ATLANTA REGIONAL MANAGED LANE SYSTEM PLAN

SOCIAL EQUITY AND ENVIRONMENTAL EFFECTS EVALUATION

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Atlanta Regional Managed Lane System Plan

Technical Memorandum 9: Social Equity and Environmental Effects Evaluation

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SOCIAL EQUITY AND ENVIRONMENTAL EFFECTS EVALUATION OF MANAGED LANES

A. Purpose

This is a high-level environmental scan to determine the potential social equity and environmental issues related to implementing managed lanes in the Atlanta region. For the corridors showing promise for further evaluation, the next planning step towards implementation would consist of detailed analysis of impacts per all relevant regulation such as National Environmental Policy Act of 1969 (NEPA) regulations and appropriate documentation.

The social equity and environmental effect of managed lanes could focus on EJ population identification and air quality effects from managed lanes. Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations*, directs federal agencies to "promote nondiscrimination in federal programs substantially affecting human health and the environment and provide minority and low-income populations access to public information on, and an opportunity for public participation in, matters relating to human health or the environment." The study area traverses the Atlanta region, which is comprised of a diverse demographic. Minority and low-income populations will be considered in the implementation of managed lanes, especially if property acquisition and construction effects among other impacts. Examples from around the country will be highlighted to reflect on previous experience as it applies to the Atlanta Region.

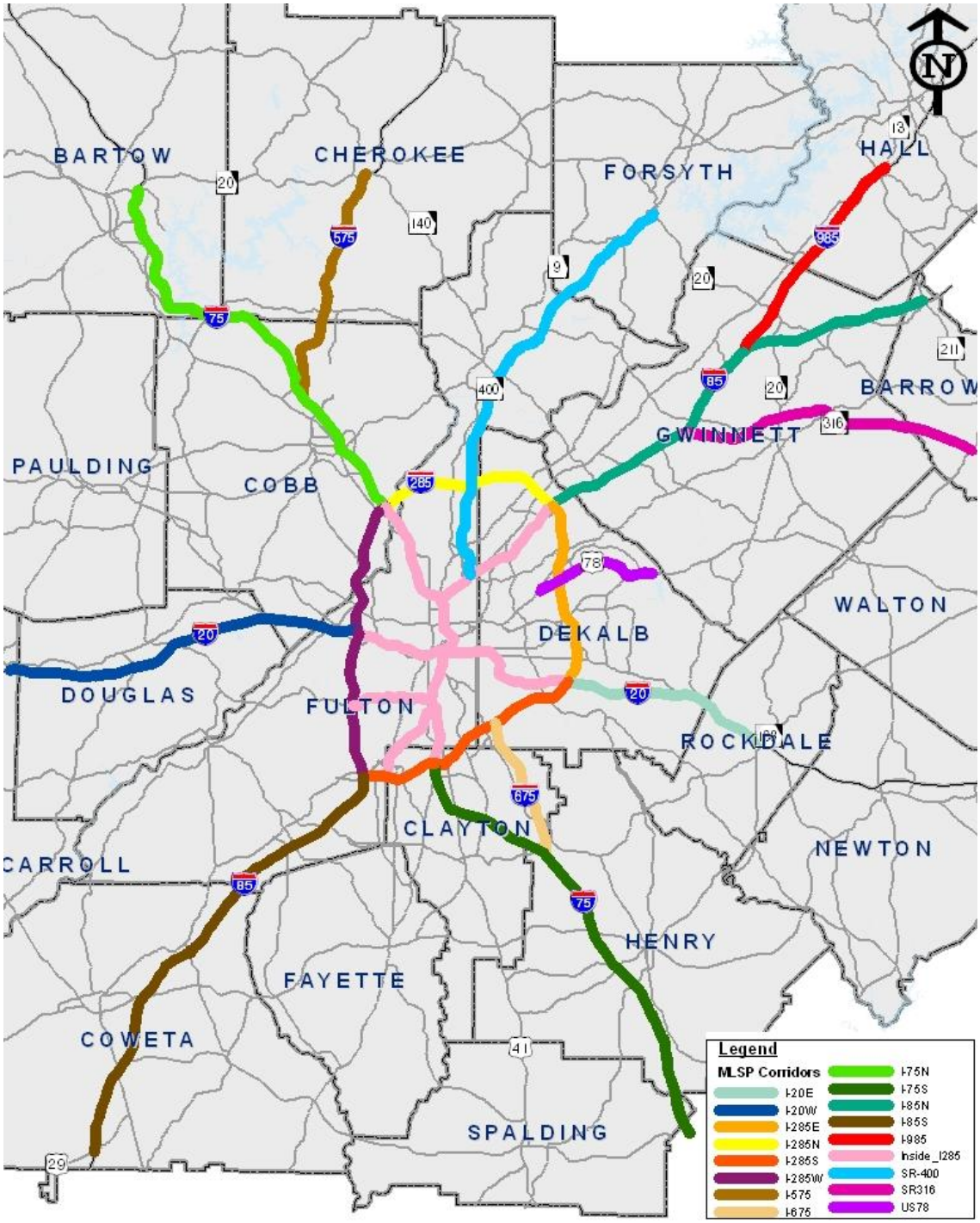
B. Background

Dwight D. Eisenhower envisioned the interstate highway network funded through tolls. However, that vision was unrealized in part because 1950s drivers were unwilling to stop every few miles at a toll booth to pay cash – thus, they were constructed with tax dollars. The National Highway Trust fund established to pay for this system is dwindling, with some estimates predicting for it to be depleted by as early as 2009.

Today, technology has produced several solutions to allow tolls to be collected without the need to stop, such as the use of a vehicle transponder. Managed lanes offer a way to collect tolls "on the fly" in dedicated highway lanes and are constructed as a paid alternative to the existing highway network, which is subject to traffic congestion with no mechanism for relief. Managed lanes are not the panacea for the funding crisis, nor do they totally pay for themselves; however they do make more efficient use of the highway corridor and help to mitigate congestion by providing options. Managed lanes offer the choice to pay to avoid the congestion on the non-tolled, general-purpose lanes and provide a guaranteed travel time using price (toll) management.

There is a value that people place on the ability to reach their destination in a guaranteed time. Currently, the existing infrastructure in Georgia does not supply a system that meets that perceived demand. Implementing managed lanes would create a facility to meet the transportation consumers' demand for increased travel time reliability and travel options. Figure 1 displays the initial managed lane corridors.

Figure 1: Study Area



C. Social Environment

Environmental Justice population are officially defined as minority populations as individuals who are a member of any one of the following population groups: Black or African American; American Indian and Alaska Native; Asian; Asian and Native Hawaiian, Other Pacific Islander, some other race alone, and two or more races. White Hispanic/Latinos are also included as a minority ethnicity. Low-income populations are officially identified using the annual statistical thresholds developed by the US Census Bureau, which account for income by household size.

The social equity implications of managed lanes are complicated. Charging a toll to use the managed lane may exclude those who can not afford to pay. On the other hand, increased opportunities to reach a destination in a guaranteed time may benefit lower income users equally as much as higher income users. Additionally, other managed lanes projects have benefited transit operations through more reliable travel time provisions which provide benefits to the transit dependent.

While sometimes called "Lexus lanes" benefiting the affluent, the tolls collected from managed lanes actually originate from a broad spectrum of socioeconomic sources. Regardless of income level, willing users consider the value of time saved worth the cost of the toll for a variety of reasons, whether it is relief from congestion stress, or to pick up a child from day care on time to avoid a late fee penalty, or to arrive at hospital appointment on time. Users see the value of time saved and are given a choice with managed lanes - whether or not to pay to get to where they need to go more quickly.

Case Study – Minneapolis/St. Paul, Minnesota

A case study from the MnPASS lanes on the I-394 corridor in Minnesota, the first High Occupancy Toll (HOT) road in the state which opened to traffic on May 16, 2005, reports the results from the I-394 MnPASS Evaluation Attitudinal Panel Survey and shows the frequency of users by income and their opinions about the system. The MnPASS lanes allow carpoolers, transit, and motorcycles to use the lanes for free, but solo drivers must pay. Dynamic pricing ensures continued free flow in the lanes at about 50 to 55 miles per hour by adjusting the toll up or down depending upon the amount of traffic in the lanes. The per-trip fee depends on where users enter and exit the MnPASS Express Lanes.

NuStats conducted the survey under subcontract to the State and Local Policy Program at the Humphrey Institute of Public Affairs at the University of Minnesota for the Minnesota Department of Transportation. The Wave 3 Survey, conducted during May and June 2006, occurred six months after the second wave and about one year after the implementation of the I-394 MnPASS Express Lane project. NuStats conducted 1,228 interviews, of which 343 were with panel members (i.e., interviewed in the Baseline, Wave 2, and Wave 3). These data were collected to evaluate the attitudinal and behavioral impacts of allowing solo drivers to pay to use carpool lanes.

The study results show that the managed lanes are used by a majority of the population representing all income levels, although higher income households use the managed lanes more often than lower income households. In addition, when asked how they last used the lanes, higher income households were more likely to use it as a paying single driver (40 percent) than mid-income households (18 percent) and lower-income households (7 percent). Lower income households were more likely to use the managed lane as carpoolers (75

percent), than mid-income households (66 percent) or higher-income households (52 percent). Most thought that given the time saved using the MnPASS lanes, the toll was priced appropriately.

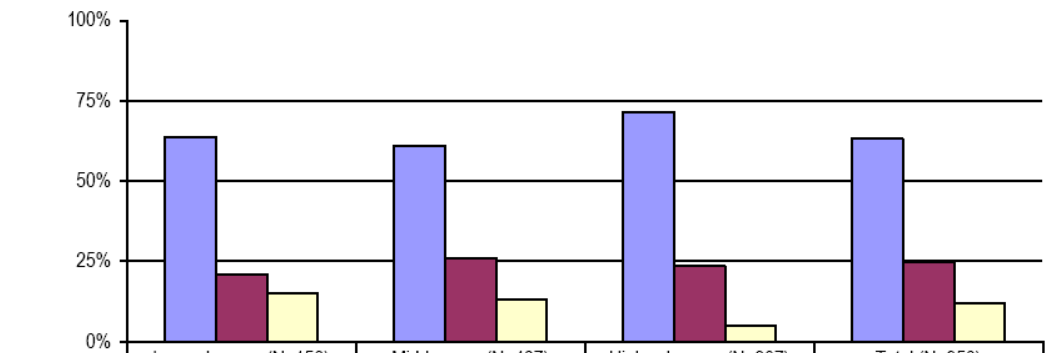
Transponder ownership reveals the demographics of the system users. The MnPASS transponder owner tends to have higher educational attainment, to be employed full-time, to be between 35 and 54 years of age, and are disproportionately white.

Although the MnPASS acceptance rates serves as an indicator of what to expect if managed lanes are implemented in the Atlanta Region, it should not be used as a substitute for detailed public involvement and outreach. The Atlanta and Minneapolis region differ in terms of population demographics and projected growth rates. There is a strong need to educate the Atlanta region on the benefits and implications of a managed lanes system. Some exploratory studies regarding the public's potential acceptances of toll roads and congestion pricing have resulted in public opposition, which is discussed in more detail in the Range of Attitudes section. It is vital to educate the public to understand the variety of benefits to managed lanes before assuming what their reactions will be. The evidence from the MnPASS survey is highlighted in the following paragraphs and figures.

A majority of respondents in all income groups responded positively to the idea of allowing SOV drivers to use carpool lanes by paying a toll, as illustrated in Figure 2. At the same time, acceptance was greater among the higher-income respondents (71 percent), than among lower-income (64 percent) or mid-income (61 percent) respondents. There were no significant differences across the income groups in terms of negative response to the concept. About one-fourth of each income group thought this concept was a bad idea (26 percent of mid-income, 24 percent of lower-income, and 21 percent of higher-income).

Figure 2: Response Opinion on Allowing Single Drivers to Use the Carpool Lanes by Household Income

What do you think of allowing single drivers to use the carpool lanes by paying a toll? Is it…



	Lower-Income (N=156)	Mid-Income (N=487)	Higher-Income (N=307)	Total (N=950)
Good Idea	64%	61%	71%	63%
Bad Idea	21%	26%	24%	25%
No Opinion	15%	13%	5%	12%

Source: I-394 MnPASS Evaluation Attitudinal Panel Survey

The top five responses as to why allowing single drivers to pay a toll to use carpool lanes was a good idea:

- Eases congestion
- It provides a better use for carpool lanes
- Only users pay, not everyone
- Time is money for some people
- Saves time for busy people

The top five responses as to why allowing single drivers to pay a tool to use the carpool lane was a bad idea:

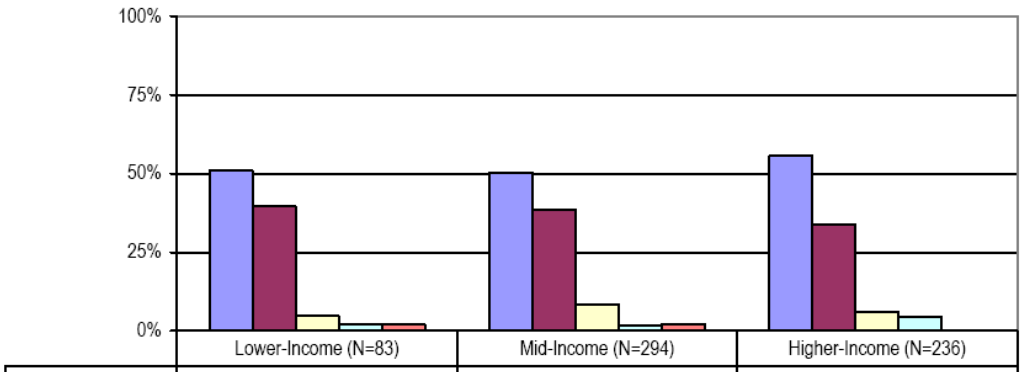
- Use of carpool lanes not encouraged enough
- Only benefits the rich
- Carpool lanes should be free to all
- Carpool lanes should only be open to carpoolers
- Road are already paid for

The majority of respondents, regardless of their income level, were satisfied with the quality of travel on the roadway used for their reference trip, as illustrated in Figure 3.

Figure 3: Satisfaction with Quality of Reference Trip by Household Income

(Among I-394 Respondents Only)

Based on this trip, how satisfied were you with the overall quality of your travel on this roadway?



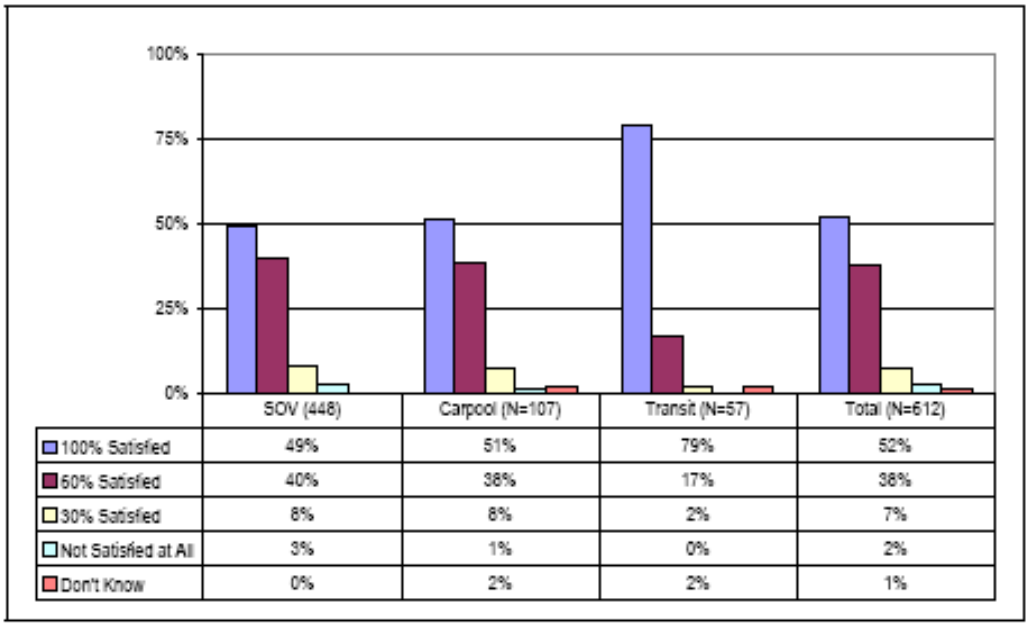
	Lower-Income (N=83)	Mid-Income (N=294)	Higher-Income (N=236)
100% Satisfied	51%	50%	56%
60% Satisfied	40%	38%	34%
30% Satisfied	5%	8%	6%
Not Satisfied at All	2%	2%	4%
Don't Know	2%	2%	0%

Source: I-394 MnPASS Evaluation Attitudinal Panel Survey

Most respondents, regardless of travel mode, were satisfied with the quality of travel on their reference trip, as illustrated in Figure 4. Transit users had the highest level of satisfaction with the quality of travel on their reference trip; 79 percent reported being "100 percent satisfied", compared with 51 percent of carpoolers and 49 percent of SOV drivers.

Figure 4: Satisfaction with Quality of Reference Trip by Reference Trip Mode

Based on this trip, how satisfied were you with the overall quality of your travel on this roadway?



	SOV (448)	Carpool (N=107)	Transit (N=57)	Total (N=612)
100% Satisfied	49%	51%	79%	52%
60% Satisfied	40%	38%	17%	38%
30% Satisfied	8%	8%	2%	7%
Not Satisfied at All	3%	1%	0%	2%
Don't Know	0%	2%	2%	1%

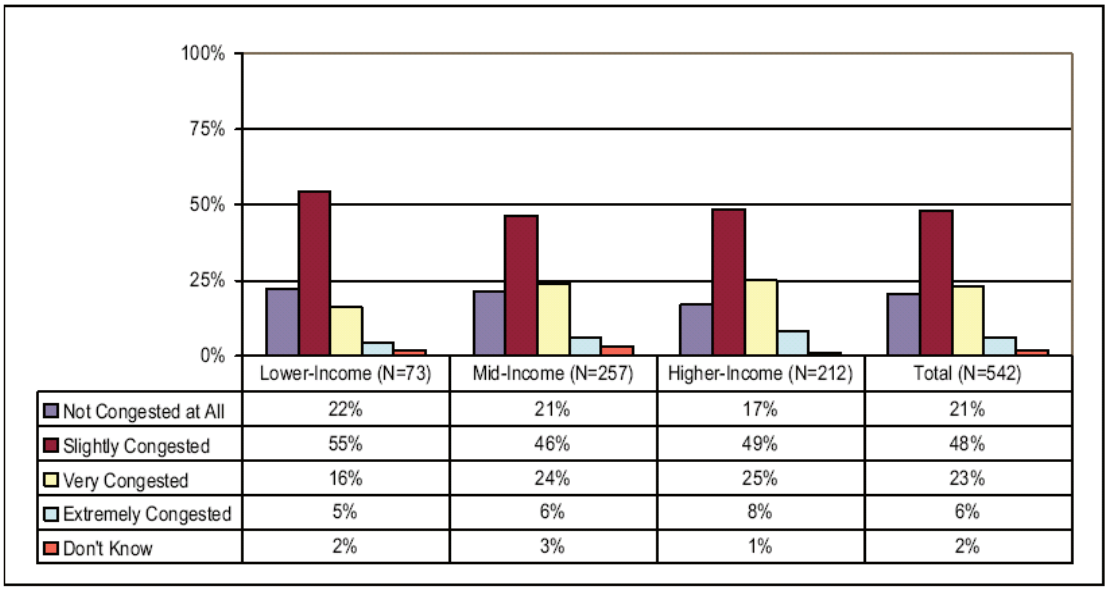
Source: I-394 MnPASS Evaluation Attitudinal Panel Survey

Figure 5 illustrates the satisfaction with travel experience. The travel experience was most enjoyable for transit users, though respondents in all travel mode categories were more likely to find the trip enjoyable than stressful. More than half (53 percent) of transit users rated the target trip as very enjoyable compared to 16 percent of SOV drivers and 23 percent of carpoolers. Similarly, a quarter of HOV or SOV users found the trip slightly stressful, compared to only 5 percent of transit users.

Figure 5: Satisfaction with Travel Experience by Reference Trip Mode

(Among I-394 Respondents Only)

What about the general traffic lanes at that time, would you say the lanes were…



	Lower-Income (N=73)	Mid-Income (N=257)	Higher-Income (N=212)	Total (N=542)
Not Congested at All	22%	21%	17%	21%
Slightly Congested	55%	46%	49%	48%
Very Congested	16%	24%	25%	23%
Extremely Congested	5%	6%	8%	6%
Don't Know	2%	3%	1%	2%

Source: I-394 MnPASS Evaluation Attitudinal Panel Survey

The lessons from the MnPASS analysis is that if implemented the managed lanes will be generally accepted, provide time savings value, ease congestion, and will provide an enjoyable experience to the transit user. There are, however, issues that the system may exclude those who can not afford the toll. The MnPASS transponder owner profile has a higher percentage of higher-income households, as well larger households and those with multiple vehicles. Managed lanes will provide advantages to carpools and transit by way of increase mobility options and more reliable travel times, two aspects that have direct benefit to lower income carpoolers and transit riders.

D. Range of Attitudes

It is important to consider the range of attitudes towards systems that are operational such as the MnPASS and I-15 systems, but it is also important to understand that these projects passed the initial public screening test in order to proceed to implementation. There have been regions that have tested the public's attitude for managed lanes and tolling concepts that have resulted in negative reactions and were tabled from proceeding forward in the planning process.

Case Study - Minneapolis/St. Paul

The Hubert H. Humphrey Institute conducted a study of public reaction to a congestion pricing plan for I-494, and I-35 in the area.

- The focus groups indicated that congestion pricing would not result in traffic reductions because the participants did not perceive that there were viable options for them to avoid using the roadway during the peak hours. The only result would be to divert the congestion problem to side streets and congestion would not be effectively reduced.
- The group was more positive towards the plan if the funds generated were to be programmed towards transit service improvements. However, a separate group of inner-city residents reported that they viewed transit as generally unsafe and pavement conditions on downtown streets as generally poor.
- The citizen's jury also felt that the HOT lane concept would unfairly impact low-income commuters. If tolls were to be implemented, they should be set up with a sunset provision to take effect when the improvements had been paid for.
- Low-income commuters favored the HOT lane concept to a greater degree than higher-income groups, indicating that they did not share the focus group and citizen jury perceptions about the impact of the plan on low-income residents.
- The improvements in freeway travel would make transit systems in the area relatively worse off from a competitive standpoint. Side streets in the area might also be negatively impacted through the diversion of traffic.
- A California study cited in the Minnesota project report stated that citizens' groups initially favored a gas tax over other options such as congestion pricing, emissions fees, and parking pricing, but after a more thorough consideration of the issues favored congestion pricing as a potential solution to the congestion problem. This finding suggests that, as with reported experiences in Norway, the public may need to be given some time to understand the issues and initial unfavorable reaction to congestion pricing approaches should not necessarily be construed as evidence that a congestion pricing plan will ultimately be unsuccessful.

Case Study – Houston

Texas Transportation Institute conducted focus groups with users of the Katy Freeway (the western portion of I-10 in Houston)

- Many of the issues raised in other areas were not indicated as problem areas by these groups - there was no consideration of social inequity from this project (although it should be noted that Katy Freeway users tend to have higher incomes across the board) and that they did not perceive the “double tax" issue either.
- There was a neutral reaction to the concept of SOV buy-in to the lanes.
- A focus group was also conducted with a wider range of residents of the entire area (not just limited to Katy Freeway users). Again income equity was not perceived as major problems for this project. However, with this group, double taxation was considered an issue.

- The group felt it would be acceptable to have SOV's buy access during off-peak hours, but definitely not during peak hours. This may have been due to the fact that 2+ peak-hour carpool lanes had proved to be highly congested on Houston freeways in the past.

Case Study - South Florida

The Center for Urban Transportation Research (CUTR) published a study of HOT Lanes in South Florida in October 2000. The purpose was to evaluate commuter acceptance and examine the equity impacting of converting HOV lanes to HOT lanes. The responses revealed that a majority of the public thought traffic congestion on I-95 was a serious problem. However, less than half thought HOV lanes were effective in relieving congestion. Researchers asked the following question,

> "One idea used in some parts of the country is to allow single-occupant vehicles, that is, vehicles with only a driver and no passengers, to use the carpool lanes during rush hour if they pay a toll of (vary price point – ask 1/3 $.50, 1/3 $1.00, and 1/3 $2.00) to use the lane. Still using the same scale of 1 to 10, to what extent do you agree that this would be a good idea to use on the I-95 carpool lanes?"

The respondents overwhelming thought this was a bad idea regardless of the toll charged. The responses ranged from 69 percent to 71 percent disagreeing that this was a good idea. The respondents were not given any information on potential benefits of a pricing project. CUTR interpreted this response as an outright rejection of the idea. Table 1 shows the distribution of responses among those who oppose the concept. A few people gave more than one response so the totals may add up to over 100%.

However, in July 2008, the Florida Department of Transportation introduced express lanes and Bus Rapid Transit service to reduce congestion on I-95 from I-395 in downtown Miami to Broward Boulevard in Fort Lauderdale as a pilot project with funding from the Urban Partnership Agreement with the USDOT.

Table 1: Reasons for Managed Lanes Opposition

Reason Opposed to HOV to HOT conversion	Actively Oppose	Little/No Support
Shouldn't have to pay	32%	19%
No effect on congestion	20%	23%
Defeats purpose of HOV	13%	8%
Already pay to many taxes/tolls	12%	6%
Just won't work	12%	9%
Need more info	3%	13%
People won't use	3%	8%
Too expensive	4%	5%
Don't want to give government money	4%	4%
All other	4%	8%

E. Location Aspects of Managed Lanes

Analysis of equity by demographics and location addresses the question of who bears the burden and who benefits from the construction of managed lanes. The managed lanes system is being studied as a region-wide system. The regional aspect of managed lanes means that mobility enhancements would be realized for an assortment of people with varying income levels, racial backgrounds, and living in diverse locations throughout the region. It is important to address the questions and concerns of minority and low-income populations pertaining to managed lanes. These groups have been identified for special recognition during the planning and public outreach and education phase.

Region and Study Area Profile

The 20-county Atlanta region is comprised of approximately 63 percent whites, 28 percent African American, and 3 percent Asian (Table 2).

Table 2: 20-county Atlanta Region

Race	Population	Percentage
White alone	2,681,322	63%
Black or African American alone	1,193,736	28%
Asian alone	134,845	3%
Other Races (including two or more)	218,589	5%
Total	4,228,492	100%

Source: 2000 U.S. Census

An EJ study area was defined by selecting 2000 U.S. Census block groups that abut the highway system in the 20-county Atlanta region. Approximately 1.1 million people live in the vicinity of highways in the study area. About 55 percent are white, 35 percent are African American, and 4 percent are Asian (Table 3).

Table 3: Managed Lanes Study Area

Race	Population	Percentage
White	591,855	55%
African American	389,898	35%
Asian	46,120	4%
Other Races (including two or more)	70,732	6%
Total	1,099,605	100%

Source: 2000 U.S. Census

Another demographic to consider at the planning stage is the Hispanic community. The identification of this population helps to establish a communication and community outreach strategy during the public involvement efforts and education campaign regarding managed lanes. The Atlanta region is home to about 7 percent Hispanic population (Table 4) and the study area is comprised of a population that is 9 percent Hispanic (Table 5). Figure 6 graphically displays the combined tabulated information.

Table 4: 20-county Atlanta Region Hispanic Ethnicity

Hispanic Ethnicity	Population	Percentage
Hispanic or Latino	293,000	7%
Non-Hispanic or Latino	3,935,492	93%
Total	4,228,492	100%

Source: 2000 U.S. Census

Table 5: Managed Lanes Study Area Hispanic Ethnicity

Hispanic Ethnicity	Population	Percentage
Hispanic or Latino	96,836	9%
Non-Hispanic or Latino	999,769	91%
Total	1,099,605	100%

Source: 2000 U.S. Census

Figure 6 identifies the block groups which have a minority percentage greater than 45 percent or a Hispanic population greater than 9 percent. The block groups that exceed these thresholds help to target areas for increased public involvement. The thresholds were established to identify the block group areas that exceed the study area percentages for low income and minority populations. A determination as to whether these groups would bear disproportionate impacts would be assessed during a detailed NEPA document. In general, the managed lane system would traverse a diverse collection of block groups, affecting a wide range of income levels and racial types.

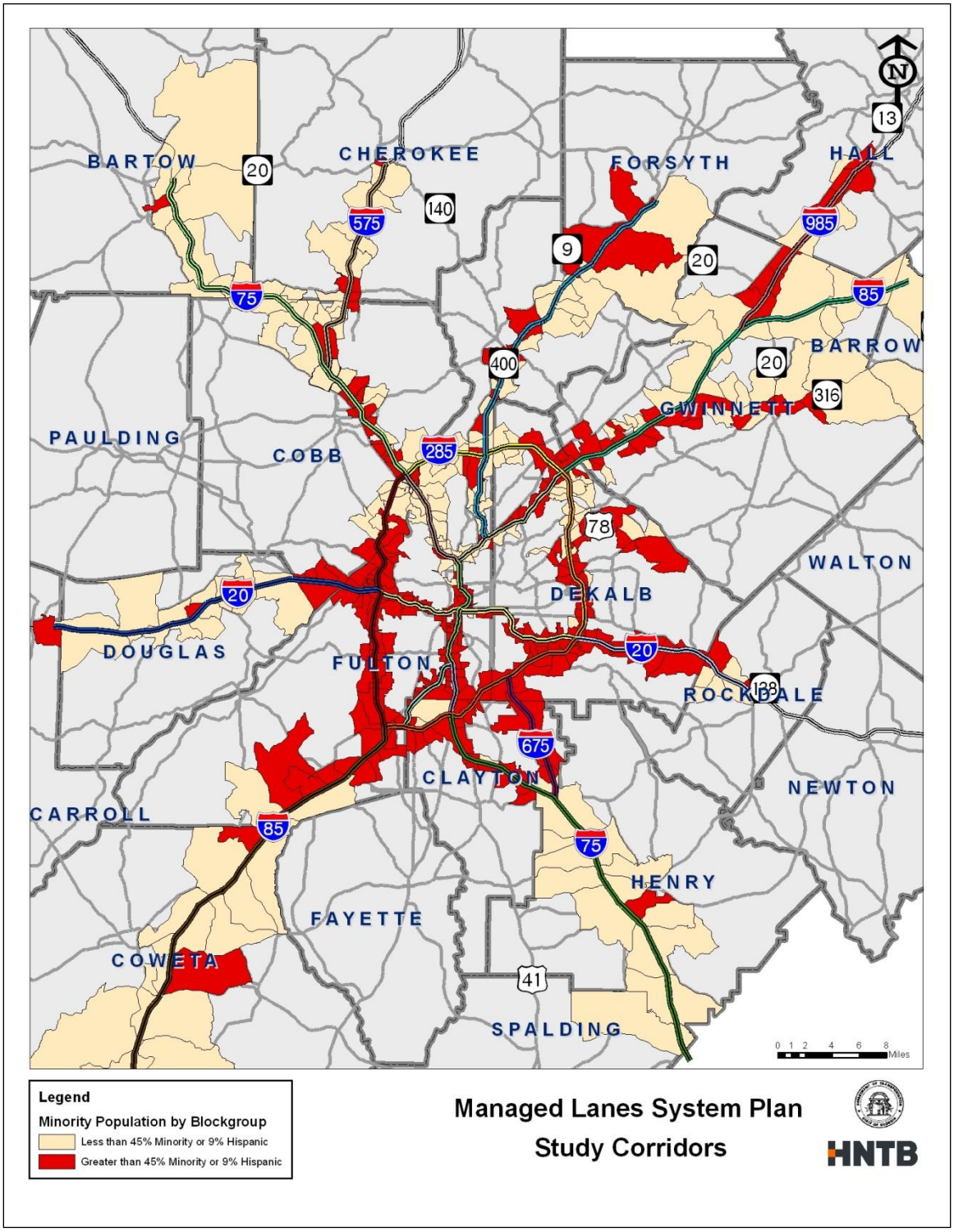
Additionally, block groups were clustered by corridor to determine if certain corridors have a higher population of minorities than others. The following table identifies the corridors with minority populations over 45 percent of the corridor's total population. The areas around I-285 and within its perimeter, and around I-85 tend to have the high percentages of minority populations as well as areas near I-20 east and west.

Table 6: Minority Populations by Managed Lanes Corridor

	White		African American		Asian		Other Races		Total	
	No. of Persons	**% of Total**	**No. of Persons**	**% of Total**	**No. of Persons**	**% of Total**	**No. of Persons**	**% of Total**	**No. of Persons**	**% of Total**
I-285 East	26,848	36%	38,549	51%	4,846	6%	4,729	6%	74,972	100%
I-285 West	20,363	24%	60,833	72%	1,048	1%	1,893	2%	84,137	100%
I-285 South	3,948	8%	45,921	88%	980	2%	1,603	3%	52,452	100%
I-75 South ITP	3,578	24%	8,615	58%	919	6%	1,762	12%	14,874	100%
I-20 East	7,150	20%	27,249	77%	183	1%	884	2%	35,466	100%
I-20 East ITP	3,709	10%	31,069	87%	106	0%	747	2%	35,631	100%
I-20 West	30,009	51%	25,642	43%	582	1%	3,071	5%	59,304	100%
I-20 West ITP	1,226	5%	22,069	91%	574	2%	455	2%	24,324	100%
I-85 South ITP	4344	27%	9,042	57%	837	5%	1,680	11%	15,903	100%
Downtown Connector	10,567	27%	25,361	64%	2,225	6%	1,455	4%	39,608	100%

Source: 2000 U.S. Census

Figure 6: Minority Population in the Managed Lane Study Area



F. Equity by Income

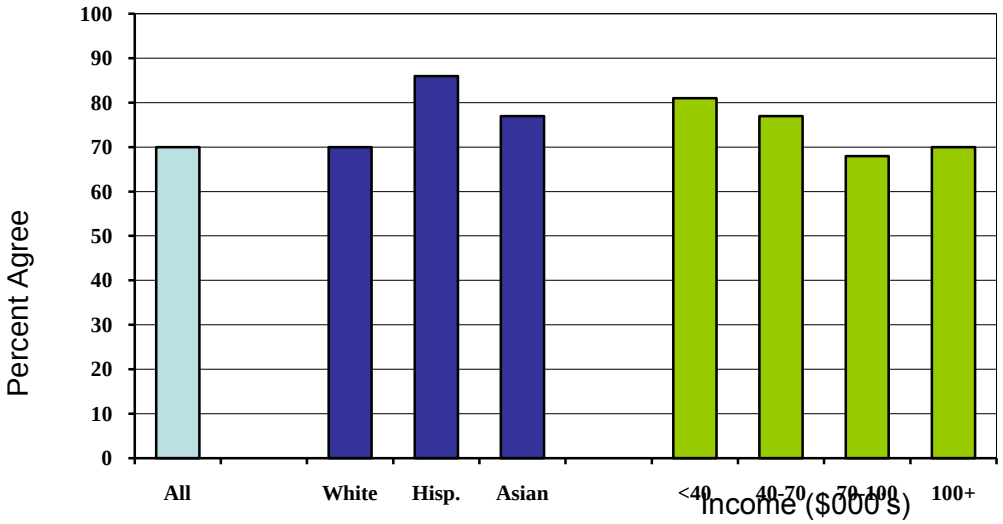
There is evidence that potential managed lane users are spread across income levels based on the idea that there are infinite reasons why one would choose to enter the managed lane to pay for a reliable travel time to one's destination. Studies indicate that managed lanes have gained acceptance when combined with increased alternative transportation services, such as transit.

MnPASS and I-15 studies indicate that users want choice in transportation options between whether to use the managed lane or general purpose lane. Additionally, the availability of transit options in the managed lane corridor provides another mode choice to reach one's destination. In some cases studies, managed lanes act as a fixed guideway for express bus or Bus Rapid Transit and allow busses to bypass the congested general purpose lanes. Increased travel time reliability makes transit in the managed lanes corridor more competitive to the private vehicle owner.

A case study in the San Diego area exemplifies the equity issues and the public's opinion of the managed lanes, in this case High Occupancy Toll (HOT) lanes. Users on San Diego's I-15 HOT lanes were more likely to have higher incomes than drivers in regular lanes, but lower-income drivers did sometimes use the HOT lanes. Attitudes of I-15 drivers displayed in Figure 7 showed a broad approval of the HOT lane program, perceived it to be fair, and noted that it had reduced congestion. Equity issues in this corridor are being addressed by dedicating some of the express lane revenues to bus service. It is important to note that I-15 does not have debt service on capital, which frees revenue for this obligation. I-15 was the first project that demonstrated how implementing tolls as a demand management measure can play a major role in paying for transit and reducing the impact of pricing on low-income individuals. Although the funding source has not been determined in the Atlanta region, it may be a challenge to provide transit because the managed lane system toll revenue would likely have to be used to pay debt service on capital for system construction.

Figure 7: Public Opinion of SANDAG by Race and Income

"People who drive alone should be able to use the I-15 Express Lanes for a fee?"



Source: SANDAG

The San Diego area boasts a high approval rating of the I-15 system, as indicated in Table 7. Eighty-eight percent of FasTrack customers approved of the system and sixty-six percent of the other I-15 users approve of the system as well, indicating that even though they are not paying to use the system they are receiving some benefit from those who are using the HOT lanes. There is evidence that general purpose lanes benefit from the reduction of traffic that is migrating to the managed lanes.

Table 7: I-15 FasTrack Approval

	FasTrack Customer	Other I-15 Users
Approve	88%	66%
Disapprove	11%	28%
Don't Know	1%	6%

Source: SANDAG

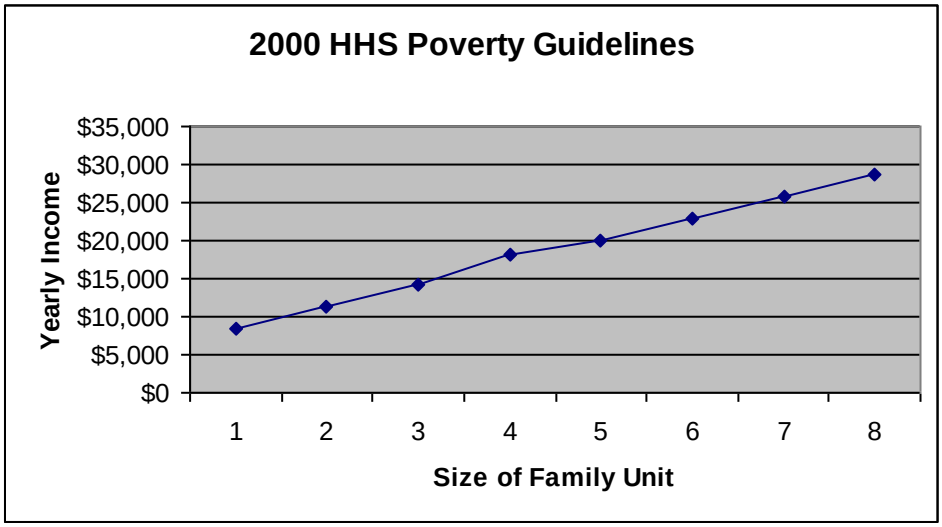
The San Diego case study provides an example to follow to address the issue of equity of managed lanes in the Atlanta region. By providing a transit component within the managed lanes, the system serves a broad range of users from lower-income transit riders to higher-income individuals who pay to ride alone in the lanes.

Managed lanes are not price discriminate; every one pays the same to get the same travel time benefits. However, high income users pay less than low income users as a proportion of their total income. To offset this regressive nature, studies have suggested transit enhancements paid through the toll revenue of the managed lanes as a method to redistribute the transportation benefits to the corridor as an effort to ameliorate the perceived transportation inequalities.

The managed lanes system will likely require a transponder. A variety of payment methods should be available to avoid adverse social impacts. A cash payment method should be allowed for those who wish to choose this payment option. Some users may not have bank accounts or credit cards and this consideration should be factored into the business model of the Managed Lane system operation.

Following the Office of Management and Budget's (OMB) Statistical Policy Directive 14, the U.S. Census Bureau uses a set of money income thresholds that vary by family size and composition to determine who is in poverty. If a family's total income is less than the family's corresponding threshold, then that family and every individual in it is considered in poverty. The official poverty thresholds do not vary geographically, but they are updated for inflation using Consumer Price Index (CPI-U). The official poverty definition uses money income before taxes and does not include capital gains or noncash benefits (such as public housing, Medicaid, and food stamps). The following graph, Figure 8, was created based on the Department of Health and Human Services (HHS) guidelines for the 48 contiguous states.

Figure 8: Poverty Thresholds



SOURCE: Federal Register, Vol. 65, No. 31, February 15, 2000, pp. 7555-7557.

The following map, Figure 9, shows the block groups that exceed nine percent of the total block group population with 1999 incomes below the poverty level. Consisting of approximately 133,000 indiviuals, these area have been identified for special recognition during the planning phase of the managed lanes system.

Table 8: Median Household Income

Location	Median Household Income
Atlanta 20-county Region	$49,613
Managed Lanes Study Area	$44,617

Source: 2000 U.S. Census

Corridors with incomes below the regional median household income are located in the vicinity of I-285 South and West as well as inside the I-285 perimeter along I-85 South and I-20 East and West and near the Downtown Connector, where I-75 and I-85 merge. These corridors were identified as consisting of a collection of block groups that have a combined median household income at least 30 percent below the regional median household income (about $49,613).

Additionally, there are specific block groups that represent the lowest twenty-five percent of the regional median household income, lower than $25,000 yearly, median household income. These block groups are identified in Figure 10.

Figure 9: Low-Income Population in the Managed Lane Study Area

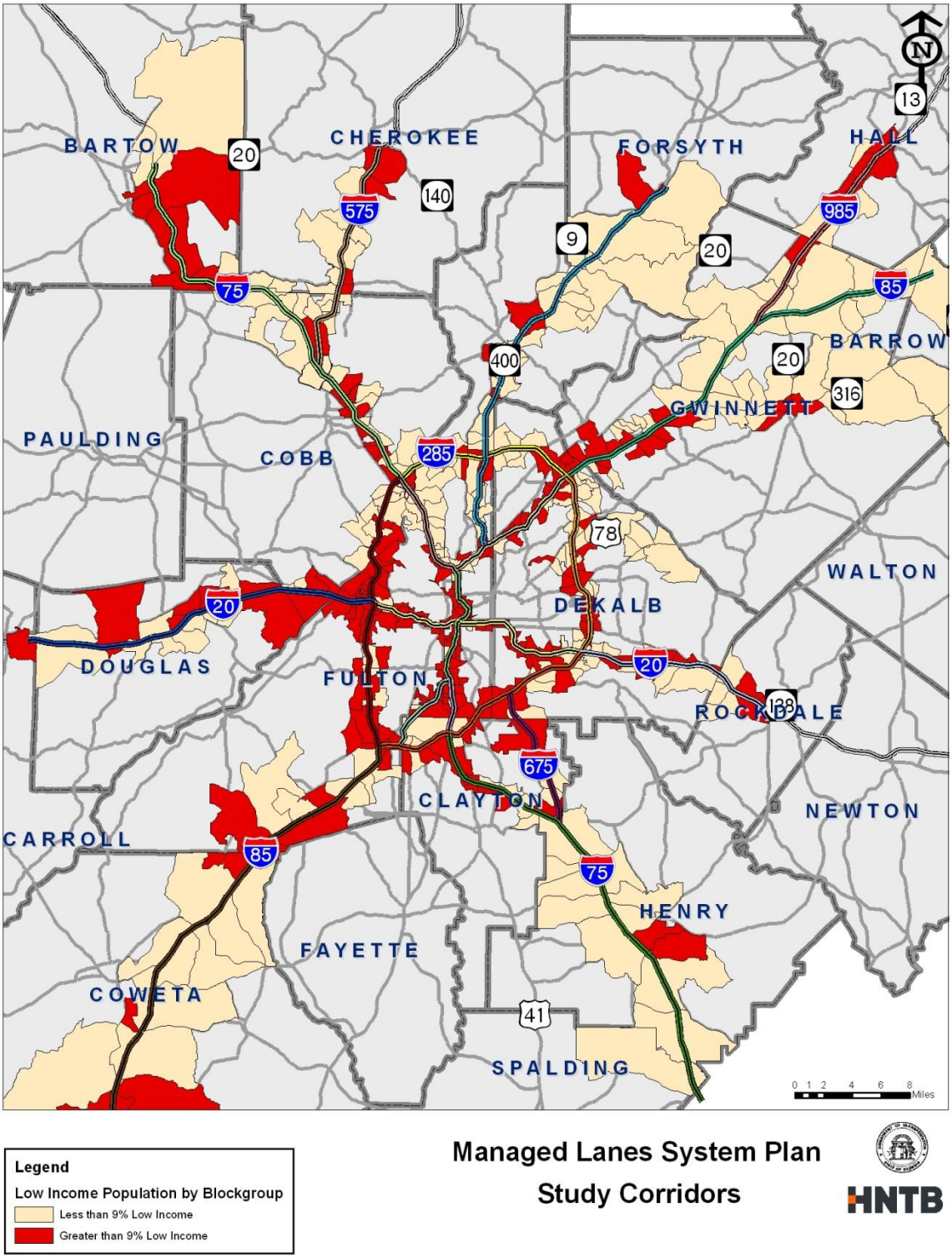
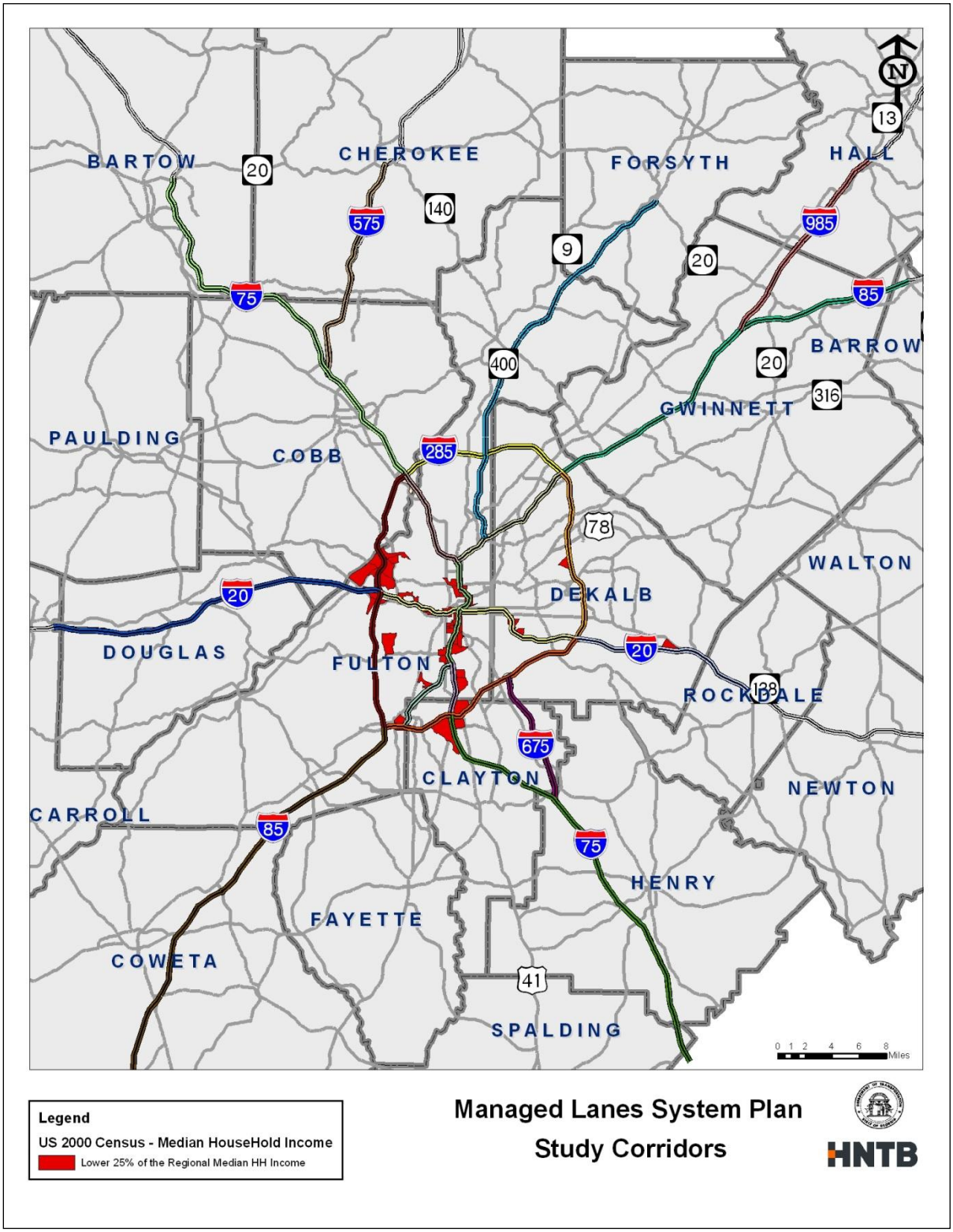


Figure 10: Lowest 25 percent of Regional Median Household Income



G. Health Assessment

A negative externality of transportation is the health effects it has on the human population. Research indicates that the pollutants released into the air from vehicle emissions have respiratory health effects including increased incidences of lung cancer, asthma attacks, respiratory tract infections, chest tightness and irritations. Health hazards are especially likely to be experienced by children elderly people, pregnant woman and people already suffering from illness[1].

Fortunately, changes in national policies over recent decades have lead to cleaner air for Americans. Careful regulation and monitoring of air quality has led to dramatic improvement, overall, in air quality since the Clean Air Act (CAA) was initiated in 1970.

The Clean Air Act is a federal law designed to protect air quality in the United States. The United States Environmental Protection Agency (US EPA) established limits on how much of a pollutant can be in the air anywhere in the US. These limits are referred to as National Ambient Air Quality Standards (NAAQS) and are set for six ambient air pollutants: ozone, lead, nitrogen dioxide, particulate matter, carbon monoxide, and sulfur dioxide. Areas exceeding the NAAQS are referred to as nonattainment areas. Individual states must develop plans to reduce air pollution to acceptable levels in the timeframe prescribed by the CAA.

The Atlanta region is in nonattainment for ground level ozone and fine particulate matter. Ozone impacts the respiratory system causing irritation to the nose, throat, and lungs. The long term effects of ozone are due to the inflammation of the lungs when ozone is inhaled; this type of exposure can be compared to repeated sunburns and can lead to permanent scarring of lung tissue, loss of lung function, and reduced lung elasticity.[2]

An Emory University study of the Atlanta region shows the importance of better air quality for children, in particular.

In perhaps the largest study of pediatric asthma visits to date, Dr. Paige Tolbert, of the Rollins School of Public Health at Emory University, and co-investigators, obtained data on emergency department visits for three summers from seven large Atlanta area hospitals. The study included information on a variety of pollutants including spatial resolution of ozone data, a broad range of exposure levels, and a balanced distribution of socioeconomic status in the study population.

Increases in both ozone and particulate matter were found to heighten the risk of pediatric emergency room visits for acute asthma. According to the authors, "*the study suggests continuing health risks at pollution levels that commonly occur in many U.S. cities*," and "*supports accumulating evidence regarding the relation of air pollution to childhood asthma exacerbation*."[3]

The 20-county age distribution has a greater percentage of the population under 18 and 65 years and over (Table 9) compared to the blocks groups abutting the managed lanes study area (Table 10). Public outreach efforts may consider focusing on elderly populations that are transit dependent.

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[1] American Lung Association
[2] Atlanta Regional Commission – Air Quality
[3] Selected Key Studies on Particulate Matter and Heath: 1997 – 2001. American Lung Association. March 5, 2001.

Table 9: 20-county Atlanta Region Age Distribution

Age Group	Population	Percentage
Under 18	1,182,312	28%
18 to 64 Years	2,724,242	64%
65 Years and Over	321,938	8%
Total	4,228,492	100%

Table 10: Managed Lanes Study Age Distribution

Age Group	Population	Percentage
Under 18	273,515	25%
18 to 64 Years	751,358	68%
65 Years and Over	74,721	7%
Total	1,099,594	100%

Transportation planning efforts should seek to provide a system that benefits air quality. Managed lanes offer reduced levels of congestion resulting in lower vehicle hours traveled, which leads to lessened vehicle emissions. Lowering the amount of vehicle emissions helps to improve air quality. The next section will elaborate on the potential effects to air quality from managed lanes.

H. Environmental Considerations

The air quality benefits of managed lanes are challenging to assess. The managed lanes have the ability to reduce congestion and emissions. However, while the tolls on managed lanes may drive some people to choose other times or forms of transportation, there will be others drawn to the system to reap the benefits of this relatively less congested option. Overall, managed lanes are a step towards the construction of a system that provides improved efficiency on the existing transportation system.

Air Quality

As the transportation sector continues to be a major contributor to harmful atmospheric emissions, it is important to analyze the potential impacts on air quality for any major transportation study. This is especially true in an area in non-compliance with EPA set National Ambient Air Quality Standards (NAAQS), as is the case in the Atlanta metropolitan region.

Additionally, as more focus is shifted towards global climate change, it is important for us to understand how transportation projects could potentially impact a region's carbon footprint. Increasingly, the inclusion of transportation projects to decrease the per capita carbon footprint plays a roll in our daily decision making.

Air Quality Index

In large metropolitan areas, the U.S. EPA now requires that ozone and other air pollutant levels be reported in terms of the Air Quality Index or AQI (formerly the Pollution Standard Index). The

AQI is an air quality indicator developed by the U.S. EPA to provide uniform and easily understandable information about the daily levels of air pollution. The AQI is reported as a percentage of the federal health standard. An AQI reading between 101 and 150 is considered unhealthy for sensitive groups such as children, asthmatics and people with existing respiratory ailments, and these groups should limit strenuous outdoor activities under these conditions. AQI readings greater than 150 are considered generally unhealthy, and it is recommended that even otherwise healthy people should consider limiting strenuous outdoor activities.

Table 11 provides a list of the ranges and colors for the Air Quality Index and the related description of general health effects for each range:

Table 11: AQI Category Index Values, Descriptors, and Colors

Index Values	Descriptor	Color
0 - 50	Good	Green
51 - 100	Moderate	Yellow
101 - 150	Unhealthy for Sensitive Groups	Orange
151 - 200	Unhealthy	Red
201 - 300	Very Unhealthy	Purple
301 - 500	Hazardous	Maroon

Source: EPA

Table 12 shows the ozone rating for the Atlanta 10-county region in 2008. Except for Coweta and Paulding counties, all the counties received a failing grade. The Atlanta region overall is an unhealthy environment for sensitive groups.

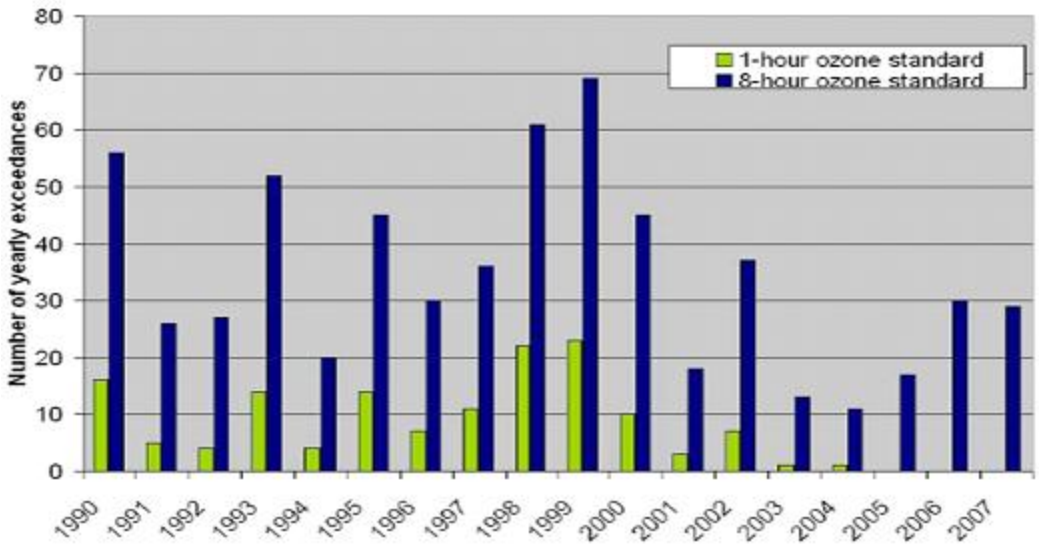
Table 12: Ozone Rating for Atlanta Region in 2008

County	High Ozone Days				
	Grade	Weighted Average	Orange Days	Red Days	Purple Days
Cobb	F	4.5	12	1	0
Coweta	C	2	6	0	0
Dekalb	F	8.2	20	3	0
Douglas	F	6	15	2	0
Fayette	F	4.3	13	0	0
Fulton	F	9	21	4	0
Gwinnett	F	4.8	10	3	0
Henry	F	6.8	19	1	0
Paulding	C	1.7	5	0	0
Rockdale	F	6.8	19	1	0

Source: American Lung Association State of the Air 2008

Additionally, Figure 11 shows the number of times the Atlanta region has exceeded the federal ozone level standards since 1990. Atlanta has exceeded the 8-Hour Federal Ozone Standard for seventeen years and the 1-hour Standard for all but the last three years.

Figure 11: Early Exceedances of the Federal Ozone Standard in Atlanta



Source: Atlanta Regional Commission

Regulated Vehicular Emissions

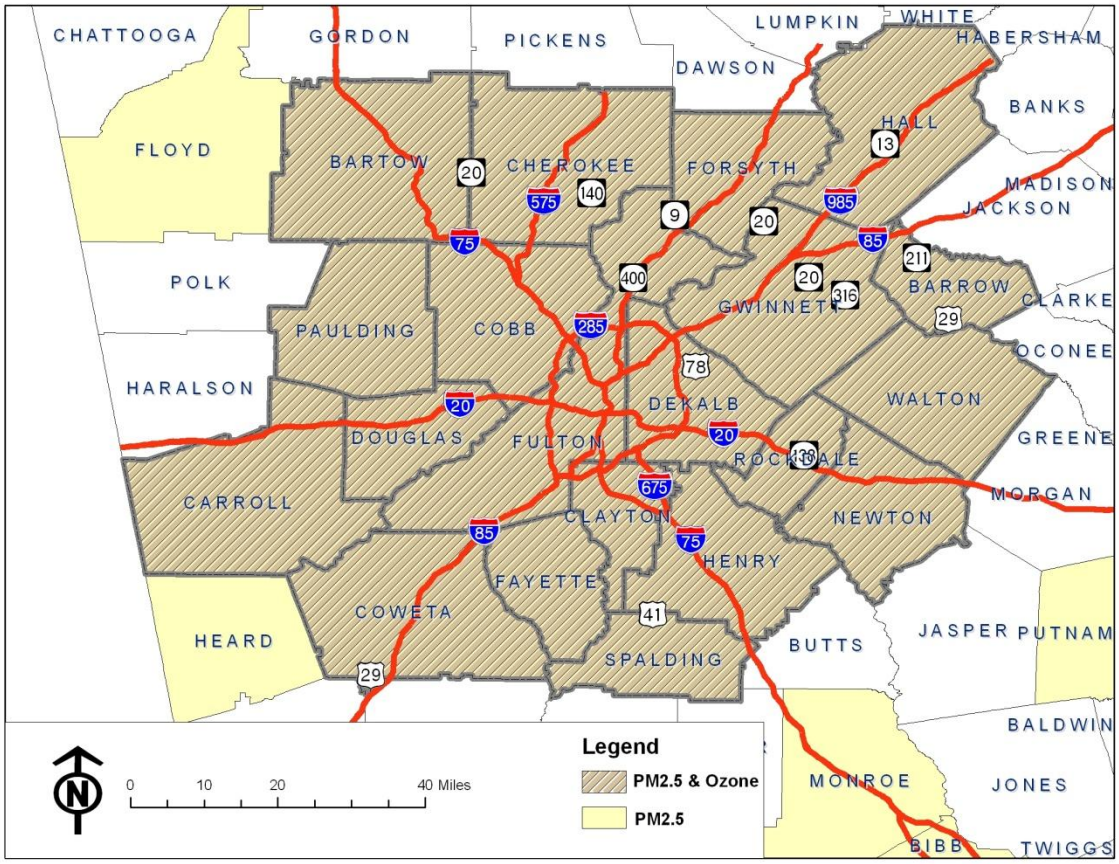
Several chemical species produced in automobile combustion engines as a waste byproduct are monitored and regulated by the Clean Air Act, last amended in 1990. The NAAQS establishes concentrations for certain criteria pollutants considered unhealthy for human exposure for certain time frames and/or concentrations. Among these are several species relevant to automobile combustion:

- Carbon Monoxide (CO)
- Nitrogen Dioxides (NO_x)
- Particulate Matter smaller than or equal to 10 µm in diameter (PM_{10})
- Particulate Matter smaller than or equal to 2.5 µm in diameter ($PM_{2.5}$)

In addition, Volatile Organic Compounds (VOCs), another automobile exhaust byproduct, can be responsible for catalyzing the creation of the photochemical smog, ozone (O_3), a criteria pollutant regulated by the Clean Air Act, and therefore its concentration is also monitored to help maintain compliance with air quality standards. It's worthwhile to note that NO_x also catalyzes the creation of O_3. Both VOC and NO_x are strictly monitored in locations in noncompliance with ambient O_3 concentrations.

All the counties in the Managed Lane study area are currently in nonattainment with NAAQS for the 8-hour O_3 and $PM_{2.5}$ standards. Transportation improvements with the potential to mitigate the increase or flat-out reduce concentrations of these species, or their precursor species like NO_x and VOC, are vital to the region's potential to conform to air quality standards. Figure 12 maps the area and shows the counties in nonattainment of NAAQS for ozone and PM2.5 as of June 2, 2008.

Figure 12: Metropolitan Atlanta NAAQS Nonattainment Counties

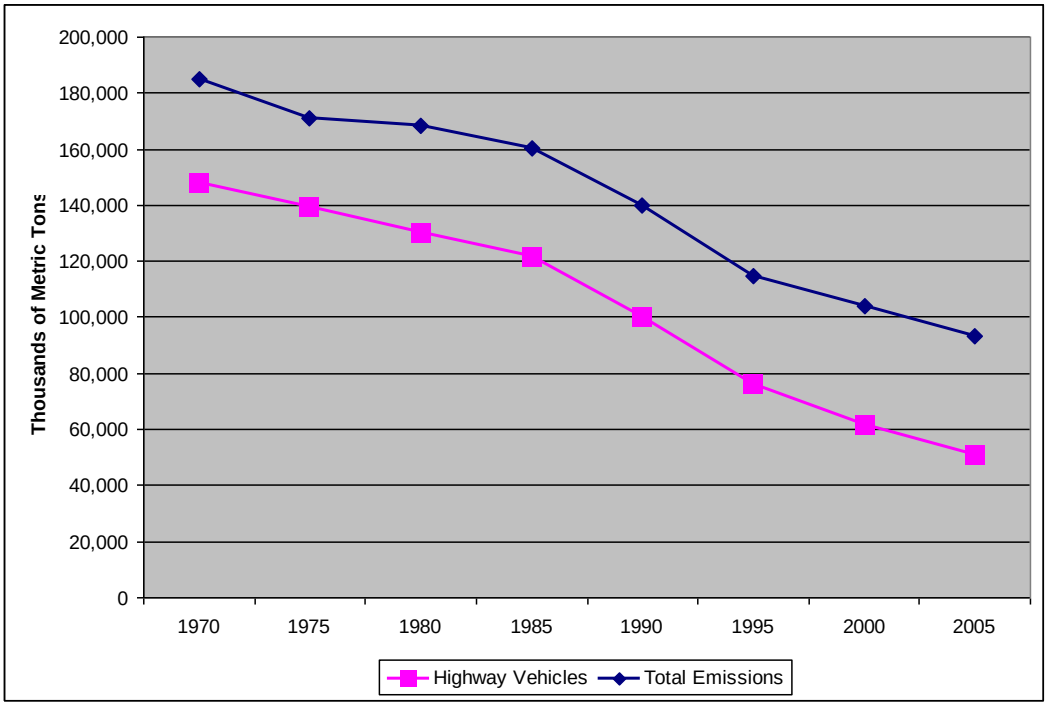


Source: EPA

Moreover, the reduction of emissions of these species is important for the protection of health and enhancement of quality of life. The World Health Organization has linked up to 2.4 million deaths annually with poor air quality. Many of these chemical species are lung irritants and are known to cause damage to internal tissues, induce asthma attacks, pneumonia and lower respiratory infections. These effects are most felt by children and the elderly. Additionally, O_3 has a host of secondary effects on the environment. It reduces outdoor visibility through the production of sight obscuring smog, can be damaging to plants, crops and animals. Coupled with haze from atmospheric PM, the enjoyment of views and landscapes can be adversely affected. This situation is exasperated in Atlanta by the tendency for water droplets to condense on particulate matter due to the high summertime relative humidity.

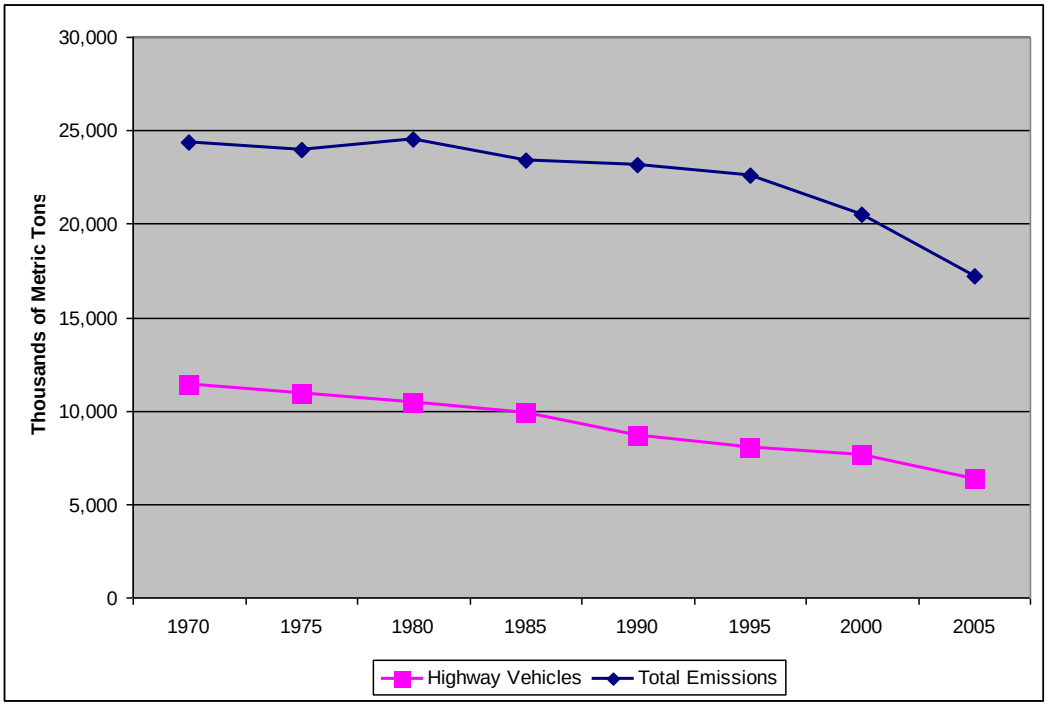
Fortunately, the trend in the emissions, and therefore the concentrations, of primary regulated pollutants has decreased dramatically since the Clean Air Act was initiated in 1970, as illustrated in Figure 13 through Figure 17, generated from EPA National Emissions Inventory (NEI) data. Note that PM_{10} wasn't regulated until the late 1980s and $PM_{2.5}$ not until the late 1990s, so the domain for these two species is smaller then the other pollutants.

Figure 13: Metro Atlanta CO Emissions 1970 – 2005



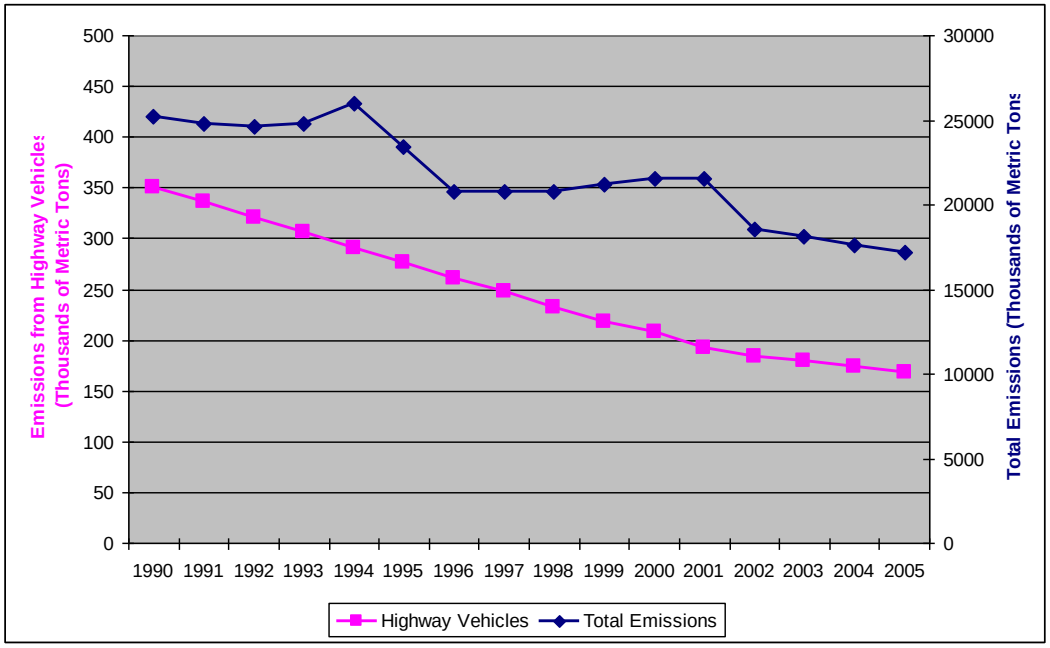
Source: EPA Dataset

Figure 14: Metro Atlanta NO_x Emissions 1970 – 2005



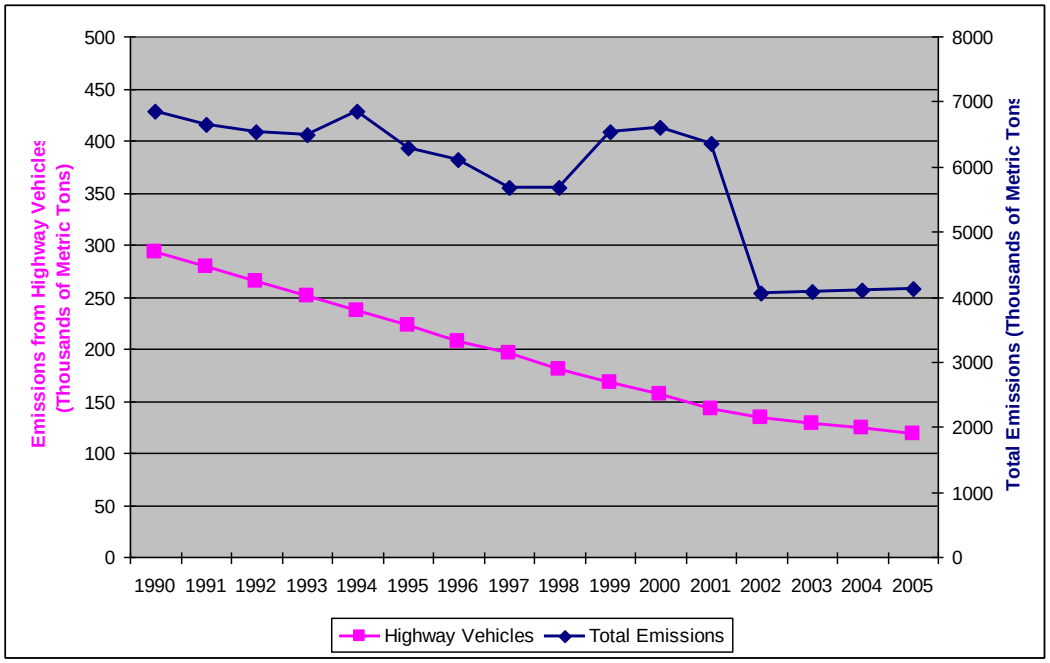
Source: EPA Dataset

Figure 15: Metro Atlanta PM_{10} Emissions 1990 – 2005



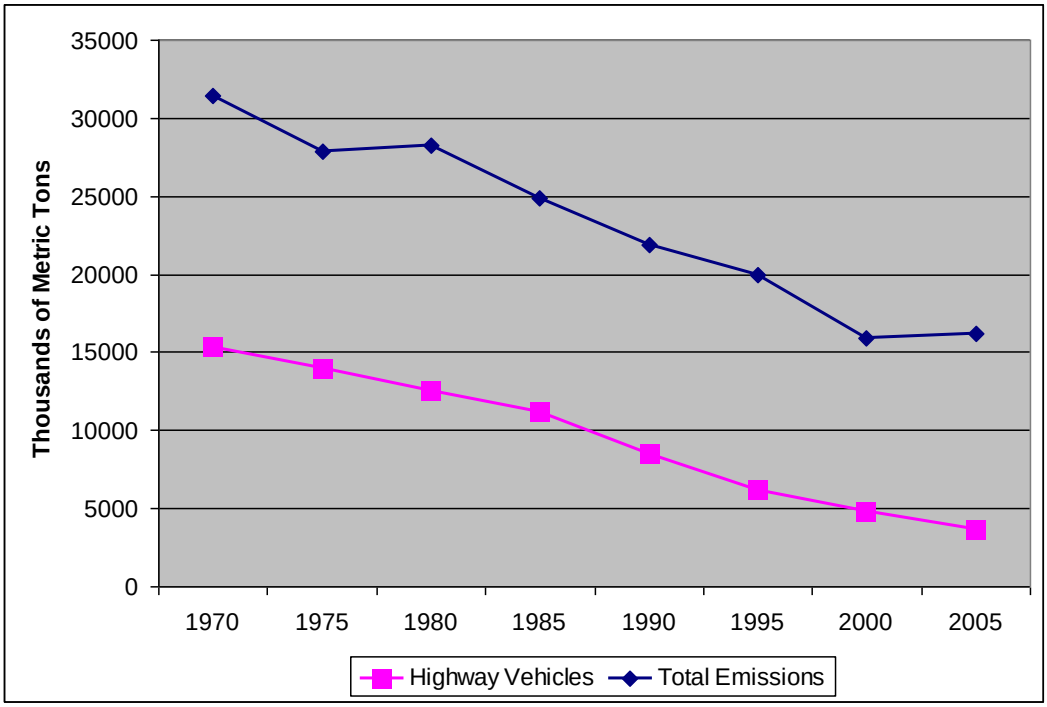
Source: EPA Dataset

Figure 16: Metro Atlanta PM_{25} Emissions 1990 – 2005



Source: EPA Dataset

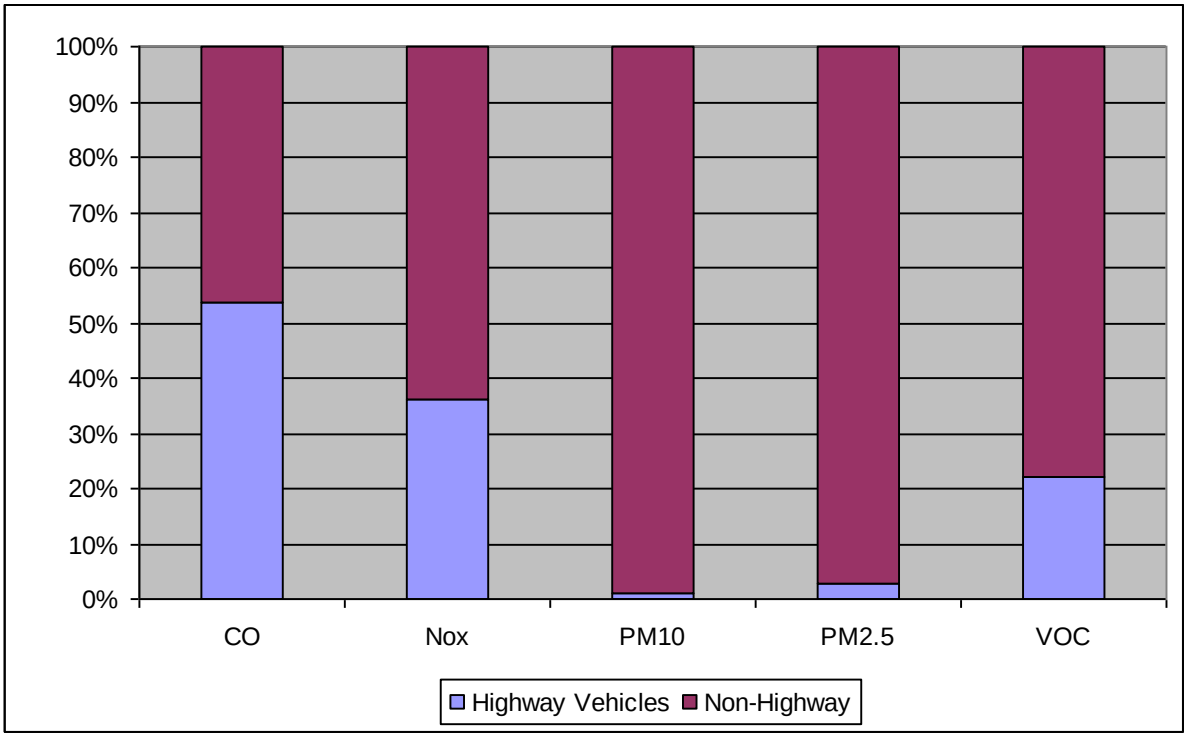
Figure 17: Metro Atlanta VOC Emissions 1970 – 2005



Source: EPA Dataset

The transportation sector, and particularly freeway traffic, continues to contribute large percentages to several regulated species' atmospheric concentrations. Figure 18 illustrates the percentage contribution highway vehicles have on the key chemical species outlined above from EPA data.

Figure 18: Percentage Contributions of Highway Emissions



Source: EPA Dataset

The transportation sector continues to be a major contributor to the emissions of CO, NO_x and to a lesser extent, VOCs. The sector contributes less to atmospheric PM overall.

By evaluating time saved in delay by implementing a managed lanes system in Atlanta, and comparing it to delay if no project is undertaken, it is possible to establish a benchmark for gasoline conserved as a result. Understanding the quantity of gasoline conserved can directly relate to reduced vehicular emissions. Table 13 estimates the year 2030 gasoline savings on each corridor based on a methodology developed by the Texas Transportation Institute. Key assumption include the consumption rate of a vehicle is of 0.68 gallons of fuel per hour and assuming 300 driving days per year. There is some uncertainty in estimating the 2030 potential fuel per hour rate, as fuel efficiency generally increases with progressive vehicle models. The low-end range represents the project that decreases delay least, typically the TOT[4] policy where available and the ETL[5] Maximum Revenue where no TOT program exists, while the high-end estimate is based on the project that most decreases average vehicle freeway delay, typically the 2+2 Maximum Throughput policy.

Table 13: 2030 Corridor Gasoline Savings

Corridor Area	Low End Estimate (millions of gallons)	High End Estimate (millions of gallons)
I-285 N	1.0	6.5
I-285 W	1.7	6.3
I-285 S	1.7	5.1
I-285 E	2.1	5.0
I-75N	7.5	18.3
I-75 S	12.2	26.9
I-85 N	4.0	10.0
I-20 W	3.4	7.8
I-20 E	1.2	1.9
GA 400	9.1	9.9
I-575	2.1	2.6
Downtown Connector	5.8	9.4
I-85 N Inside I-285	2.9	4.8
I-20 E Inside I-285	1.7	3.6
I-75 S Inside I-285	0.5	1.1
I-85 S Inside I-285	0.6	1.5
I-20 W Inside I-285	0.9	1.5
I-75 N Inside I-285	1.4	2.8

[4] TOT means the managed lanes are reserved for trucks willing to pay a toll.
[5] ETL means that all vehicles in the managed lanes pay a toll. Trucks are not permitted in the managed lanes.

Several studies have been performed to quantify emissions of these species released on per gallon of fuel consumed bases. Using these studies, it is possible to determine experimentally established vehicular emission ranges. Table 14 averages compiled ranges of results of estimated passenger car and truck emission values per gallon of fuel for key chemical species. PM is not noted for cars due to its several orders of magnitude deviation for the value expressed for trucks. Trucks are the primary emitter of highway PM.

Table 14: Vehicle Estimated Emissions

Pollutant	Truck[1] Average Emissions (g/gal diesel)	Passenger Car[2] Average Emissions (g/gal gasoline)
CO	19.81	14.44
NO_x	6.45	1.27
VOC*	1.68	1.91
PM	0.13	-

[1] *Source: Addendum Number 1 for the Class I Environmental Assessment Registration Document for the Proposed Highway 113*
[2] *Source: McGaughey et al. Analysis of Motor Vehicle Emissions in a Houston Tunnel During the Texas Air Quality Study 2000*
[*] *Concentration of VOC is approximately equal to hydrocarbon emissions*

Coupling gas savings with estimated vehicular emission rates per gallon, estimates of 2030 excess fuel-based emissions can be determined. Due to the difficulty in determining advancement in emissions technology, the values used reflect modern day estimated emission rates. Modern day gasoline composition is assumed in these emissions. The resulting values help to establish a feel for potential ranges of excess emissions compared to the no project excess gasoline consumed parameters.

Comparing these possible future scenarios to the no project alternative, and assuming that roughly 80 percent of fuel wasted will be associated with passenger cars, combusting gasoline, and 20 percent will be associated with heavy trucks, combusting diesel, a low and high end emission savings can be established and compared to no project emissions based on wasted fuel. These values do not represent the total emissions of each chemical species on Atlanta's corridors, just the potential emission reduction due to delay reduction. Table 15 compiles each corridor's estimated excess emissions, based on 2030 delay and modern day emissions, for the no project, low end and high end fuel estimates.

Table 15: Estimated 2030 Excess Emissions

Corridor	Pollutant	No Project Emissions (m tons/yr)	Total Low End (m tons/yr)	Total High End (m tons/yr)
I-285N	CO	283.28	267.77	182.43
	NO_x	42.17	39.86	27.16
	VOC	33.99	32.13	21.89
	PM	0.46	0.44	0.30
I-285W	CO	264.60	238.22	166.84

Corridor	Pollutant	No Project Emissions (m tons/yr)	Total Low End (m tons/yr)	Total High End (m tons/yr)
	NO_x	39.39	35.46	24.84
	VOC	31.75	28.59	20.02
	PM	0.43	0.39	0.27
I-285S	CO	171.50	145.12	92.36
	NO_x	25.53	21.60	13.75
	VOC	20.58	17.41	11.08
	PM	0.28	0.24	0.15
I-285E	CO	229.49	196.91	151.91
	NO_x	34.16	29.31	22.61
	VOC	27.54	23.63	18.23
	PM	0.38	0.32	0.25
I-75N	CO	553.37	436.99	269.42
	NO_x	82.38	65.05	40.11
	VOC	66.40	52.44	32.33
	PM	0.90	0.71	0.44
I-75S	CO	558.34	369.04	140.95
	NO_x	83.12	54.94	20.98
	VOC	67.00	44.28	16.91
	PM	0.91	0.60	0.23
I-85N	CO	389.98	327.91	234.81
	NO_x	58.06	48.82	34.96
	VOC	46.80	39.35	28.18
	PM	0.64	0.54	0.38
I-20W I-20W	CO	263.80	204.83	62.08
	NO_x	39.27	30.49	9.24
	VOC	31.65	24.58	7.45
	PM	0.43	0.33	0.10

Corridor	Pollutant	No Project Emissions (m tons/yr)	Total Low End (m tons/yr)	Total High End (m tons/yr)
I-20E	CO	101.39	82.77	71.90
	NO_x	15.09	12.32	10.70
	VOC	12.17	9.93	8.63
	PM	0.17	0.14	0.12
GA 400	CO	345.52	204.32	191.90
	NO_x	51.44	30.42	28.57
	VOC	41.46	24.52	23.03
	PM	0.56	0.33	0.31
I-575	CO	131.02	98.43	90.67
	NO_x	19.50	14.65	13.50
	VOC	15.72	11.81	10.88
	PM	0.21	0.16	0.15
Downtown Connector	CO	330.34	240.34	184.48
	NO_x	49.18	35.78	27.46
	VOC	39.64	28.84	22.14
	PM	0.54	0.39	0.30
I-85N Inside I-285	CO	158.20	113.20	83.72
	NO_x	23.55	16.85	12.46
	VOC	18.98	13.58	10.05
	PM	0.26	0.19	0.14
I-20E Inside I-285	CO	127.91	101.54	72.06
	NO_x	19.04	15.12	10.73
	VOC	15.35	12.18	8.65
	PM	0.21	0.17	0.12
I-75S Inside I-285	CO	43.12	35.36	26.05
	NO_x	6.42	5.26	3.88
	VOC	5.17	4.24	3.13

Corridor	Pollutant	No Project Emissions (m tons/yr)	Total Low End (m tons/yr)	Total High End (m tons/yr)
	PM	0.07	0.06	0.04
I-85S Inside I-285	CO	48.68	39.37	25.40
	NO_x	7.25	5.86	3.78
	VOC	5.84	4.72	3.05
	PM	0.08	0.06	0.04
I-20W Inside I-285	CO	57.40	43.44	34.13
	NO_x	8.55	6.47	5.08
	VOC	6.89	5.21	4.09
	PM	0.09	0.07	0.06
I-75N Inside I-285	CO	104.50	82.78	61.06
	NO_x	15.56	12.32	9.09
	VOC	12.54	9.93	7.33
	PM	0.17	0.14	0.10
Total of All Corridors	CO	4,162.42	3,234.54	2,230.63
	NO_x	619.66	481.52	332.07
	VOC	499.47	388.13	267.66
	PM	6.80	5.29	3.65

The percentage change for each species is driven by the reduction in excess gas consumed on each corridor compared to the excess gas in the no project scenario. Percentage reductions on each corridor for the low and high end estimates are illustrated graphically in Figure 19 and compiled in Table 16.

Figure 19: Percentage Reductions of Excess Emissions Compared to No Project

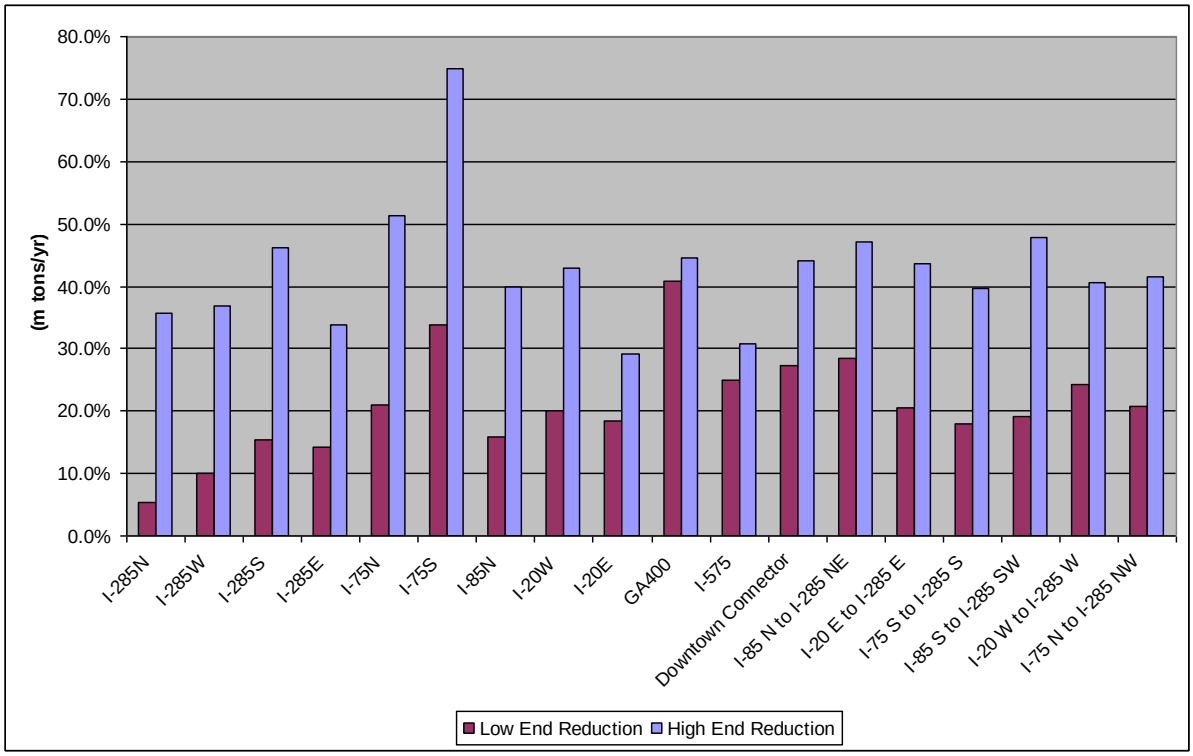


Table 16: Estimated 2030 Excess Emissions

Corridor	Percentage Reduction from Low End Estimate	Percentage Reduction from High End Estimate
I-285 N	5.5 %	35.6 %
I-285 W	10.0 %	36.9 %
I-285 S	15.4%	46.1 %
I-285 E	14.2 %	33.8 %
I-75 N	21.0 %	51.3 %
I-75 S	33.9 %	74.8 %
I-85 N	15.9 %	39.8 %
I-20 W	20.0 %	42.9 %
I-20 E	18.4 %	29.1 %
GA 400	40.9 %	44.5 %
I-575	24.9 %	30.8 %
Downtown Connector	27.2 %	44.2 %
I-85 N Inside I-285	28.4 %	47.1 %
I-20 E Inside I-285	20.6 %	43.7 %
I-75 S Inside I-285	18.0 %	39.6 %
I-85 S Inside I-285	19.1 %	47.8 %
I-20 W Inside I-285	24.3 %	40.5 %
I-75 N Inside I-285	20.8 %	41.6 %

Additionally, improving traffic flow on the corridors themselves reduces the time vehicles spend idling, which generally produces the maximum emissions per unit time. This problem is especially noted in relation to heavy trucks. In response, many cities, including Atlanta, have drafted municipal anti-idling laws to help reduce wasteful emissions.

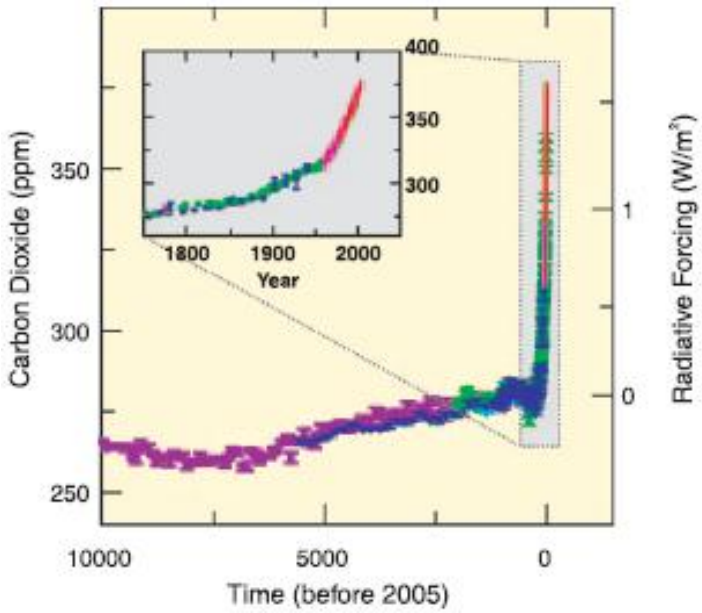
Enhancing the mobility of vehicles on the interstates pulls people off the arterial and connector roadways onto these free flowing highways, in turn reducing the amount of time people spend in stop-and-go traffic. This action serves as a further reduction to idling within a metropolitan region.

As of May 27, 2008, the EPA tightened the O_3 standards from 0.08 ppm to 0.075 ppm. The vehicular emissions reductions of VOC and NO_x from the loss of excess delay could potentially help push the region towards O_3 compliance with this new, and any future, air quality standards.

Greenhouse Gas Emissions

According to the United States Energy Information Administration (EIA), in 1999 the transportation sector surpassed the industrial sector as the leading emitter of gaseous carbon dioxide (CO_2), the primary molecule widely considered responsible for global climate change. In 2006, the sector was responsible for 1,990.1 million metric tons of CO_2 emissions, a 25.8 percent increase from 1990 values and approximately one-third total US CO_2 emissions. Of that amount, 1,186.2 million metric tons (59.6 percent of the 2006 total) was a byproduct of automobile motor combustion. The recent trend in dramatically increasing CO_2 levels is well illustrated by Figure 20. In a time of increasing climate change awareness, it is important for the transportation sector, a major contributor to the world's largest greenhouse gas emitter's CO_2 inventory, to keep track of how its policies and programs affect the atmospheric CO_2 balance and individual carbon footprints.

Figure 20: Historical CO_2 Concentrations



Source: Intergovernmental Panel on Climate Change (IPCC).Climate Change 2007: Synthesis Report. p38

A 2005 study by the Brookings Institute shows trends among CO_2 emissions for the 100 largest metropolitan areas in the nation. These trends show that Atlanta's carbon footprint has been decreasing compared to the value in 2000. The carbon footprint from the transportation sector has declined 5.7 percent, compared to a national metropolitan region increase of 2.4 percent. Despite this decline, the average Atlantan emits 1.634 metric tons of carbon from highway transportation compared to 1.310 metric tons from the average 100 largest metropolitan area resident. As a result, Atlanta ranks as the 34th highest per capita emitter among the studied regions. Of the amount emitted by transportation per capita, 1.224 metric tons is produced by passenger vehicles while trucks account for the remaining 0.410 metric tons. These values rank Atlanta as the 27th and 42nd worst emitters among the major metropolitan regions of the United States, respectively.

Like with the general emissions study, understanding the quantity of excess gasoline consumed can directly relate to surplus CO_2 emissions. Table 17 estimates the year 2030 gasoline savings on each corridor and in surrounding surface streets (a 4-mile buffer area) using similar methods as in the Regulated Vehicular Emissions section.

The implementation of a managed lane system on the major corridors of the freeway system in metropolitan Atlanta has the potential to further reduce the city's and region's contribution to global warming through reduced emissions of petroleum combusted gaseous CO_2. The carbon footprint from automobiles is a direct product of the burning of carbon compounds in gasoline in the presence of oxygen. Every gallon of gasoline combusted produces approximately 8.8 kg of CO_2 as a byproduct, while every gallon of diesel fuel produced 10.1 kg.

While it is important to note that vehicles release additional greenhouse gases, such as nitrous oxide (N_2O) and methane (CH_4), the primary species of concern for global climate change from the transportation sector is CO_2, as the percentage contributions for the other species is lower and their atmospheric concentrations several orders of magnitude smaller than CO_2.

Table 17: 2030 Corridor and 4 Mile Buffer Gasoline Savings

Corridor Area	Low End Estimate (millions of gallons)	High End Estimate (millions of gallons)
I-285 N	5.6	22.2
I-285 W	6.3	22.8
I-285 S	5.2	15.3
I-285 E	2.6	20.2
I-75N	14.2	38.3
I-75 S	16.7	38.0
I-85 N	12.3	29.5
I-20 W	7.7	24.6
I-20 E	4.7	8.3
GA 400	22.9	35.0
I-575	8.3	13.8
Downtown Connector	16.0	30.9
I-85 N Inside I-285	15.7	29.4
I-20 E Inside I-285	10.7	23.9
I-75 S Inside I-285	4.7	9.5
I-85 S Inside I-285	5.2	10.5
I-20 W Inside I-285	9.2	21.0
I-75 N Inside I-285	12.4	24.4

Maintaining a similar ratio of passenger cars to heavy trucks, as in the section above, potential ranges in CO_2 emission reductions can be established within the 4-mile freeway buffer transportation network. Estimates for these values are illustrated in Figure 21. Figure 22 illustrates the total system network reductions of CO_2.

Figure 21: Estimated Yearly Delay Induced CO_2 Emissions by Corridor Area

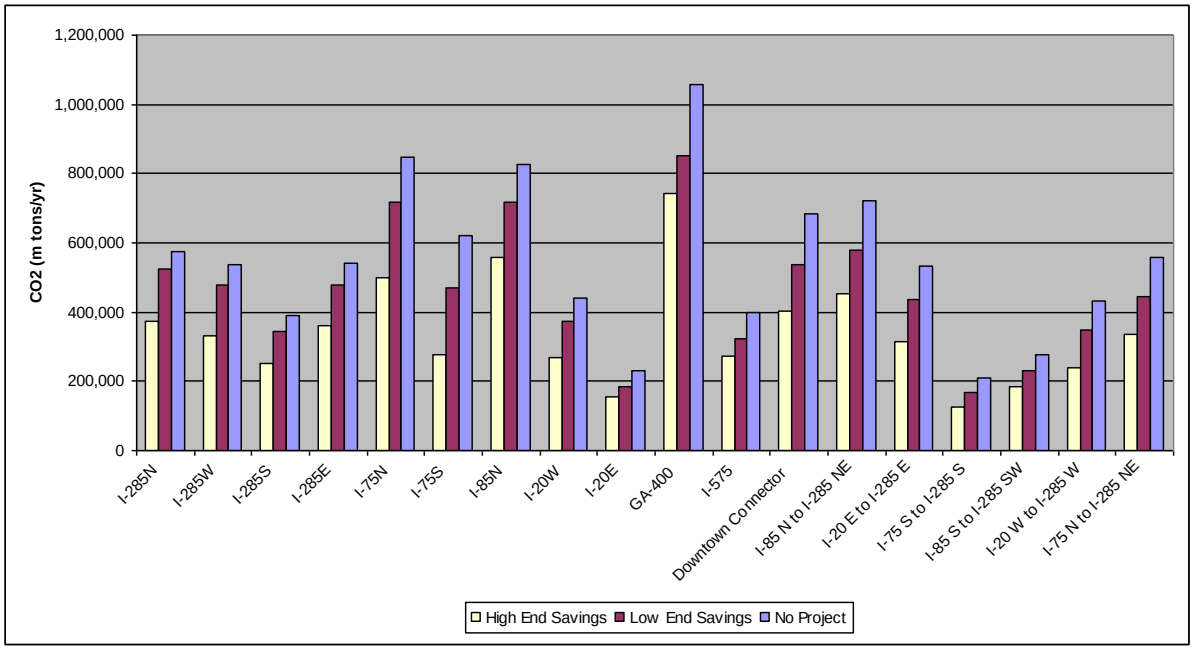
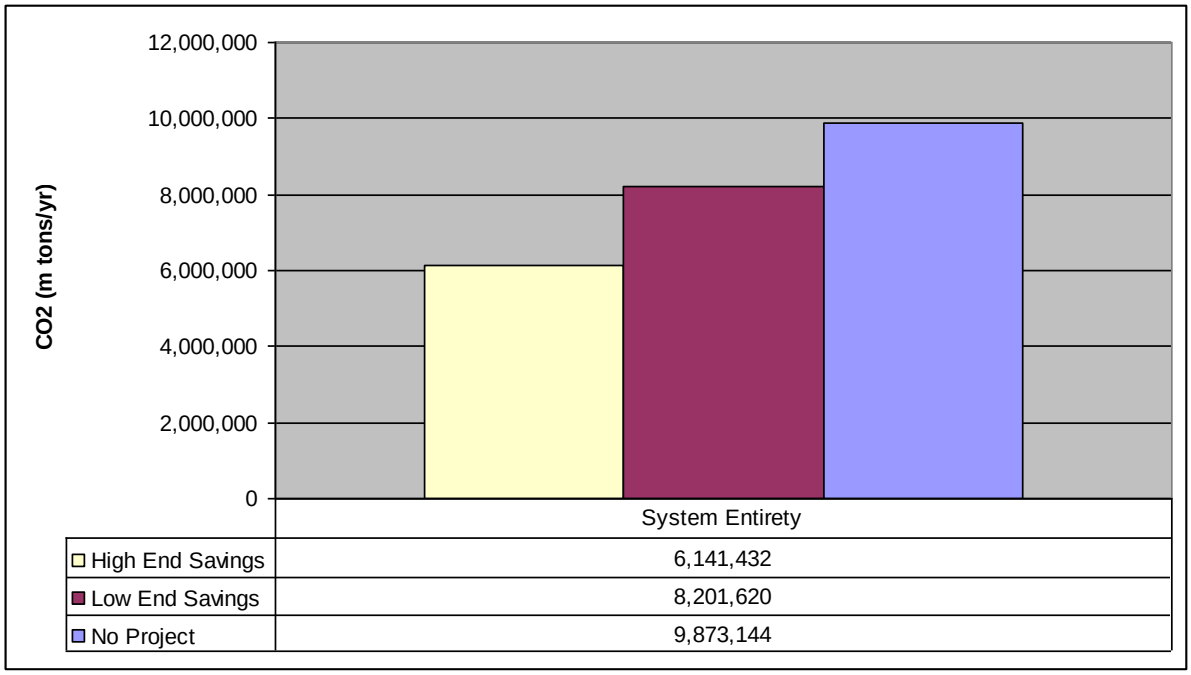


Figure 22: Estimated Yearly Delay Induced CO_2 Emissions by Area Entirety



From the figure above, if no project is implemented Atlantans will produce an extra 9,873,144 metric tons of CO_2 per year due to wasted gasoline caused by delay. By improving flow, and thereby reducing wasted fuel, Atlantans could see that amount drop to between 6.1 – 8.2 million metric tons of delay induced emissions per year, a 16.9 – 37.8 percent reduction over 2030 no project delay estimates.

The Atlanta Regional Commission projects 6.97 million inhabitants in the Atlanta metropolitan area by the year 2030. The annual delay induced emissions if no managed lanes are constructed is undertaken, from on highway emissions only, will be 0.35 metric tons per capita, this amounts to approximately 21 percent of the 2005 Brookings Institute estimates of 1.634 metric tons of carbon due to highway transportation. If managed lanes are implemented, this number could range from 0.19 – 0.27 metric tons per capita (11 – 17 percent) due to delay alone.

It is important to note that improvements to automobile fuel economy directly reduce the rate of CO_2 emissions per hour by reducing the amount of gasoline directly consumed. Further improvements to automobile efficiency promised by America's Climate Security Act of 2007 will also play a role in reducing the total CO_2 emissions per hour and per capita by 2030.

As a result of this analysis, we are able to determine that not only does the implementation of a managed lane system in metropolitan Atlanta not adversely affect the region's contribution to global climate change, but it in fact helps to mitigate it while further reducing the carbon footprint of its citizens.

Air Quality Conclusions

The implementation of a managed lane system in metropolitan Atlanta has the potential to help mitigate the city's and region's contribution to both harmful ambient vehicular emissions and global climate change inducing CO_2. The decreased fuel consumption and time spent idling in traffic, due to better managing the flow and speed of traffic on the freeways, translates into cleaner air for all citizens. Reductions in the concentrations of NO_x and VOCs can help decrease concentrations of O_3 and the number of smog alert days yearly while improving the public health and reducing the incidence of respiratory ailments among inhabitants.

Decreasing the city's carbon footprint, primarily through the reduction of CO_2 from automobile combustion, proactively advances the city of Atlanta's commitment to the mitigation of global climate change through the Mayor's Climate Protection Center; a national conference of mayors committed to the reduction of CO_2 emissions.

I. Direct, Indirect, and Cumulative Effects

Direct, indirect, and cumulative effects of the proposed action of implementing a managed lanes system in the Atlanta region should be investigated in early phases to assess the potential for issues later on in the planning process.

The Council on Environmental Quality (CEQ) regulations define direct effects as those "which are caused by the action and occur at the same time and place". Direct effects are those that are usually considered in detail by the project-level Environmental Impact Statement (EIS) as dictated by the NEPA process. The analysis should consider the direct effects to 2000 U.S. Census Block Group populations abutting the managed lanes. The focus should be on the minority and low-income residents and businesses of these areas and the social and environmental implications of Managed Lanes.

Indirect effects are "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable". Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. An indirect effect of the managed lanes is the potential to move more cars at higher speeds through the managed lanes corridors, which would lead to more efficient use of the highway and decreased negative effects on air quality. The air quality impacts are regional in nature. Additionally, the managed lanes system allows transit to operate in congestion-free lanes and provides benefit to transit operations. There is the potential for increased transit facilities such as park and ride lots. Transit-oriented development may eventually be built near the highway system to accommodate increased transit ridership and land use changes may be made to complement transit facilities.

CEQ defines cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant action taking place over a period of time." The cumulative social equity benefits to managed lanes are the option to avoid congestion delay and reliable travel times for both private vehicles and public transit. Managed lanes help to improve the negative health effects attributed to poor air quality to those populations residing near the highway system. Over time transportation's

share of particulate matter and carbon-monoxide pollution has been increasing even though the total share of all polluting sources has been declining. Transportation planning activities such as managed lanes are part of a mixture of strategies to decrease the rate of polluting emissions.

Managed lanes would be the next evolution of the highway network for Atlanta. The established corridors of the national highway system will be utilized in a more efficient manner through the introduction of managed lanes to the system. The managed lanes have the potential to decrease the negative effects on air quality when compared to a no-project scenario based on currently recognized transportation related impacts to air quality.