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16. Abstract This report summarizes the Year 2 activities under Implementation Project 5-4160-01, Managed Lanes Handbook Training. The overall objective of the project is to develop a 12-hour workshop covering <i>The Managed Lanes Handbook</i> , and teach the materials at seven locations across the state, including two pilot workshops. <i>The Managed Lanes Handbook</i> was developed for the Texas Department of Transportation (TxDOT) to help the staff make informed planning, design, and operational decisions when considering managed lanes facilities for its jurisdiction. The handbook presents the critical research results obtained over the five years of the related research project, presented in a usable format, providing a clear, concise, and step-wise approach to planning, designing, operating, and enforcing a managed lanes facility. It also refers the user to other pertinent documents that provide additional detailed information on various aspects of managed lanes. The workshop is designed to facilitate statewide use of the handbook with TxDOT and partnering agency staff involved in managed lanes project development and design. Year 2 activities included teaching the workshops, updating of workshop material as appropriate, and preparing the final deliverables for TxDOT.		13. Type of Report and Period Covered Technical Report: September 2007 – August 2008	
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**MANAGED LANES HANDBOOK TRAINING:
YEAR 2 REPORT OF ACTIVITIES**

by

Beverly T. Kuhn, Ph.D., P.E.
Senior Research Engineer

and

Ginger Goodin, P.E.
Research Engineer

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TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

DISCLAIMER

This implementation work was performed in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of FHWA or TxDOT. This report does not constitute a standard, specification, or regulation. The researcher in charge of the project was Beverly T. Kuhn (Texas P.E. No. 80308).

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Director, Office of Primary Responsibility

- Carlos Lopez, P.E., Traffic Operations Division, TxDOT

Implementation Director

- Carlos Lopez, P.E., Traffic Operations Division, TxDOT

Implementation Advisors

- Theresa Sykes, Human Resources Division, TxDOT
- Flor Tamez, P.E., Traffic Operations Division, TxDOT
- Diana Vargas, Texas Turnpike Authority Division, TxDOT

Research Engineer

- Wade Odell, P.E., Research and Technology Implementation Office, TxDOT

Contract Specialist

- Sandra Kaderka, Research and Technology Implementation Office, TxDOT

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CHAPTER 1: BACKGROUND AND HISTORY OF PROJECT

BACKGROUND AND SIGNIFICANCE

The highway system in the United States is a critical component of American life. It provides extensive and flexible personal mobility to American citizens and efficient freight movement to support the domestic economy. However, a variety of factors are interfering with this system's ability to provide these services. The growth of vehicle miles traveled continues at an accelerated rate to the extent that it outpaces the growth in the number of lane miles across the country. Additionally, congestion in urban areas is increasing, occurs during longer parts of the day, and delays more travelers every year. These trends are especially evident in Texas where increasing population growth has led to an increase in congestion in all major urban areas. This population growth has placed enormous demands on the already burdened transportation infrastructure, particularly the freeway systems.

There is a certain realization that the construction of sufficient freeway lane capacity to provide free-flow conditions during peak travel periods cannot be accomplished in developed urban areas due to cost, land consumption, neighborhood impacts, environmental concerns, and other factors. Like other transportation agencies nationwide, TxDOT is searching for methods to better manage traffic flow, mitigate the adverse effects of congestion, and thus improve the efficiency of existing and proposed networks.

Managed lanes are one method that is being used successfully across the country and in Texas to better manage traffic flow. The theory behind managed lanes is to set aside certain freeway lanes and to use a variety of operating strategies to move traffic more efficiently in those lanes. As a result, managed lanes provide travelers with an alternative to traveling on congested freeways. Using managed lanes can allow a transportation agency to leverage existing capacity and move both people and goods in the most efficient manner possible. The managed lanes concept is a tool that is available to the transportation community and may be used as part of a comprehensive plan to achieve regional goals.

The term "managed lanes" has different meanings to different agencies. In some agencies, the term is commonly thought of as high-occupancy vehicle (HOV) lanes while in others it might refer to high-occupancy toll (HOT) lanes. Still other agencies may use an even broader definition which may include HOV lanes, value priced lanes (including HOT lanes), and exclusive or special

use lanes (such as express, bus-only, or truck-only lanes). TxDOT uses the following as a definition for managed lanes as determined by the 0-4160 Project Monitoring Committee in 2000:

“A managed lane facility is one that increases freeway efficiency by packaging various operational and design actions. Lane management operations may be adjusted at any time to better match regional goals.”

The definition is very general and yet it reflects the complexity and flexibility of the managed lanes concept. The definition allows each district across the state to determine what “managed lanes” means for their jurisdiction. Thus, it respects the needs of the community without requiring the application of a specific strategy that does not meet those needs. Moreover it encourages flexibility, realizing that the needs of a region may change over time, thereby requiring a different managed lanes operational strategy.

TxDOT Project 0-4160, Operating Freeways with Managed Lanes, achieved its objectives of (1) investigating the complex and interrelated issues surrounding the safe and efficient operation of managed lanes using various operating strategies, and (2) developing guidelines to help the Texas Department of Transportation make informed planning, design, and operational decisions when considering these facilities for its jurisdiction. These guidelines are incorporated into the *Managed Lanes Handbook*. The handbook includes all of the research results from Project 0-4160 in a usable format, providing a clear, concise, and step-wise approach to planning, designing, operating, and enforcing a managed lanes facility. It also refers the user to other pertinent documents that provide additional detailed information on various aspects of managed lanes. A user-friendly preliminary screening tool accompanies the *Managed Lanes Handbook*.

The research area and development of managed lanes projects across the United States is rapidly evolving. In addition to Project 0-4160, additional TxDOT research is producing results that enhance the information available in the *Managed Lanes Handbook*, including but not limited to Project 0-4898, Criteria for Adapting HOV Lanes to HOT Lanes. Additionally, numerous managed lanes facilities will go online this year, including I-394 in Minneapolis and I-25 in Denver. The operational experiences from these facilities combined with current research indicate the wealth of knowledge that can be shared with practitioners across Texas.

TXDOT IMPLEMENTATION PROJECT 5-4160-01

It is important that TxDOT continue to remain at the forefront of managed lanes research in Texas and the United States. The *Managed Lanes Handbook* compiles the research results of Project 0-4160 into one easy-to-use resource and provides a clear, concise, and step-wise approach to planning, designing, operating, and enforcing managed lanes, and refers the user to other pertinent documents that provide additional information on various aspects of managed lanes. Furthermore, the user-friendly preliminary screening tool provided with the handbook can assist TxDOT in identifying managed lanes strategy options very early in the conceptual planning process. Agencies across the country have seen the value in this research, and the research it represents the strong leadership role TxDOT plays in this emerging congestion management issue.

The research benefits provided to TxDOT through the handbook are numerous, the primary one being time savings to TxDOT in developing more than a dozen currently planned managed lanes projects by providing a screening tool and a single go-to document for project development guidance. Furthermore, the research provides cost-savings to TxDOT by having outreach documents readily available for use in public meetings related to managed lanes projects. Given these and other potential benefits, the development of a training workshop will facilitate the use of the handbook across the state and ensure the comprehensive and appropriate use of its resources to develop managed lanes projects in Texas.

After the incredible success of the original project, TxDOT decided to proceed with an implementation project to provide a wider opportunity for disseminating the information across the state. The implementation project originated in October 2006 and ended August 2008. The work tasks across the project timeframe included:

- Task 1 – Develop workshop materials,
- Task 2 – Plan and schedule pilot workshops,
- Task 3 – Conduct pilot workshops,
- Task 4 – Update workshop material as appropriate,
- Task 5 – Document pilot workshop activities,
- Task 6 – Plan and schedule formal workshops,
- Task 7 – Conduct formal workshops,
- Task 8 – Update workshop material as appropriate,

- Task 9 – Document formal workshop activities, and
- Task 10 – Provide TxDOT with workshop material.

This report covers tasks 6-10, performed during the second year of the implementation project.

CHAPTER 2: STATUS OF YEAR 2 TASKS

TASK 6 – PLAN AND SCHEDULE FORMAL WORKSHOPS

The implementation team, in coordination with the implementation director, scheduled five formal workshops for Year 2. The dates and locations of the workshops were as follows:

- Austin, TX: 29-30 November 2007,
- San Antonio, TX: 10-11 December 2007,
- Corpus Christi, TX: 4-5 March 2008,
- Waco, TX: 24-25 April 2008, and
- El Paso, TX: 21-22 May 2008.

TASK 7 – CONDUCT FORMAL WORKSHOPS

Typical Audience

The typical audience of the *Managed Lanes Handbook* (and corresponding workshop) is made up of TxDOT staff involved in all aspects of the development of managed lanes projects. Moreover, staff from other agencies involved in these projects, such as regional mobility authorities, metropolitan planning organizations, transit agencies, toll authorities, and municipalities, can benefit from the information contained in the handbook and taught in the workshop.

Course Materials

The complete set of workshop materials includes the following:

- participant's notebook with CD-ROM,
- PowerPoint® slides, and
- instructor's notebook.

Those items all work in combination to provide TxDOT with a complete set of material to teach the course in the future.

Participant's Notebook

The participant's notebook contains the PowerPoint slides for each of the educational modules of the workshop. Additionally, it contains supporting handouts that are related to the

material along with a CD-ROM with all of the PowerPoint slides, the *Managed Lanes Handbook*, all of the research reports produced as part of the original TxDOT managed lanes research project, the Managed Lanes Preliminary Screening Tool software application, and additional TxDOT research reports related to the subject of managed lanes. The 13 sections of the participant's notebook are:

- Module 1 – Guide to the Managed Lanes Handbook and Workshop
- Module 2 – Introduction to Managed Lanes
- Module 3 – Planning Managed Lanes Facilities
- Module 4 – Legislative Issues
- Module 5 – Public Outreach
- Module 6 – Funding and Financing Managed Lanes
- Module 7 – Managed Lanes Weaving, Ramp, and Design Issues
- Module 8 – Decision-Making Needs and Traffic Control Devices
- Module 9 – Enforcement Issues for Managed Lanes
- Module 10 – Interim Use and Incident Management for Managed Lanes
- Module 11 – Staffing and Training for Managed Lanes
- Module 12 – Monitoring and Evaluating Managed Lanes Facility Performance
- Module 13 – Interoperability Issues on Managed Lanes Facilities
- Evaluations
- Reference Material

PowerPoint Slides

The PowerPoint slides are the heart of the teaching materials prepared for this course. Some of the chapters from the *Managed Lanes Handbook* were combined into teaching modules for course presentation to reduce the duplication of material. The listing below shows how the chapters equate to the slide modules. Rather than including Chapter 3 of the handbook as a stand-alone module, each slide module contains the material from Chapter 3 that is relevant to its chapter subject.

- Module 1 – Chapter 1
- Module 2 – Chapter 2
- Module 3 – Chapter 4

- Module 4 – Chapter 5
- Module 5 – Chapter 6
- Module 6 – Chapter 7
- Module 7 – Chapter 8
- Module 8 – Chapter 9
- Module 9 – Chapter 10
- Module 10 – Chapters 11 and 12
- Module 11 – Chapter 13
- Module 12 – Chapter 14
- Module 13 – Chapter 15

A set of learning objectives for each module outlines the tasks that each participant should be able to accomplish at the end of the module. [Table 1](#) identifies the module learning objectives. Each module is composed of individual PowerPoint slides. Each slide conveys a discrete unit of information and builds upon the previous slide. [Figure 1](#) shows a typical PowerPoint slide. Each slide is branded with the name of the workshop.

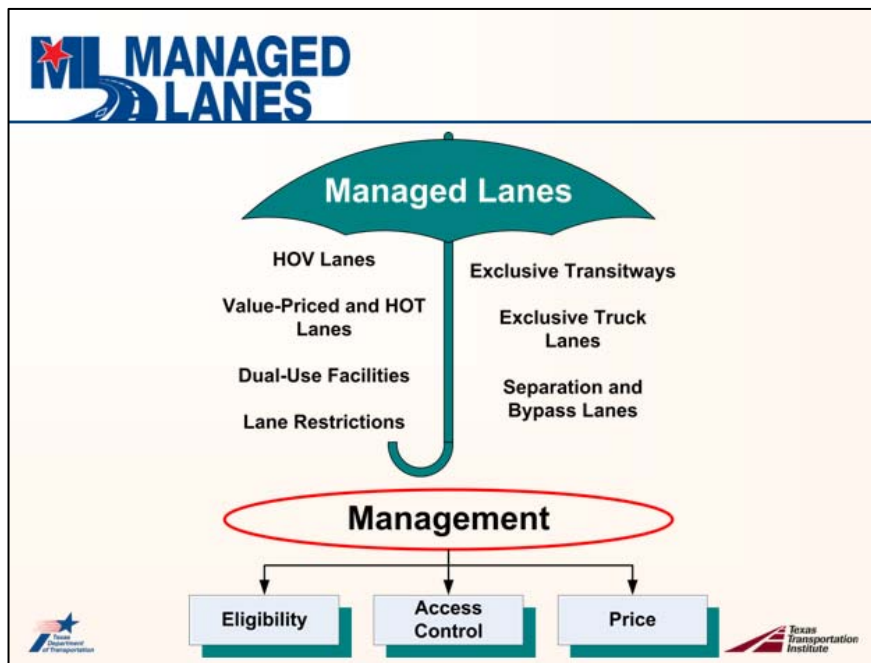


Figure 1. Typical PowerPoint Slide Used for Workshop Instruction.

Table 1. Module Learning Objectives.

Module		Learning Objectives
1	Guide to the Managed Lanes Handbook	<ol style="list-style-type: none"> 1. Understand the concept of managed lanes and the overall conceptual framework for their development. 2. Gain insight into the topics to be discussed throughout the workshop.
2	Introduction to Managed Lanes	<ol style="list-style-type: none"> 1. Be able to define managed lanes and the various operational strategies associated with the term. 2. Be familiar with managed lanes projects in operation in the United States.
3	Planning Managed Lanes Facilities	<ol style="list-style-type: none"> 1. Understand the importance of incorporating managed lanes into the planning process. 2. Understand the specific implications of the various aspects of managed lanes project planning and development of the planning process. 3. Know which aspects of managed lanes should be considered at specific phases in the planning process. 4. Understand and be able to use the Managed Lanes Preliminary Screening Tool.
4	Legislative Issues	<ol style="list-style-type: none"> 1. Be familiar with the legal issues surrounding the planning, operation, and enforcement of managed lanes projects. 2. Have an understanding of which laws govern the different types of managed lanes projects.
5	Public Outreach	<ol style="list-style-type: none"> 1. Be familiar with the common messages about managed lanes that should be communicated to the public and their relationship to project goals. 2. Know appropriate methods for communicating those messages and their potential audiences.
6	Funding and Financing Managed Lanes	<ol style="list-style-type: none"> 1. Understand the challenge of funding and financing managed lanes projects. 2. Be familiar with the types of funding and financing methods available to move managed lanes projects forward.
7	Managed Lanes Weaving, Ramp, and Design Issues	<ol style="list-style-type: none"> 1. Understand the various geometric conditions for managed lanes facilities that agencies may face. 2. Be familiar with different types of cross-sections and design considerations for terminal and access treatments that can impact operations.
8	Decision-Making Needs and Traffic Control Devices	<ol style="list-style-type: none"> 1. Be able to describe the basic information principles that govern the provision of information to roadway users. 2. Understand the information assessment process associated with managed lanes projects from the user's perspective. 3. Be familiar with good traffic control device principles for managed lanes.
9	Enforcement Issues for Managed Lanes	<ol style="list-style-type: none"> 1. Be familiar with the challenges associated with managed lanes enforcement. 2. Be able to discuss the enforcement planning and enforcement considerations in managed lanes facility design and operations.
10	Interim Use and Incident Management for Managed Lanes	<ol style="list-style-type: none"> 1. Understand and be able to discuss the operational strategies for interim use of managed lanes facilities. 2. Be familiar with the motivating conditions and considerations for interim use. 3. Know the specific implementation requirements for managed lanes interim use. 4. Understand and be able to discuss the impact of managed lanes on incident management operations. 5. Be familiar with the managed lanes considerations associated with managing incidents, including diversion issues both into and out of a managed lanes facility.
11	Staffing and Training for Managed Lanes	<ol style="list-style-type: none"> 1. Understand the staffing practices and training needs specific to managed lanes facilities. 2. Be familiar with training opportunities for staff involved in managed lanes facilities.
12	Monitoring and Evaluating Managed Lanes Facility Performance	<ol style="list-style-type: none"> 1. Be familiar with the general process for performance monitoring and evaluation of managed lanes facilities. 2. Be able to work through the specific requirements for performance monitoring and evaluation for specific managed lanes projects as put forth in the handbook.
13	Interoperability Issues on Managed Lanes Facilities	<ol style="list-style-type: none"> 1. Be able to discuss the concept of interoperability as it relates to managed lanes facilities. 2. Be familiar with the interoperability considerations when planning and developing a managed lanes project.

Instructor's Notebook

The instructor's notebook for this workshop was designed to be an easy reference guide for the workshop instructor. The front matter of the instructor's notebook details the objectives of the learning modules and the typical workshop agenda. However, the instructor's notebook primarily conveys pertinent information related to each slide used during the course.

The instructor's notes entered on the slide pages relay this information. Each note has a standard format which includes the Key Message, Details, Key Questions, and Other Information. Figure 2 shows a typical page from the instructor's notebook.

Managed Lanes Handbook Training Module 2 – Introduction to Managed Lanes

The diagram features a green umbrella with 'Managed Lanes' written on its canopy. Underneath the umbrella, several lane types are listed: HOV Lanes, Value-Priced and HOT Lanes, Dual-Use Facilities, Lane Restrictions, Exclusive Transitways, Exclusive Truck Lanes, and Separation and Bypass Lanes. Below the umbrella, the word 'Management' is enclosed in a red oval. Three arrows point from 'Management' to three boxes labeled 'Eligibility', 'Access Control', and 'Price'. The Texas Department of Transportation logo is in the bottom left, and the Texas Transportation Institute logo is in the bottom right.

Key Message:
Various operational strategies fall under the managed lanes umbrella.

Details:
Discuss how the strategies can be categorized by type of management: eligibility, access control, price, or a combination thereof.

Key Questions:
None.

Other Information:
None.

2 - 6

Figure 2. Typical Instructor's Note Page.

Additional Workshop Information

The workshop was designed to be taught in approximately 12 hours. Not every topic can be discussed in detail. It is important to remember that the handbook was also written to be a shelf reference.

Equipment Requirements

Course presentations will be delivered primarily through computerized slides projected by a liquid crystal display (LCD) projector. Presentation of the course materials requires the following equipment:

- Computer (LCD) projector with minimum 1024x768 resolution;
- Large project screen (7 ft width minimum);
- A pointing device (electronic or mechanical);
- Computer with at least: 300MHz CPU, 128 MB of RAM (256 MB if Windows XP is used), 100 MB hard-disk space available, and external mouse; and
- MS PowerPoint 2000 or later.

Workshop Results

The instructors asked attendees to fill out evaluations to provide feedback to the instructors about the quality of the workshop and the materials. The overall evaluation focused on the workshop as a whole, including objectives, teaching quality, etc. The module evaluation focused specifically on the individual modules and asked respondents to rate the quality of each module.

Overall Evaluation

The first evaluation form asked participants to answer seven general questions pertaining to the workshop. The questions, presented below, were rated on a scale of 1 to 3, with 1 representing “Yes,” 2 representing “Somewhat,” and 3 representing “No.”

[Table 2](#) shows the results of this evaluation. A total of 102 participants filled out the overall evaluation. The results show that the workshop was very well received, met the objectives, and communicated information to participants in a clear, concise, and informative manner.

Table 2. Results of Overall Workshop Evaluation.

Question	Score
1. Did the workshop meet your expectations?	1.10
2. Did the workshop description match the subject matter presented?	1.02
3. Were the workshop objectives met?	1.02
4. Was the workshop presented at the correct level of difficulty?	1.12
5. Was the information presented in an informative manner?	1.03
6. Was the overall quality and usefulness of the materials appropriately geared to providing that information?	1.10
7. Do you feel that the time spent on this course was beneficial?	1.05

Module Evaluation

The section evaluation form asked participants to rate the quality and effectiveness of the workshop modules. Each module was rated on a scale of 1 to 5, with 1 representing “Very Good,” 2 representing “Good,” 3 representing “Average,” 4 representing “Poor,” and 5 representing “Very Poor.” [Table 3](#) shows the results of the evaluation. Note that [Table 3](#) does not include a line item for the introductory materials in Module 1. The results clearly show the materials were well received and that participants rated the overall quality and information transferred with high scores.

Table 3. Results of Workshop Module Evaluation.

Module	Score
2 – Introduction to Managed Lanes	1.30
3 – Planning Managed Lanes Facilities	1.44
4 – Legislative Issues	1.53
5 – Public Outreach	1.38
6 – Funding and Financing Managed Lanes	1.60
7 – Managed Lanes Weaving, Ramp, and Design Issues	1.44
8 – Decision-Making Needs and Traffic Control Devices	1.35
9 – Enforcement Issues for Managed Lanes	1.38
10 – Incident Management and Interim Use for Managed Lanes	1.49
11 – Staffing and Training for Managed Lanes	1.69
12 – Monitoring and Evaluating Managed Lanes Facility Performance	1.49
13 – Interoperability Issues on Managed Lanes Facilities	1.44

TASK 8 – UPDATE WORKSHOP MATERIAL AS APPROPRIATE

The implementation team revised the workshop materials after each pilot and formal workshop in response to participant evaluations and comments. The team asserts that making these changes enhanced the workshop to the benefit of each district where managed lanes projects are planned.

TASK 9 – DOCUMENT FORMAL WORKSHOP ACTIVITIES

This report serves as the documentation of Year 2 activities.

TASK 10 – PROVIDE TXDOT WITH WORKSHOP MATERIAL

The final versions of all workshop materials were provided to TxDOT on a CD-ROM. The CD-ROM was formatted to play in any standard computer with no additional hardware or software necessary. The CD-ROM contains four sections as follows:

- instructor’s notebook — contains a PDF assembly of the instructor’s notebook,
- participant’s notebook — contains a PDF assembly of the participant’s notebook, along with material to be included on a CD-ROM for the participant,
- PowerPoint slides — contains all the PowerPoint slide modules and supporting materials for course instruction, and
- revised handbook chapters.

The CD-ROM also contains the technical report document page (TRDP), which covers the entire deliverable.