High Occupancy Toll Lanes

Potential for Implementation in the Atlanta Region

Atlanta HOT Lanes Study

Final Report

April 1, 2005

Prepared by:
Parsons, Brinckerhoff, Quade & Douglas, Inc.
A Member of the Parsons Brinckerhoff Team

Table of Contents

1 INTRODUCTION AND BACKGROUND 1

1.1 Historical Context 1
1.2 Purpose of Study 1
1.3 High Occupancy Toll (HOT) Concept 2
1.4 Atlanta Regional Issues 4

2 STUDY APPROACH 8

2.1 Steering Committee 8
2.2 Market Research 8
2.3 Policy Framework 9
2.4 Analysis of HOT Lane and Highway Performance 9

3 ANALYSIS RESULTS 20

3.1 Market Research Results 20
3.2 2030 Analysis Results at the Systems Level 22
3.3 2030 Analysis Results at the Corridor Level 26
3.4 Georgia SR 400 29
3.5 Revenues and Costs 29

4 RECOMMENDATIONS 32

4.1 Policy Recommendations 32
4.2 Implementation Recommendations 36

APPENDICES A-1

Appendix A. Summary of National HOT Lane Experience A-1
Appendix B. Illustration of Access Types B-1
Appendix C. Market Research Report C-1
Appendix D. Policy Framework D-1
Appendix E. Trip Assignment Module to Evaluate the Effect of Tolls E-1
Appendix F. Travel Demand Model Documentation F-1
Appendix G. Corridor Screening G-1
Appendix H. Additional Analysis Results H-1
Appendix I. Enforcement White Paper I-1
Appendix J. Toll Collection White Paper J-1
Appendix K. Operational Strategies K-1
Appendix L. Relevant Legislation L-1
Appendix M. Steering Committee Meeting Minutes M-1

List of Figures

Figure 1 “The Challenge”--Level of Service of General Purpose Lanes, PM Peak Hour, 2030..... 7

Figure 2 "The Opportunity"--Level of Service in HOV Lanes, PM Peak Hour, 2030..... 7

Figure 3 Analysis Process for Determining Feasibility of HOT Lanes..... 10

Figure 4 Candidate HOT Corridors..... 13

Figure 5 Managed Lane Corridors Included in 2015 Analysis, by RTP Implementation (Plan) Year 14

Figure 6 HOT Corridor Screening Process 16

Figure 7 HOT Corridors for 2030 Analysis..... 18

Figure 8 HOT Corridors for 2015 Analysis..... 19

Figure 9 Focus Group Participant Willingness to Pay per Mile for a Congestion Free Commute Trip 21

Figure 10 Focus Group Willingness to Pay per Trip for a Congestion Free Commute Trip..... 21

Figure 11 Corridor Vehicle Trips on HOT 2+ Managed Lanes 27

Figure 12 Corridor Vehicle Trips on HOT 3+ Managed Lanes 28

Figure 13 Corridor Vehicle Trips on HOT 4+ Managed Lanes 28

List of Tables

Table 1 Candidate Corridors for HOT Analysis 12
Table 2 HOT Lane Scenarios Included in 2030 and 2015 Analysis 17
Table 3 Sample Trip Time Savings in 2030 22
Table 4 Weekday Vehicle Miles Traveled on Limited Access Facilities (thousands) 23
Table 5 Percent Congested Weekday General Purpose (GP) Highway Miles 24
Table 6 Weekday Vehicle Trips on Managed Lanes (thousands) 25
Table 7 Weekday Person Trips on Managed Lanes (thousands) 25
Table 8 2030 Summary Measures on Managed Lanes (thousands) 26
Table 9 Sample Trip Time Savings on SR 400 29
Table 10 2030 HOT Scenario Potential Revenues and Costs 30
Table 11 2030 HOT Annual Operations and Maintenance Costs 31

Executive Summary

This study examined the feasibility of introducing high occupancy toll (HOT) lanes in the Atlanta road network as a method to provide safe reliable trips throughout the region and to maximize the use of the current and future high occupancy vehicle (HOV) system. The study was in response to Georgia Senate Resolution (SR) 575 that requested "a comprehensive study of the feasibility of implementing HOT lanes along the highways of the metropolitan Atlanta area and implementing HOV and HOT lanes along the GA 400 Corridor."

What are managed lanes?

Managed lanes are those portions of a roadway that have additional requirements placed on their usage in an effort to maintain reliable, uncongested flow. In Atlanta, we currently have a network of managed lanes that use occupancy as a means of managing the use of these lanes. Atlanta's HOV lanes currently require two or more individuals in a vehicle to be permitted in these lanes. However, restricting vehicle use through vehicle occupancy requirements is not the only means of managing the use of a lane; techniques such as charging a fee for using the lane, restricting use by vehicle type, and providing limited access points to the managed lanes are other methods that can be used.

How does pricing of managed lanes work?

By charging a fee and/or by limiting the types of vehicles that have access, a lane can be "managed" to maintain reliable and uncongested flow. This concept is already gaining use in some parts of the country where vehicles that do not meet the minimum vehicle occupancy requirements are allowed to use the HOV lane with the payment of a fee, leading to the term, high occupancy toll (HOT) lanes. In essence, applying the HOT concept to managed lanes is both a way of "selling" unused capacity in a managed lane and a way of controlling through user fees the volume in a managed lane in order to increase the efficiency of the highway system.

For purposes of this study, we define *HOT managed lanes* as the strategy of allowing vehicles not eligible to use managed lanes for free to do so by paying a fee.

What are the benefits of HOT managed lanes?

HOT managed lanes offer a variety of potential benefits for travelers and for transportation agencies. Such lanes:

- *Enhance transportation options*. Travelers have the opportunity to experience more reliable travel times by either meeting managed lane eligibility requirements or by paying a fee for access to the managed lane(s).
- *Improve efficiency*. Applying the HOT concept to managed lanes improves network efficiency, by filling available lane capacity through the managing of demand.
- *Guarantee trip reliability for transit*. Transit vehicles use managed lanes for free, thus they are able to benefit from the travel time and trip reliability benefits associated with such lanes. The HOT concept fits closely with the adopted strategy for transit operations on the Atlanta region's major expressways.
- *Generate revenue for HOT managed lane operation*. Fees can provide an additional source of revenue to pay for transportation improvements.

- *Contribute to variable operations and maintenance costs*. In particular, the revenues generated from HOT managed lanes can be used to pay for the incremental costs associated with the operations, enforcement and maintenance of the managed lanes themselves.

Why are we interested in HOT managed lanes?

The Atlanta region, like other similar metropolitan areas, is experiencing significant levels of congestion on its regional road network during peak periods. Atlanta Regional Commission (ARC) projections for 2030 show that even with the level of investment currently envisioned in the regional transportation plan (*Mobility 2030*), the road network will experience even higher levels of congestion….there is simply not enough funding to implement all of the actions that are necessary to provide significant improvement in network performance.

One of the major strategies proposed in *Mobility 2030* to improve regional mobility was to expand the current managed (HOV) lane system to all major limited access roads in the region. However, based on model projections, many sections of the current and proposed managed lane network in the Atlanta region will be unable to handle this expected demand. Projections for these sections indicate there will be too many carpools and transit vehicles that will want to use available managed lanes. In other sections, available capacity will exist in the managed lanes that could be used by travelers desiring a faster and more reliable trip. Applying a pricing strategy can provide reliable travel times in the managed lanes in all corridors. **Through such a strategy, the high cost investment of adding managed lanes to Atlanta's road network is protected because an uncongested level of service on these lanes can be preserved.**

This study has concluded that, even before 2030, several of the region's managed lanes will experience significant levels of congestion. For example, the managed lanes on the Downtown Connector, because of their critical function in the region's highway network, are of particular concern and are already congested in peak travel periods.

Even if the HOT concept is not implemented in the region, expected congestion in the managed lane network requires some level of solution from transportation agencies.

What did the study find?

The availability of capacity in the region's proposed managed lanes in 2030 was a starting point for determining whether HOT applications were feasible in the region, and if so, which corridors held the most promise. Different pricing strategies or scenarios for 2030 were assessed at both the system (regional) and corridor level. The three major pricing strategies included: charging single occupant vehicles a fee to use a managed lane (again assuming that uncongested level of service can be maintained); charging all vehicles with less than three occupants a fee to use the lanes; and charging all vehicles with less than four occupants a fee to use the managed lanes. All transit vehicles and carpools of more than four people would ride for free. In addition to these pricing strategies, a scenario was tested for comparison purposes that limited managed lane use only to those vehicles with three or more people; no other vehicles were allowed in the lane.

The demand for HOT managed lane use varied from one road corridor to another, depending on which pricing strategy was assumed. For example, requiring all vehicles with three or fewer occupants to pay a fee provides the greatest vehicle-carrying demand for HOT managed lanes on I-285N of all the scenarios tested. However, for I-75S and I-85S, the pricing strategy that produced the largest number of vehicle trips in the managed lanes was to charge a fee only to single occupant vehicles. This result will vary by corridor because of the different levels of

congestion on the expressway, and other characteristics associated with travel demand in each corridor.

Managed (HOV) lanes that are currently under design by GDOT could be open for operation by 2015. **These planned managed lanes are in travel corridors that this study shows hold promise for HOT operation; these planned managed lanes could very well be the first phase of HOT implementation in the region.**

Table ES-1 shows the results of the analysis for a regional HOT managed lane network under varying pricing scenarios. As shown, the pricing strategies that require single occupant vehicles and vehicles with two or fewer occupants to pay a fee to use the managed lanes serve the largest number of person trips.

Table ES-1: 2030 Summary Measures on Managed Lanes (thousands)

Evaluation Scenarios	Corridors on I-285			Corridors Inside I-285			Corridors Outside I-285		
	Vehicle Trips	Person Trips	VMT	Vehicle Trips	Person Trips	VMT	Vehicle Trips	Person Trips	VMT
Current HOV policy	333	922	2,089	456	1,274	1,585	546	1,511	3,601
HOV's only with 3 or more occupants can use lanes	234	820	1,528	347	1,223	1,266	370	1,303	2,508
Single occupant vehicles pay fee to use managed lanes	413	1,023	2,512	489	1,175	1,503	885	1,849	5,431
Vehicles with less than three occupants pay fee to use managed lane	360	994	1,960	410	1,147	1,176	715	1,684	4,176
Vehicles with less than four occupants pay fee to use managed lane	347	774	1,245	452	1,149	938	690	1,418	3,340

Note:
Managed lanes include HOV and/or HOT lanes under each scenario.
Corridor measures on I-285 include I-285 north of I-20 and I-285 south of I-20.
Corridor measures inside I-285 include I-75 N, GA 400, I-85 N, I-20 E, I-75 S, I-85 S, SR 166, I-20 W and the I-75/85 downtown connector.
Corridor measures outside I-285 include I-575, I-75N, GA 400, SR 141, I-985, I-85 N, SR 316, US 78, I-20 E, I-675, I-75 S, I-85 S, and I-20 W.

Table ES-2 shows travel time savings for selected trips with each pricing scenario. As shown, HOT managed lanes can offer savings to those willing to pay a fee to use the lanes. The savings vary according to congested travel times estimated by the regional travel demand model under each scenario.

Table ES-2: Sample Trip Time Savings in 2030

Sample Trip 2030 PM Peak Period	Time Saved in HOT Managed Lane[1]		
Vehicle Eligibility Strategy	**Single occupant vehicles pay fee to use managed lanes**	**Vehicles with less than three occupants pay fee to use managed lane**	**Vehicles with less than four occupants pay fee to use managed lane**
Midtown Atlanta to South Lake Mall	18 minutes	19 minutes	18 minutes
Airport to Midtown Atlanta	14 minutes	8 minutes	12 minutes
I-75 at I-285 to Town Center Mall	25 minutes	25 minutes	29 minutes
Alpharetta to Airport [2]	12 minutes	13 minutes	13 minutes
Perimeter Center to Town Center Mall [2]	17 minutes	25 minutes	27 minutes
Midtown Atlanta to Douglasville [2]	16 minutes	16 minutes	20 minutes
Stonecrest Mall to Airport	9 minutes	9 minutes	9 minutes
Mall of Georgia to Airport	13 minutes	23 minutes	22 minutes

1. Comparison of general purpose travel time to travel time in a HOT lane
2. HOT lane travel time includes time on general purpose lanes for portions of the corridor(s) that operate as HOV lanes where single and two occupant or less vehicles pay a fee to use the managed lane(s), respectively.

With respect to GA 400, given the requirement of SR 575 to study the need for HOV lanes in the GA 400 corridor, the study confirms that there is demand for HOV lanes in the GA 400 corridor by 2015, and found that HOT managed lanes would be used by a large number of GA 400 users. Travel ES-3 shows travel time savings for trips in the GA 400 corridor under different HOT managed lane scenarios.

Table ES-3: Sample Trip Time Savings on GA 400

Sample Trip PM Peak Period	Time saved in managed lane[1] in 2015; Single occupant vehicles pay fee	Time saved in managed lane[2] in 2030; Single occupant vehicles pay fee	Time saved in managed lane[3] in 2030; Two occupants or less vehicles pay fee	Time saved in managed lane[3] in 2030; Three occupants or less vehicles pay fee
Northbound from I-285 to Alpharetta (SR 120)	10 minutes	N/A	15 minutes	18 minutes
Southbound from McFarland Road to I-285	4 minutes	N/A	7 minutes	9 minutes

1 Comparison of general purpose travel time to travel time in a HOT lane, assuming a network of 12 HOT and 3 HOV corridors.
2 Under this 2030 scenario, there was no capacity to "sell" to single occupant vehicles on GA 400. Therefore, no HOT lanes were assumed and no travel time savings were available.
3. Comparison of general purpose travel time to travel time in a HOT lane, assuming the 2030 HOT scenario described.

While revenue generation is not the primary goal of HOT lanes, pricing users is a necessary tool to achieve the benefits of HOT operations. In order to assess the cost effectiveness of HOT operations, potential revenues were calculated based on miles traveled in a HOT corridor and the fee rate for that corridor. Requiring vehicles with less than four occupants to pay a fee to use the managed lane generates the most revenue (because it charges the most users in each HOT corridor). This is the only pricing strategy that resulted in potential revenues higher than estimated costs to implement the HOT concept at the system level. While these estimates are preliminary, it seems likely that some state subsidy may be necessary to cover the capital, operations and maintenance costs of the lane(s) at the systems level. Certain corridors under each scenario, however, do generate potential revenue that covers operations and maintenance costs of the HOT managed lane(s) in that corridor. For example, the strategy of having single occupant vehicles paying fees to use the managed lanes for I-75N and I-75S, (both outside I-285) covers the incremental capital and O&M costs associated with the managed lanes in each corridor. Further study on the corridor level (rather than the regional system) should address more detailed estimates on a corridor-by-corridor basis.

Other important findings of this study relate to consumer willingness to use HOT managed lanes. This study convened eight focus groups that were asked to complete written surveys and, for a smaller group, to participate in facilitated discussions on key aspects of HOT managed lanes. These efforts resulted in the following observations:

- For those indicating that they were willing to pay something for managed lane use, the average fee was just over $0.08 per mile. On a per work trip basis, the majority of participants stated that they would be willing to pay between $0.50 and $2.00.
- Participants would use the lane when their trip requires some level of certainty of arriving on time.

- Participants like the idea of having the lane as an option.

Issues that were identified included:

- Participants expressed skepticism that the HOT lanes can be guaranteed to be congestion free. There was a concern that HOT users would be "price gouged" in times of need.
- HOT lanes do not address the "real" issue of taking cars off the road. Some felt the region should be focusing on transit investment.
- Participants felt that people who could not afford the fee would not see the benefit.
- Some felt current HOV lanes do nothing to relieve congestion, so HOT lanes won't either.

The participants had mixed feelings about allowing HOT use in current HOV lanes. Some felt it "infringed on someone else's benefit" and that it might penalize current HOV drivers. However, others thought that current HOV lanes are underutilized and that HOT lanes would provide greater efficiency in using road space.

What are the challenges in implementing HOT managed lanes?

The major challenges facing the adoption of an HOT managed lane strategy for the Atlanta region fall into four major categories—institutional coordination, technology application, technical analysis capability and public acceptance.

Institutional: The range of responsibilities for HOT managed lane planning, development, operation, maintenance and enforcement are likely to be shared by a number of separate agencies. To ensure success of these concepts, some of which are likely to be controversial, coordination among the agencies responsible for these functions cannot be left to chance (leading to the first recommendation below). This coordination will be enhanced with the adoption of regional policies relating to a HOT managed lane network, such as desired performance standards.

There will also be a need to develop political and institutional "champions" for the HOT concept. This should be done through a collaborative effort on the part of the SRTA, GRTA, GDOT and ARC. Such champions could include political leaders, the business community or transportation advocacy groups.

Technology: The successful operation of HOT managed lanes will be dependent upon monitoring and fee collection technologies that could be evolving rapidly over the next decade. The managed lane fee collection technology should leverage existing fee infrastructure and intelligent technology infrastructure in the near term. The deployed technology needs to support the operational strategies of the managed lane facilities and specifically the pricing strategies and vehicle/user eligibility requirements. The current vehicle identification systems, including Cruise Card, are capable of supporting the desired HOT functions.

Fee collection enforcement should rely on existing video surveillance and license plate capture at each point where a fee is collected in the near term. However unless all users are registered with a fee tag or transponder, including designated free vehicles, video enforcement will not be totally effective. Long term, if all vehicles are registered, the tag or transponder or global positioning system (GPS) unit may be linked to vehicle sensors detecting the number of occupants in the vehicle and pass this information to the roadside at the fee collection point.

For both the conversion of existing managed lanes to HOT use and for the construction of new managed lanes with HOT use, enforcement of vehicle eligibility could occur either by video, through roaming enforcement patrols, or through a combination of the two. The role of

For both the conversion of existing managed lanes to HOT use and for the construction of new managed lanes with HOT use, enforcement of vehicle eligibility could occur either by video, through roaming enforcement patrols, or through a combination of the two. The role of enforcement may be greatly aided by emerging technology applications that help identify vehicle occupancy.

Technical analysis capability: This study was the first of its kind for the Atlanta region. The technical analysis relied heavily on the regional travel demand model used by ARC and on current data sources. As the HOT managed lane concept is further discussed and considered by the region's transportation agencies, the need for more detailed, corridor-level analysis will become apparent. More up-to-date data on travel behavior and traffic flows would be an important aspect of this analysis. In addition, the focus groups were very helpful in defining some of the key issues associated with the HOT managed lane concept. Additional focus groups would be very helpful in further understanding likely customer response to HOT managed lanes.

Public acceptance: Public outreach and marketing will be a critical element of success in the managed lane program, especially the HOT component. Importantly, regional public outreach and education on the managed lane concept should occur, while corridor-specific outreach efforts focus on HOT-specific projects. Regional transportation management associations and community improvement districts are also potential partners in a coordinated outreach effort. It might be desirable to have a designated central location and website for information on managed lanes. During the initial planning of a managed lane application in a corridor, a targeted public outreach campaign should be used in the corridor to inform, educate, and solicit feedback from the traveling public. This information portal should be used to convey information on the fee structure and how it will be applied on the managed lane. Such a portal can also be used during managed lane operation to support public outreach and marketing.

What are the next steps and recommended policies?

The following recommendations represent the next steps toward adopting a regional HOT managed lane strategy.

1. A formal interagency process and mechanism (such as a coordinating group) should be established to ensure coordination among the state and regional partners in regional planning, data collection, design, modeling and funding of a HOT managed lane program.
2. SRTA, GDOT, ARC and GRTA should work together to adopt a policy statement or resolution supporting the HOT lane concept as a direction that should be pursued in regional planning and investment decisions. The focus of such a policy statement should be on the mobility enhancing goal of HOT lanes. This group should also work closely with ARC to consider the concept of pricing on managed lanes in future transportation plans.
3. The coordinating group should focus on such activities as: developing a regional operating plan for HOT managed lanes, determining the pricing/vehicle eligibility requirements of HOT managed lanes, collecting data on travel behavior characteristics and managed lane use, financing strategies for covering the costs of operating and maintaining HOT managed lanes if revenues do not cover such costs, and the use of fee discounts/registration for certain types of lane users (e.g., carpools).

4. Additional data collection and feasibility studies should be undertaken on a corridor by corridor basis to refine the physical attributes and operational characteristics of each promising HOT corridor.
5. Managed (HOV) lanes that are currently under design by GDOT are in travel corridors that this study shows hold promise for HOT operation; these planned managed lanes should be the first phase of HOT implementation in the region.
6. The regional transportation agencies (including, but not limited to, ARC, GDOT, GRTA, and SRTA) that have the strongest connection to managed lanes should coordinate their public outreach efforts with respect to HOT information.

The steering committee agreed on the following policy recommendations:

1. For state roads, the GDOT should be considered the owner of the facility (for non-state roads, the local government would be responsible for the road);
   - SRTA should be considered the default service provider of all services associated with management and operation of the facility(ies);
   - The developer of a HOT lane could be an agency, private firm, or a consortium that builds a new managed lane with HOT capacity or adds incremental HOT capacity to existing HOV lanes, and possibly as well acts as the service provider;
   - The maintenance provider of the managed lane should be provided either by the owner, service provider, developer, some arrangement among them, or through an agreement with a private entity; and
   - The enforcement provider (of both fee collection and occupancy requirements) should be the responsibility of the service provider with the potential for arrangements with separate entities and/or secondary occupancy enforcement provided by the Department of Motor Vehicle Safety or an agency with similar powers.
2. For potential HOT application on managed lanes on a state highway with a private service provider, GDOT and SRTA should maintain oversight of operating and technology strategies, including, but not limited to, fee rates and eligibility requirements. For non-state roads, SRTA should provide oversight with respect to technology strategies to assure regional compatibility.
3. The annual fee revenues from the HOT use of managed lanes should first be used to cover:
   - the annual operations and maintenance (O&M) costs for HOT operations in the corridor, and then
   - the annual payments to repay most or all of the incremental capital costs of developing HOT capacity on existing or planned HOV facilities in the corridor.

   Excess revenues, if available in a corridor, should be considered generally for the following uses, in no order of priority:
   - supporting transit operations (not capital) in the corridor,
   - operations and maintenance costs for other managed lane corridors,
   - annual payments to repay capital costs for the managed lanes in the corridor [in order to provide flexibility to fast-track an HOV project using these fee revenues].

A decision-making and consultation structure should be developed for allocating excess revenues. Such consultation structure should include state and regional agencies in addition to managed lane operating agencies and should establish strategies for three possible cases: revenues do not cover the annual costs, revenues are equal to the annual costs, and revenues exceed annual costs.

4. The extent to which operations and maintenance costs are not covered by annual fee revenues, these costs should be assumed by the service provider and/or developer with possible contributions by the owner.

5. New managed lanes that are proposed in regional plans or corridor studies should be referred to as "managed lanes", not as HOV lanes. In addition, SRTA and its partner agencies should work closely with the state's Congressional delegation to modify language in the law that will allow the use of pricing on Interstate roads.

The following recommendations were discussed by the steering committee and although most agreed with the language, it was agreed that additional policy and technical work would be necessary to gain consensus.

1. One of the first issues that should be addressed by the regional transportation partners is the pricing strategy for the HOT managed lane network. SRTA recommends that this strategy be the one that best supports the adopted plan for regional transit service, which means that transit operations in all highway corridors should have the opportunity for uncongested and reliable operations. The policy of requiring single occupant vehicles to pay a fee for managed lane use does not provide such opportunities in eight corridors (although this scenario does provide the largest number of person trips served); the strategy of requiring vehicles with less than three occupants to pay a fee does not provide such opportunities in three important corridors-- the I-75/85 Downtown Connector, GA 400 and I-85N; whereas the strategy requiring vehicles with less than four occupants to pay a fee provides reliable transit travel times in all corridors.

2. Whatever pricing/vehicle eligibility strategy that will likely be necessary in 2030 should be the pricing/vehicle eligibility strategy adopted when new managed lanes open.

3. All project planning for current and expected managed lane projects should consider pricing options through the NEPA need and purpose process as appropriate.

The most important finding of this study is that portions of the Atlanta region's current and proposed HOV system is expected to be significantly congested by the year 2030. Although this study did not conduct engineering feasibility analysis of widening HOV lanes inside I-285, it did assume that two managed lanes in each direction could be built on limited access roads outside of I-285. With such managed lane capacity, the analysis shows that establishing a pricing and vehicle eligibility strategy for use of the managed lanes does provide better road utilization and presents road users (both passenger cars and transit vehicles) with an option for reliable and uncongested travel in the highway corridors.

The analysis shows that substantial numbers of drivers would pay a fee to use the managed lanes to improve their trip experience.

Glossary of terms and abbreviations

Access locations: Points of entry to and egress from managed lanes

ARC: Atlanta Regional Commission

AVC: Automatic Vehicle Classification

AVI: Automatic Vehicle Identification; used in reference to on-board units in HOT (or TOT) patron's vehicles that communicate the patron's identification with fee-collection devices

Buffer separated lane: Traffic lanes separated by a specified distance from other traffic lanes, usually delineated with pavement markings

Changeable message sign: Sign displaying one of a number of messages that may be changed or switched on or off as required.

CID: Community improvement district

Direct-merge access: As defined in the 2003 *GDOT HOV Strategic Implementation Plan*, A direct merge access point is "an opening in the HOV barriers (or skipped striping in a concurrent system) to allow motorists to enter and exit the HOV system" from the general purpose lanes.

DSRC: Dedicated short range communications

Electronic transponder: Device placed in a vehicle that identifies its use of the road and, in the case of HOT use, is linked to a payment system that charges a fee for such use.

Eligibility: In the context of this document, eligibility refers to a vehicle occupancy requirement to use a facility such as a managed lane. Eligibility is one strategy for managing the use of a facility.

ETC: Electronic Toll Collection; used in reference to automated collection of fees that links an identification device in a vehicle to an account maintained by a host computer system through communications infrastructure; tolls are charged at the host or central computer to the vehicle account based on information such as the current toll rate.

Excess fee revenues: Annual revenues remaining after payment of annual enforcement, operations and maintenance costs and incremental capital costs for HOT lanes.

GDOT: Georgia Department of Transportation

General purpose interchange: A highway interchange or ramps that can be used by any vehicle without vehicle occupancy or pricing restrictions.

General purpose lanes: Highway lanes that can be used without vehicle occupancy or pricing restrictions

GRTA: Georgia Regional Transportation Authority

Gross revenues: Annual revenues from HOT fee collection activity.

HOV: High occupancy vehicle

HOV interchanges: Ramps on highways that are only for use by HOV vehicles.

HOT: High occupancy toll; A high occupancy toll (HOT) lane allows the use, with payment of a fee, of a managed lane for drivers of vehicles that do not meet the minimum passenger occupancy requirements. By charging a fee and by limiting the types of vehicles allowed in the lane, the lane can be "managed" to maintain uncongested traffic.

Developer: An agency, private firm, or consortium that builds a new HOT lane or adds infrastructure, and other necessary requirements to collect fees, on existing HOV lanes.

"Infostructure": The technology and technical components such as vehicle sensor equipment, fee collection devices, and other Intelligent Transportation Systems equipment associated with HOT operations.

Infrastructure: The physical components necessary to implement managed lane facilities including, but not limited to, pavement, structures, access facilities, separation devices, signage, and striping.

Maintenance provider: The designated entity responsible for maintenance of specific HOT facility infrastructure and/or infostructure. Specific responsibilities may include the maintenance of pavement, separation devices, signage, revenue collection and vehicle sensor equipment, and other applicable equipment.

Managed lanes: Designated lanes such as HOV and HOT lanes where a variety of operating strategies may be employed to move traffic more efficiently. Throughout this document, the term managed lanes will be used to refer to HOV and HOT lanes in the Atlanta region.

Operations and maintenance (O&M) costs of HOT lanes: Costs associated with the following:

- Administration costs associated with fee collection, including marketing
- incident response (HERO) on the HOT lane(s) only
- both toll and occupancy enforcement and violations processing costs
- maintenance of "infostructure" (including toll collection and other ITS equipment)
- infrastructure maintenance of HOT lane(s) only.

Owner agency: The governmental agency responsible for the construction of the road that contains managed lanes, as designated by enabling legislation

Pricing strategy: The policy that sets fee levels and the criteria (either time of day/day of week or managed lane congestion level) that determines when a specific fee amount will be charged.

Public-private partnerships: Business relationship formed as a result of a public-private initiative, as defined by Georgia Senate Bill 257, OCGA Section 32-2-78 through 32-2-80, located in Appendix L

> *'Public-private initiative' means a nontraditional arrangement between the department* (of transportation) *and one or more private or public entities that provides for:*

(A) Acceptance of a private contribution to a transportation system project or service in exchange for a public benefit concerning that project or service;

(B) Sharing of resources and the means of providing transportation system projects or services; or

(C) Cooperation in researching, developing, and implementing transportation system projects or services.

Qualified transit vehicle: a transit vehicle that has registered with the appropriate entity and received a permit and transponder in order to travel on the HOT lanes.

Registration: A procedure for collecting managed lane user information, disbursing permits and transponders for facility use, and tracking usage of permitted vehicles on managed lanes.

RF: Radio Frequency; used in reference to roadside or overhead radio frequency transmit/read devices communicating with on board automatic vehicle identification units in passing vehicles

Separation treatment: The device(s) used to delineate managed lanes from general purpose lanes; examples include concrete barriers, tubular barriers (pylons), raised pavement markings, painted pavement markings, and buffer areas.

Service provider: The designated entity responsible for, at minimum, collection of fee revenues, management of toll pricing schedules and strategies, marketing HOT lane use, incident response (HERO) on the HOT lane, and enforcement of managed lanes.

SOV: Single occupant vehicle

SRTA: State Road and Tollway Authority

System-to-system interchanges: High-speed, continuous flow access between managed facilities; As defined in the 2003 *GDOT HOV Strategic Implementation Plan*, "System-to-system connections occur when two or more HOV system corridors meet. A system-to-system interchange allows a motorist on a HOV facility in one corridor to move seamlessly to an HOV facility in another corridor."

TMA: Transportation management association

Terminal slip ramp: As defined in the 2003 *GDOT HOV Strategic Implementation Plan*, "Terminal slip ramps allow at-grade access either into or out of the HOV system at the beginning or end of the HOV system to or from the general-purpose lanes."

Traffic monitoring sensors: Equipment used to gather traffic flow information such as volume and congestion levels. Possible traffic monitoring sensor technology includes loop detectors and radar systems.

1 INTRODUCTION AND BACKGROUND

1.1 Historical Context

The types of strategies transportation officials use to manage effectively the transportation system reflect the concerns and policy goals of the times in which the decisions are made. Thus, for example, during the late 1960s and early 1970s, many metropolitan areas began to promote the concept of reserving highway lanes for buses to provide a travel speed advantage for transit vehicles. Known at the time as bus lanes, in some cases, they were spectacularly successful (e.g., the Lincoln Tunnel in New York City) in providing much greater person flow capacity than that occurring in a general purpose highway lane. With the oil embargoes of the 1970s and a growing professional interest in encouraging the use of carpools and vanpools, the bus lanes were opened to multi-occupant vehicles, known simply as high occupancy vehicles (HOVs) and the bus lanes eventually became known as HOV lanes. Over time, the minimum required number of occupants per vehicle to use these lanes in most cities has decreased to only two occupants.

High occupancy vehicle (HOV) lanes have now become an important strategy for promoting regional mobility in many major metropolitan transportation systems in the U.S. The major purpose of such lanes is to provide faster and more reliable trips to carpools, vanpools, and transit vehicles by allowing them to use highway lanes dedicated for these types of vehicles. However, in many metropolitan areas, such as Houston, Seattle and Atlanta, many of the HOV lanes themselves are becoming congested, facing these regions with important questions as to how future HOV mobility will be achieved. On the other hand, forecasted volumes in some HOV lanes do not reach congested levels, thus presenting the possibility of using this unused capacity for single occupant vehicle use for a fee.

The transportation profession now considers HOV lanes that provide access to certain types of vehicles (such as carpools and transit vehicles) and that allows others access with payment of a fee to be "managed lanes." In this document, lanes that allow both types of vehicles will be called managed lanes. However, where appropriate because of the context being discussed, the report will also refer to HOT managed lanes or to the HOT concept.

1.2 Purpose of Study

The purpose of this study is to examine the feasibility of introducing the high occupancy toll (HOT) concept into the Atlanta metropolitan area's existing and proposed managed lane network, and to develop a policy framework for the development and management of such lanes. The study was undertaken in response to Georgia Senate Resolution (SR) 575 passed in 2003 that requested the Georgia Department of Transportation (GDOT) to "undertake a comprehensive study of the feasibility of implementing HOT lanes along the highways of the metropolitan Atlanta area and implementing HOV and HOT lanes along the GA 400 Corridor." Subsequent agreement with GDOT gave SRTA the responsibility for leading this collaborative study.

1.3 High Occupancy Toll (HOT) Concept

The pricing of managed lanes has been tried in several cities across the country, and many more are studying the concept. In some cities, e.g., Dallas, San Diego, and Washington D.C., such pricing has been defined as the major means of providing new capacity in the respective region's future highway network. In Minneapolis-St. Paul, for example, a recent study concluded that pricing the region's HOV lanes is the only way of maintaining a reasonable level of service on these lanes. Appendix A contains a summary of existing and planned managed lane facilities in the U.S. The following sections describe in more detail the specific characteristics of applying the HOT concept to managed lanes in the Atlanta region..

1.3.1 Definition of HOT Lanes

SR 575 requested that a study of HOT lanes be undertaken in the Atlanta region. As noted before, the term "managed lanes" is used to describe the more general strategy of better utilizing a highway lane's capacity through vehicle eligibility and/or pricing strategies. Thus, the HOT lane as described in SR 575 allows the use, with payment of a fee, of a managed lane by vehicles that do not meet the minimum passenger occupancy requirements. By charging a fee and by limiting the types of vehicles allowed in the lane, the lane can be "managed" to maintain uncongested traffic conditions. In essence, the HOT concept is both a way of "selling" unused capacity in a managed lane and a way of controlling, through user fees, the volume in a managed lane in order to best use the limited highway capacity that exists in a corridor.

1.3.2 Strategies for Managing Lane Use

Three primary strategies can be used to manage the use and operational performance of managed lanes: 1) restrict vehicle access to specific locations, 2) restrict eligibility of vehicles, and 3) use pricing or a fee structure to manage the demand for any available capacity in the lane.

The first strategy for managing lane use is to restrict access to the managed lanes at specified locations. In some cases, this might be an exclusive ramp or interchange that only eligible vehicles are allowed to use; in others, this might entail the entrance and egress of eligible vehicles into the managed lanes at specified locations along the highway (e.g., through special pavement markings). Appendix B shows different ways that managed lanes can be designed to control access.

The second strategy, referred to as vehicle eligibility, is to allow only certain types of vehicles to use the managed lane. For example, historically, carpools of two or more people (HOV 2+) have been allowed to use managed lanes in Atlanta without paying a fee. However, in at least one city, Houston, the vehicles with two people (HOV 2) are now being charged a fee because of the high demand for the managed lane, whereas those having three or more people (HOV 3+) ride free. By defining which vehicles are eligible to use the managed lane for free and those that have to pay, road managers can provide the most efficient management of the available road capacity. Another type of vehicle eligibility allows certain types of vehicles in the lane, regardless of vehicle occupancy. An example of this is a federal law that allows motorcycles in HOV lanes without meeting HOV requirements.

The third strategy is to price the use of available capacity, in other words, to apply the HOT concept to managed lanes. The fee that HOT users pay would vary according to the level of

congestion in the managed lane itself. This so-called variable pricing scheme maintains acceptable speeds for ridesharing and transit vehicles using the managed lane(s). High levels of congestion in the managed lanes will cause the fee to increase; similarly, lower levels of congestion result in lower fees. This supply-demand relationship allows the capacity of managed lanes to be utilized in the most efficient manner possible.

1.3.3 Benefits of HOT Managed Lanes

A HOT managed lane offers a variety of potential benefits both to travelers using the lane and to managers of the region's transportation system:

- *Enhanced transportation options*. Travelers have the opportunity to experience more reliable travel times by either meeting managed lane eligibility requirements or by paying a fee for access to the managed lane(s).
- *Improved efficiency*. Applying the HOT concept to managed lanes improves network efficiency, by filling available lane capacity through the managing of demand.
- *Guaranteed trip reliability for transit*. Transit vehicles use managed lanes for free, thus they are able to benefit from the travel time and trip reliability benefits associated with such lanes. The HOT concept fits closely with the adopted strategy for transit operations on the Atlanta region's major expressways.
- *Revenue generation for HOT managed lane use*. Fees can provide an additional source of revenue to pay for transportation improvements.
- *Contribution to variable operations and maintenance costs*. In particular, the revenues generated from HOT managed lanes can be used to pay for the incremental costs associated with the operations, enforcement and maintenance of the managed lanes themselves.

HOT managed lanes are expected to provide benefits to several travel markets, including:

- Transit riders
- Vanpools and carpools
- Commuters willing to pay a fee for guaranteed trip reliability and time savings
- Fire, police, and emergency responders
- Visitors to special events willing to pay a fee for guaranteed trip reliability and time savings

1.3.4 Basic Characteristics of HOT and Managed Lane Operation

Several assumptions of HOT and managed lane operations had to be made in order to conduct the analysis in this study. These assumptions were accepted by the Steering Committee as important characteristics of HOT managed lane operations, and in some cases, of all managed lane operations, whether or not HOT concepts are applied. These assumptions are presented here as desired characteristics of HOT managed lanes in the Atlanta region. They include:

- HOT users will experience a variable fee structure in which the fee changes based on different levels of congestion in the HOT lane(s).
- A minimum fee rate is assumed for the HOT lane network that will ensure cost-effective implementation of the fee concept.
- A maximum fee should be set in order to ensure that benefits of lane management are achieved. Regional HOT experience will help determine an appropriate maximum fee amount.
- Qualified transit vehicles will use any managed lane on the region's road network for free.
- Managed lanes will be operated 24 hours daily, seven days per week.
- Lane management strategies will be consistent region-wide (with the possible exception of the Downtown Connector or other areas that experience extreme congestion at some future time). This means that the fee rate and vehicle eligibility requirements will not differ from one part of the region to another, except in particular circumstances.
- The capital costs of implementing the HOT concept in managed lanes are assumed as follows: the lane infrastructure cost is incorporated into the cost of the managed lane itself. The incremental costs of applying HOT technology (e.g., sensors, enforcement technology, etc.) are considered incremental capital costs of the HOT managed lane.
- GDOT's typical cross section for managed lanes that is recommended in GDOT's HOV System Plan is assumed for all new managed lane projects in the study network. This cross section provides a phasing of managed lane design, starting with one lane in each direction, but possibly adding two or three more in each direction, if warranted.

1.4 Atlanta Regional Issues

The Atlanta region is facing significant challenges in keeping its transportation system operating at acceptable levels of performance. The latest regional transportation plan forecasts an additional 2.5 million people and 1.3 million more jobs in 2030 as compared to the year 2000. Several counties are expected to be near build-out conditions over the next 20 to 25 years. This tremendous growth will manifest itself on the transportation system with a 41% increase in vehicle miles traveled (VMT), a 52% increase in vehicle hours traveled, and a decrease of 10% in regional average speed (with average speeds in congested corridors declining even further). For both major highways and arterial roads, congestion is expected to increase significantly.

For the concept of HOT managed lanes to be consistent with the Atlanta region's overall strategy for future development of its transportation system, they must be compatible with the region's plans that relate to managed lanes. In particular, two plans are most important in assessing this compatibility---the region's adopted transportation plan and the Georgia Department of Transportation's (GDOT's) HOV system plan.

1.4.1 Mobility 2030: The Region's Transportation Plan

The Atlanta Regional Commission's (ARC's) most recent regional transportation plan is called *Mobility 2030*. The transportation strategies in *Mobility 2030* represent a $53 billion investment in the region's infrastructure and transportation services. The plan is based on the definition of five major transportation systems that are the target for cost effective investment.

One of these transportation systems is defined as "Managed/HOV Lanes". The focus of the proposed managed/HOV lanes concept is to "provide a foundation for expanded regional transit services and ridesharing." *Mobility 2030* expands the current managed/HOV lane network by extending it to the region's rapidly growing suburbs. The plan includes approximately 25 managed/HOV lane corridor projects, adding another 450 miles of managed lanes, totaling about $4.6 billion. The Atlanta region currently has approximately 90 centerline miles of HOV lanes. *Mobility 2030* recommends that any new managed lane constructed in the region be barrier-separated. These lanes are preferably also to be built within the highway right-of-way. As noted in *Mobility 2030*, "although designed for ridesharing and transit use, the flexibility in operation of the barrier-separated HOV facilities allows the option of permitting some single-occupant vehicle use during portions of the day if a toll is paid."

A "Regional Transit System" is another of the five transportation systems identified in *Mobility 2030*. This system targets investment in a variety of transit services that serve long distance regional trips. High speed, high capacity express bus service, referred to as bus rapid transit (BRT), uses the *Mobility 2030* proposed managed lanes in the most heavily traveled corridors.

The concept of HOT lanes is consistent with the region's vision of a managed lane network in the year 2030.

1.4.2 Georgia Department of Transportation's HOV Plan

In 2003, the Georgia Department of Transportation (GDOT) adopted a *HOV Strategic Implementation Plan for the Atlanta Region*, a plan for implementing HOV projects in the Atlanta region over the next 20 years. Known as GDOT's *HOV Plan*, the corridors selected for priority HOV application were selected on the basis of several criteria, including:

- *Congestion* – Average annual daily traffic (AADT) per lane had to surpass a given congestion threshold.
- *Connectivity* – A proposed HOV lane had to connect to the existing HOV system, serve urban centers, and be an important link in the regional HOV system.
- *Transit* - Current, planned or proposed transit service and complementary facilities were to be served by the HOV lane.
- *Safety/reliability* – The HOV lane should improve safety (determined through current crash rates) and provide improved trip reliability to large numbers of HOV users (determined through average annual daily traffic (AADT) volume).

The ability to construct HOV lanes given needed land and possible redesign of existing highways was another important determinant in project prioritization. Constructability was determined by:

- *Available right of way* - The amount of land needed to construct HOV lanes.
- *Typical HOV lane cross section* - The construction cost and overall difficulty of constructing the HOV lane in the existing highway corridor.

- *Bridge replacements* - The number of bridges to be replaced, construction costs, difficulty in maintaining traffic, and impacts to connecting roadways.

- *Environmental factors*- Potential impacts associated with the human and natural environment.

Importantly, the GDOT HOV Plan proposed a typical cross section for HOV lanes that included barrier separation, and sufficient width to allow the construction of additional lanes in each direction if such capacity was necessary. This study assumed that this cross section applied to limited access highways outside of I-285 would permit two lanes in each direction.

The corridors under consideration by GDOT in its HOV implementation plan are the same corridors that have served as the basis for the HOT study.

1.4.3 Regional Challenges and the Role of HOT Lanes

Even with over $53 billion in investment in *Mobility 2030*, the Atlanta region is facing a serious challenge in providing the mobility that will be required to sustain a vibrant and healthy region. This is particularly true in the region's road network, especially the major highway system. Figure 1 shows the expected levels of congestion in the general purpose lanes of the region's major highway system in the year 2030 during the afternoon peak period. Many corridors (shown in orange) are approaching capacity at level of service 'D' and several more (shown in red) are congested at level of service 'E' or 'F'. This figure represents a significant challenge to the region's transportation officials. However, Figure 2 shows that, assuming HOV lanes are available on all limited access facilities, capacity will be available in many of the region's HOV lanes. (Many of these corridors are proposed for implementation by 2030 in GDOT's *HOV Plan*.) The available capacity is sufficient in some corridors (shown in green) to allow those who desire to pay a fee to avoid the general purpose lane congestion by using the managed lanes. By allowing vehicles to pay a fee to use this available capacity, highway users will be given an option to achieve a more reliable trip, one that allows the user to bypass congested bottleneck points.

Figure 1 and Figure 2 combined perhaps represent the best rationale for providing HOT managed lanes in the Atlanta highway network.

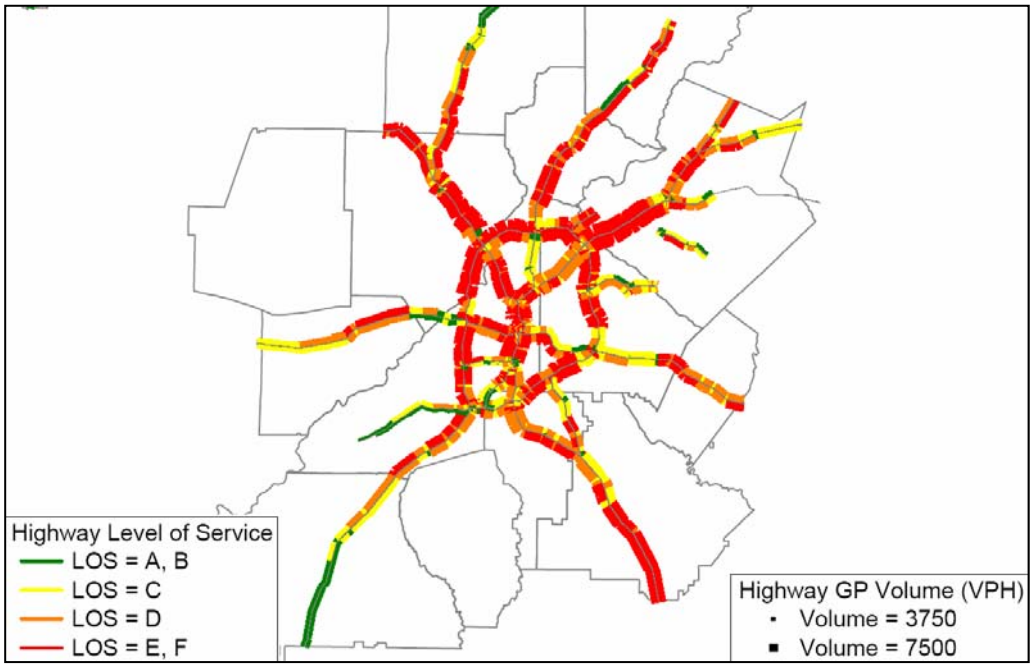

Figure 1 "The Challenge"--Level of Service of General Purpose Lanes, PM Peak Hour, 2030

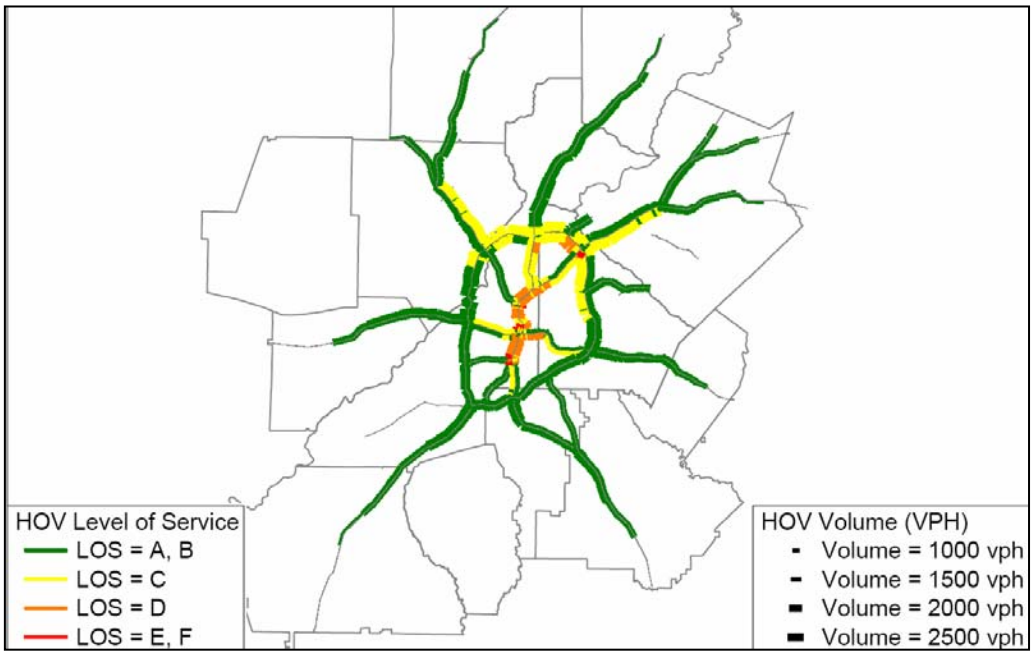

Figure 2 "The Opportunity"--Level of Service in HOV Lanes, PM Peak Hour, 2030

Note: the above figure represented projected level of service on the 2030 HOT analysis network. The HOT analysis network assumes managed lanes on all limited access facilities; while many of these facilities are included in the ARC's *Mobility 2030* regional transportation plan, the study team added managed lanes to the analysis network (where none are planned) and extended all managed lane corridors to the region's limits. See Appendix F for a description of the differences between the ARC travel demand model network and that used by the study team. Figure 5 Managed Lane Corridors Included in 2015 Analysis, by RTP Implementation (Plan) Year shows those corridors that are included in *Mobility 2030.*

2 STUDY APPROACH

This study consisted of three major tasks: 1) conduct market research on the willingness of road users to pay for managed lane use, 2) produce a *Policy Framework* that laid out the institutional, policy and management aspects of a HOT managed lane program in the Atlanta region, and 3) analyze the performance of managed lanes and highways under varying assumptions of HOT operational strategies. Throughout the study, a steering committee provided useful comments and feedback on study results and recommendations. In addition to the steering committee and market research focus groups, a website was developed to provide the general public with information about the study and educational material regarding HOT operations. After briefly describing the steering committee in Section 2.1, the rest of this section describes the approach used in completing each of these tasks.

2.1 Steering Committee

The study steering committee consisted of representatives of the following agencies:

- Atlanta Regional Commission (ARC)
- Federal Highway Administration (FHWA)
- Georgia Department of Transportation (GDOT)
- Georgia Regional Transportation Authority (GRTA)
- State Road and Tollway Authority (SRTA)

The steering committee met monthly to review study progress, discuss policy implications, and provide input. At the beginning of the study, steering committee members provided statements regarding key HOT implementation issues; and throughout the course of the study, the committee collaborated on the development of the *Policy Framework* (discussed below). Steering committee members also served as liaisons to their respective agency staff and management.

In order to involve the top management of partner agencies, study results were presented and discussed at three separate briefings for agency executives. The study team provided specialists in various aspects of HOT lane development and operations at these meetings to answer any questions relating to technical aspects of HOT lane operation.

2.2 Market Research

Eight focus groups were conducted in the fall of 2004 to solicit information on the willingness of road users to accept the concept of, and pay for, HOT managed lanes. Each of seven of these focus groups represented a different travel corridor in the Atlanta road network and one focus group represented express bus users. The selection of the participants attempted to match the regional demographic profile according to such characteristics as age, ethnicity, gender, and income. Each participant was asked to fill out a written survey that asked a series of questions relating to HOT use of managed lanes, and to participate in a conjoint survey aimed at determining a traveler's value of time and willingness to pay to save time. This approach resulted in 113 completed written and conjoint surveys. After the surveys were completed, several participants were excused, thus resulting in small groups of 7 to 8 participants who participated in a facilitated discussion of specific issues identified as being

important to HOT managed lane design and operation. Appendix C contains the Market Research Report.

2.3 Policy Framework

Any new or innovative concept to be implemented in a transportation system such as Atlanta's will likely face institutional, policy and management challenges. Recognizing this, the study produced a *Policy Framework* that represents a collaborative framework of policies, assumptions, and recommendations necessary to develop a HOT managed lane network. The *Policy Framework* was developed by focusing steering committee discussions on specific elements of such a framework and developing a consensus on parts of the *Framework* at each meeting. For those items on which a consensus could not be reached, the *Framework* suggests further efforts be undertaken to reach agreement. The *Policy Framework* includes a recommended institutional framework, desired technical characteristics, and implementation steps for a HOT managed lane system in the region. The recommendations offer flexibility for public-private initiatives, as well as HOT managed lanes developed under state or local jurisdiction. The *Policy Framework* is found in Appendix D.

2.4 Analysis of HOT Lane and Highway Performance

In order to assess the long-term performance of HOT managed lanes, the study team developed a managed lane network on all limited access facilities in (at the beginning of the study) the 10-county ARC region (note: this network added lanes to the more limited proposed managed lane network found in *Mobility 2030*). The ARC's travel demand model that was used in developing *Mobility 2030* was used for all model analysis runs in this study. In addition, the team developed a trip assignment module to evaluate the effects of tolls. Appendix E contains two memoranda describing the assignment module and its application. Both the market research findings of travelers' willingness to pay for managed lane use and recommendations from the steering committee provided input into the travel demand analysis. Performance measures such as person flow, vehicle-miles traveled, travel time savings, managed lane operational costs and revenues generated were used to compare one option versus another. Measures were developed at the system and corridor levels in order to assess potential managed lane benefits as well as the impacts on general purpose and managed lane operations.

2.4.1 Overall Analysis Logic

This study began by looking at the feasibility of HOT managed lanes in the horizon year of 2030, which corresponds to the horizon year for *Mobility 2030*. The availability of capacity in the region's managed lanes in 2030 was a starting point for determining whether HOT applications were feasible in the region, and if so, which corridors held the most promise. Different HOT managed lane strategies or scenarios for 2030 were defined in terms of vehicle eligibility and pricing. These pricing and eligibility scenarios were assessed at both the system (regional) and corridor level.

With the 2030 results under different vehicle eligibility and pricing strategies in mind, the study team then examined an intermediate year (2015) HOT scenario under the current HOV eligibility policy[1]. The purpose of the 2015 analysis was to determine which corridors show

[1] The current HOV eligibility policy designates HOV lanes for vehicles with two or more occupants, certified alternative fuel vehicles, motorcycles and emergency vehicles only.

potential for near term HOT managed lane use and to examine near term implementation steps toward a long term managed lane system. As an additional step, the study team examined what actions or activities needed to occur between now and 2015 to promote the development of HOT managed lanes in corridors with HOT potential.

Figure 3 shows how this analysis logic led to the final report.

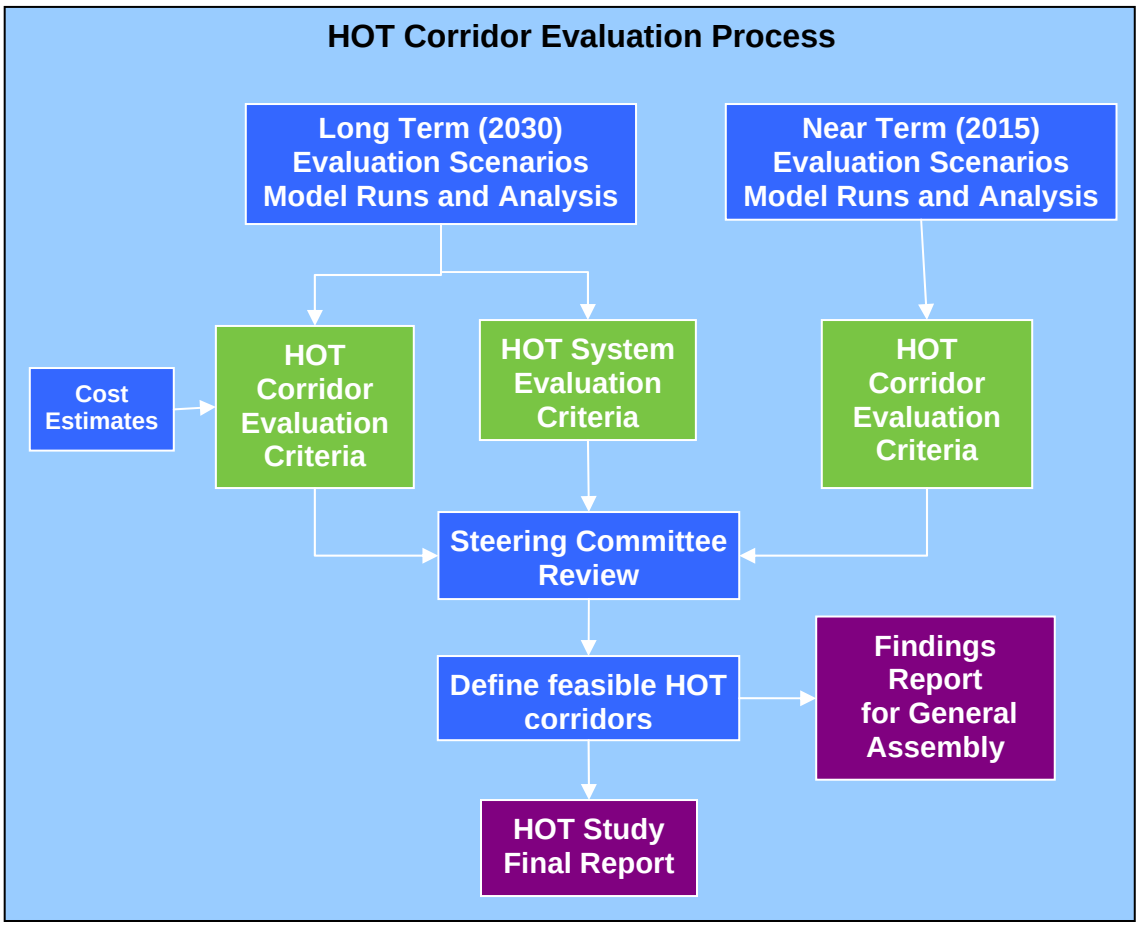

Figure 3 Analysis Process for Determining Feasibility of HOT Lanes

2.4.2 HOT Pricing and Vehicle Eligibility Scenarios

Different strategies for pricing and vehicle eligibility can be considered in a regional HOT managed lane program. Given that the primary intent of these management strategies is to manage demand in the special purpose lanes, the application of these strategies will depend on the level of demand both for free use of the lanes (for those eligible) and for use by those willing to pay a fee. The study team, in consultation with the steering committee, defined scenarios for pricing and vehicle eligibility that were considered in the 2030 analysis. Each of three HOT scenarios was analyzed for the 2030 horizon year, in addition to two base scenarios without fees. As a basis for comparison, a HOV 2+ base scenario permits only vehicles with two or more occupants to use the managed lanes for free, while a HOV 3+ base scenario permits only vehicles with three or more occupants to use the managed lanes for free. HOV 4+ was not considered by the project steering committee as a reasonable base comparison for the HOT scenarios. The three 2030 HOT scenarios are described below.

<u>HOT 2+ Scenario</u>

- HOV eligibility policy remains as it is today.
- HOVs are vehicles with two or more occupants and use the managed lane(s) for free.
- Transit vehicles and vanpools use the managed lane(s) for free.
- Where managed lane capacity is available, single occupant vehicles (SOVs) have the option to use the managed lane(s) by paying a fee.
- As an exception, the Downtown Connector operates under HOT 4+ (as described below) pricing and vehicle eligibility.
- Carpool registration is not required.

<u>HOT 3+ Scenario</u>

- Existing HOV eligibility policy changes.
- HOVs are vehicles with three or more occupants and use the managed lane(s) for free.
- Transit vehicles and vanpools use the managed lane(s) for free.
- Where there is space to "sell", 1) SOVs have the option to use the managed lane(s) by paying a fee, and 2) registered vehicles with two occupants have the option to use the managed lane by paying a reduced fee.[2]
- As an exception, the Downtown Connector operates under HOT 4+ (as described below) pricing and eligibility.

<u>HOT 4+ Scenario</u>

- Existing HOV eligibility policy changes.
- HOVs are vehicles with four or more occupants and use the managed lane(s) for free.
- Transit vehicles and vanpools use the managed lane(s) for free.
- Where there is space to "sell", 1) registered[2] vehicles with two or three occupants have the option to use the managed lane by paying a reduced fee; and 2) all other vehicles have the option to use the managed lane(s) by paying a fee.
- Registration[2] by travelers in HOVs and vehicles with two or three occupants that want a discounted fee for using the managed lane is required.

---

[2] The HOT 3+ and HOT 4+ scenarios assumed registration rates and applied fee discounts accordingly. The HOT 3+ scenario assumed that all vehicles with 2 occupants registered, while the HOT 4+ assumed rates varied by number of occupants. Further study should explore the implementation and impacts of registration policies.

2.4.3 Candidate HOT Managed Lane Corridors

The set of candidate corridors consisted of all limited access facilities in the 10-county ARC region. For purposes of analysis, I-285 and I-20 were the dividing points for candidate corridors. Thus, for example, I-75 north (I-75N) outside of I-285 was considered a candidate corridor, as was I-75 south (I-75S) outside of I-285; I-75 north and I-75 south of I-20 *inside* of I-285 were two more candidate corridors. I-285 itself was divided into a segment north of I-20, and a segment south of I-20. Using this approach, the study team identified 24 candidate highway corridors, shown in Figure 4 and listed in Table 1, for potential HOT managed lane application in 2030. For the 2030 analysis, these corridors (and the potential for HOT managed lanes) were assumed to extend to the Atlanta region's boundaries (and only on the limited access highway portions of the corridor).

The analysis for 2015 included only those corridors for which managed lanes had been identified and defined in Atlanta's regional transportation plan for implementation by 2015. Two exceptions were made: the I-75N managed lane (to be implemented by 2025 according to the plan) and the I-75S managed lane (to be implemented by 2020 according to the plan) were included in order provide managed lane termini at logical locations for HOT use. As can be inferred from this discussion, the 2015 analysis managed lanes were thus more limited in extent than those assumed for the 2030 analysis. Figure 8 shows the 2015 HOT candidate corridors.

The options for implementing the HOT concept in corridors where HOV lanes already exist are more restricted than where new managed lanes can be constructed. Except for a portion of I-85N, all existing HOV lanes are inside I-285. The study assumed that the addition of new lanes on existing highways inside of I-285 is infeasible; therefore, the analysis assumed two managed lanes (one in each direction) inside I-285. To make sure that limited capacity was not a defining factor for HOT demand outside of I-285, the study assumed that four managed lanes (two lanes in each direction) could be placed in each limited access highway right of way.

Table 1 Candidate Corridors for HOT Analysis

CORRIDORS ON I-285 (4 lanes)
I-285 N (of I-20)
I-285 S (of I-20)
CORRIDORS INSIDE I-285 (2 lanes)
I-75 N
SR 400
I-85 N
I-20 E
I-20 W
I-75 S
I-75/I-85 (Downtown Connector)
I-85 S
SR 166 (Lakewood Fwy)

CORRIDORS OUTSIDE I-285 (4 lanes)
US 78
I-575
SR 316
SR 141
I-75 N
SR 400
I-85 N
I-20 E
I-20 W
I-75 S
I-85 S
I-985
I-675

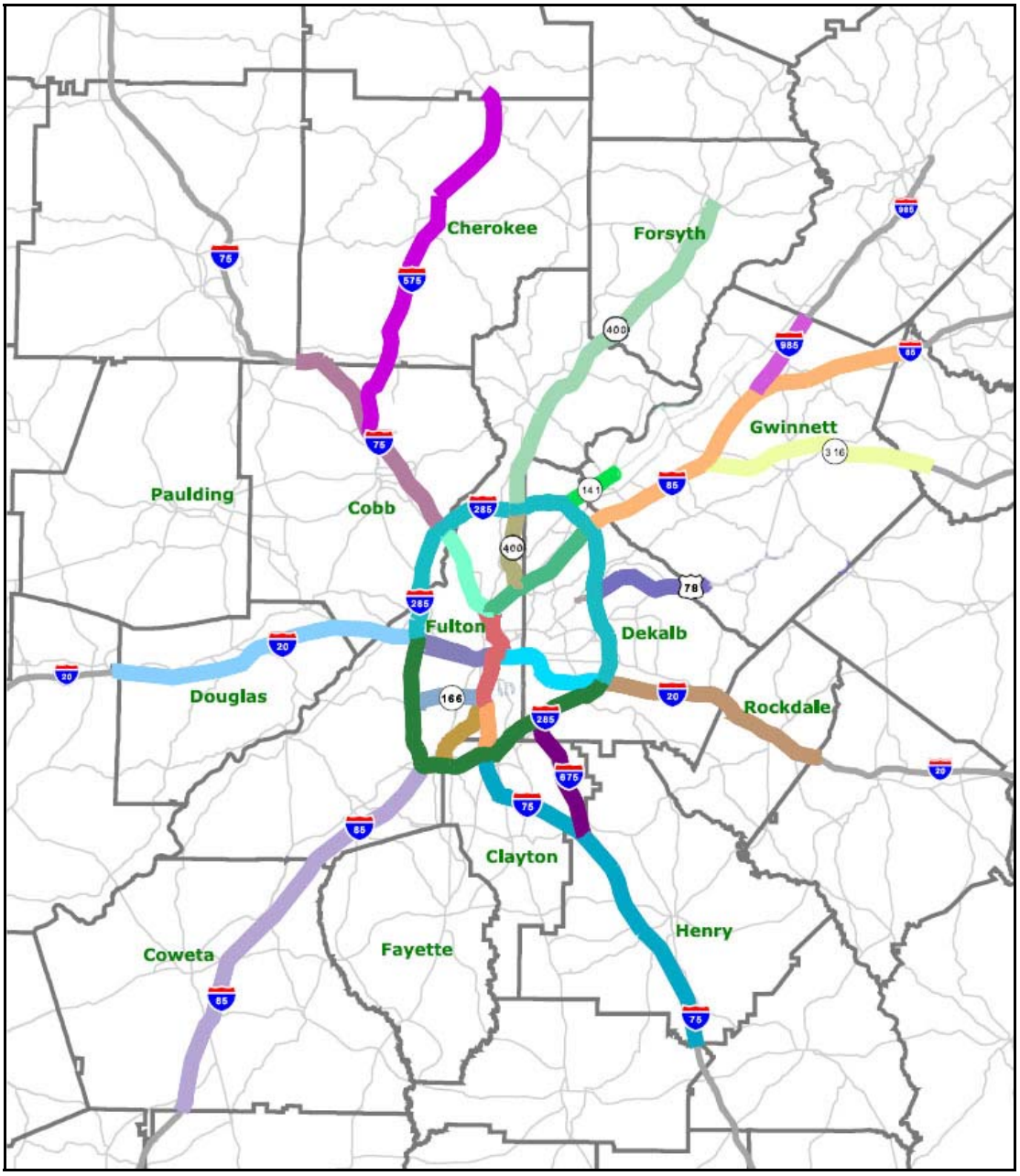

Figure 4 Candidate HOT Corridors

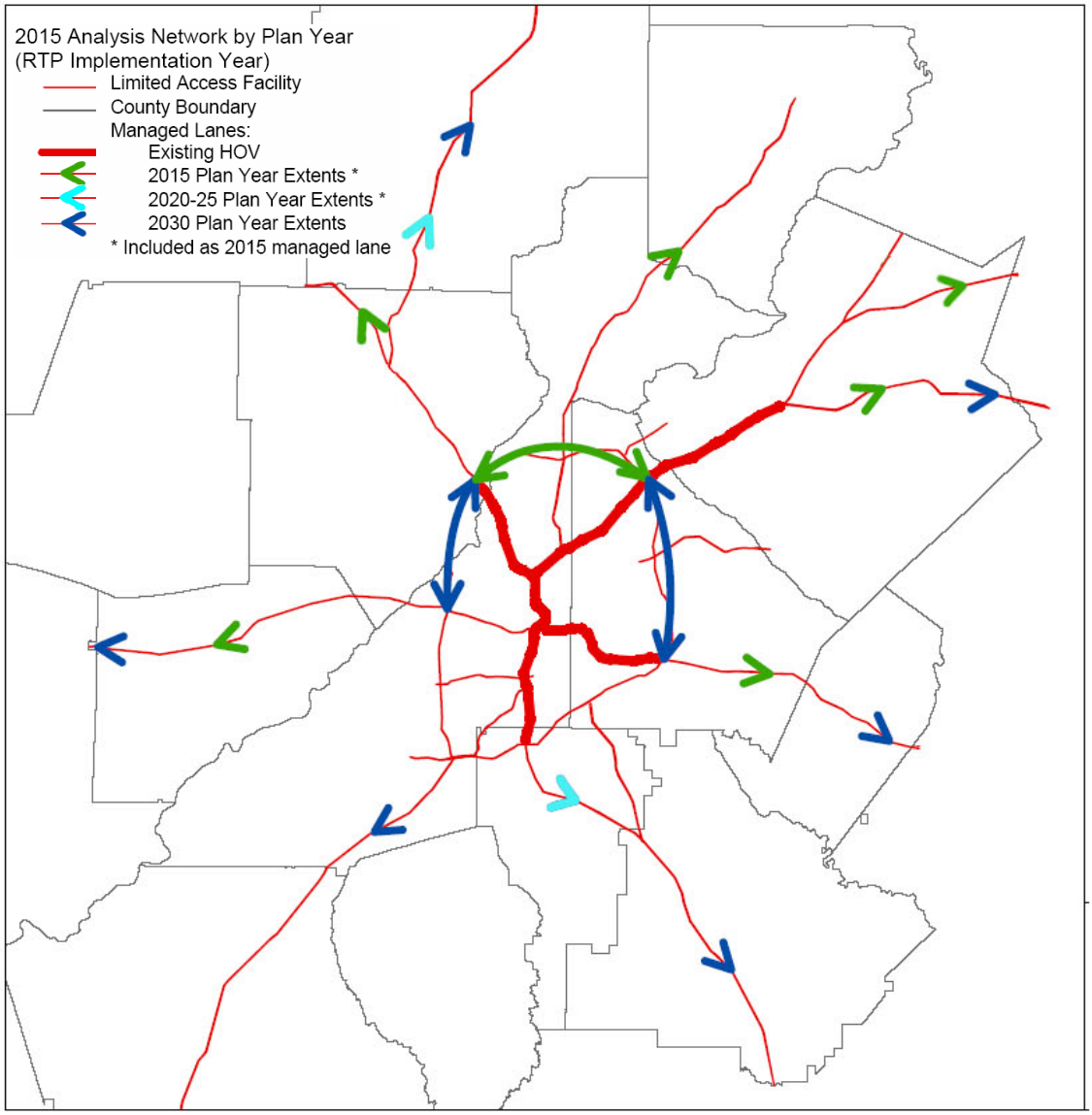

Figure 5 Managed Lane Corridors Included in 2015 Analysis, by RTP Implementation (Plan) Year

Figure 5 shows the managed lanes in the 2030 RTP, by recommended implementation year (plan year). Note that while the 2015 analysis used the RTP as a basis for corridor extents, the 2030 HOT analysis assumed managed lanes extended to the region's boundaries, as indicated in Figure 4. Appendix F contains a detailed description of the differences between the ARC *Mobility 2030* travel demand model network and the 2030 HOT analysis network.

2.4.4 Corridor Screening Process for HOT Feasibility

The analysis began first by screening candidate corridors with respect to certain criteria. Two levels of corridor screening occurred. A first level modeled two managed lanes (one lane in each direction) on all limited access facilities. Based upon steering committee input and preliminary analysis results, a second screening effort assumed two managed lanes inside of I-285 and four managed lanes (two lanes in each direction) outside of and on I-285. Figure 6 shows the screening process and criteria. The first criterion (Box 1) was that the general purpose lanes must operate at a level of service of C or worse, in other words, there was congestion in the corridor. This criterion indicated that managed lanes might offer travel benefits to users. The second criterion (Box 2) stated that sufficient space was available in the managed lanes to "sell" for HOT use. A threshold of 1650 vehicles per hour per lane (vphpl) in the HOV lane was used as the maximum value that would represent uncongested conditions on the HOV lanes. Levels above this were assumed to indicate congested conditions for HOV users. Managed lanes with demand at least 20% below this threshold (or 1320 vphpl) were assumed to have sufficient capacity to "sell" to HOT customers. The third criterion (Box 3) was that sufficient travel demand (500 vphpl) existed for a managed lane to justify building such a lane in the highway corridor.

I-85N inside of I-285 is an example of how this screening process resulted in a determination of potential feasibility. Under both the HOT 2+ and HOT 3+ scenarios, I-85N failed to meet the criterion for "available capacity to sell" (Box 2 of Figure 6), and was therefore modeled as an HOV lane without fees under both the HOT 2+ and HOT 3+ scenarios. That is, without fees, under both the HOV 2+ and HOV 3+ base scenarios, HOV demand on I-85N is at or near capacity inside the perimeter. However, applying the HOV 4+ strategy on I-85N inside I-285 provided sufficient capacity to "sell" to potential HOT lane users.

All corridors in all vehicle eligibility and pricing scenarios met the criteria for "low levels of service" at critical points on the general purpose lanes (Box 1 of Figure 6), as well as "sufficient demand to justify the investment in a managed lane" (Box 3 of Figure 6). Appendix G includes detailed corridor screening results.

Based upon steering committee input, the same vehicle eligibility and pricing strategies were applied to all corridors in the region for each scenario, with the exception of the Downtown Connector. The Downtown Connector is so crucial to connectivity within the region and has such severely congested HOV lanes that it was decided to apply the HOT 4+ strategy to this portion of the network in every scenario. As shown in Table 2, and including the Downtown Connector, the screening criteria resulted in 17 HOT corridors and 7 HOV corridors for the HOT 2+ scenario. The HOT 3+ scenario had 22 HOT corridors and 2 HOV corridors. The HOT 4+ scenario had 24 HOT corridors; in this case, every corridor, including the Downtown Connector, would have the HOT 4+ pricing and vehicle eligibility scheme.

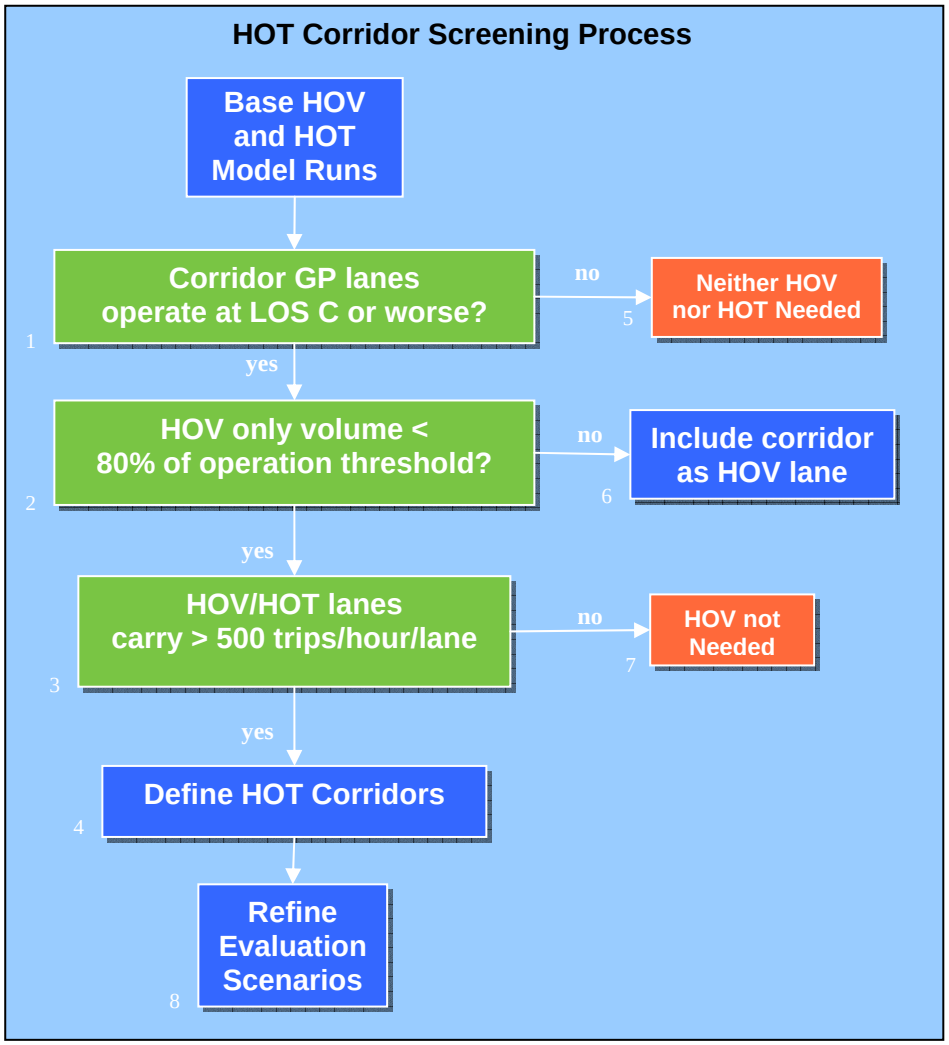

Figure 6 HOT Corridor Screening Process

Table 2 HOT Lane Scenarios Included in 2030 and 2015 Analysis

Alternatives		Number of HOV Corridors	Number of HOT Corridors	HOT Lane Permitted Vehicles and Applicable Fee Assumptions			
				SOV	HOV 2	HOV 3	HOV 4+
2030 Network	2030 HOT 2+ [2]	7	17	Optimum Fee [1]	Free	Free	Free
	2030 HOT 3+ [2]	2	22	Optimum Fee [1]	50% of Optimum Fee [3]	Free	Free
	2030 HOT 4+	0	24	Optimum Fee [1]	80% of Optimum Fee [3]	20% of Optimum Fee [3]	Free
2015 Network	2015 HOT 2+ [2]	3	12	Optimum Fee [1]	Free	Free	Free

Note:
1. Optimum fee is defined as the fee rate that results in a managed level of service 'C', representing uncongested conditions; fees vary by corridor and are per mile traveled in a HOT lane.
2. The 2030 HOT 2+, 2030 HOT 3+ and the 2015 HOT 2+ scenarios include HOT 4+ eligibility and pricing on I-75/I-85 Downtown Connector.
3. Only registered HOV vehicles receive a discount. Registration rates were assumed.

Figure 7 shows the potential HOT corridors that satisfied the screening criteria and were therefore feasible HOT corridors under each scenario in the 2030 analysis.

The screening criteria were also applied to a 2015 managed lane network in order to assess the near term HOT potential of currently planned managed lanes that may be opening in 2015. As a limited near term analysis, the 2015 screening assumed existing HOV eligibility requirements and only those managed lane corridors in the regional transportation plan (RTP). Figure 8 shows the potential HOT corridors that were considered in the 2015 analysis. These 15 managed lane corridors are those found in the 2015 time horizon of the RTP, with the exception of where the lanes were assumed to end for I-75N (which was in the 2025 RTP implementation time horizon) and I-75S (which was in the 2020 RTP implementation time horizon). Four corridors inside I-285 did not meet the screening criterion for "sufficient managed lane capacity to sell": I-85N, GA 400, I-20E, and the Downtown Connector (I-75/85). As in the 2030 analysis, the Downtown Connector was included in the HOT network with HOT 4+ pricing and eligibility. Therefore, the 2015 HOT 2+ network included 12 HOT corridors, and 3 HOV corridors. All of these managed lanes are proposed in *Mobility 2030* and most are expected to be operational by 2015.

The 2015 analysis does not recommend any one pricing and vehicle eligibility strategy for the region, but presents preliminary results for one option, HOT 2+. Further study of near term HOT implementation should include pricing and eligibility strategies other than the current eligibility policy and should reflect and contribute to the evolving regional managed lane eligibility policy.

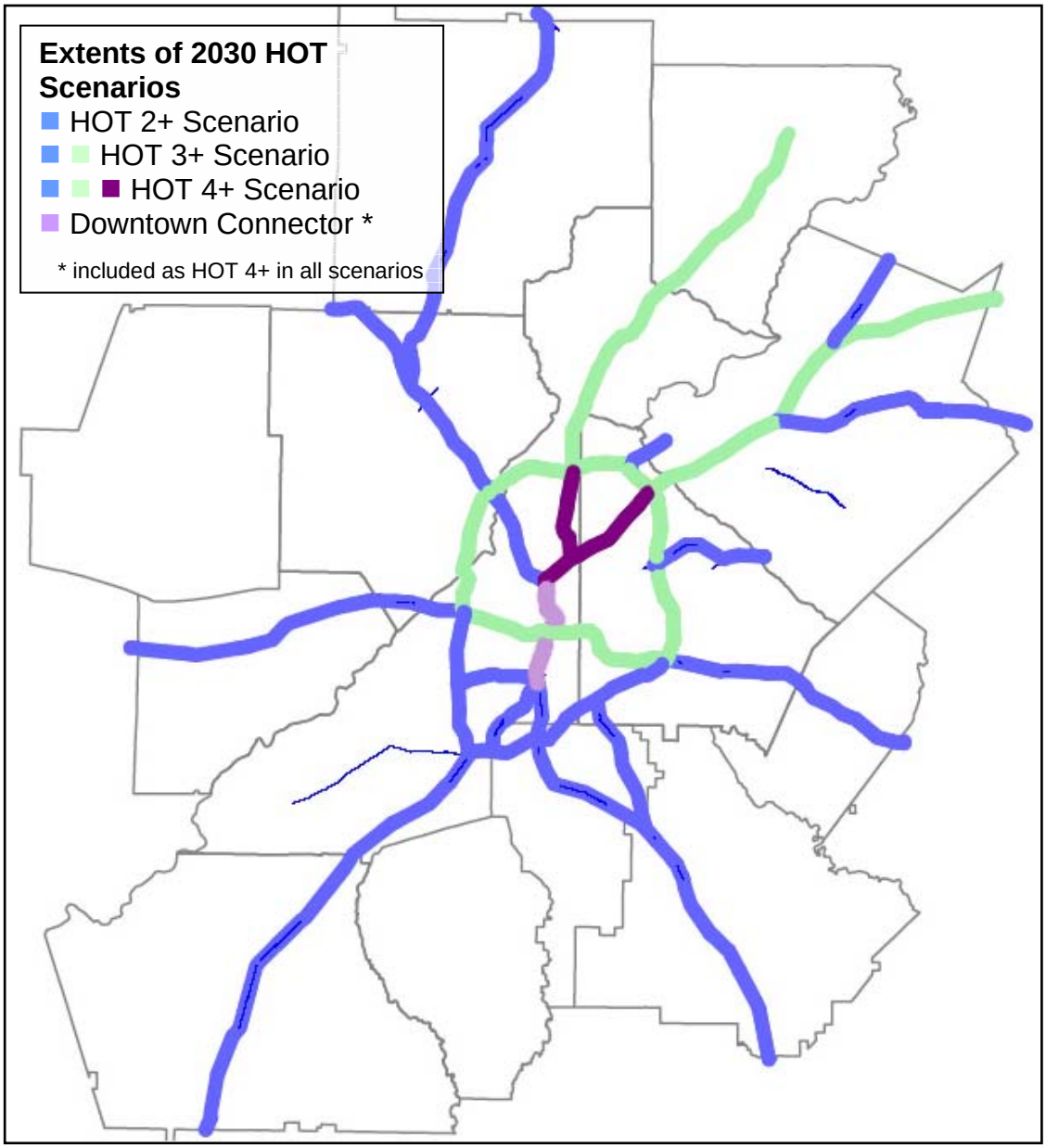

Figure 7 HOT Corridors for 2030 Analysis

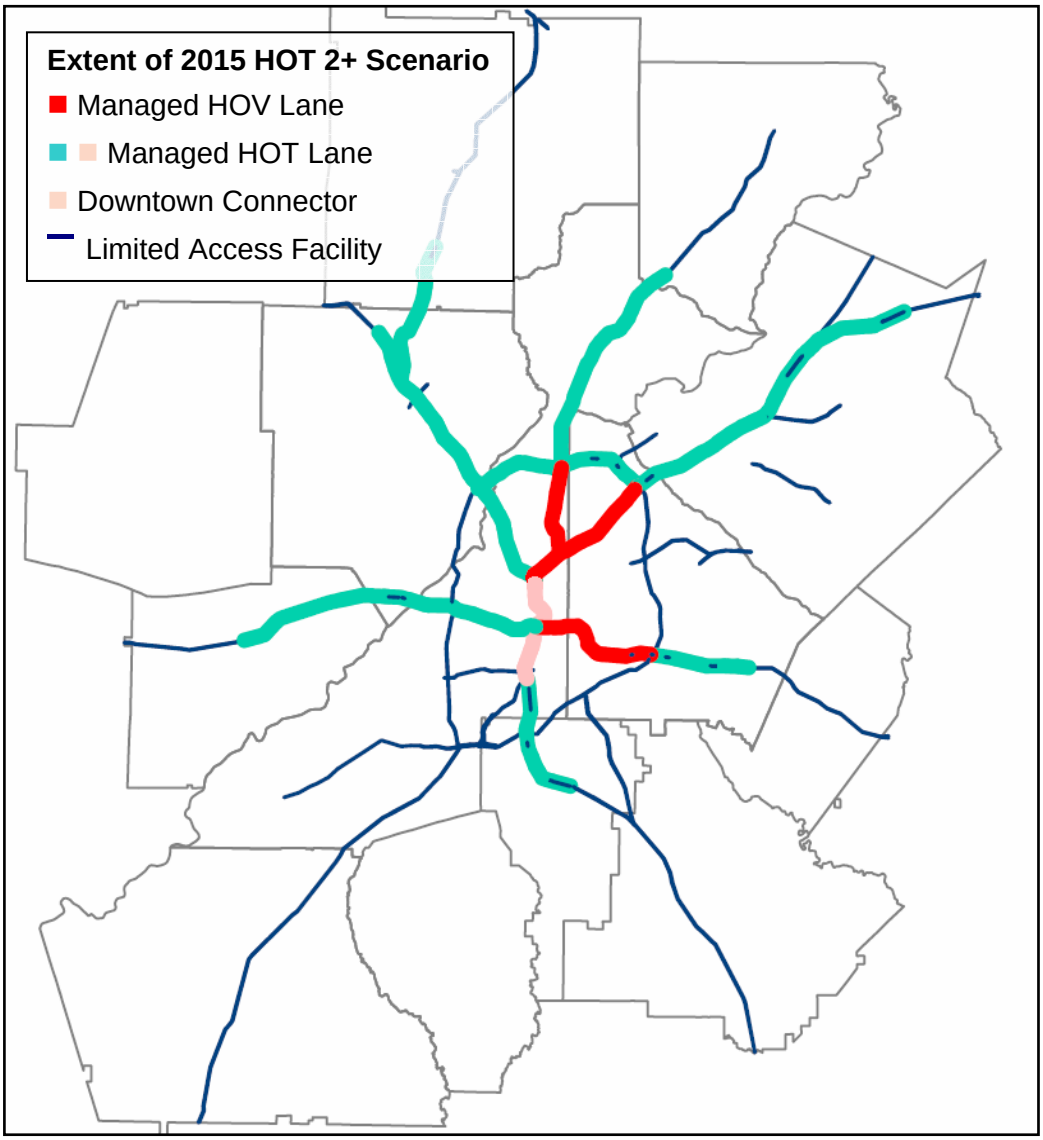

Figure 8 HOT Corridors for 2015 Analysis

Note: Neither a HOT 3+ scenario nor a HOT 4+ scenario was modeled for the 2015 analysis year. Only the current eligibility policy was included in order to provide a preliminary assessment of near term HOT feasibility under existing policy. Further study should examine a range of pricing and eligibility strategies.

3 ANALYSIS RESULTS

This section presents the analysis results for the market research effort, the 2030 horizon year, and specific results for the GA 400 corridor, as requested in Senate Resolution 575. The 2015 analysis results, given that they were used simply to make sure that the 2030 analysis did not ignore potentially feasible HOT corridors, are presented in Appendix H.

3.1 Market Research Results

The market research effort was undertaken for two major purposes: 1) to determine a "willingness to pay" fees for using managed lanes, and 2) to identify traveler opinions concerning the HOT concept. Figure 9 and Figure 10 show the results of the willingness to pay assessment. Figure 9 shows that, for those willing to pay something for managed lane use, the average fee per mile was just over $0.08. Figure 10 shows that, on a per work trip basis, the majority of participants stated that they would be willing to pay between $0.50 and $2.00. These results are consistent with analysis efforts in other parts of the U.S., which have tended to underestimate the willingness to pay for managed lanes once they have been implemented. The results shown in Figure 9 and Figure 10 should thus be considered conservative estimates of the willingness to pay for managed lane use.

The written survey and facilitated discussions resulted in the following observations:

- Participants would pay to use the HOT managed lane when their trip requires some level of certainty of arriving on time.
- Participants like the idea of having the HOT managed lane as an option.

Issues:

- Participants expressed skepticism that the managed lanes can be guaranteed to be congestion free. There was a concern that HOT users would be "price gouged" in times of need.
- HOT managed lanes do not address the "real" issue of taking cars off the road. Some felt the region should be focusing on transit investment.
- Participants felt that people who could not afford the fee would not see the benefit.
- Some felt current HOV lanes do nothing to relieve congestion, so neither will HOT managed lanes.

The participants had mixed feelings about allowing HOT use in current HOV lanes. Some felt it "infringed on someone else's benefit" and that it might penalize current HOV drivers. However, others thought that current HOV lanes are underutilized and that HOT managed lanes would provide greater efficiency in using road space.

Appendix C provides a more detailed report on the results of the market research effort.

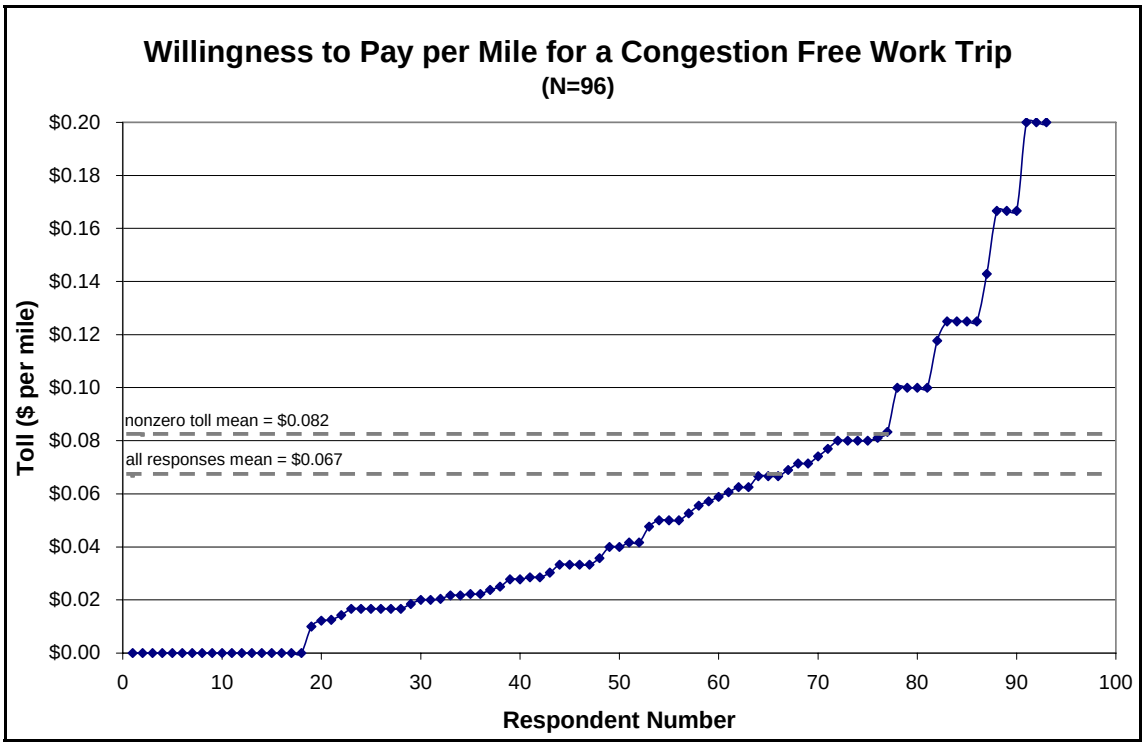

Figure 9 Focus Group Participant Willingness to Pay per Mile for a Congestion Free Commute Trip

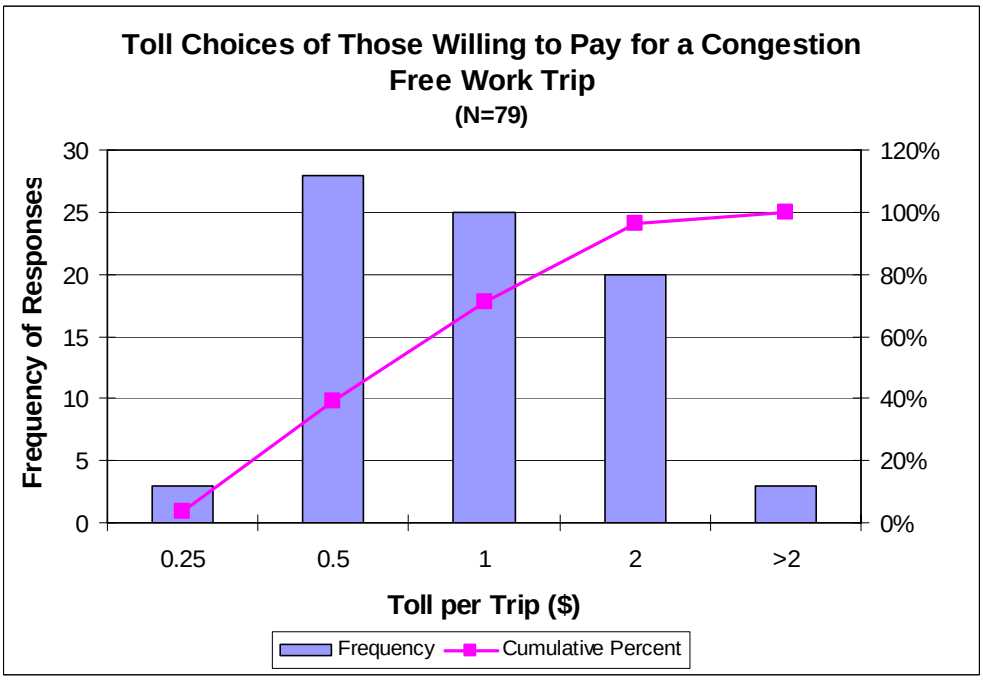

Figure 10 Focus Group Willingness to Pay per Trip for a Congestion Free Commute Trip

3.2 2030 Analysis Results at the Systems Level

Five primary performance measures were used in comparing the analysis results among the different pricing and vehicle eligibility scenarios, as well as the base cases of HOV2+ and HOV3+ , each without the HOT application. These criteria were: 1) vehicle miles traveled by HOVs and SOVs in the general purpose lanes and in the managed lanes, 2) illustrative trip time savings for managed lane users, 3) impact on congestion in the general purpose lanes of the limited access highway, 4) vehicle trips in the managed lanes and 5) person trips in the managed lanes.

3.2.1 Trip Time Savings

Table 3 shows sample trip time savings for typical origin destination trips that HOT managed lanes could offer to transit riders, travelers in eligible high-occupant vehicles, and travelers in other vehicles that are willing to pay a fee. Trip time savings indicates the difference between general purpose lane trip time and managed lane trip time using the same route.

Under the HOT scenarios, time savings are estimates for fee-paying vehicles that would only be permitted in the managed lanes if capacity were available. Therefore, time savings represent the difference between trip time in the general purpose lanes and the sum of trip times in the managed lanes and on general purpose lanes for that portion of a trip that occurs on HOV lanes (in corridors where HOT managed lanes did not pass the screening test). As described in the screening results, this applies to trips on I-20E, I-20 W, I-285N, GA 400, and I-85N under the HOT 2+ scenario and on GA 400 and I-85N under the HOT3+ scenario.

Table 3 Sample Trip Time Savings in 2030

Sample Trip 2030 PM Peak Period	Time Saved in HOT Lane[1]		
	HOT 2+	HOT 3+	HOT 4+
Midtown Atlanta to South Lake Mall	18 minutes	19 minutes	18 minutes
Airport to Midtown Atlanta	14 minutes	8 minutes	12 minutes
I-75 at I-285 to Town Center Mall	25 minutes	25 minutes	29 minutes
Alpharetta to Airport [2]	12 minutes	13 minutes	13 minutes
Perimeter Center to Town Center Mall [2]	17 minutes	25 minutes	27 minutes
Midtown Atlanta to Douglasville [2]	16 minutes	16 minutes	20 minutes
Stonecrest Mall to Airport	9 minutes	9 minutes	9 minutes
Mall of Georgia to Airport	13 minutes	23 minutes	22 minutes

1. Comparison of general purpose travel time to travel time in a HOT lane
2. HOT lane travel time includes time on general purpose lanes for portions of the corridor(s) that operate as HOV lanes in HOT 2+ or HOT 3+ scenarios.

The time savings indicated above show that under each scenario, HOT managed lanes can offer savings to those willing to pay a fee. The savings varied according to congested travel times estimated by the regional travel demand model under each scenario. Therefore, a savings of 8 minutes offered by the HOT 3+ scenario for a trip between the airport and Midtown indicates that the general purpose lanes were not as congested as they were in the other scenarios and/or that the managed lane travel time was greater under this scenario when compared to the other two. Appendix H contains a map of the sample trip origins and destinations, travel time savings estimates for each corridor under the 2030 HOT scenarios and travel time savings estimates under the 2030 HOV scenarios.

3.2.2 Vehicle Miles Traveled

Vehicle miles traveled (VMT) on managed lanes during the weekday is an indication of the utilization of these facilities. In the Atlanta region, in particular, VMT is also an important input into air quality analysis. Table 4 shows the VMT calculated for each scenario.

Table 4 Weekday Vehicle Miles Traveled on Limited Access Facilities (thousands)

2030 Evaluation Scenarios	General Purpose Lanes		Managed Lanes			Total
	HOV [1] VMT	SOV [2] VMT	HOV [1] VMT	SOV [2] VMT	Total Managed Lane VMT	Total Hwy VMT [3]
HOV 2+ without HOT lanes	2,400	41,400	7,300	0	7,300	66,600
HOV 3+ without HOT lanes	3,100	40,200	5,300	0	5,300	64,200
HOT 2+	2,500	40,600	7,100	2,300	9,400	68,200
HOT 3+	3,000	39,600	5,500	1,900	7,300	65,700
HOT 4+	5,200	39,600	2,400	3,100	5,500	58,800

1. HOV: High occupant vehicle as defined under today's policy; includes all vehicles with two or more occupants.
2. SOV: Single occupant vehicle
3. Total highway VMT includes truck traffic in general purpose lanes.

Table 4 indicates that total highway VMT is lowest under the HOT 4+ scenario and the greatest under the HOT 2+ scenario. HOT 4+ results show an increase in HOV VMT in the general purpose lanes, and a decrease in HOV VMT in the managed lanes; it therefore appears that these vehicles are shifting out of the managed lanes and into the general purpose lanes under this scenario. These results do not represent total regional VMT and any shifts from limited access facilities to alternative routes are not indicated by these results.

3.2.3 Percent Congested General Purpose Lanes, Weekday

The impact of HOT lanes on adjacent general purpose lanes is one of the important questions that will likely arise in any discussion on implementing HOT lanes. The study team estimated duration of congestion on general purpose lanes based on weekday volume and capacity of the highway network links. A level of service 'F' or a volume-to-capacity ratio greater than 1.0

defined congested conditions. Table 5 shows the estimated percent of general purpose highway miles operating under congested conditions as measured by duration of congestion.

Table 5 Percent Congested Weekday General Purpose (GP) Highway Miles

2030 Evaluation Scenarios	Percent Uncongested GP Highway	GP Highway Duration of Congestion (LOS = F)				
		>0 hours	>2 hours	>4 hours	>6 hours	>8 hours
HOV 2+ without HOT lanes	19%	81%	59%	39%	18%	4%
HOV 3+ without HOT lanes	19%	81%	58%	38%	15%	4%
HOT 2+	20%	80%	56%	35%	16%	4%
HOT 3+	21%	79%	56%	35%	13%	3%
HOT 4+	19%	81%	60%	40%	18%	5%

Table 5 shows that there is not much difference between the two base scenarios and any of the HOT scenarios. These results indicate that general purpose lane operations will not likely deteriorate as a result of HOT managed lanes.

3.2.4 Vehicle Trips on Managed Lanes, Weekday

Efficient utilization of the managed lane, indeed of the entire highway corridor, is one of the assumed benefits of managed lanes. Table 6 shows the number of weekday vehicle trips that are accommodated system wide in the managed lane system. As shown, the HOT 2+ scenario provides the greatest throughput in vehicles. This finding suggests that there is latent demand for a HOT concept in the managed lane system in Atlanta.

Table 6 Weekday Vehicle Trips on Managed Lanes (thousands)

2030 Evaluation Scenarios	Managed Lanes		
	Vehicle Trips on HOV [1] Lanes	Vehicle Trips on HOT [2] Lanes	Total Managed Lane Vehicle Trips
HOV 2+ without HOT lanes	1,335	0	1,335
HOV 3+ without HOT lanes	951	0	951
HOT 2+	637	1,150	1,787
HOT 3+	112	1,373	1,485
HOT 4+	0	1,491	1,491

1. HOV lanes: Managed lanes operated with eligibility restrictions without pricing.
2. HOT lanes: Managed lanes operated with eligibility restrictions and pricing as defined in Section 2.4.2.
3. Vehicle trips are summed from estimates on individual corridors.

3.2.5 Person Trips on Managed Lanes, Weekday

Table 7 shows the comparable number of person trips carried on the managed lane system in Atlanta by scenario. In this case, the HOT 2+ scenario carries the largest number of person trips, followed by HOT 4+ and HOT 3+.

Table 7 Weekday Person Trips on Managed Lanes (thousands)

2030 Evaluation Scenarios	Managed Lanes		
	Person Trips on HOV [1] Lanes	Person Trips on HOT [2] Lanes	Total Managed Lane Person Trips
HOV 2+ without HOT lanes	3,707	0	3,707
HOV 3+ without HOT lanes	3,346	0	3,346
HOT 2+	1,771	2,276	4,047
HOT 3+	394	3,340	3,824
HOT 4+	0	3,341	3,341

1. HOV lanes: Managed lanes operated with eligibility restrictions without pricing.
2. HOT lanes: Managed lanes operated with eligibility restrictions and pricing as defined in Section 2.4.2.
3. Person trips are summed from estimates on individual corridors.

3.2.6 Summary

Table 8 shows projections of relevant measures of the regional HOT system performing as a whole as assumed under the analysis scenarios in 2030. It should be noted that for both the HOT 3+ and HOT 4+ scenarios, registered carpools that now have to pay (e.g., two-person carpools would have to pay in the HOT3+ scenario) were assumed to pay a discounted fee. In each scenario, the percentage of carpools that would register was assumed at the beginning of the model runs. Thus, for example, the number of three-person carpools that would be willing to register in advance to receive a discounted fee rate in the HOT4+ scenario was assumed to be 50%. These assumptions could have a significant influence on the number of person trips that would be carried in the managed lanes in the HOT 3+ and HOT 4+ scenarios.

Table 8 2030 Summary Measures on Managed Lanes (thousands)

Evaluation Scenarios	Corridors on I-285			Corridors Inside I-285			Corridors Outside I-285		
	Vehicle Trips	Person Trips	VMT	Vehicle Trips	Person Trips	VMT	Vehicle Trips	Person Trips	VMT
HOV 2+ without HOT lanes	333	922	2,089	456	1,274	1,585	546	1,511	3,601
HOV 3+ without HOT lanes	234	820	1,528	347	1,223	1,266	370	1,303	2,508
HOT 2+	413	1,023	2,512	489	1,175	1,503	885	1,849	5,431
HOT 3+	360	994	1,960	410	1,147	1,176	715	1,684	4,176
HOT 4+	347	774	1,245	452	1,149	938	690	1,418	3,340

Note:
Managed lanes include HOV and/or HOT lanes under each scenario.
Corridor measures on I-285 include I-285 north of I-20 and I-285 south of I-20.
Corridor measures inside I-285 include I-75 N, GA 400, I-85 N, I-20 E, I-75 S, I-85 S, SR 166, I-20 W and the I-75/85 downtown connector.
Corridor measures outside I-285 include I-575, I-75N, GA 400, SR 141, I-985, I-85 N, SR 316, US 78, I-20 E, I-675, I-75 S, I-85 S, and I-20 W.

3.3 2030 Analysis Results at the Corridor Level

In order to evaluate the performance of individual corridors, measures were selected that represented the level of utilization of the managed lanes, costs to implement the HOT concept, and the potential fee revenues generated. Corridor level results are presented below for vehicle trips carried on managed lanes for corridors outside and on I-285. (Appendix H presents information on additional corridor-level measures.) In some cases, these results include managed lanes that did not meet the HOT screening criteria and were therefore modeled as

HOV lanes under the HOT 2+ and/or HOT 3+ scenarios. Figure 11, Figure 12 and Figure 13 show corridor-level vehicle trips in the managed lanes under the three evaluation scenarios.

Not surprisingly, which scenario handles the most vehicle trips in the corridor's managed lane will vary from on corridor to another. For example, as shown in Figure 13, the HOT 4+ scenario provides the greatest vehicle-carrying demand on I-285N of all the scenarios. However, for I-75S and I-85S, the HOT 2+ scenario produces the largest number of vehicle trips in the managed lanes. This result will vary because of the varying levels of congestion in the general purpose lane, and other characteristics associated with travel demand in each corridor. As confirmed by Table 6, the HOT4+ scenario does seem to carry more vehicle trips in most corridors than under alternative scenarios. As shown in Appendix H, however, the HOT 2+ scenario carries the most person trips.

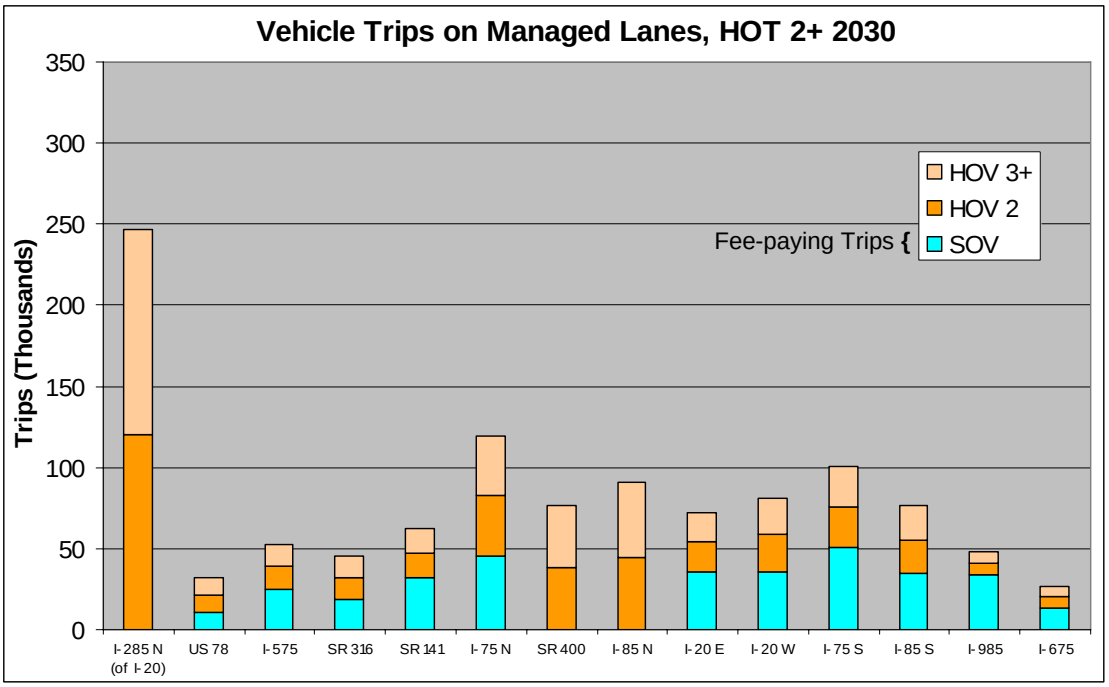

Figure 11 Corridor Vehicle Trips on HOT 2+ Managed Lanes

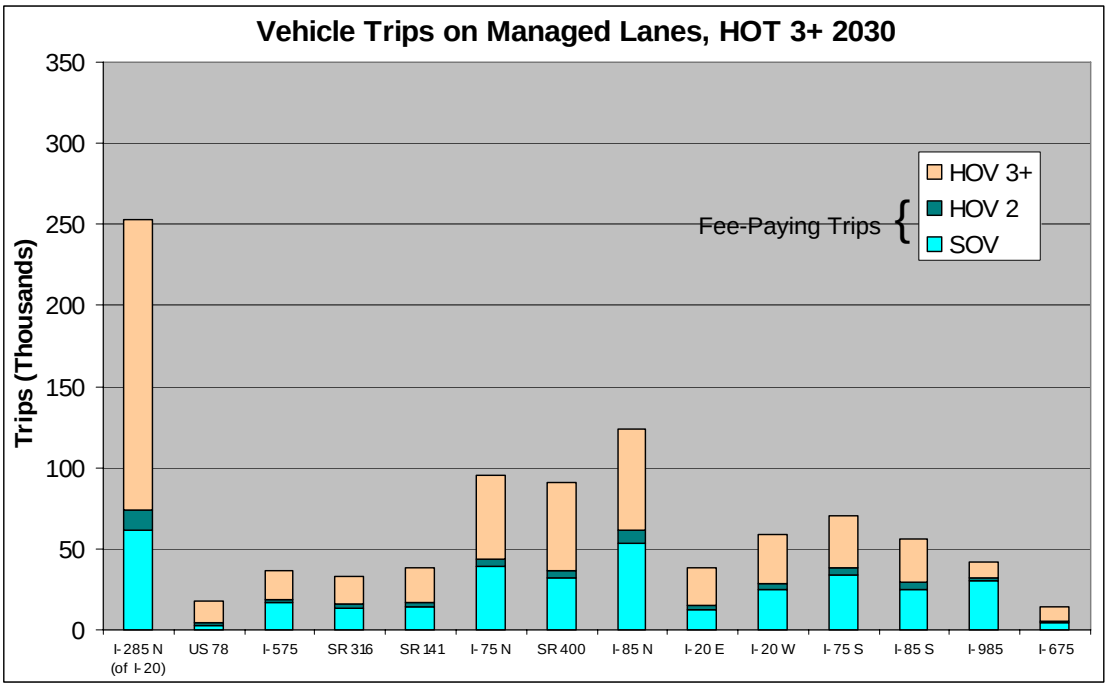

Figure 12 Corridor Vehicle Trips on HOT 3+ Managed Lanes

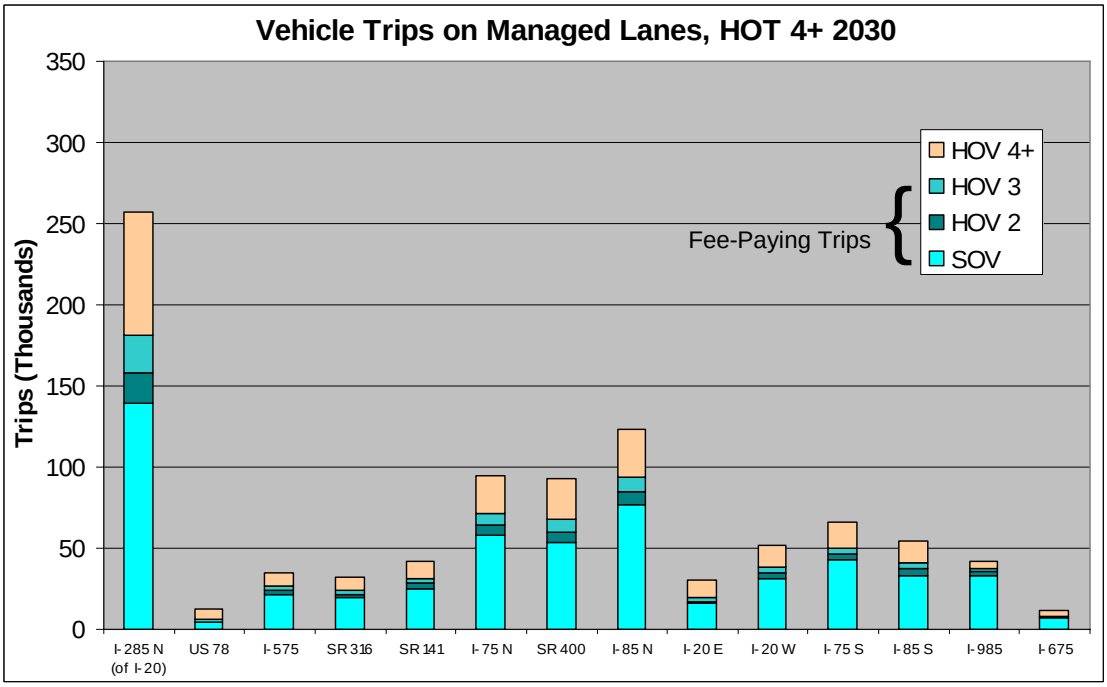

Figure 13 Corridor Vehicle Trips on HOT 4+ Managed Lanes

3.4 Georgia SR 400

Senate Resolution 575 specifically requested information on the feasibility of HOV and HOT lanes on State Route (SR) 400. GRTA's Northern SubArea Study and GDOT's HOV System Plan recommended HOV lanes on SR 400. This study confirms the demand for managed lanes on Georgia SR 400. As this report went to print, GDOT was in negotiations for HOV design contracts for managed lanes on SR 400 outside of I-285. In addition, there are several other plans that will affect operations on SR 400. For example, buses will operate on widened shoulders in the near future. New general purpose lanes are under design from Holcomb Bridge Road to McFarland Road, with these lanes eventually being converted to HOV or managed lane use at a later date. Additionally, SRTA is beginning a study of user fee concepts on SR 400 north of I-285.

The analysis shows that, under most scenarios, SR 400 outside of I-285 will have sufficient capacity to "sell" for HOT use. The analysis also shows that there is a significant demand for this capacity. Table 9 shows another finding of this study: managed lanes on GA SR 400 would provide trip time savings and more reliable travel times to travelers. Appendix H contains travel time savings estimates for the length of the GA SR 400 corridor under both the HOT and the HOV (base) scenarios.

Table 9 Sample Trip Time Savings on SR 400

Sample Trip PM Peak Period	Time Saved in HOT 2+ Lane[1] in 2015	Time Saved in HOT 2+ Lane[2] in 2030	Time Saved in HOT 3+ Lane[2] in 2030	Time Saved in HOT 4+ Lane[2] in 2030
Northbound from I-285 to Alpharetta (SR 120)	10 minutes	N/A	15 minutes	18 minutes
Southbound from McFarland Road to I-285	4 minutes	N/A	7 minutes	9 minutes

1 Comparison of general purpose travel time to travel time in a HOT lane, assuming a HOT 2+ network of 12 HOT and 3 HOV corridors.
2 Comparison of general purpose travel time to travel time in a HOT lane, assuming the 2030 HOT scenario described above. Under the 2030 HOT 2+ scenario, there was not capacity available to sell to fee-paying vehicles on GA SR 400.

3.5 Revenues and Costs

Cost estimates were developed assuming both incremental HOT-related capital expenditures (over the cost of building the GDOT's preferred managed lane cross section) and operations and maintenance costs. For the purposes of this analysis, HOT capital expenditures do not include the cost of building infrastructure such as new highway lanes; however, full capital cost estimates (including cost estimates to build lanes derived from the GDOT *HOV Plan*) are included in Appendix .H. The analysis did include the incremental capital costs for such things as barriers on existing lanes, fee collection structures, and communications and other ITS equipment. Operations and maintenance (O&M) costs include the incremental costs associated with the operations, enforcement, and maintenance of the HOT managed lanes themselves. These include administrative costs associated with fee collection, both fee collection and occupancy enforcement and violations processing costs, maintenance of HOT infostructure (including fee collection and other ITS equipment), and HOV infrastructure maintenance.

According to input received from the steering committee and from focus group participants, potential HOT revenues are recommended to cover first the incremental capital, operations,

and maintenance costs associated with applying the HOT concept to the managed lanes; any excess revenues would then be available for other transportation improvements. Table 10 shows these annual costs and revenues.

While revenue generation is not the primary goal of HOT managed lanes, pricing users is a necessary tool to achieve the benefits of HOT operations. In order to assess the cost effectiveness of HOT operations, potential revenues were calculated based on miles traveled in a HOT corridor and the fee rate for that corridor. Using ARC's regional travel demand model and a refined trip assignment module, fee rates for each weekday time period (morning, midday, evening, and night) were set in order to manage the HOT volume, and therefore manage the operating conditions of the managed lane(s). A minimum fee rate of $0.04 per mile was assumed for the purpose of analysis.

Table 10 shows that the HOT 4+ scenario generates the most revenue (because it charges the most users in each HOT corridor). HOT 4+ is the only scenario that resulted in potential revenues higher than estimated costs to implement HOT lanes at the system level. While these estimates are preliminary, it seems likely that some state subsidy may be necessary to cover the capital, operations and maintenance costs of the lane(s). Figures H45, H46, and H47 in Appendix H show that certain corridors under each scenario do generate potential revenue that covers operations and maintenance costs of the HOT managed lane(s) in each corridor. The HOT incremental capital costs shown in Appendix H also indicate that certain corridors could cover not only the annual O&M costs, but also the incremental HOT capital costs of that corridor. For example, under the HOT 2+ scenario, annual revenue estimates for I-75N, I-75S, (both outside I-285) and the Downtown Connector cover the incremental capital and O&M costs associated with each corridor. Further study on the corridor level (rather than the regional system) should address more detailed estimates on a corridor-by-corridor basis.

Table 10 2030 HOT Scenario Potential Revenues and Costs

	Potential Capital Costs* for HOT Lanes	Potential Annual Costs **	Potential Annual Revenues **
HOT 2+, Limited Network I-75/85: HOT 4+	$ 139 M	$ 52 M	$38 M
HOT 3+, Limited Network I-75/85: HOT 4+	$ 196 M	$ 66 M	$ 53 M
HOT 4+ Transit Only Free	$ 205 M	$ 80 M	$ 103 M

Note: General numbers; more detailed numbers will be developed in further studies
* The main difference in capital (and annual) costs is that each scenario has a different number of miles of managed lanes in operation.
**Assumes 30 year bonds at 5% interest; annualized costs include HOT incremental capital, and operations and maintenance costs.

Table 11 shows the breakdown of operations and maintenance costs associated with each scenario per year and per million transactions. Costs are defined as above. The lower portion of the table, showing costs per million fee transactions, demonstrates that an economy of scale is reached as annual fee transactions increase. The HOT 4+ scenario, which has the highest number of fee-paying trips, results in the lowest per transaction cost projection. In comparison with the HOT 2+ scenario, annual HOT 3+ system costs increase (for the additional five HOT corridors), but the resulting change in annual transactions does not appear to cover the added costs, resulting in a relatively higher cost per transaction. The corresponding projections for

fee-paying transactions per year are 284 M, 177 M, and 160 M for HOT 4+, 3+, and 2+ respectively.

Table 11 2030 HOT Annual Operations and Maintenance Costs

2030 HOT Total Annual Operations and Maintenance Costs *				
Annual Costs	Administrative Costs	Maintenance Costs	Enforcement Costs	Potential Annual O&M Costs *
HOT 2+, Limited Network I-75/85: HOT 4+	$ 16 M	$ 17 M	$ 11 M	$ 43 M
HOT 3+, Limited Network I-75/85: HOT 4+	$ 18 M	$ 23 M	$ 13 M	$ 54 M
HOT 4+ Transit Only Free	$ 28 M	$ 24 M	$ 14 M	$ 67 M
2030 HOT Annual Operations and Maintenance Costs per Million Transactions *				
Costs per Million Transactions	Administrative Costs	Maintenance Costs	Enforcement Costs	Potential Annual O&M Costs*
HOT 2+, Limited Network I-75/85: HOT 4+	$100 K	$104 K	$67 K	$271 K
HOT 3+, Limited Network I-75/85: HOT 4+	$100 K	$132 K	$71 K	$303 K
HOT 4+ Transit Only Free	$100 K	$ 85 K	$50 K	$235 K

Note: General numbers; more detailed numbers will be developed in further studies
*Assumes 30 year bonds at 5% interest; annualized costs include HOV and HOT lane maintenance costs.

In addition to other measures, Appendix H contains potential revenues and costs at the corridor level for both near term (2015) and long term (2030) HOT scenarios. This appendix shows total capital cost estimates and annualized capital costs for comparison with annual O&M costs and revenue projections. The enforcement, toll collection and operational strategies white papers located in Appendices I, J, and K detail assumptions by the study team in developing these cost estimates. These cost and revenue projections represent general estimates; more detailed numbers will be developed in further studies.

4 RECOMMENDATIONS

The following recommendations were developed over the course of the study based on analysis results and, in some cases, dialog and debate among the members of the steering committee. This section is a synthesis of the recommendations that are explicit or sometimes implicit in the preceding chapters of the report. Two types of recommendations are presented: those relating to policy decisions and those relating to institutional relationships, operational strategies, and management of a HOT program.

4.1 Policy Recommendations

The study has shown that a HOT managed lane network is feasible in Atlanta. Several corridors show strong potential for such a strategy, and indicate that HOT managed lanes would be used by many to improve their travel time and trip reliability. The policy recommendations that follow are aimed at making a HOT managed lane network a reality in the Atlanta region. The following policy recommendations were discussed and agreed to by the steering committee; policy recommendations for issues 10 and 11 were thought to require additional study by some committee members.

Issue 1: The range of responsibilities for HOT lane planning, development, operation, maintenance and enforcement are likely to be shared by a number of separate agencies. To ensure success of these concepts, some of which are likely to be controversial, coordination among the agencies responsible for these functions cannot be left to chance. A formal mechanism should be established (such as a regional committee, task force, or a memorandum of agreement) to ensure that coordination is achieved among the agencies involved in regional planning, design and funding.

This group should focus on such activities as: developing a regional operating plan for HOT managed lanes, determining the pricing/vehicle eligibility requirements of HOT managed lanes, collecting data on travel behavior characteristics and managed lane use, financing strategies for covering the costs of operating and maintaining HOT managed lanes if revenues do not cover such costs, and the use of fee discounts/registration for certain types of lane users (e.g., carpools).

Recommendation*: *A formal interagency process and mechanism should be established to ensure coordination among the state and regional partners in regional planning, data collection, design, modeling and funding of a HOT managed lane program.

Issue 2*:* The collaborative effort described above is best guided by common principles and visions of what such a program would look like for the region.

Recommendation*: *SRTA, GDOT, ARC and GRTA should work together to adopt a policy statement or resolution supporting the HOT lane concept as a direction that should be pursued in regional planning and investment decisions. The focus of such a policy statement should be on the mobility enhancing goal of HOT lanes.

Issue 3: Given that this study examined the HOT managed lane concept as a regional system, additional data and feasibility studies should be undertaken on a corridor-by-corridor basis to determine the specific characteristics of how HOT managed lanes could be implemented in each context.

Recommendation: Additional data collection and feasibility studies should be undertaken on a corridor by corridor basis to refine the physical attributes and operational characteristics of each promising HOT corridor.

Issue 4: It is very important that the HOT managed lane concept be consistent with the region's transportation plan and other policies and plans that focus on regional mobility. The HOT managed lane group described in Recommendation 1 should work closely with the Atlanta Regional Commission as it begins the next cycle of updating the regional transportation plan. As noted earlier, the current plan mentions HOT lanes as a future possibility in updated plans. Examples from Dallas-Ft. Worth, San Diego and Washington D.C. illustrate how this can be done.

Recommendation: The HOT managed lane coordinating group should work closely with ARC to consider the concept of pricing on managed lanes in future transportation plans.

Issue 5: The institutional framework for developing, operating, and maintaining a HOT managed lane network in the Atlanta region will require clear roles and responsibilities for the many different agencies involved.

Recommendation: For state roads, the GDOT should be considered the owner of the facility (for non-state roads, the local government would be responsible for the road);

SRTA should be considered the default service provider of all services associated with management and operation of the facility(ies);

The developer of a HOT lane could be an agency, private firm, or a consortium that builds a new managed lane with HOT capacity or adds incremental HOT capacity to existing HOV lanes, and possibly as well acts as the service provider;

The maintenance provider of the managed lane should be provided either by the owner, service provider, developer, some arrangement among them, or through an agreement with a private entity; and

The enforcement provider (of both fee collection and occupancy requirements) should be the responsibility of the service provider with the potential for arrangements with separate entities and/or secondary occupancy enforcement provided by the Department of Motor Vehicle Safety or an agency with similar powers.

Issue 6: One of the important characteristics of potential HOT managed lanes is that they could very well be developed and operated through a public/private partnership. In this case, specific roles for private entities should be defined on a project-specific basis, and could include developer or service provider of the managed lanes.

Recommendation: For potential HOT application on managed lanes on a state highway with a private service provider, GDOT and SRTA should maintain oversight of operating and technology strategies, including, but not limited to, fee rates and eligibility requirements. For non-state roads, SRTA should provide oversight with respect to technology strategies to assure regional compatibility.

Issue 7: Revenues will be generated from the fees paid by HOT users of the managed lanes. The issue of what to do with these revenues is an important consideration, often one that becomes involved in the overall determination of the political feasibility of the lanes themselves. Any annual revenues remaining from those allocated to primary cost coverage purposes should be considered excess fee revenues ("excess revenues") for that corridor. Other uses for the revenue should not be prohibited as long as they are used for transportation purposes and are higher in priority in that corridor than the three uses suggested above.

Recommendation: The annual fee revenues from the HOT use of managed lanes should first be used to cover:

- ***the annual operations and maintenance (O&M) costs for HOT operations in the corridor, and then***
- ***the annual payments to repay most or all of the incremental capital costs of developing HOT capacity on existing or planned HOV facilities in the corridor.***

Recommendation: Excess revenues, if available in a corridor, should be considered generally for the following uses, in no order of priority:

- ***supporting transit operations (not capital) in the corridor,***
- ***operations and maintenance costs for other managed lane corridors,***
- ***annual payments to repay capital costs for the managed lanes in the corridor [in order to provide flexibility to fast-track an HOV project using these fee revenues].***

Recommendation: A decision-making and consultation structure should be developed for allocating excess revenues. Such consultation structure should include state and regional agencies in addition to managed lane operating agencies and should establish strategies for three possible cases: revenues do not cover the annual costs revenues are equal to the annual costs, and revenues exceed annual costs.

Issue 8 The capital cost of managed lanes will likely be funded with a combination of fee-supported bond funds and non-fee capital funds. However, the annual operations

and maintenance costs are an important factor in determining cost feasibility and institutional responsibilities.

Recommendation: The extent to which operations and maintenance costs are not covered by annual fee revenues, these costs should be assumed by the service provider and/or developer with possible contributions by the owner.

Issue 9: The Federal Highway Administration (FHWA) has a policy for converting existing HOV lanes into HOT use or for any significant change in HOV operations. Currently, implementing a HOT concept on an Interstate road would be carried out under a value pricing project that would have to be approved by FHWA. However, different provisions for implementing the HOT concept on such highways are currently being considered in federal transportation reauthorization bills.

With respect to operational changes, according to FHWA Program Guidance, a safety study must be conducted that identifies any safety consequences associated with the changing of operational strategies for HOV lanes. This would include changing vehicle eligibility from that currently found on Atlanta HOV lanes. For new managed lanes with HOT use on highways where they currently do not exist, this federal policy does not apply as long as the lanes are not built as "HOV" lanes. The question of under what authority HOT lanes or tolling placed on federally funded roads will also have to be determined (which could very well change with a reauthorized federal transportation law). Under 49 USC section 5309, "Urban Mobility" formula funds, FTA approval to operational changes in a HOT facility if such funds are used in the lane construction would be necessary.

Recommendation*: *New managed lanes that are proposed in regional plans or corridor studies should be referred to as "managed lanes", not as HOV lanes. In addition, SRTA and its partner agencies should work closely with the state's Congressional delegation to modify language in the law that will allow the use of pricing on Interstate roads.

The following recommendations were discussed by the steering committee and although most agreed with the language, it was agreed that additional policy and technical work would be necessary to gain consensus.

Issue 10: One of the key decisions that will have to be made in the early stages of implementing a HOT managed lane program in the region is the pricing/vehicle eligibility strategy. SRTA recommends that this pricing/vehicle eligibility strategy be the one that best supports the adopted plan for regional transit service, which means that transit operations in all highway corridors should have the opportunity for uncongested and reliable operations. HOT 2+ does not provide such opportunities in eight corridors (although this scenario does provide the largest number of person trips served); HOT 3+ does not provide such opportunities in three important corridors (the Downtown Connector, GA 400 and I-85N); whereas HOT 4+ provides reliable transit travel times in all corridors. The HOT 4+ scenario meets the steering committee's recommendation to provide a HOT lane application that is consistent across the region, as well meeting the desire to provide reliable transit service in all corridors.

Whatever policy is adopted, experience suggests that it will be very difficult to change a pricing and vehicle eligibility policy once it is in place. Especially when a new managed lane is opened, the newness of the facility provides a unique opportunity to put in place a pricing and vehicle eligibility strategy that in the eyes of the user can be related directly to the new facility. However, any successful implementation of a HOT managed lane program should also recognize that flexibility in adopting a pricing/vehicle eligibility strategy reflecting the political willingness to adopt such a strategy will be an important consideration at the time of decision.

Recommendation: Whatever pricing/vehicle eligibility strategy that will likely be necessary in 2030 should be the pricing/vehicle eligibility strategy adopted when new managed lanes open.

Issue 11: Given that the managed lane projects currently under design are in highway corridors identified in this study as having the greatest HOT potential, project planning/environmental analysis for such projects should include a HOT concept, with flexibility incorporated into project planning to allow for the implementation of such a strategy. Given current federal policy and regulations, these facilities should not be called HOV or HOT lanes, but rather managed lanes.

Recommendation: All project planning for current and expected managed lane projects should consider pricing options through the NEPA need and purpose process as appropriate.

4.2 Implementation Recommendations

This section presents recommendations relating to the basic approaches to managed lane design and operations, including policies relating to lane separation treatments, access strategies, pricing strategies and the technology suggested for pricing and enforcement.

Issue 12: Public outreach and marketing will be a critical element of success in the managed lane program, especially the HOT component. Importantly, regional public outreach and education on the managed lane concept should occur, while corridor-specific outreach efforts focus on HOT-specific projects. Regional transportation management associations and community improvement districts are also potential partners in a coordinated outreach effort. It might be desirable to have a designated central location and website for information on managed lanes. During the initial planning of a managed lane application in a corridor, a targeted public outreach campaign should be used in the corridor to inform, educate, and solicit feedback from the traveling public. This information portal should be used to convey information on the fee structure and how it will be applied on the managed lane. Such a portal can also be used during managed lane operation to support public outreach and marketing.

Recommendation: The regional transportation agencies (including, but not limited to, ARC, GDOT, GRTA, and SRTA) that have the strongest connection

to managed lanes should coordinate their public outreach efforts with respect to HOT information.

Issue 13: As per the GDOT HOV System Plan, the managed lanes should be separated from the general purpose lanes with some form of barrier that conveys to the drivers that different traffic flows are being served in the respective lanes. Barriers should promote safe movement of vehicles and enhance enforcement of managed lanes. Barrier separation should conform to adopted Georgia Department of Transportation (GDOT) guidelines where feasible. Where new managed lanes are constructed, and to the extent allowed by right-of-way and other engineering considerations, the typical cross section for managed lanes should allow for concrete barrier separation.

Where right-of-way and other engineering considerations do not allow the construction of concrete barriers, pylons or some other equivalent barrier approved by GDOT may be used. This does not exclude sections of buffer-separated lanes on new or existing facilities, where absolutely necessary, upon approval by GDOT.

Recommendation: In all cases, managed lanes should be separated from the general purpose lanes with some form of barrier approved by GDOT. Adequate buffer areas between general purpose and managed lanes should be provided.

Issue 14: GDOT's current guidelines limit access to managed lanes to HOV-only interchanges, but allow direct merge access ramps at system-to-system interchanges and at managed lane terminal locations, permitting the movement of vehicles to and from the managed and general purpose lanes. As a guide, intermediate access to managed lanes from the general purpose lanes should be considered approximately 3 to 5 miles apart, subject to approval of GDOT.

Recommendation: Managed facility access locations should be consistent with GDOT's HOV System Plan (as amended) and with the adopted regional transportation plan of the Atlanta Regional Commission (December, 2004 or as amended). Intermediate access to managed lanes from the general purpose lanes should be considered approximately 3 to 5 miles apart, subject to approval of GDOT.

Issue 15: The managed lane fee collection technology should leverage existing fee infrastructure and intelligent technology infrastructure in the near term. The deployed technology needs to support the operational strategies of the managed lane facilities and specifically the pricing strategies and vehicle/user eligibility requirements. The current vehicle identification systems, including Cruise Card, are capable of supporting the desired HOT functions.

Fee collection enforcement should rely on existing video surveillance and license plate capture at each point where a fee is collected in the near term. However unless all users are registered with a fee tag or transponder, including designated free vehicles, video enforcement will not be totally effective. Products are

currently in development that may eventually provide a mobile capability to verify if a fee has recently been paid, but these products are not yet proven. There are no commercially available technologies to verify vehicle occupancy in an automated fashion. Video based solutions may evolve if privacy concerns can be addressed. Long term, if all vehicles are registered, the tag or transponder or GPS unit may be linked to vehicle sensors detecting the number of occupants in the vehicle and pass this information to the roadside at the fee collection point.

Long term, if Global Positioning System (GPS) technology can be successfully applied and integrated for revenue collection, the HOT lane infrastructure for fee collection could be eliminated.

Recommendation: The HOT fee collection capability should be provided through an extension of SRTA's existing system either directly with SRTA or a service provider using compatible technology, and that video based fee enforcement be applied at the fee collection points, supplemented with on-site enforcement and manual observation of vehicle occupancy.

Issue 16: For both the conversion of existing managed lanes to HOT use and for the construction of new managed lanes with HOT use, enforcement of vehicle eligibility could occur either by video, through roaming enforcement patrols, or through a combination of the two. The role of enforcement may be greatly aided by emerging technology applications that help identify vehicle occupancy. Various supporting strategies, such as the prominent posting of and increases in the amount of fines, can reinforce the enforcement function.

Recommendation: The initial enforcement of vehicle eligibility should occur through video cameras. SRTA should monitor continuing advances in enforcement technologies to identify emerging strategies for improving vehicle eligibility enforcement.