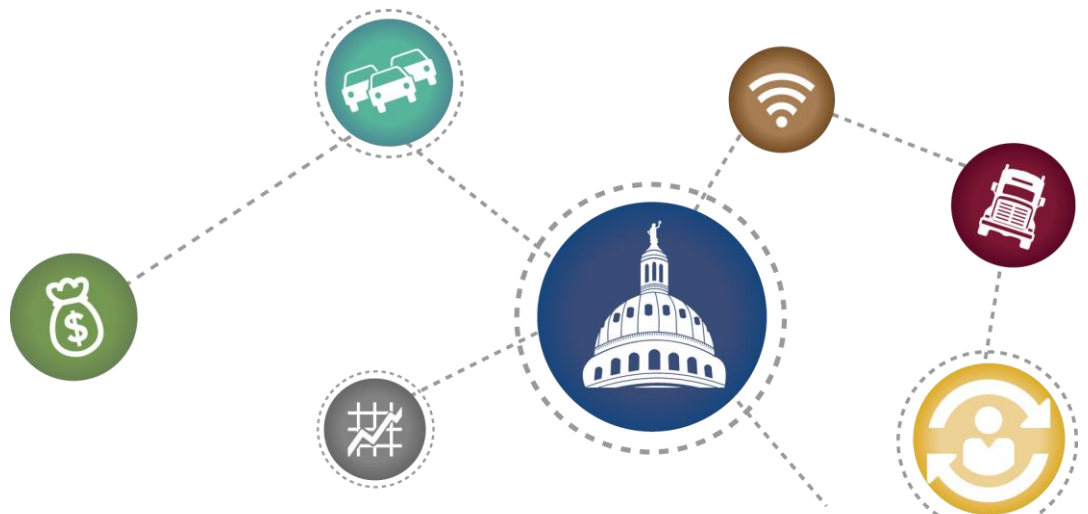


Preferential Lane Use for Heavy Trucks

Final report

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Texas A&M Transportation Institute

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Executive Summary

Freight movement is vital to the state of Texas and the nation. With several major ports, through-truck routes, and distribution centers, Texas roadways carry millions of tons of freight each year. However, congestion on Texas roadways creates delay for commercial freight vehicles, leading to increases in transportation costs for shippers, which may in turn drive up costs to consumers. In fact, the American Trucking Research Institute (ATRI) ranked Texas second in the nation for the cost of congestion to the freight industry in terms of operating costs and lost productivity (1).

One potential method for reducing the cost of congestion for freight vehicles, and possibly reducing congestion for all vehicles, is to provide trucks with alternate routes or separate (preferential) lanes that allow them to bypass congestion. This can be accomplished by developing new facilities or converting lanes and/or whole facilities for exclusive use by trucks. However, these options would require the development of new infrastructure, which could require significant funding, or the conversion of general purpose lanes to truck-only lanes, which could be problematic from a public acceptance standpoint and may affect the operations of the other lanes. There are currently very few truck-only lanes or facilities in the United States, and in most cases, these facilities were developed in very specific conditions with exceptionally high freight volumes, such as roadways serving ports. As such, existing freight volumes might not warrant consideration of truck-only lanes or facilities in many areas.

One idea that is being explored in some urban areas is to allow trucks access to managed lane facilities. Managed lane facilities typically involve general purpose lanes that are open to all vehicles but have separate (managed) lanes for special classes of vehicles. In most cases, these special classes include high-occupancy vehicles (HOVs) or transit vehicles. Furthermore, some facilities may allow a vehicle that is not considered a special class to access the managed lanes with the payment of a toll.

This report examines the issues associated with truck use of managed lane facilities. It discusses current managed lane facilities that allow for truck access and presents some findings and lessons learned from these experiments. This report also discusses some of the safety, operational, and infrastructure issues that should be considered when allowing trucks to access managed lanes.

Benefits of Managed Lanes

The underlying concept of managed lanes is that access to a congestion-free alternative, in this case the managed lanes, provides an incentive to either take a bus, carpool, or pay a toll in order to avoid traffic. This in turn can help reduce congestion on the general purpose lanes by removing vehicles from the traffic flow while providing more reliable travel times for managed lane users. Some regional entities therefore believe that allowing freight vehicles to access managed lanes can benefit their region by:

- Reducing the cost of congestion for freight operations while also potentially reducing congestion for all travelers by removing freight vehicles from general purpose traffic.

- Utilizing capacity more efficiently by allowing trucks to access managed lanes during non-congested (non-peak) periods of the day, when there may not be much demand for the congestion-free managed lanes (2).

Moreover, providing congestion-free alternatives for freight vehicles could present an economic development opportunity because shippers may decide to locate freight terminals, distribution centers, and related businesses near the managed lane facility. Shippers could also benefit from higher employee retention and productivity because drivers would have to spend less time navigating through congestion and possibly reach the maximum allowable hours of service for the day before their route is complete (2).

There are currently four managed lane facilities in the United States that allow trucks at any time of day, but truck volumes on the managed lanes themselves are relatively low. These facilities are found in Fort Lauderdale, Florida; Minneapolis–St. Paul, Minnesota; Houston, Texas; and Dallas–Fort Worth, Texas. For the first three facilities, trucks generally account for less than 2 percent of the total traffic volume in the managed lanes. However, it is unclear if these relatively low utilization rates among trucks stem from improved conditions in the general purpose lanes. In the Fort Lauderdale area, the managed lanes have helped improve traffic conditions in the general purpose lanes, which reduces the incentive for trucks to use the managed lanes. Furthermore, transportation agencies in these areas have noted that the managed lanes were built and are operated with a focus on commuters, not freight vehicles, and thus may not serve the routes and schedules used by trucks. This could also explain why trucks do not account for much of the total volume in the managed lanes. The Dallas area, on the other hand, sees close to 10 percent heavy trucks on the managed lanes on the I-635 (LBJ TEXpress Lanes) and I-820 (North Tarrant Expressway) facilities.

Several issues need to be considered by agencies looking to allow heavy trucks access to managed lanes. These include:

- **Safety**—The public has expressed concerns about the safety of allowing trucks to access managed lanes. Trucks are slower to start and stop, are less nimble in maneuvering, and often maintain maximum speeds regulated by equipment installed on the vehicle. There is evidence that significant speed differentials among vehicles can lead to more crashes. Furthermore, for most managed lane facilities, slower-moving trucks would need to use the left-most freeway lane to access the managed lane, which could cause safety and traffic flow problems near access points since trucks would have to interact with light vehicles in the passing lane of the freeway, which typically has the highest speeds.
- **Operations and Maintenance**—The operations and maintenance of the facility would likely need to be adjusted to allow use of the managed lanes by trucks. For example, the signing required to communicate access rules and restrictions for a managed lane that also includes trucks could be quite confusing and distracting to drivers due to information overload, which could result in last-minute lane changes. This is true for both the truckers

trying to use the lane and the general purpose drivers. If a metropolitan area has multiple managed lane facilities that operate with different rules for allowed vehicles, confusion among drivers might be exacerbated. Additionally, emergency response, traffic accident clearance, and enforcement activities could be affected by having trucks in managed lanes. In the event of an incident, sufficient shoulder width is needed to allow trucks to safely slow down, get out of the travel lane, and speed back up again. Trucks also create more pavement wear, so it is likely that the lane would have to be closed more frequently for pavement repair and maintenance if trucks were allowed.

- **Roadway Design**—Many roadway design features are calculated differently for trucks and cars. If a facility is being considered for truck use, many design features might have to be modified. These include but are not limited to roadway and ramp curvature, underpass/overpass height, shoulder width, pavement thickness, and crash barriers.
- **Planning**—Managed lanes are built for specific goals, generally as part of a regional transportation plan that might not include the consideration of freight vehicles as a managed lane user group. However, as time goes on and travel patterns change, these regional goals might change. If special consideration is not made for freight vehicles as part of planning and design activities, managed lanes might not be able to adequately accommodate freight vehicles after the fact.

Introduction and Background

Freight movement is vital to the state of Texas and the nation. With several major ports, through-truck routes, and distribution centers, Texas roadways carry millions of tons of freight each year. However, congestion on Texas roadways creates delay for commercial freight vehicles, and this delay can lead to increases in transportation costs for shippers, which may in turn drive up costs to consumers. In fact, ATRI ranked Texas second in the nation for the cost of congestion to the freight industry in terms of operating costs and lost productivity (1).

One potential method for reducing the cost of congestion for freight vehicles, and possibly reducing congestion for all vehicles, is to provide trucks with exclusive use of preferential lanes or routes that allow them to bypass congestion. “Preferential lane” is a general term that describes any roadway lane designated for specific vehicle types on either a full-time or part-time basis. Examples of preferential lanes include bus lanes in a downtown environment or a fully separated lane on a freeway used by HOVs. Many major cities have considered truck-only lanes, and there are several good resources available for those interested in this option (3, 4, 5, 6, 7, 8). In Atlanta, a truck-only toll lane network was considered carefully but ultimately not implemented because of negative response from the trucking industry (9).

Preferential lanes for trucks may require the development of new infrastructure, which in turn requires funding. Preferential truck lanes could also be implemented through the conversion of an existing facility, which may generate opposition from the general motoring public since it will be excluded from the facility. Truck-only facilities are therefore a rarity, and where they do exist, it is often in response to very specific conditions or exceptionally high truck traffic volumes. A 2010 report from the National Cooperative Freight Research Program identified three types of locations where truck-only lanes have been implemented in urban corridors (10):

- Congested corridors with high truck volumes and significant contribution of truck traffic to congestion (e.g., I-710 and SR 60 in Southern California).
- Major through-truck routes that go through metropolitan areas and have high truck volumes and congestion (e.g., the Mid-City Freightway in Chicago and I-5 in Seattle).
- Congested corridors providing access to major ports or intermodal facilities (e.g., I-710 in Southern California, the Port of Miami Tunnel, and the Port Connector Project in Savannah, Georgia).

Cities and regions wishing to provide preferential lanes and facilities to trucks may therefore find that existing freight volumes are not sufficient to justify the funding and outreach effort required to implement them. Therefore, another option that is being examined in urban areas is to allow trucks to access managed lane facilities. A managed lane is a type of preferential lane that is actively managed in response to travel demand conditions. Managed lane facilities typically involve general purpose lanes that are open to all vehicles but have separate (managed) lanes for special classes of vehicles. In most cases, these special classes include HOVs or transit vehicles.

Furthermore, some facilities may allow a vehicle that is not considered a special class to access the managed lanes with the payment of a toll. This is commonly known as a high-occupancy toll (HOT) lane.

The underlying concept of managed lanes is that access to a congestion-free alternative, in this case the managed lanes, provides an incentive to either take a bus, carpool, or pay a toll in order to avoid traffic. This in turn can help reduce congestion in the general purpose lanes by removing vehicles from the traffic flow while providing more reliable travel times for managed lane users. Furthermore, by incentivizing things like carpooling and transit use, managed lanes can increase the number of people moved within a corridor while reducing the number of vehicles.

In Texas, the most common managed lanes are HOT lanes. In a typical HOT lane configuration, vehicles carrying two or more people travel free in the managed lane in peak hours, while single-occupant vehicles can use the lane during peak times by paying a toll. During off-peak times, the lane may be open to all vehicles or may be tolled for all vehicles. Managed lanes can differ considerably from this basic model both in terms of who pays a toll and when. Furthermore, facilities may have different requirements for the number of occupants that qualify for access or an HOV discount. The reasons for implementing a managed lane vary by jurisdiction, but they are most commonly aimed toward providing an alternative to congestion and improving travel time reliability. As such, allowing trucks to access them is one potential method for reducing time spent by trucks in congestion.

There are several reasons to consider allowing trucks to use managed lanes. Truck use of managed lanes allows the opportunity to get the most out of the infrastructure investment made to create the lanes. Because managed lanes, and in particular HOT lanes, are meant to provide travel time savings during periods of peak congestion, they are often underutilized during off-peak periods. The question of what to do with preferential lanes during off-peak periods has faced transportation planners for many years (11). Allowing trucks to access these facilities during off-peak periods is one way to get more out of the infrastructure asset. Furthermore, providing a more reliable travel time to freight through congested urban areas may present an economic development opportunity because shippers and logistics firms might eventually locate freight terminals and related businesses near the facility. In addition, moving freight more efficiently delivers products to consumers more quickly, which also has economic impacts. Finally, the use of a managed lane by trucks may provide benefits to truck drivers by delivering a reliable, congestion-free trip. These driver benefits could carry over to freight companies through improved retention of employees.

There are some similarities in practice between having truck-only lanes and allowing trucks to use managed lanes. Both strategies remove trucks from the general purpose lanes and thus share some safety and operational issues. Managed lanes, however, may not have been built with heavy vehicles in mind and therefore have some unique considerations regarding infrastructure, public opinion, maintenance, operations, and safety. All of these issues will be discussed later in this report.

This report discusses truck access to managed lanes. It begins with an overview of why state, regional, and local transportation agencies might consider allowing trucks to access managed lanes. The report next discusses managed lane facilities that allow for truck access and those that do not. Considerations for truck access to managed lanes are then presented, followed by conclusions.

This report is not about truck-only toll lanes or truck-only lanes along freeway corridors; rather, it is about making use of existing preferential lanes and designating them truck-only during certain hours of the day. Truck lane restrictions are also not covered in this report in detail. These restrictions may prohibit trucks from specific (typically the left-most) lanes or create lanes where only trucks are allowed.

Current Practice in Truck Access to Managed Lanes

The Texas Transportation Code governs restricted lanes, including HOV lanes, exclusive lanes, and certain toll lanes (12). The code authorizes the Texas Transportation Commission to regulate the use of restricted lanes by all vehicles, including trucks. The commission has adopted rules authorizing the executive director to establish eligibility requirements for any given HOV lane (13). Trucks are allowed to access certain managed lanes and, as will be discussed in subsequent sections, are doing so on certain managed lane facilities in the state's two largest urban areas.

The Texas Transportation Code does allow heavy vehicles to use exclusive lanes on state highways as long as an “engineering and traffic study that includes an analysis of the structural capacity of bridges and pavements, current and projected traffic patterns and volume, and potential effects on public safety” has been conducted (14).

The idea of diverting other traffic to unused preferential lanes during off-peak hours has been explored in depth and offers some points to consider when deciding whether to move trucks to managed lanes in the off-peak hours. A 2000 study by the Washington State Department of Transportation (WSDOT) considered opening HOV lanes to general purpose traffic during non-peak hours (15). This study was undertaken in response to increases in traffic congestion during non-commuting times. The study considered mainly weekend use of the lanes. The authors concluded that no improvement in mobility would be gained by allowing off-peak usage of the HOV lanes by general traffic. While this study did not address truck use, many of the issues identified for passenger vehicles using the HOV lane in off-peak hours apply to truck use of the lanes as well.

The authors of the WSDOT study point out that during non-congested midday times, the majority of HOV-eligible vehicles do not use the HOV lanes, which in the region are generally paint-stripe separated lanes on the left side of the freeway. When congestion builds, even during non-commute times, use of the HOV lane does increase. They conclude that unless there is a perceived speed advantage, drivers will not select the HOV lane because of limited access points and fear of getting stuck behind a slower-moving vehicle. It is not certain that this same rationale would apply to truck drivers, but it is reasonable to assume that truckers would also not bother to enter managed lane facilities during off-peak times if there was no obvious speed advantage. While managed lanes offer a more reliable trip time, this attribute is poorly understood by drivers, who instead focus on overall trip time rather than reliability when making their route and lane selections (16).

The report also makes the important point that while a corridor may rarely experience congested conditions in off-peak hours, specific bottleneck points may experience slowdowns at all times of day. These bottlenecks may be at major interchanges or points where the number of lanes reduces. Changing HOV use policy could make conditions at those bottleneck points even worse.

For weekend use, in general, there are more midday HOV-eligible vehicles on the road on weekend days than on weekdays, but if there is no congestion in the general purpose lanes, these

vehicles may not use the HOV lanes. Thus, opening HOV lanes to trucks on weekends may take lane capacity away from potential passenger vehicle users. For HOV lanes with a single-occupant toll option (HOT lanes), this reasoning may not hold. During the week, there are more single-occupant vehicles as potential HOT lane users in midday traffic than on weekends; thus, restricting their access to the lane by allowing only trucks at these times would reduce lane capacity.

These concerns about non-truck, single-occupant vehicles using HOV lanes in off-peak hours focus more on travel demand, traffic flow, and highway capacity. The next section presents information on the truck use policy of some of the managed lanes in operation today.

According to a recent study of priced managed lanes, in 2012, there were 14 facilities in operation, another 14 under construction, and 25 in the planning stages (17). Of those in operation today, only a few allow heavy trucks. These will be discussed in more detail later, but a brief examination of some facilities where trucks are *expressly prohibited* from accessing managed lanes will provide additional context on issues to be considered. These include:

- **The state of California:** California has extensive experience with managed lanes, which include HOV and express lanes that are, as in Texas, operated by a range of state, regional, and local toll and transportation agencies. California state law prohibits commercial vehicles with more than two axles from using any of these facilities. This is accomplished through state code that defines the vehicle classes that are allowed in HOV lanes. California state code also limits the speed of trucks with three or more axles to 55 mph (California Code Section 22406). With this limit on truck speeds, introducing trucks to managed lanes could result in significant speed differentials between passenger cars and heavy trucks in the lanes, which would pose a safety concern.
- **Salt Lake City, Utah:** The Salt Lake City area has express lanes on I-15 in a buffer-separated lane. The operating rules expressly prohibit vehicles with gross vehicle weight of more the 12,000 pounds.
- **Washington State:** Washington also uses HOV vehicle eligibility rules for the managed lanes in the Seattle region. These rules limit vehicle weight to 10,000 pounds for trucks. Recreational vehicles and buses are exempt from this weight restriction and are allowed to use the lanes.
- **Other areas:** Managed lanes operated by Virginia DOT in the Washington, D.C., area prohibit trucks. The planned I-77 Express Lanes in the Charlotte, North Carolina, area will also prohibit trucks. Both of these facilities offer two lanes of travel in each direction. This type of design can alleviate some of the concerns of speed differential, but due to other concerns posed by narrow right of way, trucks are still prohibited.

Facilities Where Trucks Are Allowed

The Texas A&M Transportation Institute (TTI) research team examined four cities where trucks are allowed to access managed lane facilities. These locations, including two in Texas, are:

- Minneapolis–St. Paul, Minnesota.
- Fort Lauderdale, Florida.
- Houston, Texas.
- Dallas–Fort Worth, Texas.

Minneapolis–St. Paul

The I-394 HOT lane facility primarily serves the western suburbs of Minneapolis. In general, trucks represent between 5 to 10 percent of the vehicles on the metro-area freeway lanes, and most of that traffic is local short haul.

The I-394 HOT lanes require a MnPass toll tag for single-occupant vehicles but do not require a tag for HOVs. The current policy is to not issue an MnPass for vehicles weighing more than 26,000 pounds (18). This policy is based on the similarity between the operating characteristics of light commercial vehicles (i.e., < 26,000 pounds gross vehicle weight) and transit buses, which are allowed in the lane. The policy reflects the fact that since the facility is designed to accommodate transit buses, lighter commercial vehicles of similar size should be able to operate safely in the lanes as well. The managed lanes are generally comprised of a single lane. (The lone exception is a barrier-separated, two-lane, reversible-flow section, but regulatory signs expressly prohibit trucks from driving on that section due to its narrow lanes and access points, which were not designed to handle large trucks.) With most of the managed lane facilities featuring only one lane, officials were worried that slower-moving trucks would slow overall lane speed and possibly encourage faster vehicles to cross the lane buffer pavement markings at illegal access points in order to pass on the right. Officials were also concerned that trucks merging into the lane might create safety issues because of their size and speed.

It is technically legal, however, for a large truck to use the facility if it is carrying two passengers or more. There are no regulatory signs prohibiting this action, but Minnesota Department of Transportation staff report that the actual use is extremely small (one to two trucks per month).

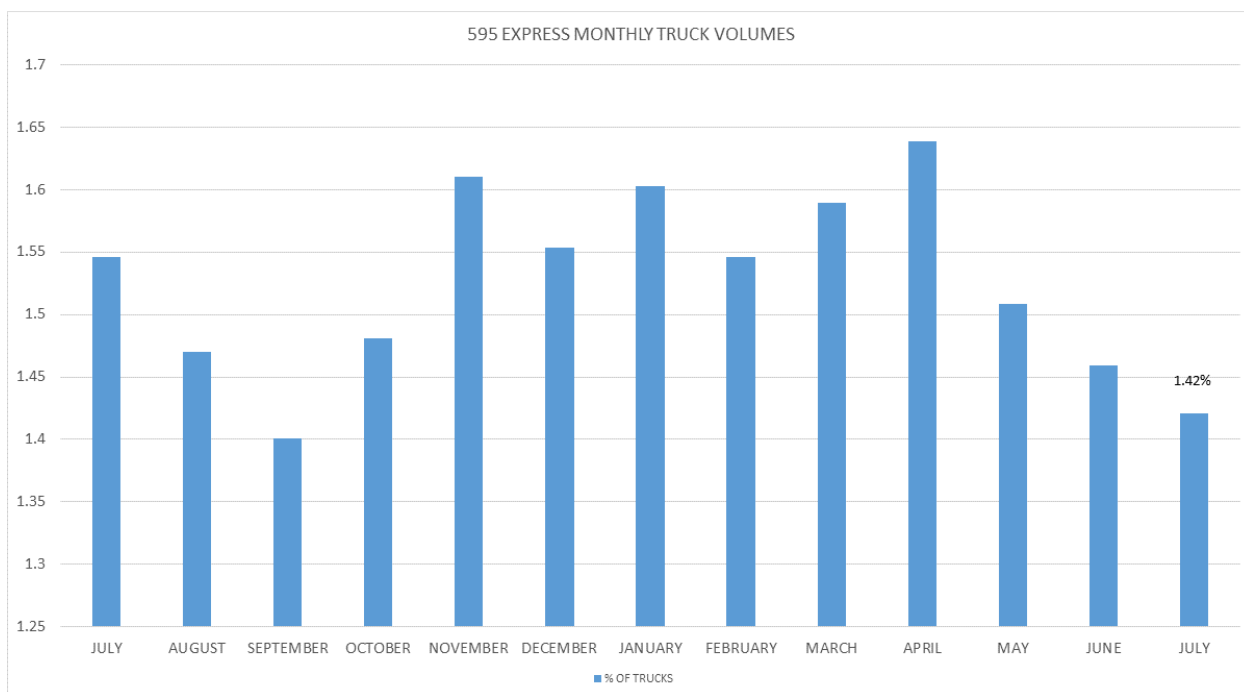
The region also features shoulder-use managed lanes where buses are allowed to travel and bypass congestion on the shoulder, and in some corridors, single-occupant passenger vehicles are allowed to pay a toll to use the shoulder lanes. To accommodate bus traffic, the pavement and other infrastructure elements, such as drainage grates, were improved during construction. As such, these shoulder-use managed lanes could accommodate heavy trucks. However, the safety and operational concerns underlying the policy to discourage truck use by not issuing MnPass transponders to heavy vehicles remain.

Fort Lauderdale

In Florida, I-595 serves as a spur that connects State Highway 869 (Sawgrass Expressway) with I-95, the Florida Turnpike, and the Port Everglades. The express lanes opened in 2014 and are comprised of three reversible lanes that operate based on a schedule. Traffic in the express lanes moves eastbound between 4 AM and 1 PM and westbound between 2 PM and 2 AM. During the weekend, all traffic in the express lanes moves eastbound only. The toll to access the facility is dynamically priced based on traffic speed in the express lanes, meaning that as speed in the lanes drops, the toll increases.

Though described in some publications as a pilot project, this project was never actually funded as a pilot, and there was no requirement in the evaluation of the project that was specific to trucks. Existing Florida legislative code allows multi-axle vehicles on express lanes, and they are expressly allowed by regulatory signs (19).

As Figure 1 illustrates, trucks generally comprise a small portion of traffic in the express lanes, at between 1 to 2 percent of total volume. This low number could be because since opening in 2014, the adjacent general use lanes have operated at free-flow conditions (Level of Service A). This removes a significant incentive to use the express lanes—bypassing congestion. The toll to use the express lanes has never risen above \$0.50 during this period because traffic speed in the express lanes has never fallen to a point that would trigger an increase in the dynamic toll price.



Source: Courtesy of K. Hall, Florida DOT

Figure 1. Truck Use as a Percentage of Total Traffic on Florida I-595 Express Lanes in 2014–2015.

The express lane route is largely used by commuters, which is why the hours of the reversible lanes favor eastbound traffic during the daytime. Schedules for freight operations at the nearby port were not considered when setting these hours of operation because the goal of the express lanes was to ease commute times for passenger vehicles.

However, the facility was constructed with consideration of trucks, and it features full 15-foot-wide lanes and 10-foot shoulders on each side. The lengths of weaving areas were extended and the horizontal curvature at entry points was adjusted to accommodate trucks. There are no lane restrictions for trucks within the express lane section—meaning they are free to use any of the three lanes.

The 595 Express Lanes intersect Florida's Turnpike west of Fort Lauderdale. Trucks traveling on the turnpike must use a ramp located in the far left lane to access the 595 Express Lanes. In 2008, however, trucks were banned from traveling in the far left lane on the turnpike. Therefore, a policy change was made for that portion of the turnpike when the 595 Express Lanes were opened to allow trucks into the left lane prior to the ramp to the 595 Express Lanes.

Houston

The Houston area has an extensive network of HOV and HOT lanes, but they are nearly all reversible and thus narrow. They were constructed on a legacy system of HOV lanes built to primarily serve transit buses. Access points in many locations require driving through a park-and-ride facility that is likely not equipped for the required turning radius or size of trucks. As such, with the exception of the Katy Freeway HOT lanes on I-10, trucks are prohibited from using HOV and HOT lanes in Houston.

The Katy Freeway HOT lanes are a new construction that features two dedicated lanes in each direction of travel with pylons that separate the HOT lanes from the general use lanes for most of the corridor. The tolls on this facility change with the time of day on a fixed schedule for passenger vehicles. For heavy trucks, the toll is a constant \$7.00 per payment point for a total of \$21.00 for a trip along the entire 11-mile section from Katy to I-610. This facility was constructed with full-width lanes and shoulders with adequate sight distances and clearances to allow heavy trucks.

According to TTI staff who monitor this facility, actual use by trucks is extremely rare—only a handful of trucks per month. This may be due to improved conditions in the general use lane since the opening of the HOT lanes. In discussions with freight experts at the Houston-Galveston Area Council, it was noted that most of the truck traffic in that section of Houston is local short haul. One official believed that constructing a managed lane along the county arterial streets that serve the Port of Houston would likely draw more freight.

Dallas–Fort Worth

In the Dallas–Fort Worth (DFW) area, new managed lanes (branded locally as TEXpress Lanes) have been constructed and are operated along I-820 (North Tarrant Expressway) and I-635 (LBJ Freeway) through a public-private partnership. Tolls are collected by the North Texas Toll Authority, with revenue being returned to the developers. The tolls on these facilities are dynamic and fluctuate with traffic volume.

The lanes were built specifically to accommodate heavy trucks in terms of geometric and pavement design. These lanes offer a discounted toll for HOVs through a mobile app associated with a toll tag account. A toll tag registered to a heavy truck could use this app to obtain a discount if multiple passengers are in the vehicle. The tolling on these facilities is done by vehicle shape, and tolls generally are three to five times those of passenger cars depending on vehicle length (20). A recent sample of traffic volume showed 9 percent of vehicles on the North Tarrant Expressway corridor were heavy trucks. Figure 2 shows a regulatory sign advising motorists of higher rates for large vehicles on this facility.



Figure 2. Regulatory sign on the North Tarrant Expressway near Fort Worth Texas
Source: Texas A&M Transportation Institute

Elsewhere in the Dallas area, the DFW Connector 114 Managed Lanes recently opened and are operated by the Texas Department of Transportation. Heavy trucks are allowed to use the facility. From July 2014–March 2016, the DFW Connector 114 Managed Lanes saw between 3 to 5 percent of traffic volume with three or more axles according to a summary prepared for the North Central Texas Council of Governments (21).

There are plans for additional managed lanes in the region that will require converting existing HOV lanes. However, these existing HOV lanes were not originally designed to accommodate heavy trucks, so trucks will be prohibited from accessing the new managed lanes once they are complete due to geometric design constraints.

Considerations for Truck Access to Managed Lanes

In its scan of managed lane facilities and associated literature, the research team identified several critical issues that should be taken into account when considering truck access to managed lane facilities. These include:

- Public perceptions of trucks in managed lanes.
- Infrastructure.
- Safety.
- Operations and maintenance.
- Planning.

The Florida Department of Transportation (FDOT) has identified similar issues as part of its managed lane evaluation and assessment efforts. Table 1 summarizes the pros and cons of allowing trucks to access managed lanes, as found in FDOT’s regional concept of operations document (22). As summarized in the previous section, the current policy of allowing trucks on I-595 was approved only because the facility was new construction and was designed to handle the larger vehicles. As such, the issues summarized in the table and discussed in this section should be taken into account when considering truck access to managed lanes.

Table 1. Pros and Cons of Allowing Trucks in Managed Lanes.

Pros	Cons
<ul style="list-style-type: none">• Increased revenue potential• More reliable travel times for freight partners in nearby port	<ul style="list-style-type: none">• Operational performance impacts• Driver expectations and comfort• Increased capital cost• Higher design standards• Complex design and operations when connecting to other express lane facilities where trucks are not allowed

Source: Adapted from (22).

Public Perception of Trucks in Managed Lanes

In general, passenger vehicle drivers prefer to travel on roads that do not have trucks on them. This conclusion is supported by several studies of managed lane users—summarized below—who cited the lack of trucks in those lanes as one of the major incentives to use them. A recent public survey on the Katy Tollway in Houston showed that one of the most frequently cited reasons people chose to pay to use the lanes, despite them providing little in terms of travel time savings, was that there were no trucks on the managed lanes (23). In many cases, this perception may be based on a belief that large commercial vehicles are inherently less safe than smaller vehicles, but it is unclear whether this perception is supported by actual crash data. It is

interesting to note that the perception of the Katy Tollway managed lanes as being free of trucks was strong, even though that facility does, in fact, allow trucks. This further illustrates how few trucks are actually using the lanes.

Likewise, in Florida, a survey of users of the I-95 Express Lanes showed that 30 percent of drivers chose the lanes because trucks are not allowed (24). A subsequent Florida study found that nearly every driver participating in that effort’s focus groups wanted trucks prohibited from the lanes (24). The majority of the focus group participants expressed a desire to have two express lanes in each direction rather than one. Drivers feared potentially being stuck behind a slow-moving vehicle while traveling on a facility with a single express lane. Furthermore, participants liked the concept of free-flow travel but were skeptical that it could be achieved regularly with only one express lane in each direction due to slow-moving vehicles. The participants also stated that they believed allowing trucks in express lanes would discourage older drivers from using the express lanes and that, in general, they felt safer in a lane without trucks.

In addition to the focus groups, FDOT conducted a stated preference survey with nearly 3000 respondents recruited from SunPass toll tag holders and postcards distributed to cash-paying customers at toll booths. The survey asked respondents to list their reasons for favoring the express lanes, and the results are shown in Figure 3. These results were used to support Florida’s policy of not permitting trucks of three or more axles to access express lanes on its turnpike system (with the exception of I-595 in Broward County) (24).

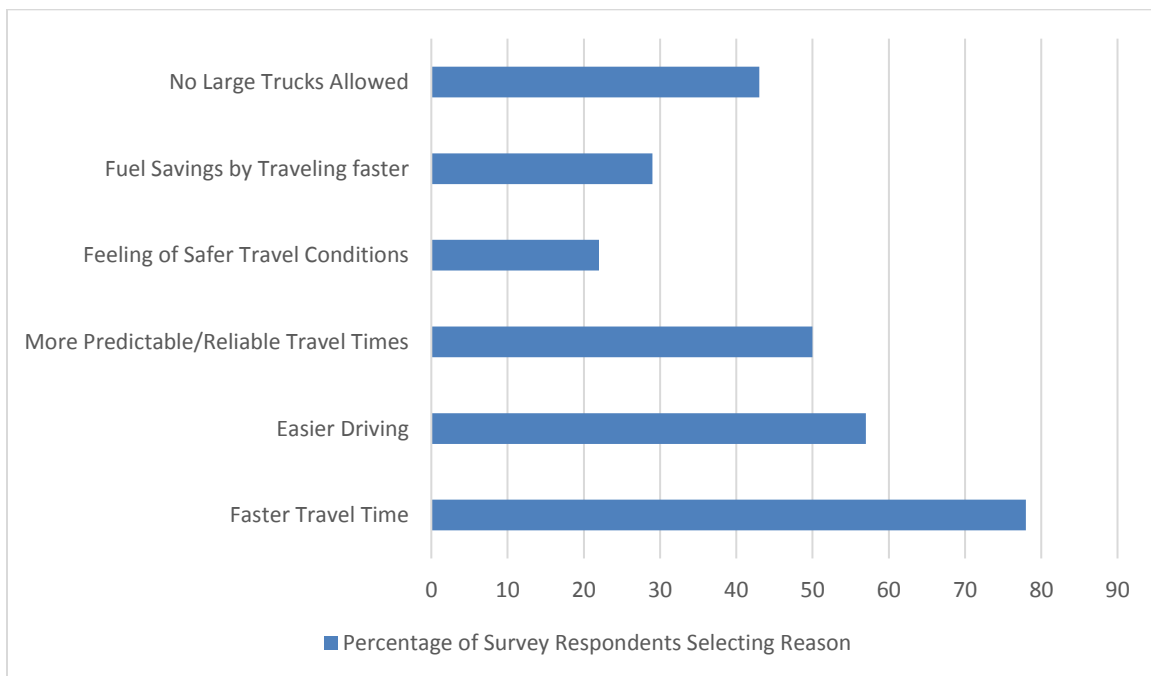


Figure 3. Results from Florida DOT Survey on Reasons Drivers Use Express Lanes.

Some managed lane operators exploit the public perception of aggressive driving, due both to congested conditions and the presence of heavy trucks, in their marketing materials (e.g., see

Figure 4). In a section on the website for the Washington, D.C., area express lanes, truck prohibition is given as a reason to choose the express lanes. It is important to note that truck drivers have been shown to not share the opinion that roads without trucks are safer (25).



Figure 4. Example Marketing Material on Aggressive Driving (26).

Infrastructure Issues

Managed lanes are often retrofitted into existing freeway cross-sections or are conversions of legacy HOV lanes. This infrastructure can present issues for truck access because these preexisting lanes and adjoining shoulders and medians may not have been designed to accommodate large trucks. Furthermore, HOV lanes may have design deviations relative to other types of roadways since they are often built on the assumption that the facility will be used by familiar drivers. As such, HOV lanes may be narrower and decision points may have more limited sight distances than lanes that are open to the general public. For example, WSDOT was approved for the following design exceptions by the Federal Highway Administration for the state's HOV lanes: narrow shoulder width (providing no breakdown lane) and shorter merge areas because lower traffic volumes are assumed in HOV lanes (15). These types of design exceptions in the original construction severely limit the ability of an agency to convert the lanes for use by heavy trucks.

Table 2 identifies the major infrastructure design elements that would need to be evaluated for determining whether a managed lane facility built for passenger vehicles could be opened to heavy trucks.

Table 2. Infrastructure Elements That Need to Be Evaluated for Adequate Design for Heavy Trucks.

Infrastructure Element	Reason for Concern
Road vertical grade	Trucks require greater distance to stop and are slower to climb hills
Roadway and ramp curvature	Trucks require greater stopping distance and less curvature to safely navigate a ramp
Access ramp acceleration lanes	Trucks accelerate more slowly and require longer acceleration lanes
Underpass/overpass height	Trucks have a taller vehicle height and require greater vertical clearance
Bridge/overpass design for weight	Structures used by heavy vehicles require different structural designs and/or materials
Pavement thickness—roadway and shoulder	Heavy vehicles impose more load on pavements
Shoulder width	Wider vehicles require more room for a breakdown lane
Crash barriers	Roadside safety hardware may need to be adjusted for roadways carrying heavy vehicles
Drainage systems; storm grate design, culvert size and design	Heavier vehicles impose more load on these systems
Entrance gates for reversible-flow lanes	Wider vehicles require more lateral clearance
Weave and merge areas	Trucks are slower to change lanes and require longer weave/merge distances
Number of lanes	Trucks are slower to accelerate and may operate at lower speeds, posing an impediment to overtaking by passenger vehicles

Safety Issues

The facilities that currently allow trucks in preferential lanes have not reported safety issues with regard to truck use. However, it is not conclusive to say that trucks do not introduce safety issues because the rate of usage by trucks on these facilities is generally so low. Other types of lane restrictions for trucks, such as having truck-only lanes or prohibiting trucks from the left-most lane, have been studied from a safety context. Truck lane restrictions have shown mixed effects on corridor safety (27). For many years, the New Jersey Turnpike has separated passenger cars from mixed-use lanes with separate multilane roadways. An analysis of crash data from the New Jersey Turnpike in 2002 showed that the mixed-use lanes (cars and trucks) had a higher crash rate than the car-only lanes and that truck-related crashes were the biggest contributor in the mixed-use lanes (28).

Crash rates are not the only metric that can be used to assess safety. Other surrogates for safety—those indices believed to predict crash rate—can also be used to assess safety. These surrogates

include things like speed differential, vehicle weaving patterns, hard braking observations, or the amount of time it takes to clear an incident (29). For example, in a policy analysis of managed lanes in Texas, TTI researchers noted that because managed lanes maintain free-flow, uncongested conditions, the chances for conflicts are minimized due to a reduction in the sudden braking of slowing traffic (30).

The main source of concern for safety is the traveling speed difference between light vehicles and heavy trucks, and there is evidence that a significant speed differential does lead to more crashes (31). Speed differential can be exacerbated in a managed lane situation because passenger cars already in the managed lane may be moving significantly faster than vehicles in the congested general use lanes. At access areas along the corridor, heavy trucks would have to first change lanes to the far left lane in order to be in a position to enter the lane. This type of lane changing in the general use lanes could cause crashes and increase congestion. Once near the access point, the truck would have to merge from near standstill congested conditions into a fast-moving managed lane. With two-lane managed lane facilities, this type of merging would be less problematic. However, many trucking companies are installing speed governors on their fleet for safety and fuel efficiency improvements. As such, even in two-lane facilities, faster-moving trucks might want to pass slower-moving trucks and move into the passing lane most often used by faster-moving passenger cars.

Other safety issues arise due to the infrastructure of the managed lane. Many lanes are separated by pylons along the length of the corridor or at the access points. Trucks, due to their size and slower lane changing, would be more likely to damage these pylons, thus posing a safety and maintenance problem due to debris in the road. Some managed lanes have signs mounted on the center concrete median, which truck mirrors may be more likely to strike. Even in facilities that have been built for trucks, such as I-595 in Florida, the breakdown lanes on shoulders must be wide enough for trucks. In areas under bridges and other structures, the vertical clearance over the shoulder must be high enough to allow a truck to park there.

From a truck driver perspective, there may be safety benefits for using a managed lane. Because these lanes provide a reliable, fast-moving trip time, their use may lessen the stress on drivers worried about on-time delivery of goods. Getting out of stop-and-go traffic could also have a positive effect on truck maintenance by reducing wear and tear on engines and brakes (32).

Operational and Maintenance Issues

In order to operate a managed lane, an agency must provide information for users through permanent signs, electronic changeable message signs, and pavement markings. The signing required to convey a complicated time-based vehicle allowance regimen on a managed lane facility can be confusing to drivers and serve as a distraction that may result in last-minute lane changes. For example, if trucks were allowed in a managed lane during the off-peak hours of 9:00 AM to 3:00 PM, the signs leading up to each access area would require information noting the times available for access, the types of vehicles allowed and prohibited, and possibly the

vehicle size limits. This additional signing must be squeezed into an approach area already cluttered with signs containing information on peak-hour use of the lane.

An evaluation of a dynamic lane assignment plan suggested that changeable message signs be used to convey the required information on managed lane access. This information would hypothetically include (33):

- Traffic congestion and backups.
- Incident events.
- Construction and lane closures.
- Detour and alternative routes.
- Average speeds and travel time.
- Speed limits.
- Managed lane entrance and exit ramps.
- Variable tolls that are based on the level of service or time of day.

Such a signing scheme could create significant information overload. This is true both for the trucker trying to use the lane and the general use drivers. Future vehicle information and mobile technologies could allow this information to be communicated to the driver in the vehicle if data from the operating agency are provided to the information provider.

Another operational consideration is emergency response time and access. First responders often use managed lanes to speed their arrival to a crash location. If trucks were allowed in the managed lane, especially a single-lane facility, this response time may be slowed. If a truck breaks down or is involved in a crash in a managed lane, incident clearance time may be affected. Sufficient shoulder width must be provided for the truck and a tow truck or service vehicle to reach the truck.

Furthermore, when a major incident affects the general use lane, traffic is often diverted to the managed lane for congestion relief. If the lane is not equipped to handle trucks, they must be provided an alternate detour route. If the lane does allow trucks, they may impede light-vehicle flow through the detour.

Traffic enforcement areas are often built along a managed lane corridor to allow a location for law enforcement to pull over speeders or HOV lane violators. If trucks were allowed in the lanes, these enforcement areas would have to be considerably larger to allow trucks adequate space to slow down to pull over and speed up to get back into traffic.

Allowing trucks to access managed lanes may also increase the cost associated with maintenance because commercial vehicles place far more wear and tear on roadway surfaces than typical passenger vehicle traffic. Removal of roadway debris may have to be scheduled more frequently

because trucks cannot maneuver around debris as easily as light vehicles can. Trucks may also stir up more debris than passenger cars and cause it to become entangled in pylons and on shoulder buffers. Several states have evaluated the effects of truck size on roadway design and maintenance for all roadways, but there are no specific resources for the impact of trucks on design and maintenance specific to managed lanes (34,35).

Planning Issues

The infrastructure limitations noted throughout this report are the main limiting factors to allowing trucks to use managed lanes, even if it is only on a part-time basis. As new managed lanes are conceived and planned, it is therefore important to design them such that they can handle trucks if warranted by policy and travel patterns.

Allowing trucks to access managed lanes could have implications for local and regional planning efforts. A key metric for planning managed lanes is the air quality improvements that the facility could generate due to reduced congestion. However, for trucks, there is a trade-off between the benefits to air quality due to reduced idling in traffic compared to the increase in emissions from traveling at high speeds (36). As such, a careful analysis of expected speeds and traffic volumes would be needed to assess the overall effects on air quality of a change in truck use policy. If changes are made to the operating policies of HOV lanes, the projected air quality improvements of the HOV lane may change, thus triggering a new National Environmental Policy Act review for the facility.

Because more metropolitan areas are moving toward establishing networks of managed lanes on a regional basis, the need for regional consistency is growing. If lane use rules are changed on one facility in a metropolitan area or region, then drivers may become confused about the rules for other facilities in the area.

Conclusions

Congestion on Texas roadways creates delay for commercial freight vehicles. This delay can lead to increases in transportation costs for shippers, which may in turn drive up costs to consumers. One potential method for reducing this cost and possibly reducing congestion for all vehicles is to provide trucks with alternate routes or separate (preferential) lanes that allow them to bypass congestion. However, there are currently very few truck-only lanes or facilities in the United States, and in most cases, these facilities were developed in very specific conditions with exceptionally high freight volumes, such as roadways serving ports. As such, existing freight volumes might not warrant consideration of truck-only lanes or facilities in many areas.

Allowing trucks access to managed lane facilities could be one option for permitting freight vehicles to bypass congestion while freeing up space in general purpose lanes. Allowing trucks to access managed lanes during non-congested (non-peak) periods of the day, when there may not be much demand for the congestion-free managed lanes, could also provide an opportunity to make better use of unused capacity.

There are currently four managed lane facilities in the United States that allow trucks at any time of day, but truck volumes on the managed lanes themselves are relatively low. These facilities are found in Fort Lauderdale, Minneapolis–St. Paul, Houston, and Dallas–Fort Worth. Truck volumes on these facilities are generally low, with trucks often accounting for less than 2 percent of the total traffic volume in the managed lanes. However, the Dallas area sees close to 10 percent heavy truck use on the managed lanes on the LBJ and North Tarrant Expressway facilities. Low rates of truck usage could be due to the fact that managed lanes themselves can reduce traffic congestion in the general purpose lanes, meaning trucks are less likely to need to take the congestion-free alternative. Furthermore, managed lanes are often built and are operated with a focus on commuters, not freight vehicles, and thus may not serve the routes and schedules used by trucks.

Several issues may need to be considered by agencies looking to allow commercial vehicles access to managed lanes. These include:

- **Safety**—The public has expressed concerns about the safety of allowing trucks to access managed lanes. Trucks are slower to start and stop, are less nimble in maneuvering, and often maintain speeds that are regulated by equipment installed on the vehicle. There is evidence that significant speed differentials among vehicles can lead to more crashes. Furthermore, for most managed lane facilities, slower-moving trucks would need to use the left-most freeway lane to access the managed lane, which could cause safety and traffic flow problems near access points since trucks would have to interact with light vehicles in the passing lane of the freeway, which typically has the highest speeds.
- **Operations and Maintenance**—The operations and maintenance of the facility would likely need to be adjusted to allow use of the managed lanes by trucks. For example, the signing required to communicate access rules and restrictions for a managed lane that

also includes trucks could be quite confusing and distracting to drivers due to information overload, which could result in last-minute lane changes. This is true for both the truckers trying to use the lane and the general purpose drivers. If a metropolitan area has multiple managed lane facilities that operate with different rules for allowed vehicles, confusion among drivers might be exacerbated. Additionally, emergency response, traffic accident clearance, and enforcement activities could be affected by having trucks in managed lanes. In the event of an incident, sufficient shoulder width is needed to allow trucks to safely slow down, get out of the travel lane, and speed back up again. Trucks also create more pavement wear, so it is likely that the lane would have to be closed more frequently for pavement repair and maintenance if trucks were allowed.

- **Roadway Design**—Many roadway design features are calculated differently for trucks and cars. If a facility is being considered for truck use, many design features might have to be modified. These include but are not limited to roadway and ramp curvature, underpass/overpass height, shoulder width, pavement thickness, and crash barriers.
- **Planning**—Managed lanes are built for specific goals, generally as part of a regional transportation plan that might not include the consideration of freight vehicles as a managed lane user group. However, as time goes on and travel patterns change, these regional goals might change. If special consideration is not made for freight vehicles as part of planning and design activities, managed lanes might not be able to adequately accommodate freight vehicles after the fact.

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