities and their value, the General Public Telephone Survey focused on a small group of core questions. These included:

- Perceptions of Traffic Conditions and Preferred Solutions
- Use of and Attitudes Toward Carpool Lane Facilities
- Commuting Patterns
- Carpooling Characteristics and Behavior
- Factors in Carpool Mode Choice
- Reactions Toward Certain Carpool Policies
- Demographic Information

3.4.1 Methodolgy

Strategic Consulting & Research conducted surveys between December 28th, 2000 and April 7th, 2001. Surveys were conducted with individuals who were at least 18 years of age and lived in Los Angeles County. The total survey sample was distributed across the nine Los Angeles County subregional Councils of Government (COG) in proportion with population. **Table 3.4.1** describes the General Public Telephone Survey sample size and respective confidence level for each COG. The survey was also balanced to match gender, age, ethnicity, and income of residents of Los Angeles County.

Table 3.4.1 General Public Telephone Survey Sample Size and Accuracy by Los Angeles County COG

Subregional COG	*Sample Size*	*Accuracy at 95% Confidence Level*
Arroyo Verdugo	168	±4.5 – 7.6%
Central Los Angeles	569	±2.5 – 4.1%
Gateway Cities	612	±2.4 – 4.0%
Las Virgenes/Malibu	47	±8.6 – 14.4%
North County	267	±3.6 – 6.0%
San Fernando Valley	373	±3.0 – 5.1%
San Gabriel Valley	531	±2.6 – 4.3%
South Bay Cities	480	±2.7 – 4.5%
Westside Cities	226	±3.9 – 6.5%
Total	*3,273*	*±1.0 – 1.7%*

Potential participants' telephone numbers were obtained using a random digit dialing (RDD) calling list that was screened to eliminate businesses, disconnected numbers, and cellular telephone numbers. This approach eliminated the potential bias that would occur if only "listed" phone numbers were used since the opinions and attitudes of residents with unlisted numbers may be different than those with listed numbers. Respondents were contacted on weekday evenings Monday through Friday between 6:00 p.m. and 9:00 p.m., and on weekend days between 9:00 a.m. and 9:00 p.m. The surveys were conducted in either English or Spanish at the preference of each individual respondent.

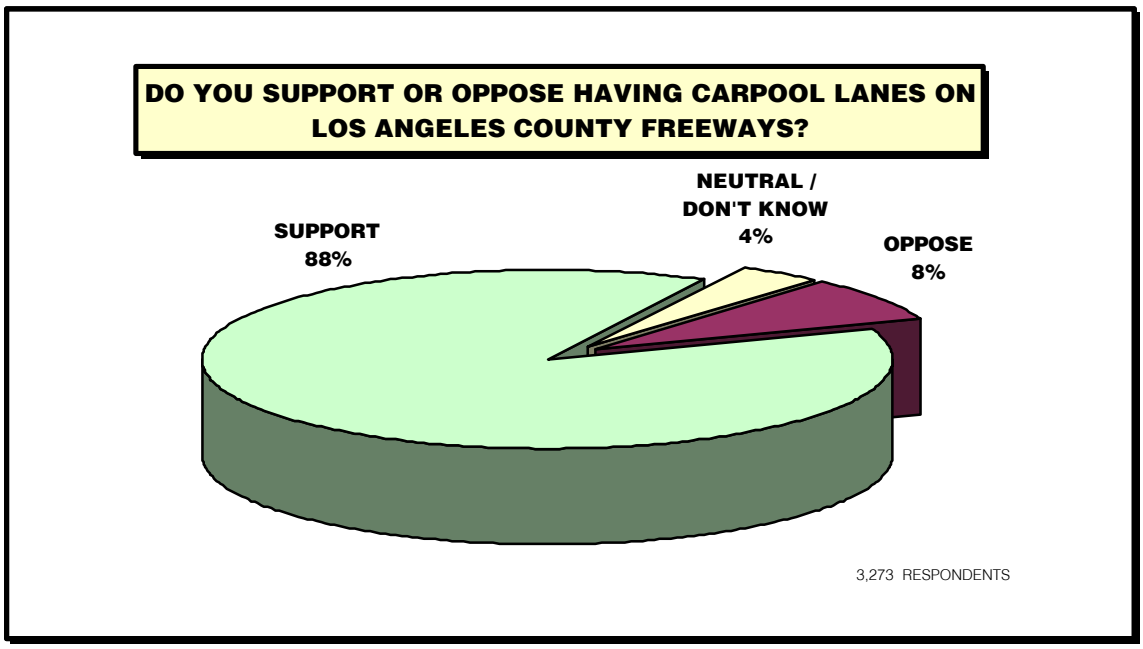
A total of 3,273 surveys were completed providing an accuracy of ±1.0% –1.7% at a 95% confidence level, which is the industry standard for consumer research of this type. This means that differences of more than 1.7% in the data set will be due to random variation only 1 out of 20 times on average, and will reflect true differences in the target population 19 out of 20 times.

3.4.2 Key Findings

Detailed results of the General Public Telephone Survey were presented in HOV Performance Program *"Technical Memorandum #11 – HOV Awareness and Attitude Study General Public Survey Summary"*, dated August 20, 2001. Overall, the residents of Los Angeles County overwhelmingly support the provision of carpool lanes on area freeways. Some 88% of the

survey respondents indicated support for carpool lanes in Los Angeles County compared to only 8% who opposed carpool lanes. **Figure 3.4.1** illustrates general public support for carpool lanes in Los Angeles County.

Figure 3.4.1 General Public Support for Carpool Lanes

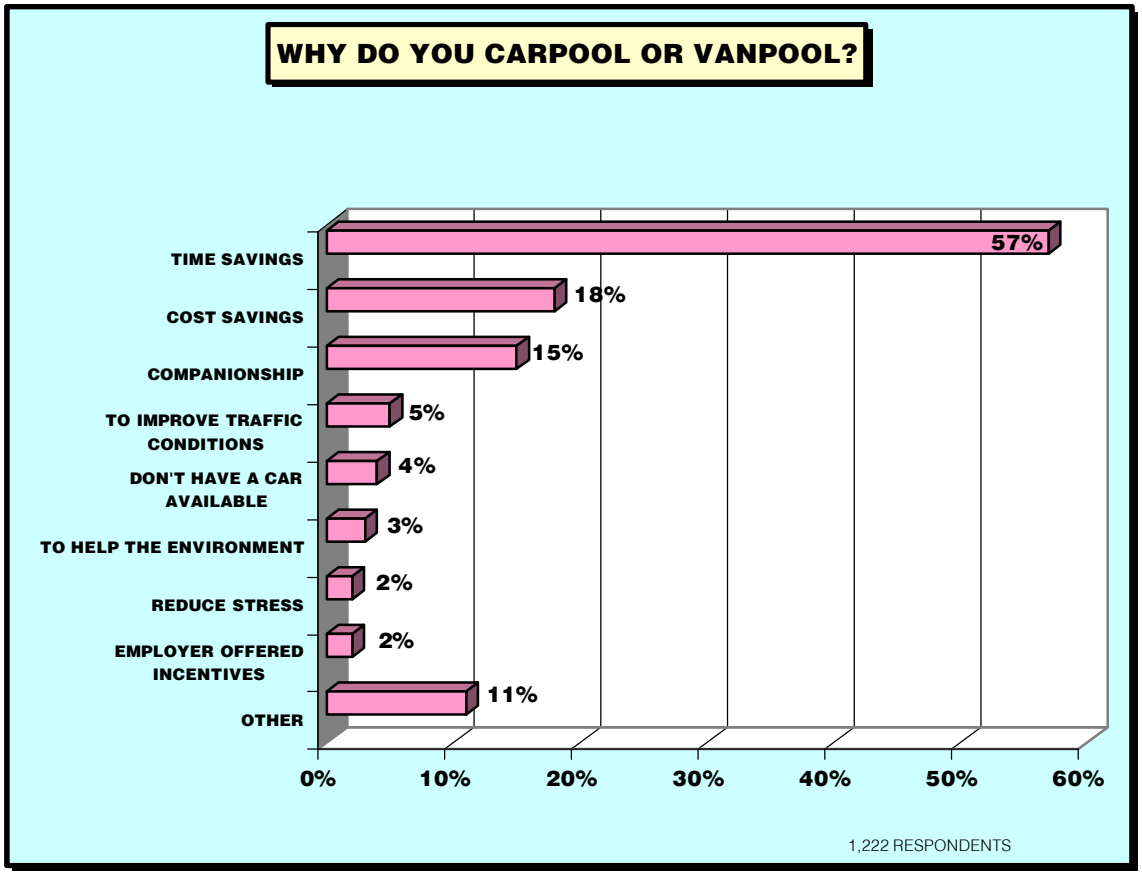


The strong support for carpool lanes is also reflected in Los Angeles County residents support for completing the proposed system of carpool lanes on all area freeways, including the provision of freeway-to-freeway carpool lane connectors (carpool lane interchanges). Furthermore, at 82%, the vast majority of Los Angeles County residents support the continued utilization of a portion of their sales tax revenues for transit-related highway infrastructure investments, include the construction of more carpool lanes and carpool lane interchanges.

Time-savings was identified by Los Angeles County residents as the major motivating factor for using carpool lanes. At 57%, well over one-half of all residents indicated that travel time-savings was a motivation for using carpool lanes. Cost-savings and companionship were also identified as common motivating factors for carpooling and using carpool lanes, with responses of 18% and 15%, respectively. **Figure 3.4.2** shows residents reasons for using carpool lanes.

Los Angeles County Residents had mixed perceptions regarding the perceived utilization of carpool lanes. Forty-two of Los Angeles County residents indicated that they felt carpool lanes are under-utilized. Thirty-seven percent of residents felt that carpool lanes were appropriately utilized, while only 8% felt that carpool lanes were over-utilized.

Figure 3.4.2 Reasons for Using Carpool Lanes



3.4.2.1 Perceptions of Traffic Conditions and the Preferred Solutions

The majority of respondents cited excessive demand as the major transportation issues facing Los Angeles County. Forty-two percent of respondents specifically identified too much traffic and congestion as the major problem while a further 16% responded that there are just too many cars on the roads. The need for more public transportation was cited by 16% of respondents.

Twenty-six percent of respondents say that traffic conditions in and around their community are extremely congested all the time. An additional 52% say highways are extremely congested in and around their community during peak hours.

The most commonly offered solution to these traffic problems was the provision of more trains, buses and public transit in general at 40%. The provision of more freeways and more freeway lanes was cited by 36% of respondents. More carpooling and the provision of more carpool lanes was offered as a solution by 21% of respondents.

3.4.2.2 Use of and Attitudes Towards Carpool Lane Facilities

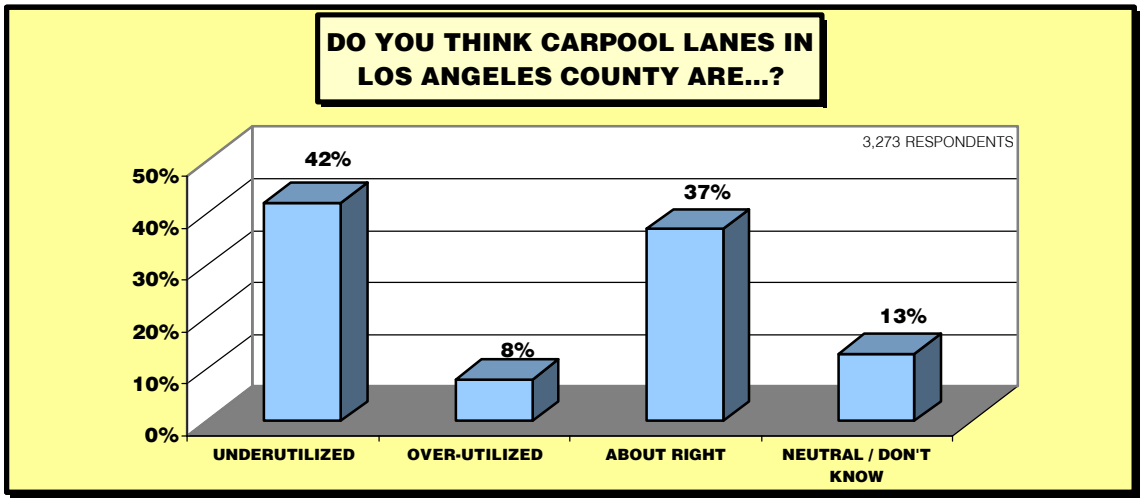
Three-quarters (75%) of all Los Angeles County residents indicate that they have used carpool lanes during the peak periods of 6:00 a.m. to 9:00 a.m. and/or 4:00 p.m. to 7:00 p.m. Seventy-

four percent of respondents indicated they have used carpool lanes during the off-peak periods including midday, nights and weekends.

Seventy-two percent of respondents strongly agree or agree that carpool lanes are more efficient than regular general-purpose freeway lanes. Additionally, almost two-thirds (64%) of respondents feel that carpool lanes reduce congestion in all freeway lanes.

As **Figure 3.4.3** illustrates, Los Angeles County residents are split on their perception of carpool lane utilization with 42% saying carpool lanes are under-utilized, 37% saying they are utilized just about right, and 8% saying they are over-utilized.

Figure 3.4.3 Carpool Lane Utilization



Seventy percent of Los Angeles County residents either strongly disagree or disagree with the statement that carpool lanes increase the number of accidents. Although a majority (52%) of respondents consider carpool lane striping and signage to be adequate, there is a minority of 42% that say these items need improvement.

On the issue of air quality, a majority of residents (56%) either strongly agree or agree that carpool lanes contribute to improving air quality.

3.4.2.3 Commuting Patterns

As would be expected, 84% of Los Angeles County residents indicate that they commute to work on a regular basis with 86% of these commuters travel during either the morning or afternoon peak periods or both. Driving alone is the primary commute mode for 73% of Los Angeles County residents. Carpooling and vanpooling was identified as the primary commute mode for 20% of commuters. Public transit including the bus or train was identified as the primary commute mode for 6% of residents.

3.4.2.4 Carpooling Characteristics and Behavior

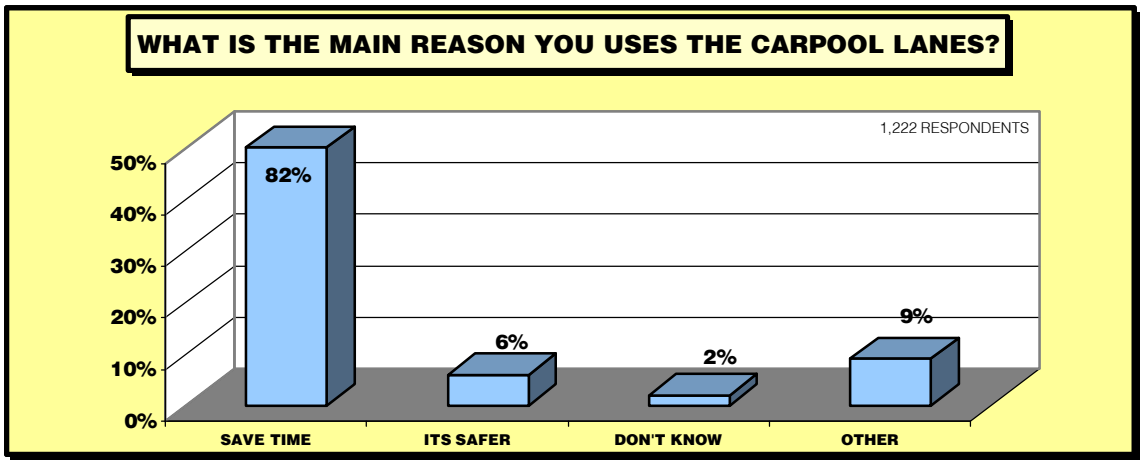
One-half (50%) of respondents that used carpool lanes characterized themselves as occasional users. An additional 26% of carpool lane users say they generally use the carpool lane if one is available, and 21% say they always use the carpool lane when one is available.

Personal and social trips constitute a slightly higher level of carpool lane use than commuting with 29% of carpool lane users using the lanes on their way to visit family and friends, while 27% use the lanes for getting to work. Another 18% use the lanes on their way to entertainment activities.

3.4.2.5 Factors in Carpool Mode Choice

As **Figure 3.4.4** shows, time-savings is by far the predominant reason for carpooling or vanpooling with 82% of carpool lane users identifying "save time" as the main reason for carpooling.

Figure 3.4.4 Main Reason for Using Carpool Lanes



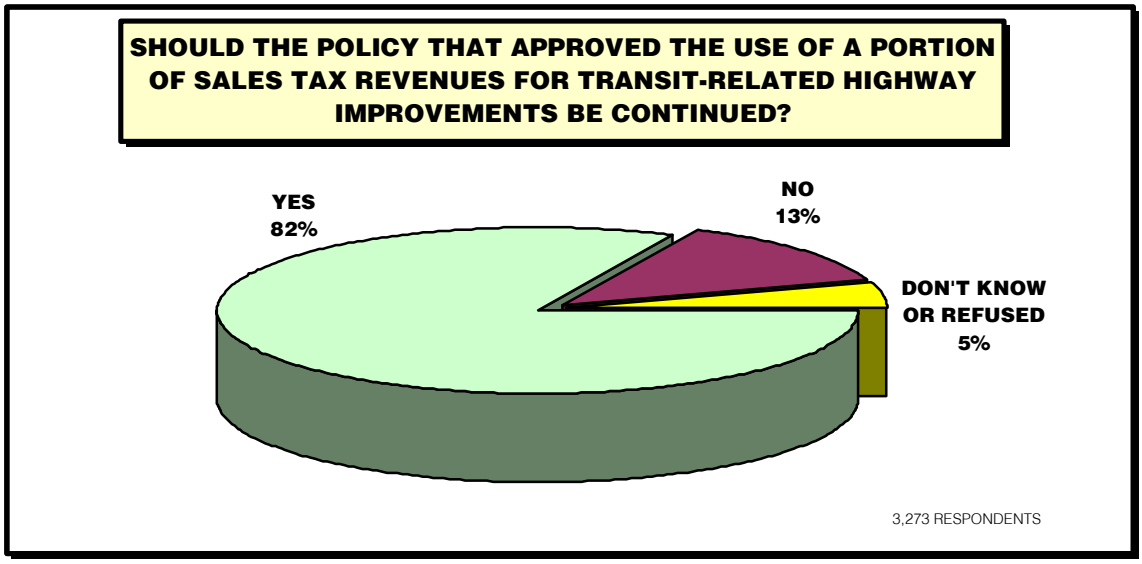
Almost three-quarters (74%) of Los Angeles County residents either strongly agree or agree that availability of carpool lanes are a strong incentive to get people to carpool. Although carpool lanes play a significant role in the formation and maintenance of carpools, 36% of carpool lane users say they would definitely continue to carpool and 38% say they would probably continue to carpool if carpool lanes were not available. Over one-quarter (26%) of carpool lane users say they would probably or definitely stop carpooling if carpool lanes were not available.

3.4.2.6 Reactions Towards Certain Carpool Policies

Los Angeles County residents clearly support the provision of carpool lanes on area freeways with 88% of residents indicating favorably. In line with the support for carpool lanes on Los Angeles County freeways, the vast majority of County residents (89%) support the completion of the carpool lane system. Three-quarters (75%) of County residents also indicate support for the completion of additional carpool lane interchanges.

The vast majority of Los Angeles County residents support of the continued utilization of a portion of the County's sales tax revenues for transit-related highway improvements such as carpool lanes. **Figure 3.4.5** depicts 82% of Los Angeles County residents supporting the dedication of taxes to transit-related highway improvements.

Figure 3.4.5 Use of Sales Tax for Transit-Related Highway Improvements



The majority (64% and 52%, respectively) of Los Angeles County residents believe that carpool lanes should be reserved for use exclusively by participants in carpools and vanpools. Only 29% of county residents agreed with the idea of opening carpool lanes to single-occupant vehicles that pay a toll. Similarly, only 35% of residents agree that low emission vehicles should be allowed to use the carpool lanes regardless of the number of people in the vehicle.

3.5 License Plate Mail-Out Survey

A license plate mail-out survey was conducted as part of the HOV Performance Program to secure usage and attitudinal information specifically from peak-hour freeway commuters observed using either general-purpose or carpool lanes on targeted freeway corridors. The license plate mail-out survey results provide a statistically significant, quantifiable database that was analyzed not only on a countywide basis, but also at the individual freeway segment level providing feedback on users of individual freeways. The results of the license plate mail-out survey were presented in HOV Performance Program *"Technical Memorandum #12 – License Plate Survey"*, dated February 20, 2002. The methodology and results of this survey are summarized in the following section.

3.5.1 Methodology

For this phase of the HOV Performance Program market research, it was determined that collecting license plate information along targeted corridors was the desired methodology to specifically identify both carpool lane users and non-users. As part of the project design, it was determined that freeways with no carpool lanes would also be incorporated into the survey

as a control group for comparison purposes. **Table 3.5.1** details the targeted corridors and the presence of carpool lanes on the specified corridors.

Table 3.5.1 Targeted License Plate Survey Corridors

Route Number	Study Route Limits	Carpool lanes	
		Yes	No
10	Alameda St to Baldwin	✓	
14	San Fernando Rd to Escondido Canyon Rd	✓	
57	Orange County Line to Rte 60	✓	
60	Brea Canyon Rd to San Bernardino County Line	✓	
91	Rte 110 to Orange County Line	✓	
105	Rte 405 to Rte 605	✓	
110	Route 91 to Adams Bl.	✓	
118	Ventura Count Line to Rte. 5	✓	
134	Rtes. 101/134 to Rte. 5	✓	
134	Rte. 5 to Rte. 210	✓	
170	Rtes. 101/134 to Rte 5	✓	
210	Rte 134 to Sunflower	✓	
405	Orange County Line to Century Blvd	✓	
405	Rte 101 to Rte 5	✓	
605	South St. to Telegraph Rd.	✓	
605	Telegraph Rd. to Rte. 10	✓	
10	Baldwin Ave. to Rte. 605		×
10	Rte. 57 to San Bernadino County Line		×
60	Rte. 605 to Brea Canyon Rd.		×
405	Rte. 10 to Rte. 101		×
605	Orange County Line to South Street		×
5	Rte. 605 to Rte. 710		×
101	Rte. 405 to Rte. 27		×

To accomplish the identification of potential survey respondents, video sampling was conducted during the second and third weeks of January 2001 for both morning and evening peak periods. Potential respondents' license plates were observed for three different sample groups:

- Those observed in carpool lanes.
- Those observed in general-purpose lanes on freeways where there are also carpool lanes.
- Those observed on freeways where there are no carpool lanes.

The videotape data was scanned using specially designed software and transcribed into a database of license plate information. The license plate information was sent to the California Department of Motor Vehicles (DMV) for a vehicle registration owner and address match in accordance with California Vehicle Code (CVC) § 1808.21.

Postage-prepaid return-addressed survey questionnaires in both English and Spanish were sent to potential respondents using the addresses provided for individual citizens, including potential respondents with registered vehicle owners addresses outside of Los Angeles County. Addresses for businesses, corporations, or other organizations as the registered

vehicle owner were eliminated from the DMV returned address list. Since most vanpool vehicles are owned and registered by organizations, and subsequently were not include in the survey mailing address list, the SCAG database of vanpool user information was utilized to identify and distribute surveys to vanpool users along the targeted corridors. Vanpool surveys were distributed in proportion to their incidence on the freeway segments in question.

In aggregate, 31,751 surveys were mailed out, and 6,178 surveys were returned for all of the corridors. Of the 6,178 surveys received, 168 surveys were collected from vanpool users and incorporated in the aggregate data set. Surveys were sent to potential participants between August 16, 2001 and August 25, 2001. Participants returned the surveys between August 27, 2001 and November 29, 2001. **Table 3.5.2** details the number of returned surveys for each study freeway segment.

Table 3.5.2 License Plate Survey Data Collection by Corridor

Route Number	*Study Route Limits*	*Number of Surveys Collected*
Study Routes with Carpool Lanes		
10	Alameda St to Baldwin	281
14	San Fernando Rd to Escondido Canyon Rd	334
57	Orange County Line to Rte 60	266
60	Brea Canyon Rd to San Bernardino County Line	256
91	Rte 110 to Orange County Line	293
105	Rte 405 to Rte 605	250
110	Route 91 to Adams Bl.	276
118	Ventura Count Line to Rte. 5	349
134	Rtes. 101/134 to Rte. 5	299
134	Rte. 5 to Rte. 210	227
170	Rtes. 101/134 to Rte 5	270
210	Rte 134 to Sunflower	315
405	Orange County Line to Century Blvd	302
405	Rte 101 to Rte 5	239
605	South St. to Telegraph Rd.	314
605	Telegraph Rd. to Rte. 10	284
Control Routes without HOV Lanes		
10	Baldwin Ave. to Rte. 605	152
10	Rte. 57 to San Bernardino County Line	132
60	Rte. 605 to Brea Canyon Rd.	146
405	Rte. 10 to Rte. 101	214
605	Orange County Line to South Street	140
5	Rte. 605 to Rte. 710	375*
101	Rte. 405 to Rte. 27	464*

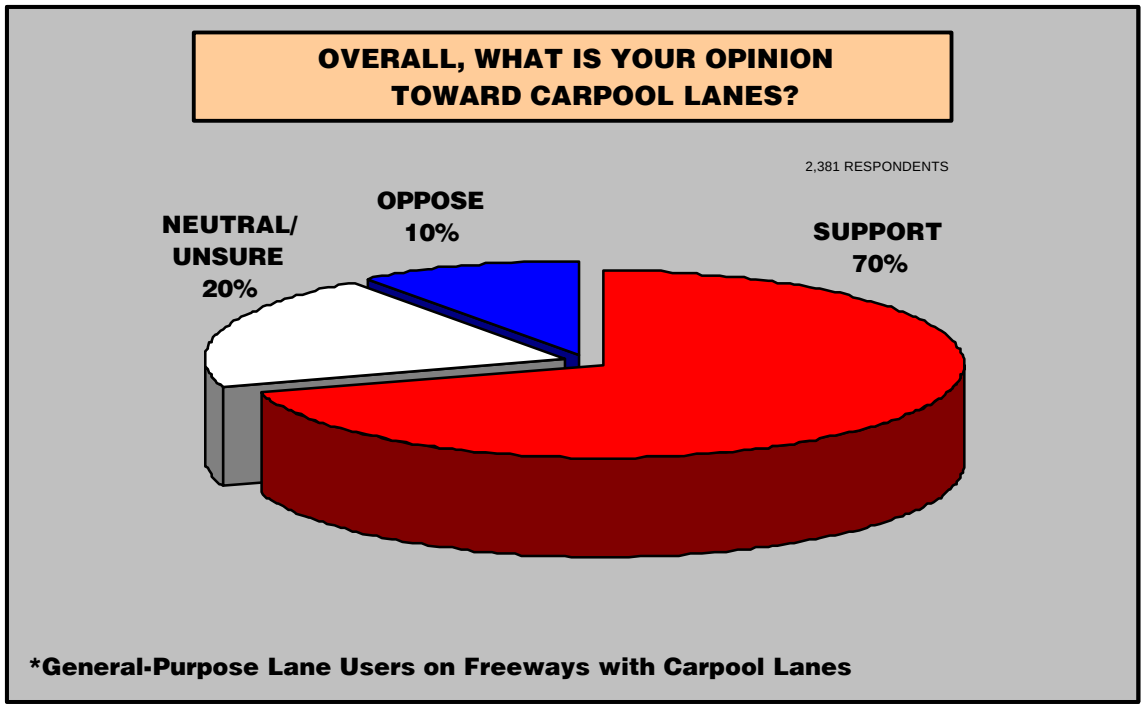
Note: * - number of surveys collected including those following supplemental mailing

The initial mailings for the Route 5 and 101 corridors yielded an insufficient response rate to meet targeted quotas. To overcome this shortfall and to meet the desired accuracy levels, surveys were re-mailed to the potential respondents observed using these two corridors.

3.5.2 Key Findings

The findings of the license plate mail-out survey confirm the overall support of carpool lanes not only by carpool lane users, but also by non-users. Seventy percent of both users of freeways without carpool lanes and general-purpose lane users on freeways with carpool lanes support carpool lanes on Los Angeles County freeways. **Figure 3.5.1** illustrates support for carpool lanes by those that use general-purpose lanes on freeways with carpool lanes. As might be expected, 91% of carpool lane users feel that carpool lanes are a good transportation improvement.

Figure 3.5.1 Overall Opinion of Carpool Lanes for General-Purpose Lane Users on Freeways with Carpool Lanes

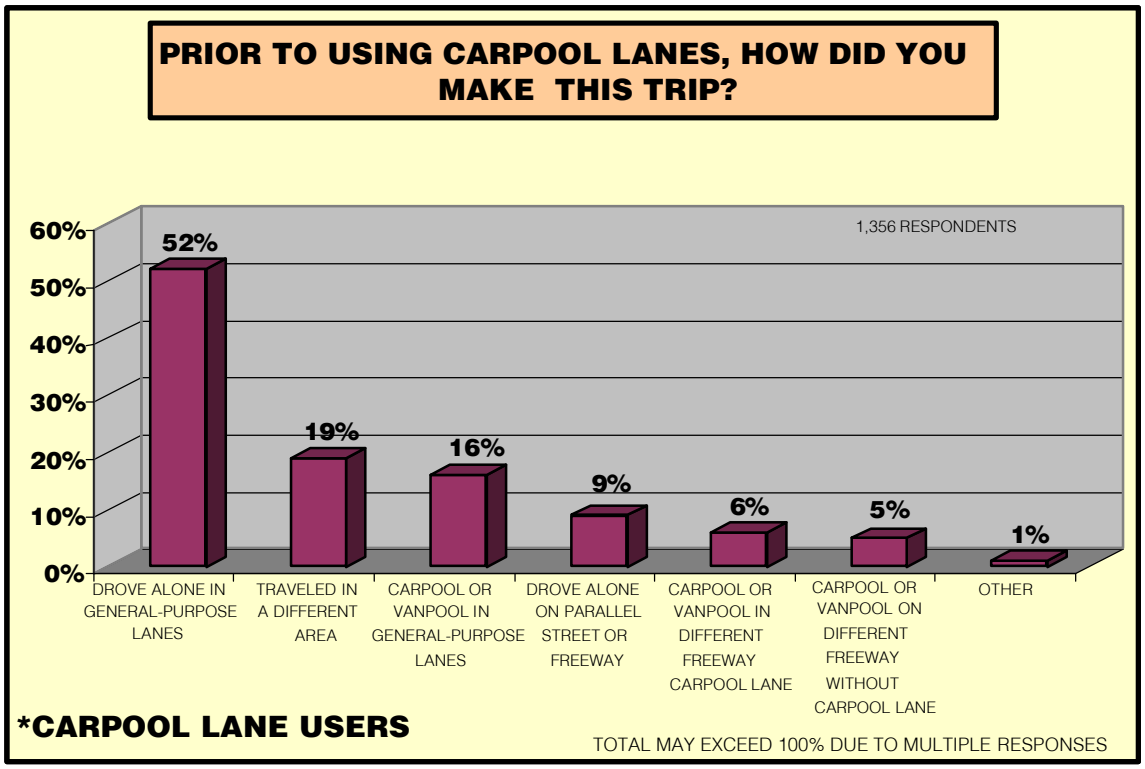


The presence of carpool lanes was particularly important in the decision to carpool for carpool lane users. Ninety-two percent of carpool lane users indicated that the presence of carpool lanes was somewhat important or very important in their decision to carpool. Additionally, 29% of drive-alone users on freeways without carpool lanes indicated that they would be inclined to carpool if carpool lanes were made available.

Sixty-one percent of carpool lane users indicated that they had driven alone on the same freeway, or on parallel streets or freeways, prior to using carpool lanes. This finding reiterates the point that the availability of carpool lanes is important in the decision to carpool, and also to form carpools. **Figure 3.5.2** shows prior mode choice for carpool lane users.

A prior survey taken in Orange County in 1988 after the opening of carpool lanes on Route 55 indicated that 56% of carpool lane users had previously driven alone on the same freeway or parallel facilities.

Figure 3.5.2 Prior Mode Choice for Carpool Lane Users



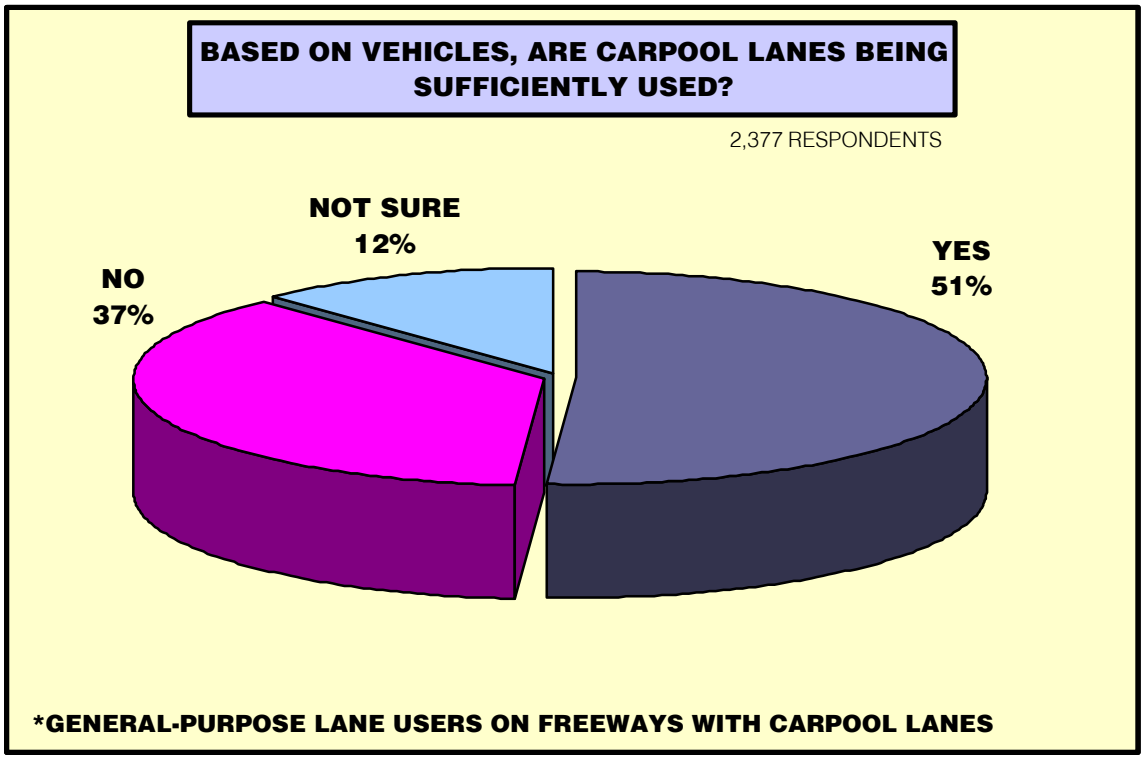
3.5.2.1 Attitudes Towards Carpool Lane Facilities

Approximately three-quarters of the respondent groups that were on freeways without carpool lanes or in general-purpose lanes think that having carpool lanes is a good idea. This favorable response increases to 91% for those who were identified in carpool lanes. Confirming the overall support for carpool lanes, a majority of all three respondent groups do not feel that carpool lanes are inherently unfair to those who choose to drive alone.

Those who do not currently have a carpool lane on their freeway, and those who use the general-purpose lanes on a freeways where a carpool lane exists, are split on the issue of whether or not carpool lanes are being sufficiently utilized. Considering this question from the perspective of both vehicles and persons using the carpool lane, the results are relatively even with only a small margin in favor of those who say carpool lanes are being sufficiently used over those who say they are not being sufficiently used. **Figure 3.5.3** depicts the opinion of general-purpose lane users on freeways with carpool lanes with regard to vehicle utilization of the carpool lanes.

Over two-thirds (69%) of those respondents using a freeway without a carpool lanes support the idea of adding carpool lanes. Hispanics (78%) and African-Americans (74%) were more likely to support the idea of adding carpool lanes than other ethnic groups. Similarly, those with annual household incomes of less than $35,000 (81%) were most supportive of adding carpool lanes to freeways where the lanes did not current exist.

Figure 3.5.3 Opinion on Vehicle Utilization of Carpool Lanes for General-Purpose Lane Users on Freeways with Carpool Lanes



3.5.2.2 Freeway Trip Characteristics

Similar to results for the general public telephone survey, the primary trip purpose for peak-hour freeway travelers is going to work. The results for general-purpose lane users on freeways with carpool lanes (94%) and on freeways without carpool lanes (92%) were slightly higher than those for carpool lane users (90%). Carpool lane users identified going to school as the primary trip purpose (4%) at twice the rate of general-purpose lane users on both freeways with carpool lanes (2%) and freeways without carpool lanes (2%).

Commute times exceeded 40 minutes for over half of all three respondent groups, as indicated in **Table 3.5.3**. For all three respondent groups, commute times tended to increase for Whites, and in proportion to household income. As expected commute distance bears a strong correlation to commute time with over one-third of all respondent groups regularly commute over 30 miles each way. Ethnicity and household income impacted commute distance in the same way that they impacted commute time.

Table 3.5.3 Commute Time

Respondent Group	Number of Minutes of One-Way Commute						
	0-10	11-20	21-30	31-40	41-50	51-60	> 60
Users of Freeways without Carpool Lanes	3%	6%	13%	14%	20%	18%	25%
General-Purpose Lane Users on Freeways with Carpool Lanes	4%	9%	16%	18%	19%	18%	15%
Carpool Lane Users	2%	7%	19%	14%	20%	18%	18%

3.5.2.3 Carpooling Characteristics and Behavior

Carpool lane users reported significant time savings from using carpool lanes during their morning and evening commutes. Survey respondents reported an average time savings of more than 19 minutes during the AM peak period and 24 minutes during the PM peak period[5]. **Table 3.5.4** indicates the reported daily time savings[6] for carpool lane users on the different freeway corridors surveyed.

Table 3.5.4 Daily Travel-Time Savings for Carpool Lane Users

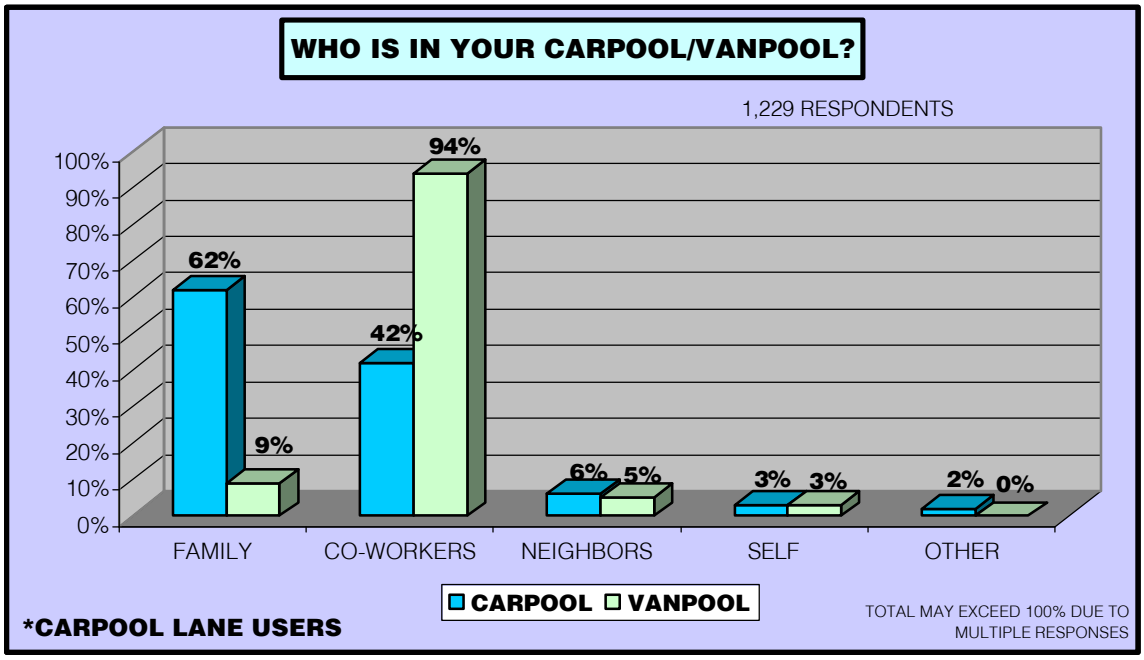
Freeway Corridor	Time Saving (in Minutes)
10 Freeway (Alameda St to Baldwin)	52.5
14 Freeway (San Fernando to Escondido Canyon)	40.8
57 Freeway (Orange County Line to 60)	41.3
60 Freeway (Brea Canyon Rd to SBD County Line)	49.9
91 Freeway (10 to Orange County Line)	49.3
105 Freeway (405 to 605)	46.1
110 Freeway (91 to Adams Blvd)	42.2
118 Freeway (Ventura County Line to 5)	31.7
134 Freeway (101/170 to 5	37.5
134 Freeway (5 to 210)	36.6
170 Freeway (101/134 to 5)	38.1
210 Freeway (134 to Sunflower Ave)	41.6
405 Freeway (Orange County Line to Century)	47.3
405 Freeway (101 to 5)	40.9
605 Freeway (South to Telegraph)	31.4
605 Freeway (Telegraph to 10)	55.7
Overall	43.4

[5] The perceived time-savings may not correspond with actual observed time savings because perceived time savings can include time-savings realized from using carpool lane ramps, carpool lane interchanges and carpool lanes on several different freeway segments for the same trip, and/or can be representative of the worst case conditions for travel time in the general-purpose lanes.

[6] Daily time savings is the sum of the average AM peak period and PM peak period time savings for the respective freeway corridor

Park-and-ride lots are utilized by only one in ten carpool lane users, but by over 60 percent of all vanpool participants. Carpool lane users indicated that 62% of carpools are comprised of family members while 94% of vanpools are comprised of coworkers. **Figure 3.5.4** illustrates the composition of carpools and vanpools for carpool lane users.

Figure 3.5.4 Composition of Carpools and Vanpools for Carpool Lane Users



3.5.2.4 Prior Mode Choice for Carpool Lane Users

Over one half of those identified as carpool lane users drove alone in the general-purpose lanes on the same freeway prior to carpooling and using the carpool lane. An additional 9% of carpool lane users indicated that they used to drive alone on a surface street or parallel freeway indicating that the introduction of a carpool lane does attract users from parallel facilities thereby reducing traffic on surface streets and other freeways.

3.5.2.5 Factors in Carpool Mode Choice

Those who were identified as current carpool lane users say carpool lanes play an important role in their decision to carpool. Seventy-nine percent of carpool lane users say that carpool lanes are very important in their decision to carpool, while an additional 13 percent say that the presence of carpool lanes is somewhat important. Furthermore, 29% of commuters who drive alone on freeways without carpool lanes say they would start to carpool if lanes were added.

One-quarter (25%) of general-purpose lane users on freeways with carpool lanes say that employer inducements would get them to carpool, vanpool or ride transit. An additional 22% indicated that providing an easy way to join a carpool or vanpool (like a rideshare program) would induce them to participate. Two-thirds of this respondent group indicated that they would be likely to start using the carpool lanes if their preferred inducement were provided.

It is interesting to note that the spike in gasoline prices that occurred during early 2001[7] did influence the decision to carpool for 43% of regular carpool participants. Additionally, 22% of regular vanpool participants were influenced to vanpool by the increase in gas prices.

General-purpose lane users on freeways with carpool lanes cited various reasons for not carpooling. Fifty-three percent of respondents from this user group indicated that irregular work hours was a reason for not using carpool lanes. Other significant barriers to using the carpool lanes included needing a vehicle for overtime or unforeseen emergencies (35%), needing a vehicle before or after work (31%), needing a car while at work (31%), and not knowing anyone to carpool with (29%). The full array of reasons for not using carpool lanes is provided in **Table 3.5.5**.

Table 3.5.5 General-Purpose Lane Users on Freeways with Carpool Lanes Reasons for not Using Carpool Lanes

Reason for Not Using Carpool Lanes	
Irregular Work Hours	53%
Need Car for Overtime/Unforeseen Emergencies	35%
Need A Car Before/After Work	31%
Need Car at Work	31%
Don't Know Anyone For Carpool	29%
Prefer Riding In My Own Vehicle	21%
Need Independence	19%
Reliability Concerns	16%
Too Much Hassle	15%
It Takes Longer	11%
Dislike Riding With Strangers	10%
Trip Distance Too Short	9%
Safety Concerns	5%
Too Expensive	3%
Other	1%

3.5.2.6 Reactions Toward Certain Carpool Policies

One-quarter of general-purpose lane users on freeways with carpool lanes say that employer incentives would induce them to carpool or vanpool. Another 22% of this respondent group indicated that providing rideshare programs to make it easier to start or join a carpool or vanpool would get them to participate. Fifteen percent of respondents advised that the provision of more express bus services on their freeway corridor would encourage them to use the carpool lanes.

While 32% of general-purpose lane users on freeways with carpool lanes supported the concept of allowing Single Occupant Vehicles (SOV) to use carpool lanes for a toll, 48% were opposed to the idea. For carpool lane users, only 16% supported the idea of allowing SOV to use carpool lanes for a toll, while 67% were opposed to the concept.

[7] The early 2001 gas price increases coincided with the period when potential survey respondents were observed using the freeways surveyed.

3.6 Transit Patronage Survey

The final market research element of the HOV Performance Program was the completion of an on-board transit patronage survey. The purpose of this survey was to assess the impact of carpool lane facilities on transit usage and patron attitudes, and to provide basic demographic characteristics for carpool lane transit patrons. In order to provide a comprehensive sample among carpool lane bus service operations throughout the region, various major transit corridors operating on carpool lanes in the Los Angeles County freeway system were included. It should be noted that while some carpool lane corridors contained significant bus transit services, others did not. The results of the Transit Patronage Survey were presented in HOV Performance Program *"Technical Memorandum #13 – Transit Patronage Survey"*, dated February 20, 2002.

3.6.1 Methodology

The transit patronage survey involved over 1,100 transit riders. The survey was conducted during weekday peak-hours over the first two weeks of December 2001. The survey was presented to potential respondents as a self-administered instrument provided in both English and Spanish. Trained survey staff distributed surveys to boarding passengers on the selected bus trips and collected the completed surveys for participating transit patrons.

Express bus services operated by four transit providers along five carpool lane corridors were the subject of the survey. **Table 3.6.1** summarizes survey participation by freeway corridor.

Table 3.6.1 Carpool Lane On-Board Transit Patronage Survey Participation by Freeway Corridor

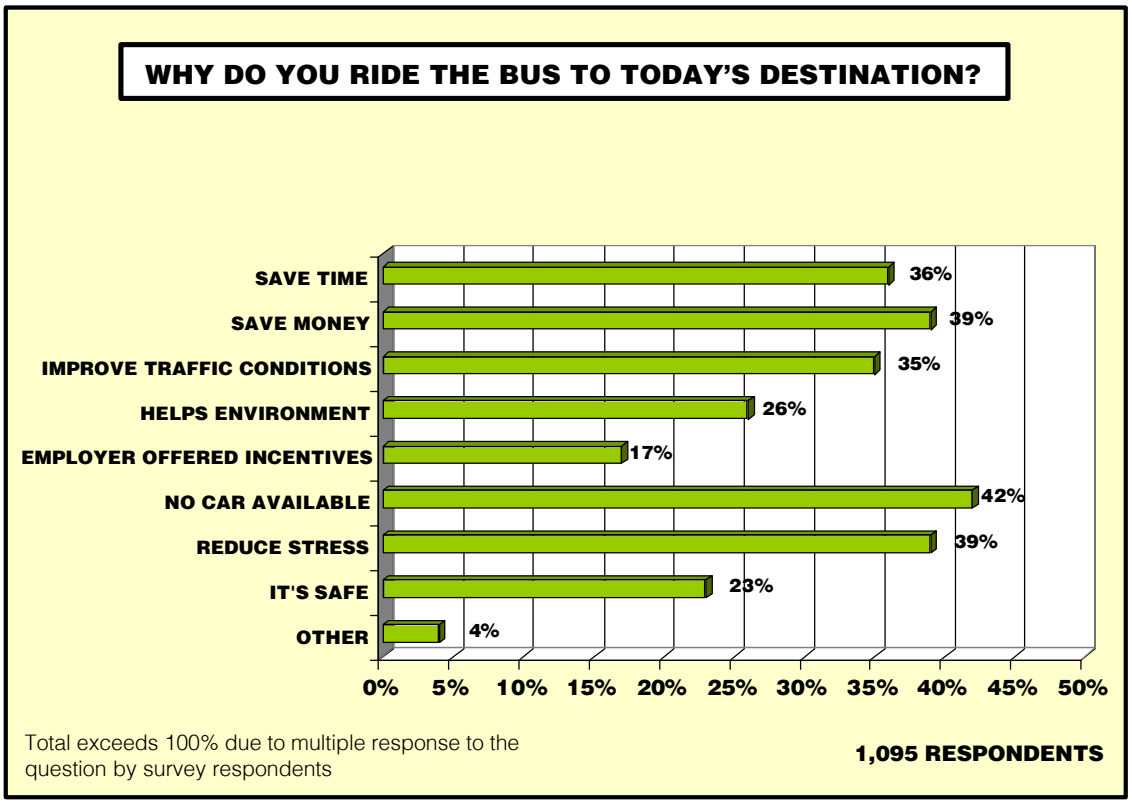
Carpool Lane Corridor	Survey Response	Transit Agency	Bus Line(s)	Date	Originating Service Area
Route 91	94	OCTA	721	12/5/01	Anaheim
Route 10	396	Foothill	480	12/6/01	West Covina
Route 210	111	Foothill	690	12/10/01	Pomona
Route 110	301	MTA	444, 446, 447, 550	12/11/01	Carson
Route 14	217	AVTA	785	12/18/01	Lancaster
Total	**1,119**				

Notes: OCTA – Orange County Transportation Authority
Foothill – Foothill Transit
MTA – Metropolitan Transportation Authority (Los Angeles County)
AVTA – Antelope Valley Transit Agency

3.6.2 Key Findings

As could be expected for peak period commuters surveyed, travel to and from work was the predominate trip purpose for carpool transit users. Various factors were cited as affecting the decision to ride the carpool transit bus. These factors include the unavailability of a car (42%), reducing stress (39%), saving money (39%), saving time (36%), and improving traffic conditions (35%). **Figure 3.6.1** shows the various reasons carpool lane transit users chose to ride the bus.

Figure 3.6.1 Reasons for Riding Carpool Transit



Over one-third (35%) of survey respondents indicated they had driven alone to their destination prior to starting to use the carpool lane bus service. An additional 20% of riders indicated they had previously used an alternate transit bus service, while 15% indicated they had not previously gone to this destination.

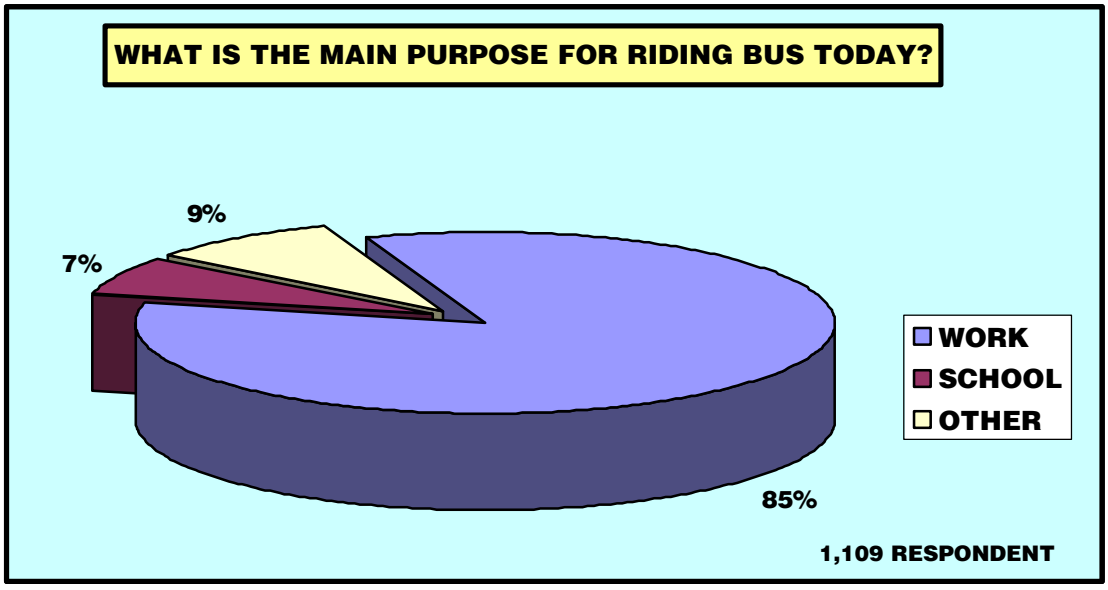
Almost one-third (32%) of carpool transit users indicated they drove to their boarding point, with almost 90% of these drivers parking in a park-and-ride lot. An additional 11% of carpool transit riders were given a ride to the boarding point where they were then dropped off. Some 20% of riders connected from another bus service and 30% of passengers walked to catch the carpool transit bus.

Like other survey respondents, carpool transit users had mixed opinions over the issue of carpool lane utilization. Forty-three percent believe utilization is about right, 22% of riders believe carpool lanes are under-utilized, while 15% say they are over-utilized.

3.6.2.1 Carpool Transit Trip Characteristics

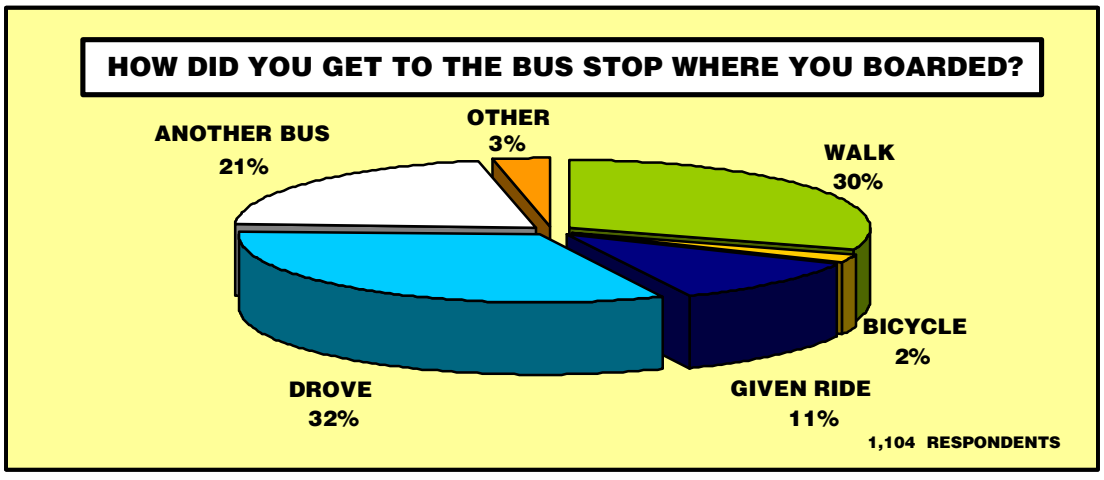
At 85%, the vast majority of passengers that ride buses that use carpool lanes do so to get to or from work. Another 7% responded say that they take the bus to or from school, and 9% identify some other trip purpose, as illustrated in **Figure 3.6.2**. As could be expected for those commuting to work, more than half of the passengers (58%) said that they ride the bus 5 days a week.

Figure 3.6.2 Carpool Transit Trip Purpose



Almost one-third of the carpool transit riders (32%) said that they drove to the bus stop where they boarded the surveyed bus, while 11% were given rides to the boarding stop. Thirty percent of riders advised that they walked to the stop. Another 21% replied that they got to the boarding stop for the bus they were on by taking another bus. **Figure 3.6.3** shows the modes carpool lane transit riders used to access the surveyed bus.

Figure 3.6.3 Modes Used to Access Carpool Transit Services



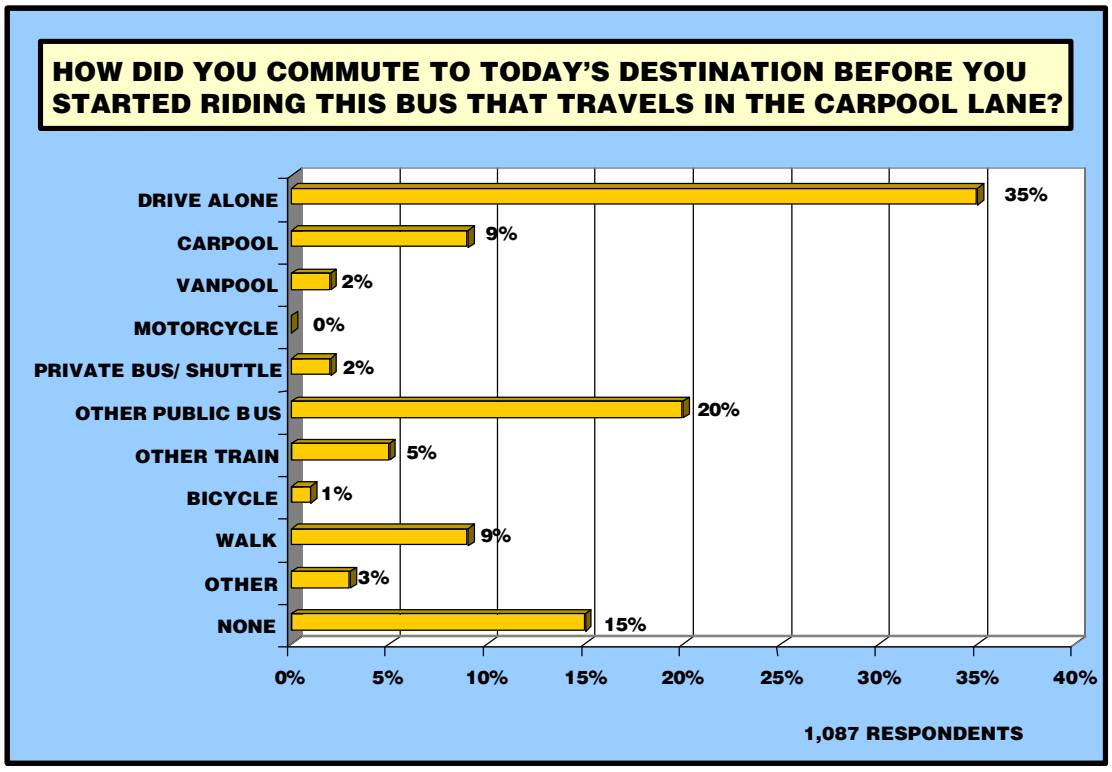
Park-and-ride lots were used by 90% of carpool lane transit riders who drove to their pickup point. Passengers with higher incomes were more likely to drive to their pickup point and use a park-and-ride lot. Lower income carpool transit riders were more likely to walk or take another bus to the boarding stop.

The carpool lane is perceived to save a significant amount of time for carpool transit users. Survey respondents reported an average time savings of 27 minutes for the AM peak period commute and 30 minutes for the PM peak period commute.

3.6.2.2 Prior Mode Choice for Carpool Lane Users

Over one-third (35%) of all carpool transit riders used to drive alone prior to riding a bus that utilizes a carpool lane. A further 20 percent of respondents said they has used a different public bus, while 9% were previously participants in carpools and 9% had previously walked to their destination. **Figure 3.6.4** illustrates prior transportation modes for carpool bus riders.

Figure 3.6.4 Prior Mode Choice for Carpool Transit Users



3.6.2.3 Factors in Carpool Transit Mode Choice

Ninety-five percent of carpool transit riders say that carpool lanes are either very important or somewhat important in their decision to use carpool lane transit service. Two-thirds of riders (66%) say they would probably (31%) or definitely (35%) discontinue riding the bus if it traveled in the general-purpose lanes on the freeway instead of the carpool lane.

Forty-one percent of carpool transit riders advise that they are transit-dependent. However, 49% of riders indicate that they have easy access to a vehicle and the remaining 10% say they have access to a vehicle with some inconvenience to others. For those that have access to a vehicle, the primary reasons for riding the bus are reducing stress (61%), saving money (51%), reducing congestion (51%), and saving time (45%).

3.7 Summary of Conclusions Among All Surveys

Based on the results of all five market research activities, it is apparent that there are consistent attitudes and opinions regarding carpool lanes across targeted sample groups. This section provides a summary of some of the consistent findings from the HOV Performance Program market research.

3.7.1 Support for Carpool Lanes

First, and foremost, the public overwhelmingly supports carpool lanes on Los Angeles County freeways. Almost 9 out of 10 residents of Los Angeles County (88%) support having carpool lanes on area freeways, including 7 out of 10 (70%) freeway users that choose not to use the carpool lanes even when they are provided. This overwhelming support for carpool lanes is reflected across all ethnic and income groups, all geographic subsections of the county, and across all freeway user types. Support tends to be highest amongst minority ethnic groups, lower income households and carpool lane users. Elected officials acknowledge that the majority of their constituents support carpool lanes. They also acknowledge a vocal minority that is opposed to carpool lanes.

The overwhelming support for carpool lanes also translates into support for the continued expansion of the envisioned countywide carpool lane system, including the provision of new carpool lanes and carpool lane interchanges where they currently do not exist. Furthermore, 82% of Los Angeles County residents support the continued utilization of a portion of their sales tax revenues for transit-related highway infrastructure investments that include carpool facilities. Not only do Los Angeles County residents support carpool lanes, but they are willing to continue paying for more to be built.

3.7.2 How Carpool Lanes are Used

Three-quarters (75%) of Los Angeles County residents report that they have used area carpool lanes. Approximately one-half (51%) of these carpool lane users indicate that they have used a carpool lane in Los Angeles County at least once in the week preceding the survey. The majority of carpool lane users primarily use the lanes for personal trips, including visiting family and friends (29%), going out for entertainment (18%), and going shopping (9%). This is reflected in the fact that nearly two-thirds of all carpools (62%) are made up with other family members. Work trips constitute a little over one-quarter of all carpool trips (27%), while carpooling and vanpooling make up one-fifth (20%) of all work trips. Los Angeles County residents are using the carpool lanes. They are using the carpool lanes for many different types of trips, and many residents are using carpool lanes on a regular basis. Those who use the carpool lanes for work trips are most likely to use the lanes more regularly than others. Co-workers make up a little under one-half of all carpools (42%), but nearly all vanpools (94%) on Los Angeles County freeways.

3.7.3 Perceived Benefits

Saving time is, by far, the principal motivating factor to get people to carpool. It is critically important that time savings in carpool lanes be maximized to continue to make them attractive to potential users. Well over one-half (57%) of all carpool lane users indicated that saving time was their primary reason for carpooling. Peak-period carpool lane users reported average daily time savings of more than 43 minutes as a result of using the carpool lanes for their work commutes.

3.7.4 Impacts of Carpool Lanes

The mere presence of the carpool lanes was a critical factor in many commuters decision to participate in a carpool or vanpool in order to realize the time savings. Almost 8 out of 10 peak-period carpool lane users (79%) say the presence of the lanes play an important role in their decision to carpool. For carpool lane transit service users, the response is even more overwhelming. Almost all the riders (95%) say the fact that the bus is using the carpool lanes is important in their decision to ride the bus.

Over one half of those identified as carpool lane users previously drove alone in the general-purpose lanes on the same freeway prior to using the carpool lane. On freeways without carpool lanes, 29% of peak-period drive-alone commuters say they would start to carpool if the lanes were added to their freeway, effectively removing vehicles from the freeway. The introduction of carpool lanes to a freeway has been effective at getting people to start to carpool. Los Angeles County commuters are willing to change their ways to use the carpool lanes, when the lanes are provided.

3.7.5 Utilization of Carpool Lanes

Los Angeles County residents and commuters have mixed opinions on the utilization of carpool lanes. Whether considered in terms of vehicles or people, opinions are basically divided on the issue of lane utilization. For the general population, approximately 45% of all residents feel that carpool lanes are sufficiently utilized, while 42% feel they are underutilized. For those who use the general-purpose lanes on freeways with carpool lanes, 51% feel the carpool lanes are sufficiently utilized while 37% feel they are underutilized. The perception that carpool lanes suffer from the “empty-lane” syndrome is real for many area residents and commuters. According to the focus groups, this perception appears to be based on the fact that the carpool lanes typically move faster than the adjacent general-purpose, and therefore must be empty.

3.7.6 Agency Sponsorship

The role of the MTA as the lead agency in the planning and programming of carpool facilities is most often overlooked by members of the public. The participants of the focus group meetings were unclear about which agency (or agencies) is responsible for planning, designing and funding HOV projects in Los Angeles County emphasizing the need for the MTA to consider expanding the public’s perception on it’s role as a multi-modal transportation agency, rather than merely a transit service provider.

4.0 DATA ANALYSIS

4.1 Introduction

The data analysis element of the HOV Performance Program represents the core of the program audit. This data analysis builds upon the evaluation framework outlined in the Evaluation Plan described in **Chapter 2.0**. The accomplishment of the data analysis tasks involved the collection and compilation of a significant quantity of transportation related data, and the utilization of a variety of data management and analysis techniques, including the DMP developed specifically to support this effort, and a modified version of the California Life-Cycle Benefit-Cost Analysis (Cal-B/C) Model. The analysis also consolidated the results of previously completed market research activities, both in Los Angeles County and elsewhere in the country, to address the broad range of MOEs defined in the Evaluation Plan.

The purpose of this chapter is to provide an overview of the data sources utilized, the analysis methodology and assumptions, and the effectiveness thresholds that led to the findings that are summarized. The data analysis results are quantified, where possible, for each of the MOEs to allow for objective considerations of the results by all potential audiences. This chapter also includes qualitative interpretation and assessment of the analysis results to help provide a better understanding of key findings, and any apparent correlation between results for the different MOEs.

This chapter is divided into five sections, each focusing on a specific objective of the HOV Performance Program. These five objectives are as follows:

1. Manage Travel Demand by Increasing the Person Movement Capacity in Congested Freeway Corridors.
2. Encourage Carpooling, Vanpooling and Bus Use by Providing Travel and Mobility Options.
3. Provide Travel Time Savings and Trip Reliability to Travelers Using the HOV Facilities.
4. Provide Air Quality Benefits.
5. Promote a Cost-Effective Transportation System.

Each section includes a description of the MOEs related to the specific objective, an overview of the analysis approach and, where appropriate, the evaluation parameters, and a summary of the findings. For Objectives 1, 3 and 4, discussion regarding the analysis methodology and findings of the closely interrelated MOEs is combined for each objective, respectively. For Objectives 2 and 5, discussion of the more disparate MOEs is provided individually for each MOE.

Chapter 4.0 concludes with a consolidated summary of the key findings from the analysis of each objective. These findings subsequently lead to the development of recommended guiding principles as described in **Chapter 5.0**.

4.2 Objective 1: Manage Travel Demand by Increasing the Person Movement Capacity in Congested Freeway Corridors

The first objective set forth in the Evaluation Plan described in **Chapter 2.0** is to manage travel demand by increasing the person movement capacity in congested freeway corridors. This objective focuses on increasing the AVO for the freeway and increasing the person trips, rather than vehicle trips, carried. As discussed in **Chapter 2.0**, five MOEs were developed in the Evaluation Plan for evaluating carpool lane performance relative to person movement and utilization of the lanes:

- MOE 1A: AVO - Number and percent change in the average vehicle occupancy for the HOV lanes, the general-purpose lanes, and the total freeway.
- MOE 1B: Person Trips - Number and percent change in the person trips carried for the HOV lanes, the general-purpose lanes, and the total freeway.
- MOE 1C: Percent of Persons verses Vehicles - Percent of persons carried in the HOV facility compared to percent of vehicles.
- MOE 1D: Carpools/Vanpools - Percent and percent change in the number of carpools/vanpools; and number of vehicles in the HOV lane.
- MOE 1E: Buses and Bus Riders - Number of public transit buses and bus riders.

4.2.1 Analysis Methodology

Due to the interrelation of the Objective 1 MOEs, the method for evaluating the various Objective 1 MOEs was generally consistent. Overall, the process for evaluating the Objective 1 MOEs consisted of two steps. It began with the extraction and reformatting of a subset of data to be used in the MOE calculations from the larger set of data requested from and provided by Caltrans and other agencies. It ended with the computation of the full range of measures that could reasonably be used in the final Objective 1 analyses. The results of these analyses are discussed below.

Table 4.2.1 summarizes the effectiveness thresholds, time periods, and data used for the evaluation of each of the Objective 1 MOEs.

Table 4.2.1 Summary of Objective 1 MOEs, Effectiveness Thresholds and Data Specifications

MOE		Effectiveness Thresholds	Times of Day & Directions Analyzed	Time Periods Analyzed [a]	Data	Comments
1A	AVO - Number & Percent Change in AVO for Carpool Lanes, General-Purpose Lanes & Total Freeway	AVO for facilities with HOV lanes should be higher than AVO for "comparable" control facilities without carpool lanes. *[threshold 1A-1]*	Weekday AM & PM peak hours for peak direction	Current (2000)	AVO (current) (all lanes)	Aggregated to Los Angeles County average AVO (2+ & 3+)
		Percent change in AVO for facilities with HOV lanes over time should exceed that for control facilities without carpool lanes. *[threshold 1A-2]*	Weekday AM & PM peak hours for peak direction	Before vs. Current (2000)	AVO (before, current) (all lanes); % Change in AVO (before vs. current) (all lanes)	
1B	Person Trips - Number & Percent Change in Person Trips Carried for Carpool Lanes, General-Purposes Lanes & Total Freeway	More peak hour person trips per lane should occur on a facility with a carpool lane than on a "comparable" control facility. *[threshold 1B-1]*	Weekday AM & PM peak hours for peak direction	Current (2000)	Person Trips per Lane [b] (current) (all lanes)	
		Percent change in peak hour person trips for facilities with carpool lanes over time should exceed that for control facilities without carpool lanes. *[threshold 1B-2]*	Weekday AM & PM peak hours for peak direction	Before vs. Current (2000)	Person Trips [b] (before, current) (all lanes); % Change in Person Trips (before vs. current) (all lanes)	
		On facilities with carpool lanes, the number of peak hour person trips per lane being carried in the carpool lane should be greater than in the mixed-flow lanes. *[threshold 1B-3]*	Weekday AM & PM peak hours for peak direction	After, Current (2000)	Person Trips per Lane [b] (after, current) (carpool lanes, general-purpose lanes)	
		No threshold. For informational purposes (not used for MOE evaluation).	Weekday hourly person trips in carpool lanes summed to daily total across both directions	Current (2000)	Person Trips [b] (current) (carpool lanes)	Aggregated to Los Angeles County total daily person trips in carpool lanes
1C	% of Persons vs. Vehicles - Percent of Persons Carried in Carpool Facility Compared to Percent of Vehicles	Percent of person trips carried by the carpool lane should exceed the percent of vehicle trips carried. This is equivalent to saying that the AVO in the carpool lane should exceed the AVO in the mixed-flow lanes. *[threshold 1C-1]*	Weekday AM & PM peak hours for peak direction	After, Current (2000)	% of Person Trips Carried in Carpool Lane (after, current); % of Vehicles Carried in Carpool Lane (after, current)	
		Percent of person trips carried by the carpool lane should exceed the percent of freeway lanes that are carpool lanes. *[threshold 1C-2]*	Weekday AM & PM peak hours for peak direction	After, Current (2000)	% of Person Trips Carried in Carpool Lane (after, current); % of Freeway Lanes that are Carpool Lanes	

Table 4.2.1 Summary of Objective 1 MOEs, Effectiveness Thresholds and Data Specifications

MOE		Effectiveness Thresholds	Times of Day & Directions Analyzed	Time Periods Analyzed [a]	Data	Comments
1D	Carpool/Vanpools - Percent & Percent Change in Number of Carpools/ Vanpools; Number of Vehicles in Carpool Lane	Compared to "control" facilities, facilities with carpool lanes should, generally speaking, have a higher percentage of carpools and vanpools than facilities without carpool lanes. *[threshold 1D-1]*	Weekday AM & PM peak hours for peak direction	Current (2000)	% of Vehicles that are Carpools or Vanpools (current) (all lanes)	Note that in comparing the number of carpools and vanpools using an HOV facility versus a "control" facility, the same carpool/vanpool occupancy definition (e.g., 2+ HOV or 3+ HOV) should be compared.
		Percent change in number of carpools/vanpools for facilities with carpool lanes over time should exceed that for control facilities without carpool lanes. *[threshold 1D-2]*	Weekday AM & PM peak hours for peak direction	Before vs. Current	% Change in Number of Carpools or Vanpools (before vs. current) (all lanes)	
		Minimum volume of vehicles using carpool facility during heaviest hour of day of 600 vphpl for a new facility & 800 vphpl for a mature (3 years or older) facility, indicating if carpool lane is being sufficiently utilized. *[threshold 1D-3]*	Hour with maximum hourly volume in carpool lane at any time of weekday day	Current (2000)	Vehicles per Lane in HOV Lanes (current)	The NCHRP *HOV Systems Manual* suggests minimum HOV lane threshold volumes ranging from 400 to 800 vph for concurrent flow freeway HOV lanes. The Caltrans *HOV Guidelines for Planning, Design and Operations* (July 1991) identifies a minimum carpool lane capacity of 800 vph for carpool lanes more than 1 year old.
		Maximum volume of vehicles using carpool facility during heaviest hour of day of 1,650 vphpl, indicating whether carpool lane is overloaded. *[threshold 1D-4]*	Hour with maximum hourly volume in carpool lane at any time of weekday day	Current (2000)	Vehicles per Lane in Carpool Lanes (current)	Caltrans suggested a value of 1,650 vph as maximum desired volume in carpool lanes to maintain flow.
1E	Buses & Bus Riders - Number of Public Transit Buses & Bus Riders	Number of public transit bus trips on facilities with HOV lanes should exceed those on freeway control corridors without carpool lanes. *[threshold 1E-1]*	Weekday daily, summed across both directions	Current (2000)	Number of Daily Revenue Bus Trips (current) (all lanes)	
		Public transit bus ridership on facilities with HOV lanes should exceed those on freeway control corridors without carpool lanes. *[threshold 1E-2]*	Weekday daily, summed across both directions	Current (2000)	Average Weekday Daily Bus Riders (current) (all lanes)	

Notes:

a. "Current" = current year of evaluation for the HOV Performance Program; for this initial performance evaluation, the year 2000 was generally used. "Before" = before construction of an HOV lane (data from 1 to 12 months before start of HOV lane construction preferred; if not available, data from 13 to 36 months before start of construction or during construction period was used). "After" = nominally one year after an HOV lane opens, representing conditions when lane is still immature (data from 13 to 36 months after opening was used). An exception was Route 10 (the El Monte Busway), for which year 1999 data before the HOV lane occupancy requirement was temporarily changed from 3+ to 2+ was used rather than year 2000 data during the demonstration project.

b. Person trips calculated from occupancy data and vehicle volume data.

General parameters governing the evaluation of the Objective 1 MOEs included the following:

- Times of Day and Directions Analyzed - Although traffic congestion may occur at any time, the benefits of carpool lanes are expected to be greatest during the morning and afternoon peak periods when the highest demands are placed on the freeway system. Therefore, MOE analyses were generally conducted for the peak direction of travel during the AM peak hour and the peak direction of travel during the PM peak hour, although daily statistics were measured in selected instances (i.e., daily person trips in carpool lanes, daily bus trips, and daily bus ridership). Peak hours were defined separately for each analysis segment and direction based on the highest hour of total vehicle volume (general-purpose plus carpool lanes) on the individual facility.

- Seasons and Days of Week Analyzed - The benefits of carpool lanes are expected to be greatest during weekday commute peak periods when the greatest demands are placed on the freeway system. Therefore, MOE analyses were conducted for weekday conditions. Volume data was averaged across three midweek days (Tuesday, Wednesday, and Thursday) for a representative week, to ensure that any potential abnormal conditions on a particular day do not unduly influence the analysis results. Volume data from April or October (intended to represent typical spring or fall conditions) was preferred. Volume data from other months was used only when April or October data was not available.

- Time Periods Analyzed - Depending on the MOE, up to three "time periods" were analyzed:

    - "Current," which is the current year of evaluation for the HOV Performance Program, using data collected as part of the current monitoring program. Year 2000 data generally represented current conditions for this initial iteration of the HOV Performance Program[8]. The current year will change in future iterations to the most recent year of data availability at the time the evaluation is being conducted.

    - "After," which is the period defined as nominally one year after an HOV lane was opened to traffic, representing conditions when the HOV lane is still immature but beyond the initial opening period. For the purposes of after analyses, data from the period between 13 and 36 months after the lane opened was used.

    - "Before," which is the period before an HOV lane was constructed on a particular freeway. For the purposes of before analyses, data from the period between 1 and 12 months before the start of construction of the HOV lane was preferred (before construction start, rather than before opening of the lane, was preferred to avoid potential impact of construction activities on traffic

[8] An exception was Route 10 (the El Monte Busway). For Route 10, 1999 volume and occupancy data were used to represent "current" conditions. This is due to the fluctuating carpool lane occupancy requirements on Route 10, with a demonstration project reducing the occupancy requirement from 3+ to 2+ from January 2000 to July 2000. Data during the 2+ period in early 2000 was determined to be non-representative. A complete set of data was not available for late 2000 to enable evaluation after conversion back to 3+ during peak periods. Caltrans District 7 has authorized two operational study reports assessing the effectiveness of the demonstration project and subsequent changes on Route 10.

conditions). If not available, data from the period between 13 and 36 months before start of construction or during the construction period was used.

- Control Routes - Both non-HOV Control Routes (Routes 5 and 101) were used for comparison to each HOV Study Route. For AM and PM peak hour MOE calculations and comparisons, data for the peak hour and peak direction of each control route was used. For Route 5, the AM peak direction was northbound and the PM peak direction was southbound. For Route 101, the AM peak direction was southbound and the PM peak direction was northbound.

The analysis of the Objective 1 MOEs required four general types of data:

- Vehicle Volumes - Vehicle volume count data from the Caltrans District 7 TMG loop system.

- Vehicle Occupancy - Vehicle occupancy counts conducted manually by Caltrans District 7.

- Number of Lanes - Number of lanes from the Caltrans 1997 California State Highway Log (most recent version available), combined with information on lane addition/subtraction projects occurring between 1990 and 2000 provided by Caltrans District 7.

- Bus Data - Bus ridership, number of buses, and carpool lane usage data provided by various public transit operators.

The data was subjected to a series of checks to ensure accuracy, reliability, and suitability for the purposes of the HOV Performance Program evaluation.

4.2.2 Effectiveness Thresholds

The analysis of Objective 1 first involved the computation of several measures guided by the parameters outlined in **Section 4.2.1**. These measures were then compared to baselines and/or effectiveness thresholds listed below. This comparison determined the extent to which a given HOV Study Route satisfied each MOE. However, any single MOE did not solely determine achievement of Objective 1 but rather the ability of a HOV Study Route to satisfy the majority of the MOEs was considered.

4.2.2.1 MOE 1A: AVO - Number and Percent Change in the Average Vehicle Occupancy for the HOV Lanes, the General-Purpose Lanes, and the Total Freeway

The effectiveness thresholds established for MOE 1A are as follows:

- AVO for facilities with HOV lanes should be higher than AVO for “comparable” control facilities without HOV lanes. [threshold 1A-1]

- Percent change in AVO for facilities with HOV lanes over time should exceed that for control facilities without HOV lanes. [threshold 1A-2]

4.2.2.2 MOE 1B: Person Trips - Number and Percent Change in the Person Trips Carried for the HOV Lanes, the General-Purpose Lanes, and the Total Freeway

The effectiveness thresholds established for MOE 1B are as follows:

- More peak hour person trips per lane should occur on a facility with a carpool lane than on a "comparable" control facility. [threshold 1B-1]

- Percent change in peak hour person trips for facilities with carpool lanes over time should exceed that for control facilities without carpool lanes. [threshold 1B-2]

- On the HOV Analysis Segment, the number of peak hour person trips per lane being carried in the carpool lane should be greater than in the general-purpose lanes. [threshold 1B-3]

4.2.2.3 MOE 1C: Percent of Persons vs. Vehicles - Percent of Persons Carried in the HOV Facility Compared to Percent of Vehicles

The effectiveness thresholds established for MOE 1C are as follows:

- The percentage of person trips carried by the carpool lane should exceed the percentage of vehicle trips carried. This is equivalent to saying that the AVO in the carpool lane should exceed the AVO in the general-purpose lanes. [threshold 1C-1]

- The percentage of person trips carried by the carpool lane should exceed the percentage of freeway lanes that are carpool lanes. [threshold 1C-2]

4.2.2.4 MOE 1D: Carpools/Vanpools - Percent and Percent Change in the Number of Carpools/Vanpools; and Number of Vehicles in the HOV Lane

The effectiveness thresholds established for MOE 1D are as follows:

- Compared to "control" facilities, facilities with carpool lanes should, generally speaking, have a higher percentage of carpools and vanpools than facilities without carpool lanes. Note that in comparing the number of carpools and vanpools using an HOV facility versus a "control" facility, the same carpool/vanpool occupancy definition (e.g., 2+ HOV or 3+ HOV) should be compared. [threshold 1D-1]

- Percent change in number of carpools/vanpools for facilities with carpool lanes over time should exceed that for control facilities without carpool lanes. [threshold 1D-2]

- Minimum volume of vehicles using carpool facility during the heaviest hour of day of 600 vehicles per hour per lane (vphpl) for a new facility and 800 vphpl for a mature (3 years or older) facility, indicating whether the carpool lane is being sufficiently utilized[9]. [threshold 1D-3]

[9] The National Cooperative Highway Research Program (NCHRP) HOV Systems Manual suggests minimum lane threshold volumes ranging from 400 to 800 vph for concurrent flow freeway carpool lanes. The Caltrans HOV Guidelines for Planning, Design and Operations (July 1991) identifies a minimum lane threshold volume of 800 vph for carpool lanes more than 1 year old.

- Maximum volume of vehicles using carpool facility during the heaviest hour of day of 1,650 vphpl, indicating whether the carpool lane is overloaded[10]. [threshold 1D-4]

The latter two sets of thresholds relate to the maximum hourly volume of HOVs (motorcycles, carpools, vanpools, and buses) using the carpool facility versus minimum and maximum thresholds. A maximum vehicles-per-hour threshold would indicate whether the carpool lane is overloaded and at risk of experiencing significant traffic congestion. A minimum threshold would indicate whether the carpool lane is being sufficiently utilized.

4.2.2.5 MOE 1E: Buses and Bus Riders - Number of Public Transit Buses and Bus Riders

The effectiveness thresholds established for MOE 1E are as follows:

- Number of public transit bus trips on facilities with carpool lanes should exceed those on freeway control corridors without carpool lanes. [threshold 1E-1]

- Public transit bus ridership on facilities with carpool lanes should exceed those on freeway control corridors without carpool lanes. [threshold 1E-2]

4.2.3 Summary of Findings

The findings of the Objective 1 MOE evaluation are summarized in the following section. The results of the evaluation are summarized for each of the respective MOEs.

4.2.3.1 MOE 1A – Average Vehicle Occupancy

The results of the evaluation of MOE 1A are summarized in **Tables 4.2.2(a)** and **4.2.2(b)**, and **Figures 4.2.1(a)** and **4.2.1(b)**. The results of the evaluation of MOE 1A indicate that the HOV Study Routes exceed the threshold criteria for AVO as compared to the two Control Routes, with only five HOV Study Routes observed to be lower than the Route 5 control during the PM peak period. Current average AVOs across all lanes range from 1.17 to 1.55 during the AM peak period and from 1.21 to 1.55 during the PM peak period. Current AVOs on the Control Routes are 1.13 (AM) and 1.23 (PM) on Route 5 and 1.16 (AM) and 1.18 (PM) on Route 101. Current average AVOs across all lanes exceed those on Route 101 during both peak periods and on Route 5 during the AM peak period on each of the 16 Study Routes.

AVOs in the carpool lanes exceed 2.0 on all of the Study Routes with a 2+ occupancy requirement and far exceed 3.0 on the El Monte Busway with the 3+ occupancy requirement. This indicates low levels of violations and high compliance with occupancy requirements.

AVOs on both of the Control Routes (Route 5 and Route 101) have generally been declining over time. With the exception of Route 170 (which remained flat), average AVOs across all lanes have increased from before the carpool lane was constructed to current conditions on all of the HOV Study Routes during the AM peak, while both increases and decreases were experienced during the PM peak.

[10] Caltrans District 7 staff suggested a value of 1,650 vph as a maximum desired threshold volume in carpool lanes to maintain traffic flow.

Table 4.2.2(a) MOE 1A: Number and Percent Change in the Average Vehicle Occupancy (AM Peak Period/AM Peak Direction of Flow)

HOV Study Routes			Length (miles)	Threshold 1: AVO for routes with HOV lanes should be higher than AVO for "comparable" Control Routes without HOV lanes.			Threshold 2: Percent change in AVO for segments with HOV lanes should exceed that for Control Segments (i.e. Segments without HOV lanes).				
				(Current)			(Before vs Current)				
				HOV Study Route AVO (all lanes)	Greater than 5 NB AVO (1.13)?	Greater than 101 SB AVO (1.16)?	HOV Study Route % (all lanes)	5 NB Control Segment %	101 SB Control Segment %	Greater than 5 NB?	Greater than 101 SB?
10	WB	Alameda to Baldwin	11.0	1.55	yes	yes	HOV data not available				
14	SB	San Fernando to Escondido Canyon	16.3	1.32	yes	yes	13%	-1%	0%	yes	yes
57	SB	OCL to 60	4.5	1.21	yes	yes	8%	-2%	-1%	yes	yes
60	WB	Brea Canyon to SBCL	7.5	1.28	yes	yes	17%	-2%	-1%	yes	yes
91	WB	110 to OCL	14.3	1.21	yes	yes	3%	-3%	-1%	yes	yes
105	WB	405 to 605	16.0	1.27	yes	yes	not applicable (no before condition)				
110	NB	91 to 105	4.0	1.27	yes	yes	5%	-6%	-1%	yes	yes
110	NB	105 to Adams	6.7	1.41	yes	yes	HOV data not available				
118	WB	VCL to 5	11.4	1.18	yes	yes	3%	-6%	-1%	yes	yes
134	WB	101/170 to 210	12.9	1.19	yes	yes	6%	-5%	-1%	yes	yes
170	SB	101/134 to 5	6.1	1.23	yes	yes	0%	-9%	0%	yes	no
210	WB	134 to Sunflower	18.5	1.24	yes	yes	4%	-7%	0%	yes	yes
405	NB	OCL to 110	13.0	1.18	yes	yes	7%	-4%	2%	yes	yes
405	NB	110 to Century	9.2	1.17	yes	yes	HOV data not available				
405	SB	101 to 5	10.1	1.22	yes	yes	2%	1%	-1%	yes	yes
605	SB	South to 10	16.9	1.18	yes	yes	8%	-4%	1%	yes	yes
Number of HOV Study Routes with data available:					**16**	**16**				**12**	**12**
Percent that meet threshold test:					**100%**	**100%**				**100%**	**92%**

Notes:
[1] Assumed 24-hour 3+ occupancy requirement conditions for Route 10 (i.e. year 1999 data for current conditions, prior to January 2000 when 2+ demonstration project began).
[2] Assumed 24-hour 2+ occupancy requirement conditions for Route 14 (i.e. prior to January 2001 when part-time operation demonstration project began.)

Figure 4.2.1(a) MOE 1A: Average Vehicle Occupancy (AM Peak Period/AM Peak Direction of Flow)

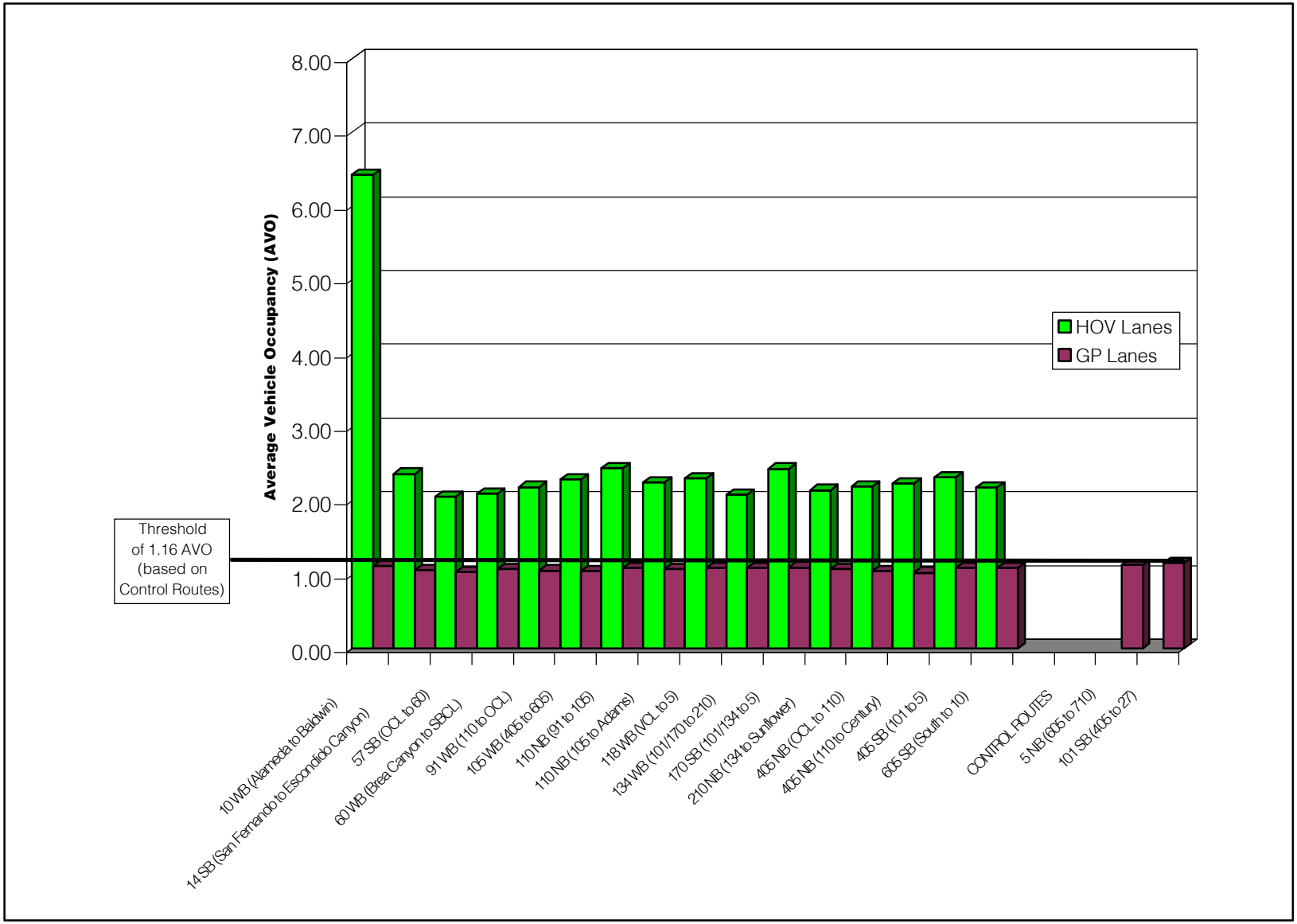
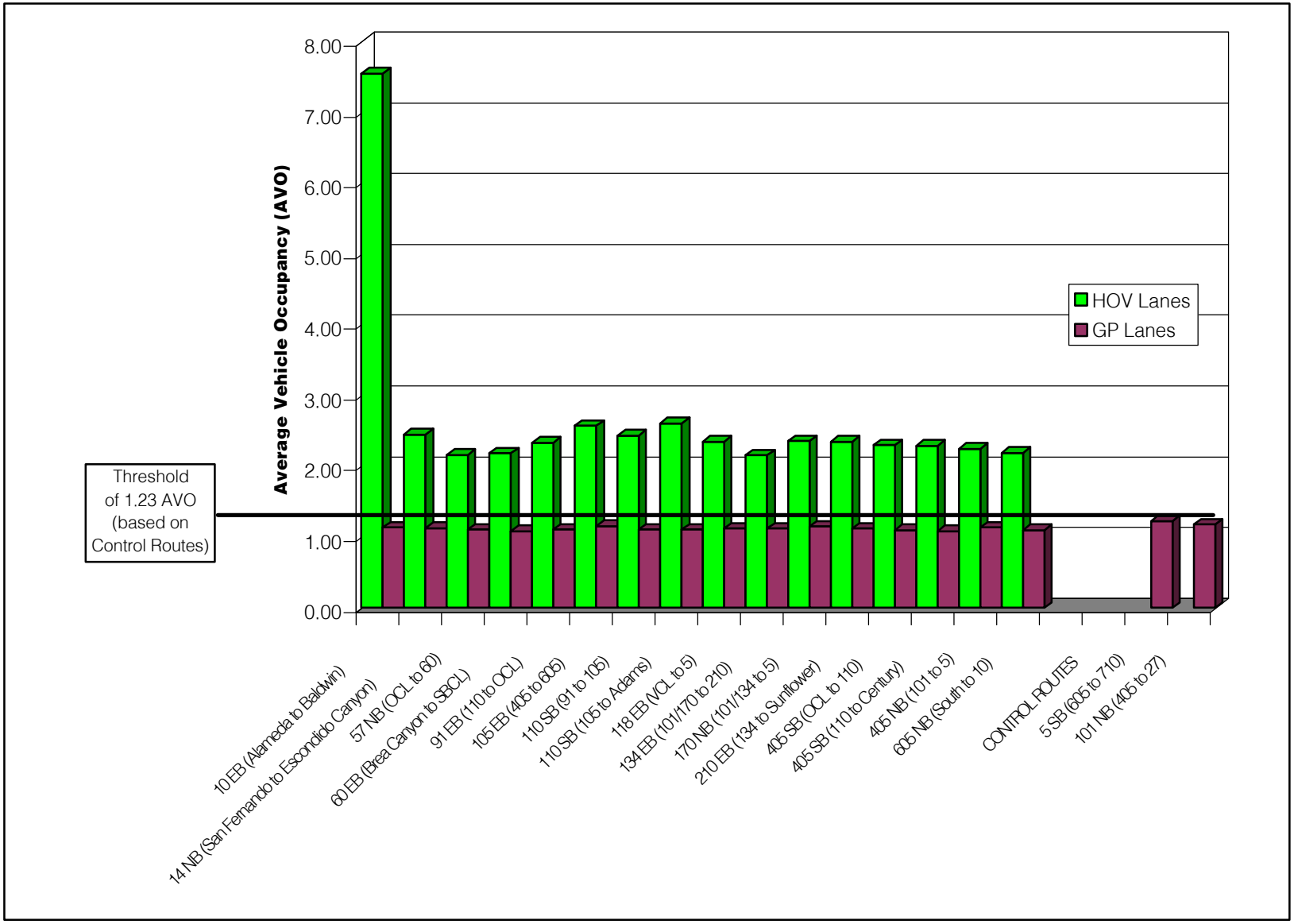


Table 4.2.2(b) MOE 1A: Number and Percent Change in the Average Vehicle Occupancy (PM Peak Period/PM Peak Direction of Flow)

HOV Study Routes			Length (miles)	Threshold 1: AVO for routes with HOV lanes should be higher than AVO for "comparable" Control Routes without HOV lanes.			Threshold 2: Percent change in AVO for segments with HOV lanes should exceed that for Control Segments (i.e. Segments without HOV lanes).				
				(Current)			(Before vs Current)				
				HOV Study Route AVO (all lanes)	Greater than 5 SB AVO (1.23)?	Greater than 101 NB AVO (1.18)?	HOV Analysis Segment % (all lanes)	5 SB Control Segment %	101 NB Control Segment %	Greater than 5 SB?	Greater than 101 NB?
10	EB	Alameda to Baldwin	11.0	1.55	yes	yes	HOV data not available				
14	NB	San Fernando to Escondido Canyon	16.3	1.35	yes	yes	9%	-1%	-5%	yes	yes
57	NB	OCL to 60	4.5	1.28	yes	yes	9%	-4%	-5%	yes	yes
60	EB	Brea Canyon to SBCL	7.5	1.26	yes	yes	12%	2%	-5%	yes	yes
91	EB	110 to OCL	14.3	1.28	yes	yes	5%	-2%	-7%	yes	yes
105	EB	405 to 605	16.0	1.44	yes	yes	not applicable (no before condition)				
110	SB	91 to 105	4.0	1.21	no	yes	-5%	2%	-5%	no	yes
110	SB	105 to Adams	6.7	1.43	yes	yes	HOV data not available				
118	EB	VCL to 5	11.4	1.21	no	yes	3%	2%	-5%	yes	yes
134	EB	101/170 to 210	12.9	1.23	no	yes	-2%	-1%	-6%	no	yes
170	NB	101/134 to 5	6.1	1.26	yes	yes	3%	-2%	-7%	yes	yes
210	EB	134 to Sunflower	18.5	1.21	no	yes	-4%	-2%	-10%	no	yes
405	SB	OCL to 110	13.0	1.26	yes	yes	6%	-1%	-6%	yes	yes
405	SB	110 to Century	9.2	1.26	yes	yes	HOV data not available				
405	NB	101 to 5	10.1	1.27	yes	yes	-3%	2%	-5%	no	yes
605	NB	South to 10	16.9	1.22	no	yes	-2%	2%	-5%	no	yes
Number of HOV Study Routes with data available:					**16**	**16**				**12**	**12**
Percent that meet threshold test:					**69%**	**100%**				**58%**	**100%**

Notes:
[1] Assumed 24-hour 3+ occupancy requirement conditions for Route 10 (i.e. year 1999 data for current conditions, prior to January 2000 when 2+ demonstration project began).
[2] Assumed 24-hour 2+ occupancy requirement conditions for Route 14 (i.e. prior to January 2001 when part-time operation demonstration project began.)

Figure 4.2.1(b) MOE 1A: Average Vehicle Occupancy (PM Peak Period/PM Peak Direction of Flow)



Nonetheless, the percentage change in AVO from before carpool implementation to current was better than on the Route 5 Control Route for all of the Study Routes during the AM peak. It was also better than on the Route 101 Control Route for all but Route 170 during the AM peak and for all routes during the PM peak.

Table 4.2.3 summarizes AVO in all lanes averaged across all HOV Study Routes to a Los Angeles County average for before, after, and current conditions. As indicated in **Table 4.2.3**, experience in Los Angeles County indicates that implementation of carpool lanes results in an immediate increase in AVO, which then quickly stabilizes over time. Although the AVOs do not then continue to increase further over time, it should be recognized that this nonetheless represents progress, since AVOs on the Control Routes and more generally on the freeway system as a whole have been declining over time (reflecting national trends).

Table 4.2.3 MOE 1A: Average Vehicle Occupancy Aggregated Across All HOV Study Routes (Average AVO Across All Lanes)

	Before HOV Implementation	After HOV Opening	Current (2000)
2+ Occupancy Routes			
AM Peak Period	1.15	1.24	1.24
PM Peak Period	1.23	1.28	1.28
3+ Occupancy Route (Route 10 – Alameda-Baldwin)			
AM Peak Period	n/a	n/a	1.55
PM Peak Period	n/a	n/a	1.55

4.2.3.2 MOE 1B – Person Trips

The results of the evaluation of MOE 1B are summarized in **Tables 4.2.4(a)** and **4.2.4(b)**, and **Figures 4.2.2(a)** and **4.2.2(b)**.

The analysis results for MOE 1B indicate that current peak hour person trips per lane carried in the carpool lanes exceed those in the adjacent general-purpose lanes for all but five of the HOV Study Routes during the AM peak hour and during the PM peak hour. The exceptions are Routes 118, 134, 170, 405 (101 to 5), and 605 during the AM peak, and Routes 110 (91 to 105), 118, 134, 170, and 210 (605 to Sunflower) during the PM peak. For Route 210 eastbound (605 to Sunflower), the location of the count data loop detector immediately west of the eastbound carpool lane terminus is responsible for the extremely low carpool lane volume and person trips for this Analysis Segment. As a result, PM peak results for this Analysis Segment are not considered to be representative of conditions in the carpool lanes.

Peak hour person trips for HOV Study Routes generally increased on HOV Study Routes and generally declined on the two Control Routes over time from before carpool lane implementation to current. The percentage of change over time exceeded that for one or both control routes during one or both peak hours for all of the HOV Study Routes with data available. The percentage of change exceeded that for both control routes during both peak hours for 70% of these routes.

Table 4.2.4(a) MOE 1B: Number and Percent Change in the Person-Trips Carried (AM Peak Hour/AM Peak Direction of Flow)

HOV Study Segments	Threshold 1: More peak hour person-trips-per-lane should occur on a route with an HOV lane than a "comparable" Control Route.			Threshold 2: Percent change in peak hour person trips for routes with HOV lanes should exceed that for Control Routes (i.e. routes without HOV lanes).					Threshold 3: On the HOV Study Route, the number of peak-hour PTPL being carried in the HOV lane should be greater than that of the general-purpose lanes.					
	(Current)			(Before vs Current)					(Current)			(After)		
	HOV Study Route PTPL (all lanes)	Greater than 5 NB PTPL (1,855)?	Greater than 101 SB PTPL (2,267)?	HOV Study Route % (all lanes)	5 NB Control Route %	101 SB Control Route %	Greater than 5 NB?	Greater than 101 SB?	HOV Study Route PTPL (HOV lane)	HOV Study Route PTPL (GP lanes)	HOV > General-Purpose?	HOV Study Route PTPL (HOV lane)	HOV Study Route PTPL (GP lanes)	HOV > General-Purpose?
10 WB Alameda to Baldwin	2,340	yes	yes	HOV data not available					4,682	1,862	yes	HOV data not available		
14 SB San Fernando to Escondido Canyon	1,859	yes	no	HOV data not available					2,846	1,527	yes	3,030	1,689	yes
57 SB OCL to 60	1,980	yes	no	15%	9%	-10%	yes	yes	2,877	1,764	yes	2,616	1,804	yes
60 WB Brea Canyon to SBCL	2,136	yes	no	27%	9%	-10%	yes	yes	2,708	1,938	yes	2,708	1,938	yes
91 WB 110 to OCL	2,207	yes	no	19%	-24%	-2%	yes	yes	2,976	2,040	yes	1,751	1,775	no
105 WB 405 to 605	2,380	yes	yes	not applicable (no before condition)					3,457	2,110	yes	HOV data not available		
110 NB 91 to 105	2,053	yes	no	HOV data not available					3,129	1,836	yes	HOV data not available		
110 NB 105 to Adams	2,252	yes	no	HOV data not available					3,005	1,866	yes	3,104	1,893	yes
118 WB VCL to 5	1,955	yes	no	9%	-26%	-9%	yes	yes	1,480	2,083	no	1,354	2,657	no
134 WB 101/170 to 210	1,951	yes	no	11%	-26%	-7%	yes	yes	1,577	2,042	no	1,539	1,824	no
170 SB 101/134 to 5	1,965	yes	no	13%	-29%	-1%	yes	yes	1,881	1,984	no	1,546	1,966	no
210 WB 134 to Sunflower	1,943	yes	no	-3%	-25%	-1%	yes	no	2,718	1,770	yes	HOV data not available		
405 NB OCL to 110	2,088	yes	no	29%	-8%	-7%	yes	yes	2,427	2,014	yes	2,483	2,129	yes
405 NB 110 to Century	2,314	yes	yes	HOV data not available					2,601	2,248	yes	HOV data not available		
405 SB 101 to 5	2,245	yes	no	43%	-21%	-9%	yes	yes	2,213	2,247	no	1,973	2,218	no
605 SB South to 10	2,075	yes	no	14%	-9%	-9%	yes	yes	1,872	1,999	no	2,013	2,082	no
Number of HOV Study Routes with data available:		**16**	**16**				**10**	**10**			**16**			**11**
Percent that meet threshold test:		**100%**	**19%**				**100%**	**90%**			**69%**			**45%**

Notes:

[1] Assumed 24-hour 3+ occupancy requirement conditions for Route 10 (i.e. year 1999 data for current conditions, prior to January 2000 when 2+ demonstration project began).

[2] Assumed 24-hour 2+ occupancy requirement conditions for Route 14 (i.e. prior to January 2001 when part-time operation demonstration project began.)

Figure 4.2.2(a) MOE 1B: Person Trips Per Lane (AM Peak Hour/AM Peak Direction of Flow)

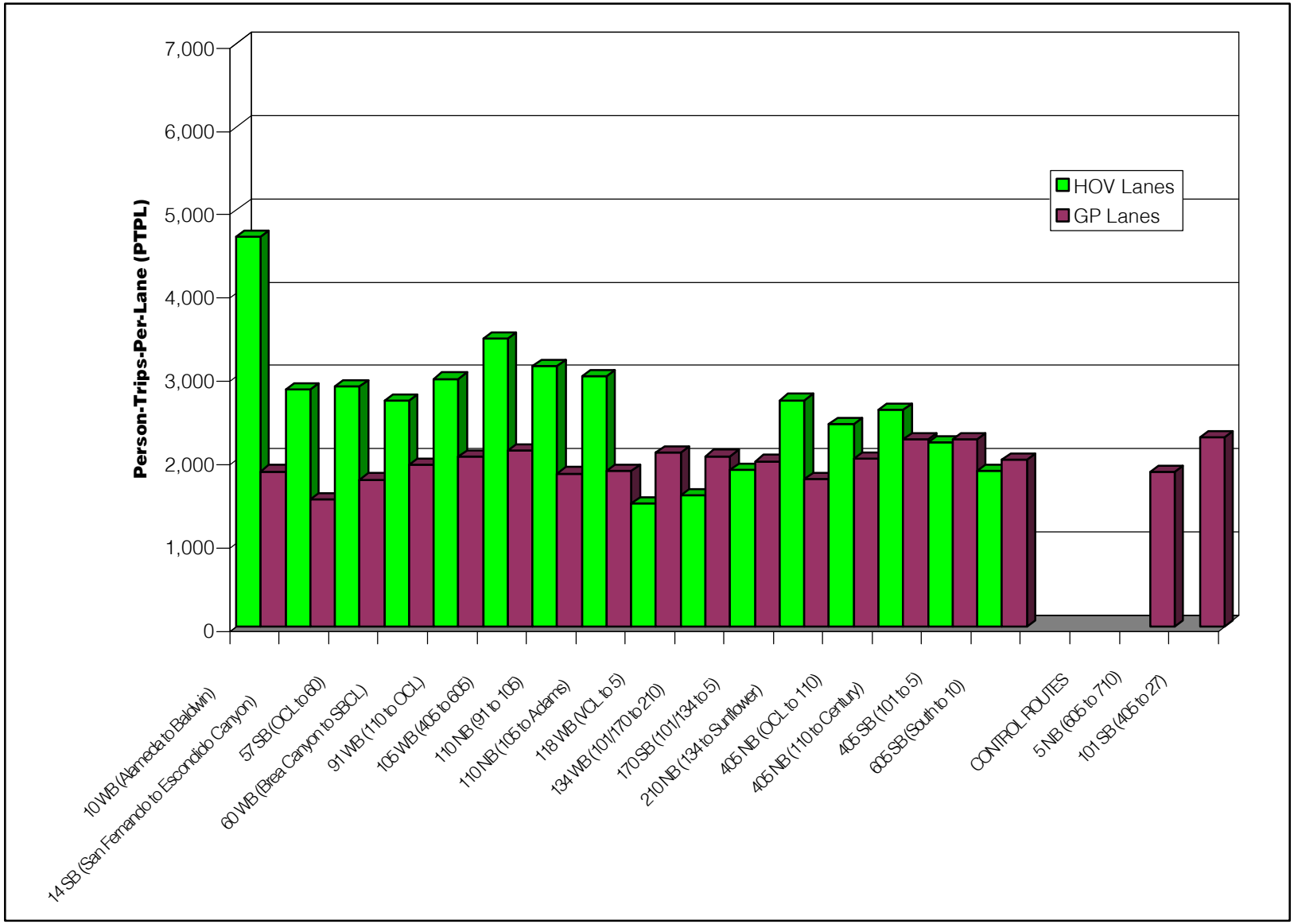


Table 4.2.4(b) MOE 1B: Number and Percent Change in the Person-Trips Carried (PM Peak Hour/PM Peak Direction of Flow)

HOV Study Segments	Threshold 1: More peak hour person-trips-per-lane should occur on a route with an HOV lane than a "comparable" Control Route.			Threshold 2: Percent change in peak hour person trips for routes with HOV lanes should exceed that for Control Routes (i.e. routes without HOV lanes).					Threshold 3: On the HOV Study Route, the number of peak-hour PTPL being carried in the HOV lane should be greater than that of the general-purpose lanes.					
	(Current)			(Before vs Current)					(Current)			(After)		
	HOV Study Route PTPL (all lanes)	Greater than 5 SB PTPL (2,166)?	Greater than 101 NB PTPL (2,395)?	HOV Study Route % (all lanes)	5 SB Control Route %	101 NB Control Route %	Greater than 5 SB?	Greater than 101 NB?	HOV Study Route PTPL (HOV lane)	HOV Study Route PTPL (GP lanes)	HOV > General-Purpose?	HOV Study Route PTPL (HOV lane)	HOV Study Route PTPL (GP lanes)	HOV > General-Purpose?
10 EB Alameda to Baldwin	2,265	yes	no	HOV data not available					6,215	1,852	yes	HOV data not available		
14 NB San Fernando to Escondido Canyon	1,713	no	no	HOV data not available					2,526	1,449	yes	2,547	1,422	yes
57 NB OCL to 60	1,991	no	no	16%	24%	-6%	no	yes	2,668	1,817	yes	2,421	1,947	yes
60 EB Brea Canyon to SBCL	2,161	no	no	58%	32%	-6%	yes	yes	2,835	1,984	yes	2,835	1,984	yes
91 EB 110 to OCL	2,245	yes	no	7%	-15%	-6%	yes	yes	3,085	2,056	yes	2,924	2,199	yes
105 EB 405 to 605	2,404	yes	yes	not applicable (no before condition)					3,623	2,052	yes	HOV data not available		
110 SB 91 to 105	1,879	no	no	HOV data not available					1,756	1,909	no	HOV data not available		
110 SB 105 to Adams	2,675	yes	yes	HOV data not available					3,097	2,456	yes	2,812	2,441	yes
118 EB VCL to 5	2,033	no	no	23%	-9%	-8%	yes	yes	1,499	2,173	no	835	2,368	no
134 EB 101/170 to 210	2,020	no	no	12%	-12%	-8%	yes	yes	1,720	2,094	no	1,659	2,213	no
170 NB 101/134 to 5	1,661	no	no	-6%	-16%	-6%	yes	no	1,473	1,715	no	1,365	1,879	no
210 EB 134 to 605	2,158	no	no	1%	-15%	-9%	yes	yes	3,026	1,988	yes	HOV data not available		
210 EB 605 to Sunflower	1,597	no	no	-14%	-21%	-1%	yes	no	423	1,892	no	HOV data not available		
405 SB OCL to 110	2,091	no	no	16%	9%	-8%	yes	yes	3,087	1,886	yes	3,041	1,886	yes
405 SB 110 to Century	2,582	yes	yes	HOV data not available					3,372	2,391	yes	HOV data not available		
405 NB 101 to 5	1,912	no	no	0%	-9%	-8%	yes	yes	2,321	1,824	yes	2,079	1,918	yes
605 NB South to 10	2,146	no	no	21%	12%	-7%	yes	yes	2,175	2,090	yes	2,409	1,991	yes
Number of HOV Study Routes with data available:		**17**	**17**				**11**	**11**			**17**			**11**
Percent that meet threshold test:		**29%**	**18%**				**91%**	**82%**			**71%**			**73%**

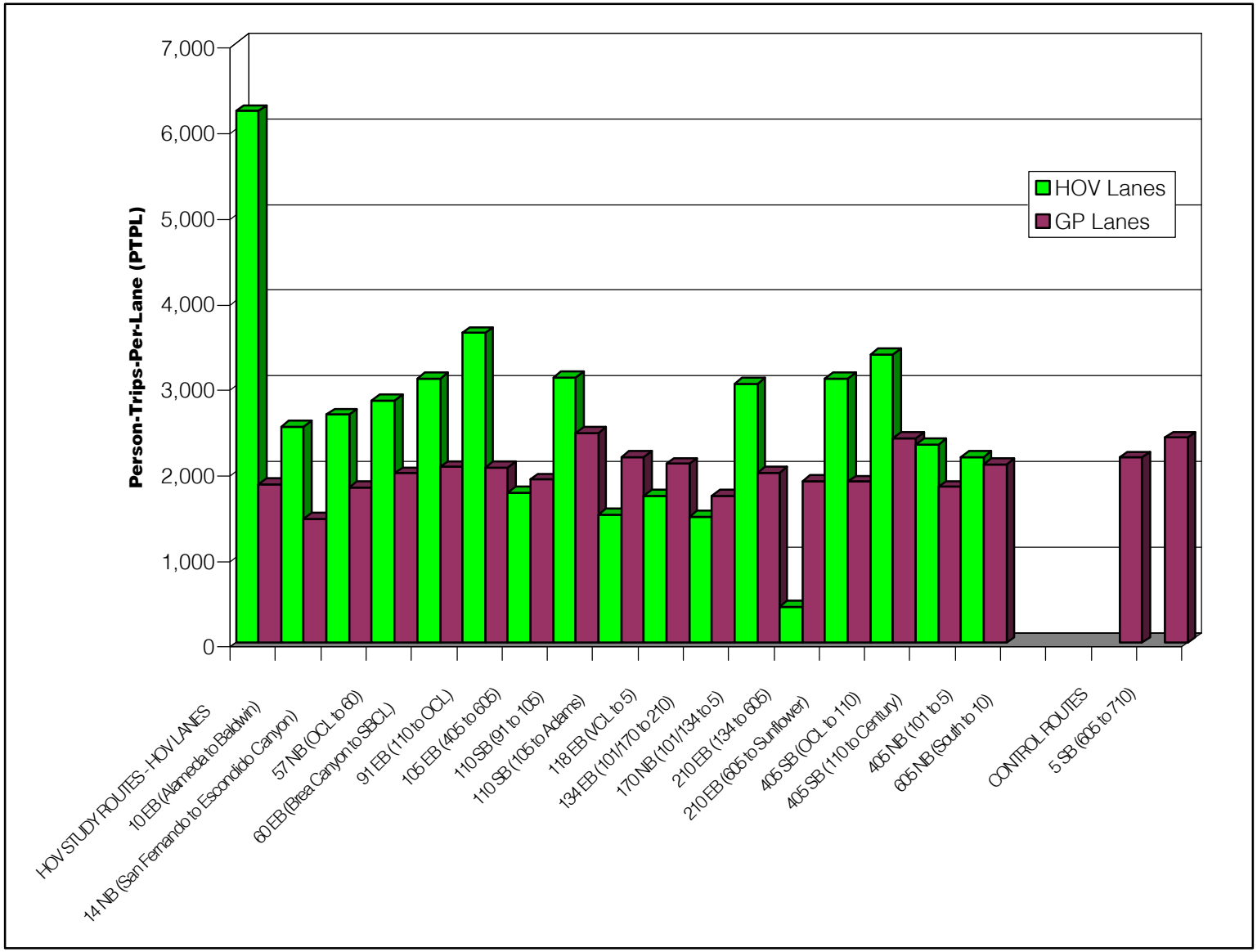
Notes:

[1] Assumed 24-hour 3+ occupancy requirement conditions for Route 10 (i.e. year 1999 data for current conditions, prior to January 2000 when 2+ demonstration project began).

[2] Assumed 24-hour 2+ occupancy requirement conditions for Route 14 (i.e. prior to January 2001 when part-time operation demonstration project began.)

[3] Route 210 Study Segment results shown for two Analysis Segments due to significant difference between respective Analysis Segment results during the PM Peak Hour.

Figure 4.2.2(b) MOE 1B: Person Trips Per Lane (PM Peak Hour/PM Peak Direction of Flow)



Peak hour person trips per lane on the two Control Routes are quite high, primarily due to high vehicular volumes on the Control Routes. The two freeways selected as Control Routes (Routes 5 and 101) are among the most heavily traveled freeways in Los Angeles County and generally do not have the same operational characteristics as the Study Routes. In addition, the Study Routes are not necessarily parallel to the Control Routes and typically do not serve the same corridor areas. As a result, with a few exceptions (Routes 10, 105, 110/105 to Adams and 405/Orange County line to 110, and all routes when compared against Route 5 during the AM peak), person trips per lane on the HOV Study Routes do not exceed those on the Control Routes.

Table 4.2.5 shows that current bi-directional daily person trips carried in the carpool lanes range from approximately 19,300 on Route 170 to over 122,000 on Route 110 (105 to Adams). A total of almost 740,000 daily person trips are carried on the 16 HOV Study Routes in the aggregate.

Table 4.2.5 MOE 1B: Current Daily Person Trips In HOV Lanes

HOV Study Route	Length (miles)	Current Daily Person Trips in HOV Lanes (Both Directions Summed)
10 (Alameda to Baldwin)	11.0	73,600
14 (San Fernando to Escondido Canyon)	16.3	30,500
57 (Orange County Line to 60)	4.5	42,500
60 (Brea Canyon to San Bernardino County Line)	7.5	42,500
91 (110 to Orange County Line)	14.3	33,800
105 (405 to 605)	16.0	62,600
110 (91 to 105)	4.0	48,500
110 (105 to Adams)	6.7	122,800
118 (Ventura County Line to 5)	11.4	17,800
134 (101/170 to 210)	12.9	27,300
170 (101/134 to 5)	6.1	19,300
210 (134 to Sunflower)	18.5	38,600
405 (Orange County Line to 110)	13.0	55,300
405 (110 to Century)	9.2	52,200
405 (101 to 5)	10.1	29,100
605 (South to 10)	16.9	41,300
Total - All Study Routes		**737,700**

4.2.3.3 MOE 1C – Percent of Person Trips vs. Vehicle Trips

The results of the evaluation of MOE 1C are summarized in **Tables 4.2.6(a)** and **4.2.6(b)**. As indicated in these tables, the percentage of person trips carried in the carpool lanes exceeds the percentage of vehicle trips for all 16 of the HOV Study Routes, during both the AM and PM peak periods. The percentage of person trips ranges from 15% to 44% during the AM peak period and from 14% to 39% during the PM peak period, while the corresponding percentage of vehicles ranges from 8% to 28% during the AM peak period and from 5% to 21% during the PM peak period, depending on location.

4.2.3.4 MOE 1D – Percent of Carpools/Vanpools and HOV Lane

The results of the analysis of MOE 1D are provided in **Tables 4.2.7(a)**, **4.2.7(b)** and **4.2.8**, and **Figures 4.2.3**, **4.2.4** and **4.2.5**.

The analysis results for MOE 1D shows that the percentage of carpools and vanpools averaged across all lanes exceeds that on the Route 5 Control Route during the AM peak and on the Route 101 Control Route during both peaks for each of the 15 HOV Study Routes with a 2+ occupancy requirement. On Route 10 (the only facility with a 3+ occupancy requirement), the percentage of 3+ carpools/vanpools averaged across all lanes exceeds the 3+ carpool/vanpool percentages on both Control Routes during both peaks.

Table 4.2.6(a) MOE 1C: Percent of Persons Carried on HOV Study Route Compared to Percent of Vehicles (AM Peak Period/AM Peak Direction of Flow)

HOV Study Route	Threshold 1: The % of person trips carried by the HOV lane should exceed the % of vehicle trips carried. This is equivalent to saying that the AVO in the HOV lane should exceed the AVO in the general-purpose lanes.						Threshold 2: The percent of person trips carried by the HOV lane should exceed the percent of freeway lanes that are HOV lanes					
	(Current)			(After)			(Current)			(After)		
	% of person trips	% of vehicle trips	% person-trips > % vehicle-trips?	% of person trips	% of vehicle trips	% person-trips > % vehicle-trips?	% of person trips	% of freeway lanes	% person-trips > % freeway lanes?	% of person trips	% of freeway lanes	% person-trips > % freeway lanes?
10 WB Alameda to Baldwin	34%	9%	yes	HOV data not available			34%	17%	yes	HOV data not available		
14 SB San Fernando to Escondido Canyon	38%	22%	yes	37%	22%	yes	38%	25%	yes	37%	25%	yes
57 SB OCL to 60	29%	17%	yes	27%	15%	yes	29%	20%	yes	27%	20%	yes
60 WB Brea Canyon to SBCL	32%	19%	yes	32%	19%	yes	32%	25%	yes	32%	25%	yes
91 WB 110 to OCL	24%	13%	yes	17%	9%	yes	24%	18%	yes	17%	17%	no
105 WB 405 to 605	33%	19%	yes	HOV data not available			33%	23%	yes	HOV data not available		
110 NB 91 to 105	25%	13%	yes	HOV data not available			25%	17%	yes	HOV data not available		
110 NB 105 to Adams	44%	28%	yes	45%	27%	yes	44%	33%	yes	45%	33%	yes
118 WB VCL to 5	15%	8%	yes	11%	6%	yes	15%	20%	no	11%	20%	no
134 WB 101/170 to 210	16%	9%	yes	17%	10%	yes	16%	20%	no	17%	20%	no
170 SB 101/134 to 5	19%	10%	yes	16%	9%	yes	19%	20%	no	16%	20%	no
210 WB 134 to Sunflower	26%	15%	yes	HOV data not available			26%	19%	yes	HOV data not available		
405 NB OCL to 110	21%	11%	yes	21%	11%	yes	21%	19%	yes	21%	19%	yes
405 NB 110 to Century	22%	12%	yes	HOV data not available			22%	20%	yes	HOV data not available		
405 SB 101 to 5	20%	10%	yes	18%	9%	yes	20%	20%	no	18%	20%	no
605 SB South to 10	18%	11%	yes	20%	10%	yes	18%	20%	no	20%	20%	no
Number of HOV Study Routes with data available:			**16**			**11**			**16**			**11**
Percent that meet threshold test:			**100%**			**100%**			**69%**			**45%**

Notes:

[1] Assumed 24-hour 3+ occupancy requirement conditions for Route 10 (i.e. year 1999 data for current conditions, prior to January 2000 when 2+ demonstration project began).

[2] Assumed 24-hour 2+ occupancy requirement conditions for Route 14 (i.e. prior to January 2001 when part-time operation demonstration project began.)

Table 4.2.6(b) MOE 1C: Percent of Persons Carried on HOV Study Route Compared to Percent of Vehicles (PM Peak Period/PM Peak Direction of Flow)

HOV Study Route	Threshold 1: The % of person trips carried by the HOV lane should exceed the % of vehicle trips carried. This is equivalent to saying that the AVO in the HOV lane should exceed the AVO in the general-purpose lanes.						Threshold 2: The percent of person trips carried by the HOV lane should exceed the percent of freeway lanes that are HOV lanes					
	(Current)			(After)			(Current)			(After)		
	% of person trips	% of vehicle trips	% person-trips > % vehicle-trips?	% of person trips	% of vehicle trips	% person-trips > % vehicle-trips?	% of person trips	% of freeway lanes	% person-trips > % freeway lanes?	% of person trips	% of freeway lanes	% person-trips > % freeway lanes?
10 EB Alameda to Baldwin	30%	5%	yes	HOV data not available			30%	17%	yes	HOV data not available		
14 NB San Fernando to Escondido Canyon	37%	21%	yes	37%	21%	yes	37%	25%	yes	37%	25%	yes
57 NB OCL to 60	27%	16%	yes	24%	14%	yes	27%	20%	yes	24%	20%	yes
60 EB Brea Canyon to SBCL	26%	15%	yes	26%	15%	yes	26%	20%	yes	26%	20%	yes
91 EB 110 to OCL	24%	13%	yes	21%	11%	yes	24%	18%	yes	21%	17%	yes
105 EB 405 to 605	34%	18%	yes	HOV data not available			34%	23%	yes	HOV data not available		
110 SB 91 to 105	16%	8%	yes	HOV data not available			16%	17%	no	HOV data not available		
110 SB 105 to Adams	39%	21%	yes	36%	20%	yes	39%	33%	yes	36%	33%	yes
118 EB VCL to 5	15%	8%	yes	8%	4%	yes	15%	20%	no	8%	20%	no
134 EB 101/170 to 210	17%	10%	yes	16%	9%	yes	17%	20%	no	16%	20%	no
170 NB 101/134 to 5	18%	9%	yes	15%	8%	yes	18%	20%	no	15%	20%	no
210 EB 134 to Sunflower	14%	8%	yes	HOV data not available			14%	19%	no	HOV data not available		
405 SB OCL to 110	25%	14%	yes	24%	14%	yes	25%	17%	yes	24%	17%	yes
405 SB 110 to Century	26%	14%	yes	HOV data not available			26%	20%	yes	HOV data not available		
405 NB 101 to 5	20%	11%	yes	18%	10%	yes	20%	17%	yes	18%	17%	yes
605 NB South to 10	20%	12%	yes	24%	12%	yes	20%	20%	no	24%	20%	yes
Number of HOV Study Routes with data available:			**16**			**11**			**16**			**11**
Percent that meet threshold test:			**100%**			**100%**			**63%**			**73%**

Notes:
[1] Assumed 24-hour 3+ occupancy requirement conditions for Route 10 (i.e. year 1999 data for current conditions, prior to January 2000 when 2+ demonstration project began).
[2] Assumed 24-hour 2+ occupancy requirement conditions for Route 14 (i.e. prior to January 2001 when part-time operation demonstration project began.)

Table 4.2.7(a) MOE 1D: Number and Percent Change in the Number of Carpools/Vanpools (AM Peak Period/AM Peak Direction of Flow)

HOV Study Route	Threshold 1: Routes with HOV lanes should, generally speaking, have a higher percentage of carpools and vanpools than routes without HOV lanes (i.e. Control Routes).			Threshold 2: Percent change in carpool/vanpool percent for routes with HOV lanes should exceed that for routes without HOV lanes (i.e. Control Routes).				
	(Current)			(Before vs Current)				
	HOV Study Route % (all lanes)	Greater than 5 NB (9% 2+ or 2% 3+)?	Greater than 101 SB (12% 2+ or 2% 3+)?	HOV Study Route % (all lanes)	5 NB Control Route %	101 SB Control Route %	Greater than 5 NB?	Greater than 101 SB?
10 WB Alameda to Baldwin	8%	yes	yes	HOV data not available				
14 SB San Fernando to Escondido Canyon	24%	yes	yes	HOV data not available				
57 SB OCL to 60	20%	yes	yes	94%	-23%	-27%	yes	yes
60 WB Brea Canyon to SBCL	24%	yes	yes	226%	-23%	-27%	yes	yes
91 WB 110 to OCL	17%	yes	yes	43%	-50%	-9%	yes	yes
105 WB 405 to 605	22%	yes	yes	not applicable (no before condition)				
110 NB 91 to 105	20%	yes	yes	HOV data not available				
110 NB 105 to Adams	32%	yes	yes	HOV data not available				
118 WB VCL to 5	15%	yes	yes	44%	-56%	-27%	yes	yes
134 WB 101/170 to 210	16%	yes	yes	75%	-55%	-17%	yes	yes
170 SB 101/134 to 5	17%	yes	yes	7%	-59%	-9%	yes	yes
210 WB 134 to Sunflower	21%	yes	yes	27%	-56%	-9%	yes	yes
405 NB OCL to 110	16%	yes	yes	407%	-39%	5%	yes	yes
405 NB 110 to Century	14%	yes	yes	HOV data not available				
405 SB 101 to 5	18%	yes	yes	58%	-36%	-27%	yes	yes
605 SB South to 10	17%	yes	yes	252%	-40%	-11%	yes	yes
Number of HOV Study Routes with data available:		**16**	**16**				**10**	**10**
Percent that meet threshold test:		**100%**	**100%**				**100%**	**100%**

Notes:

[1] Assumed 24-hour 3+ occupancy requirement conditions for Route 10 (i.e. year 1999 data for current conditions, prior to 2+ demonstration project).

[2] Assumed 24-hour 2+ occupancy requirement conditions for Route 14 (i.e. prior to January 2001 when part-time operation demonstration project began.)

[3] Percent carpools/vanpools shown for Route 10 includes 3+ carpools/vanpools only.

Table 4.2.7(b) MOE 1D: Number and Percent Change in the Number of Carpools/Vanpools (PM Peak Period/PM Peak Direction of Flow)

HOV Study Route	Threshold 1: Routes with HOV lanes should, generally speaking, have a higher percentage of carpools and vanpools than routes without HOV lanes (i.e. Control Routes).			Threshold 2: Percent change in carpool/vanpool percent for routes with HOV lanes should exceed that for routes without HOV lanes (i.e. Control Routes).				
	(Current)			(Before vs Current)				
	HOV Study Route % (all lanes)	Greater than 5 SB (21% 2+ or 2% 3+)?	Greater than 101 NB (15% 2+ or 1% 3+)?	HOV Analysis Segment % (all lanes)	5 SB Control Segment %	101 NB Control Segment %	Greater than 5 SB?	Greater than 101 NB?
10 EB Alameda to Baldwin	5%	yes	yes	HOV data not available				
14 NB San Fernando to Escondido Canyon	26%	yes	yes	HOV data not available				
57 NB OCL to 60	23%	yes	yes	74%	18%	-17%	yes	yes
60 EB Brea Canyon to SBCL	22%	yes	yes	184%	43%	-17%	yes	yes
91 EB 110 to OCL	21%	no	yes	24%	-17%	-24%	yes	yes
105 EB 405 to 605	28%	yes	yes	HOV data not available				
110 SB 91 to 105	17%	no	yes	HOV data not available				
110 SB 105 to Adams	28%	yes	yes	HOV data not available				
118 EB VCL to 5	18%	no	yes	55%	-1%	-20%	yes	yes
134 EB 101/170 to 210	20%	no	yes	2%	-11%	-24%	yes	yes
170 NB 101/134 to 5	20%	no	yes	-4%	-18%	-24%	yes	yes
210 EB 134 to Sunflower	17%	no	yes	-20%	-20%	-31%	no	yes
405 SB OCL to 110	20%	no	yes	62%	13%	-24%	yes	yes
405 SB 110 to Century	20%	no	yes	HOV data not available				
405 NB 101 to 5	22%	yes	yes	-10%	-1%	-20%	no	yes
605 NB South to 10	20%	no	yes	33%	21%	-19%	yes	yes
Number of HOV Study Routes with data available:		**16**	**16**				**10**	**10**
Percent that meet threshold test:		**44%**	**100%**				**80%**	**100%**

Notes:

[1] Assumed 24-hour 3+ occupancy requirement conditions for Route 10 (i.e. year 1999 data for current conditions, prior to 2+ demonstration project).

[2] Assumed 24-hour 2+ occupancy requirement conditions for Route 14 (i.e. prior to January 2001 when part-time operation demonstration project began.)

[3] Percent carpools/vanpools shown for Route 10 includes 3+ carpools/vanpools only.

Table 4.2.8 MOE 1D: Number of Vehicles in the HOV Lane (Peak Hour in HOV Lane/Peak Direction of Flow)

HOV Study Routes		Threshold 3: A minimum absolute vehicles-per-hour-per lane threshold would indicate if the HOV lane is being sufficiently utilized. "Current" vphpl during peak hour in HOV lane >= 800 for a mature facility (3+ years) and 600 for an immature facility (less than 3 years old).				Threshold 4: A maximum vehicles-per-hour threshold would indicate if the HOV lane is overloaded.		
		(Current)				(Current)		
		HOV Study Route VPHPL (HOV lane)	Threshold (vphpl)	HOV Lane Opening Date	Greater than Threshold?	HOV Study Route VPHPL (HOV lane)	Threshold (vphpl)	Overloaded or ok?
10	Alameda to Baldwin	1,047	800	1/1/73	yes	1,047	1,650	ok
14	San Fernando to Escondido Canyon*	1,277	600	5/5/98	yes	1,277	1,650	ok
57	OCL to 60	1,418	600	8/22/97	yes	1,418	1,650	ok
60	Brea Canyon to SBCL	1,363	600	2/2/99	yes	1,363	1,650	ok
91	110 to OCL *	1,407	800	12/14/94	yes	1,407	1,650	ok
105	405 to 605	1,549	800	10/14/93	yes	1,549	1,650	ok
110	91 to 105	1,277	800	6/26/96	yes	1,277	1,650	ok
110	105 to Adams	1,336	800	6/26/96	yes	1,336	1,650	ok
118	VCL to 5	819	800	3/7/97	yes	819	1,650	ok
134	101/170 to 210 *	879	800	8/30/96	yes	879	1,650	ok
170	101/134 to 5	771	800	2/11/96	no	771	1,650	ok
210	134 to Sunflower	1,387	800	12/16/93	yes	1,387	1,650	ok
405	OCL to 110 *	1,521	600	10/8/98	yes	1,521	1,650	ok
405	110 to Century	1,473	800	4/8/93	yes	1,473	1,650	ok
405	101 to 5	1,049	800	10/22/96	yes	1,049	1,650	ok
605	South to 10 *	1,084	600	4/3/98	yes	1,084	1,650	ok
Number of HOV Study Routes with data available:					**16**			**16**
Percent that meet threshold test:					**94%**			**100%**

Notes:

[1] Assumed 24-hour 3+ occupancy requirement conditions for Route 10 (i.e. year 1999 data for current conditions, prior to January 2000 when 2+ demonstration project began).

[2] Assumed 24-hour 2+ occupancy requirement conditions for Route 14 (i.e. prior to January 2001 when part-time operation demonstration project began

* Most recent opening date shown. Some subsections of HOV lanes opened earlier as listed below:

Route 14 (Sand Canyon to Escondido Canyon) HOV lanes opened on 9/23/99

Route 91 (110 - 605) WB HOV lane opened on 3/11/93 and EB HOV lane opened on 6/10/85.

Route 134 (101/170 - 5) HOV lanes opened on 10/2/95 and Route 134 (5 -2) HOV lanes opened on 3/12/96.

Route 405 (710 - OCL) HOV lanes opened on 2/12/98 and Route 405 (Bellflower - OCL) SB HOV lane opened on 10/2/93.

Route 605 (South - Telegraph) HOV lanes opened on 4/2/97.

Figure 4.2.3 MOE 1D: Vehicles Per Hour Per Lane (Peak Hour in HOV Lane/Peak Direction of Flow)

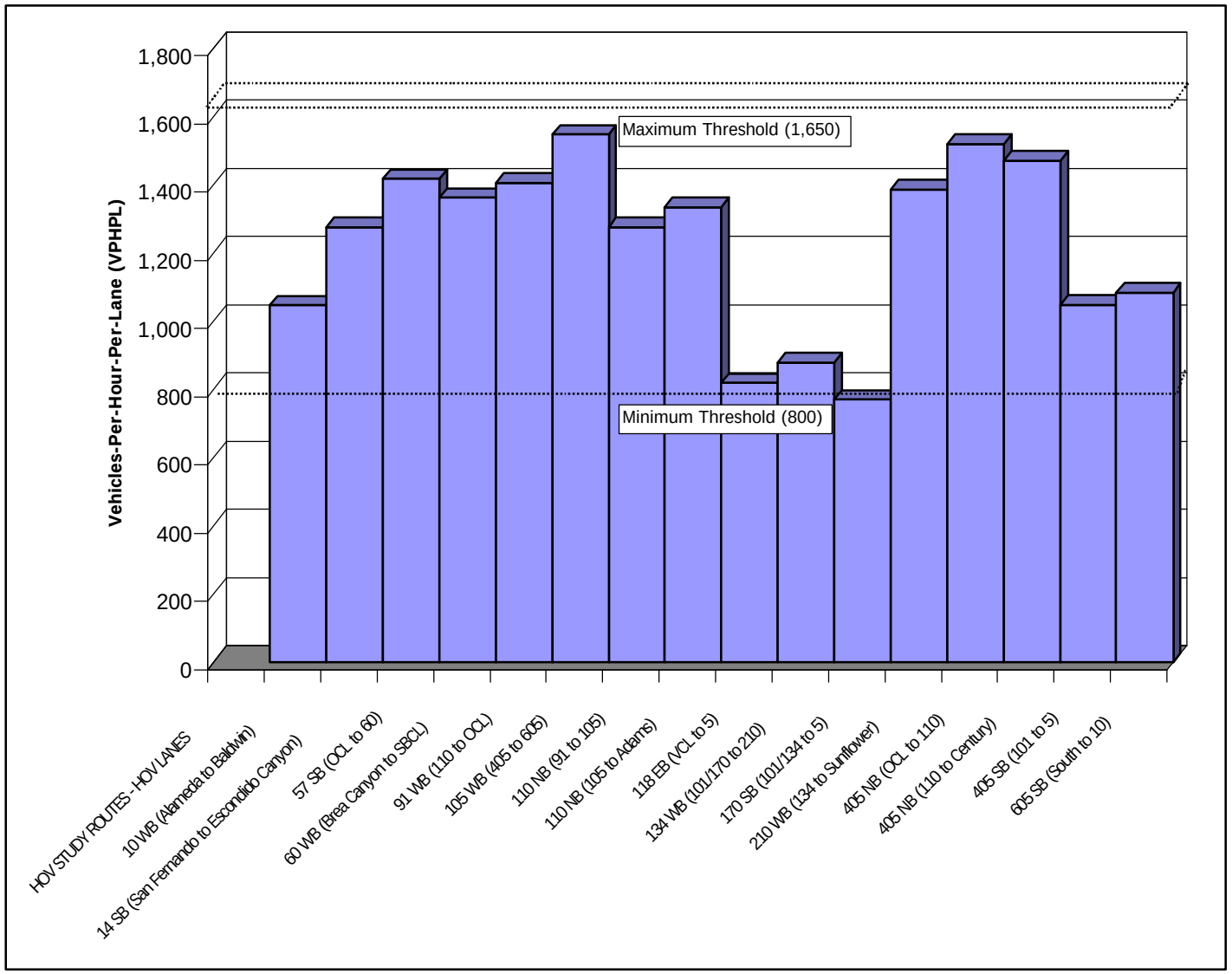
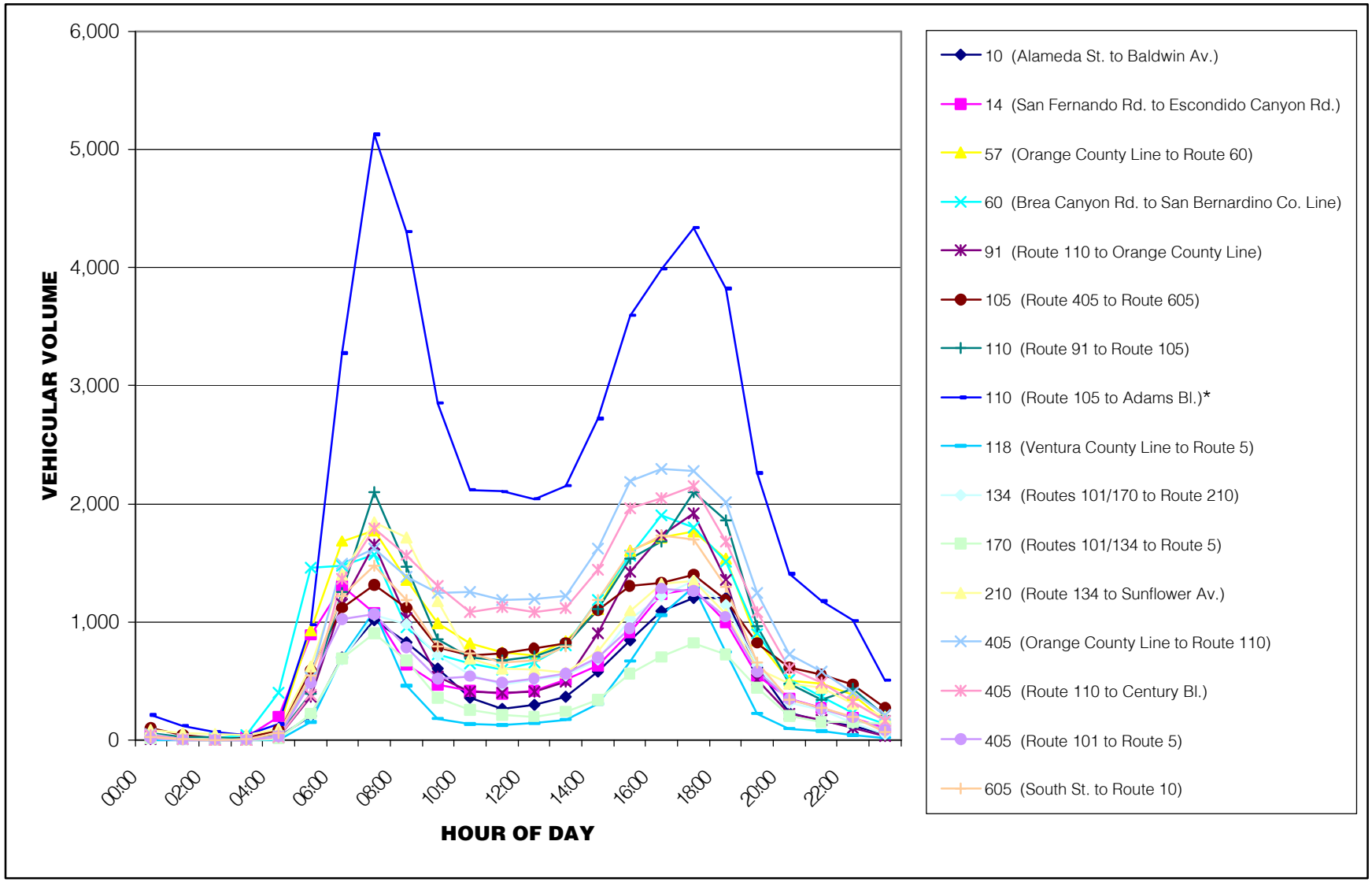
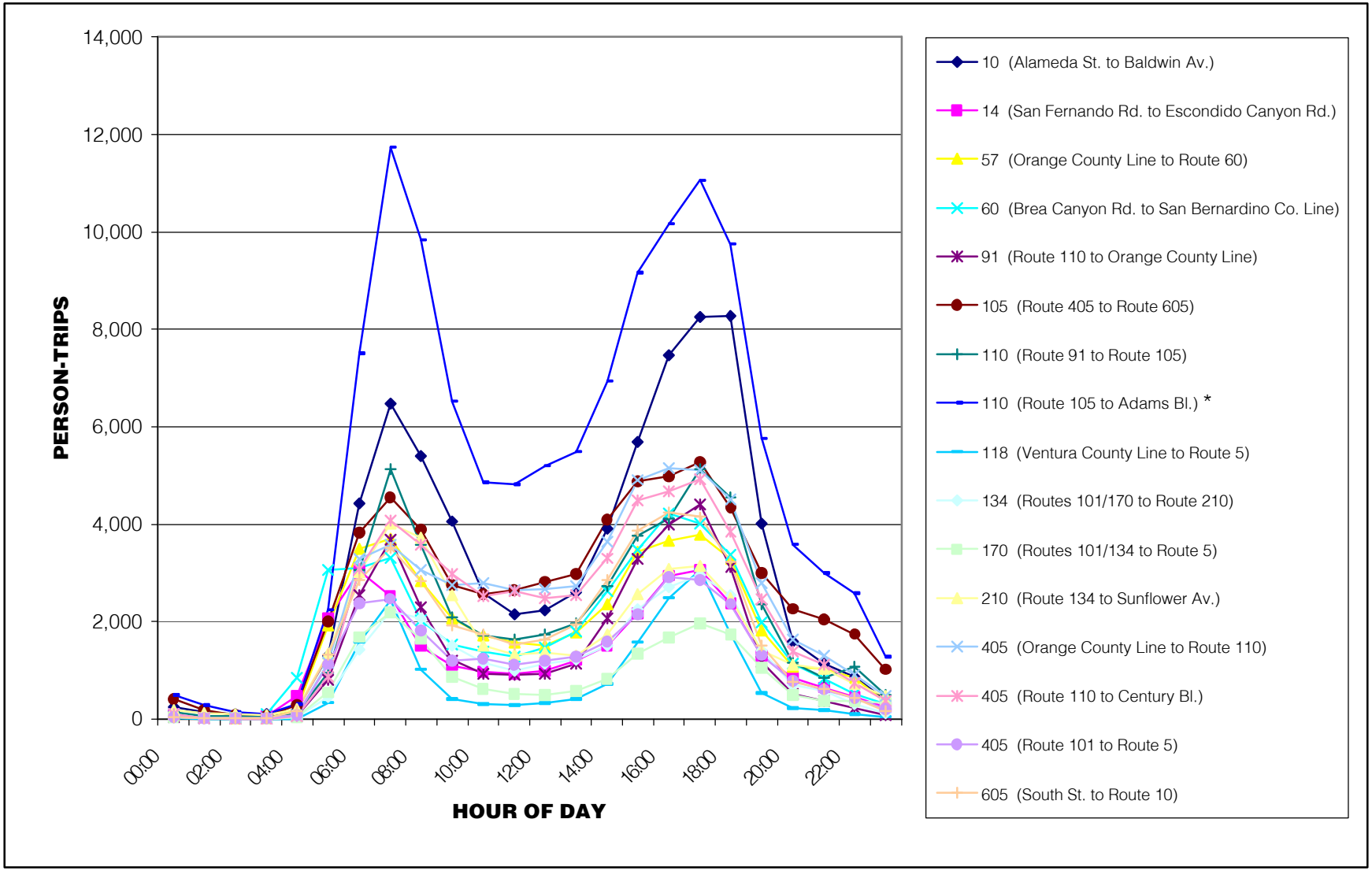


Figure 4.2.4 MOE 1D: Current Year HOV Route Vehicular Volumes (Both Directions Summed)



Note: * - Vehicular volume for Route 110 (Route 105 to Adams Boulevard) reflects total volume for all four carpool lanes (two in each direction)

Figure 4.2.5 MOE 1D: Current Year HOV Route Person Trips (Both Directions Summed)



Note: * - Person Trips for Route 110 (Route 105 to Adams Boulevard) reflects total trips for all four carpool lanes (two in each direction)

The percentage of carpools and vanpools generally increased over time from before carpool lane implementation to current on the HOV Study Routes and generally declined on the two Control Routes. With the exception of Routes 210 and 405 (101 to 5) during the PM peak hour compared to Route 5, the percentage of change in carpool/vanpool percent over time exceeded that of the two Control Routes during both peaks for all of the Study Routes with data available.

A key criterion for carpool lane success is the HOV lane utilization in terms of the number of vehicles using the carpool lanes. Current peak volumes in the carpool lanes exceeded the minimum threshold of 800 vphpl during the single highest hour of the day on all but one of the 16 HOV Study Routes. The exception is Route 170, with about 770 vphpl, which just below the minimum threshold. Route 118 and Route 134 have peak carpool lane volumes in the 800 to 900 vphpl range. The remaining 13 HOV Study Routes have peak volumes in excess of 1,000 vphpl.

Peak carpool lane utilization actually exceeds 1,200 vphpl (or over 70% of the maximum threshold of 1,650 vphpl) on 10 of the 16 HOV Study Routes: Routes 14, 57, 60, 91,105, 110 (91 to 105), 110 (105 to Adams), 210, 405 (Orange County line to 110), and 405 (110 to Century). Two HOV lanes are present in each direction on Route 110 between 105 and Adams, with each of the two lanes carrying 1,200 to over 1,300 peak direction vehicles per hour (a total of 2,400 to almost 2,700 peak direction vehicles in the two lanes).

It should be noted that the carpool lane volume data provided in the HOV Performance Program evaluation represents a typical average comprising volumes for several days at sample counting stations for each of the HOV Study Routes. Although the analysis results indicate many carpool lanes experience peak volumes in excess of 1,200 vphpl, Caltrans District 7 reports that the volumes in the carpool lanes for select locations often exceed the maximum threshold of 1,650 vphpl during peak hours. Caltrans has documented carpool lane volumes in excess of 1,700 on Route 105 (westbound AM peak at Van Ness) and 1,800 on Route 210 (eastbound PM peak at Wilson). In addition, Route 405 (Orange County line to 110 and 110 to Century Boulevard) typically experiences volumes in the 1,500 vphpl range, approaching the maximum peak volume threshold and the likelihood of congestion in the carpool lanes.

The minimum criterion for carpool lane utilization was established as 800 vphpl during the single highest hour of the day which, as noted above, was achieved by all of the Study Routes except Route 170. However, closer inspection of the volume data indicates that the 800 vphpl threshold was exceeded not only during the single highest hour of the day but in at least one direction during both peak periods on all but three (Routes 118, 134, and 170) of the HOV Study Routes. Furthermore, the 800 vphpl threshold was exceeded on both sections of Route 110 in both directions during both peak periods, and in both directions on Route 405 (Orange County line to 110) during the PM peak. This indicates that the vast majority of the HOV Study Routes are achieving high carpool lane utilization during more than one peak hour and direction.

Although a lower carpool lane utilization threshold of 600 vphpl was established for new HOV lanes (less than three years from opening), all of the carpool lanes that had been in place less than three years as of the current analysis year 2000 (Routes 14, 57, 60, 405 (Orange County

line to 110), and 605) far exceeded not only the 600 threshold but also the established 800 threshold[11]. Review of the analysis results indicates that the degree that carpool lanes in Los Angeles County are utilized does not correlate to the age of the lane as much as it does to the level of congestion that exists in the adjacent general-purpose lanes and/or the perception of reliable HOV travel time savings being available.

Figures 4.2.4 and **4.2.5** are graphs illustrating the current year vehicular volume and person trips, respectively, on the HOV Study Routes by hour throughout a 24-hour period. The graphs indicate expected peaking during both the AM and PM peak periods. However, the graphs also indicate that there is significant volume and person trip usage of the carpool lanes during midday and evening off-peak periods on most of the facilities.

4.2.3.5 MOE 1E – Buses and Bus Riders

The results of the evaluation of MOE 1E are summarized in **Tables 4.2.9** and **Figure 4.2.6**. The MOE 1E evaluation results clearly indicates that no scheduled fixed route bus services operate on five of the 16 HOV Study Routes including Routes 60, 134, 170, 405 (Orange County Line to 110), and 405 (110 to Century). On two additional HOV Study Routes, Routes 57 and 605, scheduled fixed route bus services do operate on the route but not in the carpool lanes, usually due to the short distances the buses travel on the freeway.

The levels of scheduled fixed route bus service (i.e., number of bus trips provided) and the bus ridership does not exceed the levels experienced on the two control routes (Routes 5 and 101) for 7 of the 11 HOV Study Routes with public transit service. These routes are Routes 57, 91, 105, 118, 210, 405 (101 to 5), and 605.

The only HOV Study Routes with scheduled fixed route bus service levels and ridership substantially higher than on both of the two control routes are Route 10 (the El Monte Busway) and the two study sections of Route 110 (the Harbor Transitway). Service levels and ridership on the Harbor Transitway, and the El Monte Busway in particular, are on an order of magnitude significantly greater than the level of service provided on the control routes. Both of these facilities serve the traditional suburb-to-downtown commute pattern, although the El Monte Busway also serves a strong reverse commute travel market. Both of these HOV facilities were constructed with specific design elements (e.g., separated guideways, direct bus access ramps, on-line bus stations) to facilitate high levels of public transit use. Daily bus ridership on Route 14 is approximately equivalent to that on both of the control routes.

More person trips are carried in the HOV lanes on Routes 10 and 110 (almost 5,000 to over 6,000 person trips in the peak hour/peak direction on each) than on any other of the HOV Study Routes. This is due in part to the high transit service utilization of the respective freeway carpool lanes.

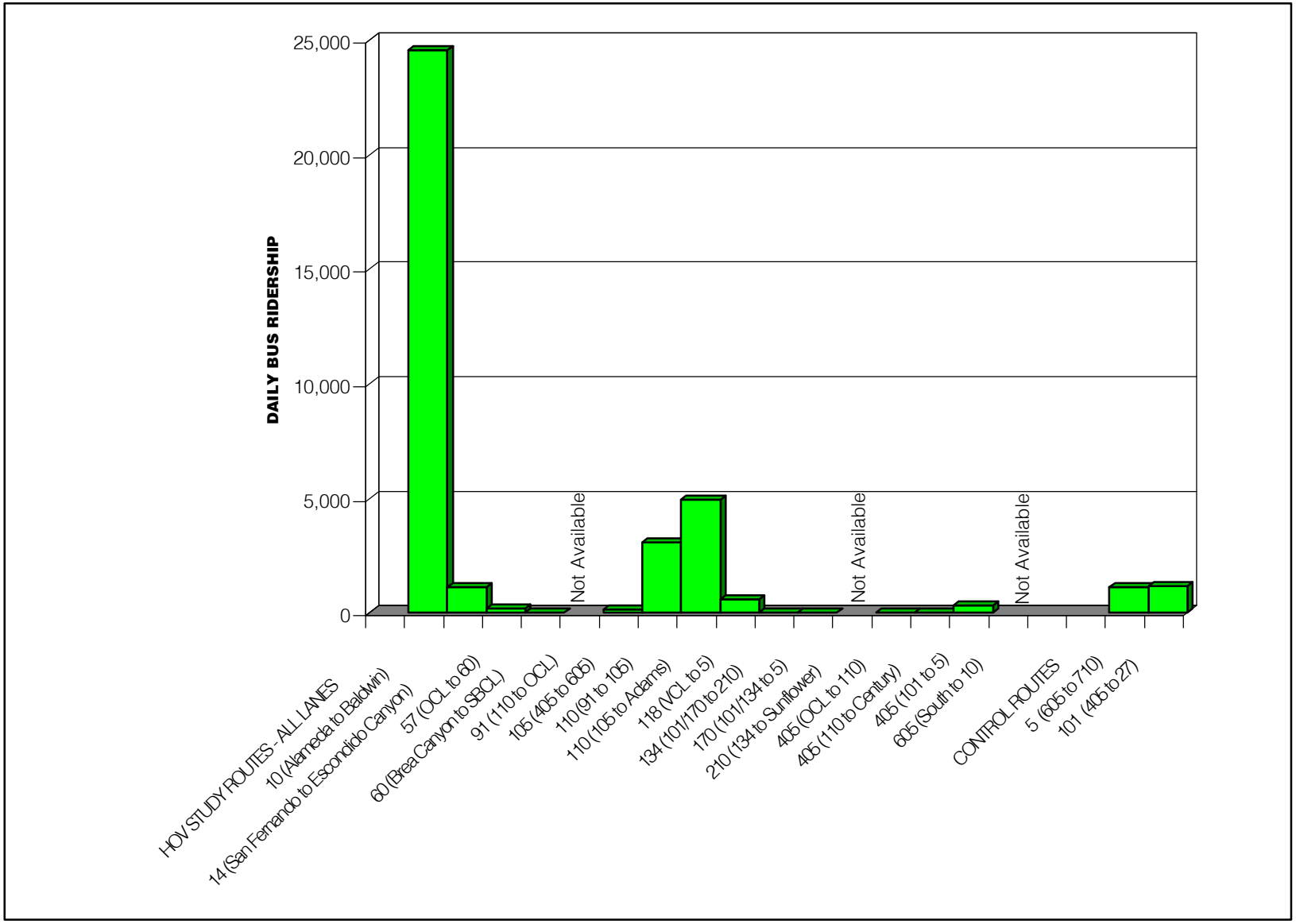
[11] The Caltrans *HOV Guidelines for Planning, Design and Operations* (July 1991) identifies a minimum HOV lane capacity of 800 vph for HOV lanes more than one year old.

Table 4.2.9 MOE 1E: Number of Buses and Bus Riders (Daily/Sum of Both Directions of Flow)

HOV Study Routes		Threshold 1: Routes with HOV lanes should, generally speaking, have a higher number of bus trips than routes without HOV lanes (e.g. Control Routes).			Threshold 2: Routes with HOV lanes should, generally speaking, have a higher number of bus riders than routes without HOV lanes (e.g. Control Routes).		
		(Current)			(Current)		
		HOV Study Route Bus Trips (all lanes)	Greater than 5 (80 trips)?	Greater than 101 (68 trips)?	HOV Study Route Bus Riders (all lanes)	Greater than 5 (1,127 riders)?	Greater than 101 (1,157 riders)?
10	Alameda to Baldwin	853	yes	yes	24,557	yes	yes
14	San Fernando to Escondido Canyon	39	no	no	1,135	yes	no
57	OCL to 60 [1]	36	no	no	195	no	no
60	Brea Canyon to SBCL	0	no	no	0	no	no
91	110 to OCL [2]	20	no	no	not available	not available	not available
105	405 to 605 [3]	12	no	no	133	no	no
110	91 to 105 [2]	273	yes	yes	3,082	yes	yes
110	105 to Adams [2,3,4]	328	yes	yes	4,957	yes	yes
118	VCL to 5	34	no	no	575	no	no
134	101/170 to 210	0	no	no	0	no	no
170	101/134 to 5	0	no	no	0	no	no
210	134 to Sunflower [5]	not available	not available	not available	not available	not available	not available
405	OCL to 110	0	no	no	0	no	no
405	110 to Century	0	no	no	0	no	no
405	101 to 5	62	no	no	327	no	no
605	South to 10 [3,6]	12	no	no	not available	not available	not available

Notes:
[1] Bus ridership on OCTA Route 757 not available. Affects 57 (Orange County Line to Route 60).
[2] Bus ridership on OCTA Route 721 not available. Affects all Route 91 segments. No other bus routes on Route 91 Segments. Also affects 110 (Route 91 to Route 105) and 110 (Route 105 to Adams).
[3] Bus ridership on OCTA Route 701 not available. Affects 105 (Route 710 to Route 605). No other routes on that segment. Also affects 110 (Route 105 to Adams) and 605 (South to Route 105). No other bus routes on the 605 segment.
[4] Data not available for Torrance Transit Routes 1 and 2. Affects 110 (Route 105 to Adams).
[5] Data not available for Foothill Transit Route 690 along all Route 210 segments. No other bus routes run along these Segments.
[6] Data not available for Foothill Transit Routes 493 and 495 along Route 605 (Route 60 to Route 10). No other bus routes on this segment.

Figure 4.2.6 MOE 1E: Bus Ridership (Daily/Sum of Both Directions of Flow)



It should be noted that many of the HOV Study Routes are freeways that typically serve suburban-to-suburban trip patterns in Los Angeles County. These trips patterns are more difficult to serve with regular fixed route transit service than the traditional suburban-to-downtown trip pattern. This is evidenced in the analysis results with those routes serving suburban-to-downtown commutes (HOV Study Routes 10, 14 and 110, and Control Routes 5 and 101) having the highest transit utilization rates.

Light rail transit (MTA Green Line) service is provided in the median of Route 105, likely impacting bus ridership, AVO and person trips in the adjacent carpool lanes of this HOV Study Route. Similarly, commuter rail (Metrolink) service is provided immediately adjacent and parallel to Route 14 and Route 60, likely impacting bus ridership, AVO and person trips in the carpool lanes on these HOV Study Routes.

4.3 Objective 2: Encourage Carpooling, Vanpooling, and Bus Use by Providing Travel and Mobility Options

Objective 2 considers the effectiveness of carpool lanes to encourage people to carpool, vanpool or ride transit by providing mobility options. The evaluation of Objective 2 involved the consideration of three MOEs. Utilizing a diverse range of data, the Objective 2 MOEs evaluated Transit Operator Attitudes, Ridersharing Activities, and System Connections, respectively. The analysis methodology and summary of findings for three disparate Objective 2 MOEs is discussed separately for each in the following sections.

4.3.1 MOE 2A: Transit Operators Attitudes

4.3.1.1 Analysis Methodology

MOE 2A covered the public and private transit sectors' attitudes toward carpool lanes. Information from the Executive Interviews discussed in **Chapter 3.0** was utilized to qualitatively analyze this MOE. The public and private transit sector attitudes toward carpool lanes were gauged to supplement the views and opinions of the general public with targeted input from elected officials and transit managers in both the private and public sectors.

4.3.1.2 Summary of Findings

In general, the availability of carpool lanes does impact the routing choices for public and private transportation agencies in order to reduce travel times. However, the availability of carpool lanes is typically not a primary consideration in overall route planning, but rather an added convenience when routes are available. Both public and private transportation agencies indicate that they do modify routes to utilize carpool lanes.

The public transportation agencies have altered their routes to utilize carpool lanes in the delivery of service. The agencies stated that major benefits reaped by using carpool lanes include reduced travel time, improved travel-time reliability, fewer serious accidents, increased operating efficiency, and lower costs.

The private transportation providers such as Super Shuttle, Yellow Cab, and Greyhound all agree that carpool lanes reduce travel time. Super Shuttle proactively seeks out carpool lanes whenever possible in order to reduce travel time and experience less congestion. One

drawback mentioned by Super Shuttle included an increased perception of high-speed accidents due to speed differentials caused by vehicles illegally crossing the buffer where no carpool lane access is provided. The Yellow Cab Administrative Service Co-op stated that whenever possible, drivers alter their routes to utilize carpool lanes. Additionally, Yellow Cab operators always use carpool lanes regardless of congestion levels. Greyhound does not specifically alter bus routing to access carpool lanes, but are very aware of carpool lanes and believe that carpool lanes reduce accidents and travel time while allowing schedules to be maintained.

4.3.2 MOE 2B: Ridesharing Activities

4.3.2.1 Analysis Methodology

Three types of data were utilized in the analysis of MOE 2B: ridesharing programs, census information, and survey results. Two ridesharing programs were identified in the Southern California region, and another in the Pacific Northwest. Because comprehensive data analysis was not possible due to limited and variable statistics, a qualitative analysis was performed for this MOE. Census information was extracted from the 1990 and 2000 census results. Several surveys, described in **Chapter 3.0**, were reviewed with respect to ridesharing programs. Pertinent questions and answers were extracted from the data in order to evaluate this MOE. A comparison of surveys for similar geographic regions with carpool lane systems was conducted, utilizing information from surveys in Seattle (1993 and 1998) and Portland (December 2000).

4.3.2.2 Summary of Findings – Ridesharing Programs

Southern California Rideshare, funded in Los Angeles County by MTA, provides marketing, outreach and program development assistance in the area of transportation demand management (TDM) to employers throughout Los Angeles County. In addition, commuter assistance in the areas of carpooling and vanpooling are provided via the 1-800-COMMUTE telephone information number. Southern California Rideshare, formerly Commuter Transportation Services, is the oldest and largest commute management organization in the country. Southern California Rideshare annually provides services to over 2,500 work sites in Los Angeles County, produces and distributes over 200,000 RideGuides (personalized commuter planners that highlight all of an individual's available commute options, including carpool matchlists), responds to over 10,000 individual requests for rideshare information and maintains the regional database with more than 375,000 individual names for ridematching purposes. Core rideshare services are also provided to commuters within the counties of Orange, Riverside, San Bernardino and Ventura and are funded by the transportation commissions within those respective counties. The rideshare program is an effectual, cost-effective strategy in reaching the sizeable commuter market, attracting new rideshare participants and maintaining existing rideshare arrangements.

In July 2002, responsibility for rideshare program activities for Los Angeles County commuters and employers transitioned from SCAG to MTA. Under the Los Angeles County Rideshare Rewards Program, commuters who previously drove alone to work and then switched to an alternative mode for at least three months are offered a $2 a day rideshare subsidy up to $130. Approximately 79 percent of Rideshare Rewards participants continue to rideshare after their first three months. Existing rideshare participants can take advantage of the Club Metro

Program that enables participants to receive discounts/gift certificates at local vendors as a reward for continuing in their rideshare arrangement. Similar incentive programs operate in both Riverside and San Bernardino counties. Ridesharing activities are also undertaken by transportation management associations and at thousands of employer work sites throughout Los Angeles County. These rideshare programs have provided an effective means to attract carpool and vanpool participants and to sustain ongoing participation.

SCAG conducts the State of the Commute Report every other year to gauge travel behavior characteristics and make comparisons with previous studies. The State of the Commute study also investigates the level of public awareness of rideshare assistance and advertising as well as explores commuter attitudes.

4.3.2.3 Summary of Findings – Census Information

Table 4.3.1 compares the commuting characteristics of Los Angeles County to that of the nation, based on the 1990 and 2000 U.S. Census results. Although Los Angeles County has seen a slight decline in the carpool participation rate during the 1990's, this decline is one-third the rate of decline experienced nationwide. The development of the carpool lane system in Los Angeles County during the 1990's has enabled Los Angeles County to moderate the decline in carpool participation, despite the significant national trend toward drive alone commuting and away from ridesharing and transit.

Table 4.3.1 Commuting Characteristics for Los Angeles County

Means of Transportation	***1990***		***2000***		***1999-2000***
Los Angeles County	***Number***	***Share***	***Number***	***Share***	***Share Change***
Drove alone	2,884,615	70.1%	2,714,944	70.4%	0.3%
Carpooled	**639,570**	**15.5%**	**582,020**	**15.1%**	**-0.4%**
Public Transportation	267,210	6.5%	254,091	6.6%	0.1%
Total: All Workers Age 16 & Over	4,115,248	100.0%	3,858,750	100.0%	
National	***Number***	***Share***	***Number***	***Share***	***Percent***
Drove alone	84,215,298	73.2%	97,102,050	75.7%	2.5%
Carpooled	**15,377,634**	**13.4%**	**15,634,051**	**12.2%**	**-1.2%**
Public Transportation	6,069,589	5.3%	6,067,703	4.7%	-0.6%
Total: All Workers Age 16 & Over	115,070,274	100.0%	128,279,228	100.0%	
Source: Census 1990, Census 2000					

The 1990 Census revealed an average commute time of 25.8 minutes for Los Angeles County residents. Census 2000 indicates that commuting time has increased to 29.4 minutes on average in Los Angeles County reflecting the expansion of residential areas in the suburban periphery of the county and the general decline of population and employment in the urban core of the county.

4.3.2.4 Summary of Findings – Survey Results

According to the results for the General Public Survey, three-quarters of all residents have used carpool lanes in the past, either during peak or off-peak periods. Twenty-six percent of respondents utilized carpools, vanpools, or buses as their primary means of commuting, and more than half of the respondents used carpool lanes in the week prior to completing the survey.

License plate mail-out surveys were conducted with 6,178 respondents who travel Los Angeles County freeways during peak commuting hours. The results of the license plate survey revealed that the availability of carpool lanes plays a significant role in almost 8 out of 10 users decision to carpool or vanpool. Similarly the use of carpool lanes is an important factor in the decision to use carpool lane transit service for 95% of the riders.

Fifty-two percent of Los Angeles County carpool lane users indicated that they had driven alone on the same freeway prior to using carpool lanes, while an additional 9% indicated they had previously driven alone on parallel streets or freeways. This finding clearly demonstrates that the availability of carpool lanes is important in the decision to carpool, and more importantly encourages former drive alone commuters to form carpools.

For SOV commuters on freeways without carpool lanes, almost 30% indicate that they would use carpool lanes if lanes were made available on their freeway. For general-purpose lane users on freeways with HOV lanes, two-thirds indicated that they could be influenced to carpool with some kind of inducement. One-quarter of these respondents indicated that some sort of employer incentive would be enticement to carpool, vanpool, or ride transit, while an additional 22% advised that an easy way to start or join a carpool or vanpool, like the availability of a rideshare program, would be sufficient inducement.

4.3.2.5 Summary of Findings – Survey Comparisons Outside of Los Angeles

The comparison revealed that the percentage of people driving alone is relatively similar in the Seattle and Portland metropolitan regions when compared with Los Angeles, with a range of 64 percent (Seattle) to 73 percent (Los Angeles) of those driving alone. The comparison also revealed that the number of drive-alone vehicles declined in Seattle between 1993 and 1998 and that the total for other commute modes increased during that same time. While the percentage of single drivers in Portland did not vary between 2000 and 2001, there was an increase in carpooling and vanpooling during this time. These results reveal that the Los Angeles carpool lanes carry a lesser share of total commuters than Seattle and Portland, although this comparison does not take into account the much higher population and proportion of total vehicle trips occurring in Los Angeles County and inherent differences in the survey questions and methodology. A comparison of carpool lane usage by qualified carpoolers showed that 53% of Seattle drivers use carpool lanes compared with 47% of Los Angeles drivers. While these values are similar, the lower local value may reflect saturation conditions reached on some Los Angeles County carpool lanes deterring additional use among eligible carpools.

4.3.3 MOE 2C: System Connections

4.3.3.1 Analysis Methodology

System connectivity considers how continuous carpool lanes are and where gaps between lane segments or the availability of park-and-ride facilities could effect use. Park-and-Ride lot information was compiled using the SCAG Park-and-Ride database. Total park-and-ride lots, spaces and utilization rates were summarized for lots located along each of the HOV Study Routes. System continuity was qualitatively assessed using the Los Angeles County carpool lane system maps. Gaps of less than 5 miles between different carpool lanes were identified as system discontinuities. The location of existing carpool lane interchange freeway-to-freeway connector ramps and carpool lane direct access ramps that enhance system connectivity and access were also identified.

4.3.3.2 Summary of Findings – Park-and-Ride Lot Usage

The SCAG rideshare database identifies a total of 124 park-and-ride lots providing 34,289 spaces in Los Angeles County. All Los Angeles County park-and-ride lots are served by some form of public transit services. Twenty-two lots, providing 7,222 spaces, are associated with Metrolink stations, while 102 lots and 27,067 spaces are served by bus and/or Metro rail.

A total of 66 park-and-ride lots providing 17,424 spaces are located within one mile of the HOV Study Routes. Overall utilization for the park-and-ride lots located along the study routes is 53%, although utilization varies significantly along different routes. The single park-and-ride lot located along Route 57 is one of the ten lots that are fully utilized along the study corridors. Approximately 94% of the 2,425 spaces provided in 5 lots along Route 10 (the El Monte Busway) are utilized, while 93% of the 1,231 spaces provided in 2 lots adjacent to Route 134 are utilized. By contrast, only 13% of the 1,950 spaces provided in 5 lots along Route 105 are utilized.

Nine park-and-ride lots providing 635 spaces are located along the Control Routes. Utilization of park-and-ride lots along the Control Routes also varies, with 80% of the 405 spaces available along Route 101 being utilized, while 36% of the 230 spaces provided along the Route 5 are utilized.

Table 4.3.2 highlights the utilization rates for park-and-ride lots along the HOV Study Routes and Control Routes. Many potential factors may affect park-and-ride lot utilization, including transit service and headways provided, market characteristics, trip lengths, security, and access to the lot. Carpool lane proximity or access is only one factor, although it is an important factor.

Table 4.3.2 HOV Study Route Park-and-Ride Lot Utilization

Route	Route Miles	Number of Lots	Number of Spaces	Utilization of Spaces	Lots At or Over Capacity
10	11.0	5	2,425	94%	1
14	16.3	10	1,913	57%	3
57	4.5	1	140	100%	1
60	7.5	3	605	77%	1
91	14.3	2	506	28%	0
105	16.0	10	5,399	33%	0
110	10.7	5	1,950	13%	0
118	11.4	5	819	74%	0
134	12.9	1	215	29%	0
170	6.1	2	1,231	93%	1
210	18.5	5	516	80%	1
405 (101-5)	10.1	2	349	59%	0
405 (OC-Century)	22.2	6	679	30%	1
605	16.9	2	1,865	41%	0
All HOV Study Routes*	***178.4***	***66***	***17,424***	***53%***	***10***
5	6.9	4	230	36%	0
101	8.1	5	405	80%	1

Note: * - Totals adjusted for lots serving more than one HOV Study Route

4.3.3.3 Summary of Findings – System Continuity

Table 4.3.3 shows where gaps exist in the carpool lane system based on a review of Los Angeles County carpool lane maps. **Table 4.3.4** identifies where carpool lane interchange ramps and carpool lane direct access ramps have been provided to enhance connectivity on, and access to, the carpool lane system.

The most notable gaps in the carpool lane system are located near the transition between freeway corridors where carpool lanes terminate prior to freeway-to-freeway interchanges. Relatively short extensions of the Route 10 and Route 110 carpool lanes on both ends would provide a continuous carpool lane corridor extending from Route 605 in the north and Route 405 in the south, a length of approximately 42.8 miles. Similarly, the completion of short segments of carpool lanes on Route 5 and Route 14 would provide carpool lane connections from the Antelope Valley via Route 14 to Simi Valley, Encino, Universal City and San Dimas via Routes 118, 405, 170 and 134/210, respectively.

The only existing carpool lane interchange in Los Angeles County is located at the Route 105/110 interchange. At this interchange, freeway-to-freeway carpool lane connector ramps are provided for both directions of Route 105 to and from the north on Route 110. Direct access ramps between the carpool lanes and arterial streets, park-and-ride lots and transit centers are also provided at the eastern terminus of the Route 105 carpool lanes, and at both the northern and southern termini of the Route 110 carpool lanes. Direct access ramps for the carpool lanes are also provided at four separate locations along Route 10, including the El Monte Bus Station and Route 710 (to and from the north).

The provision of carpool lane direct connections provides benefits for carpool lane users by minimizing the need for interaction between carpool lane traffic and general-purpose traffic. To provide better system continuity, closure of the gaps and the provision of additional carpool lane interchange and direct access ramps could represent priorities for future carpool lane investments in Los Angeles County.

Table 4.3.3 Carpool System Gaps in Los Angeles County

Route(s)	Location	From (Post Mile)	To (Post Mile)
5	405 to 14	41.60	45.73
14		24.79	27.05
5	170 to 118 (via I-5)	36.36	39.36
5	118 to 405 (via I-5)	39.36	41.60
110	110 to 10	20.50	23.73
10		14.84	16.97
10	Baldwin to 605	27.96	31.15
110	405 to 91	8.78	9.87
101	134 to 405 (via US-101)	11.75	17.17
134	5/134 interchange	5.10	5.50

Table 4.3.4 Carpool System Direct Connections in Los Angeles County

Route(s)	Connection Type	Location
105	Carpool lane interchange	105 at 110 (to/from north)
110		
10	Direct access ramps	El Monte Bus Station
10	Direct access ramps	Del Mar Avenue
10	Direct access ramps	710 (to/from north)
10	Direct access ramps	Alameda Street
105	Direct access ramps	Norwalk Metro/Studebaker Road
110	Direct access ramps	Adams Boulevard/Flower Street
110	Direct access ramps	Artesia Transit Center/182nd Street
210	Direct access ramp	Fair Oaks Avenue (to east)

4.4 Objective 3: Provide Travel Time Savings and Trip Reliability to HOV Lane Users

The third objective set forth in the Evaluation Plan described in **Chapter 2.0** is to provide travel time savings and trip time reliability to carpool lane users. As discussed in **Chapter 2.0**, two MOEs were developed in the Evaluation Plan for evaluation of HOV performance relative to travel time savings and trip time reliability:

- MOE 3A: Travel Time Savings - Difference in travel time for vehicles in the HOV lane from those in the freeway general-purpose lanes during the peak period in the peak direction.

- MOE 3B: Speed - Average travel speed in the HOV lanes as an indicator of congested conditions.

The first MOE under this objective focuses on travel time savings for vehicles in the carpool lane(s) compared to those in the adjacent general-purpose lanes on the same freeway. The second MOE indicates whether a particular carpool facility is utilized to such an extent that it is operating under congested conditions, thereby reducing trip reliability.

4.4.1 Analysis Methodology

Evaluation of the interrelated Objective 3 MOEs involved analysis of average travel speeds and comparative travel time savings. **Table 4.4.1** presents the effectiveness thresholds, time periods, and data used for the evaluation of the Objective 3 MOEs.

Table 4.4.1 Objective 3 Measures Of Effectiveness – Evaluation Parameters

MOE		Effectiveness Thresholds	Times of Day & Directions Analyzed	Time Periods Analyzed [a]	Data	Comments
3A	Travel Time Savings - Travel Time Saved by Using HOV Lane	Travel time saved in the carpool facility should be at least 0.5 minutes per mile for peak period in peak direction, compared against the adjacent general-purpose lanes. *[threshold 3A]*	Weekday AM & PM peak periods for peak direction	Current (2000)	Average Travel Time (current) (carpool lanes, general-purpose lanes); Travel Time Saved (current) (carpool lanes vs. general-purpose lanes); Travel Time Saved per Mile (current) (carpool lanes vs. general-purpose lanes)	
3B	Speed - Average Travel Speed in HOV Lane indicating Congestion	Average speeds in the carpool lane should be greater than 35 miles per hour (mph). Speeds less than 35 miles per hour indicate congestion. *[threshold 3B]*	Weekday AM & PM peak periods for peak direction	Current (2000)	Average Travel Speed (current) (carpool lanes, general-purpose lanes)	Caltrans defines congested freeway locations as those where average speeds are 35 mph or less during peak commute periods on a typical incident-free weekday.

Notes:

a. "Current" = current year of evaluation for the HOV Performance Program; for this initial performance evaluation, the year 2000 was used. The Caltrans travel time runs on Route 10 (the El Monte Busway) were conducted in the summer of 2000 during the transition period from 2+ to 3+ persons per vehicle operation. Actual travel time savings on the El Monte Busway before the 2+ demonstration project began (i.e., before January 2001) and again after conditions stabilized after conversion back to 3+ during peak periods (later in 2002) were and are greater than those reported herein.

General parameters governing the evaluation included the following:

- Times of Day and Directions Analyzed - Although traffic congestion may occur at any time, the benefits of carpool lanes are expected to be greatest during the morning and afternoon peak periods when the greatest demands are placed on the freeway system. Therefore, MOE analyses were generally conducted for the peak direction of travel during the AM peak period and the peak direction of travel during the PM peak period.

- Days of Week Analyzed - Although traffic congestion may occur on any day, the benefits of carpool lanes are expected to be greatest during weekday commute peak periods when the greatest demands are placed on the freeway system. Therefore, MOE analyses were conducted for weekday conditions.

- Time Periods Analyzed - Historical speed data was not available from Caltrans' files. Therefore, the Objective 3 MOEs were evaluated for "current" (year 2000) conditions only. The Caltrans travel time runs conducted for this study were conducted for most of the HOV Study Routes in 2000, although a few routes were conducted in late 1999 or early 2001.

Analysis of the Objective 3 MOEs specifically required the following data:

- Tach Runs - Travel time runs conducted by Caltrans District 7 staff. Numerous runs were conducted by different observers on each HOV Study Route, by direction and separately for the carpool and general-purpose lanes. Travel time and delay data were recorded automatically from the vehicle tachometer for each run.

The data was subjected to a series of checks to ensure accuracy, reliability, and suitability for the purposes of the HOV Performance Program evaluation.

4.4.2 Effectiveness Thresholds

4.4.2.1 MOE 3A: Travel Time Savings - Difference in Travel Time for Vehicles in the HOV Lane from those in the Freeway General-Purpose Lanes During the Peak Period, in the Peak Direction

The effectiveness threshold established for MOE 3A, travel time savings, is as follows:

- Travel time saved in the carpool facility should be at least 0.5 minutes per mile for the peak period in the peak direction, compared to the adjacent general-purpose lanes. *[threshold 3A]*

The HOV Systems Manual (NCHRP Report 414, 1998) identifies minimum travel time savings of 1.0 minute per kilometer or a total time savings of five to seven minutes per trip as appropriate thresholds. The HOV Systems Manual threshold values were considered by the HOV Performance Program PAT in establishing the threshold for MOE 3A. It was determined that due to the average length of HOV Study Routes (11.1 miles) and the average commute time of Los Angeles County residents (29.4 minutes[12]), a minimum travel time savings of 0.5 minutes per mile would be appropriate to reflect a total travel time savings of more than five minutes for the duration of an average commute using one or more HOV Study Routes.

[12] Census 2000 Summary File 3 (SF 3) for Los Angeles County

4.4.2.2 MOE 3B: Speed - Average Travel Speed in the HOV Lanes as Indicator of Congested Conditions

The effectiveness threshold established for MOE 3B, average travel speed in the carpool lanes as an indicator of congestion, is as follows:

- Average speeds in the carpool lane should be greater than 35 miles per hour (mph). Speeds less than 35 mph indicate congestion.[13] *[threshold 3B]*

4.4.3 Summary of Findings

The Objective 3 evaluation results are presented in **Tables 4.4.2** and **4.4.3** and **Figures 4.4.1(a)**, **4.4.1(b)**, **4.4.2(a)** and **4.4.2(b)**. A review of the Objective 3 analysis results indicate that all of the carpool lanes realize travel time savings to varying degrees over the adjacent general-purpose lanes. Ten of the 16 HOV Study Routes realize travel time savings that meet or exceed the MOE 3A threshold criterion of 0.5 minutes per mile during one or both peak periods: Routes 10, 57, 60, 91, 110 (105 to Adams), 170, 210, 405 (Orange County line to 110), 405 (110 to Century), and 405 (101 to 5). The six exceptions that do not meet or exceed the threshold during one or both peaks are Routes 14, 105, 110 (91 to 105), 118, 134, and 605. Travel time savings on four of the HOV Study Routes, Routes 91, 110 (105 to Adams), 210, and 405 (101 to 5), exceed the threshold test level during both peak periods.

Three of the 16 HOV Study Routes experience average travel speeds of less than 35 mph during one or both peak periods, indicating congested conditions as prescribed by MOE 3B. The three HOV Study Routes are Route 57 (both peaks), Route 105 (eastbound during PM peak), and Route 405 (southbound during AM peak).

Further review of the MOE 3B analysis results indicate that travel time savings on six of the 16 HOV Study Routes, although real, did not meet the threshold criterion for one of the following reasons:

- High speeds in both the carpool and general-purpose lanes on freeways that, based on the speed and travel time data, currently do not experience high levels of congestion. Examples are Routes 14, 110 (91 to 105), 118, and 134. On Route 14 and Route 110 (91 to 105), the carpool lanes are heavily utilized (greater than 1,200 vphpl each peak period/peak direction) despite the relatively low level of travel time savings, suggesting that motorists may be choosing to use the carpool lanes for trip time reliability in addition to merely time savings. On each of these freeways, it is anticipated that continued traffic growth will ultimately lead to lower travel speeds in the general-purpose lanes, increasing the carpool travel time savings in the future and further improving the attractiveness of the carpool lanes relative to the general-purpose lanes.

- Low speeds in the HOV lanes related to high levels of lane utilization. Examples include Route 57 southbound during the AM peak period and Route 105 eastbound during the PM peak period. It should be noted that, although the desired travel time savings may not be realized in this situation, the high level of HOV lane utilization actually suggests the HOV lanes are very successful.

[13] Caltrans defines congested freeway locations as those where average speeds are 35 mph or less during peak commute periods on a typical incident-free weekday.

Table 4.4.2 MOE 3A: Travel Time Savings for HOV Lanes Compared to General-Purpose Lanes

(Threshold: Minutes saved per mile in HOV lanes relative to general-purpose lanes should exceed minimum threshold value)

HOV Study Routes		Length (miles)	Travel Speed (mph) *[a]*		HOV Travel Time Savings (minutes)		HOV Travel Time Savings (minutes per mile)		Time Savings Threshold	Meets or Exceeds Threshold
			AM Peak Direction	PM Peak Direction	AM Peak Direction	PM Peak Direction	AM Peak Direction	PM Peak Direction		
10	Alameda St. to Baldwin Av. *[b]*	11.0	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound		
	Mixed Flow Lanes		*27*	*39*	*12.9*	*4.5*	*1.2*	*0.4*	*>= 0.5 min/mile*	***yes***
	HOV Lanes		*57*	*53*						
14	San Fernando Rd. to Escondido Canyon Rd. *[c]*	16.3	Southbound	Northbound	Southbound	Northbound	Southbound	Northbound		
	Mixed Flow Lanes		*64*	*62*	*1.7*	*1.0*	*0.1*	*0.1*	*>= 0.5 min/mile*	***no***
	HOV Lanes		*72*	*66*						
57	Orange County Line to Route 60	4.5	Southbound	Northbound	Southbound	Northbound	Southbound	Northbound		
	Mixed Flow Lanes		*26*	*22*	*0.7*	*2.6*	*0.2*	*0.6*	*>= 0.5 min/mile*	***yes***
	HOV Lanes		*28*	*28*						
60	Brea Canyon Rd. to San Bernardino County Line *[c]*	7.5	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound		
	Mixed Flow Lanes		*39*	*57*	*3.9*	*1.0*	*0.5*	*0.1*	*>= 0.5 min/mile*	***yes***
	HOV Lanes		*59*	*65*						
91	Route 110 to Orange County Line	14.3	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound		
	Mixed Flow Lanes		*32*	*26*	*12.5*	*15.8*	*0.9*	*1.1*	*>= 0.5 min/mile*	***yes***
	HOV Lanes		*60*	*50*						
105	Route 405 to Route 605	16.0	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound		
	Mixed Flow Lanes		*43*	*26*	*2.7*	*2.6*	*0.2*	*0.2*	*>= 0.5 min/mile*	***no***
	HOV Lanes		*49*	*28*						
110	Route 91 to Route 105	4.0	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound		
	Mixed Flow Lanes		*55*	*59*	*0.3*	*0.4*	*0.1*	*0.1*	*>= 0.5 min/mile*	***no***
	HOV Lanes		*59*	*66*						
110	Route 105 to Adams Bl.	6.7	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound		
	Mixed Flow Lanes		*22*	*34*	*11.5*	*4.5*	*1.7*	*0.7*	*>= 0.5 min/mile*	***yes***
	HOV Lanes		*59*	*55*						
118	Ventura County Line to Route 5	11.4	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound		
	Mixed Flow Lanes		*63*	*59*	*1.2*	*1.8*	*0.1*	*0.2*	*>= 0.5 min/mile*	***no***
	HOV Lanes		*71*	*70*						
134	Routes 101/170 to Route 210	12.9	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound		
	Mixed Flow Lanes		*57*	*57*	*2.0*	*1.7*	*0.2*	*0.1*	*>= 0.5 min/mile*	***no***
	HOV Lanes		*67*	*65*						
170	Routes 101/134 to Route 5	6.1	Southbound	Northbound	Southbound	Northbound	Southbound	Northbound		
	Mixed Flow Lanes		*33*	*34*	*4.2*	*2.1*	*0.7*	*0.3*	*>= 0.5 min/mile*	***yes***
	HOV Lanes		*53*	*42*						
210	Route 134 to Sunflower Av.	18.5	Westbound	Eastbound	Westbound	Eastbound	Westbound	Eastbound		
	Mixed Flow Lanes		*27*	*24*	*11.1*	*21.6*	*0.6*	*1.2*	*>= 0.5 min/mile*	***yes***
	HOV Lanes		*37*	*45*						
405	Orange County Line to Route 110 *[c]*	13.0	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound		
	Mixed Flow Lanes		*46*	*35*	*4.0*	*7.3*	*0.3*	*0.6*	*>= 0.5 min/mile*	***yes***
	HOV Lanes		*60*	*52*						
405	Route 110 to Century Bl.	9.2	Northbound	Southbound	Northbound	Southbound	Northbound	Southbound		
	Mixed Flow Lanes		*25*	*31*	*10.3*	*7.8*	*1.1*	*0.8*	*>= 0.5 min/mile*	***yes***
	HOV Lanes		*47*	*55*						
405	Route 101 to Route 5	10.1	Southbound	Northbound	Southbound	Northbound	Southbound	Northbound		
	Mixed Flow Lanes		*13*	*41*	*28.8*	*3.1*	*2.9*	*0.3*	*>= 0.5 min/mile*	***yes***
	HOV Lanes		*34*	*52*						
605	South St. to Route 10 *[c]*	16.9	Southbound	Northbound	Southbound	Northbound	Southbound	Northbound		
	Mixed Flow Lanes		*43*	*41*	*6.4*	*7.5*	*0.4*	*0.4*	*>= 0.5 min/mile*	***no***
	HOV Lanes		*59*	*59*						

Notes:

a. Based on Caltrans tach runs conducted during peak periods primarily between mid-2000 and early 2001, depending on location.

b. Travel time data collected in summer 2000 during transition period from 2+ to 3+ persons per vehicle during peak hours.

c. HOV lanes in operation for less than three years at time of travel time data collection.

Figure 4.4.1(a) **MOE 3A: Average Travel Time Savings (AM Peak Period/Peak Direction of Flow) (Minutes Saved Along Entire HOV Study Route)**

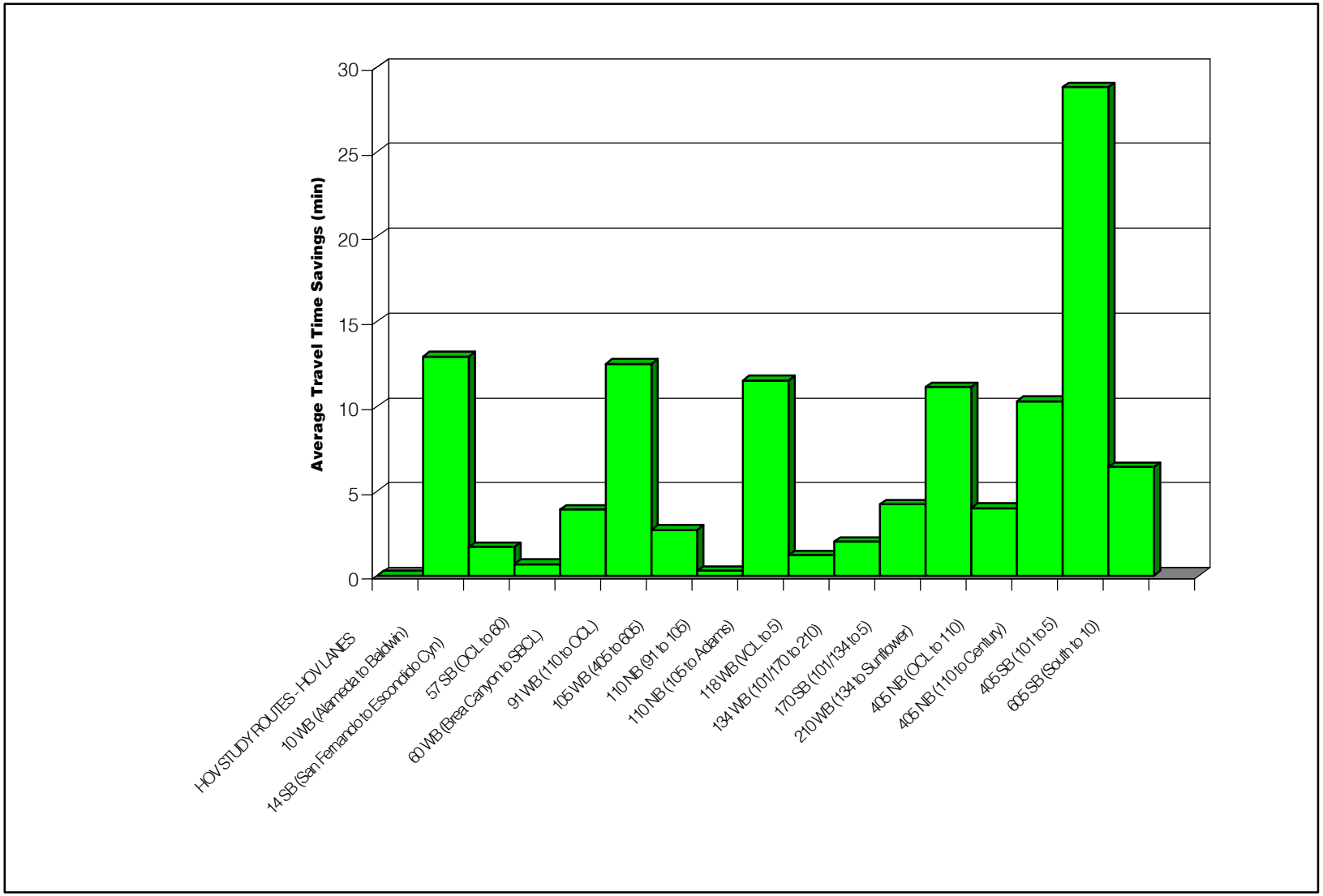


Figure 4.4.1(b) **MOE 3A: Average Travel Time Savings (PM Peak Period/Peak Direction of Flow) (Minutes Saved Along Entire HOV Study Route)**

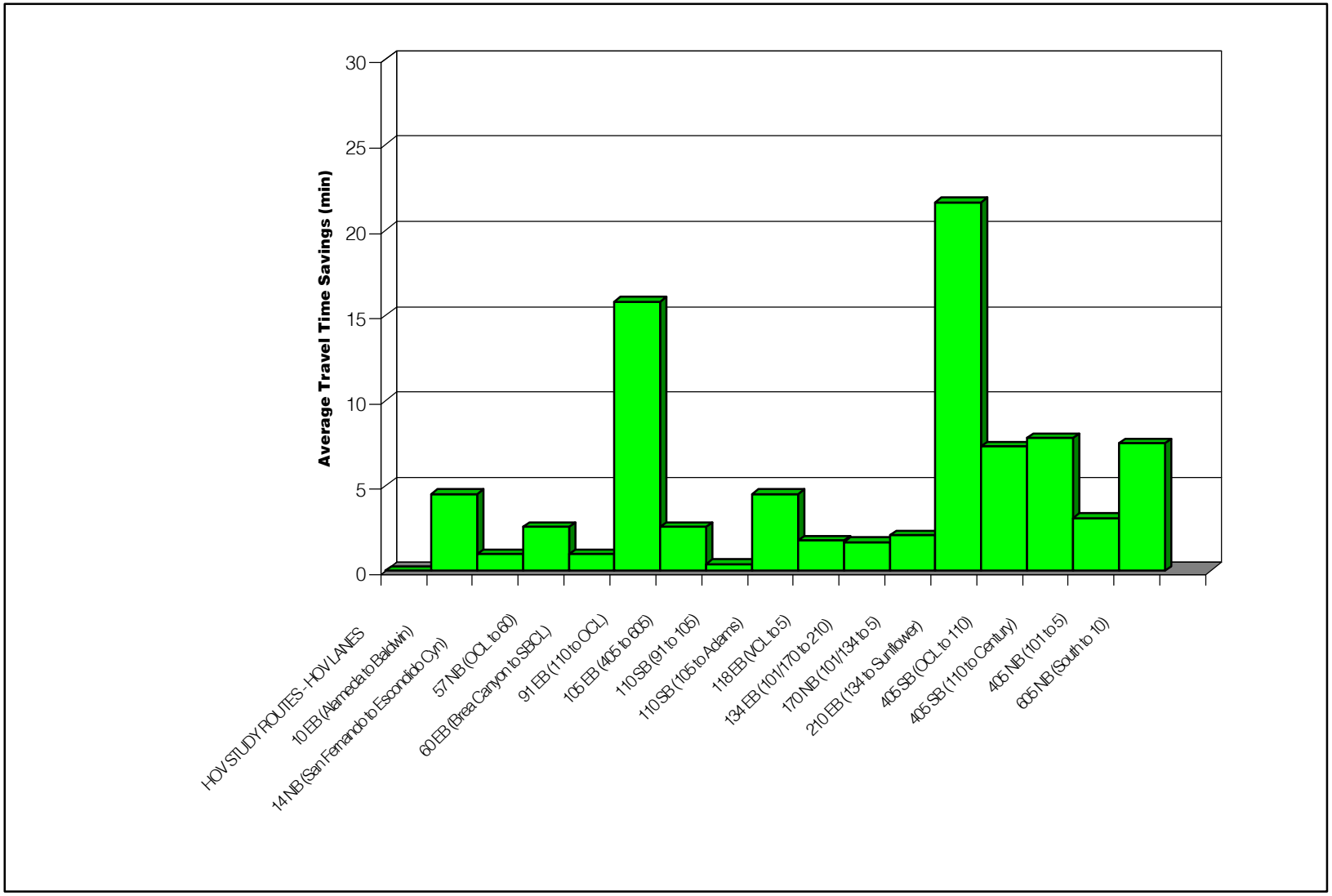


Table 4.4.3 MOE 3B: Average Travel Speed in HOV Lanes
(Threshold: Minimum speed threshold indicating if the lane is congested)

HOV Study Routes		Length (miles)	Travel Speed (mph) *[a]*		Congestion Threshold	HOV Lanes Congested?		Notes
			AM Peak Direction	PM Peak Direction		AM Peak Direction	PM Peak Direction	
10	Alameda St. to Baldwin Av. *[b]*	11.0	Westbound	Eastbound		Westbound	Eastbound	
	HOV Lanes		*57*	*53*	*<= 35 mph*	***ok***	***ok***	*[b]*
14	San Fernando Rd. to Escondido Canyon Rd. *[c]*	16.3	Southbound	Northbound		Southbound	Northbound	
	HOV Lanes		*72*	*66*	*<= 35 mph*	***ok***	***ok***	*[c]*
57	Orange County Line to Route 60	4.5	Southbound	Northbound		Southbound	Northbound	
	HOV Lanes		*28*	*28*	*<= 35 mph*	***congested***	***congested***	
60	Brea Canyon Rd. to San Bernardino County Line *[c]*	7.5	Westbound	Eastbound		Westbound	Eastbound	
	HOV Lanes		*59*	*65*	*<= 35 mph*	***ok***	***ok***	*[c]*
91	Route 110 to Orange County Line	14.3	Westbound	Eastbound		Westbound	Eastbound	
	HOV Lanes		*60*	*50*	*<= 35 mph*	***ok***	***ok***	
105	Route 405 to Route 605	16.0	Westbound	Eastbound		Westbound	Eastbound	
	HOV Lanes		*49*	*28*	*<= 35 mph*	***ok***	***congested***	
110	Route 91 to Route 105	4.0	Northbound	Southbound		Northbound	Southbound	
	HOV Lanes		*59*	*66*	*<= 35 mph*	***ok***	***ok***	
110	Route 105 to Adams Bl.	6.7	Northbound	Southbound		Northbound	Southbound	
	HOV Lanes		*59*	*55*	*<= 35 mph*	***ok***	***ok***	
118	Ventura County Line to Route 5	11.4	Westbound	Eastbound		Westbound	Eastbound	
	HOV Lanes		*71*	*70*	*<= 35 mph*	***ok***	***ok***	
134	Routes 101/170 to Route 210	12.9	Westbound	Eastbound		Westbound	Eastbound	
	HOV Lanes		*67*	*65*	*<= 35 mph*	***ok***	***ok***	
170	Routes 101/134 to Route 5	6.1	Southbound	Northbound		Southbound	Northbound	
	HOV Lanes		*53*	*42*	*<= 35 mph*	***ok***	***ok***	
210	Route 134 to Sunflower Av.	18.5	Westbound	Eastbound		Westbound	Eastbound	
	HOV Lanes		*37*	*45*	*<= 35 mph*	***ok***	***ok***	
405	Orange County Line to Route 110 *[c]*	13.0	Northbound	Southbound		Northbound	Southbound	
	HOV Lanes		*60*	*52*	*<= 35 mph*	***ok***	***ok***	*[c]*
405	Route 110 to Century Bl.	9.2	Northbound	Southbound		Northbound	Southbound	
	HOV Lanes		*47*	*55*	*<= 35 mph*	***ok***	***ok***	
405	Route 101 to Route 5	10.1	Southbound	Northbound		Southbound	Northbound	
	HOV Lanes		*34*	*52*	*<= 35 mph*	***congested***	***ok***	
605	South St. to Route 10 *[c]*	16.9	Southbound	Northbound		Southbound	Northbound	
	HOV Lanes		*59*	*59*	*<= 35 mph*	***ok***	***ok***	*[c]*

Notes:

a. Based on Caltrans tach runs conducted during peak periods primarily between mid-2000 and early 2001, depending on location.

b. Travel time data collected in summer 2000 during transition period from 2+ to 3+ persons per vehicle during peak hours.

c. HOV lanes in operation for less than three years at time of travel time data collection.

Figure 4.4.2(a) MOE 3B: Average Travel Speed (AM Peak Period/Peak Direction of Flow)

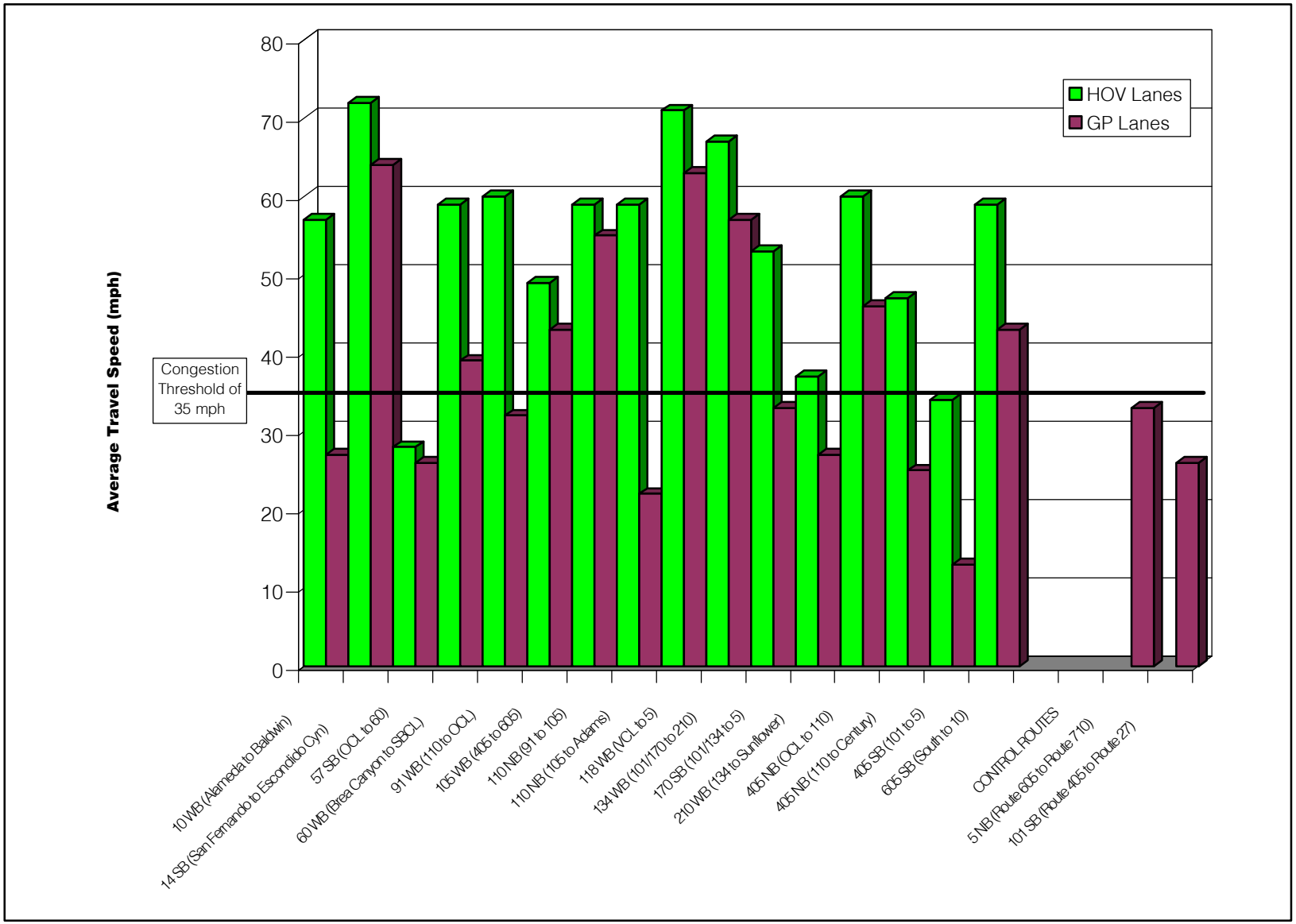
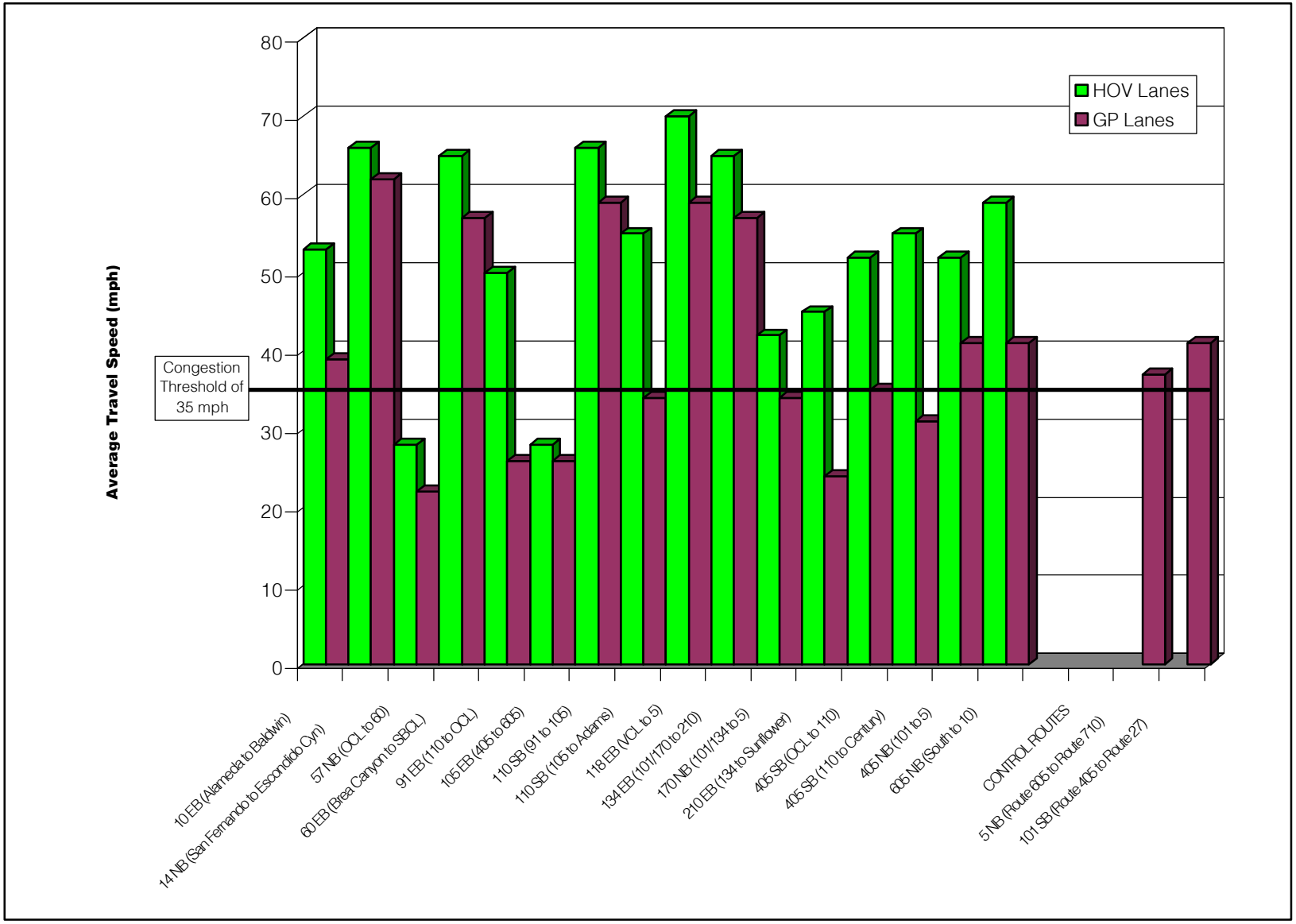


Figure 4.4.2(b) MOE 3B: Average Travel Speed (PM Peak Period/Peak Direction of Flow)



- Low speeds encountered as vehicles in the carpool lanes approach the carpool lane terminus and experience delays reentering the general-purpose traffic stream. These delays can nullify travel time savings accrued upstream while traveling in the carpool lane. Examples include Route 134 westbound during both peak periods and Route 170 northbound during the PM peak period. The low travel speeds (less than 35 mph) on Route 57 northbound during the PM peak and Route 405 (101 to 5) southbound during the AM peak are also related to this effect, even though the travel time savings on these facilities exceeded the threshold value.

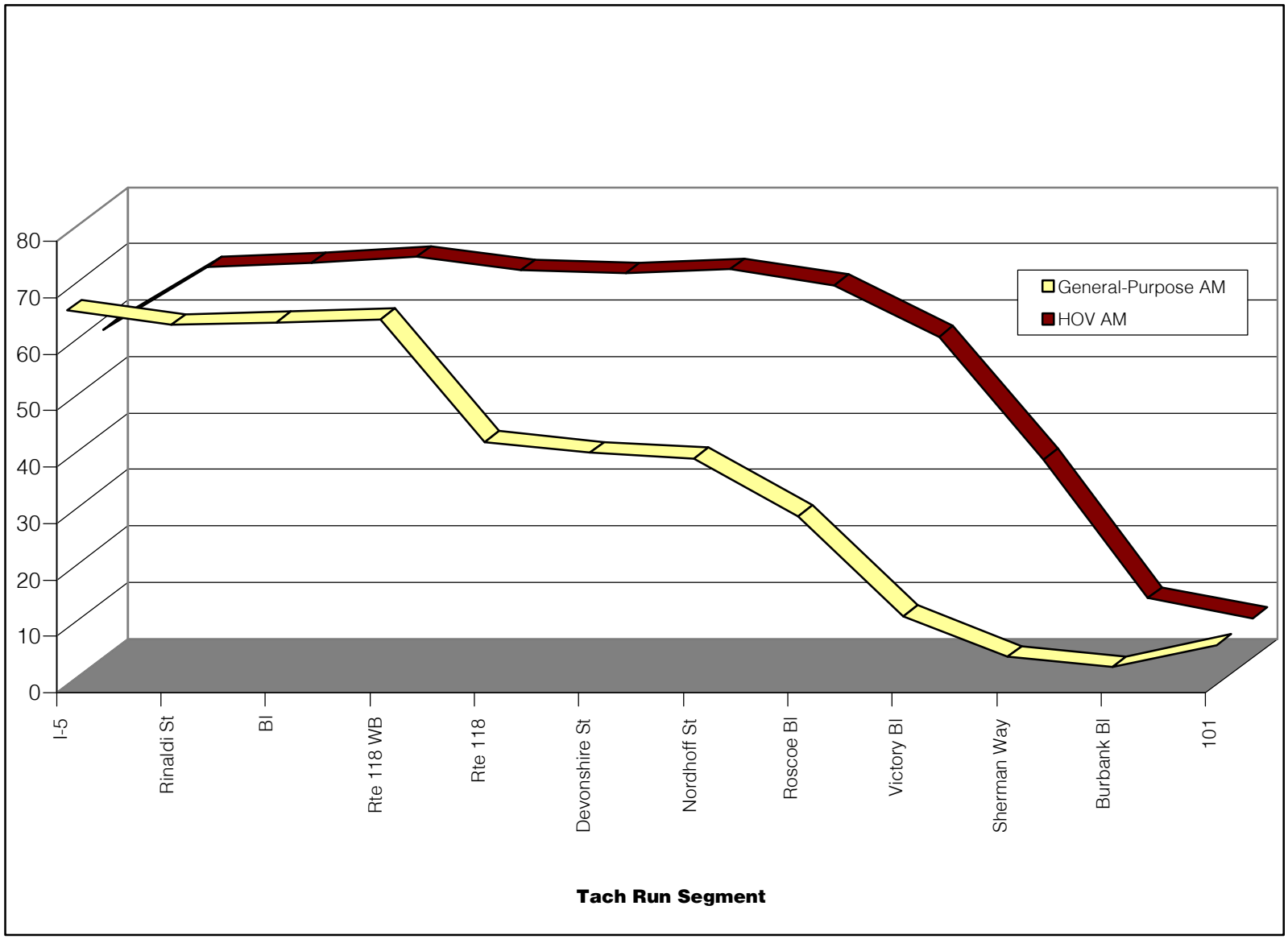
  Figure 4.4.3 presents an example of this phenomenon, illustrating the southbound AM average speeds per tach run link for Route 405 from 5 to 101. The chart in this figure illustrates the average travel speeds in both the carpool lane and the adjacent general-purpose lanes. The area between the lines in this chart is illustrative of the travel time savings being realized by carpool lane users. As can be seen, the general-purpose lanes began to slow down south of Route 118 and dropped below 35 mph south of Roscoe Boulevard. High speeds were maintained in the carpool lanes until around Victory Boulevard, where the speeds declined dramatically as the carpool lane neared its endpoint negating some of the previously accumulated travel time savings.

  The Route 405 (101 to 5) southbound AM peak period delay at the carpool lane terminus has since been alleviated with the extension of the southbound HOV lane across Sepulveda Pass to Waterford, which opened in January 2002 subsequent to the current year of analysis data for the HOV Performance Program. This suggests that extending and eliminating gaps in the HOV system could improve travel time savings by reducing the number of terminus locations at which delays are incurred.

It should be noted that the Caltrans travel time runs on Route 10 (the El Monte Busway) were conducted in the summer of 2000 during the transition period from 2+ to 3+ persons per vehicle operation. Actual travel time savings on the El Monte Busway before the 2+ demonstration project began (i.e., before January 2000) and after conditions stabilized following conversion back to 3+ during peak periods (later in 2000) were and are greater than the travel time savings results reported herein.

It should also be noted that the travel time run data upon which the above analyses were based reflect travel times and speeds along the mainline portions of the carpool lanes only. Carpool lane users experience additional travel time savings not reflected in the Objective 3 analyses at freeway on-ramp HOV bypass lanes and direct access ramps located throughout the system. Furthermore, carpool lane users utilizing the carpool lane direct connector ramps at the 105/110 interchange accrue additional travel time savings by not having to exit the carpool system and merge through congested general-purpose traffic in order to transition between the two freeways. Separate field data collected in February of 2002 indicates that average travel time savings at the 105/110 carpool lane direct connector ramps range from 20 seconds to up to eight minutes during the AM peak period and from 15 seconds to over two minutes during the PM peak period, depending on the direction of the ramp.

Figure 4.4.3 Average Speed by Tach Run Link (Southbound Route 405 from Route 5 to Route 101/AM Peak Period)



4.5 Objective 4: Provide Air Quality Benefits

It is generally believed that by carrying more people in fewer vehicles, carpool lanes should have a positive influence on air quality. While this issue has been greatly debated, no comprehensive evaluation has ever been conducted to confirm this hypothesis.

The evaluation of Objective 4 was an initial attempt to quantify the affects of roadways containing carpool lanes on vehicular emissions in Los Angeles County. The evaluation was completed using existing speed and vehicle occupancy data for carpool and general-purpose lanes. Due to data limitations, a comprehensive air quality evaluation was not possible. The evaluation of Objective 4 involved a simple comparison of vehicle emission between the carpool study routes and the two control routes, and a comparison of vehicle emissions between carpool lanes and adjacent general-purpose lanes on the same route.

4.5.1 Analysis Methodology

The evaluation of Objective 4 involved the estimation of vehicular emissions for a number of carpool analysis segments that include carpool and general-purpose lanes, and the two study control routes that are comprised only of general-purpose lanes. Emissions were estimated in grams of pollutant emitted per passenger mile traveled. Emission rates for carbon monoxide (CO), nitrogen oxides (NO_x), reactive organic gases (ROG), and particulate matter (PM_{10}) were compared between the carpool analysis segments and the control routes using actual traffic conditions for current AM and PM peak periods.

Caltrans version of the California Air Resources Boards EMissionFACtors7F program (CT-EMFAC) emission factor algorithm was used to estimate CO, ROG and NO_x emission factors. The USEPA Part 5 algorithm was used to estimate PM_{10} emission factors.

Emission rates in grams per vehicle mile for the two control segments were estimated directly using the appropriate emission factor algorithms and input variables. These values were then divided by the appropriate AVO rates to normalize emission rates in grams per person mile.

Vehicular emission rates for the combined carpool/general-purpose lane analysis segments were developed by separately estimating the emission rates for the carpool and general-purpose lanes, and then calculating weighted-average values for each combined freeway segment. These composite emission factors were then compared to the values for the control routes.

4.5.2 Summary of Findings

4.5.2.1 MOE 4A: HOV Corridor Vehicle Emissions

Based on the results illustrated in **Figures 4.5.1** and **4.5.2**, it appears that approximately one-half (in the AM peak period) to three-quarters (in the PM peak period) of the carpool analysis segments do not perform as well as the two control routes. However, in considering these results, it is necessary to note the limitations of this analysis.

Figure 4.5.1 Comparison of AM Peak Period Emission Rates to Control Routes

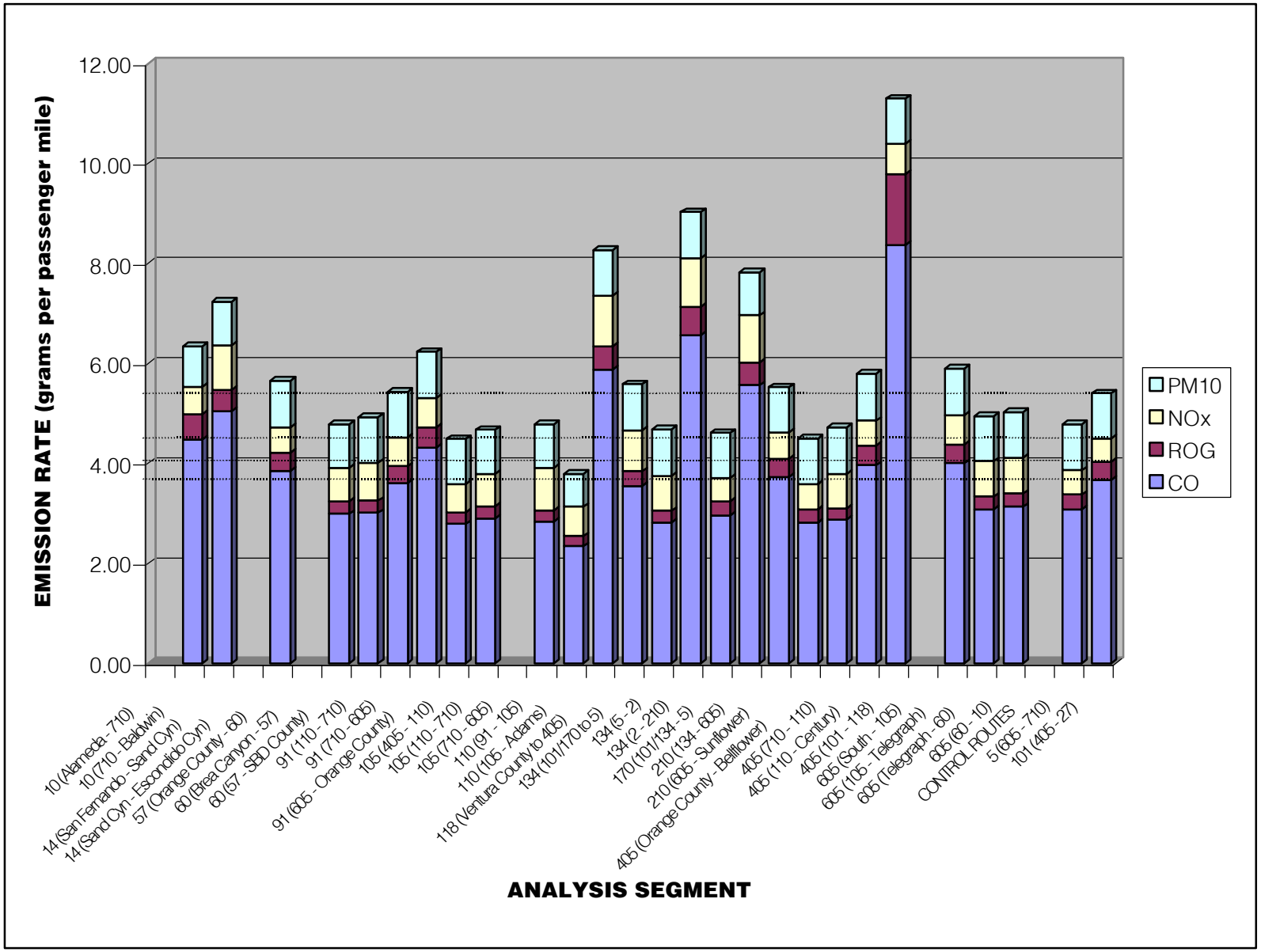
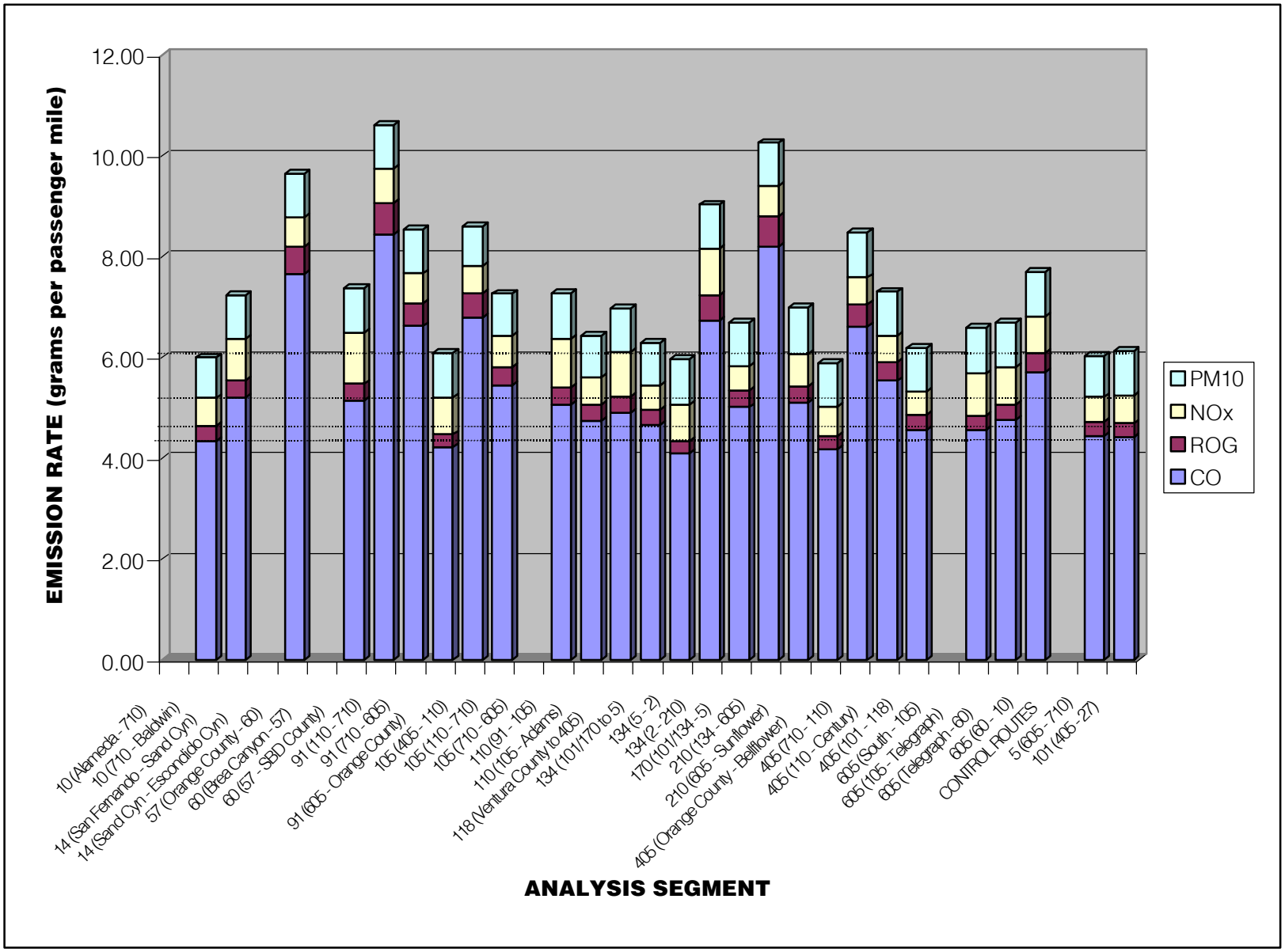


Figure 4.5.2 Comparison of PM Peak Period Emission Rates to Control Routes



The analysis of emissions for freeways with carpool lanes was limited to a comparison with two control routes that are both operating at speeds generally within the optimal speed range for most pollutant types. Many of the carpool analysis segments analyzed had significant congestion in the general-purpose lanes compared to traffic conditions on the two control routes, resulting in higher emission rates for many of the carpool analysis segments. Despite higher AVO in the carpool lanes, the substantially greater traffic volume and lower AVO in the general-purpose lanes offset any emission benefit of the carpool lanes making it difficult to conclusively determine the comparative benefit between corridors with carpool lanes, and those without. To better assess the comparative emissions between freeways with carpool lanes and freeways without carpool lanes, it would be appropriate to consider a larger sample of control routes before the results of this analysis could be considered to be statistically valid.

4.5.2.2 MOE 4B: HOV Lane Vehicle Emissions

Figure 4.5.3 and **4.5.4** summarize the results of the evaluation of MOE 4B. When comparing the relative emissions between carpool lanes and general-purpose lanes in the same analysis segment, it is evident that the general-purpose lanes typically generate most of the emissions. For the majority of analysis segments, carpool lane emission rates are half those of the adjacent general-purpose lanes even though carpool lanes typically carry more person trips. A notable exception was the Route 110 (105 to Adams) analysis segments during the AM peak period where emissions in the carpool lanes exceeded those in the general-purpose lanes. This result is most likely a product of the average travel speed differential between each lane type, and the relationship between average travel speed and emission rates. Significantly lower emission rates in the carpool lanes contribute to effectively reduce the emission rate for the overall corridor. However, despite the contribution of carpool lanes to generally reduce corridor emissions, the lower emission rates of carpool lanes are not able to substantially offset the higher emission rates in more congested and more heavily traveled general-purpose lanes.

Figure 4.5.3 Combined AM Peak Period Emission Rates by Lane Type (Combined CO, ROC, NO_X and PM_{10} Emission Rates)

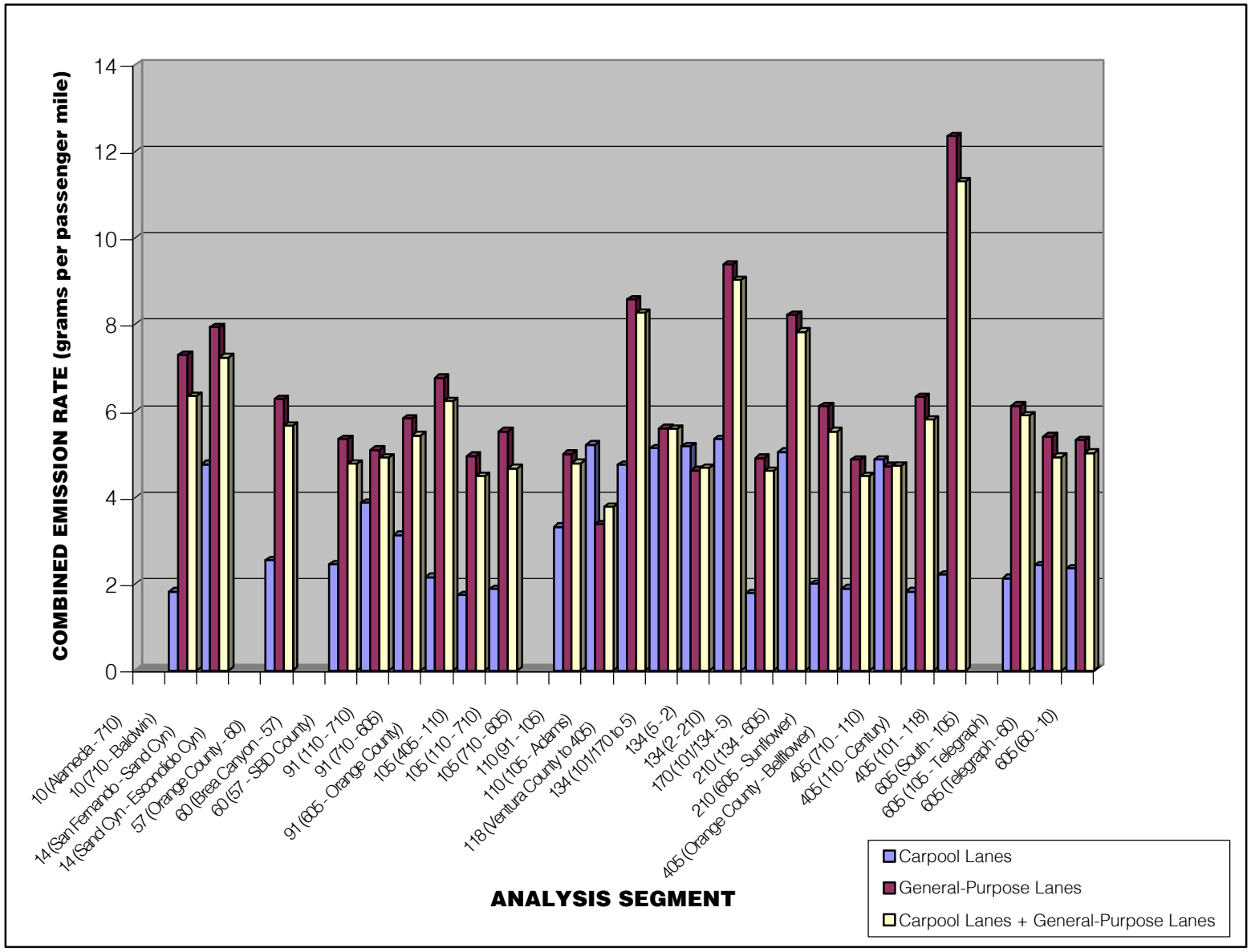
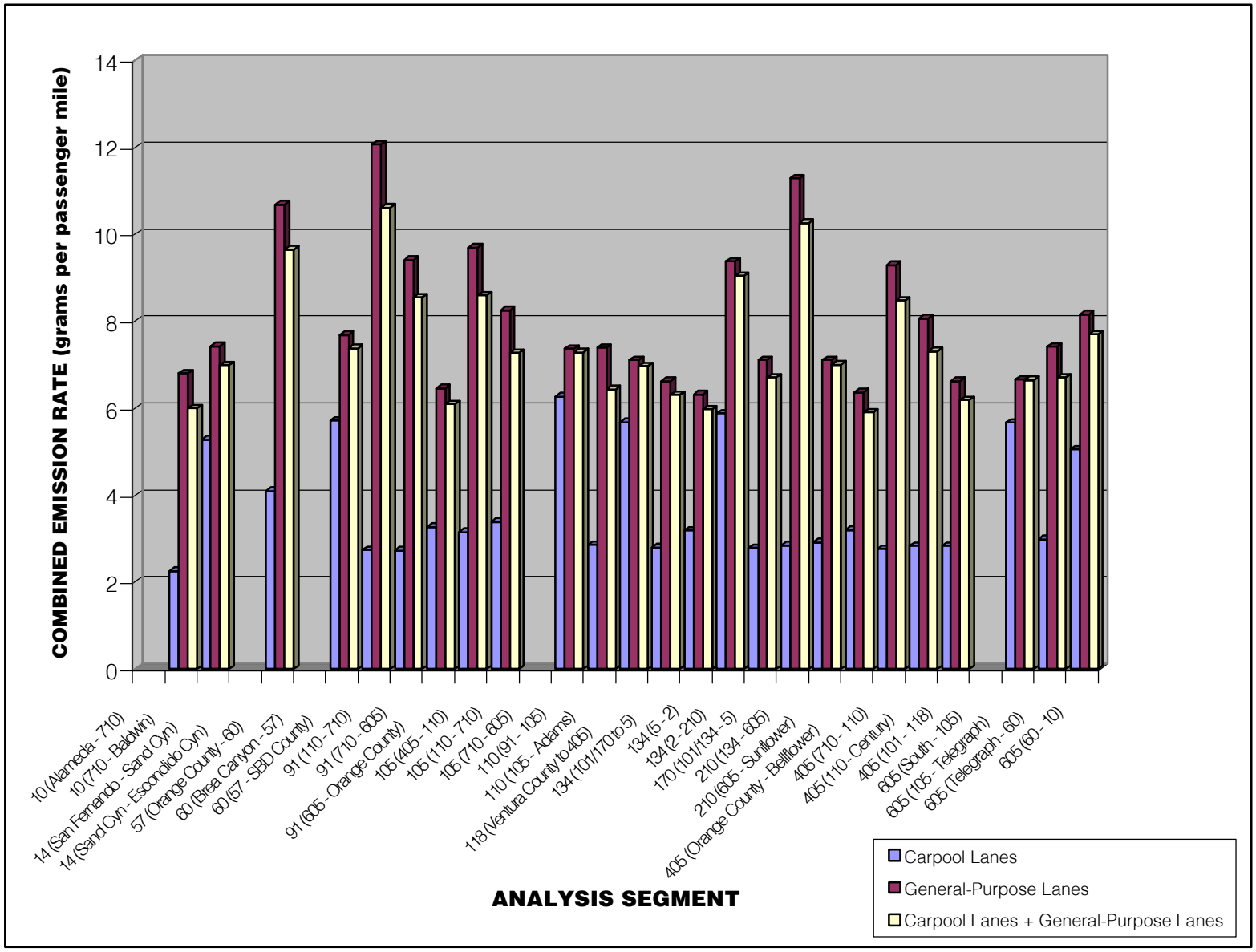


Figure 4.5.4 Combined PM Peak Period Emission Rates by Lane Type (Combined CO, ROC, NO_X and PM_{10} Emission Rates)



4.6 Objective 5: Promote a Cost-Effective Transportation System

4.6.1 MOE 5A: Transit Operations

Currently, 46 bus routes operate on the HOV Study Routes with 42 of these routes operating within the carpool lanes. The major operators are the MTA, Foothill Transit, AVTA, and Santa Clarita Transit. Executive interviews with transit providers and a review of express bus route cost data were the basis for the qualitative analysis of this MOE.

4.6.1.1 Analysis Methodology

A detailed quantitative analysis of this MOE was not possible due to the lack of necessary operating cost data specific to carpool lane transit operations. The transit operators made available limited cost data on express bus operations, and comments made by transit personnel during the Executive Interviews provide an indication of the benefits that carpool lanes provide to express bus operations. A more detailed analysis was not possible based on records kept by the transit operators.

4.6.1.2 Summary of Findings

Due to limited existing and historical data, only selected types of operating cost data were compiled and presented in **Table 4.6.1**. The variations and inconsistency in available transit operating data meant it was not possible to conclusively evaluate transit performance for routes that operate in carpool lanes as part of this study.

During the executive interviews, representatives from four transit systems – Foothill Transit, LADOT Commuter Express, OCTA, and Torrance Transit – all indicated that the carpool lanes have positively influenced bus operations. Personnel from MTA and Santa Clarita Transit indicated that the carpool lanes had not significantly influenced their daily bus operations. The two major reasons for this reaction was that they are not able to utilize the carpool lanes extensively, and buses get stuck in traffic on other parts of their routes, negating any travel time savings realized from the carpool lanes. Representatives from all six transit systems noted that they have altered transit routes to some extent to take advantage of the carpool lanes.

Table 4.6.1 Available Cost Data on Express Bus Operations (In Actual Year Dollars)

Transit System	Route	Date	Operating Cost Per Mile[a]	Operating Cost Per Passenger	Operating Cost Per Passenger Mile[b]
AVTA	Average for Routes 785, 786, and 787	FY 1997	$0.63	$1.95	$0.75
		FY 1999	$0.40	$1.19	$0.46
		FY 2000	$0.46	$1.28	$0.52
		FY 2001 (YTD)	$0.51	$1.44	$0.61
Foothill Transit	Route 494	FY 1999	$2.88 (tm)	$1.09	n/a
		FY 2000	$2.58 (tm)	$1.14	n/a
LA DOT Commuter Express	Route 438	FY 97-98	$5.36 (tm)	$5.72	$1.42
		FY 98-99	$6.21 (tm)	$5.89	$0.27
		FY 99-00	$4.22 (rm)	$4.22	$0.20
	Route 488	FY 97-98	$4.14 (tm)	$4.17	$1.43
		FY 98-99	$4.91 (tm)	$4.41	$0.27
		FY 99-00	$5.06 (rm)	$6.13	$0.03
	Route 573	FY 97-98	$2.96 (tm)	$5.47	$1.90
		FY 98-99	$3.57 (tm)	$5.15	$0.18
		FY 99-00	$5.57 (rm)	$7.26	$0.26
	Route 574	FY 97-98	$3.06 (tm)	$4.25	$0.68
		FY 98-99	$5.97 (tm)	$8.21	$0.41
		FY 99-00	$8.00 (rm)	$8.00	$0.37
OCTA[c]	Route 701	1998	$4.27 (sm)	$7.97	n/a
		1999	$5.92 (sm)	$15.44	n/a
		2000	$5.88 (sm)	$15.07	n/a
		2001	$6.08 (sm)	$17.76	n/a
	Route 721	1998	$4.69 (sm)	$9.00	n/a
		1999	$6.02 (sm)	$14.75	n/a
		2000	$4.55 (sm)	$10.88	n/a
		2001	$4.74 (sm)	$9.83	n/a
	Route 757	1998	$5.85 (sm)	$10.03	n/a
		1999	$6.46 (sm)	$14.36	n/a
		2000	$6.36 (sm)	$13.21	n/a
		2001	$6.72 (sm)	$20.76	n/a
Santa Clarita Transit	Route 791	FY 99-00	$0.79 (rm)	$11.63	$0.35
	Route 792	FY 99-00	$2.19 (rm)	$63.52	$2.23
	Route 793	FY 99-00	$0.20 (rm)	$0.07	$0.00
	Route 795	FY 99-00	$1.22 (rm)	$3.83	$0.08
	Route 796	FY 99-00	$1.56 (rm)	$3.08	$0.10
	Route 797	FY 99-00	$2.21 (rm)	$8.03	$0.28
	Route 798	FY 99-00	$1.70 (rm)	$10.98	$0.22

Notes:
a – Abbreviations: (tm) – total mile; (rm) – revenue mile; (sm) – service mile.
b – Abbreviation: n/a – data not available.
c – OCTA costs provided for average month of each year.

4.6.2 MOE 5B: Benefit-Cost

4.6.2.1 Analysis Methodology

A modified version of the Cal-B/C Model was used to evaluate the economic viability of existing freeway carpool lane facility investments in Los Angeles. The Cal-B/C Model was chosen because it is the California State standard for evaluating transportation projects. Moreover, there is no widely adopted approach for evaluating the cost effectiveness of carpool lane facilities, and where existing research has examined carpool lane facilities for economic viability, the methods have been conceptually consistent with the Cal-B/C Model.

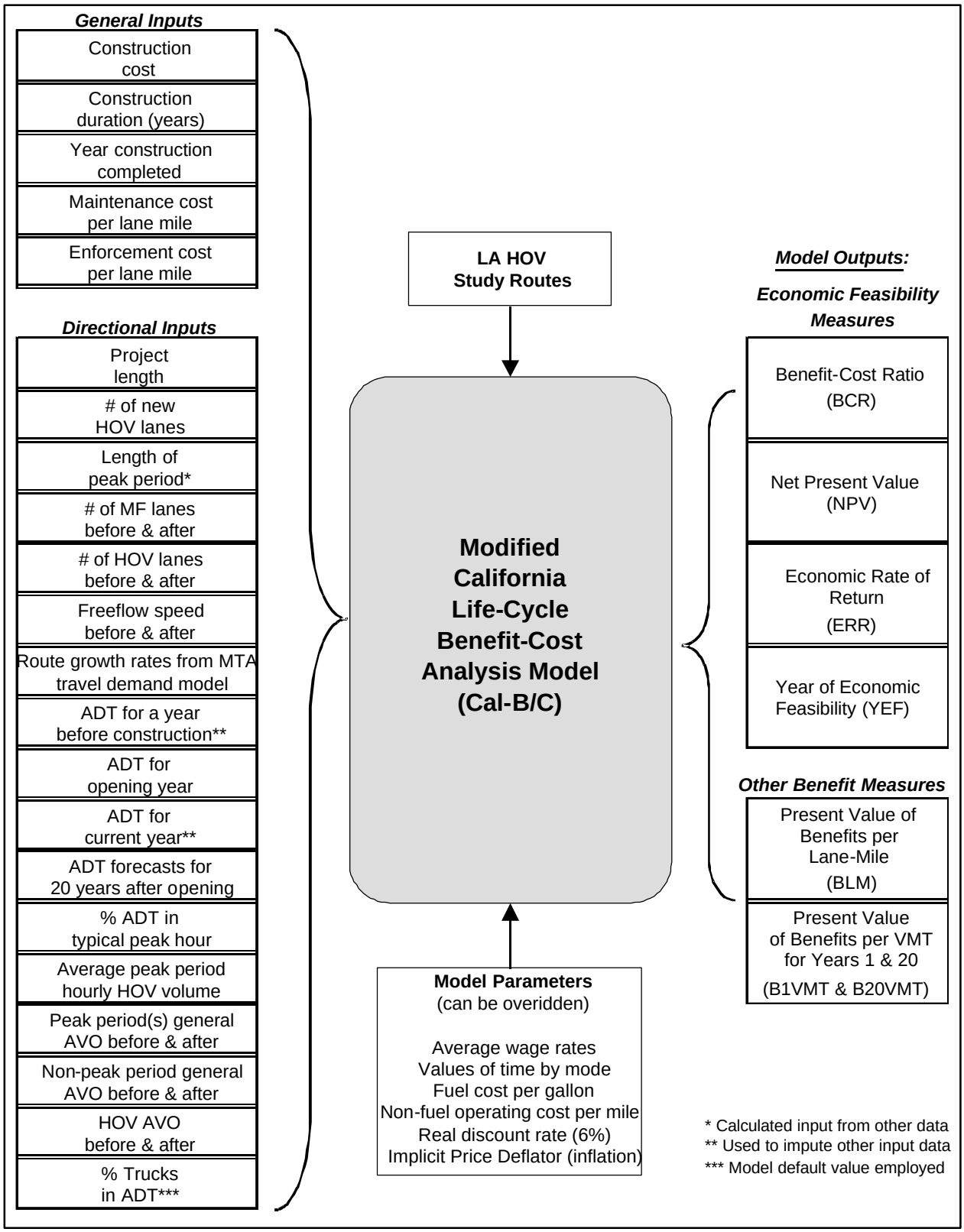
The Cal-B/C Model is intended for evaluating a wide range of planned transportation projects. It was designed to use data from the "before" or "without project" case along with projections for future travel demand and information about the proposed project to evaluate whether or not the improvement is an economically efficient use of resources, relative to the case without the improvement. The model considers the sum of the construction duration in years plus 20 years for benefits to accrue as the overall evaluation period. Because the approach of this study involves the evaluation of existing freeway carpool facilities, it was necessary to modify the Cal-B/C Model framework to change the point of reference to the "after" or "with project" case at a time part way through the evaluation period, and then estimate what would have happened historically without the carpool lane(s), as well as predict the differences between the "with" and "without" cases over the remainder of the post-construction evaluation period.

Future volumes through whatever date would be 20 years beyond the year of opening were forecasted using the average annual growth factor for the route as interpolated from the MTA travel demand model. All costs and benefits were converted to constant year 2000 dollars.

To be conservative in the evaluation of carpool lane facility benefits, it was assumed that the HOV demand observed and projected in the future would be the same for comparison to the hypothetical case without carpool lanes. In other words, any HOV demand that may have been induced by the Los Angeles County carpool lane system was assumed to exist in the without carpool lanes case for purposes of evaluation. Similarly, emission reduction benefits were not factored into the benefit-cost evaluation due to limitations of the Cal-B/C Model to properly assess emissions under congested stop-and-go or variable speed conditions. Finally, accident reduction benefits were not considered in the benefit-cost evaluation because existing research suggests that carpool lane facility impacts on safety have been inconclusive.

Figure 4.6.1 graphically depicts the data inputs, parameters and resulting outputs of the Cal-B/C Model as modified for the evaluation of the Los Angeles County HOV Study Routes.

Figure 4.6.1 Cal-B/C Model Data Inputs, Parameters and Resultant Outputs for HOV Performance Program



4.6.2.2 Summary of Findings

The results of the benefit-cost evaluation are summarized in **Table 4.6.2**. The 14 HOV study segments evaluated represent a wide range of project sizes and project costs. Historical costs for various projects may not be completely comparable (especially when comparing cases where right-of-way was already owned with those where it had to be purchased). Accordingly, four benefit-cost performance measures are reported to reflect the economic feasibility of respective projects. These measures are not intended to provide a comparison between projects but simply provide the ability to assess the economic merits of individual investments. The distinctions and intended uses of these benefit-cost performance measures are as follows:

Benefit-Cost Ratio (BCR): The BCR is defined as the present value of all benefits divided by the present value of all costs. Values greater than 1.0 are considered economically feasible. The BCR is a useful measure for comparing "the bang for the buck" produced by projects of different magnitude when the project size differences are relatively unimportant. Total project costs greatly influence BCR.
Net Present Value (NPV): In contrast to the BCR, the NPV is the present value of all benefits less the present value of all costs. Because the result is a dollar amount, both the ratio of the benefits and costs as well as the size of the project(s) considered affect the results. Values greater than $0.00 are considered economically beneficial. The NPV is a useful measure for comparing the overall dollar value of net benefits.
Economic Rate of Return (ERR): The ERR, also referred to as the internal rate of return (IRR), gives the real discount rate for which a project's evaluation period present value benefits and costs break even (are equal), such that the BCR = 1.0 and the NPV = $0. The ERR allows projects with different costs, different benefit flows, and different evaluation time periods to be compared.
Year of Economic Feasibility (YEF): This measure was developed specifically for this project to identify the actual or expected year (within the project evaluation period) that each HOV facility's NPV exceeds or will exceed $0.00. The objective of this measure is to identify those HOV projects that have already proved their worth, and for the remainder, to predict when the milestone of economic feasibility will be achieved.

The following "benefit-only" performance measures were also reported, and are useful for comparing facilities with non-comparable costs and considering differences in scale among facilities.

Present Value Benefits per Lane Mile (BLM): The BLM measures the evaluation period benefits, in millions of present value dollars, divided by the number of facility HOV lane miles.
Present Value of Year 1 Benefits per Vehicle Miles Traveled (B1VMT): The B1VMT measures the present value dollar benefits per vehicle mile traveled in the opening year of the facility.
Present Value of Year 20 Benefits per Vehicle Miles Traveled (B20VMT): The B20VMT measures the present value dollar benefits per vehicle mile traveled in the 20th year of operations — the end of the facility's operating evaluation period.

Table 4.6.2 Benefit-Cost Analysis Results

Route / HOV Facility Information				Measures of Economic Feasibility				Other Benefit Measures		
#	Description / Segment Limits	First Full Year of Operation*	Construction Cost per Lane-Mile (2000 $)	Benefit-Cost Ratio (BCR)	Net Present Value (NPV)	Economic Rate of Return (ERR)	Year of Economic Feasiblity (YEF)	PV Benefits per Lane-Mile (BLM)	Year 1 PV Benefits per VMT (B1VMT)	Year 20 PV Benefits per VMT (B20VMT)
10	Alameda to Baldwin	1973	*Not Evaluated — Incomplete Data*							
14	San Fernando Rd to Escondido Cyn Rd	1999	$1.7 M	6.7	$332.9 M	20.0%	2011	$12.0 M	$0.01	$1.20
57	Orange County Line to Rte 60	1998	$2.2 M	1.3	$5.2 M	7.8%	2016	$2.8 M	$0.00	$0.12
60	Brea Cyn Rd to San Bernardino Cty Line	2000	$1.8 M	11.1	$266.6 M	28.5%	2006	$19.5 M	$0.13	$1.39
91	Rte 110 to Orange County Line	1995	$0.1 M	15.4	$81.4 M	77.7%	1998	$3.0 M	$0.03	$0.12
105	Rte 405 to Rte 605	1993	*Not Evaluated — No Pre-HOV Existing Facility*							
110-A	Rte 91 to Rte 105	1997	$17.3 M	0.9	– $13.0 M	5.1%	2017+	$15.3 M	$0.37	$0.51
110-B	Rte 105 to Adams	1997	$8.6 M	3.8	$648.0 M	24.3%	2002	$32.7 M	$0.97	$0.89
118	Ventura County to Rte 5	1998	$0.6 M	26.9	$411.4 M	103.4%	1999	$18.7 M	$1.54	$0.28
134	Rte 101/170 to Rte 210	1997	$0.8 M	11.3	$236.5 M	38.2%	2002	$9.8 M	$0.13	$0.80
170	Rte 101/134 to Rte 5	1997	$0.7 M	1.6	$5.4 M	9.8%	2014	$1.2 M	$0.01	$0.14
210	Rte 134 to Sunflower Ave.	1994	$0.2 M	8.2	$89.5 M	27.8%	2002	$2.8 M	$0.00	$0.21
405-A	OCL to Rte 110	1999	$2.4 M	2.7	$103.6 M	13.5%	2013	$6.3 M	$0.01	$0.33
405-B	Rte 110 to Century Blvd	1994	$0.5 M	36.2	$390.6 M	171.6%	1995	$21.8 M	$0.51	$0.87
405-C	Rte 101 to Rte 5	1997	$1.0 M	5.6	$95.8 M	25.5%	2004	$5.8 M	$0.09	$0.33
605	South St to Rte 10	1999	$0.8 M	8.1	$205.8 M	33.3%	2003	$6.9 M	$0.14	$0.31

* In cases with multiple construction projects on the same route, the completion date for the last project was used to determine first full year of operation.

In general, Los Angeles County carpool lanes appear to have been good investments. User benefits already exceed costs in present value terms for several facilities, and nearly all of the study routes will achieve economic feasibility within the allotted 20-year evaluation period. Carpool lanes in Los Angeles County have an average payback period of about nine years, with the majority of the facilities evaluated (nine out of fourteen) estimated to achieve a positive net present value by 2006.

The average BCR for the 14 HOV facilities analyzed was 10.0 and the median was 7.4. This result suggests that Los Angeles County carpool lane facilities are efficient, with user benefits that exceed taxpayer costs.

The Route 405 study segment from 110 to Century Boulevard shows an exceptionally high benefit/cost ratio of 36.2 reflecting a relatively low initial capital cost and solid user benefits. The travel time savings provided by the carpool lane in this corridor is particularly high and the presence of the carpool lane has provided substantial benefit for general-purpose travel speeds as well. As a result, this facility has strong benefits for both carpool lane and general-purpose lane users that combine to yield an exceptionally high benefit-cost ratio.

In contrast, Route 110 from 91 to 105 shows a benefit-cost ratio of 0.9 and does not achieve the point of economic feasibility within the 20 year evaluation period, despite the fact that this facility shows high present value benefits per lane mile and per vehicle miles traveled (VMT) compared to other facilities. The low benefit-cost ratio for this segment of Route 110 is a product of the exceptionally high HOV project construction cost as part of the transitway development in this freeway corridor, including integrated transit stations and a lengthy direct

connector ramp to the Artesia Transit Center. Given the exceptionally high project cost and the unique multi-modal design of the facility, an evaluation period of greater than 20 years may be appropriate.

As might be expected, carpool lanes in congested freeway corridors generally enjoy higher benefits due to the potential for greater travel time savings to carpool lane users compared to general-purpose lane users. In less congested freeway corridors, although initial HOV benefits are lower, the benefits begin to accrue rapidly in future years as the levels of congestion in the adjacent general-purpose lanes reach critical thresholds resulting in greater time savings for carpool lane users.

Examples of corridors where initial carpool lane benefits are lower but accrue rapidly in future years as the levels of congestion increases include Routes 14 (San Fernando Road to Escondido Canyon Road), 60 (Brea Canyon Road to San Bernardino County Line) and 134 (101/170 to 210). In the case of the Route 14 carpool lanes, the year 1 present value per VMT for this facility is extremely low ($0.01), which is consistent with the present low travel time savings in the corridor as reported in **Section 4.4**. However, 20 years after opening, congestion in the Route 14 corridor is likely to progress to a point where the benefit has increased dramatically to $1.20 per VMT.

4.6.3 MOE 5C: Accidents

The objective of this section is to evaluate the effect of carpool lanes on safety, based on an assessment of overall freeway accidents and violations in the carpool lanes. In order to perform this evaluation, accident data was provided by Caltrans District 7 for the each of the HOV Study Routes, the Control Routes and the Look-Ahead Routes where carpool lanes will be added. The data was provided annually by direction, and was available for a ten-year period between 1990 and 2000. The accident information for year 2000 only covered the first six months of the year. The TASAS Table B was provided by direction for each Study Route and showed the total number of accidents, the total number of fatalities and injuries, the actual accident rate and the statewide average accident rate for similar facilities. In addition, TASAS Table C, which reports high accident concentration locations on a quarterly basis, was provided for the period from the first quarter of 1996 through the second quarter of 2000.

Based on the information provided and discussions with Caltrans staff, it was determined that data on the types of accidents by lane (general-purpose lanes versus carpool lanes) could not be determined from the Caltrans TASAS Selective Record Retrieval Information System without going back to the originally filed accident report. Even then, anecdotal evidence suggested that there is no uniform way that carpool lane related accidents are coded in the accident reports. Consequently, the original approach to identify the number and type of accidents in the carpool lanes and general-purpose lanes separately was redefined to utilize the available data. For this reason, the evaluation focused on the accident rate of the facility segments and its comparison with the statewide average. Information on the number of violating SOV using the carpool lanes (carpool lane occupancy violations) for each of the study segments was also compiled from the occupancy count data, which was discussed in **Section 4.2**.

4.6.3.1 Analysis Methodology

The accident rates for each study route were identified by direction for specific time periods. The accident rates for these routes were compared to the statewide average and the control route accident rates to determine any apparent trends or significant changes due to the opening of the carpool lanes. The year selected for analysis varied based on the carpool lane opening year and was determined as follows:

- For the HOV Study Routes, the year in which the carpool lane opened was identified. The analysis time period was determined by selecting data for one-year after opening of the carpool lane and two-years prior to its opening, as well as the current (1999) conditions.
- For the Look Ahead Routes, the current (1999) conditions time period was selected.
- For the Control Routes, the entire data set was analyzed because the comparison year that was used varied based on each HOV study route's opening year.

Using the selected data, comparison tables and graphs were prepared to identify any significant changes or patterns between each HOV Study Route and the Control Routes, and also between each Look Ahead Route and the Control Routes. The statewide average accident rate for similar facilities is also included in these tables and graphs, so that routes exceeding the average accident rate can be easily identified. The following section summarizes the safety and accident findings for facilities with carpool lanes, both before and after opening, and compares their performance to those facilities without carpool lanes (control routes). Accident rates for each Study Route are presented per million vehicle miles (MVM).

4.6.3.2 Summary of Findings

The accident rates for each HOV Study Route are presented in **Table 4.6.3**. The table shows the opening year of the carpool lane, the accident rates by direction two years before and one year after opening, as well as current (1999) conditions. The statewide average accident rate for similar facilities is also shown and locations where the Study Route accident rate exceeds the statewide average are highlighted in bold. These results are also depicted in **Figures 4.6.2**, **4.6.3** and **4.6.4**. The current (1999) accident rates for the Look Ahead Routes are presented in **Table 4.6.4**, by direction, with locations exceeding the statewide accident rate highlighted in bold.

Based on the analysis results, no distinct trends or patterns were identified that can be attributed directly to facilities with carpool lanes versus freeways without carpool lanes. In general, it was determined that accident rates on the facilities with carpool lanes are influenced by traffic congestion, vehicular mix and roadway conditions in the same way that these factors affected facilities without carpool lanes.

Overall, the freeway facilities in Los Angeles County tended to be near or below the statewide average accident rate for similar facilities, which is typical for freeways in urbanized areas where travel speeds are typically lower that those in less developed areas. The observed differences in accident rates between the HOV Study Routes are related to the specific traffic flow and congestion patterns of each route and do not appear to be inherent to the presence of carpool lane facilities.

Table 4.6.3 HOV Study Route Accident Rates

Route	Year	Average Accident Rate (total accidents per MVM)		Statewide Average Accident Rate
		EB or NB	WB or SB	
I-10 (1973)				
Current	1999	**1.18**	**1.22**	1.15
SR-14 (1998)				
2 Years Before	1996	0.50	0.66	0.69
1 Year After/Current	1999	0.52	0.54	0.70
SR-57 (1997)				
2 Years Before	1995	0.67	0.43	0.86
1 Year After	1998	**1.08**	0.46	0.87
Current	1999	**0.98**	0.37	0.89
SR-60 (1999)				
2 Years Before	1997	**1.22**	**1.18**	1.10
Current	1999	0.86	**1.44**	1.14
1 Year After	2000*	0.99	**1.48**	1.14
SR-91 (1994)				
2 Years Before	1992	**1.00**	0.81	0.93
1 Year After	1995	0.79	**1.01**	0.93
Current	1999	0.83	**1.08**	0.93
I-105 (1993)				
1 Year After	1994	0.46	0.39	1.01
Current	1999	0.68	0.61	1.05
I-110 (1996)				
2 Years Before	1994	0.96	**1.01**	0.97
1 Year After	1997	0.78	0.79	1.00
Current	1999	0.95	0.82	1.03
SR-118 (1997)				
2 Years Before	1995	**0.81**	**0.82**	0.79
1 Year After	1998	0.72	0.76	0.84
Current	1999	0.62	0.74	0.85
SR-134 (1996)				
2 Years Before	1994	0.54	0.58	0.86
1 Year After	1997	0.68	0.86	0.88
Current	1999	0.57	**0.90**	0.87
SR-170 (1996)				
2 Years Before	1994	0.91	**1.23**	0.92
1 Year After	1997	**1.02**	**1.14**	0.93
Current	1999	0.64	**1.09**	0.96
I-210 (1993)				
2 Years Before	1991	0.45	0.50	0.95
1 Year After	1994	0.55	0.63	0.95
Current	1999	0.73	0.76	0.97
I-405 (1998)				
2 Years Before	1996	1.08	0.78	1.18
1 Year After/Current	1999	0.79	1.11	1.18
I-605 (1997)				
2 Years Before	1995	0.70	0.74	1.13
1 Year After	1998	0.95	1.12	1.15
Current	1999	1.05	1.17	1.17

Bold denotes routes where the Average Accident Rate is greater than the Statewide Average Accident Rate
Source: Caltrans TASAS Table B

Figure 4.6.2 HOV Study Route Accident Rates Two Years Before Opening

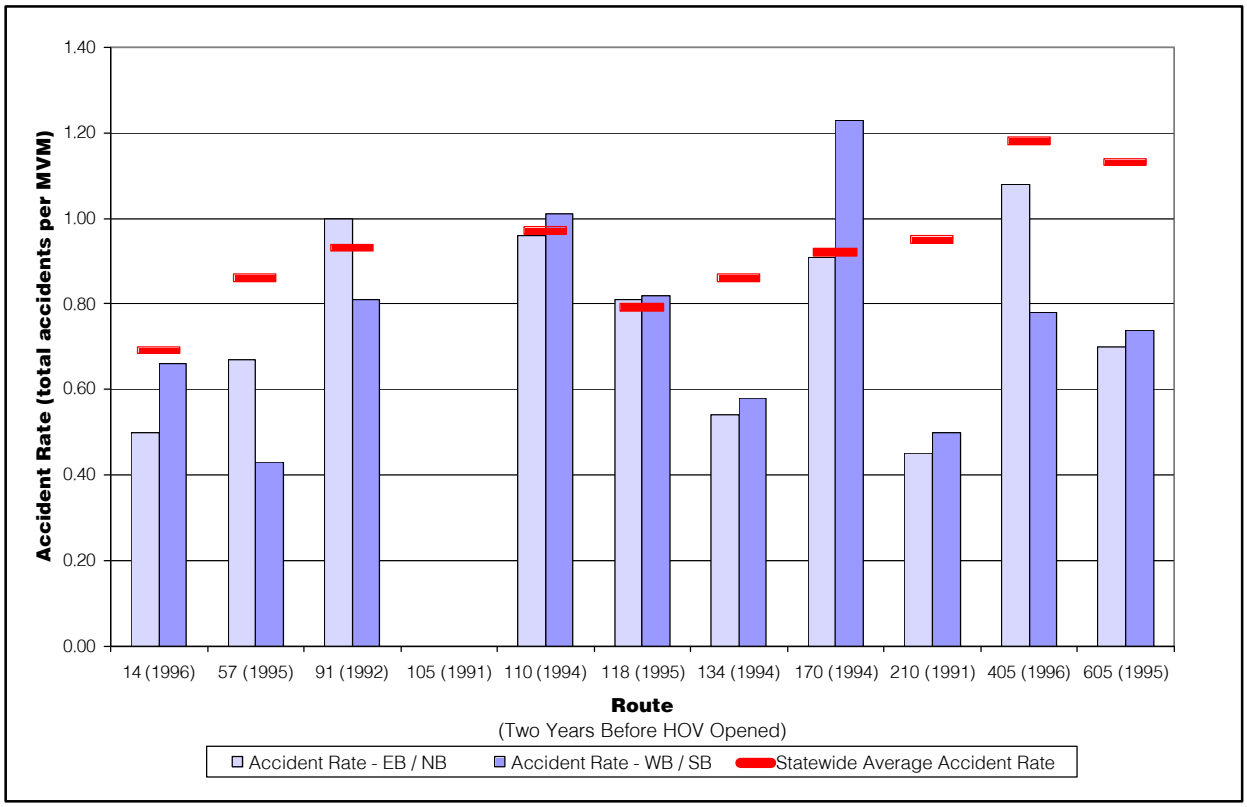


Figure 4.6.3 HOV Study Route Accident Rates One Year After Opening

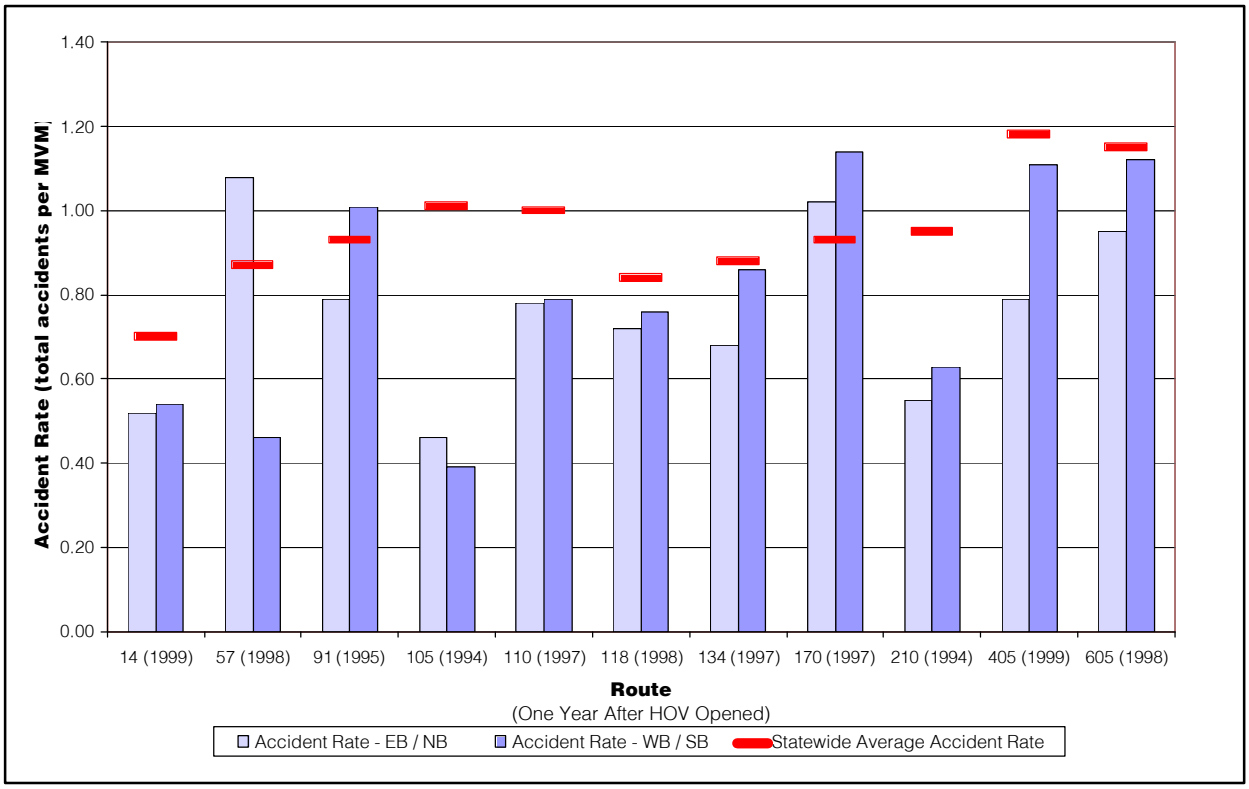


Figure 4.6.4 HOV Study Route Current Year (1999) Accident Rates

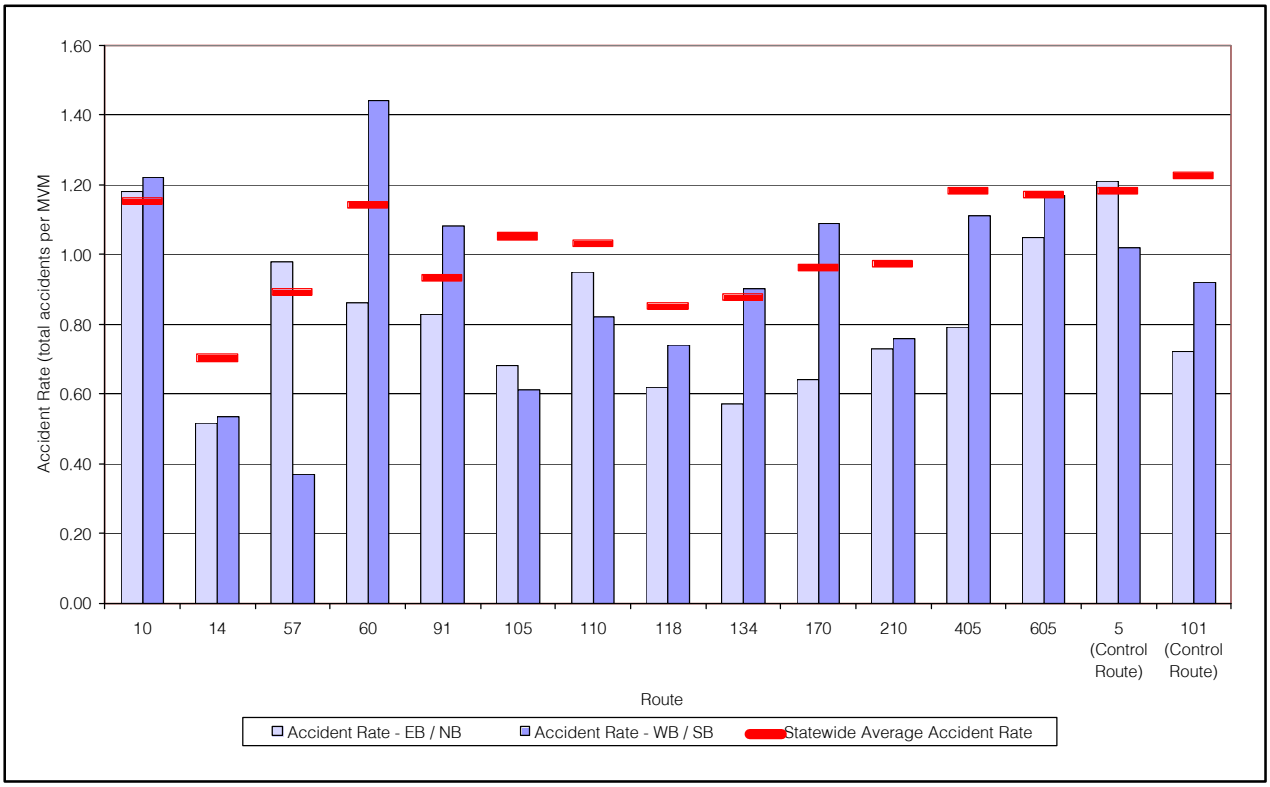


Table 4.6.4 Five-Year Look Ahead Current Year Accident Rates

Route	Year	Average Accident Rate (total accidents per MVM)		Statewide Average Accident Rate
		EB or NB	WB or SB	
I-10 (Baldwin Ave. to Route 605)	1999	**1.33**	**1.22**	1.08
I-10 (Route 57 to San Bernardino County Line)	1999	1.12	**1.43**	1.19
SR-60 (Route 605 to Brea Canyon Rd.)	1999	0.96	1.10	1.10
I-405 (Route 10 to Waterford St.)	1999	0.70	**1.55**	1.33
I-405 (Waterford St. to Route 101)	1999	0.97	0.84	1.19
I-605 (Orange County Line to South St.)	1999	0.73	0.75	1.14

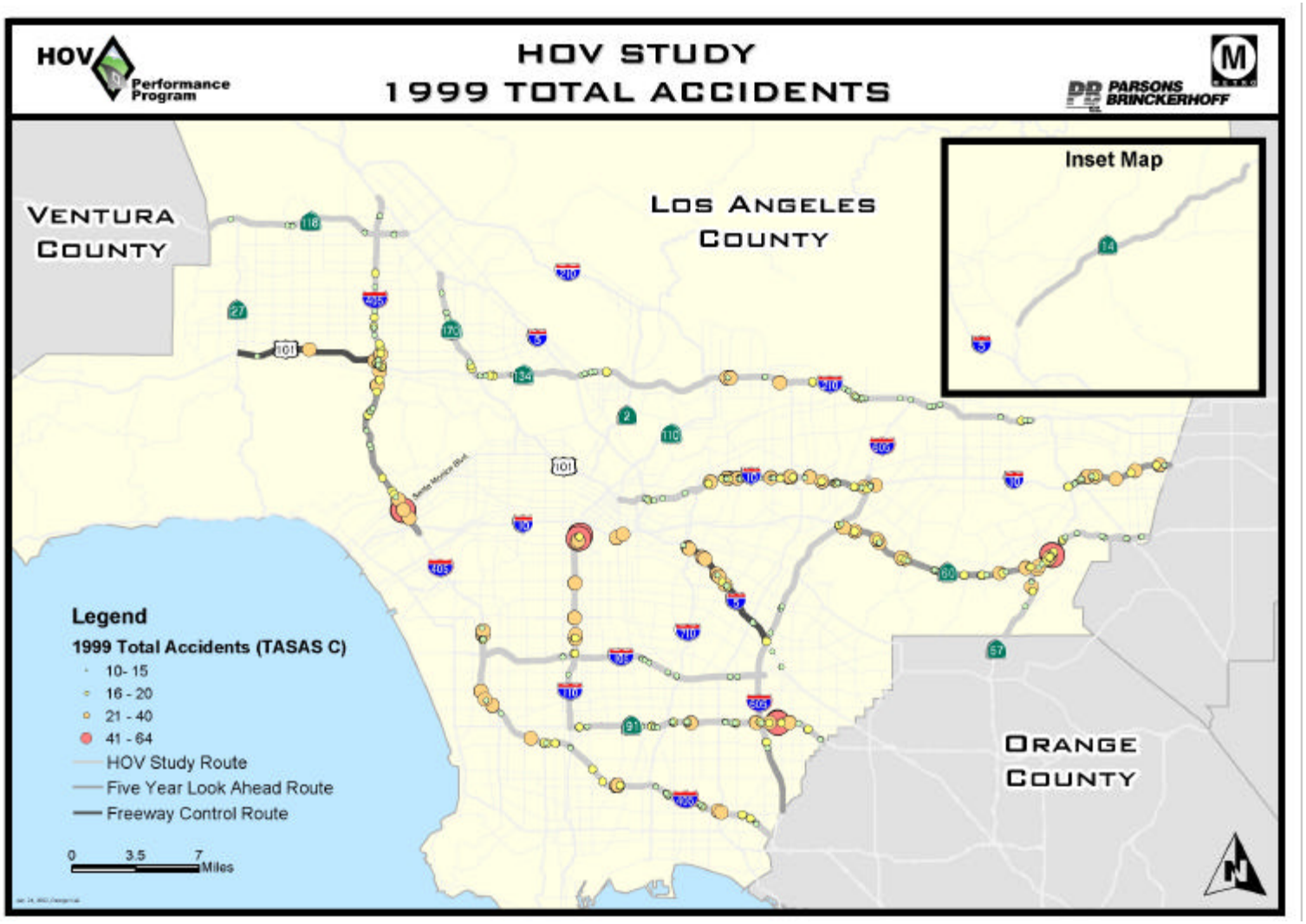
Data limitations prevented a detailed assessment of the number, type and cause of accidents within the carpool lanes. It should be noted that current accident recording procedures, as presented in the TASAS Selective Record Retrieval output, do not identify the carpool lane separately in the "Collision Location" section. Consequently, it is a recommendation of this study that the "Collision Location" section within TASAS be modified to provide a separate line item for collisions within the carpool lane. In order for this change to take effect, the accident report form also needs to be modified, so that officers filing the report can easily differentiate between the carpool lane and the left-most (Number 1) general-purpose lane.

High accident concentration locations were compiled from TASAS Table C and plotted on a system map to identify Study Route accident "hot spots", as shown in **Figure 4.6.5**. Current (1999) conditions show four high accident clusters within Los Angeles County. These accident hot spots are located on Route 405 at Santa Monica Boulevard, Route 110 at Route 10, Route 60 at Route 57, and Route 91 at Route 605.

It is difficult to conclusively determine the factors contributing to the high incidence of accidents at these four locations based on the information provided by the TASAS tables. In order to conclusively identify contributing factors, an exhaustive study of individual accident reports would be necessary to identify trends in accident type, location, and prior driving behavior. However, for the purposes of completing the evaluation of this MOE, a qualitative consideration of each hot spot was made to identify possible contributing factors. Based on this qualitative assessment, it appears that the high number of accidents at these locations can be attributed to a combination of several factors as described below:

- *Route 405 at Santa Monica Boulevard* – most likely attributable to geometric constraints and specifically the short weaving distance on the northbound Route 405 from the Route 10 merge to the Santa Monica Boulevard diverge. There are no existing carpool lanes in the vicinity of this accident hot spot.
- *Route 110 at Route 10* – most likely a combination of high traffic volumes and weaving between the Route 110 mainline, the Route 10 ramps and the downtown Los Angeles collector-distributor (C-D) lanes serving the various freeway entrances and exits. This location could also be impacted by localized traffic congestion at the ends of the carpool lanes upstream on northbound Route 110.
- *Route 60 at Route 57* – most likely the result of heavy traffic weaving at the junction of the Route 60 and Route 57 freeways. The provision of carpool lanes on Route 60 is not likely to be a significant contributing factor to the high number of accidents at this location.
- *Route 91 at Route 605* – most likely a product of congestion on the westbound Route 91 approach to the Route 605 interchange, and the resultant sudden slowing of traffic. Traffic diverging from westbound Route 91 to the Route 605 ramps, including traffic attempting to weave from the carpool egress to the northbound Route 605 ramp in a short distance, may also be a contributing factor at this location.

Figure 4.6.5 Current Year (1999) Study Route High Accident Locations



4.6.4 MOEs 5D and 5E – Public Perceptions

4.6.4.1 Analysis Methodology

Three surveys were conducted as a part of the HOV Performance Program, as discussed in **Chapter 3.0**. These surveys included a general public telephone survey, a license plate mail-out survey, and an on-board transit survey. Results from selected attitudinal questions on each survey were compared as part of the analysis of MOE 5D: Public Perception - Adequate Use and MOE 5E: Public Perception - Good Improvement. Other survey results from Houston, Texas, Dallas, Texas, Minneapolis, Minnesota, Northern Virginia/Washington, D.C., and Los Angeles were also reviewed as a part of this analysis. Although some questions were worded somewhat differently, the common responses were summarized and examined in the analysis.

4.6.4.2 Summary of Findings – MOE 5D: Public Perceptions – Adequate Use

When asked if they have ever used a carpool lane during peak travel periods, three-quarters (75%) of the General Public Telephone Survey respondents indicated that they had. Similarly, 74% say that they have used a carpool lane during off-peak travel periods including weekends. When asked how often they use carpool lanes when they are traveling on freeways that have a carpool lane, one-half (50%) of the respondents responded that they occasionally utilize the available facility. Fifty-one percent of the respondents replied that they have used a carpool lane in the last week, and from those who have used the facility during that time, two-thirds (67%) have used it between one to five times during the AM and/or PM peak periods.

When asked about their primary means of transportation, 73% indicated that they drive alone and 20% indicated they either carpool or vanpool. Residents were also asked their opinions on the utilization of carpool lanes in Los Angeles County. Many were divided between believing they are underutilized (42%), and just about right (37%). Eight percent of respondents think that carpool lanes are overutilized, and 13 percent are neutral or don't know.

Approximately half (51%) of the License Plate Mail-out Survey respondents who do not use carpool lanes but commute on freeways that have these facilities perceive that carpool lanes are sufficiently utilized when observing the total number of vehicles. When the same group was asked a similar question relating to the number of people using the carpool lane, 44% believe that the facility is being sufficiently utilized.

The On-Board Transit Survey results from Los Angeles were compared with those from Houston, Dallas, Minneapolis, and Northern Virginia/Washington, D.C. A total of 58% of the respondents in the HOV Performance Program On-Board Transit Survey indicated that utilization of the carpool lanes in Los Angeles County was about right or over-utilized. This percentage is lower than the 75% to 88% of bus riders on the four Houston area carpool lane corridors responding to a slightly different question asking if they felt the lanes are used sufficiently to justify the project, as shown in **Table 4.6.6**.

Table 4.6.6 Is the HOV Lane Sufficiently Utilized to Justify the Project?

Houston (1990)	I-10W	US-290	I-45N	I-45S
Yes	87%	88%	88%	75%
No	4%	5%	4%	9%
Not Sure	9%	7%	8%	16%

Source: An Assessment of Carpool Utilization of the Katy HOV Lane and the Characteristics of Houston's HOV Lane Users and Non-Users, Texas Transportation Institute, 1990

Based on the responses to these surveys, it appears that the residents and commuters of Los Angeles County are using carpool lanes and are doing so on a somewhat regular basis. However, despite their use of carpool lanes, the public's perception of the utilization of carpool lanes tends to be mixed.

4.6.4.3 Summary of Findings – MOE 5E: Public Perceptions – Good Improvement

Participants in the General Public Telephone Survey feel that investment in more public transit (40%) would best help to improve the flow of traffic on Los Angeles County freeways. Investing in building more freeways or freeway lanes (36%) and developing more carpool lanes (21%) were also recommended by a substantial number of the survey respondents. When asked about the main reason for supporting having carpool lanes, 54% of Los Angeles County residents felt that the carpool lanes helped to reduce congestion.

Almost three-quarters of the General Public Telephone Survey participants strongly agree (19%) or agree (53%) that carpool lanes are more efficient than regular freeway lanes. The majority of people (64%) agreed that carpool lanes reduce congestion in all lanes and over one-half (56%) of respondents believe that carpooling improves air quality. Most people (72%) disagree with the idea that carpool lanes make traffic worse in the non-carpool lanes. Seventy percent disagree (59%) or strongly disagree (11%) that carpool lanes increase the number of accidents.

The majority of those surveyed in the License Plate Mail-Out Survey (79%), regardless of their use of carpool lanes, believe that carpool lanes are a good transportation improvement. Ninety-one percent of current carpool lane users indicated that carpool lanes were a good transportation improvement. For those commuting on freeways without carpool lanes, or in the general-purpose lanes and freeways with carpool lanes, 73% of respondents believe that carpool lane facilities are a good transportation improvement.

Based on the responses to the two surveys, it appears that the residents and commuters of Los Angeles County clearly believe that carpool lanes are good transportation improvements.

4.6.5 MOE 5F: Violation Rates

4.6.5.1 Analysis Methodology

Information on the number of single-occupant vehicles (SOVs) using the carpool lane (HOV violations) for each of the HOV Study Routes was compiled from the occupancy count data that was provided by Caltrans District 7 and utilized in the evaluation of Objective 1 described in **Section 4.2**. This information was subsequently used to determine the percentage of carpool lane violations for each study route.

4.6.5.2 Summary of Results

The percentage of minimum occupancy violators in the carpool lanes, based on observations as part of the vehicle occupancy counts, shows that all HOV Study Routes except Route 10 have a low violation rate ranging from 0 to 3 percent. Maintaining a low carpool lane occupancy violation rate is important in Los Angeles County, particularly where carpool lanes are highly utilized to ensure that the maximum lane capacity is available for use by higher occupant vehicles and not drive alone violators.

The minimum occupancy violation rate for Route 10 is notably higher than that observed on all other HOV Study Routes, particularly for the eastbound (PM peak) direction where the violation rate exceeds 11%. The high violation rate on Route 10 is most likely attributable to the variable minimum occupancy requirement in this corridor and the resultant driver confusion, particularly during the minimum occupancy transition periods. Since July 24, 2000 the minimum occupancy requirement for Route 10 has varied for both directions from 2+ during the weekday off-peak periods and on weekends to 3+ during the weekday peak periods (5:00 AM to 9:00 AM and 4:00 PM to 7:00 PM).

Route 10 (Alameda – Baldwin) is the only carpool lane corridor in Los Angeles County (and Southern California) that currently requires a 3+ minimum occupancy rate at any time. By contrast to Southern California, several carpool facilities in the Northern California have a 3+ minimum occupancy requirement, including Route 80 from the San Francisco-Oakland Bay Bridge in to Route 4 in Contra Costa County, and the San Francisco-Oakland Bay Bridge and Carquinez Bridge Toll Plazas. Violation rates on Route 80 range from 18% to 22% in the peak direction during the AM peak period and exceed 24% during the PM peak period[14], more than doubling the violation rate observed on Route 10 in Los Angeles County.

The percentage occupancy violation rate for each Los Angeles County HOV Study Route is summarized in **Table 4.6.7**. It should be noted that the violation rates identified in **Table 4.6.7** do not represent citations issued by CHP and do not account for other carpool usage violations such as illegally crossing the buffer.

[14] Source: 2001 District 4 HOV Report, California Department of Transportation, District 4 Oakland, February 2002.

Table 4.6.7 HOV Study Route Minimum Occupancy Violation Rates

HOV Routes	% Violators	
	NB or EB	SB or WB
I-10*	11%	5%
SR-14	0%	0%
SR-57	1%	0%
SR-60	0%	0%
SR-91	1%	0%
I-105	1%	1%
I-110	1%	1%
SR-118	0%	1%
SR-134	3%	1%
SR-170	1%	0%
I-210	2%	1%
I-405	0%	2%
I-605	2%	1%

Note: * - data for I-10 based on 2001 HOV Annual Report, California Department of Transportation District 7, May 2002.

The CHP provided information on carpool related citations that take into consideration violations of other usage regulations, such as illegally crossing the lane delineation buffer. Although the CHP data represents a more extensive data set, the information does not differentiate between citations along a continuous carpool lane versus a carpool ramp by-pass lane, nor does it differentiate between the type of carpool violation (SOV in carpool lane versus illegally crossing the lane buffer) by freeway. As a result, the CHP citation data was inconclusive in evaluating MOE 5F in the context of the carpool lanes. Consequently, it is recommended that CHP carpool citation reporting procedures be modified to identify the type of HOV location (freeway lane versus ramp), as well as to tabulate data regarding the type of carpool violation.

4.7 Summary of Conclusions

4.7.1 Overall Effectiveness

The analysis of the HOV Performance Program MOEs indicate that overall, the carpool lane system in Los Angeles County is performing effectively. In terms of person trips and mobility, the carpool lane system generally meets or exceeds the established thresholds. Despite minimal transit service on most HOV Study Routes, all carpool lanes presently operate below maximum capacity thresholds. On those routes with significant carpool transit services, the total number of person trips per carpool lane was exceptionally greater than any other freeway corridor in Los Angeles County.

Although travel time savings in the carpool lanes varied, all of the HOV Study Routes realized travel time savings to carpool lane users. Similarly, average speeds in the carpool lanes generally exceeded the minimum threshold for congestion, which was not the case for the general-purpose lanes on many HOV Study Routes. The analysis results indicated that carpool

lanes typically produce less vehicle emissions per unit of mobility than the adjacent general-purpose lanes, although the reduced emissions of carpool lanes did not necessarily translate to reduced emissions for the carpool lane corridor when compared to Control Routes.

Carpool lanes generally represent cost effective infrastructure investments. This is reflected in the overall public perception of the carpool lane system as a good transportation investment.

The analysis results indicated that carpool lane violation rates in Los Angeles County are extremely low overall. The analysis results also indicated that there does not appear to be any correlation between increased accident rates and the provision of carpool lanes.

4.7.2 Carpool Lane Utilization

Generally, the carpool facilities performing at the highest levels include the two transitways (Routes 10 and 110) and Routes 14, 60, 105, and portions of 405. Routes 57, 91, 210, and 605 also all perform well, satisfying most mobility criteria. Those performing least well relative to the various mobility criteria and the other routes are Routes 118, 134, and 170.

The carpool lane system in Los Angeles County is highly utilized. All but one (Route 170) of the HOV Study Routes exceeds the minimum utilization criteria of 800 vphpl during at least one hour of the day. All but three exceed the criteria in at least one direction during both peaks. Ten of the 16 Study Routes operate at over 1,200 vphpl, or more than 70% of the maximum threshold. Route 110 between 105 and Adams carries a total of 2,400 to almost 2,700 peak direction vehicles, effectively utilizing the two carpool lanes provided in each direction.

The high utilization of carpool lanes in Los Angeles County extends beyond the normal weekday peak periods. The analysis results indicate there is also significant vehicular and person trip usage of the carpool lanes during midday and evening off-peak periods on most of the facilities studied.

The lower volume threshold of 600 vphpl for immature carpool lanes (less than 3 years old) did not prove to be an effective evaluation tool. The degree to which carpool lanes in Los Angeles County are utilized does not seem to correlate to age of the lane as much as it does to the level of congestion in the adjacent general-purpose lanes and the perception of reliable travel time savings.

Consistent with the data analysis results, survey results indicate that the residents and commuters of Los Angeles County are using carpool lanes and are doing so on a somewhat regular basis. However, despite their use of carpool lanes, the public's perception of the utilization of carpool lanes tends to be mixed, with opinions basically divided between those who perceive the lanes are sufficiently utilized and those who do not.

4.7.3 Travel Time Savings

All of the carpool lanes in Los Angeles County provide travel time savings to varying degrees over the adjacent general-purpose lanes. Travel time savings was identified by the majority of Los Angeles County carpool lane users as their primary motivation for using carpool lanes. Most of the HOV Study Routes realize travel time savings that meet or exceed the threshold criterion during one or both peak periods, with four of the HOV Study Routes exceeding the

threshold test level during both peak periods. A review of the analysis results indicate that travel time savings on the HOV Study Routes are often reduced by one or two of the following factors

- High speeds in both the carpool and general-purpose lanes on freeways that do not experience high levels of congestion, thereby reducing the comparative travel time savings to carpool lane users.

- Low speeds in the carpool lanes due to high levels of carpool lane utilization.

- Low speeds encountered in the carpool lanes as vehicles approach the end of the carpool lanes and experience delays reentering the general-purpose traffic stream.

All of the carpool lanes analyzed have average travel speeds faster than those in the adjacent general-purpose lanes. Three of the HOV Study Routes experience average travel speeds of less than 35 mph during one or both peak periods, indicating congested conditions. The slowest carpool lanes are typically located in the most congested freeway corridors and carry the most vehicles indicating they may be becoming too well utilized.

4.7.4 Person Movement

The two control routes (Routes 5 and 101) have experienced a general decline in AVO over time, which is consistent with national trends. The analysis results indicate that AVO on the HOV Study Routes, on the other hand, have generally increased from before carpool lane implementation, indicating that this trend has been reversed on Los Angeles County freeways with carpool lanes.

The percentage of person trips carried in the carpool lanes exceeds the percentage of vehicle trips for all 16 of the HOV Study Routes, during both the AM and PM peak hours. The percentage of person trips carried in the carpool lanes also exceeds the percentage of total freeway lanes that are carpool lanes on most of the routes.

The 3+ carpool lane occupancy requirement on Route 10 (the El Monte Busway) results in a reduced percentage of eligible carpools but increases the person moving capacity. Considering persons in 3+ carpools only (i.e., not including those carried in buses), the portion of the Route 10 HOV lanes east of Route 710 carry more persons per lane than any other HOV Study Route during the PM peak.

4.7.5 Transit Use

More person trips are carried in the carpool lanes on Routes 10 and 110 (almost 5,000 to over 6,000 person trips in the peak hour/peak direction on each) than on any other of the HOV Study Routes, due in part to the high transit service levels. The only HOV Study Routes with public transit service levels and ridership higher than on both of the control routes are Route 10 (the El Monte Busway) and Route 110 (the Harbor Transitway). In addition, daily bus ridership on Route 14 is roughly equivalent to that on both of the control routes. Like the two control routes, each of these HOV Study Routes serves a traditional suburb-to-downtown commute pattern that is typically easier to serve with fixed route transit services.

In contrast, most of the remaining HOV study routes generally serve suburban-to-suburban trips that are more difficult to serve with fixed route transit services. As a result, five of the HOV Study Routes have no transit service, while the remaining routes have service and ridership levels lower than the Control Routes.

The majority of transit operators indicate that the provision of carpool lanes has positively influenced bus operations. Transit operators have altered transit routes to some extent to take advantage of the carpool lanes, although the alteration is generally incidental involving routes that already coincide with new carpool lanes.

4.7.6 Cost Effectiveness

In general, Los Angeles County carpool lanes appear to have been good investments. User benefits have already exceed costs for several HOV Study Routes. Carpool lanes in Los Angeles County have an average payback period of about nine years, with the majority of the facilities estimated to achieve a positive net present value by 2006.

Carpool lanes in congested freeway corridors generally enjoy higher benefits due to the potential for greater travel time savings to carpool lane users compared to general-purpose lane users. In less congested freeway corridors, although initial carpool benefits are lower, the benefits begin to accrue rapidly in future years as the levels of congestion in the adjacent general-purpose lanes reach critical thresholds.

The cost effectiveness of carpool lane investments is reflected in the overall public perception of the carpool lane system as a good transportation investment. Over three-quarters of all Los Angeles County residents and commuters feel that carpool lanes are good transportation improvements. Of those individuals that generally choose not to use carpool lanes for their commute, 73% believe that carpool lanes are a good transportation improvement.

4.7.7 Safety

Although the results of the accident analysis are somewhat inconclusive, it appears that there is no correlation between accident rates and the provision of carpool lanes. Although carpool lanes do not appear to be inherently unsafe, it is recommended that CHP modify the way accidents are reported in the carpool lanes to provide better data for future carpool lane safety evaluation.

The Los Angeles County carpool lane system experiences an extremely low level of occupancy violations compared to other cities nationally. This low incidence of occupancy violations reflects high compliance with carpool lane minimum occupancy requirements and ensures that the maximum possible carpool lane capacity is available for eligible carpools.

4.7.8 Air Quality

The analysis results indicate that carpool lanes generally produce less emissions per unit of mobility than adjacent general-purpose lanes. However, despite the lower emission rates in carpool lanes, this does not necessarily translate to reduced emissions for the HOV Study Routes when compared to Control Routes. To better assess the comparative emissions between freeways with carpool lanes and freeways without carpool lanes, it would be

appropriate to consider a larger sample of Control Routes before the results of this analysis could be considered to be statistically valid.

An alternative more traditional air quality evaluation approach would be to estimate emissions of one selected analysis segment before and after the incorporation of carpool lanes. The availability of current year data archived as part of the HOV Performance Program provides the opportunity for the future evaluation of the Five-Year Look Ahead Routes using this type of air quality analysis approach.

5.0 DEVELOPMENT OF HOV POLICIES

5.1 Introduction

This chapter presents HOV policies that will help direct future investments in HOV capital facilities, services, and operating decisions. The chapter is divided into four sections following this introduction. First, the process undertaken to develop the policies is described. Second, the roles and responsibilities of the MTA and other transportation agencies relating to HOV facilities and current HOV goals, policies, and objectives are reviewed. Third, the HOV policies are presented. Fourth, coordination and cooperation efforts to assist in the ongoing development and operation of the countywide HOV system are highlighted.

5.2 Policy Development Process

A number of activities were undertaken to develop the HOV policies presented in this chapter. These activities included reviewing current HOV policies and standards of practice adopted by transportation agencies in Los Angeles County and the state, examining HOV policies from other agencies in the country, conducting workshops with staff from the MTA and other participating agencies, examining the results of the performance assessment and measures of effectiveness, developing draft policies, and reviewing these policies with MTA and participating agency staff.

The first step involved reviewing the HOV-related goals, policies, objectives, and standards of practice adopted by the MTA, Caltrans, SCAG, and other appropriate agencies. The results of this review are summarized in the **Section 5.3**. The existing goals, policies and objectives provided a base for the development of the HOV policies presented here. A review was also conducted of HOV policies adopted by agencies in Florida, Texas, Minnesota, and Washington.

Two policy workshops were held with staff from the MTA and other participating agencies. The first workshop was conducted early in the study process on October 19, 2000. This workshop focused on reviewing current HOV policies in Los Angeles County and other areas of the county; identifying policy issues of concern in Los Angeles County; and rating the policy issues that should be addressed first. An initial list of 26 policy issues was identified at the first workshop. This list was consolidated into eight major issue areas through further discussions at monthly HOV Performance Program PAT meetings and with participating agency representatives.

Two policy statements, one on agency roles, coordination, and cooperation and one addressing public information and awareness, were developed and reviewed by agency staff. The development of other policy statements occurred after the completion of the data collection and analysis process. A second workshop was held with MTA and Caltrans staff on February 13, 2002. Participants at this workshop reviewed the measures of effectiveness analysis and discussed the policy implications of the study results.

The comments from agency representatives provided direction for the development of the HOV Guiding Principles presented to the MTA Planning and Programming Committee on September 18, 2002 and subsequently adopted by the MTA Board of Directors on September 26, 2002.

To conform to the format for MTA program policies, the HOV Guiding Principles were reformatted to HOV Policies that were affirmed by the MTA Board of Directors on November 22, 2002. The HOV Policies provide direction for more efficient HOV lane operation and cost effective completion of the countywide HOV system. The MTA Board of Directors action of November 22, 2002 directs MTA staff to utilize the policies described in this Section 5.4 of this report, and to share these policies with other interested organizations, as appropriate, in the development of MTA's HOV Program.

5.3 Agency Roles and Responsibilities and Existing HOV Policies

In Los Angeles County, carpool lane facilities represent just one element of the overall intermodal transportation system. Ensuring that carpool lane facilities are coordinated with other transportation system components and that each mode and system element is used appropriately is key to the success and long term sustainability of carpool lane programs. Examples of other elements of the intermodal transportation system include mixed-flow freeway lanes, ramp metering, freeway service patrols, local roadways, traffic and transportation management systems, Intelligent Transportation Systems (ITS), ridesharing programs, travel demand management (TDM) strategies, and local and freeway express bus services operated by MTA and municipal operators, Metro Rail, Metrolink commuter rail, and other transportation services.

Agency cooperation and coordination is especially important due to the unique nature of carpool lane projects and the need to involve representatives from highway, transit, rideshare, and enforcement agencies, as well as other groups. Consequently, the FHWA instituted policy directing state departments of transportation to work with metropolitan planning organizations (MPO) and affected agencies on regional carpool lane plans and to coordinate specific projects with appropriate agencies. In 1992, the Los Angeles County Transportation Commission (LACTC), a predecessor agency to the MTA, partnered with Caltrans to expedite the completion of the Los Angeles County carpool lane system. The LACTC Board directed staff to jointly work with Caltrans to plan, program, schedule and monitor the progress of the design and construction of freeway-based carpool lane projects through a Master Cooperative Agreement between Caltrans and the LACTC.

In 1998, since the passage of Senate Bill (SB) 45, Caltrans provides MTA with cost estimates and delivery schedules for all highway capital projects, including carpool lane projects. MTA staff works with Caltrans to improve the accuracy of project cost estimates and delivery schedules. Furthermore, with the additional responsibilities and authority granted to the MTA in accordance with SB 45, MTA now reviews Caltrans' work plans, monitors project budgets, scopes and schedules (including a cost containment program) to ensure the cost effective and timely delivery of the HOV capital investment program.

Multi-agency teams have been emphasized on numerous HOV studies and carpool projects in the County and in the Southern California region on inter-county and corridor specific issues. These teams involve representatives from the appropriate agencies and groups responsible for implementing and operating the various elements of the carpool lane system in the County. They have been successful in helping to ensure that the appropriate groups are knowledgeable of and involved in all phases of the various carpool lane projects, and are essential for ongoing public and policy-maker support.

SCAG is the MPO for the Los Angeles region. SCAG conducts long-range planning activities for the region and operates the regional rideshare system. The CHP enforces driving laws, including HOV requirements.

The MTA, Caltrans, and SCAG have existing policies and objectives addressing HOV facilities. Current agency goals, policies, and objectives focusing on HOV facilities are highlighted in the following sections.

5.3.1 MTA Vision for Year 2020.

"Our Region will offer a better quality of life where all people can travel quickly, economically and safely in a clean environment."

5.3.2 MTA Mission Statement.

"To provide the leadership and resources for a safe, efficient transportation system that keeps Los Angeles County moving. A better tomorrow rides on us."

5.3.3 MTA 1995 HOV Integration Plan.

"The purpose of the High-Occupancy Vehicle (HOV) system in Los Angeles County is to enhance mobility for all County residents by providing a system of dedicated lanes that serves to both encourage use of transit and carpools, as well as support other county-wide objectives of improving air quality, trip reduction, and efficient movement of persons and goods."

5.3.4 MTA 2001 Long-Range Transportation Plan.

"The Long Range Transportation Plan (LRTP) is based on three goals addressing mobility, air quality, and access. These goals will be accomplished through four key strategies: maintaining the existing transportation system, maximizing system efficiency, increasing system capacity, and managing demand. HOV facilities, public transportation, and ridesharing are major elements of the Long-Range Plan."

5.3.5 California Department of Transportation (Caltrans)

Caltrans objectives related to properly designed, free flowing HOV lanes include the following:

- Increase the people-moving capacity of the freeway system.
- Reduce overall vehicular congestion and motorist delay by encouraging greater HOV use.
- Provide time and commute costs savings to the users of HOV lanes.
- Increase overall efficiency of the system by allowing HOVs to bypass congestion on lanes designed for their use.
- Improve air quality by decreasing vehicular emission.

State of California policy requires Caltrans to obtain approval from the MTA before establishing an HOV lane in the County. Caltrans policy on operations calls for most new carpool lanes to have a 2+ vehicle-occupancy level and provides criteria for carpool lane performance in terms

of vehicles-per-hour and persons-per-hour. The Director of Caltrans decides on vehicle-occupancy requirements to maintain stable flow in a carpool lane. Caltrans policy also calls for the carpool lane planning processes to include consideration of park-and-ride lots, bus/transit stations, and ingress/egress to encourage express bus service. An operational objective of Caltrans and CHP is for violation rates in carpool lanes to be not more than 10 percent of total usage.

5.3.6 Southern California Association of Governments (SCAG)

The mission of SCAG is to provide leadership, vision, and progress that promotes economic growth, personal well-being and livable communities for all Southern Californians. The 1996 State of the Commute Report notes the importance of supporting efforts to expand and retain the regional HOV network. The report notes that travel time savings were rated second only to convenience as the most important factors influencing commuter's mode choice decisions. SCAG's Regional Transportation Plan calls for planning for transportation improvements to include consideration of alternatives to single-occupant vehicles lanes. In addition, SCAG's rideshare program provides a basis for HOV education and promotion activities.

5.4 HOV Policies

MTA promotes the use of HOV lanes as a viable transportation choice that is safe, environmentally supportive and encourages ridesharing in an effort to improve mobility throughout the Los Angeles County Transportation System. The HOV Policies implement MTA's commitment to promote the use of carpools, vanpools and transit. The findings of the HOV Performance Program verify that HOV lanes shorten overall travel times and move more people faster than general-purpose lanes.

The HOV Policies provide direction for more efficient HOV lane operation and cost effective completion of the countywide HOV system. The MTA Chief Executive Officer is responsible for ensuring that the HOV Policies are converted to an action plan, budgeted and appropriately implemented.

5.4.1 Capital Investments

Based on results from the performance program, three areas were identified where future capital investments in the HOV system plan are needed:

- HOV Gap Closures. The MTA will pursue completion of gaps in the currently defined countywide HOV system plan and its connections with adjacent counties. The MTA will generally utilize the methodology that was developed and tested on select freeway-to-freeway connectors as part of the performance program. This methodology utilized future traffic volume and travel time forecasts generated using the MTA Travel Simulation Model, existing average vehicle occupancy rates and accident locations derived from performance program data, and conceptual design impacts and cost estimates specifically developed for each location to score and rank the potential facilities. For the purpose of future gap closure evaluation, this methodology will be further enhanced by incorporating a benefit-cost element that will follow the modified California Benefit Cost (Cal BC) Model that was applied as part of the performance program evaluation of existing HOV facilities. The MTA will work with Caltrans to

perform these evaluations and to secure and program funding for needed gap closures. The MTA will discuss parameters and needed modification to this methodology with Caltrans such as life-cycle periods, transit service, etc. This approach will ensure a planning process that advances the most logical evolution of a more continuous system of HOV lanes, promotes increased transit and ridesharing, and optimizes operational efficiency where lane discontinuities currently constrain freeway and HOV operations.

- Freeway-to-Freeway HOV Connectors. The MTA will pursue freeway-to-freeway HOV connectors at strategic locations between intersecting HOV freeway corridors. The MTA will generally utilize the methodology that was developed and tested on select freeway-to-freeway connectors as part of the performance program. This methodology utilized future traffic volume and travel time forecasts generated using the MTA Travel Simulation Model, existing average vehicle occupancy rates and accident locations derived from performance program data, and conceptual design impacts and cost estimates specifically developed for each location to score and rank the potential facilities. For the purpose of future potential HOV Direct Connectors evaluation, this methodology will be further enhanced by incorporating a benefit-cost element that will follow the modified California Benefit Cost (Cal BC) Model that was applied as part of the performance program evaluation of existing HOV facilities. The MTA will work with Caltrans to perform evaluations to prioritize candidate locations and to secure and program the funding needed for these capital investments. Implementing HOV connectors will provide even greater travel time saving and trip reliability to bus riders and carpoolers, and will enhance both HOV and freeway operations by minimizing HOV weaving and merging at freeway interchange locations.

- Transit Facilities. The MTA will actively plan and implement transit services, transit stations, park-and-ride lots, and direct access ramp connections with existing HOV lanes to gain greater efficiency and use of the current HOV lane investment. Transit facility investments are particularly critical on routes where HOV lane operational capacity has been reached and increasing occupancy requirements to three or more persons per vehicle are required. In order to achieve the same success as evidenced on the El Monte Busway, the MTA will work with Caltrans and affected transit service providers and jurisdictions to develop an evaluation methodology to identify transit markets that could be better served using HOV facilities, and to define, evaluate and rank specific transit investments that will be needed.

5.4.2 Operations

- The MTA supports the operation of HOV facilities on a 24-hours/7 days a week basis. Only when the measured HOV lane volumes are less than federal and state standards (e.g., 800 vehicles per hour) and other remedial actions have not been successful in increasing use of the facility, part time HOV operation would be considered. Part time HOV operations should not be considered during the first 3 years of operation to allow adequate time for ridesharing and transit use to develop. Any part time HOV operations must be coordinated with and approved by appropriate state and federal agencies, and may require repayment of any federal funds used for HOV capital investments.

- The MTA will work with Caltrans and other agencies to examine HOV facilities currently reaching capacity at the 2+ vehicle-occupancy level for possible operating alternatives to sustain travel time savings and trip time reliability. These alternatives may include restriping or otherwise modifying lane design to address isolated capacity conditions, raising the vehicle-occupancy requirement to 3+ during congested periods, and adding or increasing transit services as a means of regulating demand. Evaluations will be needed to address the best combination of strategies which will preserve current benefits and generate the potential to serve additional person movement.

- The MTA supports a 2+ vehicle-occupancy requirement. When maximum design limits for HOV traffic volumes (1,600 vehicles per hour) are being approached, 3+ vehicle-occupancy level would be considered during peak commute hours. Before the 3+ vehicle-occupancy restriction is put in effect, a comprehensive analysis based on the Caltrans methodology for evaluating the benefit-cost of capacity enhancing projects will be conducted to assess the best combination of strategies to transition a project from 2+ to 3+. After the 3+ vehicle-occupancy restriction is in effect, the effectiveness of the restriction would be assessed.

- The MTA will periodically assess the need for new bus services and expanding existing services on HOV lanes. The assessments will evaluate existing routes, common origin/destination pairs in unserved travel markets, and major employment locations. The assessment will be undertaken in coordination with Caltrans and transit operators.

- The MTA endorses the California Highway Patrol (CHP) role in providing ongoing enforcement of the HOV lanes, and will work with CHP and Caltrans to pursue innovative strategies and facility modifications to improve enforcement and to reduce the costs associated with enforcement.

5.4.3 Public Education and Awareness

- MTA shall prepare and annually update/revise an HOV Education and Promotion Plan. Elements of the HOV Education and Promotion Plan shall include:

    1. Assessment of existing HOV market conditions (actual usage, users and non/user attitude and opinion data, etc.) as needed;
    2. Goals and objectives of the HOV Education and Promotion activities and determination of target markets for the calendar year;
    3. Descriptions of specific activities to be undertaken;
    4. Schedule of implementation, desired measurable outcomes and required budget; and
    5. The annual budget for HOV Education and Promotion activities which might vary based on the introduction of new HOV facilities, market research efforts, and ongoing education needs.

- Information outlining HOV goals, objectives and performance and future visions will be included as part of the annual program for elected officials (cities, County, State officials representing LA County) and key County stakeholder outreach undertaken by MTA. It is desirable that the HOV education outreach be implemented within 3 months

of election of a newly elected official and within 4 months of a re-elected official and a minimum of annually with key County stakeholders.

- The MTA will target specific HOV corridors, implement a more focused HOV corridor promotion program and periodically assess the common origin/destination pairs in underutilized HOV corridors. The assessment will be undertaken in coordination with Caltrans.

- MTA shall ensure that an education and promotion specialist is an active member of the HOV Planning and Design Team(s). The role of this specialist will be to identify and coordinate opportunities for education and promotion at the earliest stages of HOV project development.

- HOV education and promotion elements shall be incorporated into the outreach activities of rideshare organizations receiving funding from MTA (including the MTA managed programs that benefit rideshare) and other incentive programs, as well as transportation management and transit operator associations and/or organizations.

- Funding for project specific HOV education and promotion shall come from HOV project funds. Agencies applying for HOV project funding will include an estimate for HOV education and promotion in the overall project cost estimate, after a thorough research of available promotional materials that currently exist at the MTA.

5.4.4 Performance Monitoring

- The MTA will coordinate with Caltrans, CHP, and other agencies in conducting periodical assessment of the performance of the Los Angeles County HOV lanes. The performance assessment will focus on "key" measures of effectiveness (MOEs) outlined in **Section 2.3** of this HOV Performance Program Evaluation Report. Some of these MOEs include vehicle volumes, persons per lane per hour, travel time savings, improvements in speed, vehicle occupancy levels, violation rates, and others. Caltrans will provide data support (i.e., tach runs and vehicle-occupancy counts) by implementing a computerized freeway monitoring program and by incorporating the HOV data collected in this performance improvement program; transit operators will provide ridership counts and operating cost data; and CHP will provide violation data. The MTA will assist and coordinate with Caltrans in summarizing data and publishing status report.

5.5 Coordination and Cooperation Efforts in the Development and Operation of a Countywide HOV System

Specific actions that are needed to improve the performance of HOV lanes will be carried out in consultation and coordination with Caltrans and other transportation agencies and the public. "Partnership" is key to the success of the operation and design of HOV lanes because: (1) by statute, the MTA is the planning and programming agency for all State highway capacity enhancement improvements; (2) Caltrans is the owner and operator of the freeways and is responsible for their operations and maintenance; and (3) the California Highway Patrol (CHP) is responsible for the enforcement of traffic laws on the freeways. Agency coordination and

cooperation efforts in the development and operation of a countywide HOV system are highlighted in this section.

- MTA has long-standing partnership of jointly working with Caltrans to deliver all elements of the highway/freeway system as an integrated transportation system including general-purpose lanes, HOV lanes, HOV connectors, ramp metering and by-pass lanes, park-ride lots, soundwalls, transit centers, intelligent transportation systems, traffic management strategies, rideshare and transportation demand management programs, and other operational strategies. MTA will lead local (county-level) planning efforts and support Caltrans in statewide efforts. MTA will support Caltrans in all other aspects of delivering an integrated transportation system.

- Through the State Transportation Improvement Program (STIP) process, SCAG's Regional Transportation Plan (RTP), and MTA's Long Range Transportation Plan, MTA takes a proactive role in promoting and coordinating the development of a system of continuous HOV facilities throughout the County as well as connections to planned and existing HOV facilities in adjacent counties and throughout the region. Examples of this role include the active solicitation of HOV projects that provide a continuous HOV system and corresponding connections from proposing agencies, and the development of project selection scoring to favor projects that provide a continuous HOV system and the corresponding connections.

- MTA pursues interagency coordination in planning, designing, implementing, marketing, operating, enforcing, and monitoring and evaluating HOV facilities, including the use of multi-agency teams and other appropriate mechanisms. Example forums that have been established include the MTA Streets and Freeways Subcommittee, the MTA/Caltrans Planning Coordination Task Force, and the SB 45 Coordination Committee.

- In support of federal and state guiding principles on the coordination of transportation planning and project development processes, the MTA reviews the Master Cooperative Agreement between MTA and Caltrans annually to determine if modifications are needed. If the Agreement is deemed to be in need of modification, MTA will lead the effort to update and amend the Agreement to ensure responsiveness to revisions to transportation legislation and new agency roles and responsibilities pertaining to HOV facilities.

- MTA will advocate for and participate on a regional HOV Systems Committee or similar body to coordinate regional policy-making and to resolve issues that cut across county borders. SCAG, which is the federally designated Metropolitan Planning Organization (MPO) that encompasses the six Southern California county region, is the designated agency to take the lead role in this activity.

- Intermodal considerations and coordination shall take place throughout the HOV planning and development phases. These principles are outlined in the MTA 1996 HOV Systems Integration Plan.

- When significant changes are to occur to the HOV system or its components, MTA shall request that Caltrans coordinate such changes through a regional process, as

designated by MTA, SCAG or other regional forum. Significant changes may include addition HOV mainline lanes not currently envisioned in the HOV element of the MTA Long Range Plan, deletion of HOV lanes that are currently in the plan, and changes to the hours of operation or vehicle-occupancy designation on any of the freeway HOV facilities in the county.

6.0 CONCLUSIONS FROM THE HOV PERFORMANCE PROGRAM

This chapter provides an overview of conclusions and recommendations derived from the HOV Performance Program audit of the carpool lane system on Los Angeles County freeways. The chapter is divided into sections that provide conclusions for a range of topic areas highlighting study objectives and measures of effectiveness (MOEs). These objectives and corresponding MOEs are as follows and are not presented in any priority order:

Objective 1: Manage Travel Demand by Increasing the Person Movement Capacity in Congested Freeway Corridors

Measures of Effectiveness

- MOE 1A – Average Vehicle Occupancy. Actual number and percent change in the average vehicle occupancy (AVO) for the HOV lanes, the general-purpose lanes, and the total freeway.
- MOE 1B – Person Trips. Actual number and percent change in the person trips carried for the HOV lanes, the general-purpose lanes, and the total freeway.
- MOE 1C – Percent of Persons vs. Vehicles. Percent of persons carried in the HOV facility compared to percent of vehicles.
- MOE 1D – Carpools and Vanpools. Actual number and percent change in the number of carpools and vanpools; number of vehicles in HOV lane.
- MOE 1E – Buses and Bus Riders. Actual number of public transit buses and bus riders.

Objective 2: Encourage Carpooling, Vanpooling, and Bus Use by Providing Travel and Mobility Options

Measures of Effectiveness

- MOE 2A – Transit Operators Attitudes. Public and private transit operators attitudes toward HOV facilities.
- MOE 2B – Ridesharing Activities. Change in the nature and level of ridesharing program activities and services to existing and new markets.
- MOE 2C – System Connections. Change in connections with other HOV facilities, transit facilities, and major activity centers.

Objective 3: Provide Travel Time Savings and Trip Reliability to HOV Lane Users

Measures of Effectiveness

- MOE 3A – Travel Time Savings. Difference in the travel time for vehicles in the HOV lane from those in the freeway general-purpose lanes during the peak-period, in the peak direction.
- MOE 3B – Travel Speed. Average travel speed in the HOV lane.

Objective 4: Provide Air Quality Benefits

Measures of Effectiveness

- MOE 4A – HOV Corridor Vehicle Emissions. Comparison of vehicle emissions on HOV analysis segments compared to Control Routes.
- MOE 4B – HOV Lane Vehicle Emissions. Comparison of vehicle emissions in HOV lanes compared to adjacent general-purpose lanes.

Objective 5: Promote a Cost-Effective Transportation System

Measures of Effectiveness

- MOE 5A – Transit Operations. Comments from transit personnel on benefits of HOV lanes for transit operations.

- MOE 5B – Benefit-Cost - Benefit-Cost Ratio (BCR), Net Present Value (NPV), Economic Rate of Return (ERR) and Year of Economic Feasibility (YEF) for the HOV facility.

- MOE 5C – Accidents. Accident rates for freeways with carpool lanes.

- MOE 5D – Public Perceptions – Adequate Use. Actual and percent of users, non-users, policy makers, and the public responding to questions on adequate use of the HOV facilities in surveys and other market research techniques.

- MOE 5E – Public Perceptions – Good Improvement. Actual and percent of users, non-users, policy makers, and the public responding to questions on HOV facilities as good transportation improvements in surveys and other market research techniques.

- MOE 5F – Violation Rates. Number and percent of vehicles in the HOV facility that do not meet the minimum occupancy requirement or other use regulations.

This chapter includes a matrix summarizing overall findings of the performance evaluation with respect to each of the predefined objectives and MOEs. The chapter concludes with recommendations for the continued development, enhancement and performance monitoring of the Los Angeles County carpool lane system.

6.1 Overall Findings

This performance and monitoring program has been the most comprehensive ever undertaken of any carpool lane system in the United States. Accordingly, it is difficult to summarize all of the many findings in a few pages. The study team compiled a summary matrix that provides on a single page an overall scorecard of how the Los Angeles County carpool lane system fared against the various objectives and MOEs established. This summary matrix is presented as **Table 6.1.1**. Overall, the findings are positive. The resources and efforts made to implement carpool lanes in Los Angeles County represent perhaps one of the best transportation infrastructure investments to have been made since the construction of a regional freeway system many years ago. Based on the number of daily users and travel time saved, increased mobility is provided to individuals with other travel choices and those with few modal choice options. The levels of use of, and public appreciation for, this investment are excellent when compared to other HOV systems nationwide. Design and operational practice represent the best and most appropriate balance for the constrained settings that the carpool lanes were implemented in. In some instances, this system may have been compromised by a design with too much access and occupancy requirements that are not restrictive enough to prevent carpool lane projects from becoming saturated with use in a rather short timeframe. Changes may be needed in the future to preserve the mobility benefits currently afforded.

Currently, California has approximately 45% of the total carpool lane miles in the nation with 383 lane miles of California's 1,060 carpool lane miles (36%) located in Los Angeles County[15]. The California Legislative Analysts Office (LAO) Report published on January 7, 2000 cited the state's carpool lanes for not fully achieving the effectiveness they were intended to provide. This study provides a better perspective of the strengths and weaknesses of the Los Angeles County carpool lanes.

- *Reducing Congestion Versus an Alternative to Congestion.*

  The LAO Report suggests that carpool lanes have failed in their goal to reduce congestion, yet this is not a goal commonly expressed for carpool lane development nationwide. Feedback from elected officials, public surveys and from performance monitoring indicates that carpool lanes are effective in providing an alternative to congestion by promoting person movement and mobility. Indeed, this study has shown that the presence of congestion is the best indicator for successful utilization of a carpool lane.

- *Person Movement in Carpool Lanes.*

  The LAO Report states that California's carpool lanes carry 2,518 people per hour which is more than a general-purpose lane operating at maximum capacity. This study affirms the LAO finding for Los Angeles County, with an average of 2,698 persons/hour being moved.

[15] Source: 2001 HOV Annual Report, California Department of Transportation District 7, May 2002

Table 6.1.1 HOV Study Route Evaluation Summary Matrix

● ◕ ◑ ◔ ○

Most Effective — *Least Effective*

		Objective 1: Manage Travel Demand					Objective 2: Encourage Carpooling			Objective 3: Travel Time Savings		Objective 4: Air Quality Benefits		Objective 5: Promote Cost-Effective Transportation					
		MOE 1A	MOE 1B	MOE 1C	MOE 1D	MOE 1E	MOE 2A	MOE 2B	MOE 2C	MOE 3A	MOE 3B	MOE 4A	MOE 4B	MOE 5A	MOE 5B	MOE 5C	ME 5D	MOE 5E	MOE 5F
HOV Study Routes		Average Vehicle Occupancy	Person Trips	Percent Persons vs. Vehicles	Number of HOV Vehicles	Buses and Bus Riders	Transit Operator Attitudes	Ridesharing Activities	System Connections	Travel Time Savings	Average Speeds	Corridor Vehicle Emissions	Lane Vehicle Emissions	Transit Operations	Benefit-Cost	Accidents	Public Perceptions Adequate Use	Public Perceptions Good Improvement	Violation Rates
10	Alameda St. to Baldwin Av.	●	●	●	●	●			●	◑	●	◔	●	●	na	na			◑
14	San Fernando Rd. to Escondido Canyon Rd.	●	◕	●	●	◑			◑	○	●	○	●	◕	◕	◕			●
57	Orange County Line to Route 60	●	◕	●	●	○			◑	◑	○	○	●		◕	◔			●
60	Brea Canyon Rd. to San Bernardino County Line	●	◕	●	●	○			◑	◑	●	◑	●	◑	◕	◑			●
91	Route 110 to Orange County Line	●	◕	●	●	○			◔	●	●	◔	●		●	◑			●
105	Route 405 to Route 605	●	●	●	●	○			●	○	◑	◔	●		na	na			●
110	Route 91 to Route 105	◕	◑	◕	●	◕			◕	○	●	◑	●	●	◑	●			●
	Route 105 to Adams Bl.	●	●	●	●	◕				●	●	◑	◑		●				
118	Ventura County Line to Route 5	●	◑	◑	●	◔	◕	◕	◑	○	●	○	●		●	●	◑	●	●
134	Routes 101/170 to Route 210	◕	◑	◑	●	○			○	○	●	◔	◕		●	◔			●
170	Routes 101/134 to Route 5	●	◔	◑	◕	○			◕	◑	●	◑	●		◕	◑			●
210	Route 134 to Sunflower Av.	◕	◑	◕	●	na			◑	●	●	◔	●	◑	●	◑			●
405	Orange County Line to Route 110	●	◕	●	●	○			◔	◑	●	◕	◕		◕				●
	Route 110 to Century Bl.	●	●	●	●	○				●	●	○	●		●	◕			
	Route 101 to Route 5	●	◑	◕	●	◔			◔	◑	◑	○	●		◕				
605	South St. to Route 10	◕	◑	◑	●	○			◑	○	●	◔	●		◕	◑			●
System Summary (Average for All Routes)		●	◕	◕	●	◔	◕	◕	◑	◑	●	◔	●	◕	◕	◑	◑	●	●

Notes:

na - data not available

(1) Matrix results for the Objective 1 MOEs reflect consolidation of the various individual threshold tests and of AM and PM peak hours to one summary result for each of the five MOEs (1A, 1B, 1C, 1D and 1E).

(2) Matrix results for MOE 2A reflects public and private transit sector attitudes toward carpool lanes in general. MOE 2B reflects the availability and effectiveness of regional rideshare programs and incentives to encourage rideshare participation countrix re

(3) Matrix results for Objective 2C reflect a combination of the availability and utilization of park-and-ride facilities and the presence of carpool system gaps and/or direct connections.

(4) Matrix results for the Objective 3 MOEs reflect consolidation of results for the AM and PM peak periods.

(5) For MOEs 4A and 4B, data was not available for the following analysis segments: 10 (Alameda - 710), 14 (Sand Cyn to Escondido Cyn), 60 (Brea Cyn - 57), 105 (710 - 605) and 605 (South - 105). In these locations, matrix results reflect the balance of th 4B, data was not av Matrix results reflect the consolidation of analysis segment results for CO, ROC, NOx and PM10, and AM and PM peak hours.

(6) For MOE 5A, matrx result represents transit system operators indication of positive influence of carpool lanes on transit operations, and transit operation levels for HOV Study Routes.

(7) For MOE 5C, matrx result represents combination of before and after accident rate comparison, and current year accident rate comparison with statewide average.

(8) MOEs 5D and 5E are based on the findings of the market research surveys and reflect the public's perception of carpool lane utilization and carpol lanes as a good transportation improvement.

(9) Not all Los Angeles County carpool lanes were analyzed as part of the HOV Performance Program. Route 30 was not analyzed due to the short length of the carpool lanes. Carpool lanes on segments of Route 405 and 605 were not analyzed as they were openel Los Ange subsequent to data collection activities.

- *Available Capacity on Carpool Lanes.*

  The LAO Report indicates that carpool lanes are operating at only two-thirds of their vehicle capacity. This study found that a majority of routes in Los Angeles County were operating at more than 70% of their capacity, and saturation was essentially the threshold of 1,650 vehicles per hour. Above this threshold time savings would likely be compromised.

- *Inducing People to Carpool.*

  The LAO Report states that HOV lanes do induce people to carpool, but statewide impacts on carpooling were unknown due to a lack of data. This study found that more than 50% of HOV use was from new carpool formation, which substantiates a similar finding from a 1988 survey from Route 55 in Orange County.

- *Air Quality Impacts.*

  The LAO Report notes that exact impacts of carpool lanes on air quality are unknown. This study affirms there are generally lower emission rates for carpool lanes compared to general-purpose lanes, although any air quality benefits are offset by the vastly greater amount of adjacent general-purpose traffic. These findings also build a case for better data collection and tracking for future air quality monitoring, particularly for the analysis of air quality impacts before and after the addition of carpool lanes.

- *Meeting Minimum Criteria of Moving 800 Vehicles per Hour.*

  All but one of the Los Angeles County carpool lanes exceed the minimum threshold of 800 vehicles per lane in the peak hour. Ten of the HOV Study Routes exceed this threshold by more than 50%.

- *Adjusting Operating Hours.*

  The LAO Report suggests more flexibility statewide in adjusting hours of operation on carpool lanes. This study found moderate to high use of carpool lanes among all daylight hours on most corridors in Los Angeles County, suggesting that the current 24-hour operating policy is appropriate.

- *Encouraging High Occupancy Toll (HOT) Lanes.*

  The LAO Report encourages legislative creation of HOT lanes for carpool lanes that have unused capacity (presumably to "sell" capacity to single-occupant vehicles). This study found limited opportunity for HOT lanes because of the high utilization of the carpool lanes during periods when the greatest demand for other users would occur. Pricing is one possible strategy to regulate 2-occupant demand if restrictions are raised to 3-persons or more during these limited capacity periods.

- *Encourage Data Collection Efforts for Performance Monitoring.*

  Both this study and the LAO Report express the need for ongoing data collection and performance monitoring. This study has created a Data Management Program to help foster future performance updates.

The following discussions highlight key findings from various aspects of the HOV Performance Program.

6.1.1 Carpool Lane Utilization

- *Approximately two-thirds of the HOV Study Routes (10 out of 16) operate above 1,200 vehicles/hour.*

  The minimum criterion for carpool lane utilization of 800 vphpl during the peak hour was attained for all but one study route (Route 170). Approximately two-thirds of the HOV Study Routes operate in excess of 1,200 vphpl during the peak hour or 72% of their maximum operation threshold of 1,650 vphpl. This information suggests that during peak periods much of the Los Angeles County carpool system is operating at a near saturated condition with little available operational capacity to provide for future growth. Furthermore, Caltrans reports that several carpool lanes, including Routes 105 and 210, periodically exceed the maximum operational threshold during peak hours.

- *Congestion is experienced in the carpool lanes at high demand locations.*

  Los Angeles County carpool lanes typically do not carry more than the 1,650 vphpl maximum threshold indicating an overloaded carpool lane, although two of the routes typically carry more than 90% of this level and an additional eight routes typically carry more that 80% of this level. Volumes in excess of 1,700 vphpl have periodically been observed by Caltrans at select locations on Routes 105 and 210. Peak period speeds of less than 35 mph, indicating congestion, are experienced in the HOV lanes on three of the 16 routes.

- *Carpool lanes typically experience rapid growth after projects open, then demand levels off.*

  The majority of the carpool lanes built in the Los Angeles basin are heavily utilized, including locations where more than one carpool lane is provided in each direction (Route 110). Utilization of the carpool lanes does not correlate to age of the facility but rather to the presence of congestion in the adjacent general-purpose lanes, and better trip reliability and travel time savings. Similarly, AVO increases rapidly after carpool lanes open, then level off.

- *"High" mid-day demand is typically 35-60% of peak demand which generally justifies an all-day operation policy.*

  With the exception of Route 118, average midday two-way demands on the Los Angeles County carpool lane system range from 35% to 60% of the peak period demand levels. While recurring congestion is seldom experienced in the adjacent

general-purpose lanes to generate carpool lane demand during these periods, there may be other factors for this finding that the study was not able to ascertain. More non-work related carpool trips (social, recreational and shopping), carpool lane trip reliability, and familiarity with using the carpool lanes and the benefits of using the lanes are very likely key factors in generating high mid-day lane demand.

- *Public opinions mixed on the perceived utilization of carpool lanes.*

  Public survey results indicate that the residents and commuters of Los Angeles County are using carpool lanes and are doing so on a somewhat regular basis. However, despite their use of carpool lanes, the public's perception of the utilization of carpool lanes tends to be mixed, with opinions basically divided between those who perceive the lanes are sufficiently utilized and those who do not. Yet traffic data show that more than half of the routes are operating at over 70% of their maximum operational threshold during peak periods. Improving public awareness of what constitutes an effectively utilized carpool lane should represent a priority for education and awareness marketing in Los Angeles County.

6.1.2 Travel Time Savings

- *Travel time savings is, by far, the primary motivation for people to use carpool lanes.*

  The majority of Los Angeles County residents (57%) indicate that travel time savings is their primary motivation for using carpool lanes. Commuters who use carpool lanes in Los Angeles County perceive a significant time savings advantage when using carpool lanes, carpool lane bypass ramps and carpool lane interchanges (freeway-to-freeway direct connector lanes). Carpool lane investments and operating policies need to be structured to preserve travel time savings for carpool lanes.

- *All routes generate time savings.*

  All of the carpool lanes realize travel time savings to varying degrees over the adjacent general-purpose lanes. The amount of time saved during peak periods ranges from less than one minute to more than twenty minutes over the length of the facility, depending on the route. The additional time savings provided by carpool lane bypass ramps and carpool lane interchanges was not calculated as part of the time savings for each route, but nonetheless represents an important consideration for carpool lane users. Public surveys showed that *perceived* time savings were greater than those measured as part of the data analysis.

- *The majority of the HOV Study Routes achieve travel time savings in excess of the minimum threshold of ½ minute per mile.*

  The minimum time savings criterion of ½ minute per mile was met by 10 of the 16 study routes in at least one direction during one peak period and by four of the routes during both peak periods. Where this criterion was not fully met, it appears to be due to the following factors:

- A lack of congestion in the adjacent general-purpose lanes, resulting in diminished carpool lane speed differential and travel time savings. Examples include Routes 14, 110 (91 to 105), 118, and 134.
- Too much HOV demand resulting in congestion in the carpool lanes. Examples include Route 57 southbound during the AM peak period and Route 105 eastbound during the PM peak period.
- Time savings lost due to spot congestion resulting from merging difficulties at the end of carpool lanes. Examples include Route 134 westbound during both peak periods and Route 170 northbound during the PM peak period.

♦ *Marketing activities should focus on time savings where additional carpool lane capacity exists.*

The opportunity for saving time by using the carpool lanes should be the focus of future marketing activities where additional carpool lane capacity exists. Targeted marketing efforts on the time savings benefit of carpool lanes could be used to encourage new carpool participants where they can be adequately accommodated in the carpool lanes. Examples include Route 10, Route 405 (Route 101 – Route 5), Route 605, and Route 170.

6.1.3 Person Movement

♦ *Carpool lanes are moving substantially more people than general-purpose lanes.*

On average across all HOV Study Routes, each carpool lane moves the equivalent number of people as 1.4 general-purpose lanes operating at maximum capacity. Carpool lanes on Route 10 (the El Monte Busway), the only facility with a 3+ peak period occupancy requirement, carry the equivalent number of people as 2.5 to 3.2 general-purpose lanes. Carpool lanes with a 2+ occupancy requirement move the equivalent number of people as 1.2 to 1.3 general-purpose lanes on average, with some 2+ facilities carrying as many as 1.9 general-purpose lanes.

♦ *Daily carpool lane use exceeds 700,000 person trips in Los Angeles County.*

The bi-directional daily person trips carried in the carpool lanes range from approximately 19,300 on Route 170 to over 122,000 on Route 110 (Route 105 to Adams). Countywide, approximately 740,000 daily person trips are carried on the 16 HOV Study Routes.

♦ *Person movement capacity is generally capped without physical or operation changes.*

Where carpool lanes are approaching operational capacity, additional person movement is generally capped unless more lanes are provided, more transit service is provided or the minimum occupancy is increased. There are few parallel examples in the United States where this situation is so widespread affecting a number of routes. Past experience in Southern California has been to pursue lane widening where converging carpool lanes created a bottleneck. However, this strategy is not possible for all of the extensive route sections that are becoming saturated. While the completion of new carpool lane corridors may help to redistribute some of the regional

carpool demand, a future move to tie an increase to 3+ occupancy restrictions during peak periods with increased transit service and/or metering 2-occupant carpool with pricing or access restrictions may be the only viable long term strategy. Testing this type of strategy as a demonstration along a good candidate transit corridor where maximum capacity is being reached would be a good first step.

6.1.4 Carpool Formation

- *AVOs have generally increased on the HOV Study Routes, while AVOs on the two Control Routes without HOV lanes have gone down over time.*

  The two Control Routes (Routes 5 and 101) that do not have carpool lanes have experienced a general decline in AVO over time, which is consistent with national trends. Experience in Los Angeles County indicates that implementation of carpool lanes results in an immediate increase in AVO that then stabilizes at a higher level over time. This increase in AVO after the implementation of carpool lanes indicates that the national trend has been reversed on Los Angeles County freeways with carpool lanes.

- *Over 50% of existing carpools were previously SOVs.*

  Survey results indicate that over one half of those identified as carpool lane users previously drove alone in the general-purpose lanes on the same freeway prior to using the carpool lane. The introduction of carpool lanes to a freeway has been effective at getting people to start to carpool, indicating that Los Angeles County commuters are willing to change their ways to use the carpool lanes when the lanes that provide travel time savings are implemented.

- *Changing to 3+ minimum occupancy reduces the percentage of eligible carpools, but increases person moving capacity.*

  Experience on Route 10 (the El Monte Busway) suggests that the 3+ minimum occupancy requirement results in more persons carried. Considering people in 3+ carpools only, the Route 10 carpool lanes carry more people per lane than any of the 2+ HOV Study Routes during the PM peak, even without considering the substantial number of people carried as passengers on buses.

- *For highly utilized carpool lanes, marketing activities should focus on ridesharing and vanpooling to help increase AVO.*

  For HOV Study Routes where carpool lanes are highly utilized and very little capacity exists for additional carpools, marketing activities should focus on programs that facilitate and encourage people to ride transit, vanpool or increase their carpool occupancy. By promoting ridesharing to increase AVO in highly utilized carpool lanes, more people can be accommodated in the carpool lanes without impacting time savings. Examples include Routes 57, Route 91, Route 105, Route 110 (Route 105 – Adams), Route 210, and Route 405 (Orange County – Route 110, and Route 110 – Century).

6.1.5 Cost Effectiveness

- *The benefits of carpool facilities generally exceed taxpayer costs.*

  The average benefit-cost ratio (BCR) for Los Angeles County carpool lane facilities was 10.0, suggesting that the facilities are very effective investments, with user and non-user benefits that exceed taxpayer costs. BCR is a useful measure for comparing "the bang for the buck", with BCR values of greater than 1.0 considered economically beneficial.

- *The average "payback period" for carpool lanes was nine years.*

  Carpool lanes are economically beneficial investments with an average payback period of about nine years. The payback period is the time between the start of the project and the point at which the net benefits accrued by the facility first exceeds the capital investment costs. Only Route 110 (91 – 105) is not expected to achieve payback within 20 years primarily due to the exceptionally high capital cost associated with this multi-modal HOV facility that includes in-line transit stations and direct connector ramps to the Artesia Transit Center.

- *Almost half of the HOV facilities evaluated have already proven to be economically justified.*

  A majority of Los Angeles County's carpool lanes were implemented after 1990, and almost half have already proven their economic feasibility with existing benefits to date exceeding all costs in present value terms. Almost all of the carpool facilities will achieve a positive net present value by 2006.

6.1.6 Transit Use

- *Carpool lanes are very important to carpool lane transit riders.*

  Ninety-five percent of the carpool transit riders responding to the Transit Patronage Survey say that carpool lanes are either very important or somewhat important in their decision to use carpool lane transit service. The majority of riders say they would most likely discontinue riding the bus if it traveled in the general-purpose lanes on the freeway instead of the carpool lane.

- *Transit Agencies like carpool lanes and alter routes to use carpool lanes to save time.*

  All of the transit agencies that participated in the Executive Interviews utilize carpool lanes in their delivery of services and indicate that they have altered their routing, at least to some extent, to use the carpool lanes in the delivery of service. Most public transit agencies believe that carpool lanes save time for routes that utilize carpool lanes and provide a more reliable travel time thereby making transit a more attractive alternative to commuters. The transit providers indicated that carpool lanes provide lower costs as a result of better trip efficiency. The transit providers also indicated they felt that carpool lanes offered a safer alternative for freeway bus operations because

they reduce opportunities for vehicles to swerve in front of the bus and cause an accident.

- *Only two HOV Study Routes have high levels of transit service.*

  Route 10 (the El Monte Busway) and Route 110 (the Harbor Transitway) are the only two HOV Study Routes with exceptionally high levels of public transit service and ridership. Daily transit ridership on the El Monte Busway exceeds 24,500 passengers, while ridership on the Harbor Transitway approaches 5,000 passengers per day. Route 14 is the only other HOV Study Route that exceeds the Control Routes with approximately 1,100 daily transit riders. Five of the HOV Study Routes have no transit service using the carpool lanes.

6.1.7 Safety

- *All projects are safe and meet Caltrans minimum criteria.*

  All carpool projects are inherently safe, and are planned, designed and built to meet the minimum design criteria set forth in the American Association of State Highway and Transportation Officials (AASHTO) and Caltrans HOV Guidelines. Accident rate patterns in corridors with carpool lanes were found to be no different than those on Control Routes. Accidents were influenced most by traffic congestion, vehicular mix and roadway conditions.

- *Accident rates and trends are inconclusive with no overall change in rates associated with carpool lanes.*

  No distinct trends or patterns can be attributed directly to facilities with carpool lanes compared to the Control Routes without carpool lanes. Observed differences in accident rates between the HOV Study Routes before and after the year of opening were influenced by the specific traffic flow, vehicle mix and congestion patterns of each route and do not appear to be associated with the presence of the carpool lanes. Overall, accident rates for freeways being studied tended to be near or below the statewide average accident rate for similar facilities, which is typical for freeways in urbanized areas where travel speeds are typically lower than those in less developed areas.

- *Extremely low violation rates compared to national experience.*

  All of the HOV Study Routes, with the exception of Route 10, have an extremely low percentage of drive-alone violators in the carpool lanes. The violation rates for Los Angeles County ranged from 0 to 3 percent for all the HOV Study Routes except Route 10. Violation rates on Route 10 ranged from 5% to 11% most likely reflecting the impact of the variable minimum occupancy requirement used in the corridor. The violation rates in Los Angeles County are extremely low when compared to other areas such as the San Francisco/Oakland Bay Area, Seattle, Dallas and Atlanta.

6.1.8 Air Quality

- *Carpool lanes generate less emissions per person mile than adjacent general-purpose lanes*

  For the majority of the HOV Study Routes, carpool lane emission rates are about half those of the adjacent general-purpose lanes. Significantly lower emission rates in the carpool lanes contribute to effectively reduce the emission rate for the overall corridor. However, despite this contribution, the lower emission rates of carpool lanes are not able to offset the higher emission rates in more congested and more heavily traveled general-purpose lanes.

- *Comparative findings at a corridor level are inconclusive based on a lack of historical data and a limited number of Control Routes.*

  Approximately one half of the HOV Study Routes generate more vehicle emissions than the two Control Routes. However, it should be noted that the analysis of emissions for freeways with carpool lanes was limited to a comparison with two control routes that are both operating at speeds generally within the optimal speed range for most pollutant types. It would be appropriate to consider a larger sample of Control Routes before the results of this analysis could be considered to be statistically valid.

- *A more traditional air quality analysis at a route level may be more appropriate to evaluate carpool lane performance.*

  An alternative, more traditional air quality evaluation approach that estimates emissions of one selected analysis segment before and after the incorporation of carpool lanes may be a more appropriate method for evaluating carpool lane performance. The availability of current year data archived as part of the HOV Performance Program provides the opportunity for the future evaluation of the Five-Year Look Ahead Routes using this type of air quality analysis approach. A system or regional level evaluation using travel demand forecast modeling data is not likely to be sensitive enough to effectively evaluate carpool lane performance and the impact of carpool lanes on air quality.

6.1.9 Public Attitudes

- *88% of Los Angeles County residents support carpool lanes.*

  The residents of Los Angeles County are knowledgeable about the benefits of carpool lanes and overwhelmingly support the provision of carpool lanes on Los Angeles County freeways. According to statistically valid surveys, almost 9 out of 10 residents of Los Angeles County support having carpool lanes on area freeways, including 7 out of 10 (70%) freeway users that choose not to use the carpool lanes even where they are provided. This overwhelming support for carpool lanes is reflected across all ethnic and income groups, all geographic subsections of the county, and across all freeway user types.

- *82% of Los Angeles County residents support future investments in a countywide carpool lane system.*

  The overwhelming support for carpool lanes translates into support for the continued expansion of the envisioned countywide carpool lane system, including the provision of new carpool lanes and carpool lane interchanges where they currently do not exist. Los Angeles County residents support carpool lanes and are willing to pay for more to be built with 82% supporting the continued utilization of a portion of their sales tax revenues for transit-related highway infrastructure investments that include carpool lane facilities.

- *Well over half of carpool lane users identified time savings as their primary motivation to use carpool lanes*

  Saving time is, by far, the principal motivating factor to get people to use carpool lanes. It is critically important that time savings in carpool lanes be maximized to continue to make them attractive to potential users. Well over one-half (57%) of all carpool lane users indicated that saving time was their primary reason for carpooling. Peak-period carpool lane users reported average daily time savings of more than 43 minutes as a result of using the carpool lanes for their work commutes. Although perceived time savings appear to be greater than those measured in this study, these perceptions may combine multiple routes, factor for the worst case scenario, and include the benefits of carpool lane bypass ramps and freeway-to-freeway connectors that are not reflected in the available time saving data.

- *There is a vocal minority that remains opposed to carpool lanes.*

  Despite the documented overwhelming public support for carpool lanes in Los Angeles County, elected officials interviewed as part of the HOV Performance Program market research acknowledged that there is a vocal minority who are opposed to carpool lanes. However, these elected officials also acknowledge that a majority of their constituents do support carpool lanes.

- *Approximately half of Los Angeles County residents and commuters feel carpool lanes are appropriately utilized while slightly fewer feel they are underutilized.*

  Whether considered in terms of vehicles or people, the opinions of Los Angeles County residents and commuters are basically divided on the issue of lane utilization. For the general population, approximately 45% of all residents feel that carpool lanes are sufficiently utilized, while 42% feel they are underutilized. For those who use the general-purpose lanes on freeways with carpool lanes, 51% feel the carpool lanes are sufficiently utilized while 37% feel they are underutilized. According to focus group participants, the perception that carpool lanes suffer from the “empty-lane” syndrome is real for many area residents and commuters and appears to be based on the fact that the carpool lanes typically move faster than the adjacent general-purpose lanes, and therefore must be empty. Education and marketing initiatives should be focused to increase public awareness of what constitutes an effectively utilized carpool lane.

6.2 Recommendations

The following recommendations for future action are based on the findings of the HOV Performance Program. The recommendations are **not** presented in any order of priority.

- *Complete the carpool lane system to capture significant overall system and traveler benefits.*

  While much of the envisioned countywide carpool lane system has been completed over the past decade, key missing gaps and carpool lane freeway-to-freeway connections need to be addressed for the current lanes to perform as a system and for future demand to be accommodated. This study has documented that while carpool lane volumes are high, some of the travel time savings is lost where carpool lanes end, causing spot congestion and an artificial bottleneck on all traffic due to merging conditions. Findings also show that where such gaps are addressed (such as the recently completed Route 405 southbound carpool lane extension through Sepulveda Pass), operations for all users are improved. Carpool lane freeway-to-freeway connectors hold the promise of providing added travel time savings and reduced weaving problems for high volume movements. Public attitudes among all users overwhelming support this investment in tax dollars.

- *Address carpool lane bottlenecks and lane drops.*

  Perhaps the best near-term strategy to addressing some of the documented travel time loss is a reassessment of carpool lane end treatments. A variety of strategies, including interim changes where carpool lane restrictions end, restriping to carry the lane further downstream, or adjusting project priorities to address critical gaps are all options for addressing specific terminus bottlenecks.

- *Implement policies to support future investments and an ongoing monitoring and reporting program.*

  The HOV performance program has confirmed both the cost effectiveness and viability of investments made in carpool lanes. Policies that promote future planning studies and investments to complete the system will help increase the system's use and effectiveness as a modal choice for Los Angeles County. The HOV Performance Program also established a Data Management Program (DMP) that makes future audits much easier if key data is collected. These data and the DMP will be critical to annually track key performance evaluation parameters including HOV Performance Program MOEs 1A, 1B, 1C, 1D, 3A, and 3B. Coordination between those agencies responsible for data collection is necessary to prioritize and focus data collection efforts and techniques to ensure that more consistent, reliable data are collected to support ongoing performance evaluation. Policies developed as part of this program specify agency roles and responsibilities for these activities. Continued monitoring and performance reporting will help promote public understanding and agency credibility for investments being made and operation policies being applied.

- *Implement a public education and promotion plan to sustain use and promote understanding.*

  Surveys from this study clearly indicate public understanding of the role and effectiveness associated with carpool lanes. The key theme to future outreach should address travel time savings, which is overwhelmingly confirmed as the number one benefit for using the carpool lanes. However, surveys also point to a sizeable proportion of the public lacking an understanding and appreciation of adequate carpool lane utilization. This perception can be addressed with a selected public information and awareness program, as outlined in the HOV Performance Program Education and Promotion Plan. Such a promotion can also target potential users for transit and vanpool services to increase AVO in the carpool lanes.

- *Emphasize transit investments to grow bus transit mode share.*

  As carpool lane vehicle and person movement volumes approach capacity on a considerable number of routes, lane capacity limitations will justify a reconsideration of how to preserve time savings benefits to serve more people. Investments in transit direct access ramps, park-and-ride lots and related treatments in concert with transit service expansion will be needed to encourage bus ridership. Without these investments, the person movement capabilities of current carpool lane investments will not be able to be substantially increased in future years.

- *Emphasize vanpooling to encourage increased vehicle occupancy in the carpool lanes.*

  Vanpooling provides an effective means to increase the carpool lane occupancy rates, particularly where carpool lane volumes are approaching capacity. Support for vanpooling and rideshare incentive programs in Los Angeles County is appropriate to expand participation in vanpooling thereby moving more people in the carpool lanes using fewer vehicles.

- *Address operation policies for projects exceeding and not meeting usage thresholds.*

  The current practice of maintaining a consistent countywide and regionwide carpool operation and eligibility policy for most projects has worked well for the early stages of Los Angeles County's carpool lane system development. The HOV Performance Program documents a considerable number of routes that are approaching capacity during selected peak hours, while only one route has not yet generated a level of use that would be expected to substantiate a successful operation. These conditions justify a select assessment of the current carpool operation policies affecting the respective routes to re-examine the best balance in managing demand from a corridor and system perspective. Current operation policies need to provide a flexible framework to address changes in rules and regulations, with the intent of maximizing lane use and time savings benefits for the greatest number of persons. Such future actions need to be driven by performance results affirmed by all affected planning, implementing and operating agencies and not by legislated directives.

- *Change accident reporting to better aid in future monitoring.*

  Accident monitoring and reporting for HOV performance would be measurably improved in the future if the current accident form used by CHP was modified to separately code carpool lanes apart from other travel lanes and CHP officers were trained to use the revised for to report carpool lane related accidents. Without this additional information, tracking and monitoring of accidents and incidents associated with carpool lanes will not be able to accomplished. Promoting awareness on how accidents are written up to determine if carpool lane operations contributed to the incident, or if the incidents occur in the carpool lane or end up there from other lanes, is essential to providing the information necessary to effectively evaluate the impact of carpool lanes on accident rates.

ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
C-D	Collector – Distributor
CHP	California Highway Patrol
COG	Council of Governments
COM	Component Object Model
CVC	California Vehicle Code
DMP	Data Management Program
DMV	Department of Motor Vehicles
EPA	Environmental Protection Agency
ERR	Economic Rate of Return
ESTC	Eric Schreffler Transportation Consultant
ETC	Employee Transportation Coordinator
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
GP	General-Purpose
HOV	High Occupancy Vehicle
HOT	High Occupancy/Toll
HSPA	Heidi Stamm Public Affairs
ITS	Intelligent Transportation Systems
KA	Kaku Associates, Inc.
LACTC	Los Angeles County Transportation Commission
LADOT	City of Los Angeles Department of Transportation
LAN	Local Area Network
LAO	California Legislative Analyst Office
LEV	Low Emission Vehicle
LPG	Liquefied Petroleum Gas
LRTP	Long Range Transportation Plan
MassHighway	Massachusetts Highway Department
MF	Mixed Flow
MOE	Methodology and Methods of Effectiveness
MPO	Metropolitan Planning Organizations
MTA	Los Angeles County Metropolitan Transportation Authority
MVRAP	Moving Vehicle Run Analysis Package
NPV	Net Present Value
NCHRP	National Cooperative Highway Research Program
NYSDOT	New York State Department of Transportation
OCTA	Orange County Transportation Authority
OLE	Object Linking and Embedding
PAT	Project Advisory Team
PBQD	Parsons Brinckerhoff Quade and Douglas, Inc.
PC	Personal Computer
PeMS	Performance Monitoring System
RTP	Regional Transportation Plan
SB	Senate Bill
SCAG	Southern California Association of Governments

SCR	Strategic Consulting and Research
SOV	Single Occupancy Vehicle
STIP	State Transportation Improvement Program
Tach	Tachometer
TASAS	Traffic Accident Surveillance and Analysis System
TCM	Transportation Control Measures
TDM	Travel Demand Management
TMG	Traffic Monitoring Group
TSN	Transportation System network
TTI	Texas Transportation Institute
UC	University of California
UCLA	University of California, Los Angeles
VBA	Visual Basic for Applications
VMT	Vehicle Mile Traveled
WAN	Wide Area Network
WSDOT	Washington State Department of Transportation
YEF	Year of Economic Feasibility

GLOSSARY OF TERMS

- **Accident Rate** – The rate at which accidents occur on a freeway segment or facility measured in the number of accidents per million vehicle miles (MVM). This actual rate is compared to a statewide average accident rate for similar facilities to determine if the segment or facility under consideration is operating below or above the statewide average.

- **After** – "After" is the period defined as nominally one year after an HOV lane opens to traffic, and is intended for analysis of conditions when the lane is still immature but beyond the initial opening period. For the purposes of after analyses, data from the period between 13 and 36 months after the lane opened was used. Also see definitions of Before and Current.

- **Analysis Segment** – Subdivisions of HOV Performance Program monitoring system Study Routes for analytical purposes. The following criteria were used to define Analysis Segments:

    - Freeway/freeway interchange to freeway/freeway interchange - If a freeway/freeway interchange fell within a study route, this generally was used to break the study route into separate Analysis Segments. The exception to this rule was if one of the two segments that would otherwise be created would be a stub end section of the HOV lane extending beyond the freeway/freeway interchange for only a short distance (nominally less than two miles). Note that freeway/surface street intersections were not considered as potential Analysis Segment breakpoints. An example of this rule would be subdividing the Route 91 study route from Route 110 to the Orange County Line into three Analysis Segments with breakpoints at Route 710 and at Route 605.

    - Different HOV opening years - A study route was subdivided into separate Analysis Segments if the HOV lanes on separate segments of the study route were constructed as separate projects and opened in different years, regardless of whether the breakpoint was a freeway/freeway interchange.

  There are 38 Analysis Segments in total, including 30 HOV Analysis Segments (subdivisions of HOV Study Routes – routes with operational HOV lanes), 6 Analysis Segments on five-year-look-ahead routes (priorities for before data collection), and 2 Analysis Segments on control routes (no HOV lanes present or planned). Also see definition of Study Route.

- **Average Vehicle Occupancy (AVO)** – The average number of persons within a vehicle.

- **Before** – "Before" is the period before an HOV lane is constructed on a particular freeway. For the purposes of before analyses, data from the period between 1 and 12 months before the start of construction of the HOV lane was preferred (note that before construction start, rather than opening of lane, was preferred to avoid potential impacts of construction on traffic conditions). If not available, data from the period between 13

and 36 months before the start of construction of the HOV lane is used. If the latter is not available, data from the construction period is used. Also see definitions of After and Current.

- **Carpool** – Refers to a vehicle that is carrying one or more passengers in addition to the vehicle driver. Also referred to (interchangeably) as a high-occupancy vehicle (HOV).

- **Carpool Lane** – In general terms is a freeway or roadway lane restricted specifically to use by eligible vehicles carrying a minimum number of people. The minimum number of people required to be eligible to use a particular lane can vary by freeway or region, but is typically 2 or 3 people. On some facilities, motorcycles with a driver only, ultra-low emission vehicles with a driver only, and toll paying vehicles with a driver only are eligible to use lane. Also referred to (interchangeably) as HOV lane.

  Specifically in Los Angeles County, the minimum occupancy for carpool lanes is 2 people, 24 hours per day, 7 days per week. In accordance with state law, motorcycles and ULEV with single occupants are also permitted to use the lanes. Exceptions to these minimum occupancy requirements are the I-10 (El Monte Busway), which has a minimum occupancy requirement of 3 people during peak periods, and SR-14, which is open to all traffic during non-peak hours (on an experimental basis).

- **Control Route** – A study route that does not have HOV lanes and is included in the data collection and analysis effort for comparison purposes. There are two control routes in the study: Route 5 between Route 605 and Router 710 (on which no improvements have been made within the past decade); and Route 101 between Route 405 and Route 27 (on which mixed-flow lanes were added, becoming operational in 1993).

- **CT-EMFAC** – Caltrans' version of the California Air Resources Board's EMissionFACtors7F program for calculating composite on-road emission factors. This is for use in California instead of the USEPA MOBILE5 program.

- **Current** – "Current" is the current year of evaluation for the HOV Performance Program. For the initial performance evaluation, the year 2000 was used. For future performance evaluations to be conducted as part of future implementation of the performance program, the year would be the most recent year of data availability at the time the evaluation is being conducted. Also see definitions of Before and After.

- **Five-Year Look Ahead Route** – A study route which does not have operational HOV lanes as of the current base year for analysis, but is programmed for implementation of future HOV lanes and is included in the current data collection and analysis effort in order to establish a baseline for "before" data collection[16].

[16] Although two 5-year look ahead routes (I-405 southbound lanes through Sepulveda Pass, and I-605) opened before the completion of this program audit, they were opened subsequent to the current base year used for analysis in this study, and thus are considered look ahead.

- **General-Purpose Lane (GP lane)** – A freeway or roadway travel lane not restricted to use by high-occupant vehicles only. Also referred to (interchangeably) as a mixed-flow lane.

- **High-Occupancy Vehicle (HOV)** – Refers to a vehicle that is carrying one or more passengers in addition to the vehicle driver. Often referred to as a carpool and/or vanpool.

- **HOV Lanes** – In general terms is a freeway or roadway lane restricted specifically to use by eligible vehicles carrying a minimum number of people. The minimum number of people required to be eligible to use a particular lane can vary by freeway or region, but is typically 2 or 3 people. On some facilities, motorcycles with a driver only, ultra-low emission vehicles (ULEV) with a driver only, and toll paying vehicles with a driver only are eligible to use lane. Also referred to (interchangeably) as HOV lane.

  Specifically in Los Angeles County, the minimum occupancy for HOV lanes is 2 people, 24 hours per day, 7 days per week. In accordance with state law, motorcycles and ULEV with single occupants are also permitted to use the lanes. Exceptions to these minimum occupancy requirements are the I-10 (El Monte Busway), which has a minimum occupancy requirement of 3 people during peak periods, and SR-14, which is open to all traffic during non-peak hours (on an experimental basis).

- **HOV Study Route** – A study route that has operational HOV lanes.

- **Mixed-Flow Lane (MF lane)** – A freeway or roadway travel lane not restricted to use by high-occupant vehicles only. Also referred to (interchangeably) as a general-purpose lane.

- **Park-and-Ride** – Park-and-Ride facilities are designated parking areas that provide parking specifically for people who wish to transfer from their personal vehicle to carpools, vanpools or public transportation.

- **Peak Hour** – The 1-hour interval of the day that experiences the highest traffic demand and volume. In most cases, separate peak 1-hour intervals are identified for the morning (AM Peak Hour) and evening (PM Peak Hour).

- **Peak Period** – The morning and evening periods of the day that typically experience the highest traffic demand and volumes. For this study, the AM (morning) Peak Period was defined as 6:00 a.m. to 9:00 a.m., while the PM (evening) Peak Period was defined as 3:00 p.m. to 6:00 p.m.

- **Qualified Users** – Carpool lane users that meet the required passenger minimums to qualify as a High Occupancy Vehicle or carpool.

- **Rideshare Program** – Programs that assist people traveling together between their residences and park-and-ride lots, and their worksite or other destinations for the *majority* of the total trip distance. Program features can include travel partner matching, rideshare information resource, marketing, and incentive distribution.

- **Single-Occupant Vehicle** (SOV) - A vehicle that is carrying only the driver.

- **Study Route** - The MTA request for proposal for the HOV Performance Program study originally defined 28 Study Routes in total on 19 different freeways, including 21 HOV Study Routes (with operational HOV lanes) on 13 different freeways, 5 five-year look ahead routes (priorities for before data collection) on 4 different freeways, and 2 control routes (no HOV added) on 2 different freeways. Several of the original 21 HOV Study Routes on adjacent and similar sections of a given freeway route, were aggregated to provide a more concise set of data for presentation purposes. Similar sections of freeway would have proximate HOV lane opening dates. This aggregation affected Routes 14, 60, 134, 405, and 605.

  One of the original 21 HOV Study Routes was disaggregated into two Study Routes. Route 110 was split at the 110/105 interchange because it changes facility type at this location. As a result of this aggregation and disaggregation, there are a total of 16 HOV Study Routes. Also, there are 5 five-year look ahead routes and 2 control routes as defined in the original RFP, resulting in a total of 23 Study Routes.

- **Tach (Tachometer) Run** - The California Department of Transportation "floating car" method used for collecting travel time data. Using this method, vehicles are equipped with a Distance Measuring Instrument (DMI) and a laptop computer that records speeds, distances and times as the equipped vehicle is driven along the section of the freeway under study. Individual round trips are made in the study lane (for general-purpose traffic this is the second lane from the left commonly referred to as “lane #2”) at 15 to 30 minutes intervals for segments of approximately 7 miles in length. Data is collected during peak commute periods, generally Tuesday through Thursday, and are considered representative of "typical" days in which no incident or special event occurs.

- **Traffic Accident Surveillance and Analysis System (TASAS)** - The California Department of Transportation maintains an accident database called the Traffic Accident Surveillance and Analysis System (TASAS). Every three months highway, intersection, and ramp locations that meet a certain accident threshold are sent to all District Traffic Safety Engineers for safety investigations to be completed. These investigations will try to determine if engineering or other countermeasures can be taken to reduce or alleviate crash potential at a certain location.

- **Vanpool** - A vanpool is a group of people who share the commute to and from work. A vanpool is typically an organized group of between 5 and 15 passengers.