North Carolina Department of Transportation

December 2000

I-85 Sub-Area Study Final Report

The Need for Congestion Management

Mecklenburg, Cabarrus, and Rowan Counties have experienced significant growth in population and employment. While this growth has brought with it many benefits, it also has resulted in very high travel demand in these three counties, particularly along I-85.

Traffic congestion in the Charlotte region has increased and is projected to continue to grow. According to a 1997 study by the Texas Transportation Institute, Charlotte ranks fourth in its rate of congestion growth among the largest fifty United States metropolitan areas.

Over the next twenty-six years, Charlotte-Mecklenburg's population is estimated to grow by 345,000 people, a 57 percent increase. Between 2000 and 2020, Cabarrus County's population is projected to increase by over 34 percent, reaching 164,000 persons. In light of this projected growth, the Charlotte region must make appropriate land use and transportation decisions and implement them consistently in upcoming decades. If not, the region will confront the same difficulties as other regions struggling to sustain economic growth and facing competition from other jurisdictions less hampered by congestion.

The I-85 corridor between Charlotte and Concord/Kannapolis is one of the five major transportation and development corridors identified in the Centers and Corridors Plan. The *2025 Charlotte-Mecklenburg Integrated Transit/Land Use Plan* also included transportation and land use recommendations for the portion of the I-85 corridor in Mecklenburg County. The land use portion of the 2025 Plan plays a critical role in developing options to solo commuting. While land use planning cannot dictate use of alternative transportation modes, it can provide a framework that makes these other modes successful. Integrated transportation and land use planning can encourage an environment where activities and centers of interest are closely located and easily accessed.

There is a growing awareness in the Charlotte region that new approaches are needed to manage congestion. Residents of the region are beginning to understand that alternative transportation modes such as high occupancy vehicle (HOV) lanes, light rail transit (LRT), or bus rapid transit (BRT) provide reliable travel times as demand grows, in stark contrast to ever lengthening auto commute times as highway lanes become filled. New technologies such as Intelligent Transportation Systems (ITS) provide commuters with travel information that aids them in making mode and route decisions in order to avoid congestion.

Other urban areas in North Carolina have become interested in Transportation Demand Management (TDM) to address congestion without costly road building. TDM strategies are effective because of their flexible application and the appeal of lower cost, faster response. Many of the actions are behavior-based and work well in employment environments because commuter behavior can be somewhat influenced by employers who prescribe everything from work hours to parking spaces. Given the limited resources to widen I-85 as quickly as necessary,

implementation of a comprehensive TDM program involving major companies in this corridor could be an appropriate way to reduce the number of single occupant vehicle trips.

The desire for improved choices when making trips in the I-85 corridor is motivating local and State governments as well as the private sector to consider new transportation "business practices". Public and private support of these new "practices", once they are identified, indicates a commitment to more effective and sustainable planning, land use and economic development, as well as good transportation decision-making.

The I-85 Sub-area Study Process

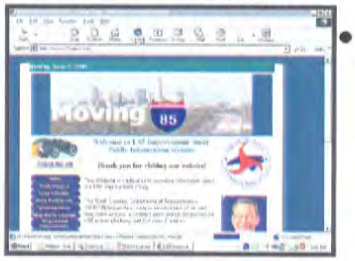
The purpose of the I-85 Sub-area Study, sponsored by the North Carolina Department of Transportation (NCDOT), was to identify short and long-term actions to address existing and projected peak-period traffic in this interstate corridor. The study evaluated alternatives such as adding roadway capacity, constructing HOV or "managed" lanes, upgrading interchanges, and implementing public transit improvements. The study also identified strategies to maximize roadway capacity through TDM, incident management and ITS.

The study focused on the area along I-85 between exit 43 in Charlotte (US-29/NC-49 Connector) and exit 58 in Concord (US-29/601 interchange). The study area included roadways crossing I-85 at its eight interchanges as well as parallel highways such as US-29, Mallard Creek Road, and Derita Road.

The study included a comprehensive public outreach program designed to provide citizens numerous opportunities to express their views. The program involved:

- Two series of community workshops, with meetings in both Cabarrus and Mecklenburg Counties on each occasion. These meetings provided citizens with an opportunity to learn not only about the I-85 study but also about other transportation and land use initiatives affecting the corridor. Residents also had an opportunity to offer suggested improvements. Meeting notices were faxed to more than 400 persons and mailed to an additional 300 residents.

- Public involvement web site, www.i-85move.com. The web site was useful for communicating project progress and soliciting public feedback on corridor issues and possible solutions.



- The site received over 1100 "hits" between May and November 2000.
- Periodic fax/e-mail newsletters to keep corridor stakeholders informed of study progress.
- Media relations activities including notifying reporters of upcoming community meetings and assisting the media with information and story ideas.

Study recommendations reflect citizen input obtained through both community meetings and the web site. This input included resident opinions on I-85 corridor

problems, sub-area issues, and the priority of short-range improvements.

Key Recommendations

Figures E-1 and E-2 illustrate the I-85 study recommendations described in the following sections.

Traditional Capacity Improvements

Work completed in this study has confirmed all of the highway projects already programmed by NCDOT and the City of Charlotte as well as those identified in long-range transportation plans by the Mecklenburg-Union Metropolitan Planning Organization (MPO) and the Concord-South Rowan MPO. I-85 should be widened to at least eight lanes to match the freeway cross-sections north and south of the sub-area. The following highway and bridge improvements also are needed to address travel demand in the I-85 corridor:

- Auxiliary lanes on I-85 between Mallard Creek Church and I-485 and I-485 to Speedway
- New bridge across I-85 at Quay and Old Holland Roads
- New bridge across I-85 between Harris Boulevard and Mallard Creek Church Road
- US-29 Widening to 6 lanes (I-485 to City Boulevard)
- US-29/Harris Boulevard Interchange Feasibility Study
- New bridge across I-85 between Mallard Creek Church Road and I-485

HOV Lanes

- Sufficient demand for concurrent flow HOV lanes would not likely occur until I-85 widening to eight lanes is completed, and the lanes are congested. This could occur as soon as 2010 on selected segments of I-85.

- A future 9th/10th lane envelope in the median of I-85 should be considered for future HOV use. Figure E-3 illustrates the current typical I-85 cross-section and a possible I-85 cross-section including HOV lanes. This configuration would permit adoption of a variety of concurrent-flow lane operational strategies, including buffer-separated and limited ingress/egress zones.

Rapid Transit

- The concept of borrowed use of the outside shoulder during peak periods for buses appears feasible, particularly if associated with upcoming reconstruction activities and restricted to bus movements between successive on- and off-ramps. This shoulder lane treatment could connect early transit improvements along I-85 such as park-and-ride lots. The shoulder treatment could encourage a shift to transit during

construction when potential timesaving benefits are greatest.

- The Bus Rapid Transit (BRT) alternatives under consideration in the Charlotte Area Transit System's (CATS) Northeast Corridor Major Investment Study include bus-only shoulder lanes along both I-85 and I-485. If BRT is part of the selected technology option for the Northeast Corridor, I-85 re-construction by NCDOT should incorporate the long-range design needs for the selected BRT alternative. This becomes even more critical with the extension of the BRT system along I-85 into Cabarrus County.
- The possibility of Light Rail Transit (LRT) operation along US-29 also must be considered when analyzing the widening of this arterial to six lanes from the I-85 Connector to I-485. The re-evaluation of the feasibility study for the US-29/Harris intersection should reflect the potential for LRT operations if this rapid transit technology and location is chosen in the Northeast Corridor.

Intelligent Transportation Systems (ITS)

ITS strategies represent an opportunity to increase the capacity of I-85 until freeway widening can occur later this decade. Key recommendations include:

- Implement surveillance, detection, and traveler information in the I-85 study corridor prior to beginning major roadway widening.
- Conduit and fiber-optic cable through the entire I-85 corridor.
- Out-of-pavement detection every half-mile (begin with temporary locations that may be shifted to permanent sites).
- Surveillance cameras (pan/tilt/zoom) every half-mile (begin with temporary locations and move as appropriate).

- Changeable Message Signs (CMS) at locations before the construction zone and at other key sites; portable CMS where necessary.
- Highway Advisory Radio at locations before the construction zone and at other key sites.
- Install conduit and fiber-optic cable along US-29 right-of-way from US-29/NC-49 Connector to Speedway Boulevard; connect detectors and cameras at intersections.
- Develop an integrated Regional Incident Management Program (improve coordination between NCDOT IMAP and Charlotte/Mecklenburg and Cabarrus police/fire/EMS and 911 dispatch centers); expand IMAP through study corridor.

- Install surveillance cameras at I-85 interchanges with Statesville, Graham, Sugar Creek, and Poplar Tent.

- Provide traveler information using NCDOT website and through Commercial Vehicle Operations.
- Integrate I-85 corridor ITS with regional transit and arterial signal systems on US-29, Harris, and Speedway Boulevards.

- Install wireless detection and surveillance on Mallard Creek Church Road, Poplar Tent Road, and NC-73.
- Implement ramp metering in the corridor by beginning initially southbound on I-85 in the morning peak; coordinate ramp signals on crossing arterials to accommodate ramp metering; and study further metering at other times and in northbound direction.

Transportation Systems Management (TSM)

During the I-85 Sub-area Study, the following short-term improvements were identified:

- Perform signal progression studies and improvements along NC-73, Poplar Tent, and Speedway Boulevard.
- Perform arterial management studies for:
  - Harris between Mallard Creek and US-29
  - US-601 between I-85 and US-29
  - Speedway Boulevard between Derita and US-29
  - US-29 between I-85 and I-485
- Complete access management studies along Derita, Poplar Tent, and NC-73; conduct detailed analyses on Mallard Creek Church Road and Speedway Boulevard at their interchanges with I-85.
- Repair and upgrade where possible existing traffic signals in the corridor.
- Improve the signal for motorists traveling from westbound Harris to southbound I-85.
- Widen ramp terminals and turn lanes at the I-85/ Poplar Tent interchange.
- Add new eastbound lane on Harris just past the US-29 intersection.

Travel Demand Management (TDM)

The TDM recommendations build upon initiatives already underway in the region:

- Conduct a joint Commuter Management Roundtable between the University Area Council of the Charlotte Chamber and the Cabarrus Regional Chamber of Commerce; develop "best practices" programs for early implementation.
- Expand CATS Employee Transportation Coordinator (ETC) Program among Northeast Mecklenburg companies.
- Develop an approach for extending CATS ETC program to Cabarrus County employers.

- Publish CATS new Commuter's Register including ridesharing information for the region.

- Implement the recommendations of the Countywide Transit Services Plan regarding regional expansion of selected TDM programs.
- Adopt zoning ordinance in Mecklenburg and/or Cabarrus Counties to set aside reserved parking for carpools and vanpools.
- Adopt travel reduction zoning ordinance in Mecklenburg and/or Cabarrus Counties, including employer-based Vehicle Miles of Travel (VMT) reduction goals.
- Establish telecommuting centers in the corridor.

- Construct park-and-ride facilities at I-85 interchanges with Poplar Tent, Crisco, and NC-73 as part of I-85 widening project (should be coordinated with express bus plan for I-85 shoulders).

Land Use/ Transportation Integration

Because several land use/ transportation planning initiatives are already underway, the I-85 study's recommendations relate to implementation of the strategies and land development tools evolving from these efforts:

- Implement recommendations of Northeast Corridor land use study upon its completion in Fall 2001.
- Consider land use recommendations from the Urban Land Institute (ULI) panel for the I-85 North corridor.
- Identify sites for transit-oriented development zoning in the I-85 corridor following Unified Development Ordinance adoption in Cabarrus County.
- During the review of land development proposals, do not allow driveways, median openings, or crossovers within a minimum distance of 1000 feet of an interchange ramp terminus.

Conclusions

During the I-85 Sub-area Study, factors that either facilitate or hamper actions to improve travel conditions in the I-85 corridor were identified.

State Highway Funding Constraints

The inadequacy of North Carolina's highway financing program has delayed I-85 improvements to a critical level. Without additional funding to accelerate work on this I-85 segment, serious peak-hour delays associated with average daily volumes of 70,000 vehicles would worsen over the next decade as volumes grow to 100,000 vehicles per day.

This lack of adequate funding also affects construction of needed arterial roads on the State highway system, small-scale improvements to eliminate "bottlenecks," and implementation of ITS strategies to reduce peak-period congestion.

Table E-1 illustrates the projected shortfall in State highway funding for the I-85 sub-area over the next decade. The draft 2002-2008 North Carolina Transportation Improvement Program includes

approximately $70 million in State highway funding for the I-85 corridor between 2002 and 2008. As shown by Table E-1, NCDOT already has identified a need for an additional $131 million to complete work on three roadway projects in the sub-area, including I-85 widening to NC-73. Capacity improvements recommended in this study for the short and mid-range periods result in a need for an additional $28 million in State funds between 2002 and 2010, creating a total highway funding shortfall of $158 million.

There also is a need for additional State funds to finance ITS, TDM, and transit improvements. Approximately $2.5 million in recommended short-term TSM projects require NCDOT funding. There is a need for about $5 million to implement ITS improvements along the fifteen-mile I-85 study corridor. Once CATS identifies the locally-preferred rapid transit alternative for the Northeast Corridor, there will be a need for State funding for up to 25 percent of design and construction costs.

The Legislative Study Commission, created by the North Carolina General Assembly to explore transportation finance issues, will be recommending ways to address the State's transportation funding crisis. The General Assembly will likely be considering this issue during their 2001 legislative session.

Uncontrolled Growth

Rapid residential and commercial development in northeast Mecklenburg, Cabarrus, and Rowan Counties has resulted in I-85's changing from an interstate corridor serving primarily cross-state travel to a key commuting corridor to the University area and beyond in addition to being a major route to major commercial developments along the freeway.

Recent development in the corridor has not been designed to promote alternative transportation modes. Also, land developments have not been designed to mitigate impacts on road capacity through access management, improved connections between adjoining land uses, etc.

There is a growing awareness of the link between land development and the need for transportation facilities in the corridor. Several key initiatives are underway:

- Northeast Transit/Land Use Study
- I-85 North ULI Panel
- Cabarrus County Unified Development Ordinance
- Charlotte-Mecklenburg's "Smart Growth" Study

These studies must provide regulations and ordinances that effectively implement transportation/land use principles.

Lack of Efforts on Non-Highway Travel Options

Until recently, there have been minimal efforts to promote alternatives to single-occupant commuting. Persons living or working in the I-85 corridor were limited to driving alone with no public transportation options, minimal information on ridesharing possibilities, and inadequate pedestrian facilities. There has not been enough funding for ITS or TSM projects to reduce

bottlenecks and increase roadway capacity.

Passage of the one-half percent sales tax for public transportation in Mecklenburg County in 1998 has enabled new transit services to be started in northeast Mecklenburg. The new Charlotte Area Transit System (CATS) will be expanding bus service in the I-85 corridor, providing new travel options for commuters. CATS is building upon its TDM programs to provide new marketing tools such as the Commuters Register. Concord also is considering start-up of public transit services in Cabarrus County, including routes to Concord Mills in the I-85 corridor.

Charlotte-Mecklenburg's new transit tax is financing studies exploring the potential for rapid transit alternatives in the I-85 corridor. Although the Northeast Transit/Land Use study currently ends near the Cabarrus County line, this planning effort could be extended to investigate the feasibility of transit options such as BRT and LRT for this county.

Need for Collaborative Problem-Solving

Throughout this study, stakeholders, local governments, and citizens have pointed to NCDOT and/or other jurisdictions as responsible for the current congestion along highways in the I-85 corridor. Citizens, major traffic generators, and large employers must acknowledge their role in addressing congestion in this corridor. Although NCDOT is behind schedule in implementing I-85 corridor improvements, there are strategies available for corridor residents and companies to improve travel conditions.

A Call to Action

The I-85 sub-area study has identified a broad range of projects to address peak-period congestion, from traditional approaches of increasing highway capacity to reducing the demand for peak-hour solo driving through ridesharing and public transit. While major improvements such as the acceleration of I-85 widening to eight lanes would require significant increases in State funding, this study has identified short-term roadway improvements that could provide immediate congestion relief in the corridor. NCDOT, local governments, and sub-area companies should begin work immediately on the short-range projects included in Tables E-2 through E-4.

In addition to actions on short-range projects, NCDOT and local governments must implement longer-term recommendations from efforts such as the Northeast Corridor Land Use/Transit Study, ULI panel's review of the I-85 North corridor from Charlotte to Salisbury, and the Metrolina ITS Plan. These documents are proposing new transportation and land use "business practices". Public and private support of these new "practices", once they are identified, is critical to more effective and sustainable planning, land use and economic development, and good transportation decision-making.

Table E-1. Traditional Capacity Improvements: Funding Shortfall (2000-2010)

Project No.	Description	Funds Programmed	Funds Needed
NCTIP Projects			
I-3803	Widen I-85 from US-29/NC-49 to NC-73	$ 34,500,000	$ 106,600,000
U-2507	Mallard Creek Road Re-location	$ 12,400,000	
U-2508C	Widen Mallard Creek Church Road from US-29 to NC-49	$ 7,900,000	
U-3415	Widen Poplar Tent from Derita to US-29/601 Bypass	$ 9,200,000	$ 10,600,000
R-2420	City Boulevard Extension from Mallard Creek Relocation to Neal Road	$ 5,400,000	$ 13,300,000
Projects Identified in I-85 Sub-area Study			
	Add I-85 auxiliary lanes		$ 8,700,000
	Re-evaluate US-29/Harris feasibility study		$ 35,000
	Widen Derita from Mecklenburg County line to Poplar Tent		$ 7,400,000
	Widen Mallard Creek and Odell School from Prosperity Church to Cabarrus County line		$ 5,000,000
	Widen US-29 between City Boulevard and I-485		$ 4,850,000
	Construct bridge over I-85 between Harris and Mallard Creek Church interchanges		$ 1,750,000
TOTALS		**$ 69,400,000**	**$ 158,235,000**

Table E-2. I-85 Corridor Short-Range Projects: NCDOT Responsibility

Rank	Project	Estimated Cost
1.	Add eastbound lane on Harris Blvd. South of US-29 intersection	$ 1,300,000
2.	Widen ramp terminals/turn lanes at I-85/NC-73 interchange	$ 400,000
3.	Improve Harris/I-85 signal	$ 5,000
4.	Develop integrated Regional Incident Management Program with expansion to I-85 corridor	$ 200,000 (study)
5.	Improve access management near interchange ramps (allow no access less than 1000 feet)	Not Applicable
6.	Complete ITS installation along US-29 (U-3315), particularly at US-29/I-485 interchange	Under Construction
7.	Perform signal progression studies on NC-73, Poplar Tent and Speedway	$ 150,000
8.	Perform access management studies along: a. Mallard Creek/Odell School/Derita (Prosperity Church to Poplar Tent) b. Poplar Tent (Derita to Crisco) c. NC-73 (Crisco to International) d. I-85/Mallard Creek Church interchange e. I-85/Speedway interchange	$ 280,000
9.	Perform arterial management studies on Harris, US-601, Speedway and US-29	$ 350,000
10.	Provide traveler information using NCDOT website	In progress
11.	Implement ITS improvements along I-85	$ 5,080,000
12.	Implement peak-period bus operations on I-85 upgraded shoulders as traffic mitigation strategy (in conjunction with CATS)	$ 3,600,000 (construction)
13.	Implement ramp metering southbound on I-85 during morning peak (in conjunction with CDOT)	TBD

Table E-3. I-85 Corridor Short-Range Projects: Charlotte/Mecklenburg Responsibility

Rank	Project	Estimated Cost
1.	Improve access management near interchange ramps (permit no access less than 1000 feet)	Not Applicable
2.	Ensure private sector construction of Quay/Old Holland bridge over I-85	$1,950,000 (developer)
3.	Perform access management study on Mallard Creek/Odell School Roads and I-85/Mallard Creek Church interchange (in conjunction with NCDOT)	TBD
4.	Perform arterial management studies on Harris and US-29 (in conjunction with NCDOT)	TBD
5.	Complete Northeast Corridor Major Investment Study (MIS), including Locally Preferred Alternative (LPA) and land use recommendations; perform preliminary engineering for LPA	$6,000,000
6.	Implement peak-period bus operations on I-85 upgraded shoulders as traffic mitigation strategy (in conjunction with NDCOT)	TBD (as part of MIS)
7.	Conduct joint Commuter Management Roundtable between University Area Council and Cabarrus Chamber (in conjunction with Cabarrus Chamber)	$5,000
8.	Expand CATS Employee Transportation Coordinator (ETC) Program among Northeast Mecklenburg companies	$10,000
9.	Determine approach for expanding ETC program to Cabarrus employers (in conjunction with Concord, Kannapolis and Cabarrus Chamber)	Not applicable
10.	Implement recommendations of Countywide Transit Services Plan regarding expanded TDM measures	TBD
11.	Implement Urban Land Institute (ULI) land use recommendations in Charlotte-Mecklenburg	TBD
12.	Perform extensive Vehicle Occupancy Rate (VOR) studies along I-85 and US-29	$25,000

Table E-4. I-85 Corridor Short-Range Projects: Concord, Kannapolis and Cabarrus County Responsibility

Rank	Project
1.	Improve access management near interchange ramps (allow no access less than 1000 feet)
2.	Perform access management studies along: Derita Road (Mecklenburg County line to Poplar Tent) Poplar Tent Road (Derita to Crisco) NC-73 (Crisco to International) I-85/Speedway Blvd. Interchange
3.	Perform arterial management studies on US-601, US-29 and Speedway
4.	Adopt Unified Development Ordinance (UDO) in Cabarrus County; identify Transit-Oriented Development (TOD) sites in I-85 corridor
5.	Determine approach for expanding ETC program to Cabarrus employees (in conjunction with CATS)
6.	Implement ULI land use recommendations in Cabarrus County

Figure E-1. Roadway and TSM Recommendations

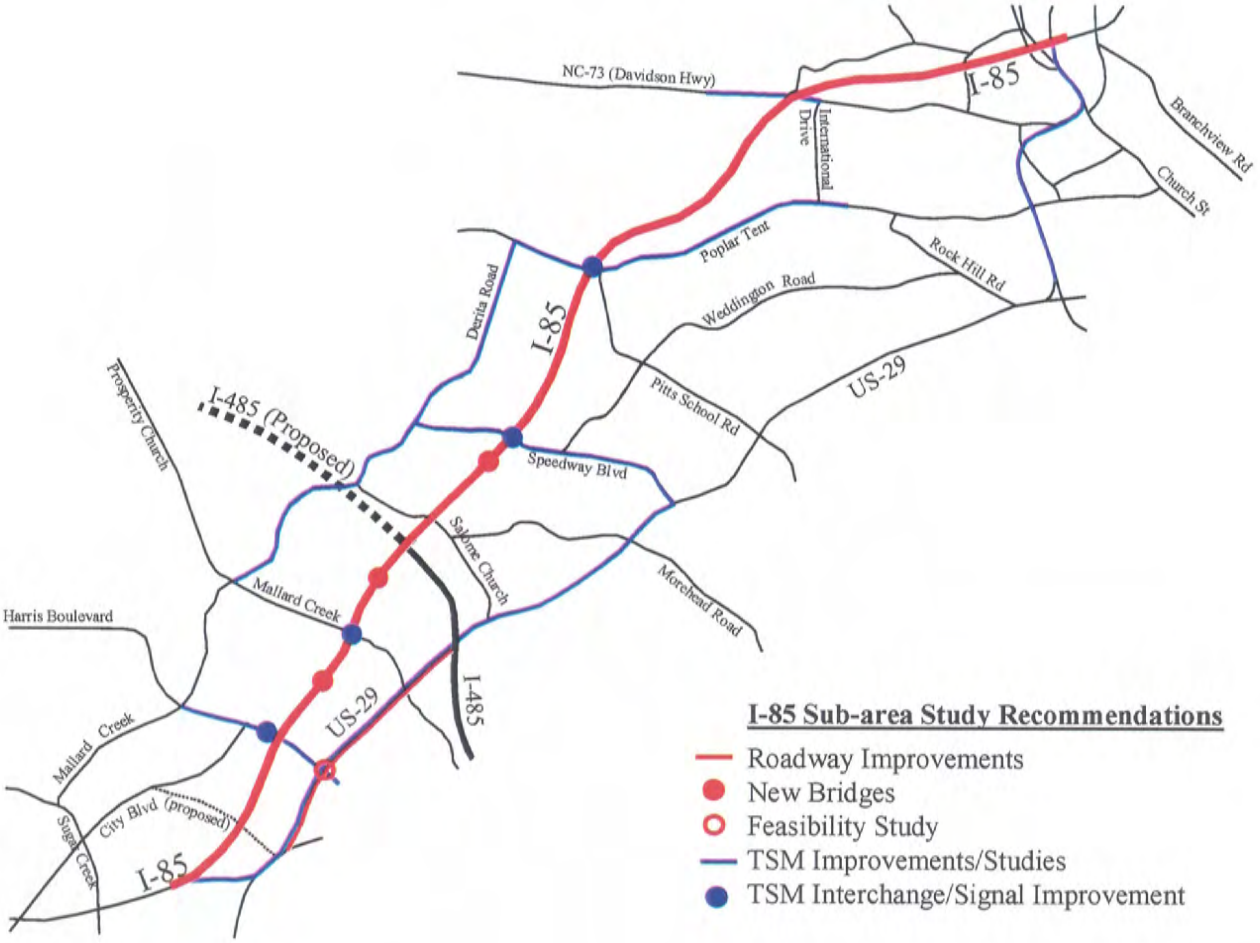


Figure E-2. HOV, ITS and Transit Recommendations

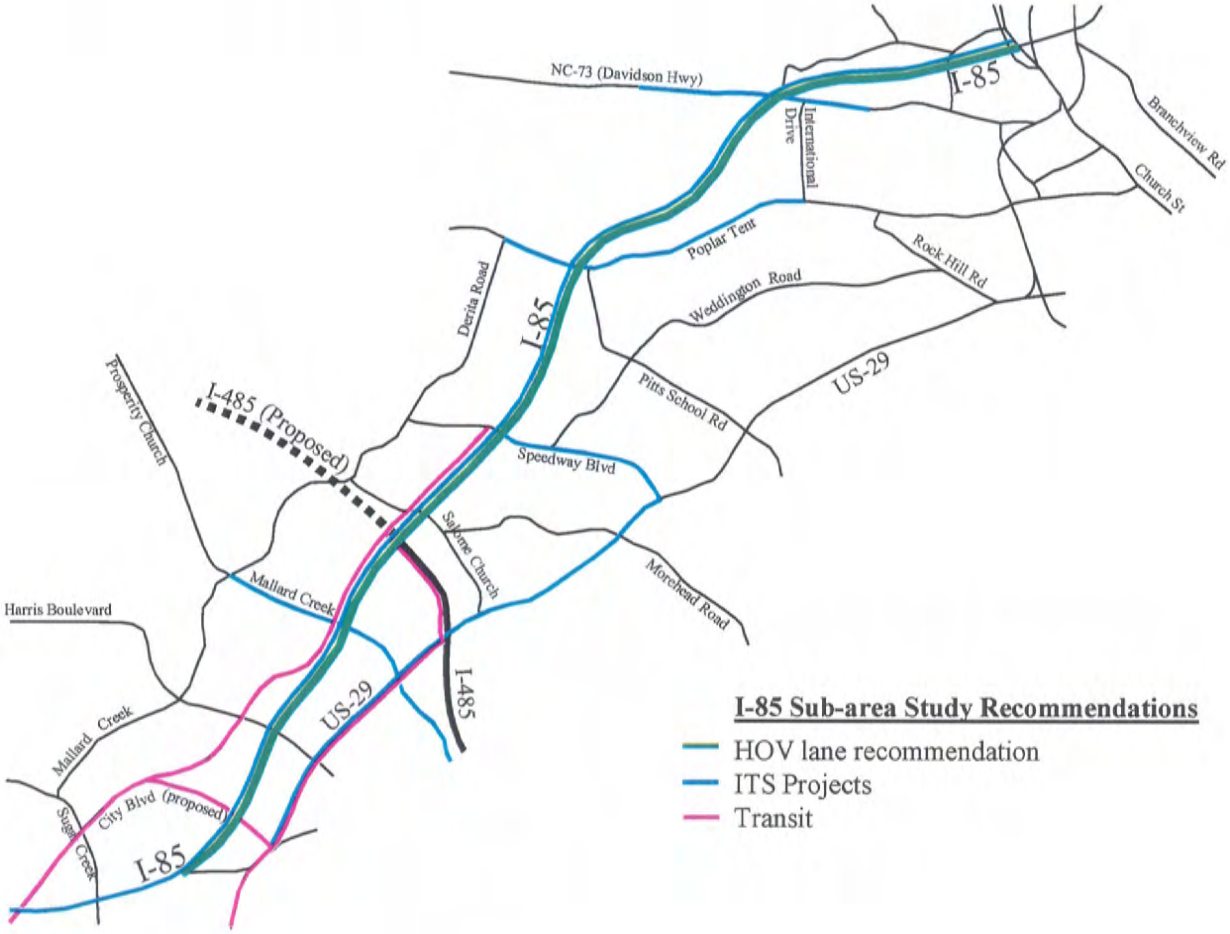
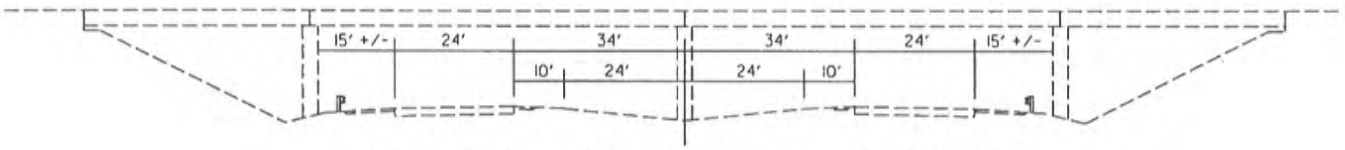
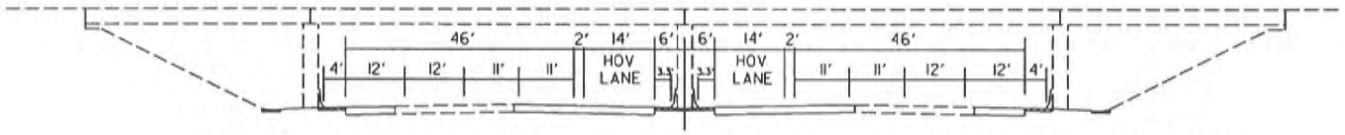


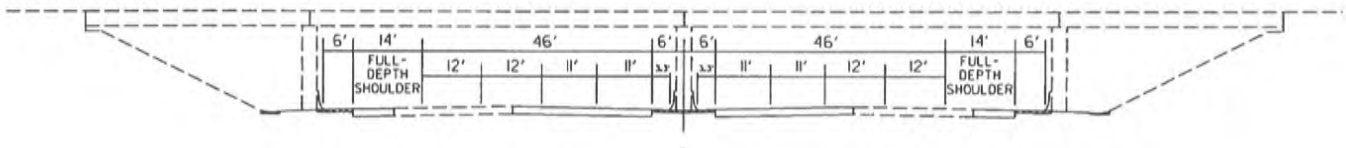
Figure E-3. Future I-85 Cross-Section



EXISTING I-85 TYPICAL SECTION
UNDER FOUR SPAN BRIDGES



EIGHT LANE TYPICAL SECTION AT INTERCHANGES
WITH TWO NEW THRU LANE AND ONE HOV LANE
ADDED IN EACH DIRECTION IN THE MEDIAN
(BUSES ON RAMP)



EIGHT LANE TYPICAL SECTION WITH TWO
NEW THRU LANE ADDED IN THE MEDIAN AND
BUSES USING OUTSIDE SHOULDER

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1. INTRODUCTION

1.1 Study Purpose

Although the North Carolina Department of Transportation (NCDOT) has programmed a $35 million widening project for the I-85 segment between US 29/NC 49 and I-485, construction is not scheduled to begin until 2004. Recent planning efforts by NCDOT have indicated a need for as many as twelve lanes for the I-85 section between exits 48 and 49 to accommodate 2020 traffic volumes. The lengthening of peak period travel times and the increasing frequency of congestion over the past year have prompted a study of the I-85 corridor.

The purpose of the I-85 study is to develop a plan that outlines short and long-term actions to address existing and projected traffic volumes during peak commute periods in the I-85 corridor. This sub-area study evaluates alternatives such as adding roadway capacity, constructing high occupancy vehicle (HOV) or "managed" lanes, upgrading interchanges, building collector roads and implementing access management. The study explores both short and long-range transit alternatives. The study also includes strategies to maximize roadway capacity through travel demand management (TDM), incident management, and Intelligent Transportation Systems (ITS) technologies.

1.2 Study Area

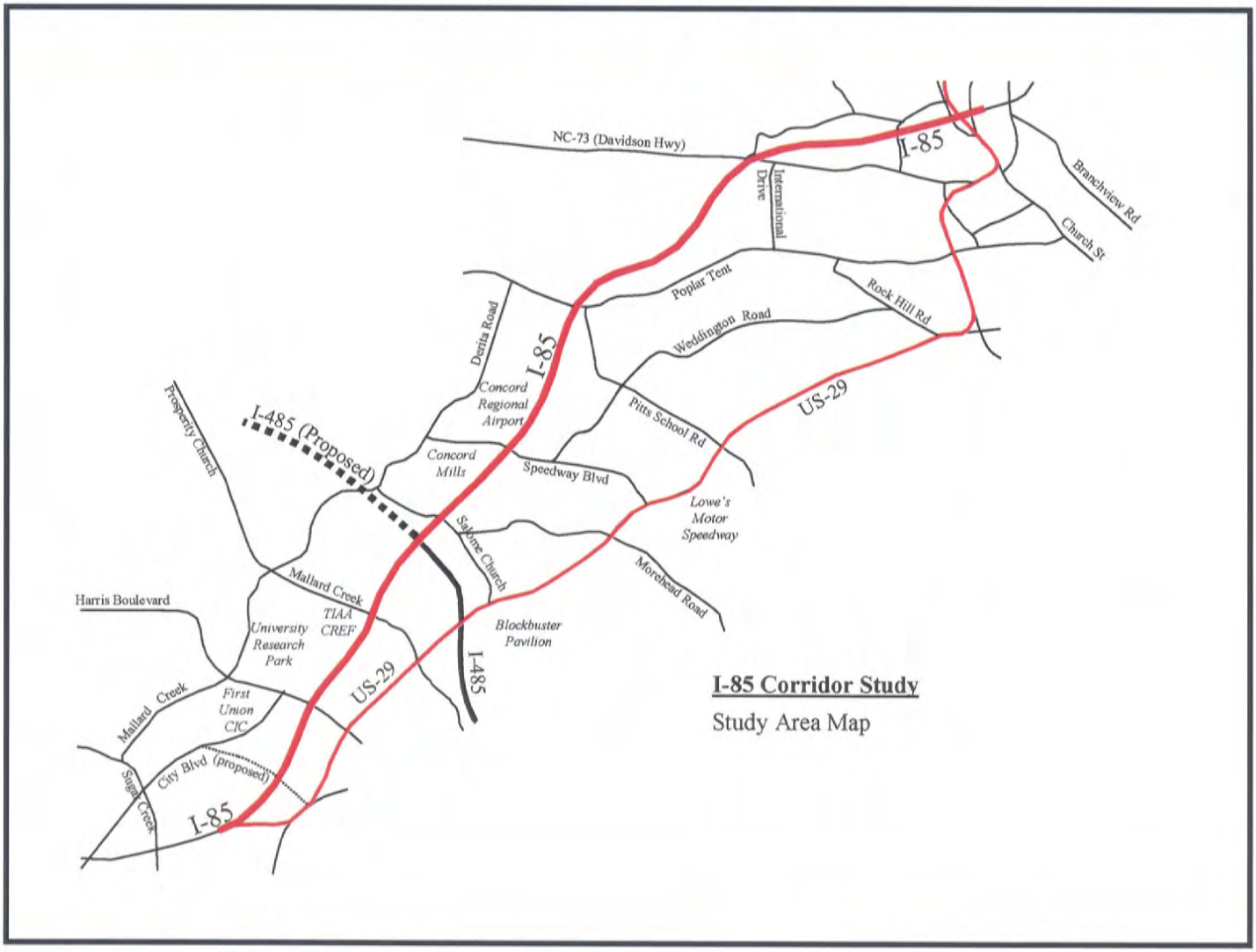
The study focuses on the area along I-85 from exit 43 in Charlotte (the US-29/NC- 49 Connector) to exit 58 in Concord (the US-29/601 interchange). The primary study area includes eight interchanges along I-85 and parallel roadways (US-29, Mallard Creek Road, and NC-73). **Figure 1-1** illustrates the study area.

1.3 Study Approach

The study, conducted over a ten-month period, included technical analyses, stakeholder and public outreach meetings, and the framing of issues and trade-offs for a wide range of alternatives to address travel demand, mobility, and system performance in the I-85 sub-area. The approach consisted of five phases:

Phase	Activity
1	Study Initiation: start-up activities, determination of problems, objectives, and goals, initial outreach efforts, documentation of existing land use and development opportunities, initial definition of land use and transportation system alternatives, and the development of evaluation methods and measures;
2	Initial Technical Analysis: further development and definition of the alternatives and the preparation of initial technical results, such as current/recent development trends, travel projections, cost estimates, etc.
3	Refined Technical Analysis: updated and final technical analyses to support the evaluation of the alternatives;
4	Evaluation: framing the technical results as an evaluation of the alternatives using the measures identified in the first phase; and
5	Report Preparation: documenting study results and providing information to interested stakeholder groups.

FIGURE 1-1. Study Area Map



1.4 Executive and Technical Committees

1.4.1 Executive Committee

Throughout the I-85 sub-area study, two committees reviewed technical products and provided advice on final recommendations and public outreach activities.

The Executive Committee met four times during the study and included the following members:

Frank E. Emory, Jr.	Chairman, Member, N.C. Board of Transportation, Division 10
C. David Hughes, Jr.	Member, N.C. Board of Transportation, Division 10
Lee Myers	Chairman, Mecklenburg/Union Metropolitan Planning Organization
Kenneth Geathers	Chairman, Cabarrus/South Rowan Metropolitan Planning Organization
Frank A. Rankin III, PE, PLS	Chairman, Cabarrus Regional Chamber of Commerce
Bob Morgan	Group Vice President for Public Policy, Charlotte Chamber
Benton Payne, PE	Division 10 Engineer, NCDOT
Janet D'Ignazio	Chief Planning and Environmental Officer, NCDOT

1.4.2 Technical Steering Committee

The Technical Steering Committee met six times over the ten-month study period and included representatives of Federal, State, and local agencies:

NCDOT

Dewayne Sykes, PE	Roadway Design
Derrick Lewis, PE	Feasibility Studies
Linda Dosse, PE	Statewide Planning
Joseph Springer, PE	Statewide Planning
James Dunlop, PE	Congestion Management
Gary Faulkner, PE	Congestion Management
James A. McInnis, PE	Project Development & Environmental Analysis
Larry Gordon, PE	Division 10

Federal Highway Administration

Chris Gatchell, PE	Area Engineer

Cabarrus – South Rowan MPO

Mike Byrd	Cabarrus County Planning Services
Mike Legg	Kannapolis Planning Department

Mecklenburg/Union MPO

Tim Gibbs, AICP	Charlotte-Mecklenburg Planning Commission
Bill Finger, PE	Charlotte Department of Transportation

1.5 The Need for Congestion Management

Mecklenburg, Cabarrus, and Rowan Counties have experienced significant growth in population and employment. While this growth has brought with it many benefits, it also has resulted in very high travel demand between these three counties, particularly along I-85.

Traffic congestion in the Charlotte region has increased and is projected to continue to grow. According to a 1997 study by the Texas Transportation Institute, Charlotte ranks fourth in its rate of congestion growth among the largest fifty United States metropolitan areas.

As illustrated by **Figure 1-2**, the combined populations of Mecklenburg, Cabarrus, and Rowan Counties will grow by over 500,000 persons during the next thirty years. During this same period, employment for these three counties is projected to increase 63 percent (**Figure 1-3**). In light of this projected growth, the Charlotte region must make appropriate land use and transportation decisions and implement them consistently in upcoming decades. If not, the region will confront the same difficulties as other regions struggling to sustain economic growth and facing competition from other jurisdictions less hampered by congestion.

The I-85 corridor between Charlotte and Concord/Kannapolis is one of the five major transportation and development corridors identified in the *Centers and Corridors Plan*. This *2025 Charlotte-Mecklenburg Integrated Transit/Land Use Plan* also included transportation and land use recommendations for the portion of the I-85 corridor in Mecklenburg County. The land use portion of the 2025 Plan plays a critical role in developing options to solo commuting. While land use planning cannot dictate use of alternative transportation modes, it can provide a framework that makes these other modes more successful. Integrated transportation and land use planning can encourage an environment where activities and centers of interest are closely located and easily accessed.

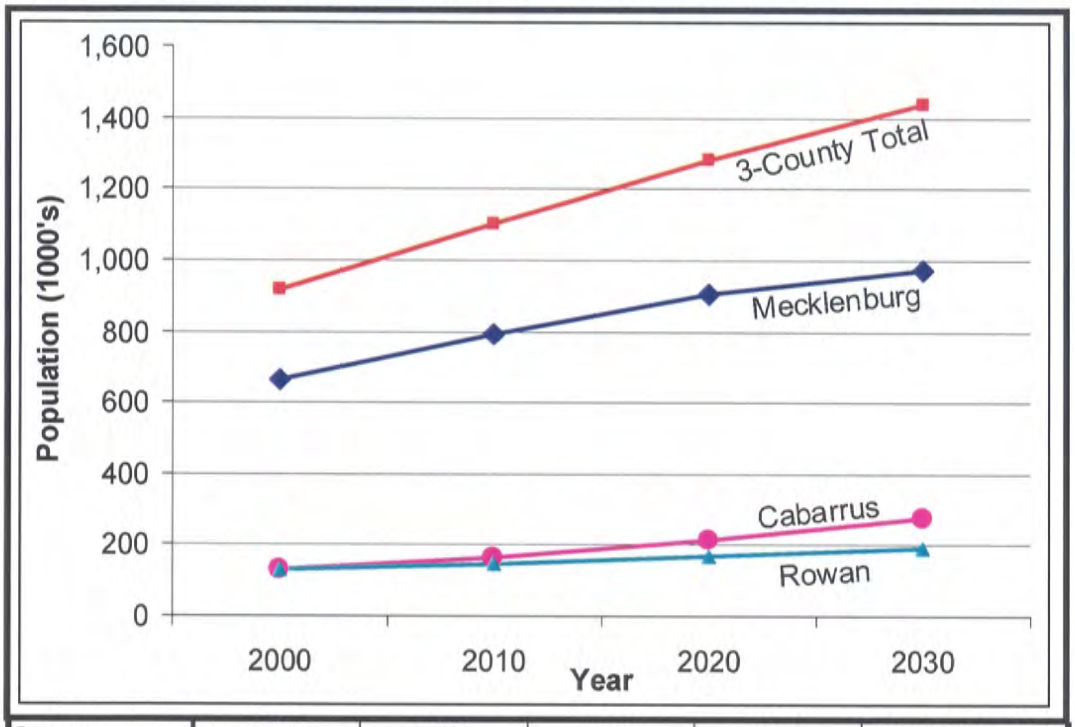
No urban area has succeeded in curbing congestion with a roads-only strategy. New highway capacity generally only provides short-term relief – within three years or so, roads are again close to full capacity because new growth shifts to the improved corridors and commuters shift their travel back to the peak hour. Highway widening is a finite activity because of limited availability of land and significant negative impacts on adjoining homes or businesses.

There is a growing awareness in the Charlotte region that new approaches are needed to manage congestion. Residents of the region are beginning to understand that alternative transportation modes such as high occupancy vehicle lanes, light rail transit, or bus rapid transit provide reliable travel times as demand grows, in stark contrast to ever lengthening auto commute times as highway lanes become filled. New technologies such as Intelligent Transportation Systems (ITS) provide commuters with travel information that aids them in making mode and route decisions in order to avoid congestion.

Other urban areas in North Carolina have become interested in Transportation Demand Management (TDM) to address congestion without costly road building. TDM strategies are effective because of their flexible application and the appeal of lower cost, faster response. Many of the actions are behavior-based and work well in employment environments because commuter behavior can be somewhat influenced by employers who prescribe everything from work hours to parking spaces. Given the limited resources to widen I-85 as quickly as necessary, implementation of a comprehensive TDM program involving major companies in this corridor could be an appropriate way to reduce the number of single occupant vehicle trips. The desire for improved choices when making trips in the I-85 corridor is motivating local and state

governments as well as the private sector to consider new transportation "business practices". Public and private support of these new "practices", once they are identified, indicates a commitment to more effective and sustainable planning, land use and economic development, as well as good transportation decision-making.

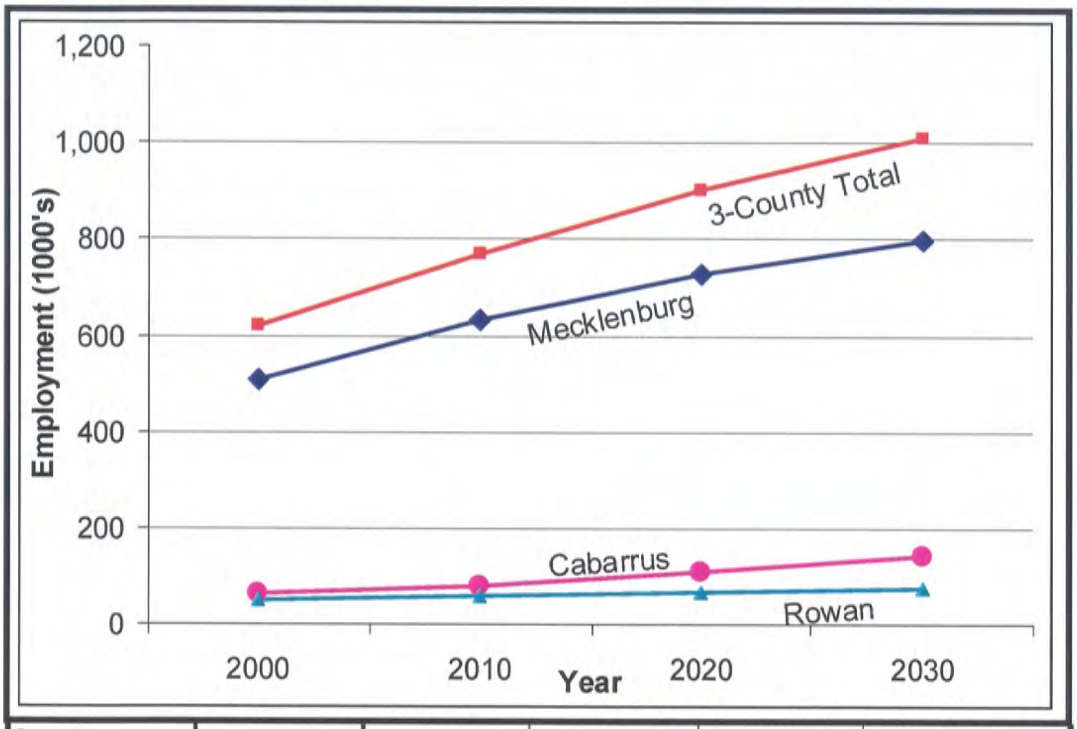
FIGURE 1-2. Population Growth Forecasts for the I-85 North Counties



County	2000 Population	2010 Population	2020 Population	2030 Population	30-Yr Projected Increase
Mecklenburg	660,000	790,000	903,000	973,000	48%
Cabarrus	127,000	163,000	212,000	273,000	115%
Rowan	128,000	146,000	167,000	191,000	49%
3-County Total	915,000	1,099,000	1,281,000	1,437,000	57%

Source: Kissel Consulting Group, August 2000

FIGURE 1-3. Employment Growth Forecasts for the I-85 North Counties



County	2000 Employment	2010 Employment	2020 Employment	2030 Employment	30-Yr Projected Increase
Mecklenburg	508,000	630,000	727,000	796,000	57%
Cabarrus	61,000	80,000	107,000	140,000	130%
Rowan	51,000	58,000	65,000	73,000	43%
3-County Total	620,000	768,000	899,000	1,009,000	63%

Source: Kissel Consulting Group, August 2000

2. REVIEW OF PREVIOUS STUDIES

2.1 Section Overview

This section reviews four previous planning efforts that are pertinent to the I-85 Sub-area Study and outlines additional developments and issues applicable to the study.

2.2 I-485 Interchange Analysis Report

This study was completed in June 1999, and the Mecklenburg – Union Metropolitan Planning Organization (MPO) endorsed the recommendations on July 21, 1999. The study focused on proposed interchanges along I-485. Three of the interchanges are within the immediate vicinity of this study. The I-85 and I-485 interchange has already been built. The other two interchanges are US-29 to the east and Mallard Creek Road to the west of I-85.

Construction of I-485 and the proposed interchanges directly impacts land use and development in the vicinity of these roadways. The I-485 interchange with I-85 is of a high level freeway-to-freeway design. Interchanges at US-29 and Mallard Creek Church Road are proposed as simple diamond interchanges to be upgraded to an urban diamond in the future. Improved access and uncontrolled growth in the corridor has the potential to increase traffic congestion on I-85. Recognizing this fact, prior studies stressed the importance of integrating land use and transportation planning by recommending that design of these facilities should encourage internal connectivity between land uses/development near interchanges. Streetscape improvements, such as landscaping and adequate lighting, should be used to better integrate the interchanges into the community. The design also should make provisions for bicycle and pedestrian facilities.

2.3 1999 Northeast Area Plan

Due to significant growth inside both Mecklenburg and Cabarrus counties, the Charlotte – Mecklenburg Planning Commission initiated a study of the area located between US-29 and the proposed Mallard Creek/I-485 interchange. The first Northeast District Plan was adopted in 1987 and a revision was made to the plan in 1996. The 1999 Northeast Area Plan was conducted to amend the 1996 adopted plan.

The Northeast Area Plan recommends the use of open space and land development that is sensitive to existing communities and compatible across county lines. It emphasizes the need to move away from dispersed development and move toward higher-density, mixed-use, transit-oriented development through integrated land use planning. The study recommends an improved transportation network and transportation mode choices.

A major mixed-use development, Kings Grant, is planned for the west side of I-85 between Mallard Creek Road and south of Concord Mills. When Kings Grant is completely developed by 2010, it will have 700,000 square feet of commercial/ retail, a 150-room hotel, 1.5 million square feet of office spaces, and 2350 multifamily and 120 single-family dwelling units. As part of the development, Odell School Road and Mallard Creek Road are recommended for realignment

and widening. A bridge across I-85, connecting Quay Road on the west and Old Holland Road on the east, is planned during phase II of the development.

2.4 Regional Transportation Infrastructure Inventory

The Centralina Council of Governments produced this report for the Business Community for Regional Transportation Solutions (BCRTS). The report, completed in January 2000, serves as a sourcebook that identifies roads of significant importance, the road-building process for the region, and ongoing, planned (funded and non-funded) projects. Projects in the State Transportation Improvement Program (STIP) relevant to the study corridor are shown in **Table 2-1.**

TABLE 2-1. Projects Relevant to I-85 Corridor

PROJECT	PROJECT LIMITS	DESCRIPTION
I-85	US-29 to NC-49 in Mecklenburg County and to US-73 in Cabarrus County	Construct additional lanes.
I-485	Charlotte eastern outer loop, US 74 east to I-85 north.	Construct freeway on a new location, partially completed.
I-485	Charlotte western outer loop, west of I-77 to I-85 north.	Construct freeway on a new location.
New	City Boulevard extension, Neal Road to I-85 at the US-29/NC-49 interchange	Four lanes divided facility, part on new alignment under construction.
US-29	Between Pavilion Boulevard and Rocky River Road.	Widen to 6 lanes, with potential of reversible lane and ITS capabilities.
New	West Sugar Creek Road from south WT Harris to David Cox Road.	Construct 2-lane facility on a 4-lane right of way
Widen	Mallard Creek Church Road between US-29 and NC-49.	Widen to 4 lanes with median facility.
Widen	Prosperity Church Road between Mallard Creek Road to proposed Hucks Road.	Widen Prosperity Church Road to a 4-lane facility.
Widen	Mallard Creek Road/ Graham Street extension from University Boulevard to WT Harris.	Widen to 4 or 5 lanes.

2.5 2025 Integrated Transit/Land Use Plan

This study identified I-85 as one of the five major transportation corridors in the Charlotte region. After careful evaluation of bus options and rail alternatives, the study recommended Bus Rapid Transit (BRT) for further investigation in this corridor.

The BRT alternative follows North Graham Street to I-85, travels along I-85 north to Mallard Creek Church Road and uses Mallard Creek Church Road and NC-49 to terminate at UNCC. The recommendation includes the following improvements:

- Share the transitway from the Charlotte Transportation Center to North Graham Street.
- A busway on North Graham Street to I-85.

- Low-cost widening and strengthening of the outside shoulders on I-85 between North Graham Street and Mallard Creek Church Road for use by buses in the peak hours when congestion is worst.
- An exclusive bus connection (flyover) to IBM Drive in the University Research Park to provide service to the employment centers in this area. Buses also could exit at W.T. Harris Boulevard, and/or express service can be provided to University of North Carolina at Charlotte (UNCC) via the proposed west entry.
- From I-85, buses operate in mixed traffic to UNCC and a terminal park-and-ride lot at the intersection of NC-49 and I-485. Bus service would also be provided to University Place and the University Hospital.

2.6 1999 Mecklenburg Bicycle Transportation Plan

The Mecklenburg Bicycle Transportation Plan identified US-29 and Mallard Creek Church Road as Priority Bikeway Improvement projects. There is an increasing awareness within communities in this corridor to improve quality of life. Residents are very supportive of projects including open space planning, park/greenway planning, and accommodating bicycle and pedestrian facilities.

2.7 Other Developments and Issues

In addition to these reports, there are other on-going and planned developments that would impact the I-85 corridor.

- In the vicinity of the I-485 and I-85 interchange, a business park has been proposed for the southwest quadrant. Concord Mills, 1.5 miles north, has 1.7 million square feet of retail with other retail, office, and multi-family development underway nearby.
- Near the I-485 and US-29 interchange, Salome Church Road is proposed for re-alignment with Pavilion Boulevard, including installation of a traffic signal. US-29 has been widened to six lanes with reversible lane operation and access control between the I-485 interchange and Pavilion Boulevard. Just south of the interchange, Blockbuster Pavilion, Starlight multiplex theater, and other retail developments could overburden US-29 at times.
- East of the Mallard Creek Road and I-485 interchange, 100,000 square feet of retail, 100 single-family, and 420 multi-family developments have been approved. There is also a plan for a retail center at Mallard Creek Road and Ridge Road.
- Charlotte Area Transit System (CATS) will be completing a Countywide Transit Services Study by fall 2001.
- The City of Concord is considering start-up of transit services in 2001.
- Widening both segments of Mallard Creek Road (between I-485 and the Mecklenburg – Cabarrus county line and I-485 and Prosperity Church Road) is recommended, but these are listed as non-funded projects in the *2020 Transportation Plan.*
- According to an earlier study, *1996 Northeast District Plan*, the majority of the land was recommended for research use. The *1999 Northeast Area Plan* recommends use of research land for transit oriented, higher density, mixed-use development (single-family, multi-family, retail, and commercial).

3. PUBLIC OUTREACH

3.1 Section Overview

The I-85 Sub-area Study included a comprehensive public outreach program that was approved by both the Executive and Technical Steering Committees. The program was designed to provide the public with opportunities to express their views. This section outlines the public outreach program objectives and elements. The section also reviews public opinions on problems in the I-85 corridor and summarizes citizens' rankings of possible improvements.

3.2 Program Objectives

The objectives of the public outreach program for the I-85 Sub-area Study included:

- Let the public know that something is going on to address I-85 congestion; create awareness of major issues.
- Generate public input in the development of congestion management strategies for the I-85 corridor.
- Identify and monitor public sentiment/opinion on congestion management/land use strategies.
- Build support for the strategies chosen to address I-85 corridor problems.

The program was designed for the following audiences:

Elected officials

Mecklenburg - Union Metropolitan Planning Organization

Cabarrus – South Rowan Metropolitan Planning Organization

City/Town Councils in corridor

Advisory Groups

Executive Committee

N.C. Board of Transportation

NCDOT/Local staff

Technical Steering Committee

Technical Coordinating Committees

Business Community

Charlotte Chamber

Cabarrus Regional Chamber of Commerce

University Research Park

Major employers/commercial centers

UNC-Charlotte

Neighborhood Associations

Media

3.3 Program Elements

To support the technical planning process, the public outreach program included the following elements:

- Two series of community workshops, with meetings in both Cabarrus and Mecklenburg Counties. These meetings provided citizens with an opportunity to learn not only about the I-85 study but also about other transportation and land use initiatives affecting the corridor. Residents also had an opportunity to offer suggested improvements. Meeting notices were faxed to more than 400 persons and mailed to an additional 300 residents.
- Public involvement web site, www.i-85move.com. The web site was useful for communicating project progress and soliciting public feedback on corridor issues and possible solutions. The site received over 1100 "hits" between May and November 2000.
- Periodic fax/e-mail newsletters to keep corridor stakeholders informed of study progress.
- Media relations activities including notifying reporters of upcoming community meetings and assisting the media with information and story ideas.

3.4 Public Comments

3.4.1 Problems, Issues, and Suggested Improvements

During May and June 2000, citizens provided input on corridor problems, sub-area issues, and ideas on improving I-85 or parallel roadways using comment forms included on the web site and distributed at the June 20 and 22 community meetings.

As shown in **Table 3-1**, the overwhelming majority of respondents (58 percent) considered the lack of sufficient roadway capacity on I-85 as the biggest problem in the sub-area. As illustrated by **Table 3-2**, all respondents mentioned congestion as the most important issue for the corridor. Citizens mentioned safety and the need for transit alternatives as two other key issues for the I-85 sub-area.

Table 3-3 summarizes citizen suggestions on how to improve I-85 or parallel roadways. Respondents offered a wide variety of thoughts on corridor improvements.

3.4.2 Ranking of Proposed I-85 Improvements

In September and October 2000, citizens had the opportunity to prioritize recommended projects to improve peak-period travel in the I-85 sub-area. Residents completed project rankings using forms distributed at the September 13 and 14 community workshops, a feedback form on the web site, or a rating form included in a University City Magazine insert to the northeast Mecklenburg edition of *The Charlotte Observer*.

Respondents ranked fifteen possible improvement projects in the I-85 sub-area, and the following list prioritizes the improvements from most important to least important. While it is not surprising that the widening of I-85 to eight lanes ranked as the most popular project, the ranking of I-85 High Occupancy Vehicle lanes as the second highest project indicates interest among area residents in alternatives to solo commuting.

Possible Improvement Projects in the I-85 Sub-Area:

1. Widen I-85 to 8 lanes
2. Build High Occupancy Vehicle (HOV) lanes in the center of I-85
3. Widen Mallard Creek/Derita Rd. to 4 lanes (Mallard Creek Church to Poplar Tent)
4. Build a US-29/Harris Blvd. interchange
5. Install camera detection system along I-85
6. Install ramp metering southbound on I-85 for the morning peak
7. Widen US-29 to 6 lanes from City Blvd. to I-485
8. Build a new bridge across I-85 at Quay/Old Holland
9. Build I-85 auxiliary lanes (Mallard Creek Church to I-485 and/or I-485 to Speedway)
10. Build a Mallard Creek Greenway Extension underneath I-85
11. Provide traveler information on NCDOT's website
12. Strengthen I-85's shoulders to permit peak hour use by express buses
13. Widen Poplar Tent including at I-85 interchange (Derita to US-29/601 Bypass)
14. Install camera detection system along US-29
15. Widen Pitts School Rd. to 4 lanes (Shelton to Roberts)

TABLE 3-1. Citizen Opinions on I-85 Corridor Issues

PROBLEM	PERCENT OF RESPONDENTS
Lack of Roadway Capacity	58
High Percentage of Truck Traffic	15
Adding Interchanges without Widening Freeway	12
Need to Accelerate Roadway Improvements	8
High Percentage of Single Occupant Vehicles	4
Traffic Delays Resulting from Accidents/Incidents	4

TABLE 3-2. Citizen Viewpoints on I-85 Corridor Issues

ISSUE	PERCENT OF RESPONDENTS
Congestion	100
Safety	62
Transit Alternatives	39
Pollution	35
Law Enforcement	23
Noise	12
Driveway Access	0

TABLE 3-3. Citizen Suggestions on I-85 Corridor Improvements

ISSUE	PERCENT OF RESPONDENTS
Expedite I-85 widening	16
Improve long-range planning in NCDOT	16
Build bridges wide enough to accommodate future widening	16
Build HOV lanes	16
Build minimum of 8 lanes on I-85	12
Provide truck lane or impose truck restrictions	12
Improve ramp design/ramp metering	8
Provide more convenient public transit services	8
Provide bike lanes in study area	8
Improve transportation/land use integration	8
Improve Mallard Creek and Salome Church roads	4
Widen Derita Road	4
Increase NCDOT construction & maintenance funds	4
Provide I-85 auxiliary lanes	4
Provide areas for law enforcement vehicles	4

4. RECOMMENDED STRATEGIES

4.1 Section Overview

Strategies from the following categories are recommended to address existing and future congestion in the I-85 corridor:

- Traditional Capacity Improvements
- "Managed" Lanes (High Occupancy Vehicle (HOV), Express, and Reversible)
- High Occupancy Toll (HOT) Lanes
- Transit System Improvements
- Intelligent Transportation Systems (ITS)
- Transportation Systems Management (TSM)
- Travel Demand Management (TDM)
- Land Use/Transportation Integration

This section discusses the evaluation measures used in project selection. It also includes a description of each of the congestion management categories and the key findings and recommendations for the I-85 sub-area.

4.2 Evaluation Measures

Because of problems with data availability or a model to perform a quantitative analysis of options, "guiding principles" were used to evaluate congestion management strategies. The recommended projects in this section are based on the extent to which the option helps or hinders the achievement of these principles.

Table 4-1 lists the six "guiding principles" together with the associated evaluation criteria and performance measures. When a simulation model becomes functional for the I-85 sub-area, the recommended strategies and projects from this study could undergo a quantitative analysis to determine relative benefits of implementation.

TABLE 4-1. Evaluation Measures

GUIDING PRINCIPLES	RESULTS OF STRATEGY IMPLEMENTATION	EVALUATION CRITERIA	TRADITIONAL PERFORMANCE MEASURES
CHOICE	1) Increases 2) Minimal Effect 3) Decreases	1) Improved Reliability for: * Single-occupant vehicles * High-occupancy vehicles * Transit vehicles * Commercial goods	* Variance in travel times
		2) Improved Accessibility for: * Single-occupant vehicles * High-occupancy vehicles * Transit vehicles * Commercial goods	* Travel time savings/reduced delay * Change in transit operating speeds
		3) Improved Capacity for: * Single-occupant vehicles * High-occupancy vehicles * Transit vehicles	* Volume/capacity (V/C) ratio
PRESERVATION	1) Supports 2) Minimal Effect 3) Hinders	1) Air Quality 2) Open Space/Park Impacts 3) Economic Viability	Improve, Minimal Effect, Worsen Add, No Impact, Lose Improve, Minimal Effect, Worsen
DEFINES FUTURE DIRECTION	1) Significant Step 2) Minimal Effect	1) Capital Costs 2) Operation/Maintenance Costs 3) Open Space/Park Impacts 4) Institutional Support	High, Medium, Low High, Medium, Low High, Medium, Low High, Medium, Low
INCREMENTAL APPROACH	1) Supports 2) Minimal Effect 3) Hinders	1) Capital Costs 2) Operation/Maintenance Costs 3) Engineering Feasibility	High, Medium, Low High, Medium, Low High, Medium, Low
TRANSPORTATION/ LAND USE INTEGRATION	1) Supports 2) Minimal Effect 3) Hinders	1) Consistency with Vision 2) Plan Compatibility	Support or conflict with vision Support or conflict with plans
STATE/REGIONAL COORDINATION	1) Supports 2) Minimal Effect 3) Hinders	1) Plan Compatibility	Support or conflict with plans

4.3 Traditional Capacity Improvements

4.3.1 What Are Traditional Capacity Improvements?

For purposes of this study, traditional capacity improvements involve both widening existing roadways and construction of new roadways oriented to I-85, the freeway network, and other major arterials. It could involve both the construction of roads on new alignment and the widening of existing streets and highways. Interchange improvements and other major projects, such as the widening of a bridge, would be classified as a traditional capacity improvements.

Other elements of traditional capacity improvements are numerous smaller improvements – signal installations, intersection realignments and widening, safety improvements, and even the inclusion of Intelligent Transportation Systems (ITS). These are crucial elements of traditional capacity improvements and must be included. These items are examined as Transportation System Management (TSM) improvements.

4.3.2 Programmed Improvements

NCDOT and the City of Charlotte have included certain highway improvement projects in the I-85 sub-area in their capital investment programs. Key funded projects include (NCDOT project numbers in parentheses):

- I-85 Widening – US-29/NC-49 in Mecklenburg County to NC-73 (I-3803)
- US-29 Widening – I-485 to Rocky River (U-3115)
- Mallard Creek Church Widening – US-29 to NC-49 (U-2508C)
- City Boulevard – Mallard Creek Relocation to US-29 (R-2420 & Charlotte CIP)
- Mallard Creek Road Relocation (U-2507)
- Poplar Tent Widening – Derita to US-29/601 By-pass (U-3415)

The widening of I-85 between Exit 55, NC-73 in Cabarrus County, and Exit 68, US-29/601 in Rowan County, is an identified but non-funded project (I-3802) in NCDOT's highway improvement program.

4.3.3 Planned Improvements

Long-range transportation plans for both the Mecklenburg-Union and Cabarrus-South Rowan urban areas include recommended roadway improvements in the I-85 study area. The following projects have been identified to provide additional highway capacity in the I-85 corridor:

- Derita Road Widening (Mecklenburg County line to Poplar Tent)
- Mallard Creek/Odell School Road Widening (Prosperity Church to Cabarrus County line)
- Pitts School Road Widening (Shelton to Roberta)

4.3.4 Key Findings and Recommendations

Work during this study has confirmed the need for all of the aforementioned capacity improvements. I-85 should be widened to at least eight lanes to match the freeway cross-sections north and south of the study area. The manner in which the highway should be improved is discussed in further detail in the section on Managed Lanes.

During work on this study, the following highway and bridge improvements also have been identified to address congestion in this corridor:

- Auxiliary lanes on I-85 between Mallard Creek Church Road and I-485 and I-485 to Speedway Boulevard
- New bridge across I-85 at Quay and Old Holland Roads
- New bridge across I-85 between Harris Boulevard and Mallard Creek Church Road
- US-29 Widening to 6 lanes (I-485 to City Boulevard)
- US-29/Harris Boulevard Interchange Feasibility Study
- New bridge across I-85 between Mallard Creek Church Road and I-485

These recommendations are illustrated in **Figure 4-1**.

4.4 Managed Lanes (HOV, Express and Reversible)

4.4.1 Description

Various managed lanes were considered for I-85. These included reversible lanes using moveable barrier, concurrent-flow or contiguous HOV or bus lanes and express lanes. Each is described below:

Concurrent Flow Facilities

Concurrent flow managed lanes are defined as a freeway lane in the same direction of travel, not physically separated from the general-purpose traffic lanes, designated for the exclusive use by HOVs for all or a portion of the day. Concurrent flow lanes are usually, although not always, located on the inside lane or shoulder. Paint striping is a common means used to delineate these lanes. HOV facilities of this type are usually open to buses, vanpools, and carpools. Concurrent flow lanes are typically divided into two general types:

Buffer separated. With this treatment, the HOV lane is separated from adjacent mixed-flow freeway lanes with a designated buffer width of one foot or more. A four-foot wide painted median is very common. Ingress and egress to the HOV lane can occur by driving across the barrier at designated access points or by crossing the buffer at random locations.

Buffer separated HOV lane

Non-buffer separated. With this treatment, the HOV and mixed-use traffic are separated by a single point stripe. In most cases, HOV traffic is allowed to freely cross the stripe either into or out of the HOV lane, eliminating the need for specific ingress and egress points.

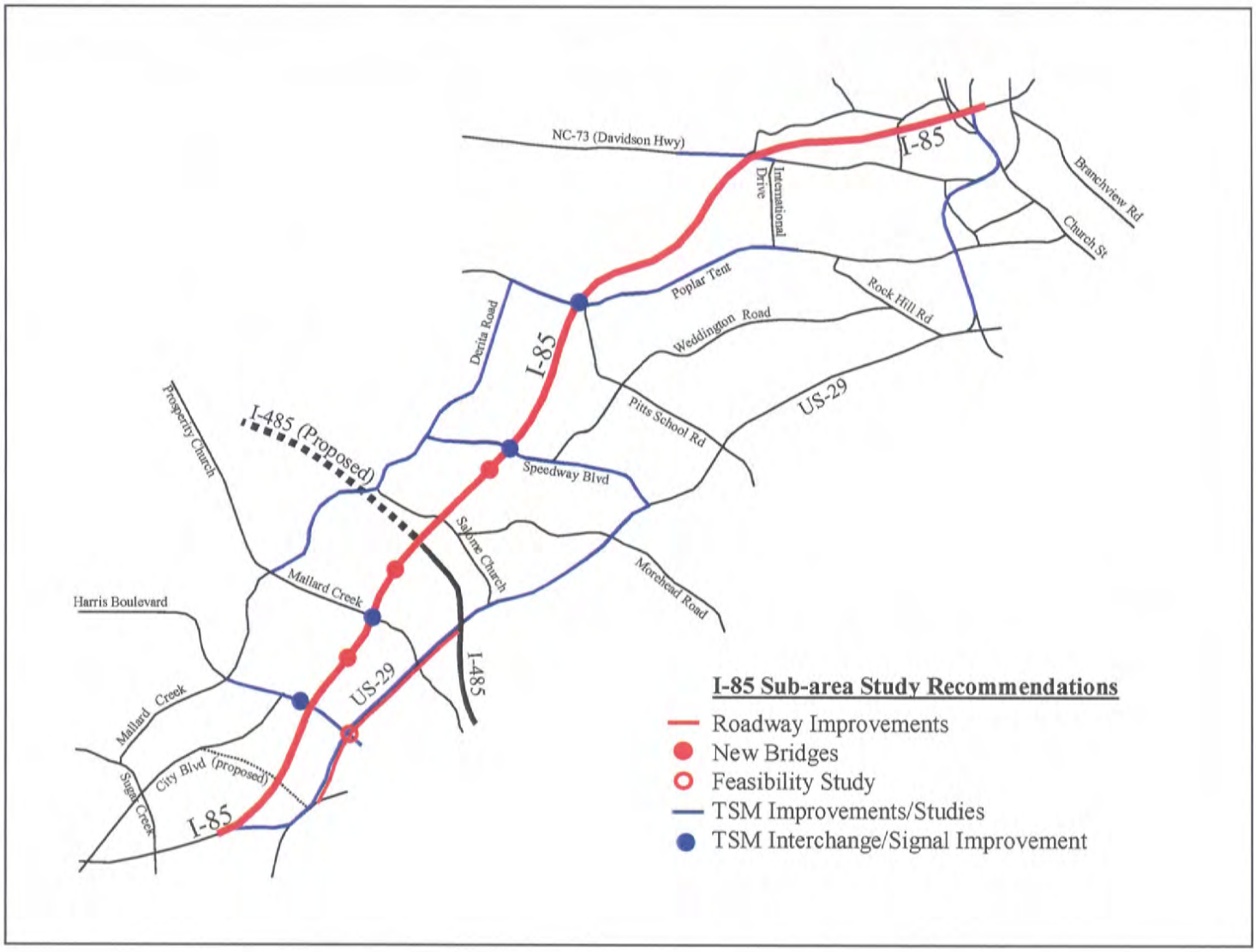


FIGURE 4-1. I-85 Sub-Area Recommended Roadway Improvements

Non-buffer separated HOV lane

Studies on the advantages and disadvantages of buffer separated and non-buffer separated facilities have yielded varying results. Buffer separation removes HOV traffic from congested mainline traffic, but potentially concentrates lane changes if ingress and egress points are formed. Buffer separated facilities have enforcement advantages. Of course, the additional buffer width requires additional right-of-way.

Reversible HOV Facilities

The other type of exclusive HOV treatment is a reversible lane or lanes. This approach involves a lane or lanes within the freeway right-of-way that are physically separated from the general-purpose freeway lanes and are used exclusively by HOVs for all or a portion of the day. Reversible HOV lanes, which are separated from the general-purpose lanes by concrete barriers, are usually open to buses, vanpools and carpools. Exclusive reversible HOV facilities usually operate inbound toward the central business district (CBD) or other major activity center in the morning and outbound during the afternoon. Some type of daily set up is required with reversible facilities.

4.4.2 Justification for Managed Lanes

For the I-85 Sub-area Study, rules of thumb for the operation and planning of successful HOV facilities were applied. These criteria are based on the experience of the Federal Highway Administration (FHWA) and numerous DOTs from across the nation, and include:

Reversible HOV facility

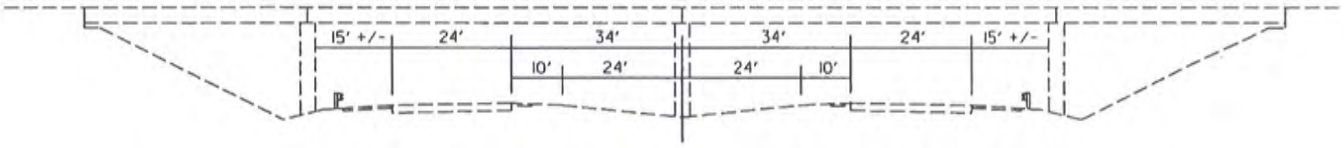
- There typically must be six or more general-purpose lanes in the corridor.
- Users must save five or more minutes per average commute trip in the HOV lane.
- There must be at least 500 HOVs per hour per lane in the opening year (to avoid the "empty lane" syndrome which can lead to criticism from motorists sitting in congested traffic in the adjacent lanes).
- There must be 750 HOVs per hour per lane in the design year in the peak direction.
- There should be the potential for express transit in the HOV lanes.
- It must be physically feasible to add HOV lanes within the available right-of-way (ROW).
- The minimum length of HOV lane operation in the corridor would be approximately six miles.

4.4.3 Key Findings and Recommendations

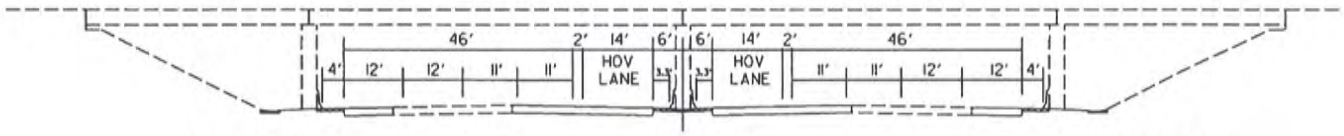
- Potential HOV volumes for I-85 were developed using the Charles River Associates (CRA) method for estimating HOV lane usage and year 2000 traffic and vehicle occupancy counts. Morning peak HOV estimates, shown in **Tables 4-2 and 4-3**, are based on a 2+ HOV requirement. Sufficient demand for concurrent-flow lanes would not likely occur until I-85 widening to eight lanes is completed, and the lanes have reached saturation. This condition could occur as soon as 2010 in some portions of the corridor. Afternoon HOV volumes were reviewed during the study, and there are indications that HOV volumes could be higher than those shown in **Tables 4-2 and 4-3**. More extensive vehicle occupancy studies along I-85 and US-29 are recommended to determine more clearly the current level of ridesharing activity in the corridor.
- While no immediate justification for managed lanes exists, a future $9^{th}/10^{th}$ lane envelope in the median should be considered for future managed lanes. **Figure 4-2** illustrates the current typical I-85 cross-section and possible I-85 cross-sections including HOV lanes. This configuration would permit adoption of a variety of concurrent-flow lane operational strategies, including buffer-separated and limited ingress/egress zones.
- The focus of transit services in the vicinity of Concord Mills and the adjoining Kings Grant transit-oriented development may create a need to provide future direct access to median HOV lanes using a two-way drop ramp at the proposed Quay/Old Holland Bridge over I-85. Approximately 50 feet should be preserved in the median for this ramp.
- The concept of a reversible lane with a moveable barrier does not appear feasible. Although use of a moveable barrier is a cost-effective way of achieving added capacity, an insufficient number of lanes, coupled with an inability to borrow an existing lane without causing major traffic disruption, suggests that this concept is not promising. Projected traffic conditions after I-485 is complete indicate even less directionality of travel demand.
- Express lanes do not appear feasible. Implementation of this concept is complicated by high existing and forecast volumes at successive interchanges, limited percentage of through movements within the study corridor, and impacts to the existing highway and interchanges. A more desirable version of this concept involves enhanced collector-distributor roads between I-485 and Speedway Boulevard in each direction, thereby reducing erratic weaves in this portion of I-85.

TABLE 4-2. Estimated HOV (2+) Demand on I-85 for Year 2000

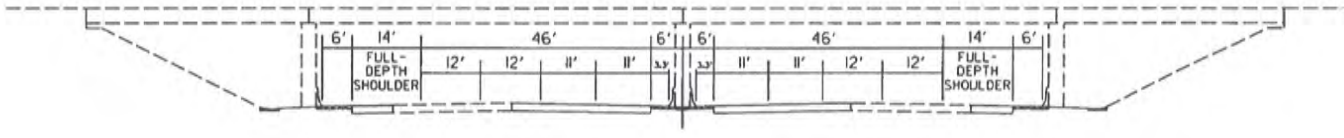
I-85 SEGMENT	AM PEAK-HOUR VOLUMES	
	Peak Direction (Southbound)	Off-Peak Direction (Northbound)
US-29/NC-49 to City Boulevard	790	590
City Boulevard to Harris	450	380
Harris to Mallard Creek Church	410	350
Mallard Creek Church to I-485	380	330
I-485 to Speedway	600	380
Speedway to Poplar Tent	420	270
Poplar Tent to Crisco	430	270
Crisco to NC-73	370	250
NC-73 to US-29/601	350	240
Average	**470**	**340**



EXISTING I-85 TYPICAL SECTION
UNDER FOUR SPAN BRIDGES



EIGHT LANE TYPICAL SECTION AT INTERCHANGES
WITH TWO NEW THRU LANE AND ONE HOV LANE
ADDED IN EACH DIRECTION IN THE MEDIAN
(BUSES ON RAMP)



EIGHT LANE TYPICAL SECTION WITH TWO
NEW THRU LANE ADDED IN THE MEDIAN AND
BUSES USING OUTSIDE SHOULDER

FIGURE 4-2. Current and Possible I-85 Cross-Sections (Including HOV Lanes)

TABLE 4-3. Estimated HOV (2+) Demand on I-85 for Year 2020

I-85 SEGMENT	AM PEAK-HOUR VOLUMES	
	Peak Direction (Southbound)	Off-Peak Direction (Northbound)
US-29/NC-49 to City Boulevard	910	900
City Boulevard to Harris	790	660
Harris to Mallard Creek Church	750	620
Mallard Creek Church to I-485	690	580
I-485 to Speedway	890	620
Speedway to Poplar Tent	640	440
Poplar Tent to Crisco	680	450
Crisco to NC-73	610	420
NC-73 to US-29/601	610	420
Average	**730**	**570**

4.5 High Occupancy/Toll (HOT) Facilities

4.5.1 What are HOT Lanes?

In some areas of the country, facilities called High Occupancy/Toll (HOT) lanes are being used. Typically, HOT lanes are managed lanes or roadways that can be used by both HOV and single-occupancy vehicles (SOV). Higher-occupancy HOVs either travel free, or they pay a lower toll depending upon the number of occupants. Lower occupancy HOVs or single occupancy vehicles pay a toll to use the lane. Tolling is simply a means to manage the number of users to ensure that the HOT lane remains free-flowing.

HOT Lanes in the U.S.

Successful HOT lanes are in operation in many areas of the United States. An 8-mile, 2-lane reversible HOT section operates in San Diego. Opened in 1996 for peak hour operation only, it costs between $0.50-$4.00 for non-HOV and is free for 2+ passenger vehicles. The dynamic toll rate changes prices every six minutes, and only two access points are provided for the barrier-separated facility. The lanes serve 23-percent of peak period volumes saving customers up to 20 minutes per trip, and there are current plans for expansion. Another very different HOT facility serves commuters in Anaheim. The 10-mile, 4-lane facility opened in 1996 using 100-percent private funding for construction and operation. The user cost is between $0.75-$3.50 with a 50-percent discount for HOV 3+. Its lanes serve 25-percent of the peak period market with variable pricing by time of day and week while saving up to 90 minutes per day for its customers.

A variation on the HOT lane concept is the Valu*Express* lane. Under this concept, all vehicles pay the same fee or toll regardless of the number of passengers, i.e., HOVs pay the same fee as SOVs. This avoids the need of distinguishing between HOVs and SOVs, avoiding enforcement costs. It also is intended to provide an incentive for carpooling since the cost per vehicle is unchanged, and more people in the vehicle means a lower cost per person. This is simply a normal toll facility, and in reality operation of HOT lanes generally rely upon some basic HOT screening rules of thumb including:

- There must be five or more minutes savings per average commute trip in the HOT lane
- Demand must exceed 250 vehicles per hour per lane (vphpl) for fee-paying users
- There must be a 300 or more vphpl capacity available for fee-paying users (assume a 1,700 vphpl capacity for the lane)
- Revenues should cover administrative costs
- There must be the ability to manage the roadway and ensure high-speed travel
- It is physically feasible to add HOT lanes within the available ROW

4.5.2 Recommendations

I-85 is not an acceptable candidate for HOT lane implementation in the short to mid-term timeframes for the same reasons cited in the HOV lane analysis. For management and enforcement purposes, HOT lanes should be separated by a barrier from adjacent general-purpose lanes. This creates design considerations for the long-term implementation of managed lanes along I-85.

4.6 Transit System Improvements

4.6.1 The Need for Transit

A visible transit system provides a transportation alternative for communities with limited road expansion possibilities. While no form of transit could begin to serve all trips within the Charlotte region, a well-developed transit system would provide an alternative for those trips that have common destinations.

4.6.2 Overview of Charlotte Corridors Major Investment Studies (MISs)

The Charlotte Corridors MISs are the culmination of over a decade of land use and transportation planning by local officials and citizens.

In 1994, the City of Charlotte and Mecklenburg County approved the *Centers and Corridors* vision, a comprehensive guide for future land use and development in the region. As part of this plan, future development and redevelopment in the region would be focused along five major transportation corridors that were strong candidates for transit service and transit-oriented development. These recommendations were reaffirmed by the Mecklenburg-Union Metropolitan Planning Organization and included in its *2015 Transportation Plan* for the region.

In support of the *Centers and Corridors* vision, the *2025 Integrated Transit/Land-Use Plan* was completed in 1998. A key element of this plan was the development of a regional rapid transit system that would improve mobility, encourage balanced growth, and support the proposed land use initiatives in each of the region's five growth corridors. A wide range of alternative transit

options and land use scenarios were evaluated for each of the five major corridors: South, North, Northeast (University), Southeast (Independent), and West (Airport). In November 1998, Mecklenburg County citizens approved a local sales and use tax (one-half percent) to support implementation of the *2025 Integrated Transit/Land-Use Plan*. In February 1999, Mecklenburg County, the City of Charlotte, and the Towns of Cornelius, Davidson, Huntersville, Matthews, Mint Hill, and Pineville entered into an Interlocal Agreement to plan, finance, and implement a regional transit system, now known as Charlotte Area Transit System (CATS).

During 1999, the City of Charlotte conducted a MIS of potential transit options in the South Corridor. Detailed analyses of ridership, costs, transportation issues, major environmental impacts, and land use issues were completed for the South Corridor transit alternatives identified in the *2025 Integrated Transit/Land-Use Plan*. The results of the MIS analysis reaffirmed the *2025 Plan's* findings. In February 2000, the Metropolitan Transit Commission (MTC) adopted light rail transit operating within the railroad alignment as the Locally Preferred Alternative (LPA) for a new fixed-guideway transit system serving the South Corridor.

In 2000, CATS began MISs in the other four corridors included in the *2025 Plan*. The primary purpose of the MISs is to provide the necessary land use and transportation technical analysis, stakeholder and public outreach, and framing of issues and trade-offs to support MTC selection of a LPA for each corridor. Each corridor MIS also is designed to fulfill the Federal requirements for a MIS under the Federal Highway Administration (FHWA)/Federal Transit Administration (FTA) Metropolitan Planning Regulations, particularly for a potential Federal capital funding of any project that may emerge from a MIS. While a National Environmental Policy Act (NEPA) Environmental Assessment (EA) or Environmental Impact Statement (EIS) would not be completed until preliminary engineering of the LPA is undertaken in each corridor, each MIS would initiate the NEPA scoping process, including publication of a Notice of Intent (NOI) in the *Federal Register*. Environmental analysis, conducted as an integral part of the MIS, should support eventual fulfillment of NEPA requirements for a Federally-funded project, or one requiring a Federal action, that could emerge from a MIS.

The Northeast Corridor includes the portion of the I-85 study area from the US-29/NC-49 Connector to Speedway Boulevard, approximately six miles. The MIS involves analysis of three rapid transit technologies – commuter rail, light rail transit (LRT), and bus rapid transit (BRT). The MTC will be selecting a LPA for the Northeast Corridor in early 2002.

The BRT concept recommended for the Northeast Corridor in the *2025 Integrated Transit/Land Use Plan* has evolved in conjunction with the I-85 Sub-area Study because of the sub-area study's extension into Cabarrus County. The BRT concept includes both physical facilities such as stations, segments of exclusive busway, preferential treatment at intersections, and operating concepts designed to expedite bus flow and provide a one-seat ride to the maximum number of users.

A LRT alternative under consideration for the Northeast Corridor would use US-29 between the I-85 Connector and I-485. The following paragraphs describe the BRT and LRT alternatives within the I-85 sub-area.

4.6.3 Potential BRT Improvements in the I-85 Corridor

What is BRT?

BRT consists of buses operating in exclusive busways with on-line stations similar to LRT systems, or on roads with improvements to allow buses to bypass traffic congestion. A key attribute of a BRT system is the ability to employ express buses that combine feeder, line-haul and distribution functions. A range of vehicle technologies are available that can be matched to travel demand patterns, air quality and noise concerns.

Exclusive Busway in Ottawa

The typical operating regime consists of a line haul service that operates in both directions in the BRT busway right-of-way stopping at each station just like a rail service. The buses used on this service are usually specially identified articulated or double articulated low floor buses. New technology buses that could be used include hybrid diesel-electric and diesel-trolley buses that are much quieter and produce significantly less pollution than a standard city bus.

The BRT stations are served by feeder buses and park and ride facilities just like a rail station. The key service difference between BRT and LRT is the ability of the BRT alignment to also accommodate express bus services that serve residential and employment/commercial centers beyond a convenient walking distance of the BRT right-of-way. These bus services travel to and from the BRT alignment on the local road system, enter, and leave the BRT right-of-way via an exclusive bus ramp. Once in the BRT right-of-way, these express buses may operate in a non-stop or limited stop mode to another exclusive ramp where they would again join the local road system.

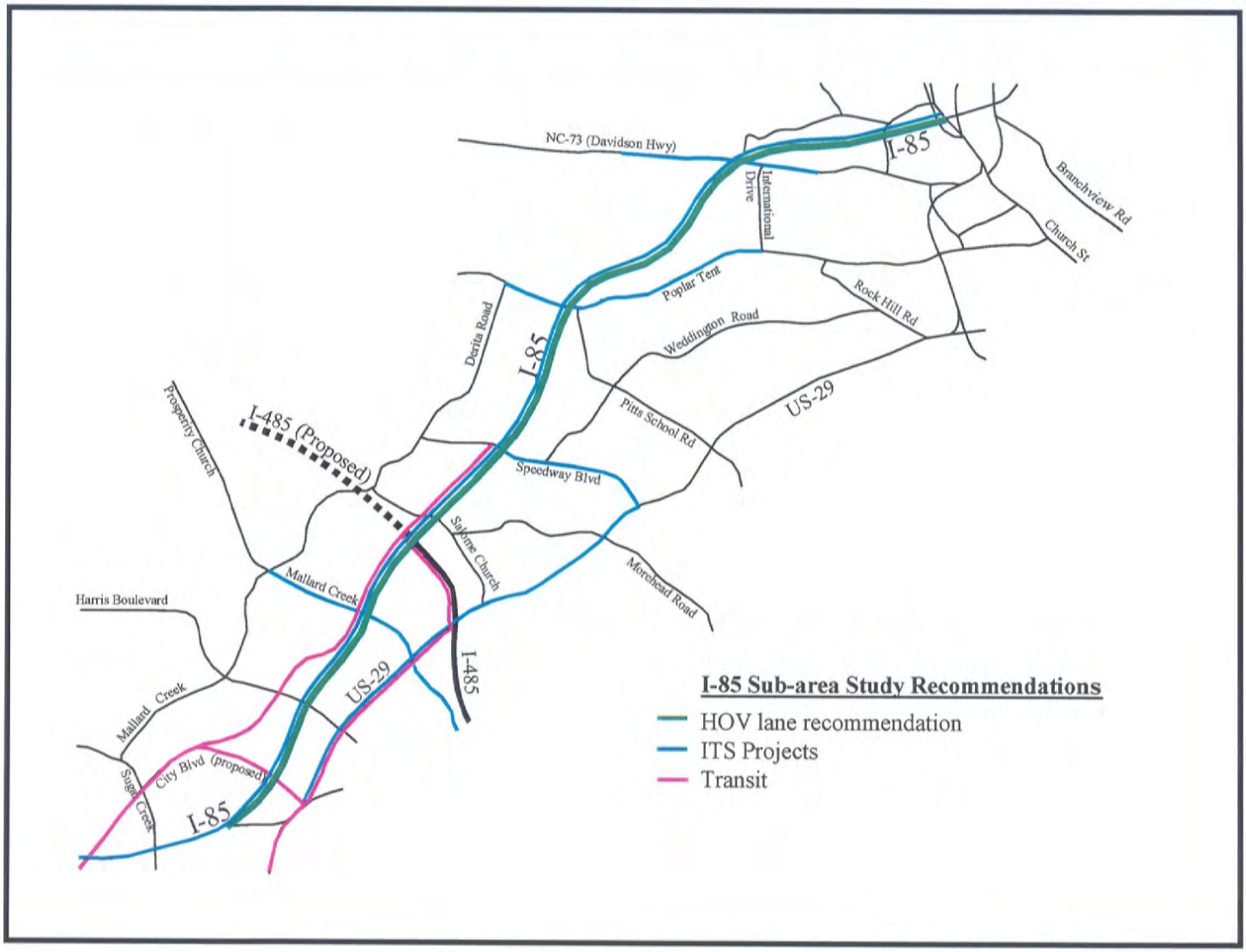
BRT Transfer Station (Ottawa)

Rapid Bus is similar to the line-haul busway service. The only difference being that rather than operating in its own exclusive or semi-exclusive right-of-way, rapid bus vehicles operate on a street or highway in mixed traffic with minor bus lane or signal priority. The rapid bus stops are not usually fully developed stations as is the case for a BRT busway service but are more like specially designed bus stops at wider spacing than the normal bus stop spacing.

BRT Alternatives

Two BRT alignments are being considered in the Northeast Corridor MIS. As illustrated by **Figure 4-3**, one alternative follows I-85 in the study area from the US-29/NC-49 Connector to Speedway Boulevard. In the I-85 right-of-way, this option uses a mix of shoulder bus lanes and short sections of busway where it diverts out of the right-of-way to serve adjacent land uses. It includes an exclusive busway through the King's Grant development.

FIGURE 4-3. I-85 Sub-Area Transit and HOV Alternatives



A second option (also shown in **Figure 4-3)** divides into two segments in the I-85 sub-area: a northern section through University Research Park and a southern segment along US-29.

The northern segment of this alternative includes:

- Bus-only shoulder lanes along I-85 from Salome Church Rd to W. T. Harris Boulevard
- A short segment of exclusive busway between W. T. Harris Blvd. and IBM Drive
- Preferential treatment along IBM Drive to Neal Road, and along Neal Road to City Boulevard and North Graham Street

The southern or US-29 segment of this option includes:

- Bus-only shoulder lanes along I-485 from the I-85 interchange to US-29
- Preferential treatment along US-29 to City Boulevard

BRT service could originate at the county line, but is likely to come from Concord Mills, where several feeder routes are envisioned to enter the BRT system. Some of these will operate via the US-29 alignment while others travel I-85. A transfer station currently envisioned at Concord Mills (although it could be in King's Grant, depending on the timing of that development) would enable passengers to select the alignment that brings them closest to their destination.

Although it is unlikely that all of these locations will develop, potential BRT station locations in the Mecklenburg portion of the I-85 sub-area, as identified in the Northeast Corridor MIS, include:

VICINITY OF	SERVING TRAFFIC GENERATORS AND AREAS
I-85 and Mallard Creek Church Road (could be Galloway Road, or opposite the TIAA/CREF facilities)	Fountaingrove, north end of University Research Park
I-85 and W. T. Harris Blvd.	Feeder bus routes, University Research Park; school complex on Neal Road
US 29 and Frontage Road between I-485 and Mallard Creek Church Road	Hunt Club, Queens Grant Mobile Home Park
US 29 at J. W. Clay Blvd.	UNCC, University Place Town Center
US 29 at W. T. Harris Blvd.	University City, University Hospital
US 29 and NC 49 (north of new University City Boulevard extension)	New development; existing shopping centers along US 29

Possible BRT stops within the Cabarrus segment of the sub-area as developed during the I-85 sub-area study include:

LOCATION	ACCESS ROUTE	FACILITY TYPE
I-85 @ Exit 58	Before getting on I-85; probably from US 29 via existing ramp; Queue jumper lane if needed.	Park/ride; turnaround for future local shuttles
I-85 @Exit 55	Exit I-85 via existing diamond interchange; return to I-85 same interchange. Alternate route from downtown Concord via NC 73.	Park/ride on inbound side.
I-85 @ Crisco (Future Exit 54)	Exit I-85 via existing diamond interchange; return to I-85 same interchange.	No stop until area develops and demand warrants, then Park/ride.
I-85 @ Exit 52 (Poplar Tent)	Exit I-85 via existing diamond interchange; return to I-85 same interchange.	No stop until area develops and demand warrants, then Park/ride.
I-85 @ Exit 49 (Speedway Blvd.)	Southbound: Exit I-85 via existing off-ramp. Cross over Speedway Blvd., then via new slip ramp from on-ramp to SB I-85 to exclusive busway or semi-exclusive roadway through Concord Mills and Kings Grant. Return to I-85 or I-485 via new exclusive ramp. Northbound TBD. Either via new bus-only off-ramp to new Quay Road bridge across I-85 to exclusive roadway, north to Speedway, return NB I-85 via existing NB I-85 on-ramp. **OR** via existing Speedway exit, SB on exclusive roadway, cross I-85 on new bridge, return via new east side roadway network to existing NB I-85 on-ramp.	Major transit station with park/ride facility as close to Concord Mills as development allows. (Direct weather-protected link to Concord Mills if feasible.) This facility will also have spaces for shuttle/feeder buses. Second transit station going south (primarily for Kings Grant walk-in traffic); third located further west and south for walk-in traffic from center portion of Kings Grant; fourth located to serve walk-ins from south portion of Kings Grant.

4.6.4 Potential LRT Improvements in the I-85 Sub-area

What is LRT?

The technological descendant of the streetcar, a distinctive feature of LRT is that vehicles draw power from an overhead wire. LRT can operate in mixed traffic on tracks embedded in the street, on an at-grade right-of-way with street and pedestrian crossings, or on exclusive rights-of-way. Top speeds for LRT vehicles range from 45 to 60 miles per hour. Headways are typically more frequent (e. g., at least twice as often) than for commuter rail services. This makes the service more attractive for non-work trips that occur outside of peak hours, as does the [typically] closer stop spacing than for commuter rail. Key characteristics include:

LRT in Downtown Portland

LRT in Toronto, Canada

- LRT vehicles can operate as a single car or multi-unit train.
- LRT can serve closely spaced stations (less than one mile apart) because of the ability of vehicles to accelerate and decelerate rapidly.
- LRT vehicles cannot operate on the same tracks as railroad locomotives because of different vehicle strength requirements, unless they are schedule and time separated.

- While there are no definitive standards, an LRT track located adjacent to freight tracks should be separated by at least 25 feet.

LRT on Downtown Street in Portland

LRT services may operate in a traditional streetcar/tram mode – in mixed traffic on city streets, with stops as frequent as every ¼ mile. They also operate on exclusive rights-of-way with stops spaced over a mile apart. LRTs operate in these cities as upgrades of former streetcar routes (selected examples): Boston, Cleveland, Philadelphia, Pittsburgh, San Francisco and Toronto. New LRT systems include Baltimore, Buffalo, Calgary, Denver, Hudson-Bergen (Jersey City), Los Angeles-Long Beach, Portland, Sacramento, St. Louis, San Diego, and San Jose. Their range of trip purposes served tends to be broader than for commuter rail. This results from both a higher level of service (frequency and stop spacing) and their setting vis-à-vis adjacent land uses enabling walk-in patronage.

LRT Alternatives

An alternative (**Figure 4-3**) in the Northeast Corridor MIS includes LRT operation in an exclusive transit way in the median of US-29 between the US-29/NC-49 Connector and I-485. The following are possible station locations within the I-85 study area:

VICINITY OF	SERVING TRAFFIC GENERATORS AND AREAS
NC 49 and US 29	New development; existing shopping centers along US 29
US 29 at W. T. Harris Boulevard	University City, University Hospital
US 29 at J. W. Clay Blvd.	UNCC, University Place Town Center
US 29 at I-485	Park/ride; Blockbuster Pavilion (special events only)

4.6.5 Recommendations

The concept of borrowed use of the outside shoulder during peak periods for buses appears feasible, particularly if associated with upcoming reconstruction activities and restricted to bus movements between successive on- and off-ramps. This shoulder lane treatment could connect early transit improvements along I-85 such as park-and-ride lots. The shoulder treatment could encourage a shift to transit during construction when potential timesaving benefits are greatest.

The BRT alternatives under consideration in the Northeast Corridor MIS include bus-only shoulder lanes along both I-85 and I-485. If BRT is part of the LPA for the Northeast Corridor, I-85 re-construction should incorporate the long-range design needs for the selected BRT alternative. This becomes even more critical with the extension of the BRT system along I-85 into Cabarrus County.

The possibility of LRT operation along US-29 also must be considered when analyzing the widening of this arterial to six lanes from the I-85 connector to I-485. The re-evaluation of the feasibility study for the US-29/Harris intersection should reflect the potential for LRT operations if LRT is selected as the LPA.

4.7 Intelligent Transportation Systems (ITS)

4.7.1 What is ITS?

Intelligent Transportation Systems (ITS) are central elements of a modern, efficient transportation network. ITS uses advanced technology, such as telecommunications, computing and control software, to provide better, more efficient management of the transportation system. ITS includes the use of these technologies as tools to:

- Gather accurate, real-time data on traffic conditions,
- Detect changes in traffic flow (such as incidents) that affect system capacity,
- Verify the nature of any detected incidents,
- Respond to that incident and restore normal traffic flow, and
- Inform the driving public of current traffic conditions.

Camera View of I-40 at Aviation Parkway – Online Updates Courtesy of WRAL-TV

Each element is necessary to operate the system, and any individual element has very little benefit in isolation. However, all the elements operating as a system have a significant impact on the transportation network.

Video Surveillance

Video surveillance verifies the location, severity and appropriate response for an incident. Surveillance of traffic is most commonly conducted with cable TV cameras remotely operated from a traffic control center. Although I-77 currently has 26 cameras in the Charlotte region, there are none along I-85.

Detection of changes in traffic flow

There are several technologies available to detect traffic conditions including in-pavement loops, radar, microwave, and video imaging. I-77 has 27 traffic sensors.

Changeable Message Signs (CMS)

CMS provides travelers with en-route travel and incident information while on the road. CMS are large signs mounted over the roadway with programmable letters and symbols that allow the operator to produce varied messages detailing current traffic conditions. The sign messages are developed through information provided by the ITS. Eleven CMS have been installed on I-77.

CMS Sign in Operation

Freeway service patrols

These patrols, now common incident management functions in most major U.S. cities, to provide vehicles equipped with gasoline, tire repair kits, first aid equipment, emergency supplies and trained drivers. These vehicles patrol freeway segments, respond to incidents, and assist stranded motorists. The service patrol operators have cellular phones so that they can be alerted when an incident is detected by the freeway management system and can be quickly dispatched. NCDOT currently operates such a program on fifteen miles of I-77 and I-85 called the Incident Management Assistance (IMAP). IMAP also responds to incidents on an additional 45 miles of these freeways in Mecklenburg County and on I-85 in Cabarrus County.

Equipment to assist incident management personnel in implementing the program more efficiently includes: push bumpers on police cars, portable changeable message signs, and a highway referencing system. Portable changeable message signs may be placed temporarily in advance of a major incident to provide information on the incident and could suggest diversion routes if needed (NCDOT IMAP vehicles are equipped with these signs). A highway referencing system is the provision of reference signs placed along a freeway noting the roadway and identifying a unique location. When an incident occurs, the motorist can use the reference to report the location of the incident. The operator and response staff can respond quicker when the exact location of the incident is known.

Incident Management Assistance Program (IMAP) Response Vehicle

Emergency Management

Coordination of jurisdictions and emergency response agencies (local and state law enforcement, local fire and rescue agencies, ambulance and emergency medical agencies, and hazardous materials emergency response agencies) is undertaken in order to produce a response plan. This plan should define all coverage areas and emergency responsibilities for each agency.

Highway Advisory Radio (HAR)

This technology provides travelers with en-route travel and incident information. HAR is one or more low power radio transmitters placed along roadways that broadcast travel and incident related messages along travel corridors. Real-time information is obtained from the freeway management system and is rebroadcast in near real-time. I-77 in the Charlotte Region has four HAR transmitters.

Regional Traveler Information

These systems provide mechanisms for people to find out about travel conditions before they leave for their trip and while they are en-route. Many technologies are available, including internet webpages, telephone information system, traffic-oriented television stations or programs, traffic alert paging systems, a variety of auto PC traveler information applications, and traveler information applications for personal data assistants (PDAs). These systems are often provided in a cooperative venture between the public and private sectors. The data is

provided by the public sector via freeway management and other systems and the private sector develops this data into traveler information and disseminates it through a variety of mechanisms, such as those listed above. NCDOT is currently working on agreements with Charlotte media to share video images from surveillance cameras. The agency also is developing a conceptual agreement to share traffic information with pager companies.

Ramp Metering

Ramp metering is an ITS element that is a low-cost means of controlling vehicle flow entering freeways, thereby providing a smooth and efficient flow on the freeway mainlines. It is used on freeways that are at or near a reduced flow condition.

Ramp metering is accomplished by placing a modified traffic signal at the end of a freeway entrance ramp. The signal allows individual vehicles to proceed at pre-timed intervals, at time intervals based on traffic conditions on the mainline, or at time intervals based on the length of the queue on the ramp itself. An additional lane can be added to allow buses and HOVs to bypass the ramp meter signal (referred to as HOV bypass lanes). Nationally there are many examples of successful ramp metering installations. Recently, Minnesota DOT installed freeway-to-freeway ramp meters to provide better operations on the freeway system in Minneapolis.

Ramp Metering in Atlanta, Georgia

Ramp metering is primarily a method to reduce freeway crashes and increase traffic throughput on the freeway system. Ramp metering also discourages drivers from using the freeway for very short trips and provides incentives for transit and HOV use through bypass lanes.

In order for metering to be effective, the lost time experienced on the ramp should be more than compensated for by improved freeway flow. Improvement can be in the form of improved normal flow as well as a reduction in crashes and crash-related delay. In addition, to be most effective ramp metering should be implemented as a series of ramp metered interchanges. Isolated metered locations mostly offer safety and capacity benefits at the merge, with more limited effects for greater portions of the mainline.

Ramp meters are placed at the end of the on-ramp in advance of the acceleration lane. At the meter, vehicles will be stopped. Therefore, typically the acceleration lane must be lengthened to provide sufficient distance for vehicles to reach a safe merging speed. It should be noted that the construction associated with ramp metering is minor and does not typically result in any inconvenience to motorists.

Ramp metering must be considered within the development of a larger freeway management system in order to take advantage of those same video cameras and in-pavement sensors for other purposes (i.e., incident management, variable speed control, and enforcement).

Aside from the typical engineering concerns, ramp metering faces three additional key issues:

1. *Public acceptance* - In the case of ramp metering, public acceptance will require more effort in areas where the technology is less prevalent or absent entirely.
2. *Policy* – Political support begins with the notion that the most effective system can be identified and will provide measurable benefits. Just as in other proposed improvements, those benefits must be weighed against total cost.
3. *Enforcement* - When the meters are installed, enforcement is necessary to ensure the meters are having the intended effect of stopping vehicles. In some cases, the use of video cameras may alleviate the long-term burden on law enforcement. Note that the best enforcement is the perceived notion that the ramp meters are working as intended with reasonable compromises on cross-streets and improved freeway mainline flow. Regardless, with well-designed and actively managed ramp metering systems, violation rates are very low and enforcement is not an issue.

Potential Ramp Metering Benefits

Ramp metering reduces the number and frequency of interruptions on the mainline thereby facilitating smoother and more efficient mainline flow. It results in a reduction of crashes, especially rear-end collisions and crashes in the ramp merge areas. The crash reduction is typically in the 30 percent range for the times that metering is in operation. Metering also maximizes flow rates on the freeway mainline while not exceeding downstream capacity.

A survey of traffic management centers using ramp metering reported speed increases of 16 to 62 percent, travel time improvements up to 48 percent, and volume increases from 17 to 25 percent. In addition, traffic-responsive ramp metering often produces results that are 5 to 10 percent greater than those of pre-timed metering.

Table 4-4 summarizes some cases the impacts of ramp metering as cited in the Atlanta Region CMS Task 7 Report (PB-Farradyne, December 1996):

TABLE 4-4. Ramp Metering Impacts

LOCATION	BEFORE SPEED	AFTER SPEED	CHANGE IN...		
			TRAVEL TIME	CRASHES	VOLUME
Portland, OR	16 mph	41 mph	-61%	-43%	NA
Minneapolis	34 mph	46 mph	NA	-27%	+32%
Seattle	NA	NA	-48%	-39%	+62%
Denver	43 mph	50 mph	-37%	-5%	+19%
Long Island, NY	29 mph	35 mph	-20%	NA	0

Source: PB-Farradyne, December 1996

4.7.2 Current NCDOT Initiatives

Several ITS elements have been installed on I-77 connecting to NCDOT's Metrolina Regional Transportation Center in Charlotte. NCDOT also has obtained funds to connect I-85 and US-29 to the Regional Transportation Center. This funding will finance the installation of conduit and fiber-optic cable in I-85 as far north as Speedway Boulevard.

4.7.3 Recommendations

ITS strategies represent an opportunity to increase the capacity of I-85 until freeway widening can occur later this decade. Key recommendations include:

- Implement surveillance, detection, and traveler information in the I-85 study corridor prior to beginning major roadway widening, including:

  Conduit and fiber-optic cable through the entire I-85 corridor

  Out-of-pavement detection every half-mile (begin with temporary locations that may be shifted to permanent sites)

  CCTV surveillance cameras (pan/tilt/zoom) every half-mile (begin with temporary locations and move as appropriate)

  CMS at locations before the construction zone and at other key sites; portable DMS where necessary

  HAR at locations before the construction zone and at other key sites

- Install conduit and fiber-optic cable along US-29 right-of-way from US-29/NC-49 Connector to Speedway Boulevard; connect detectors and cameras at intersections
- Develop an integrated Regional Incident Management Program (improve coordination between NCDOT IMAP and Charlotte/Mecklenburg and Cabarrus police/fire/EMS and 911 dispatch centers); expand IMAP through study corridor
- Install CCTV cameras at I-85 interchanges with Statesville, Graham, Sugar Creek, and Poplar Tent
- Provide traveler information using NCDOT web site and through Commercial Vehicle Operations (CVO)
- Integrate I-85 corridor ITS with regional transit and arterial signal systems on US-29, Harris, and Speedway Boulevards
- Install wireless detection and surveillance on Mallard Creek Church Road, Poplar Tent Road, and NC-73
- Implement ramp metering in the corridor by beginning initially southbound on I-85 in the morning peak; coordinate ramp signals on crossing arterials to accommodate ramp metering; and study further metering at other times and in northbound direction

Figure 4-3 shows the location of the study's ITS recommendations.

4.8 Transportation Systems Management (TSM)

4.8.1 What is TSM?

Transportation Systems Management is defined as modest physical and operational improvements to improve traffic performance, safety, and management. While these improvements are often installed as parts of larger projects, they also offer the potential of short-term improvements to be implemented quickly with limited funding sources. These projects typically do not involve large capital outlays; as a result most (but not all) projects with bridge improvements or substantial right-of-way acquisition are not considered TSM improvements. Potential projects can be both on a freeway system or oriented to arterial systems as shown in the **Table 4-5.**

TABLE 4-5. Potential Improvement Projects

CANDIDATE FREEWAY EXAMPLES	CANDIDATE ARTERIAL EXAMPLES
Lengthening ramps (potentially providing auxiliary ramps)	Additional right/left turn lanes
Ramp revisions	Signalized intersections
New interchanges	Grade separations
Improved signing and lane markings	Continuous left-turn lanes
Improved illumination on shoulders	Shoulders (widen/improve) Bus turn-outs/shelters Reversible lanes

The application of these solutions depends upon the specific problem being observed in the field. Examples are listed in **Table 4-6.**

TABLE 4-6. General TSM Solutions

CANDIDATE PROBLEM	POTENTIAL APPLICATIONS
High accident site	Improve lighting Improve signing and pavement markings
Erratic weaving between sites	Re-orient ramp alignments Braid ramps (grade separate) Extend acceleration length Add auxiliary lane
Isolated congestion between on & off ramps	Add auxiliary lane Meter on-ramp (isolated treatment)
Queuing from intersection onto freeway mainlines	Add intersection approach lanes Re-time signal

The Charlotte region should continue to utilize traffic operations as a means of improving the efficiency of the transportation system. Such improvements include intersection and roadway widening, channelization, motorist assistance programs, traffic signal retiming/coordination, and computerized signal systems. In addition, ITS-based projects should continue to be explored in the region.

4.8.2 Consideration in Applying TSM

In applying TSM, the following must be considered:

Advantages

- Proven track record, cost effectiveness
- Can be applied as part of an incremental improvement
- Can be implemented in shorter term
- Can be applied to both freeways and arterial roadways that cross or parallel the freeway
- Amenable for any size urban area
- Usually the first means of addressing simple problems
- Usually applied to optimize higher investment strategies once improvements are implemented

Disadvantages

- Cannot solve major capacity problems associated with corridor congestion
- High level benefits require higher level of investment

4.8.3 Recommendations

During the study, a number of short-range improvements (see **Figure 4-1**) were identified:

- Perform signal progression studies and improvements along NC-73, Poplar Tent, and Speedway Boulevard
- Perform arterial management studies for:

  Harris between Mallard Creek and US-29
  US-601 between I-85 and US-29
  Speedway Boulevard between Derita and US-29
  US-29 between I-85 and I-485

- Complete access management studies along Derita, Poplar Tent, and NC-73; conduct detailed analyses on Mallard Creek Church Road and Speedway Boulevard at their interchanges with I-85
- Repair and upgrade where possible existing traffic signals in the corridor
- Improve the signal for motorists traveling from westbound Harris to southbound I-85
- Widen ramp terminals and turn lanes at the I-85/Poplar tent interchange
- Add new eastbound lane on Harris just past the US-29 intersection

Two more expensive short-range improvements to I-85 were identified, but these must be evaluated in terms of NCDOT's programmed widening to determine whether sufficient benefits accrue prior to implementation of the longer-term project:

- Widen I-85 NB between Harris and Mallard Creek Church Road interchanges to reduce congestion from trucks climbing this grade
- Widen I-85 SB between Harris and US-29/NC-49 (through new City Boulevard interchange)

4.9 Travel Demand Management (TDM)

4.9.1 What is TDM?

Travel Demand Management (TDM) is a set of tools and actions to encourage travelers to use alternatives to driving alone, or in some cases reducing the need to travel at all. One important purpose of TDM is to reduce the number of Single Occupant Vehicles (SOVs) on the roads in the peak travel periods when the roads are most congested, as well as provide alternatives to those travelers, particularly commuters, who would prefer not to drive alone. By reducing demand, TDM maximizes the people-moving capacity of the transportation system. Generally speaking, TDM consists of three types of actions including:

- Improved alternatives to driving alone.
- Incentives, supporting actions and disincentives to encourage use of alternatives.
- Measures to shift the time at which a vehicle trip occurs, or a reduction in the number of days that the trip is made at all.

CATS Vanpool Vehicle

TDM efforts are generally focused on employment sites where actions can be coordinated and the travelers (the "market") have the same destination. However, a major incentive for travelers to rideshare or use transit is of course the travel time advantages and trip time reliability offered by HOV lanes, and improved transit service, particularly where transit vehicles can avoid congestion by using HOV lanes or busways. Therefore, TDM actions and HOV lanes are complementary, and the success of an HOV program is very dependent on strong and committed TDM programs.

4.9.2 What Benefits are Expected from TDM Initiatives?

National experience shows that potential for vehicle trip reductions for work trips to an employer work site range from 1-2 percent for information-based, modest and voluntary TDM programs, to as much as a 30 percent reduction for mandatory programs that provide significant time and/or financial savings to those who choose not to commute by driving alone. Because TDM is directed primarily at work trips, it mainly impacts peak period travel only.

4.9.3 Recommendations

The TDM recommendations build upon initiatives already underway in the region:

- Conduct a joint Commuter Management Roundtable between the University Area Council of the Charlotte Chamber and the Cabarrus Regional Chamber of Commerce; develop "best practices" programs for early implementation
- Expand CATS Employee Transportation Coordinator (ETC) Program among Northeast Mecklenburg companies
- Develop an approach for extending CATS ETC program to Cabarrus County employers
- Publish CATS new *Commuter's Register* including ridesharing information for the region

- Implement the recommendations of the Countywide Transit Services Plan regarding regional expansion of selected TDM programs
- Adopt zoning ordinance in Mecklenburg and/or Cabarrus Counties to set aside reserved parking for carpools and vanpools
- Adopt travel reduction zoning ordinance in Mecklenburg and/or Cabarrus Counties, including employer-based Vehicle Miles of Travel (VMT) reduction goals
- Establish telecommuting centers in the corridor
- Construct park-and-ride facilities at I-85 interchanges with Poplar Tent, Crisco, and NC-73 as part of I-85 widening project (should be coordinated with express bus plan for I-85 shoulders)

4.10 Land Use/Transportation Integration

4.10.1 Current Initiatives

There are a number of land use/transportation integration initiatives already underway in both Mecklenburg and Cabarrus Counties. This study's recommendations are to continue these planning efforts and to implement the strategies and land development tools evolving from them.

4.10.2 Northeast Corridor Land Use Study

In conjunction with the transit planning portion of the Northeast Corridor MIS, the Charlotte-Mecklenburg Planning Commission is analyzing key changes in existing land use patterns that must be achieved in order for the transit corridors to work effectively:

- Promote more compact, pedestrian-friendly developments
- Encourage a mix of multi- and single-family residential development
- Develop areas that include a mix of residential, shopping, and employment opportunities in close proximity

This study is scheduled for completion in Fall 2001. Its land use recommendations will include the portion of the study area from the US-29/NC-49 Connector (Exit 43) to Speedway Boulevard (Exit 49). Selection of the LPA for the Northeast Corridor would depend on the transportation mode's ability to encourage and support the preferred land use patterns.

4.10.3 ULI Panel Study for I-85 North

On October 9-13, 2000, the Business Committee for Regional Transportation Solutions (BCRTS) engaged the Urban Land Institute (ULI) to analyze the critical connection between transportation and land use in the I-85 North corridor from Center City Charlotte to Downtown Salisbury. An ULI-led panel including ten national experts focused on transportation/land use integration at six key "nodes" in the I-85 North corridor. Two of these nodes are located in the I-85 study area - Harris Boulevard between I-85 and NC-49 and the new interchange between I-85 and the Westside Bypass (Crisco Road), called the "South Gateway".

Overall Recommendations

On October 13, the ULI panel offered several transportation recommendations directly related to the I-85 sub-area study:

- Widen I-85 to eight lanes through Cabarrus County
- Analyze the addition of HOV and/or HOT lanes to I-85
- Construct rapid transit from Center City Charlotte to the I-485/US-29 interchange; operate bus services beyond I-485 with local transit services acting as lateral feeders to the rapid transit line

The panel also presented a list of land use regulatory tools useful for implementing preferred development patterns:

- Fast track permitting
- By-right zoning
- Density bonuses
- Policy for Transfer of Development Rights
- Conservation easements
- Agricultural districts
- Discouragement of large lot zoning

Harris Boulevard

The ULI panel also presented their preliminary recommendations for the six nodes. The panel recommended the following land use implementation strategies for the Harris Boulevard area:

- Create and adopt a Master Plan with a medium residential density of 10 to 30 units per acre, a medium floor area ratio of 0.5 to 3, and a parking management plan
- Establish design and development standards
- Accelerate approval of development projects

The panel outlined a transportation approach designed to create a "University Station" concept:

- Modify the street network to a more grid-like pattern. This includes a new bridge that crosses I-85 between Harris Boulevard and Mallard Creek Church Road interchanges.
- Create pedestrian-oriented spaces to provide a central focus for development
- Extend rapid transit to the US-29/I-485 interchange
- Facilitate transfers from express bus services at the US-29/I-485 and I-85/Harris Boulevard interchanges
- Increase transit circulation services in the University area to link major developments

South Gateway (I-85/Westside Bypass Interchange)

The ULI panel recommended a mixture of land uses along the Westside Bypass between I-85 and NC-73. They proposed a community commercial center at the intersection of the Westside Bypass and NC-73. The proposed transportation network for this node includes:

- A system of boulevards
- A Concord/Kannapolis transit system that serves employment and residential areas and connects to future rapid transit improvements
- Pedestrian-friendly environments within business parks

4.10.4 Cabarrus County Unified Development Ordinance (UDO)

For the past three years, Concord, Kannapolis, and Cabarrus County have been working on a single development ordinance for the entire county. This ordinance includes a new Transit-Oriented Development (TOD) zone that encourages a mixture of residential, commercial, and employment opportunities within identified light rail or other public transit stations. The zone is restricted to areas within one-half mile of a transit station, or an area equivalent to a ten-minute walking distance. Uses and development are regulated to create a more intense built-up environment, oriented to pedestrians, to provide a density and intensity that is transit supportive.

4.10.5 Recommendations

Most of the study's recommendations relate to the ongoing land use/transportation efforts previously described while one improves traffic flow through better access management:

- Implement recommendations of Northeast Corridor land use study upon its completion in Fall 2001.
- Consider land use and transportation recommendations from the ULI panel for the I-85 North corridor.
- Identify sites for transit-oriented development zoning in the I-85 corridor following UDO adoption in Cabarrus County.
- During the review of land development proposals, do not allow driveways, median openings, or crossovers within a minimum distance of 1000 feet of an interchange ramp terminus.

5. COSTS AND TIMEFRAMES

5.1 Timeframes for Implementation

The recommended projects were categorized by three planning horizons:

- Short-Range (2000-2005)
- Mid-Range (2006-2010)
- Long-Range (2011-2025)

Tables 5-1 through 5-8 summarize proposed projects by strategy for each of the planning timeframes.

5.2 Estimated Project Costs

Tables 5-1 through 5-8 also provide estimated costs for the recommended projects by strategy. Cost estimates obtained from other sources or programs are cited in the table. All other estimates were developed as part of this study.

TABLE 5-1. Traditional Capacity Improvements: Short-Range (2000-2005)

PROJECT	ESTIMATED COST
Widen I-85 from US-29/NC-49 to I-485 (I-3803A)	$34,500,000 (A)
Add auxiliary lanes to I-85: Mallard Creek Church to I-485 (Northbound)	$ 1,300,000
Add auxiliary lanes to I-85: Mallard Creek Church to I-485 (Southbound)	$ 1,700,000
Add auxiliary lanes to I-85: I-485 to Speedway Boulevard (Northbound)	$ 3,000,000
Add auxiliary lanes to I-85: I-485 to Speedway Boulevard (Southbound)	$ 2,700,000
Widen Mallard Creek Church Road to 4 lanes from US-29 to NC-49 (U-2508C)	$ 7,900,000 (A)
Construct City Blvd. from Neal to I-85 (R-2420B)	Under Const.
Construct City Blvd. from I-85 to US-29	$18,000,000 (B)
Accelerate construction of Mallard Creek Relocation (U-2507)	$12,400,000 (A)
Widen US-29 from I-485 to Rocky River (U-3115)	Under Const.
Re-evaluate NCDOT's feasibility study of US-29/Harris intersection	$ 35,000

Notes: (A) Draft 2002-2008 N.C. Transportation Improvement Program; (B) City of Charlotte estimate

TABLE 5-2. Transportation System Management (TSM): Short-Range (2000-2005)

PROJECT	ESTIMATED COST
Improve signal for westbound traffic on Harris turning southbound onto I-85	$ 5,000
Widen ramp terminals/turn lanes at I-85/NC-73 interchange	$ 400,000
Add lane on eastbound Harris just past intersection with US-29	$ 1,300,000
Perform signal progression studies/improvements for:	
NC-73	$ 50,000
Poplar Tent Road	$ 50,000
Speedway Boulevard	$ 50,000
Perform access management studies for:	
NC-73	$ 40,000
Poplar Tent Road	$ 60,000
Mallard Creek/Odell School/Derita Road	$ 80,000
I-85/Mallard Creek Church interchange	$ 50,000
I-85/Speedway Blvd. interchange	$ 50,000
Perform arterial management studies for:	
Harris from Mallard Creek to US-29	$ 100,000
US-601 from I-85 to US-29	$ 75,000
Speedway Blvd. from Derita Road to US-29	$ 75,000
US-29 from I-485 to I-85	$ 100,000
Add northbound auxiliary lane on I-85 between Harris and Mallard Creek Church (address delays from trucks climbing grade)	$ 3,900,000
Add auxiliary lane on southbound I-85 between Harris and US-29/NC-49, through I-85/City Blvd. interchange	$ 6,800,000
Repair and upgrade existing traffic signals	TBD

TABLE 5-3. Intelligent Transportation Systems (ITS): Short-Range (2000-2005)

PROJECT	ESTIMATED COST
Complete installation of wireless surveillance and detection along US-29 within study corridor (U-3315) particularly at US-29/I-485 interchange	Under construction
Implement surveillance, detection, and traveler information in corridor prior to beginning major roadway widening:	
Conduit & fiber-optic cable in I-85 corridor right-of-way (Speedway to US-29/601)	$ 1,800,000
Out-of-pavement detection every half mile (may be temporary locations)	$ 1,300,000
Closed circuit television (CCTV) surveillance Cameras (pan/tilt/zoom) every half mile (may be temporary locations)	$ 1,200,000
Changeable Message Signs (CMS) at locations before the construction zone and at other key sites; portable CMS where necessary	$ 700,000
Highway Advisory Radio (HAR) at locations before the construction zone and at other key sites	$ 80,000
Develop an integrated Regional Incident Management Program (improve coordination between NCDOT IMAP and Charlotte/Mecklenburg and Cabarrus police/fire/EMS and 911 dispatch centers); expand IMAP to study corridor	$ 200,000 (study)
Install cameras at I-85 interchanges with Statesville, Graham and Sugar Creek	$ 75,000
Provide traveler information using NCDOT Website	In progress
Implement ramp metering in the corridor, beginning initially southbound in the morning peak	TBD

TABLE 5-4. Transit & Managed Lanes: Short-Range (2000-2005)

PROJECT	ESTIMATED COST
Complete Northeast Corridor Major Investment Study (MIS); perform preliminary engineering for Locally Preferred Alternative (LPA)	$ 6,000,000
Implement peak-period bus services using strengthened shoulders on I-85 between US-29/NC-49 Connector and Speedway Blvd. (I-3803A)	$ 3,600,000
Perform extensive vehicle occupancy studies along I-85 and US-29 to determine peak-period ridesharing	$ 25,000

TABLE 5-5. Travel Demand Management (TDM) & Land Use/ Transportation Integration: Short-Range (2000-2005)

PROJECT	ESTIMATED COST
TDM	
Conduct joint Commuter Management Roundtable between University Area Council of Charlotte Chamber and Cabarrus Chamber; develop "best practices" programs for implementation	$ 5,000
Expand CATS Employee Transportation Coordinator (ETC) Program among Northeast Mecklenburg companies	$ 10,000
Determine approach for extending ETC program to Cabarrus County employees	Not applicable
Implement recommendations of Countywide Transit Services Plan regarding expanded TDM program with regional coverage	TBD
Adopt zoning ordinance in Mecklenburg and/or Cabarrus to set aside reserved parking for carpools and vanpools	TBD
Land Use/Transportation Integration	
Complete Northeast Corridor land use study and implement recommendations	Underway
Implement land use recommendations of Urban Land Institute (ULI) Panel for Charlotte-to-Salisbury segment of I-85	TBD
Adopt Unified Development Ordinance in Cabarrus County; identify sites for transit-oriented development (TOD) overlay zoning in I-85 corridor	Underway
During review of development proposals, do not allow driveways, median openings, or crossovers within 1000 feet (minimum) of an interchange ramp terminus	Not applicable

TABLE 5-6. Traditional Capacity Improvements: Mid-Range (2006-2010)

PROJECT	ESTIMATED COST
Widen I-85 from I-485 to NC-73 (I-3803B)	$ 106,600,000 (A)
Widen Poplar Tent Rd. from Derita to US-29/601 Bypass including new I-85 interchange (U-3415)	$ 19,800,000 (A)
Construct City Blvd. Extension from Mallard Creek Relocation to Neal (R-2420A)	$ 18,700,000 (A)
Construct new bridge across I-85 at Quay and Old Holland Roads (developer responsibility subject to NCDOT and FHWA approval)	$ 1,950,000
Widen Derita Rd. between Mecklenburg County line and Poplar Tent	$ 7,400,000
Widen Mallard Creek and Odell School Roads from Prosperity Church to Cabarrus County line	$ 5,000,000
Construct new bridge across I-85 between Harris and Mallard Creek Church (subject to NCDOT and FHWA approval)	$ 1,750,000
Widen US-29 to 6 lanes between:	
City Blvd. and Harris Blvd.	$ 1,500,000
Harris Blvd. and I-485	$ 3,350,000
Construct new bridge across I-85 between Mallard Creek Church and I-485 (developer responsibility subject to NCDOT and FHWA approval)	$ 2,000,000

Notes: (A) Draft 2002-2008 N.C. Transportation Improvement Program

TABLE 5-7. Mid-Range Projects (2006-2010)

PROJECTS
Intelligent Transportation Systems (ITS)
Install all field devices at permanent location; move detectors, cameras, and Highway Advisory Radio (HAR) as necessary
Install Closed Circuit Television (CCTV) surveillance cameras in conjunction with I-85 and Poplar Tent interchange improvements (U-3415)
Enhance regional traveler information system
Install fiber-optic cable along US-29 right-of-way from US-29/NC-49 connector to Speedway Boulevard; connect detectors and cameras at intersections
Install wireless detection and surveillance along Harris and Speedway Boulevards
Transit and Managed Lanes
Complete final design and construction of Locally Preferred Alternative (contingent on Charlotte Area Transit System financial plan and priority)
TDM
Adopt travel reduction zoning ordinance in Charlotte-Mecklenburg and/or Concord/Kannapolis/Cabarrus County, including Vehicle Miles of Travel (VMT) reduction goals
Establish telecommuting centers in the corridor

TABLE 5-8. Long-Range Projects (2011-2025)

PROJECTS
Traditional Capacity Improvements
Widen I-85 between NC-73 in Cabarrus County, Exit 55, and US-29/601 Connector in Rowan County, Exit 68 (I-3802)
Widen Pitts School Rd. between Shelton and Roberta ($12,400,000)
Intelligent Transportation Systems (ITS)
Integrate I-85 Corridor ITS with other regional elements:
Regional transit
Arterial signal systems on US-29, Harris, and Speedway
Provide traveler information through Commercial Vehicle Operator (CVO) program
Install wireless detection and surveillance on:
Mallard Creek Church Road
Poplar Tent Road
NC-73
Transit and Managed Lanes
Construct High Occupancy Vehicle (HOV) lanes through entire 15-mile corridor ($ 138,000,000)

6. RECOMMENDED PRIORITY OF SHORT-RANGE STRATEGIES

6.1 Section Overview

In order to address existing congestion as quickly as possible, the I-85 Study Executive Committee requested a prioritized list of recommended strategies. The list shown in **Table 6-1** reflects the following:

- Evaluation criteria discussed in Section 4.0
- Priority rankings from the I-85 Study Technical Steering Committee
- Priority rankings from citizens received from the University City newspaper insert or the public involvement web site, www.i-85move.com.

6.2 Programmed Capacity Improvements

Accelerated construction of NCDOT highway improvements such as I-85 widening between US-29/NC-49 and NC-73 (Project No. I-3803) and Mallard Creek Road Re-location (Project No. U-2507) ranks very high with both the public and the Technical Steering Committee. Advancing the schedule of these major highway improvements would require additional roadway construction funding. A State Legislative Study Commission is currently analyzing transportation financing in North Carolina. This commission's recommendations could address the financial constraints that delay construction of much-needed highway improvements.

Because the acceleration of NCDOT highway projects depends on the provision of additional revenues or re-distribution of current revenues, the priority list in **Table 6-1** focuses on strategies that offer near-term benefits. This approach facilitates implementation of lower-cost improvements while funding decisions needed for undertaking larger-scale projects are resolved.

6.3 Proposed Priority of Improvements

Table 6-1 ranks the recommended strategies and indicates the jurisdiction(s) that is responsible for implementation.

TABLE 6-1. Priority of Short-Range Projects

RANK	PROJECT	IMPLEMENTATION RESPONSIBILITY
1	Add eastbound lane on Harris Boulevard south of US-29 intersection	NCDOT
2	Widen ramp terminals/turn lanes at I-85/NC-73 interchange	NCDOT
3	Improve Harris/I-85 signal	NCDOT, Charlotte
4	Develop integrated Regional Incident Management Program with expansion to I-85 corridor	NCDOT
5	Improved access near interchange ramps (permit no access less than 1000 feet from ramps)	NCDOT, local governments
6	Complete ITS installation along US-29 (U-3315), particularly at US-29/I-485 interchange	NCDOT
7	Ensure construction of a new bridge across I-85 at Quay/Old Holland (a condition for future phase of King's Grant development and requires approval by NCDOT and FHWA)	Private developer
8	Perform signal progression studies on NC-73, Poplar Tent, and Speedway	NCDOT
9	Perform access management studies along: Mallard Creek/Odell School/Derita (Prosperity Church to Poplar Tent), Poplar Tent (Derita to Crisco), NC-73 (Crisco to International), I-85/ Mallard Creek Church interchange, I-85/Speedway Boulevard interchange	NCDOT, local governments
10	Perform arterial management studies on Harris, US-601, Speedway, and US-29	NCDOT, local governments
11	Provide traveler information using NCDOT website	NCDOT
12	Implement ITS improvements along I-85	NCDOT
13	Adopt Unified Development Ordinance (UDO) in Cabarrus County; identify Transit-Oriented Development (TOD) sites in I-85 corridor	Concord, Kannapolis, Cabarrus County
14	Complete Northeast Corridor Major Investment Study (MIS), including Locally Preferred Alternative (LPA) and land use recommendations	Charlotte, MUMPO
15	Implement peak-period bus operations on I-85 upgraded shoulders as traffic mitigation strategy	Charlotte, NCDOT
16	Conduct joint Commuter Management Roundtable between University Area Council & Cabarrus Chamber	Charlotte & Cabarrus Chamber
17	Expand CATS Employee Transportation Coordinator (ETC) Program among Northeast Mecklenburg companies	Charlotte
18	Determine approach for expanding ETC program to Cabarrus employers	Charlotte, Concord, Kannapolis
19	Implement recommendations of Countywide Transit Services Plan regarding expanded TDM measures	Charlotte
20	Implement Urban Land Institute (ULI) land use recommendations for I-85 North corridor	Charlotte, Mecklenburg County, Concord, Kannapolis, Cabarrus County
21	Perform extensive Vehicle Occupancy Rate (VOR) studies along I-85 and US-29	Charlotte
22	Implement ramp metering southbound on I-85 during morning peak	Charlotte, NCDOT
23	Re-evaluate NCDOT's feasibility study of US-29/Harris intersection improvements	NCDOT, Charlotte

7. STUDY CONCLUSIONS

7.1 Section Overview

This section identifies key factors and issues that affect travel conditions in the I-85 sub-area. It identifies the shortfall in State funding for transportation improvements in the I-85 corridor. The section also includes prioritized lists of next steps to be undertaken by NCDOT, Charlotte/Mecklenburg County, and Concord/Kannapolis/Cabarrus County.

7.2 Factors Affecting Travel Conditions in the I-85 Corridor

During the I-85 Improvement Study, factors that either facilitate or hamper actions to improve travel conditions in the I-85 corridor were identified.

7.2.1 State Highway Funding Constraints

The inadequacy of North Carolina's highway financing program has delayed I-85 improvements to a critical level. Without additional funding to accelerate work on this I-85 segment, serious peak-hour delays associated with average daily volumes of 70,000 vehicles would worsen over the next decade as volumes grow to 100,000 vehicles per day.

This lack of adequate funding also affects construction of needed arterial roads on the State highway system, small-scale improvements to eliminate "bottlenecks," and implementation of ITS strategies to reduce peak-period congestion.

Table 7-1 illustrates the projected shortfall in State highway funding for the I-85 sub-area over the next decade. The draft *2002-2008 North Carolina Transportation Improvement Program* includes approximately $70 million in State highway funding for the I-85 corridor between 2002 and 2008. As shown by **Table 7-1**, NCDOT already has identified a need for an additional $131 million to complete work on three roadway projects in the sub-area, including I-85 widening to NC-73. Capacity improvements recommended in this study for the short and mid-range periods result in a need for an additional $28 million in State funds between 2002 and 2010, creating a total highway funding shortfall of $158 million.

There also is a need for additional State funds to finance ITS, TDM, and transit improvements. **Table 5-2** includes approximately $2.5 million in recommended short-term TSM projects that require NCDOT funding. **Table 5-3** indicates a need for about $5 million to implement ITS improvements along the fifteen-mile I-85 study corridor. When CATS has identified the locally preferred rapid transit alternative for the Northeast Corridor, the agency will be requesting State funding for up to 25 percent of design and construction costs.

The Legislative Study Commission, created by the North Carolina General Assembly to explore transportation finance issues, has recommended ways to address the State's transportation funding crisis. The General Assembly will likely be considering this issue during their 2001 legislative session.

TABLE 7-1. Traditional Capacity Improvements: Funding Shortfall (2000-2010)

PROJECT NUMBERS	DESCRIPTION	FUNDS PROGRAMMED	FUNDS NEEDED
NCTIP Projects			
I-3803	Widen I-85 from US-29/NC-49 to NC-73	$ 34,500,000	$ 106,600,000
U-2507	Mallard Creek Road Re-location		$ 12,400,000
U-2508C	Widen Mallard Creek Church Road from US-29 to NC-49	$ 7,900,000	
U-3415	Widen Poplar Tent from Derita to US-29/601 Bypass	$ 9,200,000	$ 10,600,000
R-2420	City Boulevard Extension from Mallard Creek Re-location to Neal Road	$ 5,400,000	$ 13,300,000
Projects Identified in I-85 Sub-area Study			
	Add I-85 auxiliary lanes		$ 8,700,000
	Re-evaluate US-29/Harris feasibility study		$ 35,000
	Widen Derita from Mecklenburg County line to Poplar Tent		$ 7,400,000
	Widen Mallard Creek and Odell School from Prosperity Church to Cabarrus County line		$ 5,000,000
	Widen US-29 between City Blvd. and I-485		$ 4,850,000
	Construct bridge over I-85 between Harris and Mallard Creek Church interchanges		$ 1,750,000
TOTALS		**$ 69,400,000**	**$ 158,235,000**

7.2.2 Uncontrolled Growth

Rapid residential and commercial development in northeast Mecklenburg, Cabarrus, and Rowan Counties has resulted in I-85's changing from an interstate corridor serving primarily cross-state travel to a key commuting corridor to the University area and beyond in addition to being a major route to major commercial developments along the freeway.

Recent development in the corridor has not been designed to promote alternative transportation modes. In addition, land developments have not been designed to mitigate impacts on road capacity through access management, improved connections between adjoining land uses, etc.

There is a growing awareness of the link between land development and the need for transportation facilities in the corridor. Several key initiatives are underway:

- Northeast Transit/Land Use Study
- I-85 North ULI Panel
- Cabarrus County Unified Development Ordinance
- Charlotte-Mecklenburg's "Smart Growth" Study

These studies must provide regulations and ordinances that effectively implement transportation/land use principles.

7.2.3 Lack of Efforts on Non-Highway Travel Options

Until recently, there have been minimal efforts to promote alternatives to single-occupant commuting. Persons living or working in the I-85 corridor were limited to driving alone with no public transportation options, minimal information on ridesharing possibilities, and inadequate pedestrian facilities. There has not been enough funding for ITS or TSM projects to reduce bottlenecks and increase roadway capacity.

Passage of the one-half percent sales tax for public transportation in Mecklenburg County in 1998 has enabled new transit services to be started in northeast Mecklenburg. The new Charlotte Area Transit System (CATS) will be expanding bus service in the I-85 corridor, providing new travel options for commuters. CATS is building upon its TDM programs to provide new marketing tools such as the *Commuters Register*. Concord also is considering start-up of public transit services in Cabarrus County, including routes to Concord Mills in the I-85 corridor.

Charlotte-Mecklenburg's new transit tax is financing studies exploring the potential for rapid transit alternatives in the I-85 corridor. Although the Northeast Transit/Land Use study currently ends near the Cabarrus County line, this planning effort could be extended to investigate the feasibility of transit options such as Bus Rapid Transit and Light Rail Transit for this county.

7.2.4 Need for Collaborative Problem-Solving

Throughout this study, stakeholders, local governments, and citizens have pointed to NCDOT and/or other jurisdictions as responsible for the current congestion along highways in the I-85 corridor. Citizens, major traffic generators, and large employers must acknowledge their role in addressing congestion in this corridor. Although NCDOT is behind schedule in implementing I-85 corridor improvements, there are strategies available for corridor residents and companies to improve travel conditions.

7.2.5 A Call to Action

The I-85 sub-area study has identified a broad range of projects to address peak-period congestion, from traditional approaches of increasing highway capacity to reducing the demand for peak-hour solo driving through ridesharing and public transit. While major improvements such as the acceleration of I-85 widening to eight lanes would require significant increases in State funding, this study has identified short-term roadway improvements that could provide immediate congestion relief in the corridor. NCDOT, local governments, and sub-area companies should begin work immediately on the short-range projects included in **Tables 7-2 through 7-4**.

In addition to actions on short-range projects, NCDOT and local governments must implement longer-term recommendations from efforts such as the Northeast Corridor Land Use/Transit Study, ULI panel's review of the I-85 North corridor from Charlotte to Salisbury, and the Metrolina ITS Plan. These documents are proposing new transportation and land use "business practices". Public and private support of these new "practices", once they are identified, is critical to more effective and sustainable planning, land use and economic development, and good transportation decision-making.

7.3 Recommended Projects

Tables 5-1 through 5-8 summarized recommended projects by strategy for the three planning horizons: short-range (2000-2005), mid-range (2006-2010), and long-range (2011-2025).

Tables 7-2 through 7-4 indicate the entities responsible for implementing the study's short-range recommendations. These tables list the recommended projects in priority order.

TABLE 7-2. I-85 Corridor Short-Range Projects: NCDOT Responsibility

RANK	DESCRIPTION	FUNDS NEEDED
1	Add eastbound lane on Harris Blvd. south of US-29 intersection	$1,300,000
2	Widen ramp terminals/turn lanes at I-85/NC-73 interchange	$ 400,000
3	Improve Harris/I-85 signal	$ 5,000
4	Develop integrated Regional Incident Management Program with expansion to I-85 corridor	$ 200,000 (study)
5	Improve access management near interchange ramps (allow no access less than 1000 feet)	Not applicable
6	Complete ITS installation along US-29 (U-3315), particularly at US-29/I-485 interchange	Under const.
7	Perform signal progression studies on NC-73, Poplar Tent, and Speedway	$ 150,000
8	Perform access management studies along:	$ 280,000
	Mallard Creek/Odell School/Derita (Prosperity Church to Poplar Tent)	
	Poplar Tent (Derita to Crisco)	
	NC-73 (Crisco to International)	
	I-85/Mallard Creek Church interchange	
	I-85/Speedway interchange	
9	Perform arterial management studies on Harris, US-601, Speedway, and US-29	$ 350,000
10	Provide traveler information using NCDOT website	In progress
11	Implement ITS improvements along I-85	$ 5,080,000
12	Implement peak-period bus operations on I-85 upgraded shoulders as traffic mitigation strategy (in conjunction with CATS)	$ 3,600,000 (construction)
13	Implement ramp metering southbound on I-85 during morning peak (in conjunction with CDOT)	TBD

TABLE 7-3. I-85 Corridor Short-Range Projects: Charlotte and Mecklenburg County Responsibility

RANK	DESCRIPTION	FUNDS NEEDED
1	Improve access management near interchange ramps (permit no access less than 1000 feet)	Not applicable
2	Ensure private sector construction of Quay/Old Holland bridge over I-85	$ 1,950,000 (developer)
3	Perform access management study on Mallard Creek/Odell School Roads and I-85/Mallard Creek Church interchange (in conjunction with NCDOT)	TBD
4	Perform arterial management studies on Harris and US-29 (in conjunction with NCDOT)	TBD
5	Complete Northeast Corridor Major Investment Study (MIS), including Locally Preferred Alternative (LPA) and land use recommendations; perform preliminary engineering for LPA	$ 6,000,000
6	Implement peak-period bus operations on I-85 upgraded shoulders as traffic mitigation strategy (in conjunction with NCDOT)	TBD (as part of MIS)
7	Conduct joint Commuter Management Roundtable between University Area Council & Cabarrus Chamber (in conjunction with Cabarrus Chamber)	$ 5,000
8	Expand CATS Employee Transportation Coordinator (ETC) Program among Northeast Mecklenburg companies	$ 10,000
9	Determine approach for expanding ETC program to Cabarrus employers (in conjunction with Concord, Kannapolis, and Cabarrus Chamber)	Not applicable
10	Implement recommendations of Countywide Transit Services Plan regarding expanded TDM measures	TBD
11	Implement Urban Land Institute (ULI) land use recommendations in Charlotte-Mecklenburg	TBD
12	Perform extensive Vehicle Occupancy Rate (VOR) studies along I-85 and US-29	$ 25,000

TABLE 7-4. I-85 Corridor Short-Range Projects: Concord, Kannapolis, and Cabarrus County Responsibility

RANK	PROJECT
1	Improve access management near interchange ramps (allow no access less than 1000 feet)
2	Perform access management studies along: Derita Road (Mecklenburg County line to Poplar Tent) Poplar Tent Road (Derita to Crisco) NC-73 (Crisco to International) I-85/Speedway Blvd. interchange
3	Perform arterial management studies on US-601, US-29, and Speedway
4	Adopt Unified Development Ordinance (UDO) in Cabarrus County; identify Transit-Oriented Development (TOD) sites in I-85 corridor
5	Determine approach for expanding ETC program to Cabarrus employees (in conjunction with CATS)
6	Implement ULI land use recommendations in Cabarrus County