


Project Bulletin 4160-11B

Project 0-4160: Operating Freeways with Managed Lanes

*Authors: A. Scott Cothron, Douglas A. Skowronek, P.E., and
Beverly T. Kuhn, Ph.D., P.E.*

Enforcement Issues on Managed Lanes



A managed lane facility requires effective enforcement policies and programs to operate successfully. Strategies are employed on a managed lane facility to regulate demand, and those actions require enforcement to maintain the integrity of the facility. Enforcement of vehicle-occupancy requirements, use by authorized vehicles, or proper toll collection is critical to protecting eligible vehicles' travel-time savings and safety. Visible and effective enforcement promotes fairness and maintains the integrity of the managed lane facility to help gain acceptance among users and non-users.

Development of enforcement policies and programs ensures that all appropriate agencies are involved in the process and have a common understanding of a project and the need for enforcement. Participation from enforcement agencies, the

courts and legal system, state departments of transportation, and transit agencies is critical for enforcement success. This process begins by applying the appropriate enforcement strategy.

What We Did . . .

This bulletin provides a summary of research conducted addressing managed lanes enforcement issues. It provides an overview of enforcement issues for operating freeways with managed lanes and explores the role of enforcement through identifying the available enforcement strategies and elements of enforcement area design.

The state-of-the-practice for managed lane enforcement at various locations around the country gives insight into items to consider when developing an effective enforcement program. Lastly, this report

acknowledges that managed lane enforcement is becoming ever more dependent on technological advancements in presenting innovations in the area of automated enforcement technology, specifically, automated vehicle identification (AVI), license plate recognition (LPR), and electronic toll collection (ETC).

What We Found . . .

Enforcement procedures and design elements of managed lanes vary depending on user groups, operational parameters and application of available technologies. The enforcement strategy chosen for managed lanes is usually one of the following: routine enforcement, special enforcement, selected enforcement, or self-enforcement. Routine enforcement uses existing freeway patrols to monitor managed lanes while special

enforcement uses dedicated equipment and manpower specifically to monitor the managed lanes. Selective enforcement is a combination of the two strategies and may be used for specific events or concerns, such as the opening of a new managed lane facility or to combat high violation rates. The last enforcement strategy relies on the concept of self-enforcement. This involves promoting citizen monitoring and self-regulation by users of the managed lane and the motorists in adjacent general-purpose lanes.

Traditional enforcement on managed lanes often requires dedicated enforcement areas, which are usually located immediately adjacent to the managed lane facility and allow enforcement personnel to monitor the facility, pursue violators, and apprehend violators to issue appropriate citations. However, recent advances in automated enforcement technology may lower the number of dedicated enforcement areas needed in the future, thereby shifting the focus of design to proper placement of electronic equipment. Enforcement areas can also be classified as either low-speed or high-speed and usually by type of separation from the general-purpose lanes. Low-speed enforcement areas are associated with facilities that offer some sort of barrier separation and are usually located near entrance or exit ramps. High-speed enforcement areas are associated with non-barrier separated or buffer-separated facilities, either concurrent flow or contraflow, and are located along the managed lane mainline.

Busways, managed lanes on separate rights-of-way, and barrier-separated freeway projects usually locate low-speed enforcement areas at access points. Specific locations may include ramps, reversible lane entrances, and queue bypasses

where vehicle speeds are relatively slow, usually below 45 mph (75 kph). In the case of reversible-exclusive managed lane facilities, the geometric requirements for reversing a facility provide temporary enforcement areas within the ramp areas that serve the opposing peak-period direction.

Planners design areas to provide for monitoring, apprehension, and citing of violators and, where practicable, violator removal from the managed lane facility. The design feature of barrier-separation acts as a deterrent to potential misuse, as violators are confined in the lanes once the decision is made to enter the facility.

The following design features may be considered with slow-speed enforcement areas.

- The enforcement area should be at least 100 feet (30 meters) in length and preferably up to 200 feet (60 meters) on high-volume facilities, not including approach and departure tapers.
- The enforcement area should be at least a width of 14 to 15 feet (4.3 to 4.6 meters).
- The enforcement area should have an approach taper of 2:1 or 30 feet (9.1 meters).
- The enforcement area should have a departure taper of 10:1 or 150 feet (45.7 meters) to allow for vehicle acceleration into the lane.

High-speed enforcement area design usually involves spacing multiple areas periodically along facilities that have multiple at-grade access locations or are lacking continuous shoulders wide enough for enforcement. These areas are usually designed for monitoring traffic and apprehending violators. Most apprehension activities occur at a downstream enforcement area or location with a wide left or right shoulder. The following design

features may be considered with high-speed enforcement areas.

- The length of a high-speed monitoring area should be at least 100 feet (30 meters), not including the approach and departure tapers. For monitoring and apprehension, the preferable length is 1300 feet (396 meters).
- The enforcement area should be at least 14 to 15 feet (4.3 to 4.6 meters) in width.
- The enforcement area should have an approach taper of 115:1 and a departure taper of 80:1 or higher, or it may be controlled by general freeway criteria as required to fit in the design for proper acceleration to the design speed.
- Enforcement areas should be provided at a minimum interval of 2 to 3 miles (3.2 to 4.8 km) along the mainline managed lane facility.

Enforcement of two-way and reversible barrier-separated managed lane facilities is considered easier than enforcement of buffer-separated lanes due to limited access points. Violators may be stopped at entry and exit points where travel speeds are usually lower. A reversible facility allows enforcement personnel to monitor the facility from ramps that are not in use due to managed lane traffic moving in the opposing direction.

Non-barrier managed lanes are the most difficult to enforce due to motorists ability to enter and exit the lane at any time with relative ease. The maneuver is as simple as moving from one lane to another. Therefore, routine and consistent enforcement, whether perceived or seen by the public, is critical to managing lane violations. Figure 1 provides examples of cross sections and layouts for different types of enforcement techniques used with buffer-separated managed lanes.

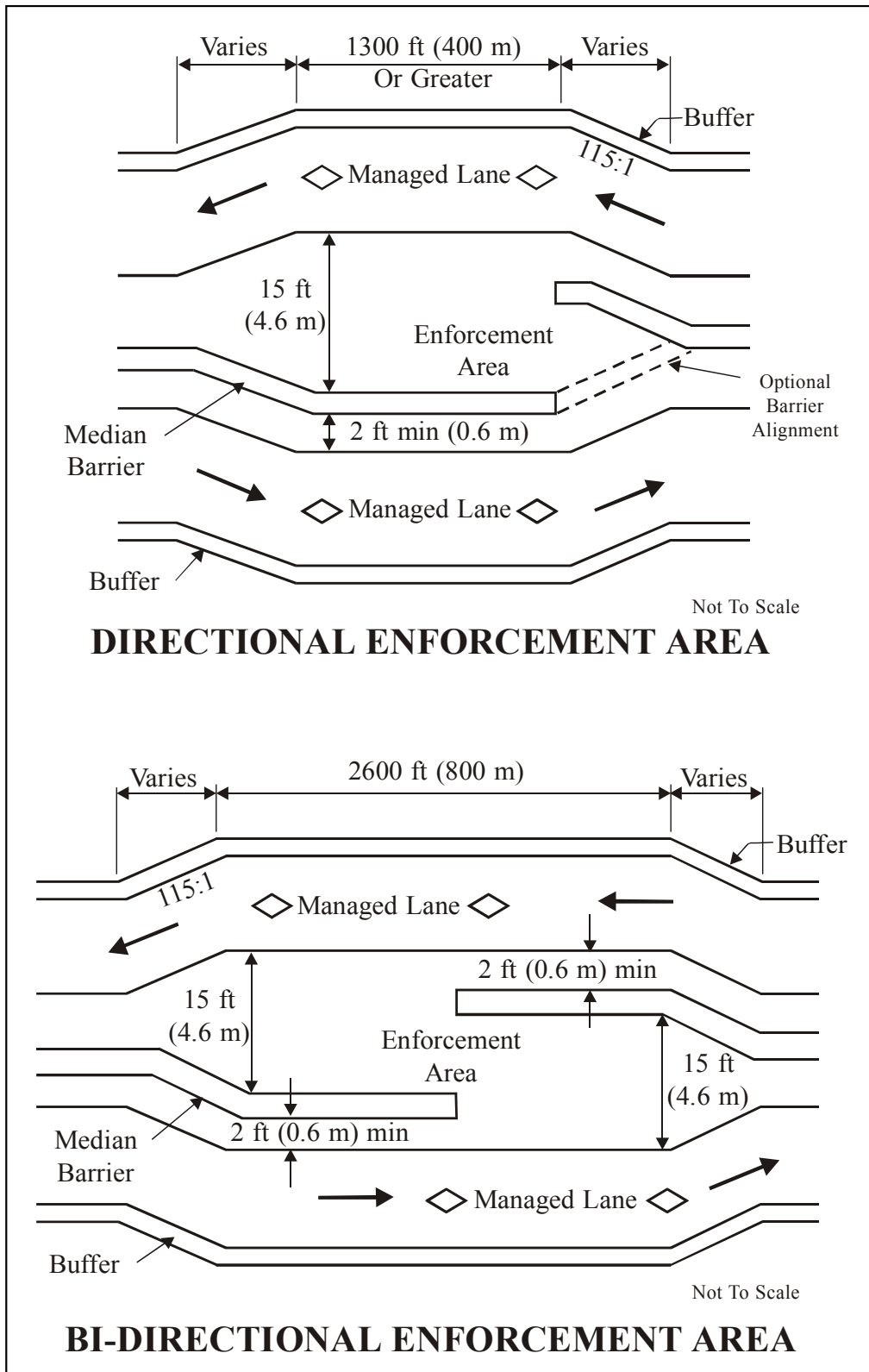


Figure 1. Examples of Directional and Bi-Directional Enforcement Area Layouts
 (Adapted from NCHRP Report 414: HOV Systems Manual).

Development of effective managed lane enforcement practices and procedures requires an understanding of existing managed lane enforcement programs and the responsible agencies. Examples of successful managed lane enforcement programs can be found in Orange County and San Diego County in California and in the Texas cities of Houston and Dallas. The “HERO” program of self-enforcement was first developed in Seattle, Washington, and has been successful as a public relations tool. The city of Minneapolis, Minnesota, is an example of an area that has had less than desirable results regarding its HOV lane enforcement program because of excessive onlooker delay from enforcement activities. An HOV lane enforcement program in the city of Toronto, Canada, offers a glimpse of the future of managed lane enforcement through the use of technology.

In California, the California Highway Patrol (CHP) has contracted their services of focused managed lanes enforcement on the SR-91 express lanes in Orange County and the I-15 express lanes in San Diego County. Prior to the CHP agreements, enforcement activities focused primarily on issues of safety and other enforcement responsibilities with managed lanes enforcement being secondary. A noticeable reduction in managed lane violations has been attributed to the dedicated CHP enforcement of these two facilities.

The transition to technology-based enforcement is evident on the I-15 express lanes in San Diego County, CA and the I-10 (Katy Freeway) and US 290 (Northwest Freeway) in Houston, TX. Electronic monitoring equipment is used in California to determine whether a solo motorist has paid the required toll to use the facility usually reserved for transponder-

equipped vehicles with two or more occupants. A similar buy-in program, known as Quickride, is available in Houston, which allows vehicles with two occupants to use the facility during time periods reserved for vehicles with 3+ occupants.

METRO police officers provide enforcement on Houston area HOV lanes. At least one METRO police officer is present in the HOV lane corridor during the hours of operation. Enforcement action is taken at specified enforcement areas that do not interfere with the flow of traffic.

The opening of the Highway 407 express toll route (ETR) has credited Toronto, Canada, as a world leader in the field of electronic tolling and enforcement. The most unusual feature of this facility is the ability to collect tolls from transponder-equipped vehicles or those with automated vehicle identification (AVI) systems, as well as cash customers, without using toll plazas. A license plate recognition (LPR) system is able to identify about 80 percent of vehicles not equipped with transponders. Digital images of the other 20 percent are reviewed by human eyes in an effort to identify vehicles for billing.

The Researchers Recommend . . .

Successful enforcement of managed lanes requires appropriate application of available resources. Enforcement strategies vary depending on the amount of enforcement required to ensure that the rules and regulations of managed lanes are maintained, ranging from continuous enforcement to the simpler process of self-enforcement. A review of the various HOV enforcement practices across the country

indicates that there are multiple variations for the enforcement of managed lanes with varying levels of success. .

Barrier-separated facilities obviously experience less violation than buffer-separated facilities due to the more restrictive nature of the design. The level of importance that responsible enforcement agencies place on managed lane facilities also dictates the restrictive nature of the facility. The enforcement practices at the operational managed lane facilities from around the country indicate the level of commitment to enforcement of several of the agencies. The most notable of these is the California Highway Patrol that has been contracted for the specific purpose of monitoring the SR-91 express lanes in Orange County and the I-15 express lanes in San Diego County.

This project also focused on the concurrent flow and barrier-separated, reversible HOV lanes in Minneapolis, Minnesota. Underutilization and excessive occupancy violations characterize HOV lane operation on both I-35W and I-394 because of limited enforcement. Previous attempts to enforce these facilities resulted in severe congestion on the general-purpose lanes due to onlooker delay. Perhaps other enforcement techniques are in order that do not interrupt the flow of traffic. This is the case with automated enforcement technology.

The use of automated enforcement technology is growing at an ever-increasing rate. This project acknowledges the use of automated vehicle identification, license plate recognition, and electronic toll collection as the way of the future concerning enforcement of managed lanes.

For More Details . . .

Related Report:

Report 4160-11, *Enforcement Issues on Managed Lanes*

Report Contacts:

A. Scott Cothron, s-cothron@tamu.edu, (817) 462-0535

Douglas A. Skowronek, P.E., d-skowronek@tamu.edu, (817) 462-0511

Beverly Kuhn, Ph.D., P.E., b-kuhn@tamu.edu, (979) 862-3558

Research Supervisors:

Beverly T. Kuhn, Ph.D., P.E., b-kuhn@tamu.edu, (979) 862-3558

Ginger Daniels Goodin, P.E., g-goodin@tamu.edu, (512) 467-0946

TxDOT Program Coordinator and Project Director:

Gary K. Trietsch, P.E., gtriets@dot.state.tx.us, (713) 802-5001

Carlos Lopez, P.E., clopez@dot.state.tx.us, (512) 416-3200

Project Website:

<http://managed-lanes.tamu.edu>

Disclaimer

The contents of this report reflect the views of the authors, who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Texas Department of Transportation (TxDOT) or the Federal Highway Administration (FHWA). This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. The engineer in charge of this task was Douglas A. Skowronek, P.E., Texas, # 80683. The engineers in charge of the overall research project were Beverly Kuhn, Texas P.E. #80308 and Ginger Daniels Goodin, Texas P.E. #64560.