

# HOV Pooled-Fund Study

## HOV Lane Eligibility Requirements and Operating Hours Handbook



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This PowerPoint presentation summarizes the High-Occupancy Vehicle (HOV) Lane Eligibility Requirements and Operating Hours Handbook developed through the HOV Pooled-Fund Study (PFS). It is the longer, more detailed PowerPoint presentation describing techniques to assess changes in HOV lane eligibility requirements and operating hours. A shorter PowerPoint presentation highlighting the key elements of the PFS project and the handbook is also available.

# Presentation

- n HOV Pooled-Fund Study
- n Handbook Objectives/Audiences
- n Overview of Handbook Chapters
- n Assessing Changes in Eligibility Requirements and Operating Hours
- n Other Pooled-Fund Study Projects

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The presentation covers five major topics. The objectives of the HOV Pooled-Fund Study and the participating agencies are described first. Second, the handbook objectives are highlighted, and the audiences for the handbook and related documents are summarized. Third, the handbook chapters are summarized. Fourth, the major portion of the presentation describes methods used to assess the impacts of possible changes in HOV eligibility requirements and operating hours. The presentation concludes by highlighting other projects sponsored by the HOV Pooled-Fund Study.

# HOV Pooled-Fund Study

## Objectives

- n Identify Issues Common Among Agencies
- n Suggest Projects and Initiatives
- n Select and Initiate Projects
- n Disseminate Reports
- n Assist in Solution Deployment
- n Track Innovations and Practices

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The HOV Pooled-Fund Study was undertaken to accomplish a number of objectives. These objectives include identifying common issues related to HOV facilities and suggesting and selecting projects and initiatives to address these issues. Disseminating reports, handbooks, and research results, as well as assisting in solution deployment and tracking innovations and practices represent other objectives.

# HOV Pooled-Fund Study

## Participating State Transportation Agencies

- |                 |              |
|-----------------|--------------|
| √ California    | √ New Jersey |
| √ Georgia       | √ New York   |
| √ Maryland      | √ Tennessee  |
| √ Massachusetts | √ Virginia   |
| √ Minnesota     | √ Washington |

## Federal Highway Administration (FHWA)

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Currently, state transportation agencies in 10 states are participating in the HOV Pooled-Fund Study, along with the Federal Highway Administration (FHWA). The 10 states are California, Georgia, Maryland, Massachusetts, Minnesota, New Jersey, New York, Tennessee, Virginia, and Washington. Additional state departments of transportation, public transportation agencies, and other organizations are welcome to join the HOV Pooled-Fund Study. Contact information is provided at the end of the PowerPoint presentation for those interested in joining the HOV Pooled-Fund Study.

# Handbook Developer

Texas Transportation Institute  
The Texas A&M University System  
Dr. Katherine F. Turnbull



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The Texas Transportation Institute (TTI), a part of The Texas A&M University System, was selected to conduct this project through a competitive procurement process managed by FHWA. TTI is part of the Battelle team on the FHWA Office of Operation Indefinition Quantities contract. Dr. Katherine Turnbull served as the Principal Investigator on the project and was the author of the Handbook.

# Project Objective

- n Guidance on methods to assess the potential impacts of changes in eligibility requirements and operating hours on HOV lanes.

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The objective of this project is to provide guidance on methods to assess the potential impact of changes in eligibility requirements and operating hours on HOV lanes.

# Project Deliverables

- n HOV Lane Eligibility Requirements and Operating Hours Handbook
- n Outreach Material – Project Fact Sheets, Frequently Asked Questions, PowerPoint Presentations

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The HOV Lane Eligibility Requirements and Operating Hours Handbook represents the major product from this project. Outreach materials developed through this project include project fact sheets, frequently asked questions, and PowerPoint presentations. A primer and a tri-fold brochure are also being developed under a different project.

# Audiences

- n Handbook – Transportation Professionals Responsible for HOV Facilities
- n Outreach Material – Agency Management Personnel and Policy Makers



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The handbook and outreach materials are targeted toward a variety of audiences and stakeholder groups. The handbook is intended for use by transportation professionals responsible for planning, designing, operating, and enforcing HOV facilities. The audiences for the outreach materials include agency management personnel and policy makers, as well as other groups interested in the operation of HOV facilities.

# Handbook Chapters

- n Chapter One – Introduction
- n Chapter Two – Executive Summary
- n Chapter Three – Managing HOV Lanes
- n Chapter Four – Assessing Vehicle Eligibility Requirements

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The handbook is divided into seven chapters and four appendices. The chapters include:

- Chapter One – Introduction  
Introduces the handbook purpose, topics, and format.
- Chapter Two – Executive Summary  
Highlights the objectives and types of HOV facilities.  
Summarizes the key topics of each chapter.
- Chapter Three – Managing HOV Lanes  
Describes the federal interest in changes in HOV operations, the agencies involved in managing the operation of HOV lanes, the link to HOV performance monitoring programs and operation and enforcement programs, and possible issues with managing the use of HOV lanes.
- Chapter Four – Assessing Vehicle Eligibility Requirements  
Describes possible vehicle eligibility requirements, factors to consider in changing vehicle eligibility requirements, and methods to assess possible changes in vehicle eligibility requirements.

# Handbook Chapters

- n Chapter Five – Assessing Vehicle-Occupancy Requirements
- n Chapter Six – Assessing HOV Operating Hours
- n Chapter Seven – Case Studies

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- Chapter Five – Assessing Vehicle-Occupancy Requirements  
Describes possible vehicle-occupancy requirements, factors to consider in changes in vehicle-occupancy levels, and methods for assessing possible changes in vehicle-occupancy requirements.
- Chapter Six – Assessing HOV Operating Hours  
Discusses the operating hours typically associated with different types of HOV lanes, factors to consider in changing operating hours, and methods to assess possible changes in operating hours.
- Chapter Seven – Case Studies  
Presents case studies on changes in HOV lane eligibility requirements, vehicle-occupancy levels, and operating hours.

# Handbook Appendices

- n Appendix A – References and Additional Resources
- n Appendix B – Glossary of Terms
- n Appendix C – List of Abbreviations
- n Appendix D – Agency Contacts

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The four appendices contain the references used in the handbook and additional resources, a glossary of terms, a list of abbreviations, and contacts at states involved in the HOV Pooled-Fund Study.

- Appendix A – References and Additional Resources

Provides the references used in the handbook and additional resources.

- Appendix B – Glossary of Terms

Provides a glossary of commonly used terms associated with HOV lane eligibility requirements and operating hours.

- Appendix C – List of Abbreviations

Provides a list of abbreviations associated with HOV lane eligibility requirements and operating hours.

- Appendix D – Agency Contacts

Provides contacts at states participating in the HOV Pooled-Fund Study.

# Handbook Features



Highlights Chapter at-a-Glance



Highlights Good Ideas

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The handbook provides an easy to use guide to assess the impacts of potential changes in HOV lane eligibility requirements and operating hours. Icons are used to highlight key points. The eyeglass icon is used to highlight the chapter-at-a-glance at the start of each chapter. The light bulb icon highlights good ideas based on best practice case studies.

# Handbook Features



Highlights Keys to Successful Practices



Highlights Case Study Examples

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The keys icon highlights keys to successful practices. Finally, the notebooks icon highlights case study examples. The case studies in the chapters provide examples to reinforce major points. The case studies in Chapter Seven provide detailed descriptions of the experiences with changes in HOV lane eligibility requirements and operating hours. The case studies expand on many of the examples in the chapters.

# Chapter One – Introduction

- n Welcome
- n Handbook Features
- n Chapters-at-a-Glance



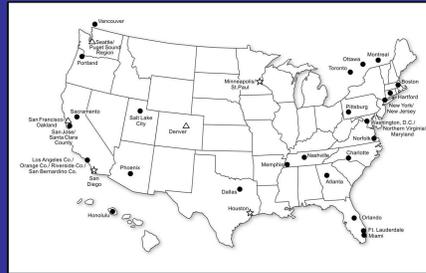
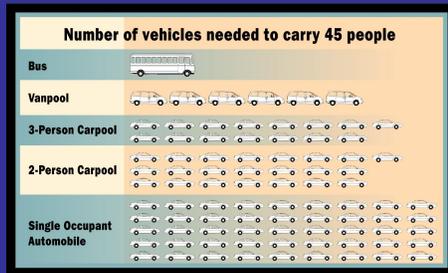
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This section of the presentation describes the major topics discussed in each chapter. Chapter One presents the objectives and audiences for the handbook, highlights the use of the four icons, and summarizes the topics covered in each chapter.

# Chapter Two – Executive Summary

- n Defining HOV Facilities
- n Key Points of Each Chapter



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Chapter Two provides an overview of HOV facilities and highlights the key points in each chapter. HOV facilities are designed and operated to provide travel time savings and trip time reliability to buses, vanpools, and carpools. HOV lanes increase the person-movement, rather than vehicle-movement, of congested travel corridors by encouraging travelers to change from driving alone to carpooling, vanpooling, or riding the bus. Currently there are approximately 130 HOV facilities on freeways and in separate rights-of-way in the 32 metropolitan areas shown on the map.

## Chapter Three – Managing HOV Lanes

- n Federal Interest in HOV Operational Changes
- n Agencies Involved in Managing HOV Lanes
- n Link to HOV Performance Monitoring Programs
- n Link to HOV Operation and Enforcement Plans
- n Possible Issues with Managing HOV Lanes
- n Process for Assessing Possible Changes in HOV Lane Operation

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Chapter Three covers the six topics listed on the slide. It summarizes federal interest in HOV operational changes and highlights the agencies typically involved in managing the operation of the HOV lanes. The link to HOV performance monitoring programs is described, along with the link to HOV operation and enforcement plans. Possible issues with managing the operation of HOV lanes are presented. The chapter concludes with a discussion of a process for assessing possible changes in HOV lane operations.

## Federal Interest in HOV Performance Monitoring

- n Maintain Federal Investments
- n Promote Efficient Use of HOV Lanes
- n Source of Funds
- n SAFETEA-LU Provisions
- n FHWA HOV Program Guidance

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FHWA, FTA, and other federal agencies have an interest in the effective and efficient operation of HOV lanes, and possible changes in HOV operations. HOV facilities on freeways and in separate rights-of-way are typically constructed with federal funds and many are located on freeways that are part of the Interstate Highway system. As a result, federal agencies have a responsibility to ensure that federal investments are maintained and that efficient use of HOV lanes is promoted. The source of funds used to construct an HOV facility, provisions of SAFETEA-LU, and FHWA HOV Program Guidance influence the consideration of possible changes in vehicle eligibility requirements, vehicle-occupancy levels, and operating hours on HOV lanes. SAFETEA-LU includes provisions relating to the use of HOV lanes by motorcycles and bicycles, tolled vehicles, low-emission and energy-efficient vehicles, and designated public transportation vehicles without meeting occupancy requirements. SAFETEA-LU includes requirements related to HOV performance monitoring and reporting when operating agencies allow certain exempt vehicles to use an HOV lane without meeting the occupancy requirements.

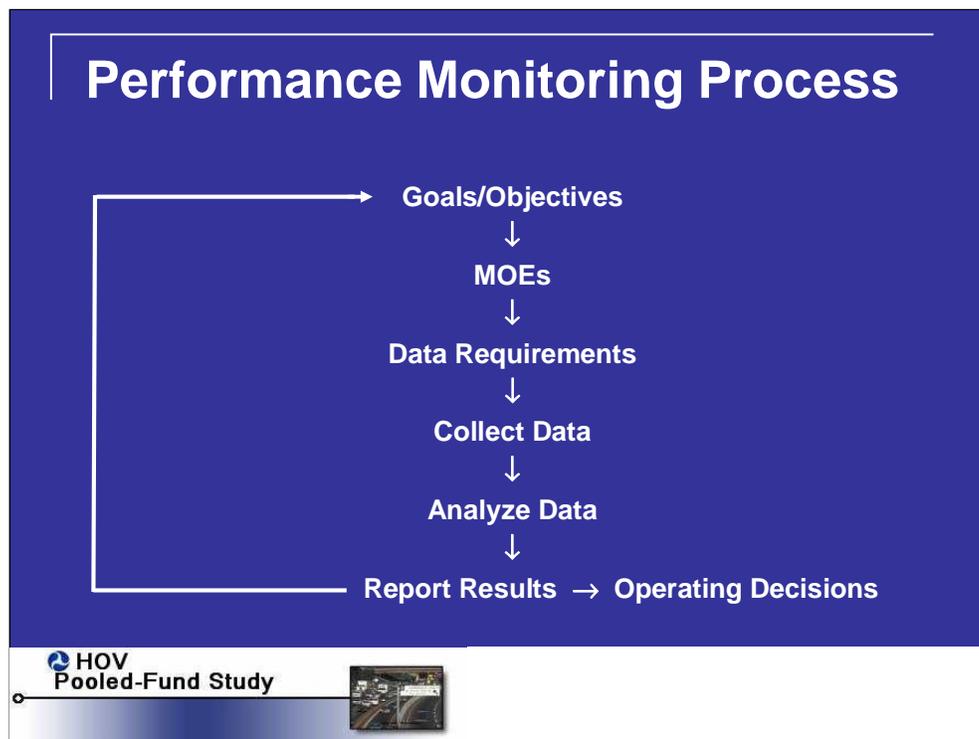
## Agencies Involved in Managing the Operation of HOV Lanes

- n State Department of Transportation
- n Public Transportation Agency
- n Rideshare Agency
- n Metropolitan Planning Organization (MPO)
- n Cities and Counties
- n State and Local Law Enforcement
- n Federal Agencies – FHWA and FTA

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The agency responsible for planning, designing, and constructing an HOV lane is typically the lead agency in operating the facility. The state department of transportation is usually responsible for managing the operation of HOV lanes on freeways and state highways. The public transportation agency is typically responsible for operating busways and frequently assists with managing the operation of HOV lanes on freeways and state roadways. Other agencies involved in assisting with managing the operation of HOV lanes include the regional rideshare organization (if separate from the public transportation agency), the MPO, cities and counties, law enforcement, and FHWA and FTA. Multi-agency teams are used in many areas to coordinate the operation of HOV lanes, including assessing potential changes in operation. These teams help ensure the involvement of all appropriate agencies in managing the operation of HOV lanes and examining possible changes. Ensuring that agency management personnel and key policy makers are kept informed of the status of HOV operations is important, especially when considering changes in operation.



Managing the operation of HOV lanes requires accurate information about performance of the HOV lanes, the general-purpose freeway lanes, and supporting services and facilities. This information is obtained through an HOV monitoring program. There is a close link between HOV performance monitoring programs and proactively managing the performance of the HOV lanes. This figure illustrates the major steps in the performance monitoring process.

- The process begins with the identification of goals and objectives for HOV facilities in an area.
- Measures of effectiveness are identified for each objective.
- The data requirements for each measure of effectiveness are outlined.
- Data are collected.
- The data are analyzed.
- The results are reported to different stakeholders and used for operating decisions, future planning, and future investment decisions. More detailed information on these steps is available in the HOV Performance Monitoring, Evaluation, and Reporting Handbook.

## Link to HOV Operation and Enforcement Plan

- n HOV Operational Alternatives
- n Ingress and Egress
- n Vehicle Eligibility and Vehicle-Occupancy Requirements
- n Transit Facilities and Services
- n HOV Operating Hours
- n Enforcement Techniques
- n Public Information and Peer Enforcement
- n Incident Management

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The development and use of an HOV operation and enforcement plan is also important in the proactive management of an HOV facility. Elements typically included in an HOV operation and enforcement plan, which are usually developed before an HOV lane opens, are highlighted on this slide.

- HOV Operational Alternatives – the operating approach, which will depend partly on the type of HOV lane, is described.
- Ingress and Egress – the type of access is determined.
- Vehicle Eligibility and Vehicle-Occupancy Requirements – the types of vehicles allowed to use the HOV lane and the vehicle-occupancy requirements are determined.
- Transit Facilities and Services – the bus services, park-and-ride lots, park-and-pool lots, rideshare programs, and other supporting elements are defined.
- HOV Operating Hours – the hours the HOV requirement will be in effect are outlined, along with how the lane will be used during other periods.
- Enforcement Techniques – the enforcement techniques and levels are determined.
- Public Information and Peer Enforcement – the public information and marketing program are defined, along with any peer enforcement programs.
- Incident Management – how incidents and crashes will be handled in the HOV lane are outlined.

## Possible Issues with Managing HOV Lanes

- n Demand Exceeding Capacity at 2+ Level
- n Not Enough Vehicles at 3+ Level
- n Exempt Vehicle Demand Exceeding Capacity
- n Bottleneck at Start or End of HOV Period

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This slide and the next slide highlight possible issues that may be encountered in managing the operation of HOV facilities. The issues and possible approaches to addressing these are discussed in more detail in Chapters Four, Five, and Six.

- Demand Exceeding Capacity at 2+ Level – too many 2+ carpools may be causing the HOV lane to become congested, degrading travel time savings and trip time reliability.
- Not Enough Vehicles at 3+ Level – there may not be enough 3+ carpools to meet the minimum vehicle volumes identified in the performance monitoring program.
- Exempt Vehicle Demand Exceeding Capacity – too many exempt vehicles, which may include tolled vehicles and low-emission and energy-efficient vehicles, may result in congestion in the HOV lane, degrading the travel time savings and trip time reliability. SAFETEA-LU requires that operating agencies monitor the use of HOV lanes by exempt vehicles and limit or restrict their use if the HOV lane becomes degraded.
- Bottleneck at Start or End of HOV Period – non-HOVs may enter an HOV lane just before the start of the restricted period and thus be in the lane during the HOV-only time. Other non-HOVs may wait on the shoulder prior to the end of the HOV operating period.

## Possible Issues with Managing HOV Lanes

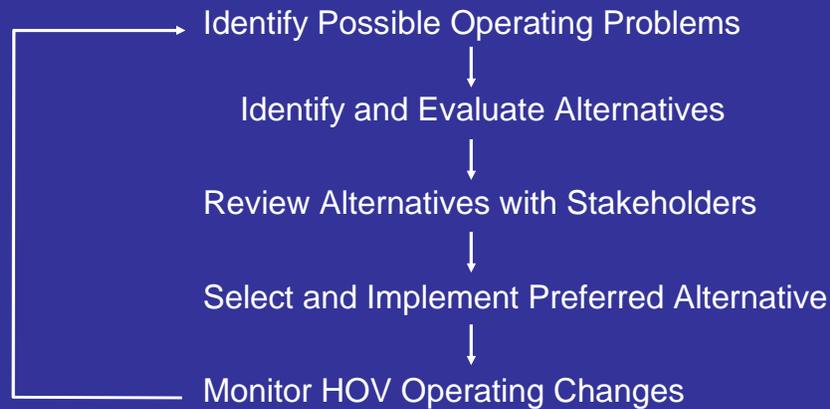
- n Use by Unauthorized Vehicles
- n Special Events Needs
- n Adjustments to Operating Hours
- n Access Controls

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- Use by Unauthorized Vehicles – vehicles other than those meeting the occupancy requirement or qualifying as exempt vehicles may be using an HOV lane illegally. Examples of unauthorized vehicles might include law enforcement personnel traveling in their own vehicles and non-qualifying low-emission and energy-efficient vehicles.
- Special Events Needs – there may be opportunities to use an HOV lane to help manage traffic for planned special events.
- Adjustments to Operating Hours – the operating hours may need to be extended or reduced in response to use levels.
- Access Controls – access points may need to be adjusted in response to service issues, such as too high volumes, too low volumes, and safety concerns.

## Process for Assessing Possible Changes



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This slide highlights a basic process for assessing possible changes in HOV operations. The following steps are typically associated with examining potential changes.

- Identify Possible Operating Problems – information from the ongoing monitoring program forms the basis for identifying possible problems that are limiting the efficiency and effectiveness of an HOV lane.
- Identify and Evaluate Alternatives – possible approaches to address the problems are identified and evaluated in this step.
- Review Alternatives with Stakeholders – discussing the alternatives with key stakeholders is an important part of the assessment process, especially if the alternatives being examined will impact motorists in the general-purpose freeway lanes.
- Select and Implement Preferred Alternative – the preferred alternative is selected and implemented in this step.
- Monitor HOV Operating Changes – the performance monitoring program provides the base for tracking the impact of the changes and continues to proactively manage the operation of an HOV lane.

## Chapter Four – Assessing Vehicle Eligibility Requirements

- n Possible Vehicle Eligibility Requirements
- n Factors to Consider in Changing Vehicle Eligibility Requirements
- n Assessing Possible Changes in Vehicle Eligibility Requirements

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Chapter Four examines HOV lane vehicle eligibility requirements. It includes an overview of vehicles that may be allowed to use HOV lanes. Factors to consider in changing vehicle eligibility requirements are discussed, along with assessing possible changes in vehicle eligibility requirements are presented.

# Vehicle Eligibility Requirements

- n Vehicles Meeting Occupancy Requirements
- n Exempt Vehicles Not Meeting Occupancy Requirements
- n Vehicles Not Usually Allowed



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Vehicles that may be considered for use of an HOV lane can be divided into three general categories. These three categories are vehicles meeting the vehicle-occupancy requirements, exempt vehicles not meeting the occupancy requirements, and vehicles not usually allowed. Vehicles in each of these three categories are highlighted on the next three slides.

# Vehicles Meeting Occupancy Requirements

n Buses



n Vanpools



n Carpools



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Vehicles meeting the occupancy requirements include buses (public transportation buses, over-the-road coaches, and school buses), vanpools, and carpools. Buses provide the highest person-carrying capacity. Many transit agencies utilize HOV lanes to provide fast, frequent, and convenient service. Articulated buses and over-the-road coaches are used in some areas. Vanpools may be organized through company programs, rideshare agencies, or third-party vendors. Carpools may be formed with family members, co-workers, neighbors, or through a ridesharing program. Taxis, airport shuttles, and other shuttles meeting the occupancy requirements for a specific HOV lane would also be included in this group.

## Exempt Vehicles Not Meeting Eligibility Requirements

- n Motorcycles
- n Designated Public Transit Vehicles With Driver Only
- n Marked Law Enforcement
- n High-Occupancy Toll (HOT) Vehicles
- n Low-Emission and Energy-Efficient Vehicles
- n Bicycles

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Vehicles not meeting the occupancy requirements that may be allowed to use an HOV lane or considered for future use include motorcycles, designated public transit vehicles with only the driver, marked law enforcement vehicles, high-occupancy toll (HOT) vehicles, low-emission and energy-efficient vehicles, and bicycles. SAFETEA-LU provides motorcycles and bicycles with access to HOV lanes unless an operating agency certifies to the U.S. Secretary of Transportation that their use creates a safety hazard and the Secretary accepts the certification. SAFETEA-LU also allows operating agencies to provide access to designated public transportation vehicles, HOT vehicles, and low-emission and energy-efficient vehicles not meeting occupancy requirements. Specific provisions must be met if these vehicles are not allowed. Most operating agencies also allow marked law enforcement vehicles to use HOV lanes.

# Vehicles Not Usually Allowed

n Trucks/Semi-Trailers



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For safety reasons trucks and semi-trailers are usually not allowed to use HOV lanes.

# Factors to Consider in Changing Vehicle Eligibility Requirements

- n Project Goals and Objectives
- n Type and Length of HOV Lane
- n Supporting Elements
- n Design or Operating Limitations/Safety
- n Segment and Areawide Continuity

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This slide highlights factors typically considered in assessing possible changes in vehicle eligibility requirements.

- Project Goals and Objectives – the goals and objectives of an HOV project or system will influence consideration of changes in vehicle eligibility requirements.
- Type and Length of HOV Lane – some types of HOV lanes may not be appropriate candidates for some vehicles. The length of an HOV lane may also impact consideration of possible vehicles. Short HOV lanes are probably not good candidates for HOT projects or low-emission and energy-efficient vehicles because they would not provide enough travel time savings to make the investment in HOT infrastructure or the purchase of low-emission and energy-efficient vehicles worthwhile.
- Supporting Elements – supporting elements may influence consideration of different types of vehicles.
- Design or Operating Limitations/Safety – design limitations may preclude some types of vehicles. For example, contraflow HOV lanes may have design limitations that make use by carpools undesirable.
- Segment and Areawide Continuity – consideration should be given to how changes in vehicle eligibility requirements on one HOV lane may impact other HOV lanes in the area.

## Factors to Consider with Exempt Vehicles

- n Target Market
- n Pricing Alternatives
- n Use of Revenues
- n Possible Equity Concerns
- n Public Reaction
- n Enforcement
- n Methods to Restrict Use

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Additional factors may need to be considered if tolled vehicles and low-emission and energy-efficient vehicles are being examined for possible use of an HOV lane. With HOT vehicles, topics related to the target market, the pricing levels and payment approaches, the use of revenue generated from the project, possible equity and environmental justice concerns, and reactions from the public and policy makers may need to be considered. With low-emission and energy-efficient vehicles, the target markets, how vehicles will be marked, equity concerns, and public and political reaction also may need to be considered. Enforcement and developing methods to restrict use if the HOV lane becomes degraded are also important factors to consider with exempt vehicles.

## Chapter Five – Assessing Vehicle-Occupancy Requirements

- n Possible Vehicle-Occupancy Requirements
- n Factors to Consider in Changing Vehicle-Occupancy Requirements
- n Assessing Potential Changes in Vehicle-Occupancy Requirements

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Chapter Five examines HOV lane vehicle-occupancy requirements. Potential vehicle-occupancy requirements are highlighted. Factors to consider in changing vehicle-occupancy requirements are discussed, and methods to assess possible changes in vehicle-occupancy requirements are described.

## Potential Vehicle-Occupancy Requirements

- n 2+ Persons Per Vehicle
- n 3+ Persons Per Vehicle
- n 4+ Persons Per Vehicle
- n Variable Occupancy (3+/2+)

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Possible vehicle-occupancy requirements include 2+ persons per vehicle, 3+ persons per vehicle, 4+ persons per vehicle, and variable occupancy levels (3+ peak hours/2+ other operating hours). Most HOV lanes open to carpools use a 2+ occupancy requirement. The advantages and limitations of different vehicle-occupancy requirements are highlighted in the following slides.

## 2+ Persons Per Vehicle

### Advantages

- n Easiest Carpool to Form
- n Often Existing 2+ Carpools

### Limitations

- n Congestion if too Many 2+ Carpools
- n AVO may not Increase



The 2+ occupancy level is the most common occupancy requirement in use on HOV lanes allowing carpools. Potential advantages of using a 2+ requirement include ease of carpool formation and the potential for significant volumes of existing 2+ carpools in the corridor. Potential limitations include high volumes of 2+ carpools causing congestion in an HOV lane and little impact on average vehicle-occupancy (AVO) and congestion levels if an HOV lane only attracts existing carpools from the general-purpose freeway lanes, rather than encouraging the formation of new carpools.

## 3+ Persons Per Vehicle

### Advantages

- n Address Congestion at 2+ Level
- n Higher Person-Moving Capacity

### Limitations

- n Harder to Form 3+ Carpools
- n Not Enough 3+ Carpools
- n 2+ Carpools Add to General-Purpose Lane Congestion

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A few HOV lanes use a 3+ vehicle-occupancy requirement during all operating periods. Examples include the Shirley Highway (I-395) in northern Virginia and the approach to the Bay Bridge in Oakland, California. Potential advantages of a 3+ occupancy requirement include addressing congestion in an HOV lane at a 2+ level and a higher person-movement capacity. On the other hand, it is more difficult for individuals to form 3+ carpools. If there are not enough 3+ carpools using an HOV lane, it will not help in addressing congestion issues. Also, 2+ carpools who are unable to find a third person may increase traffic congestion in the general-purpose freeway lanes.

# 4+ Persons Per Vehicle

## Advantages

- n Higher Person Moving Capacity
- n Address Congestion at 3+ Level

## Limitations

- n Harder to Form 4+ Carpools
- n Not Enough 4+ Carpools
- n 3+ Carpools Add to General-Purpose Lane Congestion

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A 4+ requirement is not currently in use on any HOV lane. The 4+ occupancy requirements have been used on some facilities in the past. Examples include I-395 (Shirley Highway) in northern Virginia and the I-10 West (Katy) HOV lane in Houston. A 4+ requirement provides a higher person-moving capacity and the ability to address congestion at a 3+ level. Limitations include the difficulty of forming 4+ carpools, low volumes of 4+ carpools in the HOV lane, and adding 3+ carpools to the general-purpose freeway lanes.

## Variable Occupancy (3+/2+)

### Advantages

- n Address Peak Congestion
- n Maintain Travel Time Savings and Trip Time Reliability
- n Maintain Bus Operations

### Limitations

- n Possible User Confusion
- n Enforcement May Be More Difficult

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Three HOV lanes – the El Monte Busway in Los Angeles, the I-10 West, and US 290 HOV lanes in Houston – use a variable occupancy requirement. A 3+ vehicle-occupancy level is in effect during the peak-hours, and a 2+ occupancy requirement is used during other operating periods. Advantages to this approach include addressing congestion during the peak-periods at the 2+ level, maintaining travel time savings and trip time reliability for HOV lane users, and maintaining bus operations. Limitations include possible user confusion, especially among infrequent users, and adding complexity for enforcement.

## Factors to Consider in Changing Vehicle-Occupancy Requirements

- n Project Goals and Objectives
- n Congestion Levels in HOV Lane
- n Enforcement
- n User, Non-User, and Policy Maker Perceptions
- n Segment and Areawide Continuity

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This slide highlights factors typically considered in assessing possible changes in vehicle-occupancy requirements.

**Project Goals and Objectives** – the goals and objectives of an HOV project or HOV system will influence consideration of changes in vehicle-occupancy requirements. The goals and objectives may provide guidance on the minimum and maximum thresholds to consider with possible changes in vehicle-occupancy requirements.

**Congestion Levels in HOV Lane** – the level of traffic in the HOV lanes is obviously a key factor in considering a change in the vehicle-occupancy requirement. If a lane is congested at a 2+ requirement, consideration may be given to increasing the vehicle-occupancy requirements to 3+. An HOV lane with a 3+ requirement that is not well used may be a candidate for lowering the requirement to 2+.

**Enforcement** – ensuring that any change in vehicle-occupancy requirements can be efficiently enforced is important, especially if increases in vehicle-occupancy levels or variable vehicle-occupancy requirements are being considered.

**Users, Non-Users, and Policy Maker Perceptions** – HOV lane users may not favor increasing the vehicle-occupancy requirement as it is more difficult to form 3+ carpools. Ensuring that users, non-users, and policy makers understand the reason a change in occupancy requirements is being considered is important.

**Segment and Areawide Continuity** – consideration should be given to how changes in vehicle-occupancy requirements on one HOV lane may impact other HOV lanes in the area.

## Chapter Six – Assessing HOV Operating Hours

- n HOV Operating Hour Scenarios
- n Factors to Consider in Changing HOV Operating Hours
- n Assessing Possible Changes in HOV Operating Hours

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Chapter Six examines changes in HOV operating hours. The common operating hours associated with different types of HOV lanes are summarized. Factors to consider in changing HOV operating hours are presented on assessing potential changes in HOV operating hours are discussed.

# HOV Operating Hour Scenarios

- n 24-Hour/7 Days a Week (24/7)
- n Extended Operating Hours
- n Peak-Period Only
- n Extended Hours for Special Events



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The typical HOV operating hour scenarios and the use of HOV lanes with special events are highlighted on this slide. The characteristics and types of HOV lanes associated with each scenario are noted below.

24/7 – maintains the HOV designation 24-hours a day, seven days a week. Typically used on busways and some concurrent flow HOV lanes and exclusive two-direction HOV lanes. Examples include the concurrent flow HOV lanes in Southern California and the El Monte Busway in Los Angeles.

Extended Operating Hours – this approach encompasses a major portion of the day, but not all day. Although the exact operating hours may vary, HOV lanes with extended hours typically operate from 6:00 a.m. to 11:00 a.m. and from 3:00 p.m. to 7:00 p.m. Most exclusive reversible HOV lanes have extended operating hours. Examples include the six barrier-separated, reversible HOV lanes in Houston and the two-lane barrier-separated HOV lanes on I-15 in San Diego, I-394 in Minneapolis, and I-395 in Northern Virginia.

Peak-Period Only – HOV lanes operated only during the morning and afternoon peak-periods, typically 6:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. or 7:00 p.m. This operating scenario is typically found on some concurrent flow HOV lanes and most contraflow HOV lanes. The lanes are usually open to general-purpose traffic at other times. A few contraflow HOV lanes, including Route 495, the Long Island Expressway, and the Gowanus Expressway in the New York City area, operate only during the morning peak-period in the peak-direction (inbound to New York City).

Extended Operating Hours for Special Events and Other Activities – a few exclusive HOV lanes are open extended hours to help manage traffic for major sporting or cultural events.

# Factors to Consider in Changing HOV Operating Hours

- n Project Goals and Objectives
- n Type of HOV Lane
- n Problem with Current Hours
- n Congestion Levels in HOV and General-Purpose Freeway Lanes
- n System or Regional Connectivity
- n Enforcement and Safety
- n Public and Policy Maker Perceptions

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This slide highlights factors to consider in assessing possible changes in HOV operating hours.

**Project Goals and Objectives** – the goals and objectives of an HOV project will influence consideration of changes in operating hours.

**Type of HOV Lane** – the type of HOV lanes will influence consideration of changes in operating hours. For example, reversible exclusive HOV lanes and contraflow HOV lanes have limited operating hour options.

**Problem with Current Hours** – the nature and extent of issues or concerns with current operating hours will influence options to consider.

**Congestion Levels in HOV and General-Purpose Freeway Lanes** – the level of congestion in the HOV lanes and the general-purpose freeway lanes may impact consideration of changes in operating hours.

**System or Regional Connectivity** – changing operating hours on one HOV lane may impact the operation of other HOV lanes in the area.

**Enforcement and Safety** – being able to adequately enforce any change in operating hours is important, as is ensuring that any changes will not degrade the safe operation of both the HOV lane and the general-purpose freeway lanes.

**Public and Policy Maker Perceptions** – the perceptions of HOV lane users, non-users, the general public, and policy makers are important in considering changes in HOV operating hours. The perceptions of non-users and policy makers are especially important if consideration is being given to extending HOV operating hours into periods when general-purpose traffic is currently allowed.

## Changing Operating Hour Scenarios

- n Extending Peak-Period/Extended Hours to 24/7
- n Extending Peak-Period/Operating Hours
- n Reducing Peak-Period/Extended Hours
- n Reducing 24/7 to Peak-Period/Extended Hours
- n Opening 24/7 in Evenings or Weekends

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Assessing the impacts of five possible changes in operating hour scenarios are described in the handbook. These scenarios are listed on this slide. While all of the factors noted on the previous slide are important to consider, some elements are more critical depending on the change being considered. Experience with these types of changes and some of the key elements to consider with each scenario are described.

Extending Peak-Period/Extended Hours to 24/7 – there are no examples of extending peak-periods or extending operating hours to 24/7 operations. Ensuring public and policy maker support for this type of change is critical.

Extending Peak-Period/Operating Hours – there are few successful examples of successfully extending peak-period operating hours on HOV lanes. Since this type of change frequently would restrict general-purpose traffic using the lane during the existing non-HOV operating period, the perceptions of non-users and policy makers are critical to this type of change.

Reducing Peak-Period/Extended Hours – the operating hours of some HOV lanes have been reduced, with general-purpose traffic using the lanes during the previous HOV-restricted period. Ensuring that this change does not degrade the operation of the HOV lane is important.

Reducing 24/7 to Peak-Period/Extended Hours – there are no examples of reducing 24/7 operations to extended hours or peak-period operation. Ensuring that this change does not degrade the operation of the HOV lane is important.

Opening 24/7 in Evenings or Weekends – the HOV lanes on the east side of Seattle were open to general-purpose traffic from 7:00 p.m. to 5:00 a.m. in 2003. Studies have been conducted examining opening the HOV lanes in the Los Angeles area to general-purpose traffic on weekends and holidays. The studies recommended against these changes because the HOV lanes are effectively utilized during these time periods and only minimum improvements in traffic conditions would be realized. The change was also not consistent with the goals and objectives for the HOV system in Los Angeles. Ensuring that this change does not degrade the operation of the HOV lane is important.

## Chapter Seven – Case Studies

- n I-10 West, Houston
- n El Monte Busway, Los Angeles
- n I-15, San Diego
- n I-394, Minneapolis
- n HOV Lanes, Northern Virginia
- n HOV lanes, Puget Sound Region

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Chapter Seven presents more detailed case studies on the impacts of actual changes in eligible vehicles, occupancy requirements, and operating hours. The main elements of the case studies are highlighted in the next slides.

# I-10 West HOV Lane – Houston

- n Open 1984 to Buses and Authorized Vanpools
- n Buses and Authorized Vanpools and 4+ Carpools
- n Buses and Authorized Vanpools and 3+ Carpools



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The I-10 West (Katy) HOV lane in Houston provides an example of changes in vehicle eligibility requirements and vehicle-occupancy requirements over the life of a project. As highlighted in this slide, only buses and authorized vanpools were allowed to use the HOV lane when it opened in 1984. Approximately 50 vehicles used the HOV during the morning peak-hour with these requirements. Allowing authorized 4+ carpools to use the lane added some 10 vehicles to the peak-hour volumes. The authorized carpool level was lowered to 3+ and then the authorized requirement was removed for both vanpools and carpools.

# I-10 West HOV Lane – Houston

- n Buses, Vanpools, and 2+ Carpools
- n 3+ Carpools – Peak Hours
- n QuickRide Value Pricing – 2-person Carpools



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The carpool level was lowered to 2+ in November 1986. When the HOV lane became too congested at the 2+ level, the occupancy requirement was increased to 3+ during the morning peak hour in 1988. This requirement was added in the afternoon peak-hour in 1991. The QuickRide value pricing demonstration project, which allows 2-person carpools to use the lane for a \$2.00 per trip fee during the 3+ peak-hours was implemented in 1998.

## El Monte Busway – Los Angeles

- n Opened in 1973 – Buses Only
- n 1976 – 3+ Carpools Allowed



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The El Monte Busway case study provides an example of the negative impact of lowering the vehicle-occupancy requirement from 3+ to 2+ on a well used HOV lane. The El Monte Busway was opened in 1973. Initially a bus-only facility, mixed-mode operation allowing 3+ carpools was implemented in 1976.

## El Monte Busway – Los Angeles

- n January 2000 – 2+ Carpools Allowed Based on State Legislation
  - slower speeds, longer travel times, congestion
  - bus operation impacted
- n July 2000 – 3+/ $2+$  State Legislation
  - operation returned to pre-2+ levels



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In 1999, the California Legislature approved a bill lowering the vehicle-occupancy requirement to 2+. Caltrans implemented the change in January 2000 and monitored the impact of the change. At the 2+ level, travel speeds on the busway dropped significantly. Speeds in the morning peak-hour declined from 65 mph to 20 mph, travel times increased by 20 to 30 minutes, and vehicle volumes increased from approximately 1,100 to 1,600. At the same time, there was no noticeable improvement in conditions in the general-purpose freeway lanes. As a result of the negative impacts on the operation of the busway with the 2+ designation, emergency legislation was approved in increasing the vehicle-occupancy requirement to 3+ during the morning and afternoon peak-hours.

# I-15 HOV Lanes – San Diego

- n 1988 – HOV Lanes Opened
- n 1996 – ExpressPass – Monthly Fee
- n 1998 – FasTrak™ – Variable Pricing/ETC



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The I-15 HOV lanes case study highlights the first HOV lane expanded to include HOT vehicles. The eight-mile, two-lane, reversible HOV lane opened in 1988 with a 2+ vehicle-occupancy requirement. While use of the lane grew over time, there was still unused capacity. In 1996, approximately 1,800 vehicles were using the two-lane facility in the morning peak-hour, which operated at a level-of-service C, while the adjacent general-purpose freeway lanes operated at a level-of-service F. Interest in pricing strategies emerged during an assessment of potential transportation control measures in the regional air quality plan. The HOT approach was supported by influential policy makers who sponsored needed enabling legislation for the demonstration project, which was implemented in 1996. Initially, monthly passes were sold to motorists on a first-come basis, allowing them to drive alone in the HOV lanes. The monthly fee was initially set at \$50 in December 1996 and 500 permits were sold. The monthly fee and the number of permits sold was increased to \$70 and 700 permits in 1997. The FasTrak™ phase was implemented in 1989, with Electronic Toll Collection (ETC) replacing the monthly passes. Variable pricing is used, with the price based on the level of congestion in the HOV lane. As of March 2005, there were approximately 18,670 FasTrak™ accounts and some 27,700 transponders in use. Daily weekday use of the lanes in 2004 and 2005 averaged between 19,400 and 22,340 vehicles, with 2+ carpools accounting for approximately 75 to 78 percent of these volumes and FasTrak™ users accounting for the remainder.

# I-394 HOV Lanes, Minneapolis

- n 1985 – Interim HOV Lanes
- n 1992 – Final HOV Lanes and Freeway



HOV  
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The I-394 HOV lane provides another example of a HOT project. The case study highlights the following elements.

An Interim HOV lane called the Sane Lane, was implemented in 1985 to help manage traffic during construction of I-394 and to introduce the HOV concept to motorists in the area. The completed freeway, including the HOV lanes, was open in 1992. There are two different sections of HOV lanes – a three-mile two-lane barrier-separated reversible section direction west of downtown Minneapolis and seven miles of concurrent flow HOV lanes. The reversible section operated from 6:00 a.m. to 10:00 a.m. eastbound into downtown Minneapolis and from 2:00 p.m. to 7:00 p.m. westbound out of downtown Minneapolis. It was closed to all traffic at other times. The concurrent flow sections operated in the peak-period, peak-direction of travel (6:00 a.m. to 9:00 a.m. eastbound and 4:00 p.m. to 7:00 p.m. westbound).

# I-394 HOV Lanes, Minneapolis

- n May 2005 – MnPASS HOT Project – 24/7 Operation on Contraflow Lanes
- n August 2005 – Hours Changed to Peak-period/Peak Direction



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The MnPASS HOT project, which uses ETC and variable pricing, was implemented in May 2005. The project represents the first use of tolling in the Minneapolis-St. Paul area. Toll rates vary from \$0.25 to \$8.00 depending on the level of congestion on the HOV lanes. Major changes were made in the operating hours with the implementation of MnPASS. The concurrent flow lanes were opened to HOVs and MnPASS participants on a 24/7 basis. Operating hours in the reversible lanes were extended to 6:00 a.m. to 1:00 p.m. eastbound and 2:00 p.m. to 5:00 a.m. westbound.

The change in operating hours resulted in congestion in the general-purpose freeway lanes in westbound direction in the morning. The Minnesota Senate passed a resolution supporting rescinding the off-peak tolls and other policy makers and commuters in the corridor voiced support for the change.

In responses to these concerns, Mn/DOT made initial changes in the MnPASS operating hours on the concurrent flow lanes. In August 2005, the operating hours were further reduced to 6:00 a.m. to 10:00 a.m. eastbound and 2:00 p.m. to 7:00 p.m. westbound. These hours are similar as those used from 1992 to 2005.

## HOV Lanes – Northern Virginia

- n 1993 – Legislation Establishing Clean Special Fuel License Plate
- n 1994 – Legislation HOV Use by Clean Special Fuel License Plate Vehicles
- n 2000 – Hybrid Vehicles Included in Clean Special Fuel License Plates

 HOV  
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This case study highlights the use of the I-395 HOV lanes in Northern Virginia by hybrid vehicles. The case study highlights the following elements:

State legislation approved in 1993 established a clean special fuel license plate for clean special fuel vehicles, defined to include any product or source of energy used to propel a highway vehicle, the use of which compared to conventional gasoline or reformulated gasoline, resulting in low-emissions of oxides or nitrogen, volatile organic compounds, carbon monoxide or particulates. Compressed natural gas, liquefied natural gas, liquefied petroleum gas, hydrogen, hythane (a combination of compressed natural gas and hydrogen), and electricity were included in the definition.

State legislation approved in 1994 allowed vehicles with clean special fuel license plates to use HOV lanes in the state without meeting occupancy requirements. The sunset for this provision was extended in subsequent legislation, and is currently July 1, 2006. In 2000, the Virginia Department of Motor Vehicles (DMV) began issuing the clean special fuel license plates to owners of hybrid vehicles.

## HOV Lanes – Northern Virginia

- n 2000-2005 – 10,335 Plates Issued, 95% Hybrids, 93% Reside in Northern Virginia
- n 2003-2004 – Clean Special Fuel Vehicles Account for 12% to 17% of Peak-Hour Vehicles



HOV  
Pooled-Fund Study



The number of clean special fuel license plates issued in the state increased significantly with this provision. From 1994 to 1999, 78 clean special fuel license plates were issued. With the hybrid provision, some 10,335 clean special fuel license plates were issued between 2000 and October 2004. Approximately 95 percent of the total clean special fuel license plates have been issued to hybrid vehicles and some 93 percent have been issued to residents of counties in northern Virginia.

The vehicles with clean special fuel license plates have been included in the ongoing monitoring program conducted by WASHCOG. In the fall of 2003, clean special fuel vehicles accounted for approximately 12 percent of the vehicles using the I-395 HOV lanes in the morning peak-hour. In October 2005, they accounted for some 17 percent. Concern over the use of the HOV lanes by hybrid vehicles have been raised by different groups. The Virginia HOV Enforcement Task Force has recommended different strategies for addressing these concerns.

# Puget Sound HOV Lanes

- n 24/7 Traditional HOV Operation
- n Eastside HOV Lane Pilot Program – SOV use 7:00 p.m. to 5:00 a.m.



HOV  
Pooled-Fund Study



This case study highlights changing the operating hours on HOV lanes on the east side of Seattle from 24/7 to allowing single-occupant vehicles use from 7:00 p.m. to 5:00 a.m. Most of the HOV lanes in the Puget Sound region operated on a 24/7 basis prior to the pilot program on the east side HOV lanes. Most facilities are concurrent flow HOV lanes with unlimited access. The results of the ongoing HOV lane monitoring program document that the HOV facilities are well utilized during the morning and afternoon peak-periods. Surveys conducted as part of the monitoring program indicate that there is strong public support for HOV facilities in the area. At the same time, there has also been public and policy maker interest in allowing single-occupant vehicles to use the HOV lanes during the off peak-periods. Analysis conducted over the years indicated that there is little unused HOV capacity during the peak-periods, but that excess capacity does exist in the evening and early morning periods.

# Puget Sound HOV Lanes

- n 24/7 Traditional HOV Operation
- n Eastside HOV Lane Pilot Program – SOV use 7:00 p.m. to 5:00 a.m.
- n One Year Evaluation
  - Slight Increases in Vehicle Volumes
  - No Significant Change in Travel Speeds
  - Marginal Increase in Violation Rates
  - No Change in Crash Data
  - Public Perception – Many Motorists Unaware of Change, but Positive

 HOV  
Pooled-Fund Study



In 2003, HOV lanes on the east side of Seattle were open to single-occupant vehicles from 7:00 p.m. to 5:00 a.m. as part of a pilot program. The HOV lanes on I-90, I-405, and SR 167 were included in the pilot program.

A one-year evaluation of the pilot program focused on vehicle volumes in the general-purpose freeway lanes and the HOV lanes, roadway performance as defined by travel speeds and frequency of congestion, violation rates, crash rates, and public perception. The results of the one-year evaluation indicated that overall changes in system performance were small. Late night vehicle volumes in the HOV lanes increased slightly, but travel speeds remained basically the same. Violation rates increased marginally. Before-and-after crash data was nearly identical. Surveys of motorists in the corridor indicated that while many were unaware of the changes in HOV lane operating hours, the general reaction was positive.

## Other HOV Pooled-Fund Study Projects

- n HOV Lane Performance Monitoring, Evaluating, and Reporting Handbook
- n HOV Lane Safety Considerations Handbook
- n HOV Lane Enforcement Handbook
- n HOV Inventory

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Other HOV pooled-fund study projects are highlighted on this slide.

# HOV Pooled-Fund Study

## Project Website

<http://hovpfs.ops.fhwa.dot.gov/index.cfm>

## Contact Information

Mr. Neil Spiller  
Federal Highway Administration  
Voice: (202) 366-2188  
E-mail: [neil.spiller@fhwa.dot.gov](mailto:neil.spiller@fhwa.dot.gov)

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More information on HOV Pooled-Fund Study projects, including the HOV Lane Eligibility Requirements and Operating Hours Handbook, can be obtained from the website shown on the slide or by contacting Neil Spiller at FHWA.