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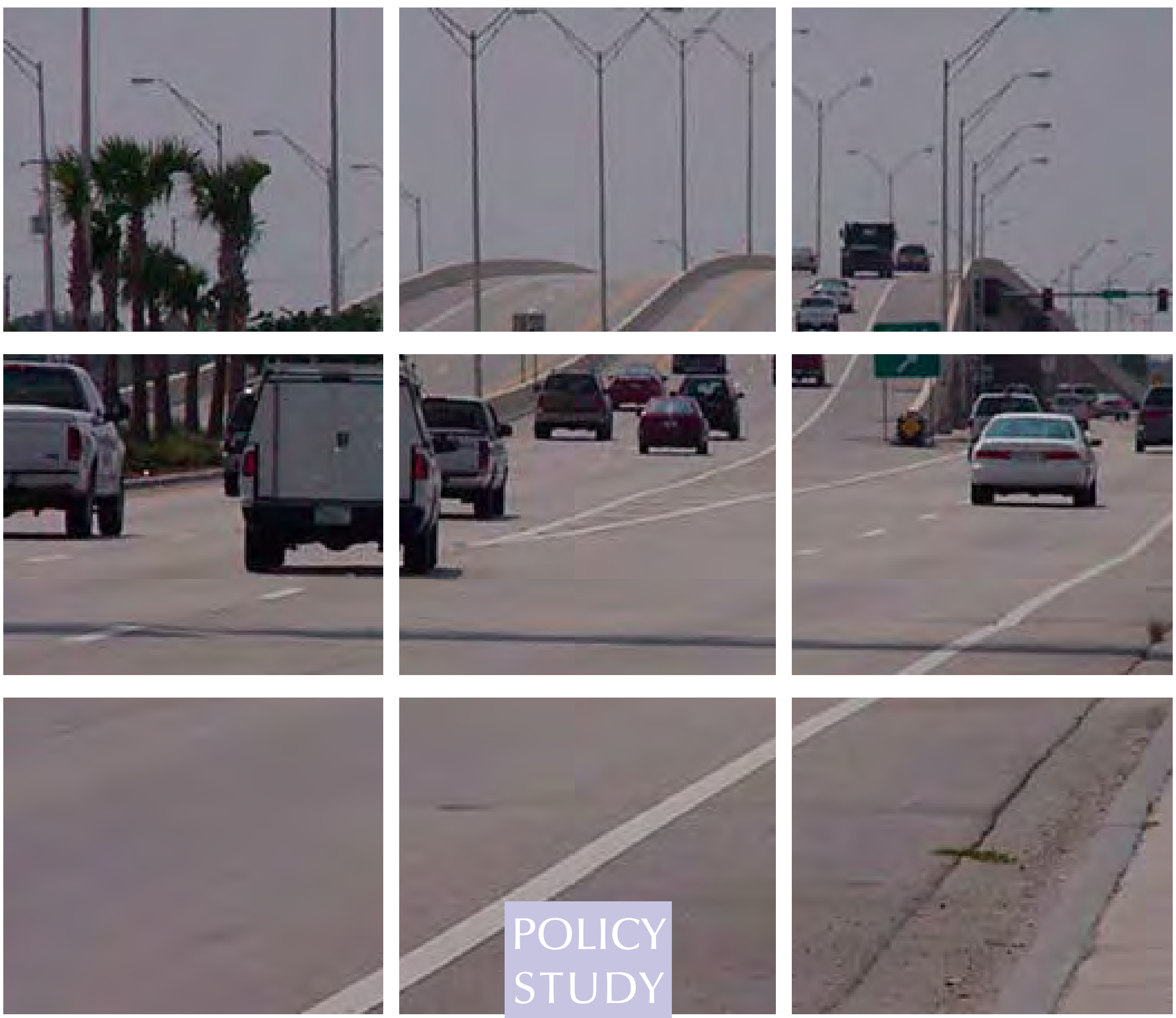
Reducing Congestion in Lee County, Florida

By Chris R. Swenson, P.E. and Robert W. Poole, Jr.



POLICY STUDY 374

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Reason Foundation

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Executive Summary

In recent decades, Lee County has been one of America's fastest growing urban areas. This growth is likely to continue once the current recession is past, and has brought with it a major problem: traffic congestion. Congestion was ranked as one of the county's top three issues by 90% of residents in a recent survey, with 30% ranking it as the number one issue.

Congestion imposes high costs. The annual Urban Mobility Report from the Texas Transportation Institute estimates that Lee County drivers spend 2.7 million man-hours each year stuck in traffic. The cost of their wasted time and fuel totals $46 million per year, which works out to $261 per commuter per year. And congestion also negatively affects the county's numerous visitors—a key concern in an area that counts tourism as a major part of its economy. Congestion also impacts businesses and the regional economy, reducing business productivity and reducing the efficiency of goods-movement and just-in-time delivery logistics. The full cost of congestion in urban areas is probably double the TTI figure, according to the chief economist of the U.S. Department of Transportation.

This report provides an analysis of congestion in Lee County and what can be done about it. It is part of a broader Reason Foundation project, the Galvin Mobility Project, whose purpose is to focus national attention on eliminating serious traffic congestion as a major urban problem in America. In addition to extensively researching the causes and consequences of congestion and on what works and doesn't work in reducing congestion, the Galvin project also develops a series of case studies of specific urban areas. This Lee County report is one of those case studies.

Our assessment finds that Lee County's only limited-access expressway, I-75, will once again be overloaded within a few years of completing the current widening from four lanes to six, but that due to natural barriers there is little or no thought of adding additional expressways. Instead, this vitally important artery must be further expanded, but in a way that will keep I-75's new capacity uncongested, on a sustainable basis. We also find that Lee County is under-supplied with arterial capacity—the major six-lane roadways that make up the other principal north-south and all east-west links in the roadway system.

After implementing all the improvements set forth in the current long-range transportation plan (based on existing funding sources), Lee County congestion in 2030 will be considerably worse than it is today. Thus, the challenge taken on in this report is to identify additional transportation improvements sufficient to eliminate serious (Level of Service F) congestion from Lee County's roadways by 2030, and to figure out how to pay for those improvements.

Traffic congestion in Lee County, as in most areas, is of two types. *Recurring* congestion is the result of traffic demand that exceeds the capacity of the existing system; it accounts for about half the current and projected congestion in Lee County. *Non-recurring* (incident-related) congestion accounts for the other half. A serious congestion-reduction approach must reduce both kinds of congestion.

A multi-part approach should be used to reduce non-recurring congestion. This includes implementing ramp metering at key entrance ramps on I-75, expanding freeway incident management with greater video camera coverage (for incident detection) and service patrols (for incident response). Legal changes can also reduce the time needed to clear up accidents on I-75. On the arterials, the county should continue to expand the extent of traffic signal coordination and access control. These kinds of system operations changes are relatively low-cost and unglamorous, but they have high ratios of benefits to costs.

To address recurring congestion, our modeling of the roadway system found that it will take the addition of 488 lane-miles of capacity (or the functional equivalent) between 2005 and 2030 beyond what is in the current long-range plan to eliminate Level of Service F (severe congestion) conditions by 2030. Our recommended tool for accomplishing this is to implement a "managed lanes" approach on both I-75 and selected arterials.

The most common form of managed lane uses variable pricing (via electronic tolling) to keep traffic demand within the limits of what the lane can handle without congestion occurring (technically, Level of Service C conditions). Compared with the stop-and-go conditions that occur in regular lanes during peak periods, throughput on managed lanes during peak periods can be as much as double that of the regular lanes. And the revenues generated mostly during those peak periods can in many cases pay for much or all of the capacity improvements.

For I-75, we propose that the phased expansion to 10 lanes by 2030 be carried out with all the new lanes being managed lanes. This approach will ensure that all the new lanes have higher throughput than they would as regular lanes during peak periods, and the revenues they generate should come close to paying for all of the new lane capacity.

In this report, we introduce the concept of managed lanes on selected arterial corridors. Grade separations (queue jumps) would be provided at key intersections, allowing four of the six lanes to bypass traffic lights. Tolls would be charged electronically for each queue jump a motorist uses. Some or all of these corridors may have express lanes between the queue jumps. Preliminary calculations for such a facility on the Daniels Road Corridor suggest that it could be self-supporting based on toll revenues. We then suggest a network of such corridors which, because of the higher throughput provided by managed lanes, would be the equivalent of adding 403 lane-miles of conventional lanes.

Together, the managed lanes on I-75 and the managed arterials would provide the infrastructure to support countywide express bus service. Because variable pricing would keep this network free-flowing and uncongested even during peak periods, it would function as the virtual equivalent of an exclusive busway network. But since the network would be paid for largely by drivers who pay tolls for its use, the transit system would be spared the billions of dollars that it would otherwise cost to build a countywide busway or rail transit system.

The combined cost of the managed lanes proposed for I-75 and the arterials is $5.7 billion, most of which could be financed based on the estimated toll revenues. Our modeling shows that the addition of this amount of new capacity would eliminate severe (Level of Service F) congestion by 2030. The benefits—primarily time savings but also reductions in vehicle operating costs and fatal accidents—are estimated at $13.25 billion over a 20-year period. Thus, the one-time investment of $5.7 billion would produce 20-year savings that are 2.33 times greater.

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Part 1

Lee County's Congestion Problem

Lee County has been one of the fastest growing urban areas in the United States, and despite a recent slowdown due to economic problems affecting the entire country, this growth is predicted to continue into the coming decades. Traffic congestion is a major problem in the county, and the problem is growing at an alarming rate. This congestion affects the residents daily, and traffic congestion was ranked as one of the county's top three issues by 90% of respondents in a recent survey, with 30% ranking it as the number one issue in Lee County.[1]

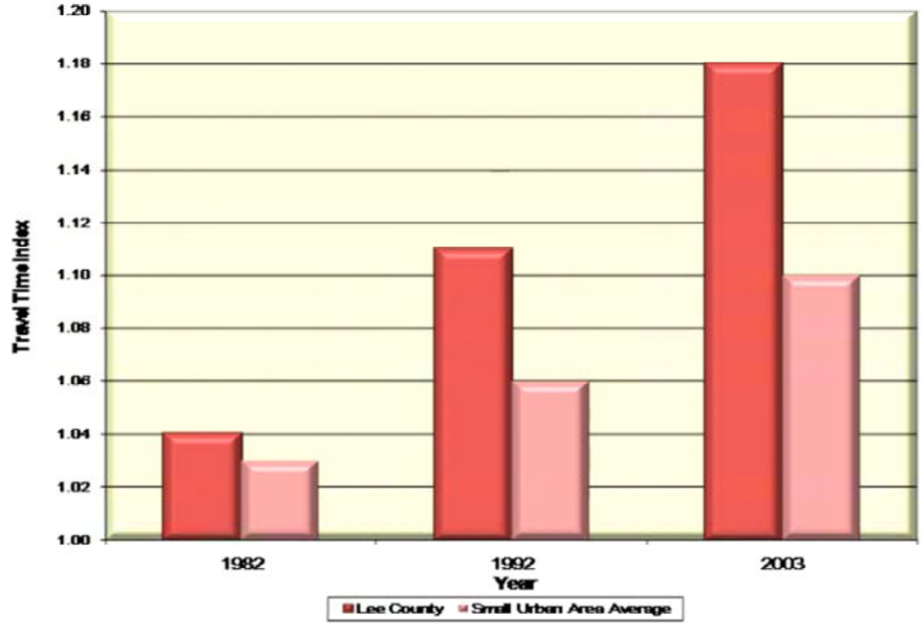
Congestion also impacts the county's many visitors. With tourism being a critical industry in Lee County, research into what visitors like and dislike about Lee County is extensive. While the overwhelming majority of visitors are satisfied, overall, with their visit, the county's Visitor and Convention Bureau uses surveys to identify any negative aspects. When visitors were asked what they disliked about their experience in Lee County, "traffic delays" was the number one response. In fact, it was mentioned as a negative by almost 20% of respondents. This is over three times more often than the next most common answer (red tide and its effects).[2]

When visitors were asked what they disliked about their experience in Lee County, "traffic delays" was the number one response.

Prior to the mid 1980s, Lee County's congestion was relatively minor. However, as can be seen in Figure 1, since 1982 Lee County's congestion has increased at twice the national average for similar urban areas. At present it takes 18% longer to travel at rush hour, when congestion is severe, than at off-hours. Researchers define this as a Travel Time Index of 1.18. Even if all the financially feasible improvements to the region's transportation system included in the current long-range transportation plan are implemented, by 2030 congestion will still increase significantly. Using analysis performed for this study with the Florida Standard Urban Transportation Modeling Structure (FSUTMS) long-range transportation planning model, we estimate that the same rush-hour trip will take 30 percent longer than at off-hours (i.e., the index will have increased to 1.30).

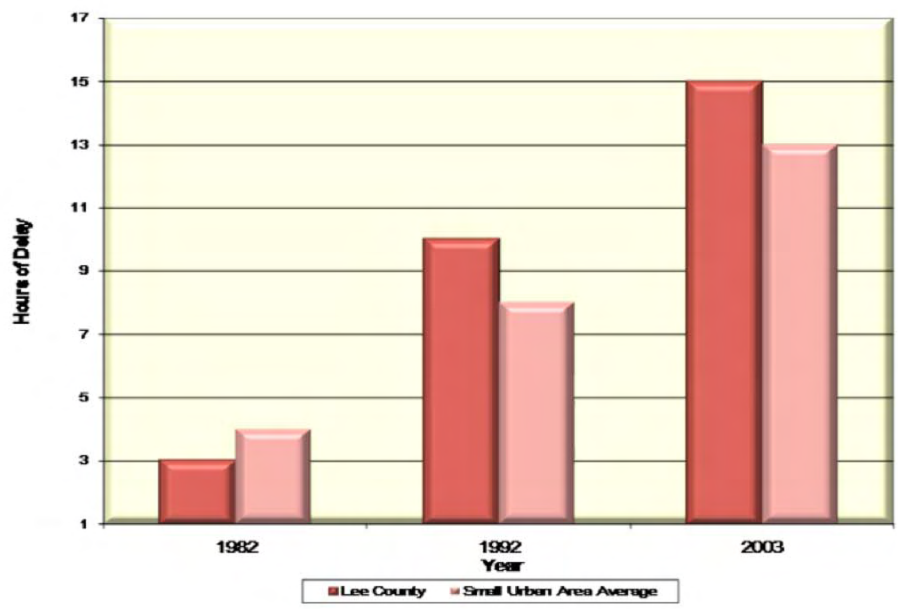
In 1982, Lee County's Travel Time Index was similar to the average for "small" urban areas. But by 2003, it had increased significantly. The growth in delay per peak traveler is also significant as depicted in Figure 2. Of special concern is that the rate of growth in congestion in Lee County is significantly higher than national averages. In retrospect, it seems clear that Lee County's transportation network has not kept up with the enormous growth the county has experienced in the last two decades.

Figure 1: Growth in Lee County's Travel Time Index



Source: The Texas Transportation Institute – *2005 Urban Mobility Report*

Figure 2: Growth in Lee County's Delay per Peak Hour Traveler



Source: The Texas Transportation Institute – *2005 Urban Mobility Report*

Congestion affects many of Lee County's roadways, but since the freeways and arterials handle the lion's share of all traffic, our focus will be on those portions of the roadway system. Congestion is at its worst during the peak periods of each weekday, generally defined as from 7 to 9 AM and from 4 to 6 PM in Lee County. And while a great many peak-period trips are not simple work-to-home trips, commute trips are the focus of most transportation planning, since those are the trips that must be made during those hours. Table 1 shows how residents of the Cape Coral Urban Area (the most heavily populated portion of Lee County) typically made their work trips in 1990 and 2000. As can be seen, between driving alone and carpooling, the automobile totally dominates the work trip, at more than 90%. The largest change in mode share between these two census years was the increase in working at home (mostly telecommuting), which grew from 2.2% to 3.5%.

Table 1: Mode of Work Travel, Cape Coral Urban Area, 1990 and 2000

Travel Mode	1990 Mode Share	2000 Mode Share
Drive alone	77.40%	78.70%
Carpool	15.30%	13.70%
Transit	0.90%	0.80%
Bicycle	0.70%	0.80%
Walk	2.00%	1.50%
Work at home	2.20%	3.50%
Other	1.40%	1.10%

Source: U.S. Census data for 2000, 1990

It is clear that the automobile dominates the daily commute in Lee County. Since transit experiences the same traffic delays as auto trips, except for the short work trips that can be made on foot or bicycle, driving provides the quickest trip, despite the added time due to congestion.

Given the continued dominant role of the automobile, the rapidly increasing population and the annual influx of seasonal residents and visitors, Lee County's transportation system is under constant assault. Many of the natural features that are part of Lee County's allure inhibit the development of a more extensive freeway and arterial system to handle the projected population growth from today's 600,000 to as many as 1,500,000 at build-out. The Caloosahatchee River and Six Mile Cypress Slough constrain opportunities for additional east-west corridors in the county from both cost and environmental standpoints. Development in western Lee County and water recharge areas in eastern Lee County (important in meeting the county's need for water to support its growing population) present barriers to additional north-south corridors.

Figure 3 shows the existing Lee County transportation system, including the natural barriers to provision of additional transportation corridors.

Figure 3: Lee County Roadway System

The data in Table 2 compare Lee County's freeway and arterial systems with those of comparable urban areas. For planning purposes at the federal level, urban areas are defined consistently across the United States. These urban areas are named based on the largest city within them, and the urban area in Lee County is called the Cape Coral Urban Area.

Looking first at freeways, the Lee County area appears to have a relatively good ratio of freeway vehicle miles of travel (VMT) per lane-mile based on Cape Coral Urban Area data contained in the Congestion Data Spreadsheet produced by the Texas Transportation Institute. This ratio would normally indicate freeways that function well and are uncongested. However, much of I-75 in Lee County is actually located outside the Urban Area Boundary and is not reflected in the TTI spreadsheet. In fact, much of I-75 currently experiences congestion that pushes traffic flow below the standards adopted by the local government, and this congestion is expected to continue even after a portion of the facility is widened from four to six lanes.[3]

The situation is also grim from an arterial standpoint. Lee County has the lowest arterial density of any of the comparable areas analyzed in this study and the second highest ratio of arterial VMT per lane mile. In other words, its arterials are overloaded. The problem is growing with a transportation funding shortfall of over $4 billion (including I-75) anticipated between 2007 and 2030.[4]

Table 2: Comparative Data on Freeways and Arterials

Urban Area	Pop (000)	Freeway VMT (000)	Freeway lane-mi	Freeway VMT (000)/ lane-mi	Arterial lane-mi.	Area (sq. mi.)	Art. lane-mi per sq. mi.	Art. VMT (000)	Arterial VMT (000)/ lane mi
Cape Coral Urban Area	325	435	45	9.67	350	280	1.25	2300	6.57
Small Urban Area Average	302	1993	179	11.13	317	173	1.83	1758	5.55
Charleston-No. Charleston, SC	470	3130	255	12.27	420	285	1.47	3150	7.50
Colorado Springs, CO	480	3435	290	11.84	440	300	1.47	2660	6.05
Columbia, SC	430	4625	390	11.86	345	225	1.53	1900	5.51
Corpus Christi, TX	320	2960	300	9.87	285	200	1.43	1200	4.21
Pensacola, FL-AL	310	1200	110	10.91	575	200	2.88	3200	5.57
Spokane, WA	355	1585	140	11.32	545	180	3.03	2745	5.04

It is possible to see what happened during the 1980s and 1990s that led to the sharp increase in traffic congestion. Lee County pursued an aggressive program of road building in the late 1980s and 1990s making it one of the few urban areas that, on a percentage basis, added roadway capacity at a rate similar to its increase in traffic. Why then has congestion increased more rapidly than in similar urban areas and why did delay per traveler increase by 500% in the two decades between 1983 and 2003?

The answer may lie in the types of roadways that carry traffic in Lee County. Of the principal roadway network, only 11% of lane-miles in the Cape Coral Urban Area are freeway miles, with the remaining 89% being arterials. This is the lowest percentage of freeway lane-miles to arterial lane-miles of the urban areas compared and less than one-third of the average percentage among small urban areas. As arterial lane-miles are only able to carry 50 to 70% of the traffic of a freeway segment, the overall system is not as efficient as roadway systems in comparable areas. Coupled with Lee County's low arterial density, the layout of the system (see Figure 3) appears to be having a significant negative effect on congestion in the county.

A. The Costs Congestion Imposes on Lee County

Current levels of congestion impose serious costs on individuals, businesses and the regional economy, which will grow as congestion worsens. The annual *Urban Mobility Report* from the Texas Transportation Institute (TTI) estimates that, as of now, Lee County drivers spend 2.7 million man-hours per year sitting in congested traffic.[5] The cost of this wasted time, along with wasted fuel from inefficient stop-and-go driving, totals $46 million per year, the equivalent of $261 per commuter per year. But it should be understood that the wasted time and fuel reported in these biannual tabulations does not constitute the full cost of traffic congestion.

The chief economist of the U.S. Department of Transportation has provided a more complete estimate of national traffic congestion costs. In addition to the $63.1 billion in wasted time and fuel reported by TTI for the largest metro areas, add another $12.8 billion for similar costs in all other metro areas. DOT estimates $38 billion in annual costs due to productivity losses (discussed below), another $38 billion due to unreliability, $3.8 billion due to cargo delay, and $12.6 billion in safety and environmental costs of congestion. The total then amounts to $168.3 billion, more than double the widely reported TTI figure.[6] Applying that ratio (168.1/63.1) to the TTI congestion cost figure for Lee County ($46 million), we estimate that the true annual cost is closer to $122 million, or almost $700 per commuter.

To understand what leads to a more expansive definition of congestion costs, consider trucking. While truck congestion is counted in TTI's methodology, the value of time used for trucks reflects only the hourly operating cost of trucks, not the value of trucking services to shippers. With the growing freight impact of Southwest Florida International Airport, commercial vehicle traffic is likely to increase even faster than overall traffic. In addition to wasting time, congestion wreaks havoc on the reliability of truck pick-up and delivery schedules—a cost that, although very real, is not included in the TTI *Urban Mobility Report* figures.

Several years ago, the National Cooperative Highway Research Program (NCHRP) funded pioneering research attempting to get a handle on the cost of congestion to regional businesses.[7] As noted above, congestion interferes with just-in-time delivery systems, thereby increasing inventory costs. It reduces the availability of skilled workers and raises payroll costs needed to attract such workers. It shrinks the market area for local firms' products and services. And it reduces the range of job opportunities for workers.

The NCHRP research team used Chicago and Philadelphia to gather data enabling them to do some preliminary modeling of these effects. On the logistics effects, they estimated that a 10% reduction in congestion would save businesses $980 million per year in Chicago and $240 million a year in Philadelphia. The labor market effects were estimated at $350 million in Chicago and $200 million in Philadelphia. The combined totals for each city, if adjusted for inflation to 2007 dollars, would be $1.65 billion per year in Chicago and $545 million per year in Philadelphia.[8]

Congestion also has substantial effects on labor markets. The basic idea is that, on average, most people will not spend more than a particular amount of time each day on the journey to work. As congestion gets worse, the number of miles they can go within this amount of time gets smaller. You can think of this as a radius of job opportunities centered on the person's home. Or flip it around and think of it as a radius of possible workers an employer can expect to attract. When congestion is low or zero, that radius is quite large, but in a congested region, it is much less. The more severe congestion is, the shorter the job/worker opportunity radius becomes.

Worse, the impact on employees and employers is exponential. Since the area of a circle is proportional to the radius squared, the area of a 20-mile radius circle is four times that of a 10-mile radius circle. If work possibilities are randomly distributed across the landscape, the 20-mile circle will include four times as many job opportunities as the 10-mile circle. And the same applies in reverse for an employer. It will have four times as many potential employees within a 20-mile circle as a 10-mile circle. All of this applies to service businesses that must travel to customers as well—delivery services, plumbers, yardkeepers, electricians, etc. Congestion reduces the number of stops or customers they can serve each day, meaning there must be more service providers for a given area as congestion worsens.

To those who study labor markets, this is not simply a matter of it being nice that people have more choices. In a large and diverse metro area, economic productivity depends on matching up skilled employees with employers who can make the best use of their abilities. When Remy Prud'homme and Chang-Woon Lee studied this question using data on travel times and labor productivity for French cities, they reached some remarkable conclusions.[9] They found a robust relationship between the effective labor market size (the size of the available circle, as defined by acceptable travel time) and the productivity of that city. Specifically, when the effective labor market size increased by 10%, productivity per worker (and hence economic output) increased by 1.8%.

In the United States, Wendell Cox and Alan Pisarski applied the Prud'homme and Lee analysis to Atlanta in 2004. They found that a scenario that maintained the existing Travel Time Index between 2004 and 2030 would lead to a 2.4 percent increase in gross personal income in the Atlanta area. A scenario that *reduced* congestion by 50 percent from current levels would increase personal income by 3.5 percent. Those numbers translate into increases of $2,450 and $3,560 per person in 2030.[10] A forthcoming Reason study measures the effects of congestion on labor markets in U.S. cities in a similar fashion to what Prud'homme and Lee did with French cities, and finds similar results.[11] Even more, it goes on to measure the effects that congestion's restrictions on labor markets have on regional economic growth, and finds substantial effects, indicating that an area such as Lee County is likely losing hundreds of millions of dollars in growth by allowing congestion to worsen.

Congestion harms the citizens of Lee County in many other ways as well. With the roads gridlocked, emergency vehicles may be seriously delayed, meaning the paramedic may not get there in time to save a life, or the firefighters may not arrive in time to knock down a fire and save much of the building. If after-work hours are seriously congested, people may avoid restaurants and theaters that become too much of a hassle to get to. People's circles of opportunity are shrunk by congestion not just when it comes to employment. Congestion also shrinks their possibilities in entertainment, recreation and social life. Even computer dating services report many participants being unwilling to matched up with people who live more than a certain distance away, because congestion simply makes it too much of a hassle to try to develop a long-distance dating relationship.

Finally, there is also the issue of economic competitiveness. Lee County is in competition with other Sunbelt metro areas as a place to live, work and do business. While all its competitors are currently plagued by traffic congestion, that situation is changing. Texas cities, for example, in

2004 signed on to the *Texas Metropolitan Mobility Plan,*[12] under which each one has selected a target Travel Time Index—well below today's level—to achieve by 2030. This effort was spearheaded by the Governor's Business Council in response to Dell Computer announcing that it would no longer expand its facilities in Austin, due to unacceptable traffic congestion. The Metropolitan Planning Organizations of the principal Texas cities—Austin, Dallas, Houston, San Antonio and others—are in the process of re-writing their long-range transportation plans to re-focus on reducing congestion as their primary goal.

In Georgia, the Governor's Congestion Mitigation Task Force recommended that reduced future traffic congestion be made the principal goal of the metro Atlanta long-range transportation plan.[13] All four principal transportation agencies agreed to this approach. A similar process has begun in Washington State, with the legislature commissioning an independent study to assess various aggressive scenarios for reducing traffic congestion in the state's major urban areas.[14]

B. Growing Focus on Congestion

It appears that Lee County's transportation leadership is considering becoming more aggressive in its approach to reducing the congestion problem facing the area. In March 2007 the Board of County Commissioners tasked the County's Department of Transportation with looking at additional transportation funding mechanisms and evaluating their use in Lee County. These mechanisms include greater use of tolls, a dedicated sales tax and use of public/private partnership arrangements.

Lee County was one of the first jurisdictions in the United States to implement variable toll pricing for travel demand management purposes, and has found that this kind of tolling can have a particularly beneficial effect. Travel demand management, usually abbreviated as TDM, recognizes that congested conditions are a result of the confluence of the lack of transportation facilities (supply) and the amount of traffic wanting to use the facility (demand) at any one time. In this case TDM uses tolls that vary by time of day to bring economic forces to bear, helping balance roadway supply with travel demand. In Lee County the use of tolls would not only reduce congestion by bringing additional facilities on line, it would also increase the efficiency of these facilities by better balancing supply and demand. Additionally, variable toll pricing is supported by the public in Lee County. In fact, recent surveys indicate overwhelming support for varying tolls by time of day for congestion relief on facilities that are currently tolled.[15]

Consideration of these additional funding mechanisms represents a bold step forward. If implemented and followed through, they would keep Lee County in the forefront of urban areas nationwide committed to serious ***reductions*** in traffic congestion, rather than (at best) holding the line or (more typically) conceding that congestion will continue to get worse over time (as is the case with current funding approaches).

C. Solving Congestion in Lee County

Lee County cannot assume that its competitor urban areas will continue to be traffic-choked indefinitely. Some appear to be committing their transportation planning to aggressive congestion-reduction strategies, while others seem content with plans under which congestion will continue to increase. Lee County is already showing a willingness to address its traffic problems and has embraced both conventional and unconventional approaches. We undertake here to build on that willingness and suggest an even bolder approach to help address the roadblocks Lee County faces in addressing its traffic congestion problems.

Lee County cannot assume that its competitor urban areas will continue to be traffic-choked indefinitely.

It is one thing to set an aggressive goal for reducing congestion; it is far more challenging to actually implement that goal. What would it mean to refocus transportation planning and investment on large-scale congestion reduction? To what extent could this be done by re-allocating existing resources (perhaps by changing the emphasis when selecting projects to strongly favor congestion relief)? To what extent would it require net new resources, from either taxes or tolls? And what sort of improvements to the transportation system would such an approach implement?

It is one thing to set an aggressive goal for reducing congestion; it is far more challenging to actually implement that goal.

This report tackles these and other questions. It is part of a national Reason Foundation research project, the Galvin Mobility Project, whose purpose is to focus national attention on eliminating serious traffic congestion as a major urban problem in America.[16] Much of the project researches why congestion has become so severe and what we've learned about what works and what doesn't work in reducing it. In addition to that research, the project is producing case studies that apply what is being learned from the research to specific urban areas—including Lee County. While time and resources do not permit this Lee County case study to provide detailed solutions, it should be sufficiently provocative and persuasive to inspire Lee County's citizens and leaders to embrace the goal of solving congestion.

Part 2

The Sources of Congestion and Possible Solutions

A. Types of Congestion

Although the explanation for traffic congestion may appear to be as simple as "trying to stuff 10 pounds of potatoes into a 5-pound sack," the reality is somewhat more complex. There are two different types of congestion—recurring and incident-related.

The first of these is what most people encounter every day on their trips to and from work—the rush hour overloading of the roadways with more vehicles than they can handle. Researchers refer to this as *recurring* congestion because it occurs with regularity. It results from a basic mismatch of highway capacity with the number of vehicles, or what economists would call demand for road space far in excess of the supply of capacity. This type of congestion is costly—but at least it's predictable.

The second type of congestion is called *incident-related* congestion. It results from a whole variety of causes, some completely unpredictable (breakdowns and crashes), some partially predictable (bad weather events), and some very predictable (construction work zones). Since most types of incident-related congestion are not known to motorists ahead of time, this type of congestion adds *unreliability* to people's trips. The additional delay added by the rubbernecking due to a fender-bender may add a random 20 minutes to what is already a congested 30-minute trip. When incidents are known to occur fairly often (though still at random), people who wish to arrive on time must add an additional cushion of time onto all such trips, even if only a random fraction of them actually encounter the extra delay of an incident. This "buffer time" is not included in standard measures of congestion, but is nevertheless part of its true cost.

It should be fairly obvious that different types of solutions are required for these two different types of congestion. The fundamental cause of recurring congestion is a mismatch between demand and capacity. So the solution for this type must involve various ways of bringing demand and supply into balance. We will make the case below that the most cost-effective approach rests largely on adding to the transportation system's capacity.

For incidents, however, the broad category of solutions lies within the realm of better system management. Detecting, responding to and clearing up breakdowns and accidents far more quickly is one example; this involves both technology and institutional changes. Lee County recently completed a study of potential Intelligent Transportation System (ITS) improvements on Colonial Boulevard. This study showed that implementation of an incident management system on Colonial Boulevard would have a benefit-to-cost ratio of almost six to one.[17] As another example, construction projects can be planned and managed in ways that disrupt peak-period traffic flows less than is typically the case today.

There is no single magic bullet that can eliminate all traffic congestion. A very large-scale effort is needed between now and 2030 to address existing congestion problems as well as to meet the ever-increasing pressure on the county's roadway system brought about by the area's fast-paced growth. As long as only the projects that are currently considered "financially feasible" in the county's Long Range Transportation Plan are completed, congestion will rapidly increase in Lee County. If more resources and more approaches to better managing capacity can be brought into play, the county could be successful in maintaining and even reducing existing levels of congestion. If this can be achieved, then ongoing efforts in subsequent years can prevent congestion from worsening again, and could reduce it further. But those ongoing efforts will have to address both recurring congestion and incident-related congestion.

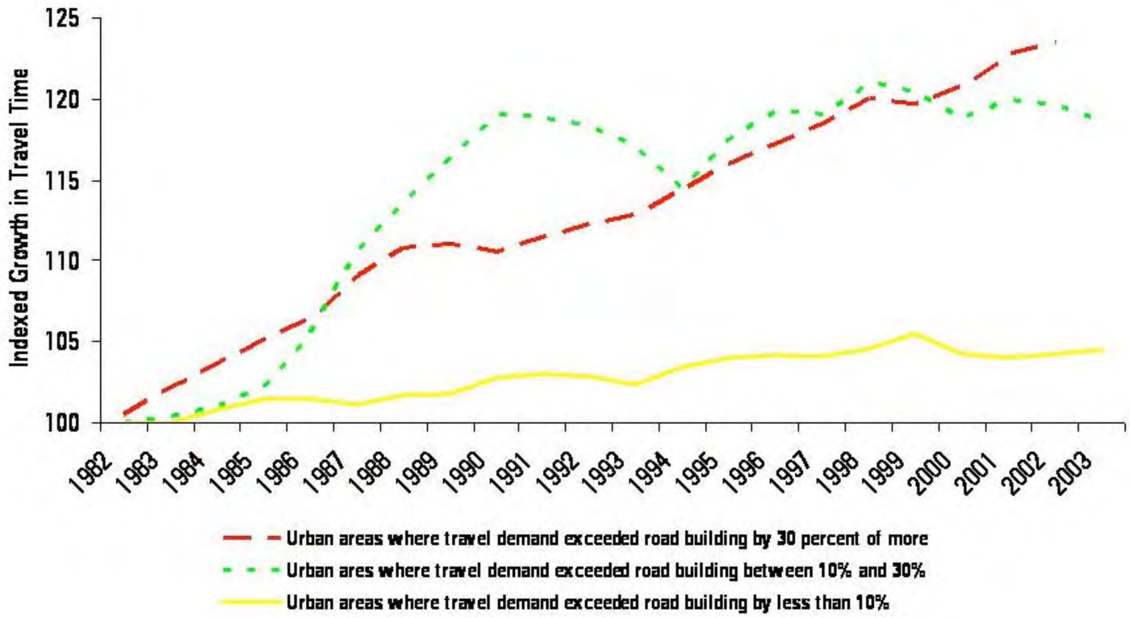
B. Countering Recurring Congestion

As noted above, recurring congestion is fundamentally about a large disparity between demand and supply. During the past two decades, the trend in urban transportation policy has been toward demand-reduction rather than supply increases. It was believed (or hoped) that expanding mass transit systems, increasing the density of land use near transit stations, and giving people incentives to carpool would significantly reduce the extent of solo driving within the planning horizon of typical long-range transportation plans, thereby reducing congestion.

Unfortunately, while good things can be said about each of these policies, there is no evidence that they have reduced either solo driving or congestion. During the same two decades that these policies were increasingly carried out, congestion reached ever-higher levels, year after year, as carefully documented in more than 20 years of *Urban Mobility Report* data.

Data from TTI on America's largest 85 urban areas shows that regions that increased roadway capacity more or less in pace with travel demand had only modest increases in congestion between 1982 and 2003, as shown in Figure 4. By contrast, urban areas that did not expand roadway capacity to keep up with travel demand experienced much larger increases in congestion. In effect, we have run a large national experiment over the past two decades, testing whether demand reduction or capacity expansion would do better at reducing recurring congestion. The data clearly show that capacity expansion has worked better.

Figure 4: Congestion Growth vs. Highway Capacity Expansion (Data for 85 urban areas)



Source: Reason Foundation calculations from data provided by Texas Transportation Institute.

Why does Lee County seem to be an exception to the national trend? Even though Lee County has done a good job adding roadway capacity over the past two decades, it still faces increasing levels of congestion. Lee County's small number of freeway lane-miles compared with other urban areas has produced a roadway transportation system that is not as effective per lane-mile as the roadway system in similar urban areas. In short, Lee County is rapidly urbanizing, but the makeup of its transportation system reflects the county's more rural past.

Autos and buses will continue to carry the overwhelming majority of personal travel in Lee County, and trucks the majority of goods, and they will use the roads. So road capacity is central to addressing congestion. A capacity expansion strategy has to address both utilization of existing capacity and adding new capacity, and in Lee County this means: eliminating bottlenecks, managing existing lanes to increase their functional capacity, and adding lanes. This will not require that Lee County dramatically change its approach to developing its transportation system. The county does, however, need to make some changes to how it manages existing capacity and find the resources to make the improvements identified as necessary to eliminate severe congestion.

1. Bottleneck Elimination

Bottlenecks are specific points in the roadway network (in particular, the freeway system), where traffic gets clogged due to specific physical features of the system. Minor bottlenecks occur where the number of lanes suddenly decreases by one and traffic has to squeeze into the remaining lanes. Others may occur where on- and off-ramps are too close together, resulting in excessive weaving as cars cross each others' paths getting on and off in too short a distance. Major bottlenecks often involve freeway interchanges that are not designed to handle traffic volumes brought about by major increases in traffic.

Traditional freeway bottlenecks are not a major issue in Lee County. Unfortunately, the reason they are not a major issue is that relatively little freeway capacity exists, and the traffic demand on the existing facilities (I-75) is so high that poor levels of service are not confined to "point" bottleneck locations.

Some of the most serious congestion in the county exists at arterial intersections that would be much improved if people could avoid stopping at frequent stop lights. Providing grade-separated lanes at intersections can increase the functional capacity of the arterials by removing interference from cross-street traffic. Part 3 of this report discusses this approach in detail.

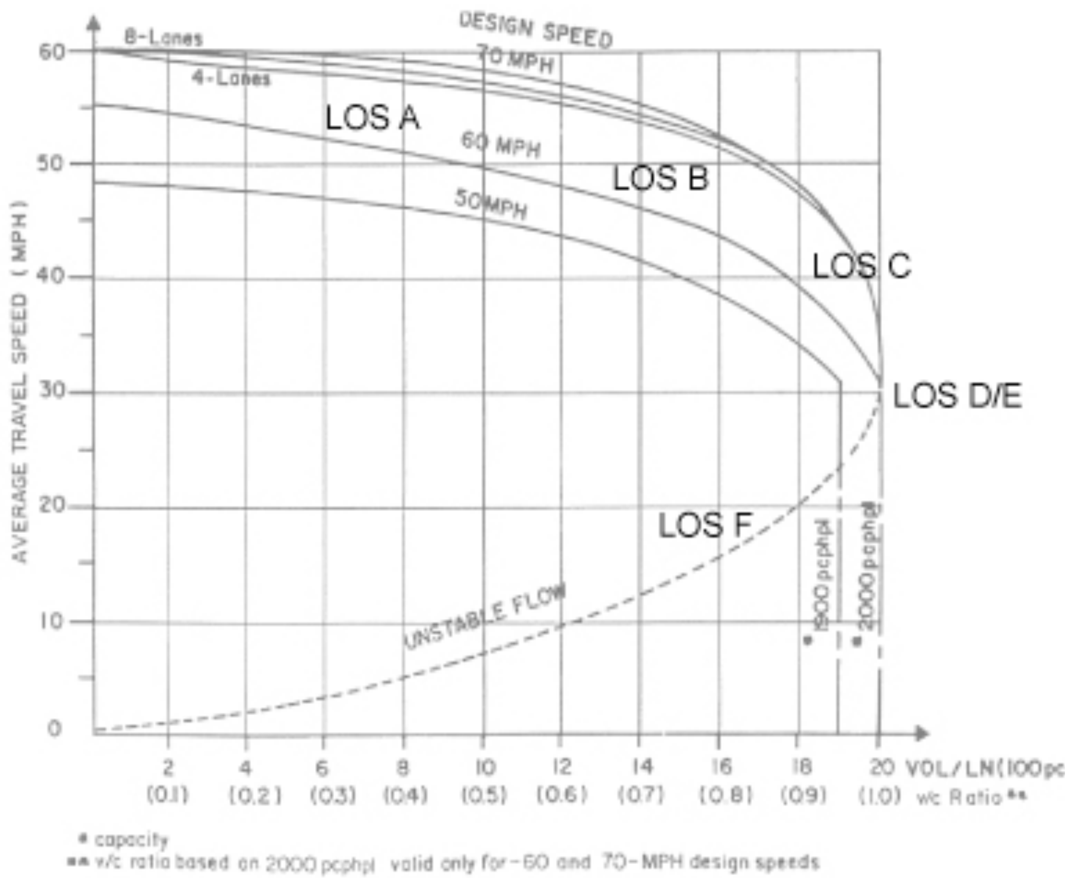
2. Increasing Functional Capacity by "Managing" Lanes

Another way of adding capacity is to manage traffic flow in roadway lanes so that they do not get into the severely congested state characterized by stop and go traffic. When traffic flow breaks down in that manner, it becomes mathematically "chaotic"—sometimes at a standstill, sometimes moving at 10 mph, sometimes at 20 mph, but nothing consistent. When traffic degenerates into this condition, the throughput (number of vehicles per lane per hour) of the roadway decreases considerably. For example, a freeway full of traffic but still moving steadily at, say, 40 mph will likely have a throughput of about 2,000 vehicles/lane/hour. Once more vehicles try to crowd onto it, the flow rate can degenerate to 1,500, 1,200, or even less as speeds drop into the zero to 20 mph range.[18] These conditions are shown in the traffic engineers' speed/flow curve, one version of which is shown here as Figure 5.

In practical terms, this means that at the time a roadway's capacity is most needed, congestion itself has actually reduced the road's ability to carry traffic by 25 to 40%. In other words, a six-lane freeway functionally becomes a four- (or less) lane freeway.

In the last 10 years, California and several other states have gained considerable experience with using variable pricing to manage traffic flow to prevent the kind of unstable flow shown in the lower portion of Figure 5. Lee County's congestion pricing program has shown that traffic demand can be managed in Lee County by the same method.

Figure 5: Traffic Throughput vs. Speed



By raising the price as demand increases, roadway managers are able to keep traffic where there is both high speed *and* high throughput. "Managed lanes" of this sort are typically priced to offer significant time savings, by allowing those willing to pay for a faster and more reliable trip to travel at, say, 60 mph. A single-lane facility of this type can maintain uncongested Level of Service[19] (LOS) C conditions while carrying about 1,700 vehicles/lane/hour, while a dual-lane facility can handle 1,800 per lane per hour in relatively uncongested conditions.

During the busiest peak periods on California's 91 Express Lanes (a dual-lane facility), the two priced lanes handle 49% of the peak-direction throughput on this six-lane (per direction) freeway, even though they represent only 33% of the *physical* lane capacity. Thus, priced managed lanes operating at LOS C during rush hour have about 50% more *functional* capacity (throughput) than the highly congested (LOS F) general-purpose lanes alongside.

Since lanes that are managed using tolls increase the functional capacity of the roadway, it is not just the drivers using the managed toll lanes who benefit. As the managed lane can carry more vehicles per hour than it would were it unmanaged, traffic on the other lanes of the freeway also benefits as fewer vehicles are competing for their capacity. In other words, all drivers win, not just those using the toll lanes. These facts have major implications for a decision that Southwest Florida is currently struggling with: whether or not to implement tolls on two new lanes of I-75, and, eventually, to toll a total of six lanes of a 10-lane facility.

3. Adding Lane Capacity

Basic capacity expansion means adding more lane-miles of freeway and arterial to the system to keep pace with demand brought about by Lee County's rapid population growth.

We estimated how many lane-miles, over and above those projects currently identified in the long-range plan as financially feasible, would have to be added to the roadway system to eliminate all severe congestion (LOS F) by 2030. We ran the Florida Standard Urban Transportation Modeling Structure (FSUTMS) using Lee County's "financially feasible" long-range transportation planning model for the base model. The results were that a total of 488 lane-miles of all types (freeway, arterial, collector, and other) would need to be added over the 25-year period from 2005 through 2030 to achieve the goal of eliminating severe (LOS F) congestion. Freeway lane-miles, in addition to the lanes currently being constructed to bring a significant portion of I-75 from four to six lanes (which are already assumed to be in place in the base model), were 85 lane-miles of this total. That would mean adding an average of 3.4 freeway lane-miles per year. Arterial additions would be 296 more lane-miles, while local streets and roads would need another 107 lane-miles. As noted previously, this report deals only with freeways and arterials.

C. Countering Incident-Related Congestion

The Texas Transportation Institute estimates that 53% of congestion in Lee County is incident-related. That percentage has remained relatively unchanged since 1983. This is not surprising, since national figures for large urban areas (greater than one million population) suggest that incident-related congestion may well be more than half of the congestion experienced on any given day. Table 3 is excerpted from a recent report from the National Cooperative Highway Research Program. As can be seen, for medium-size urban areas, incident-related congestion accounts for the majority of all congestion, on average.

As noted previously, one consequence of non-recurring congestion is that the reliability of travel times deteriorates, and many people add buffer time into their planned travel times just in case an incident occurs. Focus groups recently conducted for the Southwest Florida Expressway Authority verified that buffer time is a fact of life in Southwest Florida.[20] It should be remembered that the value of the time people waste as buffer time is very real, but it is not included in the reported cost of congestion (such as the $46 million for Lee County in 2003).

Table 3: Sources of Congestion in Medium Urban Areas	
Source of Delay	Percentage Contribution
Demand greater than capacity	26%
Poor signal timing	7%
Total Recurring Congestion	**33%**
Crashes	27%
Breakdowns	6%
Work zones	27%
Weather	7%
Special events, other	--
Total Non-Recurring Congestion	**67%**

Source: Steve Lockwood, "The 21st Century Operations-Oriented State DOT," Washington, DC: National Cooperative Highway Research Program, Transportation Research Board, April 2005. Note: While the TTI *Urban Mobility Report* still considers Lee County to be a small urban area, the comparison to a medium urban area is used to reflect that the county is nearing the medium threshold and this likely better reflects future conditions.

The general term for the kinds of measures needed to cope with non-recurring congestion is "operations strategies." In 2000, the California DOT (Caltrans) analyzed a package of such system operations strategies and found it to have a benefit/cost ratio of 8.9:1.[21] By contrast, the simple addition of conventional highway capacity had a benefit-cost ratio of 2.7:1. Both are necessary. To keep up with sustained growth in the economy and travel, capacity must be added steadily over time. But the less costly and short-run low-hanging fruit are the system operations measures, which have the additional advantages of being (1) relatively inexpensive, and (2) able to be implemented within a matter of years, rather than decades. For Lee County the most important of operational strategies include freeway ramp metering, improved incident response, and signal timing on arterials.

1. Freeway Ramp Metering

When a freeway is running near capacity, small increases in volume can push the situation into chaotic, stop-and-go conditions, and a common source of such small increases is vehicles crowding on from an on-ramp. Ramp metering puts a traffic signal on the on-ramp that introduces a calculated time interval between entering vehicles. This strategy is being considered in Southwest Florida. Extensive data now exist to show that ramp metering can have a significant impact on preventing this type of flow breakdown into LOS F conditions. The San Francisco region's Bay Area Toll Authority has estimated a 14:1 ratio of benefits to costs for ramp metering in its region.[22] It should be noted that aggressive ramp metering can lead to backups on the on-ramps, which may require additional capacity on nearby arterials. Changes can be made to lengthen the on-ramps thereby providing additional storage capacity on the ramps themselves. While I-75 in Southwest Florida likely has sufficient right-of-way to accommodate this type of change, the associated construction costs would lower the benefit-to-cost ratio.

2. Improved Incident Response

The Washington State DOT estimates that the throughput on a six-lane (three per direction) freeway can be cut 20% by a car out of gas on the shoulder, 50% by a disabled car blocking one lane, and 85% by an accident blocking two lanes.[23] Rapid response and rapid clearance of such incidents can significantly reduce the duration of such congestion, allowing the freeway's capacity to be reclaimed. The Bay Area Toll Authority estimates a benefit/cost ratio for such projects of 8:1.[24] Such projects typically involve advanced video systems for quickly spotting incidents, dispatch center(s) to send appropriate response crews, and freeway service patrols to deal quickly with minor incidents. The Freeway Management Center currently under construction for I-75 represents a very positive step by the Florida Department of Transportation for improving incident response in Lee County. Other laudable efforts are also underway by the county itself.

3. Signal Timing on Arterials

Improving traffic signal systems on busy arterials, such as providing a "rolling green" signal in the peak direction, can significantly reduce travel times in many instances. Recent research in Lee County indicates that benefit-to-cost ratios of over 30 to 1 are very realistic.[25] Efforts underway by the county itself and by the Florida DOT to expand advanced traffic signal systems in the county should continue to be supported and encouraged.

Other "operations strategies" include better management of construction work zones, provision of real-time traveler information (to enable people to choose alternate routes), and accurate prediction of impending weather impacts. Efforts in most of these areas are also under way in Lee County.

The techniques discussed here have been quantified in the NCHRP report referred to earlier. Table 4 summarizes the range of impacts that these techniques may be expected to have, if fully implemented, in urban areas of 1-3 million people. While Lee County does not currently have this large a population, it will.

Table 4: Estimated Leverage of Systems Operations and Management on Congestion

Problem	% of Total Delay	Strategy/Tools	Potential Effect (% of Total Delay)
Uncoordinated signals	4-13%	Regionwide re-timing	2-5%
Crashes & breakdowns	20-42%	Integrated freeway service patrol, incident management program	10-20%
Work zones	8-27%	Advanced work-zone traffic control; automated speed control	4-13%
Weather impacts	5-10%	Prediction/advisory, pre-treatment	2-5%

Source: Steve Lockwood, "The 21st Century Operations-Oriented State DOT," Washington, DC: National Cooperative Highway Research Program, Transportation Research Board, April 2005, Table 5.

Part 3

A Congestion Relief Strategy for Lee County's Arterial Roadways

Major capacity upgrades to existing arterial facilities would provide significant traffic congestion relief in Lee County, if sufficient funding were available. Arterials are an especially important element of the county's transportation infrastructure due to the relatively low percentage of freeway miles in the county's transportation system. Constructing additional arterial lane-miles is an approach the county is and should continue taking. However, because Lee County's ratio of limited-access facilities to arterials is relatively low, operational upgrades on selected arterials to increase functional capacity, and allow the facility to be managed to maximize capacity, would significantly enhance the county's transportation network.

A. Managed Lanes on the County's Arterials

Lee County has made good use to date of grade-separated intersections. Further, the county currently has under design for the Metro Parkway and Colonial Boulevard intersection tolled lanes that pass over the intersections. The use of grade-separated through lanes at intersections represents a compromise which provides significantly increased capacity to the roadway network while having significantly less impact on access to adjacent properties than would a fully limited-access facility or a major widening of the arterial. An example of grade-separated through lanes in Lee County is shown in Figure 6. Since they allow users to bypass at-grade congestion, these grade-separated lanes are referred to as queue jumps. Use of queue jumps will allow the county to upgrade its existing (and future) transportation facilities in a way that minimizes impacts to the surrounding land uses. It also allows the county to take advantage of the benefits of the capacity enhancement characteristics of managed lanes on its arterial roadways.

The ideal candidate corridor for a series of queue jumps will carry a significant traffic load but be unsuitable for a freeway-type facility because some level of access with adjacent properties needs to be maintained. Roadways that have been developed with closely spaced access points, such as one or more driveways for every business fronting the road, will not be likely candidates for this type of treatment. A fully separated express facility with a system of frontage roads, as is being considered for Colonial Boulevard in Lee County, or placement of queue jumps on a parallel facility, as will be discussed later in this paper, will likely be a preferable option for those types of roadways.

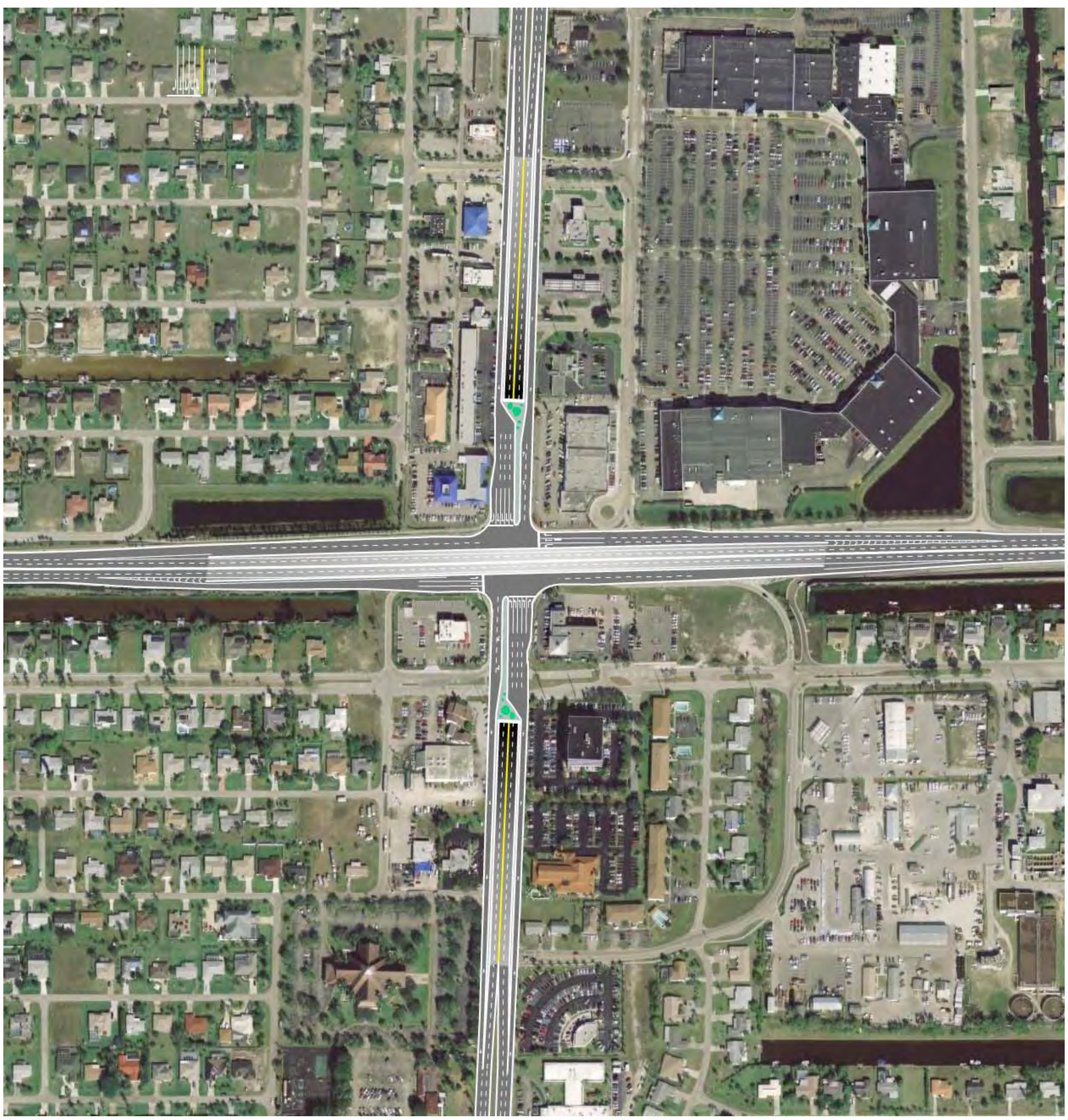
Figure 6: Colonial Boulevard/US 41 Intersection

Several options exist at the crossing of two major arterials. The most common solution is to have the busier arterial pass over the lesser arterial. A second alternative is a three-level interchange. This is usually accomplished by having a second flyover that crosses both the roadway and the first flyover. However, this would require that a major grade-separated facility be developed that is of far higher cost (likely at least double based on length and complexity) than the first flyover, and the longer flyover significantly lengthens the portion of the roadway in which access to adjoining property is substantially impacted.

While not usually considered in Florida, the second arterial can be accommodated by an underpass. While there are many issues, not the least of which is drainage, underpasses deserve consideration. Two such underpasses exist in South Florida: the Kinney Tunnel on US 1 in Fort Lauderdale (built in 1960) and another on US 27 in Hialeah (built in 2006). For purposes of this discussion, it is assumed that a cut and cover technique would be used, and that the underpass would basically consist of a depressed roadway bridged where necessary to provide the at-grade portion of the intersection. The concept is shown in Figure 7. A combined over/underpass intersection is shown in Figure 8.

Figure 7: Underpass Queue Jump

Figure 8: Combined Over/Underpass



Perhaps the greatest benefit of an underpass is the fact that the need for the most right-of-way to provide grade-separated through lanes is not at the intersection itself where you already need more right-of-way for left and right turn lanes. Another benefit of an underpass This means that right-of-way impact due to the queue jump occurs where right-of-way is not further impacted by the intersection's auxiliary turn lanes. Given the reduced need for through lanes at the intersection itself, underpasses may be especially relevant in situations where right-of-way is particularly difficult to obtain.

As described by Gregory Dehnert and Panos D. Prevedouros in 2004, it may not be necessary to provide full vertical clearance for larger vehicles in the underpass,[26] particularly since at-grade through lanes will be in place at all intersections. Determining which roadway should be the overpass and which roadway should be the underpass may be best decided by which roadway is likely to have the greater percentage of large vehicles.

A three-level interchange with an over and under pass is contemplated in this study at the intersections of Cypress Lake Drive and Summerlin Road, Daniels Parkway and US 41, as well as Daniels Parkway and Metro Parkway.

B. An Illustration: The Cypress Lake Drive/Daniels Parkway Corridor

To illustrate the potential of queue jumps deployed in a corridor, we have selected a sample corridor for development and examination. The corridor along Cypress Lake Drive/Daniels Parkway from west of Summerlin Road to west of I-75 is approximately 5.6 miles. We selected this corridor because (1) it is a major arterial, (2) demand is likely to grow for the foreseeable future, and (3) other major arterials cross this road segment, a common occurrence and issue in queue jump development.

Grade-separated queue jumps are assumed at the following intersections:

- Cypress Lake Drive and Summerlin Road
- Cypress Lake Drive – Daniels Parkway and US 41
- Daniels Parkway and Metro Parkway
- Daniels Parkway and Six Mile Cypress Parkway
- Daniels Parkway and Cross Creek Boulevard
- Daniels Parkway and Palomino Lane – Fiddlesticks Boulevard

Interchanges occur at approximately one-mile increments with actual spacing ranging from 0.8 miles to 1.3 miles. No other signalized intersections are assumed to remain in the corridor. Intersections with existing signals would likely be converted to right in/right out intersections, however, extension of elevated or depressed facilities could be considered during more detailed study. The locations and types of assumed queue jumps are shown in Figure 9.

Figure 9: Assumed Queue Jump Locations

Two of the six grade separations on the corridor, at US 41 and at Metro Parkway, are listed as "extended." This reflects the fact that conditions at the intersection will require a longer than normal length of elevated or depressed facility. At Metro Parkway, an extended length of elevated facility is needed due to the railroad track to the west of the intersection. At US 41, the length of the depressed facility is extended to the east of the intersection to accommodate the Bell Tower Drive-Sauer Drive and Daniels Parkway intersection and the Brynwood Lane-Big Pine Way and Daniels Parkway intersection. There is not sufficient length to allow the depressed queue jump lanes to return to at-grade between these intersections. However, while the queue jump lanes will need to remain depressed through the entire length of this area, structure (basically a bridge over the depressed section) will only be needed at the intersections with cross streets to accommodate turning movements.

1. Cost Calculations

To provide cost estimates for the proposed grade separations, we selected a prototype facility planned in Lee County. The current Lee County Capital Improvement Program (CIP) contains an east-west flyover at Veterans Parkway and Santa Barbara Boulevard. The CIP budgets $32.25 million for this facility. Costs for a depressed facility are based on costs associated with the Okeechobee Road depressed section under the FEC railroad in Hialeah, Florida. The winning bid for the project was just under $35 million.[27] While a rigorous analysis of the construction documents was not undertaken, the cost of the new railroad bridge is included in this bid, and the Okeechobee Road cross section is a six-lane arterial versus the four-lane arterial assumed as the depressed section in Lee County. Given this, we conservatively assumed for this analysis that the cost of developing a depressed roadway could reasonably be $32.25 million, but that the cost of the roadway structure over the depressed section needs to be added in. Based on a sketch analysis of construction costs conveyed by Pat McCue of Figg Engineering Group in 2008, an average construction cost of $100 per square foot was assumed for the roadway structure over the depressed section.[28]

A three-level design including an under and an over pass is considered in this study for intersections of Cypress Lake Drive and Summerlin Road, Daniels Parkway and US 41, as well as Daniels Parkway and Metro Parkway. In determining cost for the east-west Cypress Lake/Daniels study corridor, only the cost of the east-west grade separation is taken into account. Accordingly, only revenue from the east-west facilities is taken into account.

For the intersections with an "extended" facility, the cost was estimated based on the difference in length between the extended and the standard facility. Again, for intersections with the likelihood of both an overpass and an underpass, costs were calculated for the east-west facility only. The cost of the north-south portion of the intersection would be taken into account in the development of the north-south corridor. Costs are shown in Table 5.

Table 5: Sample Corridor Queue Jump Cost Estimates
Cypress Lake Drive/Daniels Parkway East-West Grade Separations

Intersection with	Type	Cost
Summerlin Road	Underpass	$43,800,000
US41	Underpass-Extended	$86,000,000
Metro Parkway	Overpass-Extended	$41,850,000
Six Mile Cypress	Overpass	$32,250,000
Cross Creek Boulevard	Overpass	$32,250,000
Palomino Lane	Underpass	$40,700,000
Total		$276,850,000

2. Traffic and Revenue

Projections of revenues for this type of facility are based on a series of assumptions. These assumptions include toll rates, facility usage and financial factors, including inflation rates, interest or discount rates and operating costs. While these assumptions are reasonable for an initial analysis of feasibility, these are key assumptions and will need a significant amount of additional analysis if the concept proceeds. Toll rates are based on previous work that has been completed on tolled grade-separated interchanges in Lee County. The rates used, shown in Table 6 to adjusted for inflation to 2008, are consistent with toll rates established in the county's Value Priced Queue Jump Study.[29] Queue jump usage percentages are, however, more aggressive for reasons described below.[30]

Table 6: Queue Jump Toll Rate Assumptions, 2008

Initial peak toll	$0.45
Initial shoulder toll	$0.35
Initial off peak toll	$0.20
Initial weekend toll	$0.25

Far less information is available regarding probable use of the grade-separated facility. For an overview study of this type, these projections are based on the percentage of the total approach volume that will continue through the intersection and use the grade-separated facility. This assumption takes into account both turning movements as well as drivers choosing to use the at-grade through lanes. The percentages shown are the percentage of all traffic approaching the intersection that will use the queue jump. Assumptions are shown in Table 7.

Table 7: Queue Jump Usage Assumptions (% of total traffic)	
Percent use in peak hours	60%
Percent use in shoulder hours	50%
Percent use in off-peak hours	35%
Percent use in weekend hours	40%

As shown, usage of the grade separated facility is assumed to be higher during more congested times of the day. This reflects the need for the greater capacity of grade-separated facilities during peak traffic times.

We reviewed the reasonableness of these assumptions based on turning movement projections from the Colonial Boulevard PD&E study. As a parallel arterial to the north of Daniels Parkway with many common cross streets, the Colonial Boulevard turning movement volume projections provide a good indication of the average percentage of the total approach volume that will move through any given intersections. Based on this analysis it was determined that 80% of the total approach volume could be considered as through trips for the intersections on the Daniels Corridor.

With 80% of total approach volume being through trips, we assume that 60% of total approach volume will use the queue jump in the peak hour. This equates to three of every four through trips, on average. While this may seem aggressive, there are factors that strengthen the assumption.

The capital cost of the queue jumps is not highly dependent on the number of vehicles using the facility. Given the operational benefits from two lanes in each direction on the queue jump and the fact that provision of one lane in each direction would cost far more than 50% of the cost of providing two lanes in each direction, it is unlikely that a queue jump of less than four total lanes would be considered. This means that once a decision has been made to construct a queue jump, its cost is basically a fixed amount regardless of use. The annual revenue stream needed to finance the facility is, therefore, also a fixed amount regardless of how many vehicles use the facility. Given that the revenue stream required to finance the project is set by the cost of the facility, the required toll for *each vehicle* depends on the number of vehicles using the facility. The greater the number of vehicles, the lower the required toll will be.

The number of vehicles using the queue jump at any given toll will be related to the level of congestion on the at-grade intersection through lanes, and the final number of vehicles using the queue jump versus continuing through the intersection at-grade will be an equilibrium based on both the toll for the queue jump and the level of congestion at-grade. While the queue jump side of the equilibrium can be adjusted by changes in toll rates, the congestion side of the equilibrium is also adjustable through adjustment of signal timings for at-grade movements. This phenomenon was not taken into account in the Lee County Queue Jump Study.

To be clear, we are ***not*** advocating forcing drivers into queue jump use by “punishing” them with increased congestion if they choose to proceed at-grade. However, a queue jump would only be considered in a location where congestion would be present and significant without the queue jump. In other words, without the queue jump in place, all drivers will experience significant congestion.

The advantage of queue jumps is obvious for drivers choosing to use the queue jump, however the benefits extend to non-users as well. To understand how this results in a package that benefits all drivers, we need to delve into all the benefits queue jumps deliver and how those benefits are brought about.

Every vehicle that travels through a signalized intersection at-grade does so (hopefully) when the traffic signal is green for their particular movement. The more vehicles making a particular movement, the more “green time” that must be allocated to that movement. Congestion occurs when there are more cars arriving at an intersection than there is time to move them. Traffic engineers can optimize the “timing” of the traffic signal, but there comes a point when the intersection is simply overwhelmed. Unfortunately, this is a common phenomenon well known to most drivers.

At this point the queue jump becomes a solution. For every driver choosing to use the queue jump, less green time is needed for that movement. Queue jump drivers simply bypass the signal by going over or under the intersection and no green time is consumed. Because of this, there is more green time available to other drivers. How this green time is allocated between the various movements controlled by the intersection will be a critical issue in the success of the queue jump.

We believe a solution that provides a benefit for all drivers using the intersection is the best starting point for determining how this extra green time is allocated, and all traffic movements deserve consideration. An intersection not only has the through movement served by the queue jump, it also has turns from those approaches and cross street movements that must be handled. Drivers that have the option to use the queue jump are already paying a toll for a faster trip and so receiving a benefit regardless of how the saved green time is allocated. Drivers that choose not to use the queue jump on a particular trip still have the “congestion insurance” benefit of the option to pay a toll and use the queue jump. Since the queue jump benefits all drivers going the direction served by the queue jump, we suggest that a reasonable consideration for timing signals in a queue jump environment would be to allocate saved green time in a way that no driver deals with more congestion than would have been present without the queue jump, but that drivers on movements that do not have a queue jump choice receive the majority, perhaps even all, of the benefit from the saved green time. In this scenario, the queue jump brings about benefits for all drivers. This is serendipitously the situation that, without penalizing any drivers, is also likely to minimize overall delay in the roadway network and also result in the lowest per user toll for the queue jump.

The question arises as to whether there is likely to be sufficient queue jump use under the conditions described above. While detailed analysis beyond this report would be warranted to determine a definitive answer, the sketch-level analysis performed for this study indicates that there would be. Review of calculations made for Colonial Boulevard, the “sister” corridor for this report, shows that average per vehicle delays at major intersections are likely to reach and often exceed, two minutes by 2010. By 2030, if there is no capacity improvement made, these conditions are predicted to deteriorate further with average delays often reaching three minutes and beyond.[31] Using the peak hour toll given above, a two-minute savings would equate to a value of time of $13.50 per hour and a three-minute savings would equate to a value of time of $9.00 per hour. Given a median wage rate for full-time workers in Lee County of $17.34 per hour in 2007 dollars,[32] it seems reasonable to assume that the value queue of jump time savings will result in sufficient queue jump use for financial feasibility. Additionally, work based on toll increases on the Cape Coral Bridge in the mid-1990s indicates that peak hour traffic is very insensitive to tolls, providing a further argument for high queue jump use.[33]

For analysis purposes, it is clearly possible to significantly affect queue jump usage through signal timing. The percentage of use is therefore more a matter of design rather than happenstance. The percentage of traffic using the queue jump can therefore be “set” at practically any level desired. Given this, a brief discussion of the issues that go along with this ability is warranted.

It is true that increasing congestion on the at-grade movement that has the choice of using a queue jump beyond that which would have occurred without the queue jump would result in greater queue jump use. We do not presume to set policies for communities in this paper, and there are potential justifications for this course of action. These include the potential to increase toll revenue for other needed transportation projects or lower tolls for queue jump users as well as the potential to decrease overall delay on the roadway network by maximizing the total saved green time. It is also true that favoring one intersection movement over another is a standard and necessary practice when timing standard traffic signals to bring about an efficient transportation system.

It is precisely this similarity to standard intersection timing practices that could unintentionally lead to decisions that could undermine public support for queue jumps were such policies to be pursued. Unlike traffic signals, queue jumps are a premium service for drivers, for which drivers are expected to pay. There is an inherent and easily understood equity in this concept. However, if one set of drivers is penalized for the benefit of another set of drivers, or even for the benefit of the overall roadway system, this equity can quickly move out of balance. This enforces the recommendation that most green time benefits go to drivers that don’t receive the “congestion insurance” benefits. Concentration of all benefits in one group of drivers also moves the equity issue out of balance.

As the needs of every community must be evaluated individually, we stop short of saying this type of signal timing should never be allowed. However, if a community were to see the need to impose such penalties on some drivers to make queue jumps viable, it would be an indication that solutions other than queue jumps should be strongly considered.

The analysis in this report relies on assumptions regarding likely driver behavior. As very little actual data exist to allow projection of tolled queue jump use, the ability to gather such data would be highly desirable to allow a full analysis of projected revenues. While that level of analysis is beyond this study, Lee County does have the opportunity to gather such data in the near future. With a new queue jump soon to be complete at Summerlin Road and College Parkway, consideration should be given to tolling this facility and perhaps other queue jump facilities in the county. While this might initially seem politically unfeasible, effective public education and outreach may prove otherwise.

Financial and operating assumptions affect the financial feasibility of the project. These include assumptions regarding future inflation, discount rates and operating costs. Our financial and operating assumptions are shown in Table 8. We assume operating costs are 20% of tolls collected for overpass facilities and 30% of tolls collected for underpass facilities and that costs would increase over time due to inflation.

Table 8: Financial and Operating Assumptions

Consumer price index	4.0%
Present value discount rate	6.0%
Operating costs (% of gross revenue)	20-30%

Using the assumptions in Table 8, a projection of revenues was made for a 30-year revenue stream for the six grade-separated facilities in the Daniels Road Corridor. For intersections that could have both an east-west and a north-south queue jump, only revenues from the east-west queue jump are presented in this analysis, consistent with the way in which costs were estimated. The aggregate results are shown in Table 9.

Table 9: Sample Corridor Financial Results

Total revenue over 30 years	$790,127,157
Revenue stream 30 year present value ($2007)	$284,824,915
Estimated project cost ($2007)	$276,850,000

The assumptions for traffic growth underlying these projections are far less than the growth that the corridor has experienced over the last decade. While these historic growth rates will likely wane to some extent, they nonetheless provide some insight into future growth. Projections from the FSUTMS traffic model on which the traffic growth assumptions are based have been criticized for low-growth projections in central Lee County. For this reason, growth rates were re-examined using historic growth rates. A continuing growth rate of 50% of the 10-year historic growth rate was used as a baseline for this examination. Three intersections—Summerlin Road, US 41 and

Metro Parkway—have growth rates significantly lower than 50% of the historic rate benchmark, based on the FSUTMS model.
The projected growth rates for these three intersections were set to 50% of the historic growth rate and the projected revenues regenerated. Under this scenario, the net present value of the revenue stream increased by approximately 5% to $298,500,000. While this could indicate that lower tolls are possible, it is better viewed as an indication that the revenues on which the overall analysis is based are potentially conservative.

Since the net present value of the revenue stream under either scenario exceeds the costs of construction, the project meets a basic test of economic feasibility. Although it would not meet the conservative criteria required for traditional 30-year bond funding, particularly given the debt coverage ratios and other criteria now considered for facilities without a tolling history, it could well be financeable using non-traditional funding sources. These could include partial funding via a loan from either a state or federal infrastructure bank, credit support from the federal TIFIA program, or development via a long-term toll concession form of public-private partnership. While these are still labeled as "non-traditional" funding sources, it must be noted that sources such as these are becoming much more common for larger-scale roadway projects (including Florida's Miami Port Tunnel and I-595 Express Lanes projects).

As the assumptions that are involved in the revenue analysis are rather conservative, increased tolling levels could be considered if needed. A private concession to finance, build and operate the facilities could allow a financing term longer than the traditional 30-year revenue stream and could be considered. While this would modestly increase the present value of the revenue stream, its major impact would be to allow the private sector partner to realize the benefits of depreciating the asset. This can be a very significant benefit for a private sector partner, and could potentially allow the private sector to undertake the project at a lower toll under a public/private partnership than could be obtained in a strictly public sector undertaking .

C. An Upgraded Arterial Network for Lee County

Queue jumps do have the ability to significantly upgrade the capacity of Lee County's roadway system in a manner that appears to be financially feasible if tolls are used. The upgrade of the Daniels corridor, or any similar corridor, provides a truly premium transportation facility from both a level of service perspective as well as a cost perspective. This reinforces the appropriateness of toll financing for these facilities.

These are, however, relatively expensive improvements from both a gross cost as well as on a per added unit of capacity basis. In this case, the gross cost of $277 million for the Daniels corridor compares to a cost (based on the average cost per lane-mile being used in current impact fee update) of $32.4 million for converting this same section of Daniels Parkway from six to eight arterial lanes.

But the bang for the buck in terms of capacity provided by the two different improvements—queue jumps versus eight-laning—must be taken into account. Based on the added capacity, measured in vehicle miles of travel (VMT) per dollar spent, the capacity added by the grade-separated queue jump facilities in the Daniels corridor costs approximately $1,100 per added VMT versus approximately $355 per VMT for the eight-laning. In other words, capacity from queue jumps is approximately three times as expensive as capacity from added at-grade lanes.

But while expanding an arterial to eight lanes might be cheaper, it can require a lot of right-of-way, perhaps including major impacts on businesses and residents along the route. Often such expansion of an arterial is simply not feasible. Moreover, since eight lanes is a practical maximum for arterial roadways,[34] traffic demand on many roadways in Lee County and other small and midsized urban areas will exceed the ability of surface lanes to satisfy demand. At that point, grade-separated queue jumps can be the answer.

Further development of these premium facilities as tolled improvements has other benefits for the county. As shown by the variable tolls on the Cape Coral and Midpoint Memorial bridges, there can be a significant influence on county traffic from time-of-day tolls. A greater presence of toll facilities in the county can not only result in a more efficient transportation system due to additional capacity, it can also provide improved efficiency due to the provision of incentives to travel at off-peak times, reducing peak loading on the entire transportation network. For this reason, other potential queue jump corridors should be considered. Along with the Daniels Parkway Corridor presented here, the Colonial Boulevard Corridor is already being studied by Lee County DOT. Additional corridors for consideration could include Business 41/Metro Parkway, Veteran's Parkway, Pine Island Road, Santa Barbara Boulevard, an expanded length of Daniels Parkway and Colonial Boulevard/Lee Boulevard, US 41 in Southern Lee County, Burnt Store Road, and Kismet Parkway. Potential corridors are shown in Figure 10.

Some arterial routes are not appropriate for queue jumps because they would block access to too many properties along the route, so using a parallel facility for a queue jump corridor has to be examined. In Figure 10, Santa Barbara Boulevard and Business 41/Metro Parkway are two such facilities. The Santa Barbara corridor serves north/south traffic in Cape Coral. Del Prado is, and may remain the north-south facility carrying the most traffic, unless a corridor such as Santa Barbara is upgraded. But Del Prado is heavily commercially developed with existing access to adjoining business that would have to be radically altered to develop a queue jump corridor. Using Santa Barbara or a similar parallel facility would provide greater capacity for north-south movements and simultaneously allow Del Prado to serve its commercial function with more efficiency.

Currently, US 41 is also a heavily commercial corridor, as it moves through central Lee County. As in the case of Del Prado, extensive changes to access would be required in the US 41corridor. These changes would likely be similar to changes currently being examined for Colonial Boulevard. For this reason, Business 41 as it crosses the Caloosahatchee River and connects to Metro Parkway is presented as an alternate north-south corridor.

Figure 10: Potential Queue Jump Corridors

Since the queue jumps in the corridors identified above in Figure 10 provide operational improvement rather than physical addition of new lane-miles, we have to look at the question of how they meet the goal of achieving uncongested travel from a functional standpoint.

We identified earlier the need for 403 lane-miles of roads other than freeways if Lee County is to realize uncongested travel. This is needed prior to 2030 and is in addition to the projects already in the financially feasible long-range plan. To allow comparison with operationally upgraded facilities, we convert the number of lane-miles into the added daily capacity this amount of added roadway would provide. Capacity in this case is expressed as vehicle miles of travel (VMT).

Each new lane mile adds 9,316 VMT of capacity to the roadway. Multiplying, 403 lane-miles would add 3,754,000 VMT of new capacity to Lee County's infrastructure. The queue jump corridors identified above add 102 linear miles of managed lanes to the county's infrastructure. The majority of these facilities are six-lane arterials, or could feasibly be expanded to six lanes. Converting a six-lane arterial to a managed queue jump facility with two elevated lanes in each direction at the overpasses adds 35,800 VMT of new capacity per linear mile. Multiplying, this results in an increase of 3,640,000 VMT of new capacity. While this is just shy of the 3,754,000 VMT of new capacity identified as needed, the increases from four to six lanes needed in a few areas will make up this difference.

Based on the cost of the example corridor along Daniels Parkway that was presented in this paper, the per linear mile cost of queue jump facilities is approximately $44 million for a six-lane facility with four lanes on the queue jump. This would mean a cost of $4.5 billion for the network identified in Figure 10. While this is certainly a large number, it is not necessarily surprising.

We have calculated per lane-mile cost of adding conventional arterial lanes to be $5.08 million. Thus, the total cost to add the capacity needed to eliminate congested conditions using only at-grade arterials would be $2.04 billion.

But Lee County is not going to have $2 billion to spend on improving arterials and solving congestion. A queue jump network may be more expensive, but it brings with it a new steam of revenue from tolling that makes the improvements much more feasible.

The Daniels corridor example has shown that as the need for a managed facility becomes manifest, the volume of traffic is reaching the level needed to financially support these types of facilities via tolls. We suggest an incremental strategy of beginning with queue jumps at the most congested intersections, and as revenues from those becomes robust, using that revenue stream to help finance additional queue jumps and the express lanes between them. In this way, a network of arterial managed lanes will evolve.

Grade separations can add significant capacity without requiring additional right-of-way along the entire corridor.

D. Practical Considerations with Queue Jumps

A major benefit of the grade-separated approach is its ability to add significant capacity without requiring additional right-of-way along the entire corridor, as lane additions often require. Based on generalized capacity tables from the Florida Department of Transportation (FDOT), adding two lanes to make an eight-lane arterial would result in a capacity of 67,000 vehicles per day (vpd) compared to the existing six-lane capacity of 51,800 vpd.[35] By comparison, a six-lane roadway (three lanes in each direction) connecting to a series of four-lane over/underpasses (two lanes in each direction) with one through lane at grade at the intersection each way, provides a capacity of 87,450 vpd, over 30% more capacity than the eight-lane arterial.[36] The layout of an overpass queue jump is shown in Figure 11.

Tolled queue jumps, both overpasses and underpasses, can also provide significant financial support for their development. Focus groups held as part of the Lee County Queue Jump Study several years ago indicated that there would likely be significant public support for tolled roadways that incorporated a series of queue jumps. In fact, indications are that this support would be even greater than the majority support found for stand-alone queue jumps.[37]

Figure 11: Overpass Queue Jump

The use of tolls on these facilities would significantly speed up project delivery time due to their ability to self-finance. With self-financing projects, the county can target individual intersections that are choke points in the system or implement a series of queue jumps to enhance the capacity of an entire corridor. In addition to congestion relief on the improved road, overall mobility in the surrounding areas will also be increased.

The queue jump approach provides a practical mechanism to phase in corridor upgrades. Even with a stand-alone queue jump, the time advantage gained at the queue jump is not lost at succeeding intersections, since vehicles in the queue jump travel at successive lights on earlier signal cycles than would have occurred if the driver had not used the queue jump. Choosing the most congested intersections, and then moving to the intersections with significant but lesser congestion, allows congestion relief to proceed in an optimal manner while simultaneously maximizing the cash flow/cost ratio for the improvements.

Queue jumps will not eliminate the need for adding new lanes on more traditional facilities. The arterial widenings currently identified as financially feasible will certainly still need to be constructed. Queue jumps will, however, reduce the number of roads needing additional lanes along their entire length and might even be able to provide some level of funding support for such lanes. Revised transportation modeling taking into account the capacity added by queue jumps will be needed to identify which facilities may still require additional capacity.

Managing and reducing delays caused by construction will be a key issue. Experience in Lee County has shown that managing delay during queue jump construction is possible even though the intersections involved are heavily traveled. A study of this type does not go into the level of detail necessary to develop specific planning for maintenance of traffic, however, based on experience in Lee County and other areas in Florida, maintenance of traffic during queue jump construction can be considered a significant but surmountable issue.

1. Queue Jumps vs. Arterial Managed Lanes

In considering how queue jumps might function in Lee County, a question arises whether or not to provide exclusive toll lanes between the actual queue jumps. Delay on arterials is primarily associated with intersections, not the roadway between intersections, but both approaches have merit and will need to be evaluated on a case-by-case basis.

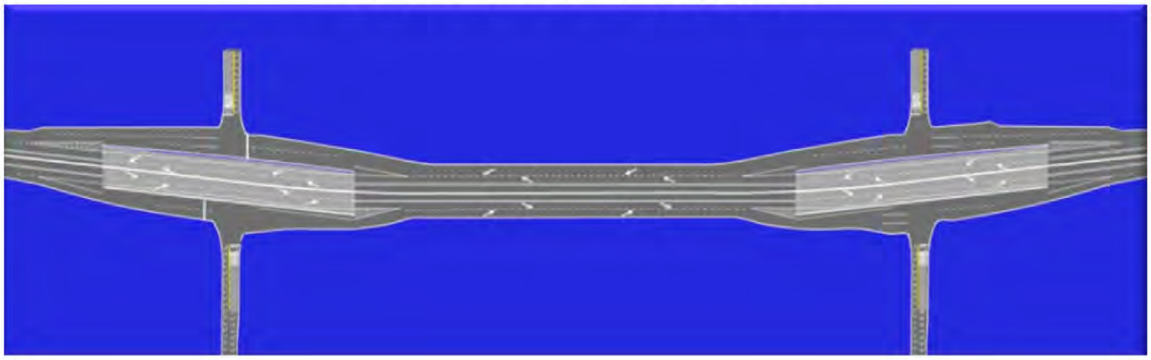
The major operational advantage of exclusive lanes between the queue jumps is the potential for increased capacity. As previously discussed, empirical data from many freeway facilities has shown that once traffic demand on the freeway exceeds the capacity of that freeway, the congestion itself causes a reduction in functional capacity below what could be handled if the congestion had been prevented. Using variable tolls, it is possible to keep traffic demand in the exclusive lane below congested levels. The exclusive lane actually moves more vehicles than its congested counterpart and moves those vehicles at a much better level of service. With the major part of arterial congestion being caused by intersection effects, whether the congestion between intersections will be sufficient for the capacity advantages of an exclusive lane will require significant analysis of each facility for which queue jumps are proposed.

Exclusive lanes also provide an additional incentive for users to choose the toll facility, by providing the additional benefit of reducing interference between tolled and non-tolled traffic. The degree to which this is an actual benefit rather than just a perceived benefit is directly tied to the level of congestion that exists on the general purpose lanes on the road.

The major drawback to extending the managed lanes between intersections is the elimination of left turn access to properties located between intersections that are blocked by the at-grade separation. The congestion relief benefits of such lanes would need to be balanced against the desirability of maintaining left turn access to properties adjoining the road.

If an exclusive lane between queue jumps is provided, access to and from the lane becomes an issue. Flexibility in providing this access can be brought about by allowing the weave/merge to and from the exclusive lane (assumed to be the innermost) to occur on the grade separation structure itself. With lengths of between 2,200 feet and 2.500 feet, there is sufficient length on the queue jump itself to allow the needed weave/merge maneuvers. It should be noted that all vehicles using the queue jump receive the benefit of intersection avoidance. All queue jump lanes are therefore premium lanes, and tolls are collected from all vehicles using the queue jump. If exclusive lanes are provided on the sections between grade-separated intersections, their only purpose is to give drivers the choice, when in between the queue jumps, of remaining separated from traffic using the at-grade facility. Of course, drivers leaving the facility will need to exit the exclusive lanes on the queue jump prior to the intersection where they will be turning. On, for example, a nominally six-lane arterial, merging between grade separations would be prohibited between the innermost lane and other lanes. Assuming a four-lane flyover (two in each direction) with the third lane in each direction continuing at-grade for handling non-toll traffic and turning traffic, traffic in the innermost exclusive lane would enter the queue jump as well as traffic from the middle lane. Again, tolls are collected from drivers in both lanes on the queue jump. Traffic in the outer lane of the arterial would continue at grade to the intersection. Vehicles wishing to use the exclusive lane between queue jumps would continue in or merge into the innermost lane on the queue jump, while traffic wishing to leave the exclusive lane would merge out at this point. This concept is illustrated in Figure 12, with the roadway width exaggerated to allow the merging concept to be more clearly seen.

Figure 12: Queue Jump Merging Plan



2. Toll Collection and Enforcement

In recent managed lanes projects in other states, premium express lanes are separated from general purpose lanes with minimal infrastructure—often just a soft pylon barrier. Hence, the additional cost to implement the exclusive lanes is not very high. The I-394 Express Lanes in Minneapolis are a recent example. The Georgia State Road and Tollway Authority (SRTA) is developing an enforcement system that works in conjunction with managed lanes separated by only double white lines to provide toll violation enforcement on these types of facilities. While the SRTA system is being developed for freeway implementation, it should also prove effective on arterials.[38]

Toll collection on queue jumps is straightforward. As the queue jump itself naturally separates tolled from untolled traffic, the queue jumps themselves are the appropriate location for toll collection (using electronic toll collection—ETC) and enforcement to occur. And ETC has been used in Lee County for over a decade and is well understood. Because of this, toll collection methodology is not an issue in determining whether exclusive lanes are developed between the intersections, or in the development of queue jumps themselves. In fact, given that it has been shown that minimal infrastructure is needed for exclusive lane separation, a project can be developed without exclusive lanes and then have exclusive lanes added when they become desirable. Given that the cost of exclusive lanes is relatively minor and fines from violations will bring additional revenues, costs associated with the provision of exclusive lanes between queue jumps are assumed to be minimal and are not directly considered in this evaluation. In any case, collection and enforcement can be provided using developed technologies and “off the shelf” equipment. We do, however, assume overall operating and maintenance costs for the queue jumps of between 20% and 30% of gross revenues.

Part 4

Interstate 75

A. Overview

Interstate 75 is the spine of Lee County's transportation infrastructure. Without a functioning I-75 providing a significant portion of the county's needed north-south capacity, the impact on the county's transportation infrastructure would be devastating.

The construction currently taking place that will widen I-75 in the southern two-thirds of Lee County from the county line to Colonial Boulevard is welcome, but it falls far short of meeting the county's needs through 2030. In fact, the Southwest Florida Expressway Authority (SWFEA) Web site states that: "Two independent traffic studies indicate that by 2015, (from) Immokalee Road to Colonial Boulevard, I-75 will experience Levels of Service E and F." [39] These conditions will prevail even with the two additional lanes currently under construction on I-75 The traffic studies were conducted by SWFEA and Florida's Turnpike Enterprise (FTE), the District of the Florida Department of Transportation responsible for the state's toll facilities.

This means that I-75 in the southern two-thirds of Lee County will be congested within just a few years of the current improvement coming online. No funding has been identified to meet this shortfall in capacity, and funding through traditional sources prior to 2030, or even beyond, appears improbable. Even with the possibility of other north-south arterial roadways coming on line, Southwest Florida will be mired in congestion without the additional interstate capacity. For this reason, the Florida legislature passed legislation forming SWFEA in 2005. The mission of SWFEA is to find ways to speed up the expansion of I-75 to the 10 lanes needed in most of Lee and Collier Counties, likely through tolling.

B. Public Opinion

Early in its existence, SWFEA began a program of public outreach to determine the attitude of the public toward I-75 and the possibility of bringing about additional lanes in a timely manner through tolling. The results of these efforts indicated strong public support for advancing additional capacity on I-75, and the fact that tolling was likely to be involved was not a deterrent.

The results of a public survey were reported at the June 2007 SWFEA meeting. Of over 1,000 responses, 80% supported while 20% opposed the concept of a 10-lane I-75 with six express toll lanes and four general purpose (free) lanes. To jumpstart the revenue stream, 72% supported and 28% opposed tolling the two lanes currently under construction when they are complete.[40]

Even earlier in the process, FTE indicated their interest in the project and focus groups were conducted independently by both SWFEA and FTE. As these focus groups were held early in the process, they presented a somewhat different concept, a total of eight lanes, four in each direction. Two lanes in each direction would be tolled. The comparison concept of six general purpose free lanes was the same in both instances. As both the 10- and eight-lane concepts are variations of the express toll lane/general purpose free lane concept, the eight versus 10-lane difference to produce substantially different results.

Both sets of focus groups produced similar results. In the SWFEA focus groups, four out of five groups favored the eight-lane option with four express toll lanes versus the six-lane, no toll option. The remaining group favored the six-lane option four to three. Of the four groups favoring the express toll option, three groups were unanimous in their decision. Interestingly, the strongest concern with the group favoring the six-lane option was not the toll, but the 12 to 24 months it would delay the project to redesign for the additional lane.[41]

In addition to the SWFEA focus groups, 78 people participated in the FTE focus groups. At the end of each focus group, participants were asked to vote for the alternative they preferred. Seventy-eight percent favored the eight-lane alternative with four express (toll) lanes and 8% favored proceeding with two additional (non-toll) lanes for a total of six lanes. The remaining 14%, including eight participants from a group of frequent I-75 users, favored building the eight-lane facility and ***tolling all eight lanes.***[42]

C. The "New Lanes"

At the January 2007 meeting of the Southwest Florida Expressway Authority Board, Chairman William Barton made a statement to the effect that if a public benefit is not realized, tolls should not be imposed. This is sound logic, and it is important to determine if tolls on I-75 would bring about a public benefit. To focus on the most immediate issue: Would it bring about a public benefit if the two lanes currently under construction were to be tolled as express lanes upon completion?

As discussed in Part 2, congestion itself causes a reduction in the functional capacity of the freeway at the very times it is needed most. Keeping in mind that I-75 will be over capacity and therefore congested soon after the opening of the two new lanes, this capacity reduction due to congestion will be an issue for Lee County. The importance of I-75 to the county's overall transportation system makes it a critical issue.

What would be the effect of managing the new lanes with tolls? Remembering the 1,200 vehicle per hour capacity when congested (per Chen and Varaiya discussed in Part 2), the one-way capacity of the I-75 under congested conditions would be around 3,600 vehicles per hour total for all three lanes. If one of those lanes (the "new" lane) is managed, the capacity of that lane conservatively increases to 1,700 vehicles per hour. This brings the total capacity of the three lanes to 4,100 vehicles per hour. This is an increase in capacity of 14% for the entire roadway *simply by managing one of the three of the lanes in each direction*.

With massive shortfalls in transportation funding, each piece of the transportation infrastructure that can be built should deliver the most value possible. The ability to manage a major investment on I-75 to maximize the benefit of that investment is an opportunity that should not be missed. In addition to significantly increasing the capacity of the facility, managing the new capacity on I-75 provides drivers a reliable alternative to the uncertainty of congested travel for time-sensitive trips. Even discounting the fact that the revenue generated becomes available to meet transportation funding shortfalls in Lee County, tolling the lanes currently under construction provides a clear and significant benefit to travelers.

D. The Future of I-75

With strong public support and tangible public benefits, why are express lanes on I-75 not moving full speed ahead? While an exhaustive analysis of why this has occurred would be of little value, two possible reasons deserve some discussion.

One reason is the fact that there has been a significant decrease in traffic in the region due to the current economic downturn, and the need for even greater capacity on I-75 may not seem as urgent. However, assuming that this is anything more than a lull in an overall pattern of strong growth in the region is unrealistic. The factors underlying Lee County's historic record of strong growth remain valid, and a strong pattern of growth will certainly return. Harry Glaze, the Director of Lee County DOT in the mid- and late 1980s often said when discussing growth in Lee County: "As long as it snows in Cleveland, people will move to Lee County." Harry was right.

It is also likely that SWFEA has fallen into a common trap in choosing to emphasize only the revenue benefits of tolling and not emphasize the other benefits that managing lanes brings about. From a strictly revenue standpoint, it is difficult to define tolls as anything more than as a mechanism for financing roadways. Other forms of road financing, such as fuel taxes embedded in the overall price per gallon of gasoline, tend to be less visible and therefore seem less painful to the public than tolls. Hence the mistaken but widely held concept of a "free" road versus a "toll" road.

As an example, Congressman Connie Mack during a visit to Southwest Florida in February of 2008, stated: "A toll on a road is a tax that commuters have to pay for a road they've already been taxed to pay for."[43] Likewise, (Collier County) Commissioners have argued that taxpayers already have paid for these lanes, and tolls would amount to double taxation.[44] While the tax may not be obvious, there is no doubt that tax is paid on the gasoline used to travel roads that are tolled.

It is clear that the significant benefits of managing lanes on I-75, including the lanes under construction, need to be brought forward in the I-75 discussions. Anticipating a potential argument, indications are that using tax financing to construct toll lanes is ***not*** likely to be viewed negatively by a majority of the public. First, the strong support in surveys for tolling the two new lanes on I-75 (being constructed with tax revenue) supports this. Second, knowing this could be a controversial issue, this question was specifically asked of SWFEA focus groups. The focus group states:

> *Participants were next asked about the appropriateness of using traditional tax funding to assist in constructing lanes that will be tolled. Almost all participants felt that this was an appropriate approach, particularly if it reduced the toll that would need to be charged to access the lanes. No participants were strongly opposed to using traditional funding sources to construct toll lanes.*[45]

A final issue deserving discussion was brought up by Collier Commissioner Fred Coyle:

> *"If we have a failing segment in our transportation system, we have an obligation under law to do something about it," Coyle said. "What I cannot accept is that the federal and state governments don't have a similar obligation, and they are looking to counties to make a decision to get them off the hook."*[46]

Coyle brings up a valid issue of fairness. Will local governments receive less state and federal funding in future years if they step forward and take these agencies "off the hook"? This is a question that deserves serious discussion at all levels of government. As a guiding principle for those discussions, we recommend the following: In allocating federal and state funds, it is wiser for local governments that take on issues such as I-75 to be rewarded, not penalized.

Tolling also creates a revenue stream that makes it more feasible to consider a public-private partnership to develop the lanes. This expands the choices Lee County can consider. A private partner could provide some or all of the capital to build the lanes, financed by the stream of toll revenue. This could free up some traditional funds for other important capacity projects and provides the region with more options to consider.

Beyond the issues of whether express toll lanes as envisioned by SWFEA can be brought to fruition, the question arises as to whether or not this plan would result in sufficient new freeway lanes to achieve the goal of uncongested travel in Lee County. In Part 2, the need for 85 lane-miles of freeway over and above those currently under construction was identified. Both traffic consultants, SWFEA's and FTE's, have recommended that the project be constructed in phases, with the first phase being a 10-lane section from Immokalee Road in Collier County to Alico Road in Lee County.[47] This is the most traveled section of the freeway and would result in 12.8 route-miles of construction in Lee County. This could be accomplished by 2014 and would result in an additional 51.2 lane-miles of freeway. This portion of the project is likely to be self-supporting from toll revenues.[48]

An additional 12.9 route-miles is contemplated between Alico Road and Palm Beach Boulevard (SR 82) adding an additional 51.6 lane-miles, for a total of 102.8 lane-miles, which would actually exceed the 85 lane-miles needed to eliminate LOS F freeway conditions by 2030. While financing of this section is more problematic, given the additional time between 2014 and 2030, the possibility of non-traditional funding, such as via a public-private partnership, and the ability to scale back the project to some extent and still meet the 85 lane-miles needed, it is not unreasonable to assume that tolling would allow the need for freeway lane-miles to be met. In other words, tolling new lanes on I-75 would make it possible to eliminate serious (LOS F) congestion on I-75 by 2030.

Part 5

Express Bus/Managed Lanes Synergy

All types of managed lanes, including queue jumps, fit together very well with express bus service/bus rapid transit (BRT). In recent years, the very high costs of rail transit lines and the limitations of federal, state and local transit capital funding have led more and more transportation planners to consider various forms of bus rapid transit as a cost-effective alternative. The idea is to be able to make limited transit funds go considerably farther by investing them in BRT over a wide area rather than light or heavy rail in just a handful of corridors. In fact, LeeTran, Lee County's transit agency, recently completed an initial study of first steps for BRT in Lee County.

Because the term BRT has come to encompass a considerable range of service types, a recent research report from the Federal Transit Administration (FTA) sought to provide some clarity by separating BRT into two basic types:[49]

- "BRT-heavy" refers to BRT systems that use dedicated rights of way and may use off-board ticketing, queue jumps, and signal priority.
- "BRT-lite" refers to BRT systems that lack dedicated rights of way and use fewer other enhancements. They may be as basic as limited-stop arterial express service with signal priority.

The basic premise—that BRT can produce more transit bang for the buck—is valid. But the BRT-heavy version, in all but a small handful of the most intensive transit environments, has two significant drawbacks. First, an exclusive right-of-way is expensive, in both land costs and construction costs. Second, very few corridors can support more than 10 such buses per hour (one every six minutes) and usually only during peak periods. Therefore, for the vast majority of the time, that expensive right-of-way is empty and unproductive. Even with one-minute headways (60 buses per hour), that exclusive bus lane could handle at least 1,600 vehicles per hour at uncongested LOS C conditions. Thus, 1,540 spaces are going to waste if that lane is used exclusively for bus service.

This waste of expensive capacity led, historically, to the original "transitways" in northern Virginia (Shirley Highway) and on Houston freeways being converted to high-occupancy vehicle (HOV) lanes. Initially, vanpools were allowed in, and when that didn't use all the capacity, four-person carpools. In most metro areas that took this path, the eventual result (as on I-95 in Miami) was

HOV lanes filled with two-person carpools. But unlimited numbers of HOV-2s led to congestion, making a mockery of "express" bus service.

This is where managed lanes come to the rescue. Thanks to the ability of variable pricing to keep such lanes flowing with both high volumes and no congestion (at LOS C), a properly run managed lane can provide express buses with performance comparable to what they get from an exclusive busway. Because of this, some have termed a managed lane that provides guaranteed access for express bus/BRT service a "virtual exclusive busway" (VEB).[50]

Another term for the same concept of synergy between priced lanes and BRT is High Quality Transportation (or HighQ). As explained by Wilbur Smith Associates:

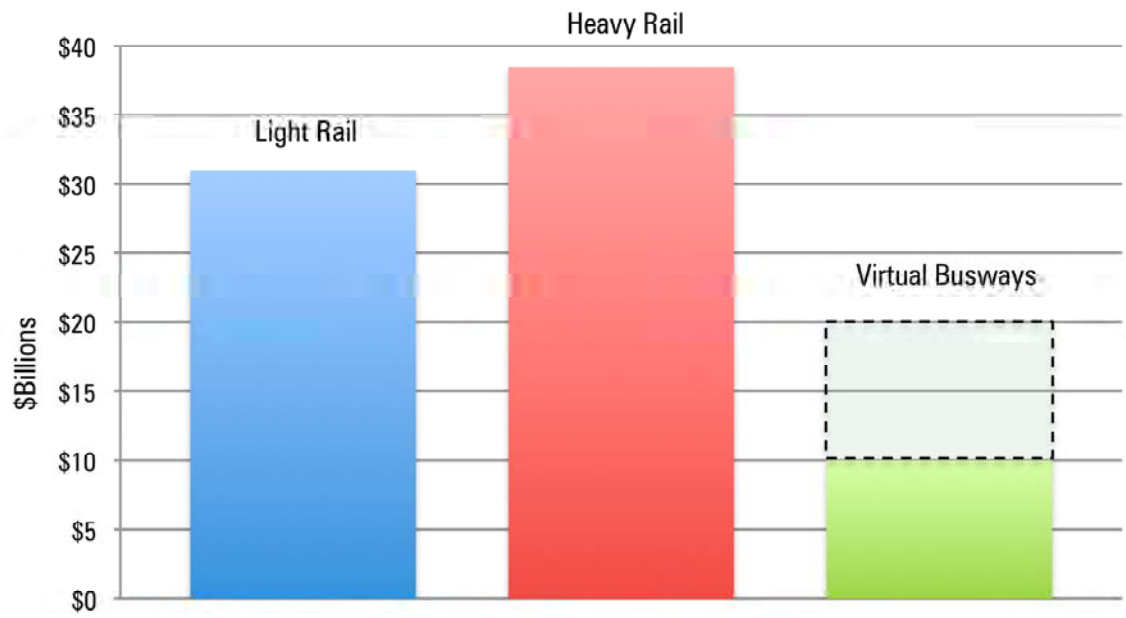
> *HighQ is a unique combination of supply-side (transit services) and demand-side (managed lanes) strategies. . . . It is the next logical step in the development of mobility strategies . . . . HighQ [can] expand the transportation network more efficiently than either adding general purpose lanes or investing in high capacity transit such as fixed guideway transit. . . . HighQ projects have been found to have greater support than HOV, toll, or BRT projects individually because together they increase traveler choices, are multimodal, are paid for by the user, and improve reliability and speed.*[51]

The first implementation of a VEB, combining managed lanes with BRT-heavy transit, is scheduled to open before the end of 2008 on Houston's Katy Freeway (I-10). The $250 million project adds four managed lanes to the median of the freeway, replacing a single reversible HOT lane, as part of a larger-scale project to rebuild and widen the freeway. It is a public-public partnership between the local toll agency (HCTRA), the local transit agency (Metro) and the Texas DOT, with the endorsement of FHWA and FTA. HCTRA financed the managed lanes and will operate and maintain them using the toll revenue for debt service and operating and maintenance costs. Metro is guaranteed up to 25% of the managed lane capacity for any combination of buses, vanpools and carpools. In a memorandum of understanding (MOU) it agreed to increase the HOV occupancy level as needed to stay within its 25% usage. HCTRA in turn agreed in the MOU to use variable pricing to maintain LOS C conditions, thereby limiting the number of toll-paying vehicles using the managed lanes.

The Katy managed lanes project is the first to explicitly embrace the VEB or HighQ concept. But that project is still confined to a single corridor. The next big step will come as congested urban areas develop networks of managed lanes incorporating the VEB approach—i.e., with the synergy between managed lanes and BRT as one of the driving forces. In July 2008, the metropolitan planning organization for the nine-county San Francisco Bay Area approved just such a plan. The $4.8 billion project will convert 790 lane-miles of existing HOV lanes and build 275 miles of new HOT lanes, to create a large-scale network of managed lanes. Region-wide express bus service is an integral part of the plan.

To get a better idea of the cost-effectiveness of such networks, Poole and Balaker in 2005 compiled data from the FTA's New Starts program on recent light rail (LRT) and heavy rail (HRT) projects. The average cost per route mile was $124 million for LRT and $154 million for HRT. If a metro area wanted to build a region-wide LRT or HRT system encompassing 250 route miles, the cost would be $31 billion for LRT or $38.5 billion for HRT.[52] A comparable VEB network would require 500 lane-miles, with one lane per direction. If all 500 lane-miles had to be added as new construction (i.e., if there were no HOV lanes to convert, at modest cost), the cost would be $5 billion if the average cost were $10 million per lane-mile or $10 billion if the unit cost were $20 million per lane-mile.

Figure 13: Cost Comparison of Transit Alternatives



That already sounds far more cost-effective (though it does not include the cost of additional buses to make full use of the new network), but the case is better than just lower capital cost. The LRT or HRT capital costs—$30 to 40 billion—would all have to be raised as federal, state, or local tax money. Passenger fares would not cover any of that, and would cover only a portion of operating and maintenance costs. By contrast, the VEB network's capital costs would be covered largely by those paying the variable-priced tolls.

Thus, transit capital funds would likely be needed only for the express bus vehicles and any off-line stations and park and ride lots developed to enhance the BRT on managed lanes service. The FTA currently does not consider a VEB (i.e., BRT on managed lanes) as an eligible "fixed guideway" for transit service. Under its New Starts program, it will provide grants to build rail guideways or *physically* exclusive busways, but not *virtually* exclusive busways. But federal *highway* funding can definitely be used to help fund managed lanes projects, to the extent that toll revenue financing is not sufficient.

The other form of BRT—what the recent report called BRT-lite—is best exemplified by the Metro Rapid program implemented by the Los Angeles County Metropolitan Transportation Authority starting in 2000. It offers limited-stop express bus service in specially marked buses along major arterials. Similar BRT characteristics are considered in Lee County's recent BRT study. In addition to making stops only about once per mile, the service operates with traffic signal priority at intersections. The initial Metro Rapid line on Wilshire Blvd. increased transit ridership in that corridor by 46%. That success has led to the rapid expansion of the service to 26 corridors with 380 arterial miles and 500 buses in Los Angeles County as of 2008.

A 2007 Transportation Research Board paper compared Metro Rapid service on Ventura Blvd. in LA's San Fernando Valley with parallel BRT-heavy service on the new Orange Line exclusive busway. The travel times worked out about the same for both, but the capital cost per boarding was only $1,300 for the BRT-lite versus $16,800 per boarding for the BRT-heavy service, primarily because of the exclusive-guideway cost for the latter.[53]

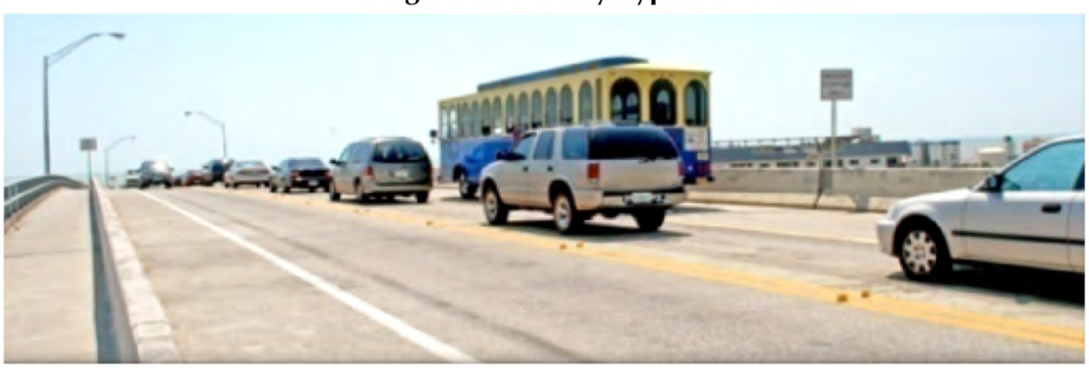
BRT-lite appears to be a highly cost-effective way to expand transit service on major arterials. And just as BRT-heavy is well-suited to operate on managed lanes on expressways such as I-75, BRT-lite could take advantage of arterial managed lanes to operate faster than what is possible on ordinary arterials with signal pre-emption. First, longer-distance express bus service could be offered on arterial managed lanes, similar to BRT-heavy services on expressway managed lanes. This would expand the network of region-wide BRT to the corridors with arterial managed lanes in addition to the expressway managed lane network. Limited-stop service of the BRT-lite nature could be offered on the arterials with managed lanes (such as the Daniels Corridor), given their approximately one-mile spacing of grade separations. Bus stops for this service should be located in bus pull-outs near the at-grade intersection, to enable patrons to transfer to and from other bus routes using the intersecting arterial.

While much BRT experience has been obtained from larger urban areas, there is strong evidence in Lee County that transit service upgraded with BRT strategies will be well received. In April of 2005, LeeTran and the town of Fort Myers Beach celebrated the more than doubling of transit ridership over the previous year after the upgrading of transit serving the town. A typical transit stop is shown in Figure 14. The service incorporated many BRT-lite elements including distinctive vehicles (replicas of vintage trolleys), reduction of headways to 10 minutes during peak hours of ridership, real time information on pending transit arrival times (using GPS and Internet technologies) at transit stops, and conversion of an existing shoulder to allow trolleys to bypass congested conditions on the bridge leading to the town (Figure 15). The trolleys also included bike racks and accommodation for large objects such as coolers.

The doubling of ridership was important for mobility in the area. The service attracted over 220,000 riders over the four-month season. Discussions with LeeTran management revealed that trolleys were often operating at "crush loads," loads even greater than the capacity of the vehicle when standing room is also included, during peak hours of operation.

Figure 14: Passengers Board the Trolley at Lynn Hall Park

Figure 15: Trolley Bypass



The overwhelming public response to LeeTran's BRT-lite approach to the Fort Myers Beach Trolley has shown that transit can be an important factor in solving Lee County's congestion problems. The guiding principle needs to be making the transit trip convenient. The time savings and reliability of managed lanes, both on arterials and on I-75, can be a significant part of this convenience, just as the Matanzas Bridge queue bypass is for the Fort Myers Beach Trolley. Perhaps the old truism that "Americans are in love with their cars" should be revised to "Americans are in love with convenient travel." A network of managed lanes coupled with BRT benefits, elements of which have been tested and found effective in Lee County, can be an integral part of a robust transit system for the county.

Part 6

Improving System Operations

A. Freeway Operations

The Texas Transportation Institute's annual Urban Mobility Report provides summary data for each urban area on Operations Strategy measures, estimating for each one how much of a contribution it is making toward reducing the area's travel time index. Four basic measures are reported, two for freeways and two for arterials. The freeway measures are the extent of ramp metering and the percentage of the system under active incident management efforts. The most recent freeway data for Lee County are shown in Table 10.

Table 10: Lee County Freeway Operations Management

	2003	2002	2001	2000
Ramp Metering				
Percent of miles of roadway	-	-	-	-
Annual delay reduction, 1000 hrs	-	-	-	-
Freeway index with strategy	1.018	1.015	1.010	1.005
Freeway index (base)	1.018	1.015	1.010	1.005
Freeway Incident Management				
a) Cameras				
• Percent of miles of roadway	-	-	-	-
b) Service patrols				
• Percent of miles of roadway	65%	65%	-	-
• Annual delay reduction, 1000 hrs	1.5	1.1	-	-
• Freeway index with strategy	1.017	1.014	1.010	1.005
• Freeway index (base)	1.018	1.015	1.010	1.005

Source: Texas Transportation Institute

As can be seen, ramp metering is non-existent in Lee County. Yet estimates of the impact of widespread ramp metering (such as in Minneapolis/St. Paul) suggest that it can have a significant effect on recurring congestion. For example, the Texas Transportation Institute's latest report estimates that ramp metering (which covers 90% of freeway miles in the Twin Cities) has saved over four million hours of delay per year (7% of all delay there). With I-75 failing in many areas in Lee County, ramp metering might result in significant time savings. Since ramp metering costs a small fraction of significant lane additions, this under-used tool clearly represents “low-hanging fruit” in reducing Lee County's congestion. Fortunately, this strategy is currently under consideration.

While incident management was non-existent in Lee County prior to 2002, the county is aggressively pursuing these strategies now. Two key elements in an effective approach are equipping the freeways with cameras so that incidents can be identified quickly and appropriate units dispatched, and creating and operating freeway service patrols that can respond rapidly to minor incidents (breakdowns and fender-benders). With incident management systems planned for the county's major bridges and the Freeway Management Center (the SWIFT center) expected to be in operation by early 2009, significant increases in time savings are likely.

The underlying problem with incident management is one of institutional conflict. Public safety agencies tend to have one set of priorities while transportation agencies have different ones. Besides tending to the injured and dealing with fuel spills, public safety agencies are concerned about thoroughly investigating and documenting major accidents, which can take considerable time. Transportation agencies, by contrast, are also concerned with the huge delay costs imposed on motorists, buses, delivery trucks and everyone else who uses the highways. In most states, including Florida, public safety agencies are either legally or de-facto in charge at incidents, which means that minimizing delay to the traveling public does not receive priority. This appears to be less the case on certain toll roads (e.g., Florida’s Turnpike and California’s 91 Express Lanes), where more aggressive efforts to minimize incident clearance times seem to have taken hold.

The National Cooperative Highway Research Program has published a synthesis report on safe, quick clearance of traffic incidents.[54] An overall program should encompass the following elements:

- Quick clearance legislation;
- Hold harmless law for incident responders;
- Fatality certification law;
- Interagency agreements (open roads policy).

Only a few states (not including Florida) permit the certification of a fatality and removal of the body by anyone other than a medical examiner—yet such policies can make a major difference in accident clearance times. Jurisdictions with such policies include the city of Chicago and the states of Maryland, Tennessee and Texas. Likewise, only a few states have developed enhanced interagency agreements that make quick clearance the overarching priority, commonly termed an “open roads policy.” Florida is a leader in this area as one of only five such states identified in a NCHRP study.

Highway construction work zones are another key source of delay, as well as a safety hot-spot. Two principal types of construction are of interest: routine resurfacing and major reconstruction projects. Both can be managed in ways that minimize the delay caused to motorists.

Routine resurfacing must be done periodically to maintain the life of the pavement, thereby preventing major reconstruction before it is really necessary. On highly congested roadways, such resurfacing operations should not be done during peak traffic periods, because the loss of lane capacity imposes too great a cost on users. In Lee County this includes both time-of-day peaks as well as seasonal peaking characteristics. The additional cost of night and weekend operations, or at least off-peak season operations (when it can be accomplished without posing an issue for hurricane evacuation), is often far less than the delay costs that would otherwise be imposed on highway users.

State-of-the-art traffic control in the vicinity of construction work zones can reduce delay and improve safety. The primary impact is to reduce accidents and therefore the delays associated with clearing them.

B. Arterial Operations

Two principal operations strategies for arterials are traffic signal coordination and arterial access management. The Texas Transportation Institute data for Lee County's use of these strategies are presented in Table 11.

Table 11: Lee County Arterial Operations Strategies

Operations Strategy	**2003**	**2002**	**2001**	**2000**
Signal Coordination				
Percent miles of roadway	77%	76%	57%	66%
Annual delay reduction (1000 hours)	19.1	30.9	24.7	28.6
Arterials index with strategy	1.215	1.200	1.177	1.174
Arterials index (base)	1.217	1.203	1.179	1.177
Access Management				
Percent miles of roadway	69%	69%	69%	69%
Annual delay reduction (1000 hours)	61.1	95.4	102.2	107.4
Arterials index with strategy	1.212	1.195	1.172	1.169
Arterials index (base)	1.217	1.203	1.179	1.177

Lee County has made significant progress in signal coordination over the past few years. Progress in this area continues with the opening of the Signals Operations Center.

Access management refers to a set of techniques to increase safety and improve traffic flow on major arterials. It typically includes such measures as consolidating driveways to minimize disruptions to traffic flow, adding median turn lanes or turn restrictions, adding raised medians and adding acceleration and deceleration lanes. Although raised medians are often a principal element in access management, under heavy traffic conditions they can increase recurring congestion due to the limits on storage capacity of left-turn bays. Once they become full, additional left-turning traffic spills into the through lanes adding to delays. But because raised medians also increase safety by reducing the number of conflict points (thereby reducing accidents) they reduce incident-related congestion. When analysts crunch the numbers, they find a net decrease in congestion from the addition of raised medians, as the latter effect outweighs the former.

Because of limitations in readily available highway data, the Texas Transportation Institute uses only the extent of raised medians as its measure of access management. This may understate the extent of congestion reduction, as actual programs in urban areas may include the other features discussed above, all of which have some impact on recurring congestion. The data in Table 11 show that Lee County has more than twice the percentage of roadways with raised medians compared with "small" urban areas, which average 31 percent of their principal arterial miles with access control via raised medians.[55] Not surprisingly, in these small urban areas the average reduction in travel time index due to this strategy is 0.003, approximately one half of the 0.005 that Lee County has achieved thus far.

Part 7

Where Next?

Even though it is among the country's more progressive urban areas in terms of innovation and action in dealing with traffic congestion, Lee County still faces major congestion challenges. If these challenges remain unmet, traffic congestion in Lee County will continue to increase and further intrude upon the quality of life that makes the Southwest Florida area so attractive. While recent economic conditions have created a lull in the county's rapid growth, to see this as anything more than a temporary phenomenon is dangerously shortsighted.

Solving the traffic congestion problem facing Lee County will be an expensive undertaking. The solutions, including the 85 additional freeway lane-miles identified in Part 2 and the queue jump corridors outlined in Part 3, carry a total price tag of $5.7 billion.[56] The question becomes: Is this a good investment?

As part the overall research effort in Reason's Mobility Project, Prof. David Hartgen of the University of North Carolina at Charlotte looked at the financial value of the benefits associated with eliminating congested LOS F travel in Lee County. Professor Hartgen's findings and the resulting benefit cost ratio are shown in Table 12.

While the $5.7 billion cost of acting to relieve congestion is high, the cost of not acting is higher still—the $13.25 billion benefit from solving severe congestion that would be forgone. And the costs would be substantially offset by toll revenue as well. Lee County faces a decision. The county can take steps to alleviate congestion over the next 20 years. The other option is to maintain the status quo, and the citizens of Lee County will pay more than twice as much in dollars, lives and time.

At this point, it is reasonable to ask if managed lanes on arterials using queue jumps is such an effective and financially feasible idea, why are they not already implemented in Lee County and other areas around the United States? There are several answers to this.

Table 12: Benefits and Cost Comparison				
	Under Current 2030 Plan	With Our Proposed Capacity Improvements	Difference	Percent Difference
Daily VMY (M)	39.813	39.406	-0.407	-1.033%
Daily VHT (M)	1.35	1.151	-0.199	-17.289%
Average speed	29.491	34.236	4.745	13.860%
Savings-Factors				
Operating costs per mile		$0.60		
Average fatal accident rate per 100M VMT		1.5		
Average fatal accident cost ($M)		$3.0		
Value of time ($/hr)		$12.00		
Savings-Daily				
Miles (M)		0.407		
Hours (H)		0.199		
Savings: Lifetime (over 20 years w/250 commuting days per year)				
Miles (M)		2035.0		
Hours (H)		995.0		
Lives		30.525		
Value of Lifetime Savings				
Lives saved ($M)		$91.6		
Operating costs ($M)		$1,221.0		
Time saved ($M)		$11,940.0		
Total benefit ($M)		$13,252.6		
Cost to relieve LOS F congestion on ($M)		$5,700.0		
Benefit/cost ratio		2.33		

Source: VMT/VHT data: CRSPE, Inc. 8-10-06

First, in Lee County queue jumps *are* being implemented and planned. The express lanes on Colonial Boulevard that are currently in preliminary planning stages are basically a series of queue jumps connected by access-controlled express lanes. While necessarily more intense and expensive than the concept proposed in this report for the Daniels Parkway corridor, the genesis of both projects is the same. Further, Lee County has already constructed several untolled queue jumps. Similar untolled facilities have been developed in other areas of the country. The suggestions in this paper simply propose a significant expansion and acceleration of this proven concept.

Access to adjoining properties along the roadway is also an issue associated with queue jump implementation, but it can be addressed as discussed in Part 3. Further, while the physical access to adjoining properties may be impacted by queue jump implementation, severe congestion, which queue jumps can relieve, also significantly degrades access to businesses, recreational opportunities and homes. Queue jump access impacts are very localized. Yet access degradation due to traffic congestion occurs not only along the entire length of a congested roadway, but it actually extends throughout the region because of the significant increase in travel time that congestion imposes.

The largest obstacle to an expanded queue jump implementation is funding, particularly perceived issues with toll financing. Using tolls to finance large portions of a community's basic transportation infrastructure has not been used widely in the United States. This is likely due to a general perception that tolls are not a politically feasible solution except on very large or very specialized transportation facilities. But in the last decade about one-third of all new limited access lane-miles built in the United States were tolled, and in states such as Texas and Florida, the share is even higher.[57]

Indeed many projects of this type across the United States, such as express toll lanes on SR 91 in Orange County, California, I-394 in Minneapolis, and I-15 in San Diego, have been obvious successes. One of the most studied projects is the conversion of the high occupancy vehicle (HOV) lanes on I-15 in San Diego to high occupancy toll (HOT) lanes. HOT lanes allow single occupancy vehicles to access HOV lanes and avoid congested conditions on the general-purpose freeway lanes by paying a toll.

Public opinion surveys found that 65% of respondents approved of San Diego's HOT lanes program. Further, this was the majority opinion across all age, ethnic and income groups. An even greater percentage of respondents, over 70%, agreed with the statement that "Tolls are a good way to keep the express lanes moving quickly."[58] While there was strong majority consensus with this statement in all income groups, the highest, with 75% of respondents agreeing, came from the lowest income group (under $40K). While this may seem counterintuitive, it is very understandable. Managed lanes are not "Lexus Lanes" as detractors have wrongly claimed. For a higher income couple enjoying a dinner out, a quick and reliable trip time is a convenience. For a single mom, who can't drop off her children at day care before 7:00 but must still be at work by 7:30, it is a necessity.

One issue relating to toll funding at the local level does, however, still need to be addressed. State and federal transportation dollars (at least those that escape congressional earmark) tend to be allocated based on where congestion is worst. This certainly seems reasonable. However, communities that have confronted their congestion problems and made the decision to deal with the lack of state and federal funding through the use of locally raised monies can be shortchanged in this process.

Even though they have helped the overall funding crisis by acting locally to solve their problem, these communities continue to pay gasoline taxes and other fees, such as license fees, that are used for transportation improvements by state and federal agencies. This brings about an inherently unfair situation that serves as a major disincentive for local communities to seek solutions, such as toll financing or local option taxes directed toward transportation, which can play a major part in solving our nationwide problem. This inequity must be addressed so that the resources and innovation available at the local level can be fully realized.

Moving Forward in Lee County

The analysis presented in this report is designed to show the possibilities, not deliver canned projects. It does point to several steps that Lee County can and should begin taking now. These steps include:

Examine the possibility of queue jump corridors as part of the upcoming Lee County Long Range Transportation Plan Update. The Lee County Metropolitan Planning Organization is beginning the process of updating its Long Range Transportation Plan in a joint effort with Collier County. This is an ideal opportunity to refine the study of the effects of queue jump corridors and the region's transportation system. The updated transportation model that will be developed as part of this effort will be especially valuable in developing traffic and revenue projections for potential managed lane corridors, including BRT opportunities. A major goal of queue jump implementation is to improve roadway efficiency, and transit—particularly BRT—can help capitalize on this efficiency.

Establish a County Infrastructure Bank. While it appears reasonable to assume that queue jumps will be self-financing over time, initial funds for construction will be needed. But the entire queue jump network identified in Part 3 will not be needed immediately. Portions of the network will not be needed for 10 or 20 years. As the need for the queue jump facility has a strong relationship to its ability to self-finance, developing the network in a logical manner allows queue jumps to be constructed, come on line, and begin producing a revenue stream in a logical progression. Having a county source modeled on current State Infrastructure Banks to manage these revenues and use them to leverage new facilities deserves thorough examination. As time progresses, the queue jumps first constructed will be producing robust revenue streams enabling queue jumps, perhaps those on the edges of the system, which may not be as financially robust, to proceed.

Consider tolling existing queue jumps. As previously discussed, queue jumps are relatively expensive facilities that provide premium service to drivers. This type of facility lends itself to toll funding. With the transportation shortfall facing the county, revenues from at least some of the queue jumps that exist or are under construction could provide the initial revenue stream needed for a County Infrastructure Bank. It should be noted that tolls would be collected solely by electronic toll collection (ETC) using the county's LeeWay system.

While implementing tolls on existing queue jumps or the Summerlin/College queue jump, which is currently planned to operate without a toll, may seem publicly and politically unrealistic, that may not be the case. Information from the MPO's 2030 Transportation Vision Survey[59] provides some insight that this may not be an untenable idea in Lee County. The MPO survey asked if respondents would support placing tolls on existing roads during rush hours solely for the purpose of managing congestion. Respondents could indicate that they favored such an idea, were neutral on the idea, or that they did not favor the idea. A plurality of respondents indicated that they did not favor the idea, however, it is interesting that this opinion did not reflect a majority opinion.

Talk to the public. Public support for managed lanes facilities has been consistently underestimated in evaluating toll-funded congestion relief projects. Gathering public opinion through surveys, focus groups and other methods that make good use of internet technologies will be needed to gain a true measure of public support. The educational portion of the public outreach effort needs to be substantial, and the public must truly be involved in developing options. Alternate modes, particularly the development of BRT, deserve a role in these discussions. A public involvement program that merely presents options that have already been developed and decided upon is not likely to prove successful. Exploring transportation options for Lee County can, and should, be an interactive effort with the public.

Explore the role public-private partnerships can play. A private partner can bring up-front capital to some projects and create opportunities for other forms of financing. These expanded options may make some projects feasible that otherwise would not be, or may be able to speed up delivery of some projects. Further, the private sector can realize asset depreciation benefits that the public sector cannot. Those possibilities should be explored, and pursued if they make sense.

Continue to pursue tolling the two lanes currently under construction on I-75. As discussed previously, the advantages to Lee County's citizens of tolling the two new lanes on I-75 currently under construction are far greater than just revenue generation for additional lanes. While revenue is important, even more important in the short term is the significant increase in capacity that managing these two lanes brings about for the entire facility. In addition to the increased capacity, the value of having a reliable option for time-sensitive trips cannot be overstated. These new lanes are a major transportation investment. The return on this investment should be maximized by using proven techniques to ensure that this new capacity returns the greatest possible benefit to drivers.

Work with state and federal agencies so that communities that develop local solutions to transportation problems are rewarded, not penalized. Discussions on finding ways to reward communities for taking on transportation issues that would have traditionally been the responsibility of state or federal government are critical for reasons already discussed. Lee County and the Florida Department of Transportation have already collaborated on projects that have been fast-tracked through the county providing current funding for state projects with repayment by the state in later years. The scope of these agreements needs to be expanded to recognize the impact of tolls and the county's existing full adoption of local option gasoline taxes. Involvement at the federal level could bring additional ideas to the process and, hopefully, provide additional incentives at the local level for developing solutions to traffic congestion.

Support and champion "iron-clad" provisions to ensure that tolls and other revenues collected for transportation will go to transportation projects. We have significant experience in dealing with the public on issues involving tolling. A constant theme expressed is the concern that tolling monies will find their way into projects unrelated to transportation. At best, many fear toll monies will simply replace the funding currently used for transportation projects resulting in no improvement in transportation funding. If any new funding source is to have a reasonable chance for public acceptance, this issue must be addressed. Enabling legislation should be as specific as possible about the use of new funds. Also, a commitment of some specific funding level from existing sources should be included in enabling legislation for new tolls or taxes. Further, this legislation should be designed so that any change in the commitment of existing sources will require an extraordinary process to enact.

Lee County has reason to be proud of its role in developing solutions to traffic congestion that are proving to be effective in many areas of the country. Its citizens are receptive to new ideas and strategies, and their willingness to participate in pilot projects, such as the county's Variable Pricing Program has been an integral part of developing these solutions. The strategies recommended in this report can continue the nationally recognized transportation leadership Lee County has shown in the past and help the county improve the quality of life for its citizens in the future.

About the Authors

Chris Swenson, president of CRSPE, Inc., has been involved in numerous aspects of transportation engineering and planning for 23 years. Mr. Swenson is nationally known for his work in the development of market-based transportation demand management programs, particularly variably priced tolls. He has personally supervised Project Development and Environment (PD&E) studies, the development of area-wide master plans, and large transportation corridor planning projects, as well as traditional and non-traditional transportation financing projects. While much of Mr. Swenson's experience is in his home state of Florida, he has also supervised or participated in transportation studies in California, Nevada, Texas, Oregon, Virginia and Arizona. Mr. Swenson has authored multiple papers and has presented at numerous conferences including the annual meeting of the Transportation Research Board, annual meetings of the Institute of Transportation Engineers, the annual meeting of ITS America, and the ITS World Congress. Mr. Swenson received a Bachelor of Civil Engineering degree in 1984 from the Georgia Institute of Technology followed by a Master of Science in Civil Engineering, also from the Georgia Institute of Technology, in 1985. Mr. Swenson is a registered engineer in the state of Florida.

Robert W. Poole, Jr. is Director of Transportation Policy at Reason Foundation in Los Angeles. He received B.S. and M.S. degrees in engineering from MIT and did additional graduate work in operations research at NYU. He worked in aerospace and for several research firms before launching Reason Foundation in 1978. His 1988 policy study, "Private Tollways: Resolving Gridlock in Southern California," directly inspired California's 1989 public/private toll roads law, which has been emulated in more than a dozen other states. He has advised the U.S., California, and Florida departments of transportation, and served 18 months as a member of California's Commission on Transportation Investment. He has also advised the last four White Houses on various transportation policy issues.

Related Reason Foundation Studies

Thomas A. Rubin, *Kenosha-Racine-Milwaukee Corridor Transit Service Options: An Investigation and Analysis***,** December 2008, Policy Study 372, http://www.reason.org/ps372.pdf

Joseph Vranich, Wendell Cox and Adrian T. Moore, *The California High-Speed Rail Proposal: A Due Diligence Report***,** September 2008, Policy Study 370, http://www.reason.org/ps370.pdf

David T. Hartgen and Ravi K. Karanam, *17th Annual Report on the Performance of State Highway Systems (1984–2006)***,** July 2008, Policy Study 369, http://www.reason.org/ps369.pdf

David Stokes, Leonard C. Gilroy, and Samuel R. Staley, *Missouri's Changing Transportation Paradigm***,** February 2008, http://www.reason.org/reason_smi_transportation_study.pdf

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Peter Samuel and Robert W. Poole, Jr., *The Role of Tolls in Financing 21st Century Highways***,** May 2007, Policy Study 359, http://www.reason.org/ps359.pdf

Robert W. Poole, Jr., *Reducing Congestion in Atlanta: A Bold New Approach to Increasing Mobility***,** November 2006, Policy Study 351, http://www.reason.org/ps351.pdf

Appendix: Calculation of Daily Roadway Capacity

As stated in the report, detailed analysis is beyond the scope or purpose of this study. This report is and should be considered a general planning study that will require a significant amount of additional analysis and design prior to implementation. As a general planning study, comparative daily capacities for various facilities types are based on Florida Department of Transportation generalized capacities. These may be found online at:

http://www.dot.state.fl.us/planning/systems/sm/los/pdfs/tables-051707.pdf

The table used to calculate the daily capacities presented in the text is found on the following page.

We calculated the capacity (at LOS E) of a six-lane facility composed of two flyover lanes in each direction and one at-grade through lane in each direction by adding the capacity of a four-lane uninterrupted flow highway to one-half of the capacity of a four-lane divided arterial. The uninterrupted flow highway represents the at-grade through lanes better than does a freeway facility due to interaction with the outside lanes which remain at grade at all times. We chose one-half of the capacity of a four-lane divided arterial, versus the capacity of a two-lane undivided arterial, as the at-grade sections of the queue jump arterials will have the benefits of a divided facility, including auxiliary turn lanes at the intersections and no interference with left-turning vehicles between intersections. The calculation is as follows:

$$70{,}200 + (34{,}500/2) = 87{,}450$$

The appropriate values are highlighted in yellow in the following table from the FDOT Web site. Values chosen for comparison with a six-lane and an eight-lane divided arterial are taken from the same table and highlighted in blue and pink respectively.

Generalized Annual Average Daily Volumes for Florida's Urbanized Areas*

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	2,200	7,600	15,000	21,300	27,100
4	Divided	20,400	33,000	47,800	61,800	70,200
6	Divided	30,500	49,500	71,600	92,700	105,400

STATE TWO-WAY ARTERIALS

Class I (>0.00 to 1.99 signalized intersections per mile)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	4,200	13,800	16,400	16,900
4	Divided	4,800	29,300	34,700	35,700	***
6	Divided	7,300	44,700	52,100	53,500	***
8	Divided	9,400	58,000	66,100	67,800	***

Class II (2.00 to 4.50 signalized intersections per mile)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	1,900	11,200	15,400	16,300
4	Divided	**	4,100	26,000	32,700	34,500
6	Divided	**	6,500	40,300	49,200	51,800
8	Divided	**	8,500	53,300	63,800	67,000

Class III (more than 4.5 signalized intersections per mile and not within primary city central business district of an urbanized area over 750,000)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	5,300	12,600	15,500
4	Divided	**	**	12,400	28,900	32,800
6	Divided	**	**	19,500	44,700	49,300
8	Divided	**	**	25,800	58,700	63,800

Class IV (more than 4.5 signalized intersections per mile and within primary city central business district of an urbanized area over 750,000)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	5,200	13,700	15,000
4	Divided	**	**	12,300	30,300	31,700
6	Divided	**	**	19,100	45,800	47,600
8	Divided	**	**	25,900	59,900	62,200

NON-STATE ROADWAYS

Major City/County Roadways

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	9,100	14,600	15,600
4	Divided	**	**	21,400	31,100	32,900
6	Divided	**	**	33,400	46,800	49,300

Other Signalized Roadways
(signalized intersection analysis)

Lanes	Divided	A	B	C	D	E
		Level of Service				
2	Undivided	**	**	4,800	10,000	12,600
4	Divided	**	**	11,100	21,700	25,200

Source: Florida Department of Transportation 05/17/07
Systems Planning Office
605 Suwannee Street, MS 19
Tallahassee, FL 32399-0450
http://www.dot.state.fl.us/planning/systems/sm/los/default.htm

FREEWAYS

Interchange spacing ≥ 2 mi. apart

Lanes	A	B	C	D	E
	Level of Service				
4	23,800	39,600	55,200	67,100	74,600
6	36,900	61,100	85,300	103,600	115,300
8	49,900	82,700	115,300	140,200	156,000
10	63,000	104,200	145,500	176,900	196,400
12	75,900	125,800	175,500	213,500	237,100

Interchange spacing < 2 mi. apart

Lanes	A	B	C	D	E
	Level of Service				
4	22,000	36,000	52,000	67,200	76,500
6	34,800	56,500	81,700	105,800	120,200
8	47,500	77,000	111,400	144,300	163,900
10	60,200	97,500	141,200	182,600	207,600
12	72,900	118,100	170,900	221,100	251,200

BICYCLE MODE

(**Note**: Level of service for the bicycle mode in this table is based on roadway geometrics at 40 mph posted speed and traffic conditions, not number of bicyclists using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Paved Shoulder/ Bicycle Lane Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	3,200	13,800	>13,800
50-84%	**	2,500	4,100	>4,100	***
85-100%	3,100	7,200	>7,200	***	***

PEDESTRIAN MODE

(**Note:** Level of service for the pedestrian mode in this table is based on roadway geometrics at 40 mph posted speed and traffic conditions, not number of pedestrians using the facility.) (Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-49%	**	**	**	6,400	15,500
50-84%	**	**	**	9,900	19,000
85-100%	**	2,200	11,300	>11,300	***

BUS MODE (Scheduled Fixed Route)

Level of Service (Buses per hour)

(**Note:** Buses per hour shown are only for the **peak hour** in the **single direction** of the higher traffic flow.)

Sidewalk Coverage	A	B	C	D	E
	Level of Service				
0-84%	**	>5	≥4	≥3	≥2
85-100%	>6	>4	≥3	≥2	≥1

ARTERIAL/NON-STATE ROADWAY ADJUSTMENTS

(alter corresponding volume by the indicated percent)

Lanes	Median	Left Turn Lanes	Adjustment Factors
2	Divided	Yes	+5%
2	Undivided	No	-20%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

ONE-WAY FACILITIES

Multiply the corresponding two-directional volumes in this table by 0.6.

* Values shown are presented as two-way annual average daily volumes for levels of service and are for the automobile/truck modes unless specifically stated. Although presented as daily volumes, they actually represent peak hour direction conditions with applicable K and D factors applied. This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Level of service letter grade thresholds are probably not comparable across modes and, therefore, cross modal comparisons should be made with caution. Furthermore, combining levels of service of different modes into one overall roadway level of service is not recommended. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, Pedestrian LOS Model and Transit Capacity and Quality of Service Manual, respectively for the automobile/truck, bicycle, pedestrian and bus modes.

**Cannot be achieved using table input value defaults.

***Not applicable for that level of service letter grade. For automobile/truck modes, volumes greater than level of service D become F because intersection capacities have been reached. For bicycle and pedestrian modes, the level of service letter grade (including F) is not achievable, because there is no maximum vehicle volume threshold using table input value defaults.

Endnotes

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10 Wendell Cox and Alan E. Pisarski, *Blueprint 2030: Affordable Mobility and Access for All of Atlanta and Georgia*, June 21, 2004 (http://ciprg.com/ul/gbt/atl-report-20040621.pdf).

11 David T. Hartgen and Gregory Fields, “Accessibility, Traffic Congestion, and Regional Economic Performance,” (Los Angeles: Reason Foundation, forthcoming 2009).

12 “Texas Metropolitan Mobility Plan—Breaking the Gridlock,” Austin: Texas Transportation Commission, Oct. 26, 2004.

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[16] A project summary will be found at www.reason.org/mobility.

[17] IDAS Modeling for Colonial Boulevard, Prepared for the Lee County Department of Transportation on behalf of PBS&J November, 2008, prepared by: CRSPE, Inc.

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[19] Level of service (LOS) is basically a “report card” on roadway operating conditions, with LOS A representing very uncongested conditions all the way to the extreme stop-and-go congestion of LOS F.

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[21] Steve Lockwood, *The 21st Century Operations-Oriented State DOT*, Washington, D.C.: Cooperative Highway Research Program, Transportation Research Board, April 2005, p. 25.

[22] Steve Hemminger, Metropolitan Transportation Commission, presentation at International Bridge, Tunnel & Turnpike Association conference in Santa Monica, CA, March 21, 2006.

[23] Doug MacDonald, “Highway Congestion: What Is to Be Done?” (www.wsdot.wa.gov/secretary).

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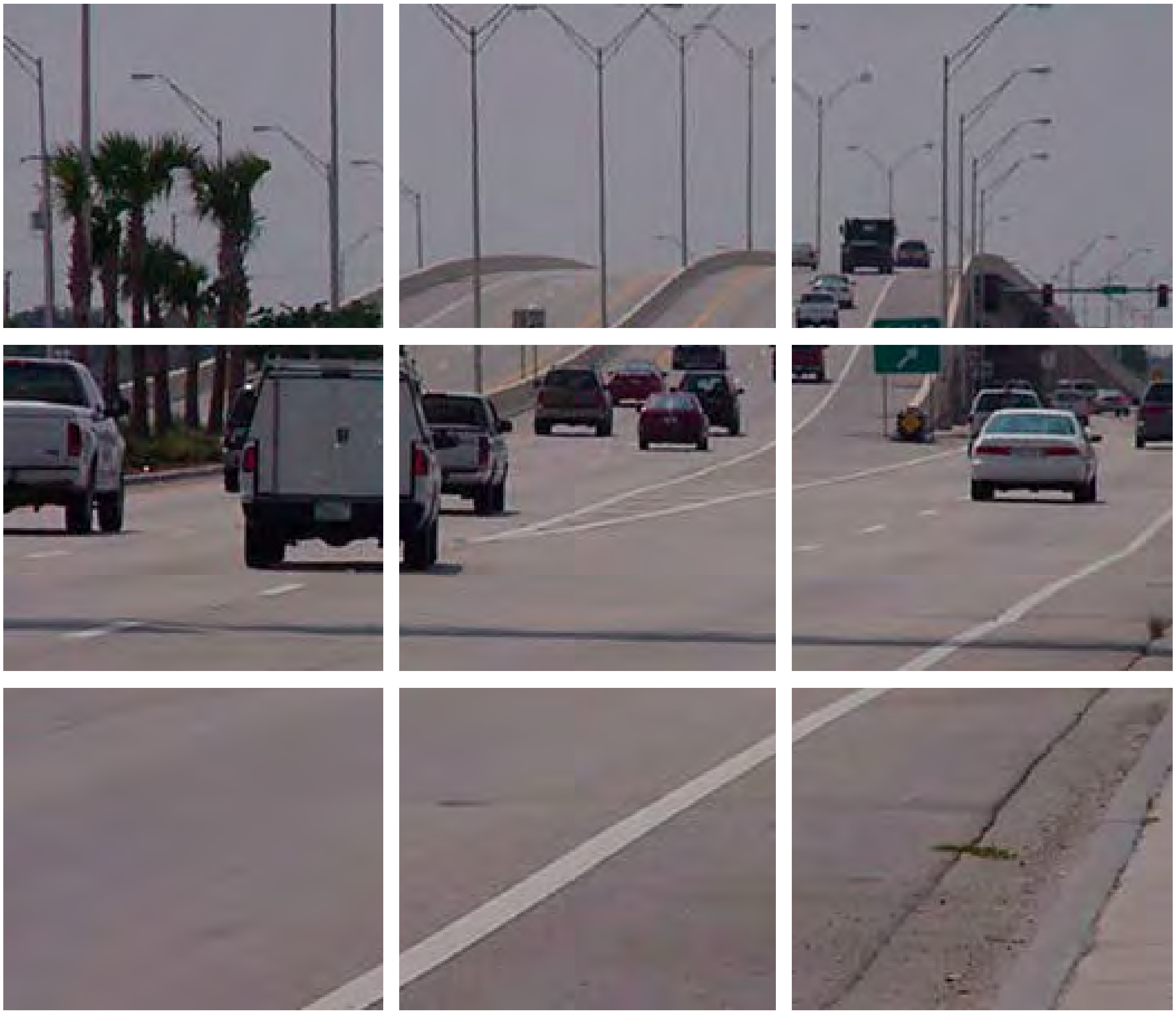

Reason

Reason Foundation
3415 S. Sepulveda Blvd., Suite 400
Los Angeles, CA 90034
310/391-2245
310/391-4395 (fax)
www.reason.org