Section 1.1 General

California's High-Occupancy Vehicle (HOV) lanes were initially considered as an innovative traffic management strategy, adding capacity during the reconstruction of the San Francisco-Oakland Bay Bridge in 1962 when an exclusive lane was provided for buses. The majority of California's HOV facilities were planned and built on a "route" or "corridor" basis. In some cases, HOV facilities were designed as "queue-jumpers" to give multiple-occupant vehicles a time advantage over single-occupant vehicles. This was understandable and appropriate, at the time, considering HOV experience (both state and nationwide) was in a fluid state where operational data was lacking and public acceptance of HOV facilities uncertain. Still, the overall performance of those HOV facilities frequently exceeded expectations and, in some cases, projected HOV demands were met within a year or two of implementation. While a region-wide HOV system is ideal, such a system requires a supporting cast of HOV freeway-to-freeway connectors, direct access ramps to local cross streets, park and ride/transit facilities, and rideshare inducement and promotional programs. The cost of providing these elements requires a high degree of political and public commitment to the HOV philosophy which, during the early years of HOV application, did not exist. However, as traffic demand continued to exceed the capacity of many of the state's metropolitan freeways, and as existing HOV facilities have proven to be successful, the California Department of Transportation (Department) and its regional partners have responded by jointly drafting HOV system plans for the six major metropolitan areas of the state: Sacramento, San Francisco Bay Area, Los Angeles, San Bernardino, San Diego and Orange County. These system plans will be revised periodically as appropriate.

Planning for HOV facilities is integrated into the District's system planning process through the District System Management Plan (DSMP), Transportation Concept Reports (TCR), and Transportation Development Plan (TDP). It also provides a linkage between system planning and the preparation of Project Study Reports (PSRs). The appropriate level of planning, analysis and system development for HOV planning must be incorporated into these documents.

Procedurally, there is no difference between HOV projects and other capital outlay projects as they advance from the planning phase into the project development process. The PSR is one of the critical documents as a HOV proposal advances from the planning phase into the project development phase. During the development of a PSR, consideration should be given to the type of HOV facility which best balances the traffic demands of the corridor with cost, right of way and environmental concerns. The next two chapters, "HOV Operations" and "HOV Geometric Design," should also be consulted when preparing the PSR and the project report.

Section 1.2 HOV Statutes and Policies

Numerous statutes and policy memoranda affect the planning and implementation of HOV facilities. Some of these are summarized below. See Appendix A for complete text.

A. Caltrans - Policy and Procedures Memorandum P89-01:

The Department will consider a HOV lane alternative for all projects which add capacity to metropolitan freeways or proposed new metropolitan freeways.

The Department will work with regional transportation planning agencies in the conceptual planning phase to develop regional HOV lane system plans in metropolitan areas and to include these systems in the regional transportation plans.

B. Caltrans - Delegation of Authority for HOV Occupancy Determination:

Occupancy requirements for HOV facilities, as well as vehicle types allowed, need to be approved by the District Director at least one month prior to the opening of the HOV lane to traffic. It is also encouraged that Districts include the California Highway Patrol concerning occupancy requirements.

C. California Transportation Commission, Resolution G-87-8:

"BE IT RESOLVED, that in the planning of any new freeway facility or freeway capacity addition in and around a metropolitan area, the Department ... shall examine and report to the California Transportation Commission on the feasibility ... of designating bus and carpool lane operation..."

"That such examination should consider the possible extension of bus and carpool lane operation into existing adjacent facilities ... that the Commission shall also give serious consideration to extending such a bus and carpool facility to existing adjacent facilities when it is demonstrated to be feasible and of likely benefit and to contribute to the operation of the bus and carpool facility within the new project." See Appendix A-6.

D. California Vehicle Code (CVC) 21655.5:

"The Department ... and local authorities ... may authorize or permit exclusive or preferential use of highway lanes for high-occupancy vehicles. Prior to establishing the lanes, competent engineering estimates shall be made of the effect of the lanes on safety, congestion, and highway capacity." See Appendices A-7 and A-8 for this and other HOV related CVC's.

The Department has determined that a separate, detachable report is required to consider the safety and capacity aspects of HOV projects. If the project already has an approved project report, this separate report should be reviewed and concurred with by District Legal and, at a minimum, signed by the chief of the unit preparing the report before the PS&E is sent to Headquarters Office Engineers. For projects without an approved project report, this report should be attached to the project report and be part of the project report approval process. The development of the HOV report is encouraged as early as possible prior to PS&E. See Appendix B for the recommended format of the report.

E. California Vehicle Code 21655.6:

"Whenever the Department of Transportation authorizes ... preferential lanes ... the department shall

obtain the approval of the transportation planning agency or county transportation commission prior to establishing the exclusive use of the highway lanes." See Appendix A-7.

F. Federal Highway Act, Title 23, Chapter 1:

Authority for Department of Transportation to approve HOV facilities on Federal Aid Systems to increase the capacity for the movement of persons.

See Appendix A-11.

G. FHWA, California Division Office, Procedure Memorandum D 6103:

Regional Transportation Planning Agencies should develop in concert with Caltrans and local agencies, route specific region-wide HOV system plans as a part of the regional transportation plan in metropolitan areas.

A HOV lane shall be an essential alternative for evaluation in the project development process when considering an additional lane by re-striping and/or reconstruction or widening on freeways with three or more lanes in one direction. See Appendix A-12.

H. Public Resources Code - Chapter 5.8, Section 25485:

"The Department shall develop programs and undertake any necessary construction to establish, for the use of carpool vehicles carrying at least three persons, preferential lanes on major freeways..."

I. Streets and Highways Code - Section 149:

"The department may construct exclusive or preferential lanes for buses ... and other high-occupancy vehicles..."

J. Surface Transportation Assistance Act - Section 167:

Motorcycles are permitted in high-occupancy and other exclusive vehicle lanes constructed with federal participation unless such use would create a safety hazard.

NOTE: The policies and statutes are intended for urban freeways and that FHWA, CTC, and Department policies do not expect rural freeways to have HOV facilities.

Section 1.3 HOV Planning

The planning of HOV facilities should focus on the people carrying capacity of the system rather than on vehicle capacity. In accordance with the Department's mission as a multi-modal organization, HOV planning should focus not only on multi-occupant cars and vans but also on buses and other transit vehicles. Therefore, the planning process should consider complimentary support elements such as park and ride lots, bus/transit stations, and ingress/egress to them.

Section 1.3.1 HOV Issues

Several specific planning issues are pertinent to HOV system planning. These issues are discussed below.

A. HOV Factors and Criteria

A HOV proposal must be:

1. Consistent-with district management strategies as identified in the DSMP and the TCR.
2. Consistent with objectives and strategies of the congestion management program.
3. Supportive of regionally adopted Transportation Control Measures (TCMs) and with the approved Air Quality Management Plan (AQMP).
4. Consistent with the short and long-term elements of the Regional Transportation Plan (RTP).

Assuming the above criteria are met, the HOV proposal should be analyzed to respond to the following questions:

1. Will geometric cross-sections conform to the Highway Design Manual? If not, will the design exception be approved?

2. Will the project result in a deterioration of highway safety?
3. Will traffic forecasts for one year from opening indicate that a minimum of 800 vehicles per hour per lane (vphpl) or 1800 persons per hour per lane (pphpl) will be using the HOV facility during the peak hour? FHWA, California Division Office, Procedure Memorandum D 6103, see Appendix A-12, stipulates that an additional lane could be a mixed-flow lane if five years after opening, the HOV option would be carrying fewer person-trips. However, experiences in California indicate that adverse public reaction from perceived underutilization of the HOV facility is a significant factor and that a one-year period may be an appropriate goal.
4. Will the HOV project be cost effective? Factors in benefit/cost analysis should include delay savings (in vehicle-minutes and person-minutes), safety benefits and construction, right of way, maintenance and operation costs. Estimates for delay should consider those incurred by the mixed-flow traffic due to HOV operations.
5. Will the project provide at least one minute of timesavings per mile for an average commute trip? A total savings of five to ten minutes is desirable.
6. Can HOV violations be enforced easily and safely? See Chapter 6, HOV Enforcement.
7. Are HOV support facilities such as park and ride lots, transit facilities and public awareness campaigns available to support the HOV proposal? Such support facilities should be considered for all HOV proposals and, if appropriate, be included in the HOV project.

B. Multiple HOV Lanes

The planning for HOV facilities should consider the eventuality when the capacity of the HOV lane is reached. To maintain the necessary incentive to use the facility, the level of service (LOS) for the HOV lane should ideally be maintained at LOS-C. The HOV facility should not be allowed to reach unstable flow (LOS-E) and certainly should not experience congestion on a regular basis. Therefore, it is essential that the planning process include options to accommodate additional future HOV traffic. These options include increasing the required occupancy or providing additional HOV lanes. An additional HOV lane to provide passing opportunities may be appropriate when the facility is in mountainous or rolling terrain, particularly if high bus volumes are anticipated.

C. Modeling

Transportation modeling based on analytical tools is being developed through traffic microsimulation and macrosimulation models to evaluate the effectiveness of HOV facilities. Microsimulation is the dynamic and stochastic modeling of individual vehicle movements within a system of transportation facilities. Examples of microsimulation software are: Aimsum, CORSIM, Paramics, Simtraffic, Transmodeller, VISSIM, and WATSIM.

FREQ, PASSER, and TRANSYT7F are examples of simulation software that are macroscopic. These tools are also designed to simulate traffic operations but they do it at the macroscopic level. They are deterministic models that model the movement of groups of vehicles or the average behavior of all vehicles on a given section of facility for a given time period.

In California, the Sacramento Area Council of Governments (SACOG), the Southern California Association of Governments (SCAG), the Metropolitan Transportation Commission (MTC), and the Orange County Transportation Commission (OCTC) are continuing the development of models to forecast travel demand. Each of these are looking at mode split, with emphasis on how many of the potential trips would be carpools, transit, recreational or other special attraction trips.

D. Funding and Prioritization of HOV Facilities

Most funding of HOV projects will be through the Flexible Congestion Relief (FCR) Program. Current efforts are underway to include re-striped HOV projects, which can be quickly implemented, into the TSM

funding program. To be eligible for the Regional Transportation Improvement Program (RTIP), the project must be included in the county's Congestion Management Programs (CMPs). Together with projects from the Commuter and Urban Rail Program and the FCR Program, the county prepares a prioritized list of projects for the RTIP. The Department's Proposed State Transportation Improvement Program (PSTIP) and RTIP are used by the California Transportation Commission (CTC) as the basis for the State Transportation Improvement Program (STIP).

The regions ultimately decide the prioritization of the HOV project within the FCR. However, it is essential that the Districts provide as much input to the regions as necessary to ensure critically needed HOV projects are prioritized accordingly.

E. Evaluation of Existing Facilities

While the operation of a facility normally includes monitoring performance, this feedback loop must be completed to ensure that appropriate models are developed, and the experience of operating mature facilities shapes planning for new facilities.

Section 1.3.2 Caltrans System Planning

System Planning is Caltrans' long-range transportation planning process and is conducted pursuant to Government Code Section 65086(a) and Caltrans policy, see Appendix A-3. The multi-jurisdictional system planning process is multi-modal and considers the entire transportation network, including rail, air, ferries, mass transit, state highways, and local streets and roads. The process produces three interrelated planning documents, which provide guidance, evaluate transportation corridors and develop system improvements. The three planning documents are: (1) the District System Management Plan (DSMP), (2) the Transportation Concept Report (TCR), and (3) the Transportation Development Plan (TDP).

The linkage of system planning with development of the HOV System Plan is through consistency in the implementation of system management objectives and strategies, the identification of corridor deficiencies and establishment of transportation solutions, and the recommendations and prioritization of system improvements.

A. District System Management Plan (DSMP)

The DSMP outlines the District's strategies to maintain, manage and develop the transportation system over the next twenty years and beyond. It is a multi-modal strategy document describing the Department's goals and policies and the District's objectives and strategies. In the DSMP, modal systems and existing and projected conditions are analyzed, transportation issues are identified and strategies to be implemented to overcome the major issues or problems are established. The DSMP addresses how statutes and policies affect HOV facilities, whether current statutes need revision, the factors that preclude or include HOV facilities from a regional perspective, and the appropriate management techniques to be applied in operating HOV lanes. The degree of detail in which specific HOV facilities are discussed within the DSMP is by a reference to the HOV System Plan. The DSMP may identify specific HOV candidate facility locations (as established within the HOV System Plan) by either a listing, or on a District map. Coordination with other Districts will be necessary when routes cross District boundaries.

The HOV System Plan must be consistent with the system management strategies identified in the DSMP.

B. Transportation Concept Report (TCR)

The Transportation Concept Report identifies multi-modal transportation deficiencies and the improvements necessary to achieve the twenty-year planning concept. The concept considers three modal elements: (1) facility type, (2) level of service, and (3) vehicle occupancy. The TCR is prepared for one of three transportation service areas: the route, corridor or area. Each corridor is evaluated as to how it can be expected to perform over the next twenty years considering funding,

environmental and political feasibility. Operating conditions in each route, corridor or area is projected for the twenty-year planning period. Beyond the twenty-year planning horizon the report identifies the ultimate transportation corridor, corridor preservation opportunities and the potential application of new technologies. The development of the route concept is guided by the management strategies and objectives established in DSMP. The TCR considers HOV proposals identified in the HOV system plan in its analysis for specific alternatives for resolving deficiencies. The HOV system plan must be consistent with the planning concepts identified in the TCRs.

C. Transportation Development Plan (TDP)

The Transportation Development Plan identifies system improvements necessary to overcome transportation deficiencies identified in the DSMP, TCR and regional studies. In recommending system improvements in the TDP, considerations must be made regarding corridor development, funding, local, regional and state priorities, and interregional travel and system continuity. The TDP is developed using two alternative funding scenarios to bracket low and high estimated funding projections. The TDP covers the five-year planning period following the seven-year STIP. Together, the seven-year STIP and the five-year TDP cover the first twelve years toward attainment of the twenty year planning concept. The TDP includes improvement alternatives identified in the TCR, which are consistent with the strategies of the DSMP and regional studies. The TDP considers the HOV System Plan in recommending and prioritizing system improvements.

The HOV System Plan identifies HOV facilities for consideration and prioritization in the TDP.

Section 1.3.3 Regional Planning

The link between HOV system planning and regional planning is expressed through several regional plans and programs, including the Regional Transportation Plan (RTP), the Congestion Management Program (CMP) and the Air Quality Plan (AQP). To be included in the State Transportation Improvement Program (STIP) and receive funding from the Flexible Congestion Relief (FCR) Program, a HOV project must be included in the Capital Improvement Program (CIP) of the CMP and be submitted through the Regional Transportation Improvement Program (RTIP). CMPs are required to be consistent with the RTP, which in turn must conform to federally required AQPs. Any project having federal-aid funds and/or approval requires a National Environmental Policy Act (NEPA) document. The project is required to be fully funded and in the financially constrained RTP/RTIP for FHWA to give NEPA approval.

A. Regional Transportation Plan (RTP)

The RTP is the document that the Regional Transportation Planning Agency (RTPA) uses to describe the existing system, discuss current trends, and express their intentions and needs for the transportation system within the region. It is prepared by the regional Council of Governments (COG), Local Transportation Commission (LTC), or statutorily created RTPA. Updated every two years, the RTP is a twenty-year plan containing maps, policies, and short-term (five to ten year) and long-term projects for each mode of transportation. For metropolitan areas, HOV facilities should be consistent for both the short and long-term elements of the RTP. Short-term projects should consider the easily implemented re-striped HOV lanes, which are normally retrofitted within the existing right of way. Long-term HOV applications should include considerations for facilities involving structures and multiple HOV lanes.

B. Congestion Management Program (CMP)

Urbanized counties over 50,000 in population are required to develop CMPs. Two of the five elements of the CMP have linkage to the HOV program. These are: (1) the Transportation Demand Management (TDM) and trip reduction element, and (2) the Capital Improvement Program (CIP). The TDM element involves HOV facilities in that its purpose includes improving system efficiency by increasing person throughput and reducing vehicle demand. In addition, the HOV project must be

included in the Capital Improvement Program of the Congestion Management Program before it can be considered for the RTIP.

HOV projects may also be included as a part of a deficiency plan that is developed by the local governments to ensure conformance with the CMP. Deficiency plans are developed to either mitigate a specific instance of nonconformance or, if the instance cannot be mitigated, to measurably improve the overall performance of the system and contribute to significant improvements in air quality.

C. Air Quality Plans (AQP)

The California Clean Air Act requires that AQPs be prepared for non-attainment areas of the state that have not met state air quality standards for ozone, carbon monoxide, nitrogen oxide and sulfur dioxide. These plans must include a wide range of control measures, which, for most areas, include Transportation Control Measures (TCMs). HOV systems plans support and conform to these TCMs, which include the following:

1. Regulatory Measures
   a. Employer based trip reduction rules
   b. Trip reduction rules for other sources that attract vehicle trips
   c. Management of parking supply and pricing
2. Transportation System Improvements
   a. HOV system plans and implementation programs
   b. Comprehensive transit improvement programs for bus and rail
   c. Land development policies for motor vehicle trip reduction
   d. Development policies to strengthen on-site transit access for new and existing land developments

Since regional transportation plans and congestion management programs must conform to the Federally required AQPs, which are focused on trip reductions, it is expected that HOV facilities could be a preferred alternative for most capacity-adding freeway projects in urban areas. Since the CTC-adopted guidelines for Flexible Congestion Relief (FCR), which include funding eligibility for rail systems, it may be that HOV projects will not compete well for funding priority in the RTIP. Therefore, the possibility exists that HOV projects will not be fundable in a timely fashion within the Flexible Congestion Relief (FCR) Program. Re-striped HOV projects can be implemented within a year and require no right of way. In the future such projects may be eligible for the Traffic System Management (TSM) program. However, current eligibility guidelines for the TSM program do not include re-striped mainline HOV facilities since such projects create a through lane.

In November 1990, Congress adopted the Federal Clean Air Act Amendments (CAAA) of 1990. The CAAA requires states that are not meeting federal standards for Carbon Monoxide (CO) and ozone to develop State Implementation Plans (SIPs). SlPs are required to be able to reduce emissions to federal standards and are closely linked to vehicle miles of travel (VMT). All RTPs must conform to the SIP. The Federal Government may impose sanctions for failure to comply with CAAA SIP requirements. These sanctions include withholding of approval of federal highway projects. However, HOV lanes may be exempt from such sanctions.