



Alternatives Analysis Final Report

Durham-Orange County Corridor

Triangle Regional Transit Program
our transit future



APRIL 2012

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LIST OF ABBREVIATIONS

AA – Alternatives Analysis
BRT – Bus Rapid Transit
CAMPO – Capital Area Metropolitan Planning Organization
CHT – Chapel Hill Transit
CSX Transportation - CSX
CRT – Commuter Rail Transit
DATA – Durham Area Transit Authority
DCHC-MPO – Durham-Chapel Hill-Carrboro Metropolitan Planning Organization
DEIS – Draft Environmental Impact Statement
EPA – Environmental Protection Agency
FEIS – Final Environmental Impact Statement
FTA – Federal Transit Administration
GIS – Geographic Information Systems
HOV –High Occupancy Vehicle
LPA – Locally Preferred Alternative
LRT – Light Rail Transit
MIS – Major Investment Study
MPO – Metropolitan Planning Organization
NCDOT – North Carolina Department of Transportation
NCRR – North Carolina Railroad
NEPA – National Environmental Policy Act
NWI – National Wetlands Inventory
PE – Preliminary Engineering
PFO – Palustrine Forested
RTP – Research Triangle Park
STAC – Special Transit Advisory Commission
TA – Transitional Analysis
TDM – Transportation Demand Management
TRTP – Triangle Regional Transit Program
TSM – Transportation System Management Alternative
UNC – University of North Carolina
USACE – United States Army Corps of Engineers
UT – Unnamed Tributary
VHT – Vehicle Hours Traveled
VMT – Vehicle Miles Traveled

Executive Summary

Introduction

The 2035 Long Range Transportation Plan, jointly adopted by the Durham-Chapel Hill-Carrboro and Capital Area Metropolitan Planning Organization in April 2009, identified corridors for major investments in fixed guideway transit over 30 years. The Transitional Analysis (Triangle Transit, 2010) was a system-level study that analyzed and prioritized fixed guideway transit corridors from the adopted 2035 Joint LRTP to be studied in further detail in an alternatives analysis (AA) process. One corridor within each of the MPO areas is recommended for more detailed study. The Durham-Orange Corridor, which is the subject of this AA report, is identified as a high-priority corridor for high-capacity transit improvements.

The AA is a component of the Triangle Regional Transit Program, a comprehensive effort to study expanded bus and rail networks across Durham, Orange and Wake Counties. This AA evaluates and screens alternative alignments, modes, and station locations within the Durham-Orange Corridor and concludes with the selection of a recommended Locally Preferred Alternative (LPA). The AA process is consistent with the Federal Transit Administration's (FTA) New Starts guidelines that enable fixed guideway projects to be eligible for federal funds.

AA Study Area

The Durham-Orange Corridor Study Area extends 17 miles, beginning in southwest Chapel Hill and encompassing the University of North Carolina (UNC) campus, downtown Chapel Hill, suburban areas along NC 54, US 15-501, NC 147 (Durham Freeway), I-40, Duke University, and downtown and east Durham.

AA Process

The AA commenced with a review of previous studies and plans; analysis of the existing and forecast socioeconomic, land use, and transportation conditions; and development of the draft Purpose and Need and corresponding goals and objectives for the project.

The project team developed a two-tiered screening and evaluation process to evaluate the suitability of transit alternatives in meeting the identified needs for the project. The two screening levels were Conceptual and Detailed. The evaluation criteria at both levels directly related to the project's goals and objectives. The criteria evolved through each level, starting with broad, qualitative measures for the conceptual screening and becoming more focused at the detailed level by using both qualitative and quantitative measures.

AA Purpose and Need

Triangle community residents and their elected officials have identified four core issues that a transportation project should address to support and advance a sustainable economy and the region's quality of life. Therefore, the purpose of a proposed high-capacity transit investment in the Durham-Orange Corridor is to provide a transit solution that addresses the following mobility and development needs:

- **Need to enhance mobility:** The Durham-Orange Corridor is forecast to absorb tremendous population and employment growth that will translate into increased travel demand. By 2035, the corridor is projected to add about 56,000 people and 81,000 jobs, which is expected to

generate 255,000 additional daily trips, many of which will be made on local roadways. These trips will increase congestion during the highest AM and PM travel periods. Alternatives to the auto are needed to address the limited capacity of the corridor's roadway system to accommodate increased travel demand. Conventional buses tend to make frequent stops and operate in mixed traffic conditions, thereby slowing travel times and offering no travel time savings over the automobile. Sample trips (Table 3.3 in Section 3.2.2) illustrate what is problematic with much of the area's transit service: not only does transit fail to provide a travel time savings, but bus travel generally takes longer than auto travel due to less direct routing between key destinations, bus stops, and, in some cases, transfers. The sample trip between Chapel Hill and Durham, which has a total travel time of approximately one-half hour by car, has a nearly 1 hour and 10 minute total travel time by bus on a typical weekday. On a weekend, that same trip by transit will take just over one and one-half hours because of a longer walk to access to the bus due to the reduced frequency in CHT transit service.

- **Need to expand transit options between Durham and Chapel Hill:** Most bus service in the Durham-Orange Corridor is concentrated in downtown Durham and downtown Chapel Hill. Transit connecting these urban centers and serving the residential areas and suburban-style retail developments between them is limited to two Triangle Transit routes and the Duke University Robertson Scholars Express Bus. Currently, these buses operate in mixed traffic along increasingly congested roadways, have limited capacity, and are not competitive with the auto for most trips. Furthermore, the Study Area does not currently offer a high premium service for choice riders.
- **Need to serve populations with high propensity for transit use:** University students and employees, as well as transit-dependent populations, are a significant percentage of the population in the D-O Corridor. Expanding transit services and increasing access to each of the university campuses and medical centers, which offer pedestrian-friendly environments, limited parking, and free transit passes, will support increased mobility options for university students, employees and other patrons. Also, expanding reliable mobility options for lower income populations and transit users who may not be able to drive will enhance economic opportunities through improved access to major jobs centers along the corridor. Providing a transit option that supports the mobility of these groups satisfies an important need within the corridor serving these communities.
- **Need to foster compact development:** Local governments recognize the need to manage growth and focus development within the Study Area. Durham City/County, Chapel Hill and Orange County have developed plans and implementation strategies that call for more compact, walkable, higher density, mixed-use development within the D-O Corridor. However, the existing transit infrastructure throughout the corridor is not fully supportive of these land use plans and implementation strategies and cannot facilitate long-term economic development. A proposed fixed guideway transit investment can channel future growth, provide a superior transit option appropriate for high density development, and help local communities realize their goals and objectives for the future.

Stakeholder and Public Involvement

The project team consisted of Triangle Transit staff and the URS Corporation Consultant Team, with broad input from stakeholders and the general public through a multi-faceted outreach program. The AA process included 19 public workshops, targeted communication with traditionally underserved groups, a public involvement steering committee, coordination with the two local MPOs and elected officials, and convening of working groups as necessary to review project alternatives. Outreach efforts

also included a project Web site (www.ourtransitfuture.com), a project hotline for telephone calls, a postal service mailing address, interior bus ads, news stories, a dedicated e-mail account, and social media outlets.

The comprehensive process yielded more than 1,100 public workshop attendees, several additional meetings with regional stakeholders, and receipt of over 500 comments through the various means of communication available.

Tier 1 Screening: Conceptual Evaluation of Alternatives

Methodology The conceptual evaluation focused on developing and evaluating transit technology alternatives and refining the transit alignment recommended in the US 15-501 Phase I Major Investment Study (1998) and the US 15-501 Phase II Major Investment Study (2001) and subsequently adopted by local governments. Screening criteria included assessment of potential transit ridership through the review of population and employment concentrations and suitability of transit mode; consistency with existing plans and studies; community support; presence of irresolvable environmental impacts; and technical and financial feasibility. Failure to meet at least one or more criterion resulted in elimination of an alternative from further consideration. The No-Build and Transportation System Management (TSM) Alternatives, both required for inclusion by the FTA, were automatically advanced to the Detailed Evaluation of Alternatives.

Transit Technology Evaluation Because a preferred transit technology was not selected through the course of the previous MIS studies, the project team developed four conceptual transit technology alternatives: Bus Rapid Transit (BRT), Streetcar, Light Rail Transit (LRT), and Commuter Rail (CRT). Streetcar was eliminated from further consideration because the mode would not sufficiently enhance mobility, increase transit efficiency, or improve transit connections throughout the project corridor. CRT was not advanced into the detailed evaluation of alternatives because it will not enhance mobility within the corridor as effectively as other transit technologies, is limited in the level of service provided to high need populations, and is cost prohibitive. BRT and LRT were found to be the most reasonable alternatives for the corridor that could address the project's Purpose and Need and were advanced for more detailed study.

Alignment Evaluation The recommended transit alignment from the US 15-501 Phase II Major Investment Study (MIS) was carried forward into the AA as the base alignment for all Build alternatives between UNC Hospitals and Duke Medical Center. Since completion of the US 15-501 Phase II MIS, however, new development, transit technology considerations, and the availability of more detailed environmental information warranted consideration of alternate routes to specific segments of the base alignment. A total of 14 alignment alternatives, as shown in ES-1, were developed across the following five subareas within the Durham-Orange Corridor Study Area:

A. UNC Hospitals The UNC Hospitals area is the western terminus of the project corridor and is generally defined as the southern campus area between the UNC Hospitals, Manning Drive and Fordham Boulevard. Alternatives were conceptualized in this area to accommodate the possible future extension of the proposed transit system to the west through Chapel Hill and into Carrboro.

B. Meadowmont The Meadowmont area is generally defined as the area along NC 54, from the US 15-501 split to Friday Center Drive/Meadowmont Lane intersection. Several alternatives were conceptualized in this area due to several destinations including Meadowmont Subdivision, the Finley Golf Course, and the Friday Center.

C. Leigh Village The Leigh Village area is generally defined as the area around NC 54, George King Road and Farrington Road. Several alternatives were conceptualized in this area due to the future development of the Leigh Village planned community, and potential impacts to wetlands associated with the water supply watershed of Lake Jordan.

D. South Square The South Square area is generally defined as the area bordered by Westgate Drive, University Drive, Shannon Road, and Tower Boulevard. Alternatives were conceptualized in this area due to the complexity of accessing the South Square Shopping Center and crossing Durham-Chapel Hill Boulevard.

E. Downtown Durham The Downtown Durham area is the area between Duke Medical Center and Alston Avenue. An alternative was developed to study an alignment alternative off the existing rail right-of-way through downtown Durham.

The alignment alternatives were narrowed to nine options which were advanced for study in Tier 2 of the screening process. More detailed information on the alignments options is presented in Section 5.2.4.

Tier 2 Screening: Detailed Evaluation of Alternatives

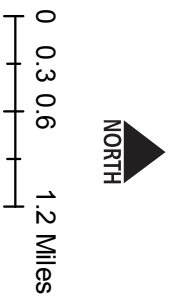
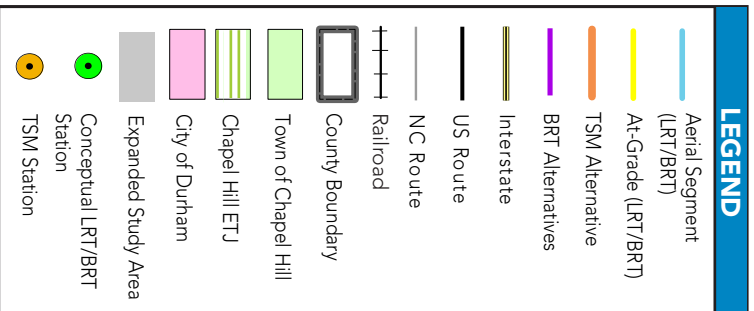
Methodology The Detailed Evaluation of Alternatives focused on identifying the LPA to be advanced for further evaluation in the Preliminary Engineering/Environmental Impact Statement (PE/EIS) process. Alternatives were evaluated based on Ridership, Transportation Operations, Expansion Potential, Economic Development Potential, Public and Agency Support, and Environmental Impacts.

Alternatives Considered In addition to the No-Build and TSM Alternatives automatically advanced from the conceptual alternatives screening, the transit technologies and alignment options remaining after the conceptual alternatives were combined into three fixed guideway alternatives for detailed evaluation (Figure ES-1):

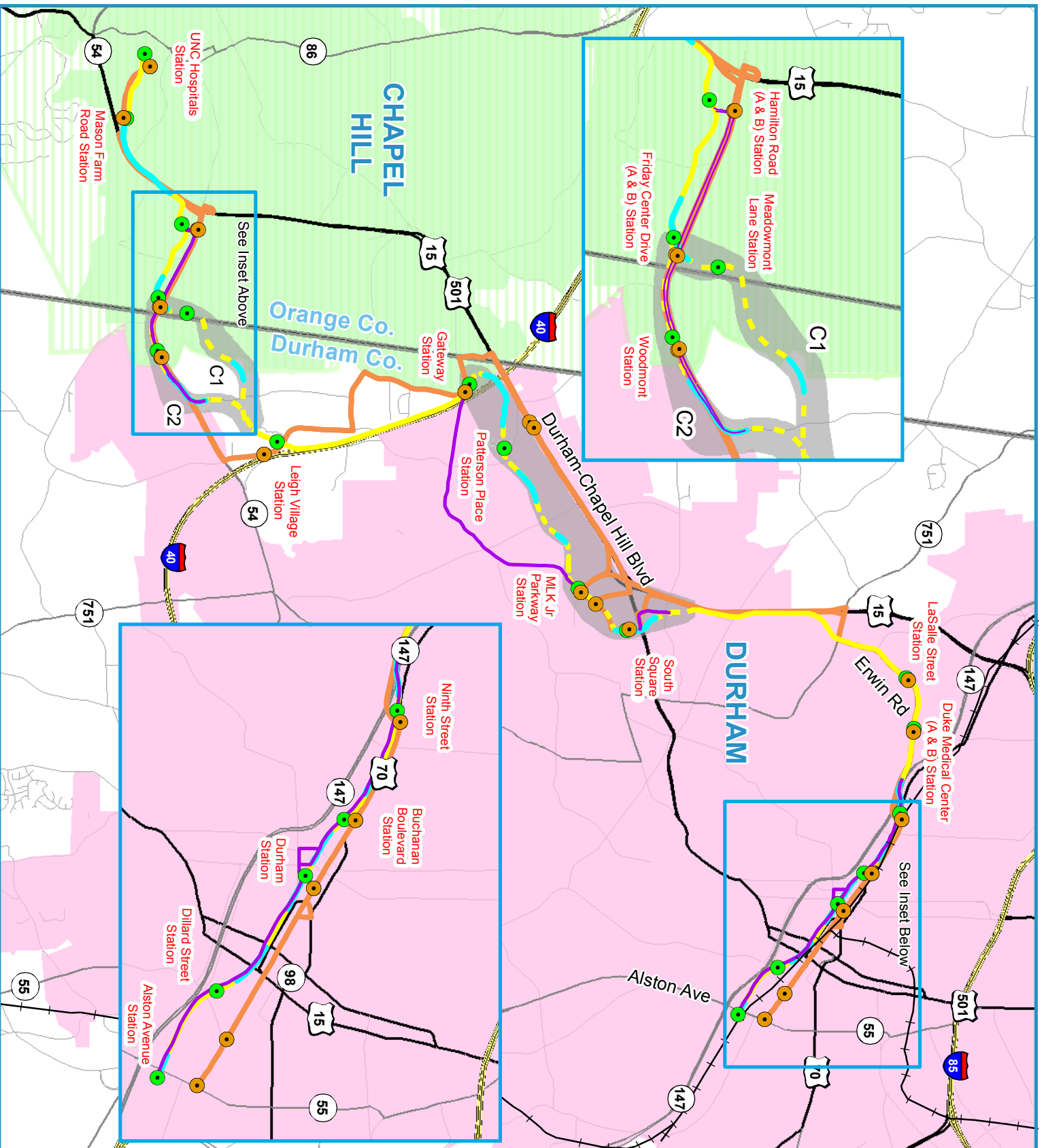
LRT Alternative This alternative would operate light rail vehicles between University of North Carolina (UNC) Hospitals and east Durham and includes alignment options in UNC Chapel Hill (A1 – UNC Hibbard Drive and A3 – UNC Southern), Meadowmont/Woodmont (C1 – Meadowmont Lane and C2 – George King Road), and South Square (D1 – Westgate Drive and D3 – Shannon Road). A total of 17 station locations are proposed.

BRT-High Alternative This alternative would operate BRT between UNC Hospitals and east Durham, generally following the same alignment as LRT and including the same station locations. The only deviation would occur through downtown Durham to the end-of-line at Alston Avenue in east Durham where the BRT-High option would utilize Pettigrew Street, while the LRT would run in the rail corridor. The BRT-High would operate similar to conventional bus in mixed traffic along Pettigrew Street, but would transition to exclusive running along a new Pettigrew Street connection to be constructed as part of this project between Campus Drive and Duke Street. The new guideway connection between these intersections would require coordination with the operating railroads, NCDOT, Durham, and other stakeholders and, potentially require further engineering and design analysis.

FIGURE ES-1 DURHAM-ORANGE CORRIDOR ALTERNATIVES



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BRT-Low Alternative A second BRT alternative was developed to take advantage of the greater flexibility offered by BRT operations. The BRT-Low Alternative alignment more closely follows existing roadways with less aerial structures and more mixed-traffic segments. The BRT-Low alignment is similar to the BRT-High alignment but would deviate from the BRT-High alignment in the following three segments: Hamilton Road Station to Leigh Village Station (BRT-Low Alternative 1), Gateway Station to MLK Jr. Parkway Station (BRT-Low Alternative 2), and Shannon Drive to Pickett Road (BRT-Low Alternative 3). A total of 18 station locations are proposed.

The summary of evaluation results focused first on narrowing down the alignment options under consideration and second on comparing and screening the Build Alternatives to arrive at a LPA recommendation.

Alignment Evaluation. An evaluation of primary opportunities and constraints of the alignment options under consideration in the UNC Chapel Hill, Meadowmont/Woodmont, and South Square subareas resulted in the following preliminary alignment recommendations for each subarea:

UNC Chapel Hill Alignment Option Recommendation: The project team recommended that alignment option A3 be carried forward as the preferred alignment option. Both the UNC and Town of Chapel Hill staff support this option.

Meadowmont/Woodmont Alignment Option Recommendation: The project team recommended alignment option C1 be advanced as the preferred alignment option and also recommended advancing alignment option C2 through to the PE/NEPA phase in order to provide an opportunity for continued study of wetlands issues in the area.

South Square Alignment Option Recommendation: The project team recommended alignment option D3 be advanced as the preferred alignment option. The potential for development for alignment option D3 and the surrounding land uses is, in the opinion of the project team, a very significant factor for the recommendation of D3 above and beyond the constraints cited.

Build Alternatives Evaluation Results Incorporating the alignment recommendations into the Build Alternatives, the project team then evaluated each alternative against a set of detailed criteria. Table ES-1 summarizes the evaluation results.¹ A discussion of how well the alternatives performed relative to the project goals follows the table.

Based on the information presented in Table ES-1, The BRT-High and BRT-Low Alternatives clearly rate well in their ability to meet the first three project goals. Both BRT Alternatives outperform the LRT Alternative in their ability to meet Goal 1: Improve mobility through and within the study corridor, Goal 2: Increase transit efficiency and quality of service, and Goal 3: Improve transit connections. The end-to-end travel time for the BRT Alternatives is slightly longer than the LRT Alternative; however, travel time does not seem to be a major differentiator with regard to passenger preference, as ridership on the BRT-High and BRT-Low Alternatives exceeds that of the LRT Alternative, even with a longer travel time. Additionally, while BRT-Low would result in marginally worse traffic impacts than LRT and BRT-High, traffic impacts is also not a major differentiator among the Build Alternatives.

¹ Public and agency support is excluded from the summary table because of the limited amount of data available for evaluation. See Public and Agency Support under Section 5.3.3 of this report for more information.

Table ES-1 Summary of Evaluation Results for LRT, BRT-High, and BRT-Low Alternatives

Goals	Evaluation Criteria*	LRT	BRT-High	BRT-Low
Goal 1: Improve mobility through and within the study corridor. Goal 2: Increase transit efficiency and quality of service. Goal 3: Improve transit connections.	Ridership: Daily Project Boardings	12,000	BRT route: 5,700** Interlined Buses: 11,900 Total: 17,600	BRT route: 4,600** Interlined Buses: 11,700 Total: 16,300
	Ridership: System-wide Trips***	140,500-141,600	142,800	141,100
	Transportation Operations: Traffic Impacts	Low	Low	Moderate
	Transportation Operations: Travel Time	35 minutes	39 minutes	44 minutes
	Expansion Potential	No engineering constraints & consistent with regional plans	Could be inconsistent with regional connectivity goals	Could be inconsistent with regional connectivity goals
Goal 4: Support local and regional economic development and planned growth management initiatives	Public and Agency Support	High	Moderate	Moderate
	Economic Development Potential	Demonstrated ability to influence development	Unproven ability to influence development	Unproven ability to influence development
Goal 5: Foster environmental stewardship	Environmental Impacts	Moderate property acquisitions, high visual impacts, moderate stream/wetland & construction impacts, no air quality impacts	Moderate property acquisitions, visual impacts, stream/wetland & construction impacts, low air quality impacts	High property acquisitions, low visual impacts, low stream/wetland impacts, moderate construction & low air quality impacts
Goal 6: Provide a cost-effective transit investment.	Estimated Cost (2011 \$) – Capital	\$1.37B	\$960M	\$810M
	Estimated Cost (2011 \$) – O&M Cost (based on offered peak hour capacity of 800 and 1500 pax/hr [±])	800 pax/hr: \$14M 1500 pax/hr: \$15M	800 pax/hr: \$11M 1500 pax/hr: \$13M	800 pax/hr: \$11M 1500 pax/hr: \$13M

*Evaluation criteria include references to sections of the report where more information can be found. | **Daily boardings for BRT-High and BRT-Low routes without interlined buses could potentially be higher as the model estimated the ridership assuming interlined buses. Interlining refers to the ability of local bus routes to use of the guideway in addition to the exclusive BRT service. The BRT numbers thus do not account for passengers that would transfer from feeder buses to BRT if the feeder buses were not sharing the BRT guideway | ***System-wide trips refer to total transit trips in the three county Triangle Region (Durham, Orange, and Wake Counties). | [±]passengers/hour

Each of the three alternatives – LRT, BRT-High, and BRT-Low also meet Goal 5: Foster environmental stewardship; however, the use of fossil fuels by buses makes LRT a more sustainable and desirable technology over the long term. And, while each would result in limited impacts to the natural and built environments, environmental impacts have not proven to be a major differentiator between the alternatives.

From a cost perspective, the BRT-High and BRT-Low Alternatives best meet Goal 6: Provide a cost-effective transit investment by providing a lower capital cost investment and O&M costs within the planning horizon for the proposed project. In terms of capital costs, while LRT presents substantially

higher costs than BRT, the cost of the LRT Alternative is still within the range of affordability as detailed in the separate Financial Plans being prepared for Durham, Orange, and Wake Counties. For O&M costs, decision makers must also consider that in the long-term, the O&M costs of the BRT Alternatives will likely escalate higher than those of the LRT Alternative due to the shorter life span of buses compared to trains, operations (driver) costs, and, potentially, fuel costs. Ultimately the decision of whether BRT or LRT is a cost-effective technology choice will depend largely on ridership. Currently, the BRT Alternatives do have slightly higher forecasted boardings but, as peak hourly volumes reach the range more comparable to existing LRT and BRT systems, LRT can meet the increased demand at a lower capital and O&M investment than BRT.

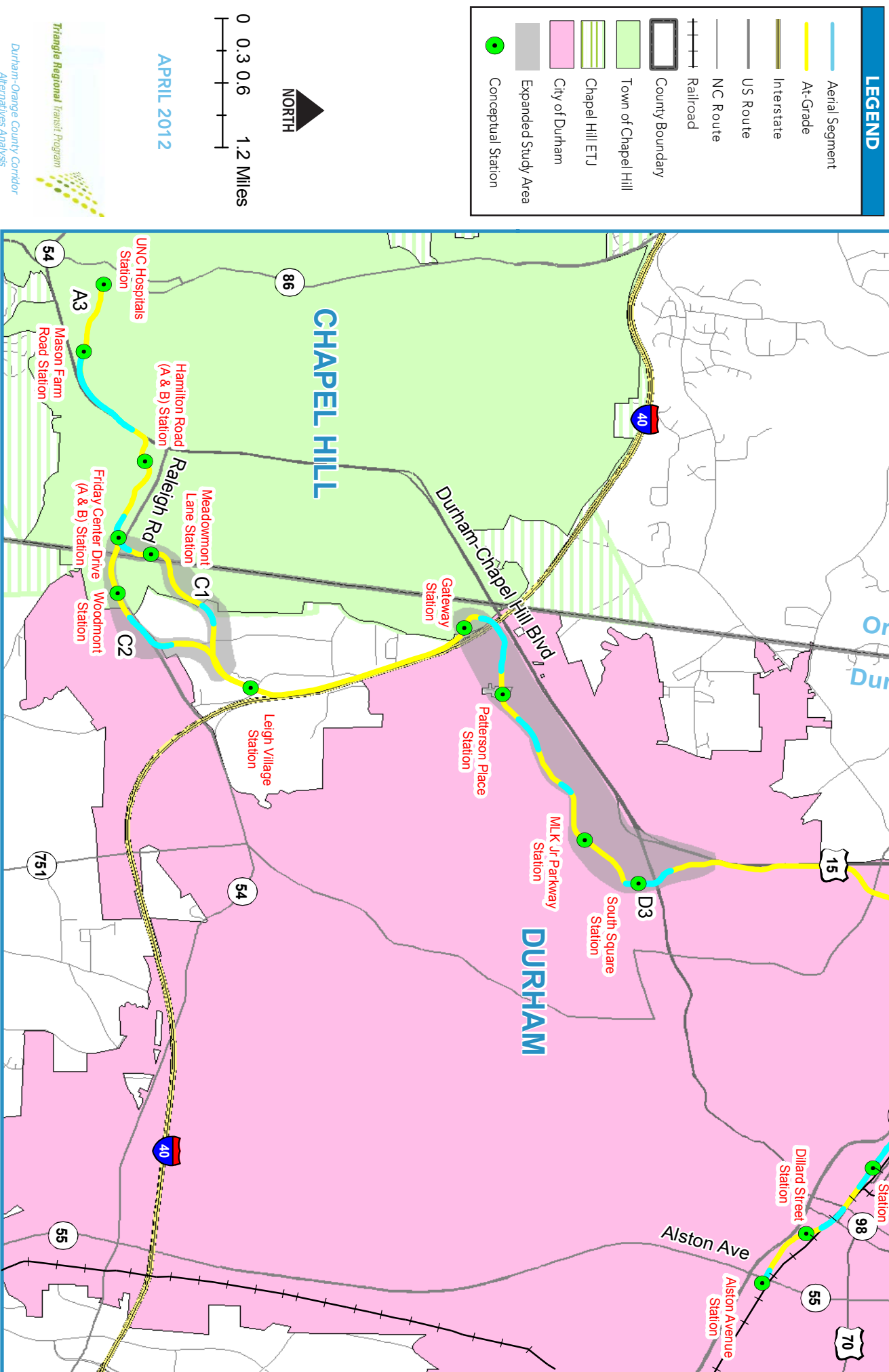
While the BRT Alternatives are competitive regarding most project goals, the LRT Alternative clearly surpasses the BRT Alternatives under Goal 4: Support local and regional economic development and planned growth management initiatives. The LRT Alternative has demonstrated public support and a proven record of producing local and regional economic development benefits by enhancing and focusing growth within LRT corridors. LRT enhances opportunities for transit-oriented development (TOD), and the resulting TOD can achieve rental rate premiums and higher land values over non-light rail served properties. Impressive levels of development have been constructed along LRT lines in many examples across the nation. As evidenced by the dollars of investment with LRT corridors such as the Charlotte Blue Line, developers are interested in constructing transit oriented development at LRT stations, as they see the value in the transportation advantage afforded by LRT. Further, in support of planned growth management initiatives, LRT's proven ability to focus growth would, in the long run, have a more substantial impact on mobility because the land use impacts will result in more choices that can reduce impacts to the highway system.

Build Alternative/Technology Recommendation: The ultimate choice of technology to carry forward is a major decision and could be considered a business decision beyond and above all else. Local and regional stakeholders place a high level of importance on economic development potential and focusing growth within the proposed transit corridor through TOD. LRT can bolster economic development and focus growth and the potential development dollars are not insignificant. The LRT Alternative alone can fully address the stated Purpose and Need for a fixed-guideway investment in the Durham-Orange Corridor; it can enhance mobility, expand transit options between Durham and Chapel Hill, serve populations with high propensity for transit use, and foster compact development. Therefore, the recommended Build Alternative (and technology) is the LRT Alternative.

LPA Recommendation

The Durham-Orange Detailed Definition of Alternatives published in July 2011, for reasons presented in the preceding subsections recommended advancing the LRT Alternative as the LPA with alignment options A3, C1, and D3 and the associated station locations. It was also recommended that the alignment option C2 be carried forward for further study in the Preliminary Engineering / Draft Environmental Impact Statement (PE/DEIS) phase based on potential impacts to wetlands and US Army Corps of Engineers (USACE) owned property associated with the C1 Alternative. Figure ES-2 illustrates the LPA.

FIGURE ES-2
DURHAM-ORANGE
RECOMMENDED
LOCALLY PREFERRED
ALTERNATIVE (LRT)



Additional Evaluation and Endorsement of the LPA

Since publication of the Detailed Evaluation of Alternatives and the recommended LPA in July, 2011, the public, Orange and Durham County Commissioners, Chapel Hill Town Council and Durham City Councils and the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO) have held public hearings, reviewed and considered the recommended LPA. DCHC MPO, in conjunction with Triangle Transit, have held public workshops and received comments on the Detailed Definition of Alternatives which presented the recommended LPA (See Appendix C). Comments received were considered by local officials and the DCHC MPO prior to selection and adoption of the LPA. The events and activities relevant to the selection of the LPA are as follows:

- June 22, 2011: DCHC MPO approves Durham County Bus and Rail Investment Plan
- June 27, 2011: Durham Board of County Commissioners (BOCC) approves Durham County Bus and Rail Investment Plan
- August 29-30, 2011: DCHC Holds Public Workshops on Durham-Orange Corridor AA
- November 8, 2011: Durham County holds successful referendum on ½ cent sales tax for transit
- January 11, 2012: DCHC MPO Conducts Public Hearing
- February 8, 2012: DCHC MPO Selects Locally Preferred Alternative. The recommended LPA was adopted with the modification that both the C1 and C2 alignment options be carried forward for further study in the Meadowmont and Woodmont station areas, with a preference for C2 (Figure ES-2).

Final Alternatives Recommended for Study

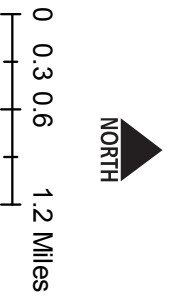
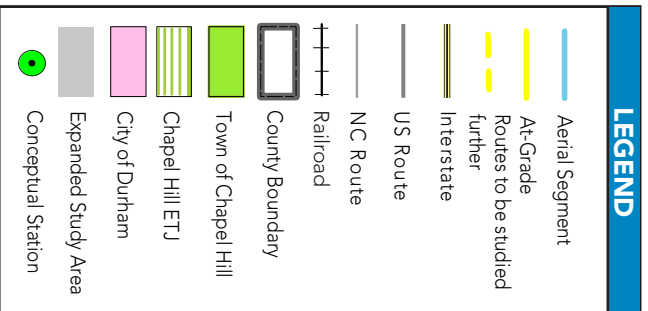
Based on this evaluation and the LPA adoption by the DCHC MPO on February 8, 2012, the final recommendations for alternatives to carry forward for study in the Draft Environmental Impact Statement are the No Build, Baseline/TSM (required by FTA for comparison to “Build” alternatives), and LRT between UNC Hospitals and Alston Avenue/NCCU, as follows:

No-Build Alternative. The No-Build Alternative is used as a starting point to provide a comparison of all Build Alternatives in terms of costs, benefits, and impacts. The No-Build Alternative includes all highway and transit facilities identified in the fiscally constrained 2035 Long-Range Transportation Plan (LRTP), with the exception of the comprehensive system-wide rail transit network, which includes the D-O LRT Project.

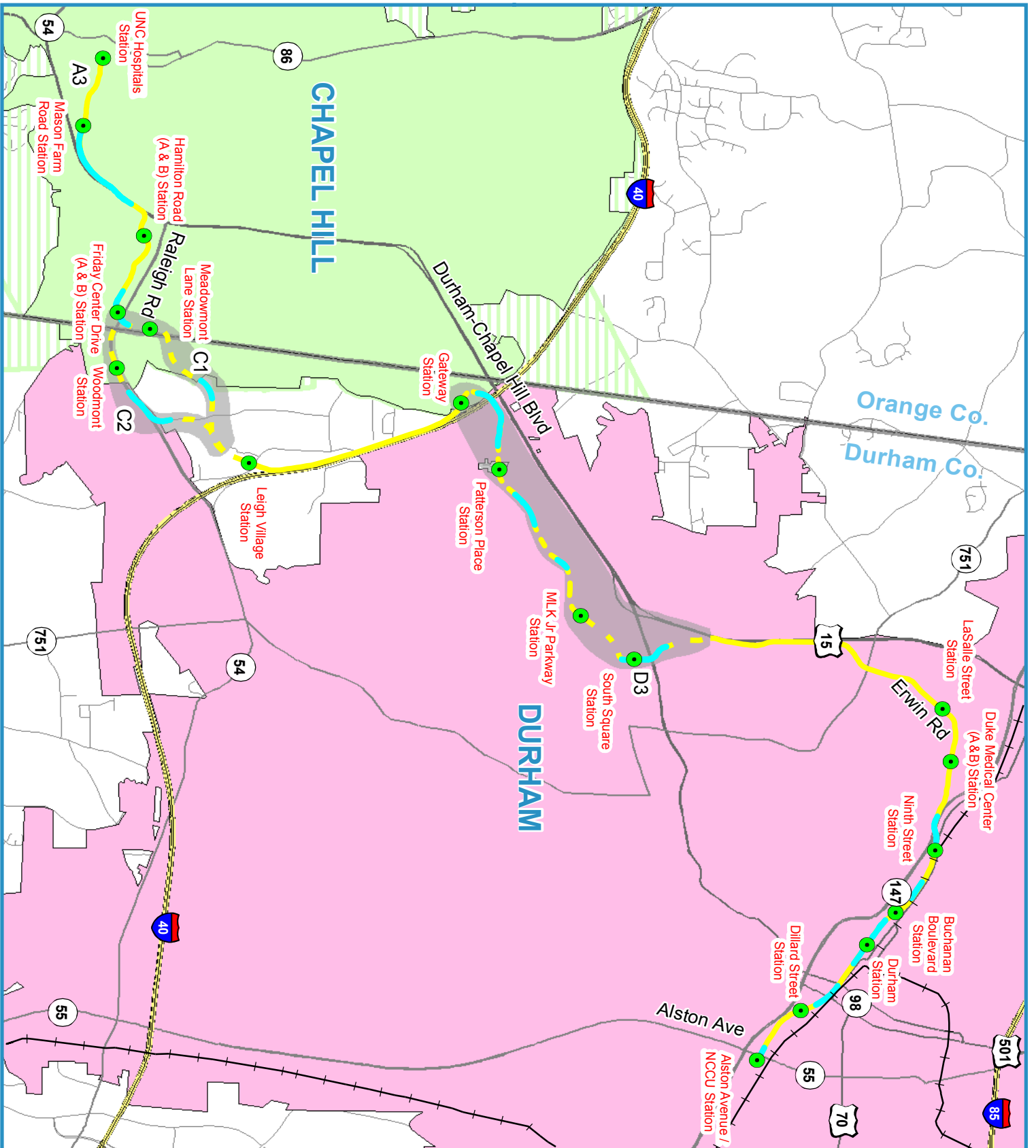
TSM Alternative. The primary purpose of the TSM Alternative is to develop an enhanced and robust bus network in the Durham-Orange Corridor that provides a level of transit service and capacity roughly equivalent to that of a fixed-guideway improvement. The TSM Alternative is required for inclusion in the DEIS by the FTA when federal funds are sought for capital improvements. The intention is to compare the efficiency and cost-effectiveness of a significant bus network in the corridor with fixed-guideway improvements to determine the impact on transit ridership, travel time, and other measures.

LRT Build Alternative –Locally Preferred Alternative. The alignment, which would be double-tracked throughout, (one track for each direction of travel), would operate primarily at-grade in a dedicated right-of-way parallel to existing roadways, with elevated sections throughout to mitigate potential traffic impacts or impacts to environmental features as needed. A total of 17 stations are proposed for the LRT Alternative. Station location refinements for stations such as Hamilton Road and Duke Medical Center will occur during the PE/EIS phase of the project, described in Section 6. During this phase, station layouts and designs will also be prepared.

FIGURE ES-3
DURHAM-ORANGE
ADOPTED
LOCALLY PREFERRED
ALTERNATIVE (LRT)



APRIL 2012



The specific location of the LPA alignment is uncertain in two areas:

1. Crossing of Little Creek between Meadowmont Village and the proposed Leigh Village development: Alternatives C1 and C2
2. Crossing of New Hope Creek and Sandy Creek between Patterson Place and South Square: Alternative alignments generally south of Durham-Chapel Boulevard.

For the purposes of avoiding and minimizing impacts to sensitive environmental resources in these locations, practicable and reasonable alignment options in these locations will be studied in the DEIS.

Next Steps

The following is a description of the work that is currently underway and the next steps needed to advance the LPA through the overall project development and approval/implementation process and the resolution of known issues related to the LPA that will require further analysis and refinement.

FTA Project Development Process. The LRT alternative has been officially selected by the DCHC MPO, and is contained in the region's financially-constrained 2035 LRTP. The project team will prepare an application for entry into the FTA's New Starts process and request approval to begin the PE/EIS phase of the project development process. A decision from FTA regarding the entry of the D-O LRT project into the New Starts funding program and authorization to commence the PE/EIS phase is anticipated to be received by mid-2013.

Concurrent with the preparation of the New Starts application, scoping activities have been initiated for the environmental review process that is required by the National Environmental Policy Act of 1969 (NEPA). After receiving approval to enter New Starts, the project will move into the PE phase of project development. This approval by FTA signals that the project is eligible to be considered for future federal funding support. In the PE/EIS phase, more detailed design and engineering will be conducted to refine project costs and support preparation of an EIS. Following completion of PE and the EIS, Triangle Transit will request FTA permission to conduct Final Design. In Final Design, the engineering is completed, and negotiations, agreements and construction plans are finalized. As that work is being completed, Triangle Transit will work with FTA to negotiate a Full Funding Grant Agreement, which formally commits federal funding for the project.

Issues for Further Analysis and Refinement

Over the course of the AA, selection of the LPA, and leading up to scoping of the PE/EIS process, the following issues were identified for further analysis or coordination:

- Evaluation of project-related environmental impacts and development of mitigation measures for unavoidable impacts.
- Study of alignment options in the US 15/501 Corridor between the proposed Patterson Place and MLK stations to avoid and minimize impacts to wetlands, streams, floodplains, ecologically sensitive resources, public lands and recreation areas associated with New Hope Creek and Sandy Creek.
- Further study of the C1 and C2 alignment options between Friday Center and Leigh Village to evaluate community impacts and to avoid and minimize impacts to wetlands, streams,

floodplains, ecologically sensitive resources, gamelands and federally-owned lands associated with Little Creek.

- Refinement of station locations such as Hamilton Road, Patterson Place, Duke Medical Center.
- Development of station layouts and designs.
- Further evaluation of traffic and transportation impacts, particularly at LRT/street at-grade crossings.
- Evaluation of possible rail operations and maintenance facility locations.
- Coordination and development of agreements with North Carolina Railroad (NCRR) and Norfolk Southern Railroad (NS) and North Carolina Department of Transportation as well as other state and local government agencies.
- Refinement of ridership estimates.
- Development of preliminary engineering drawings.
- Refinement of capital and operating and maintenance costs.
- Continued coordination with interested federal, state, and local government agencies

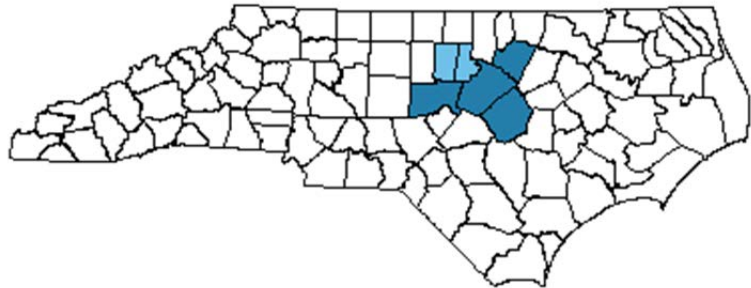
1. Introduction

Triangle Transit has commissioned an Alternatives Analysis (AA) to initiate fixed-guideway transit service between Durham and Orange counties. The AA is a component of the Triangle Regional Transit Program (TRTP), a comprehensive effort to study expanded bus and rail networks across Wake, Orange, and Durham counties.

This report documents the analysis and findings of the Durham-Orange County Corridor (Durham-Orange Corridor) AA process. The AA is an outgrowth of the system-level Transitional Analysis that was completed in fall 2010 and that recommended the Durham-Orange Corridor as one of the region's priority high-capacity transit corridors to be advanced into the more detailed AA process. The AA evaluates and screens alternative alignments, modes, and station locations within the Durham-Orange Corridor and concludes with the selection of a recommended Locally Preferred Alternative (LPA). The AA process detailed in this report is consistent with the Federal Transit Administration's (FTA) New Starts guidelines that enable fixed-guideway projects to be eligible for federal funds.

1.1. Description of the Study Area

Regional Context The Durham-Orange Corridor is located in the northwestern portion of the North Carolina Research Triangle Region (Triangle), which includes Chatham, Durham, Franklin, Granville, Harnett, Johnston, Orange, and Wake counties. The Triangle comprises two urbanized areas (UZA) and is thus under the



purview of two Metropolitan Planning Organizations (MPO). The Capital Area MPO (CAMPO) UZA covers the eastern section of the Triangle and includes all of Wake County and portions of Franklin, Granville, Harnett, and Johnson counties, along with 18 municipalities in these five counties. The Durham-Chapel Hill-Carrboro MPO (DCHC-MPO) is responsible for the western part of the Triangle, covering all of Durham County, a portion of Orange County, including the towns of Chapel Hill, Carrboro, and Hillsborough, a small portion of southwest Granville County, and Northeast Chatham County.

The Durham-Orange Corridor is located within the DCHC-MPO 2000 census Urbanized Area Boundary (UZA) and crosses portions of Durham and Orange counties. Figure 1-1 shows the Triangle, DCHC-MPO Subregion, and Durham-Orange County in relation to the Durham-Orange Corridor Study Area.

Durham-Orange Corridor Study Area The Durham-Orange Corridor AA extends from Durham to Chapel Hill. The corridor roughly follows an alignment that begins at NC 55 (Alston Avenue), parallels NC 147 through downtown Durham, turns west to Duke University campus, then parallels 15-501 to I-40, extending west to UNC Hospitals. Rather than using a set buffer width, the Study Area boundaries were delineated to include the 15-501 and NC 54 corridors as well as the existing rail corridor within downtown Durham for data collection and analysis purposes.

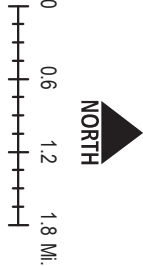
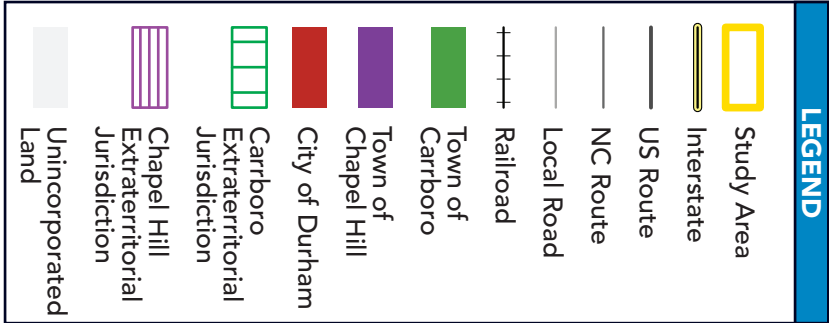
Figure 1-2 provides a detailed map of the Study Area for this AA.

LEGEND

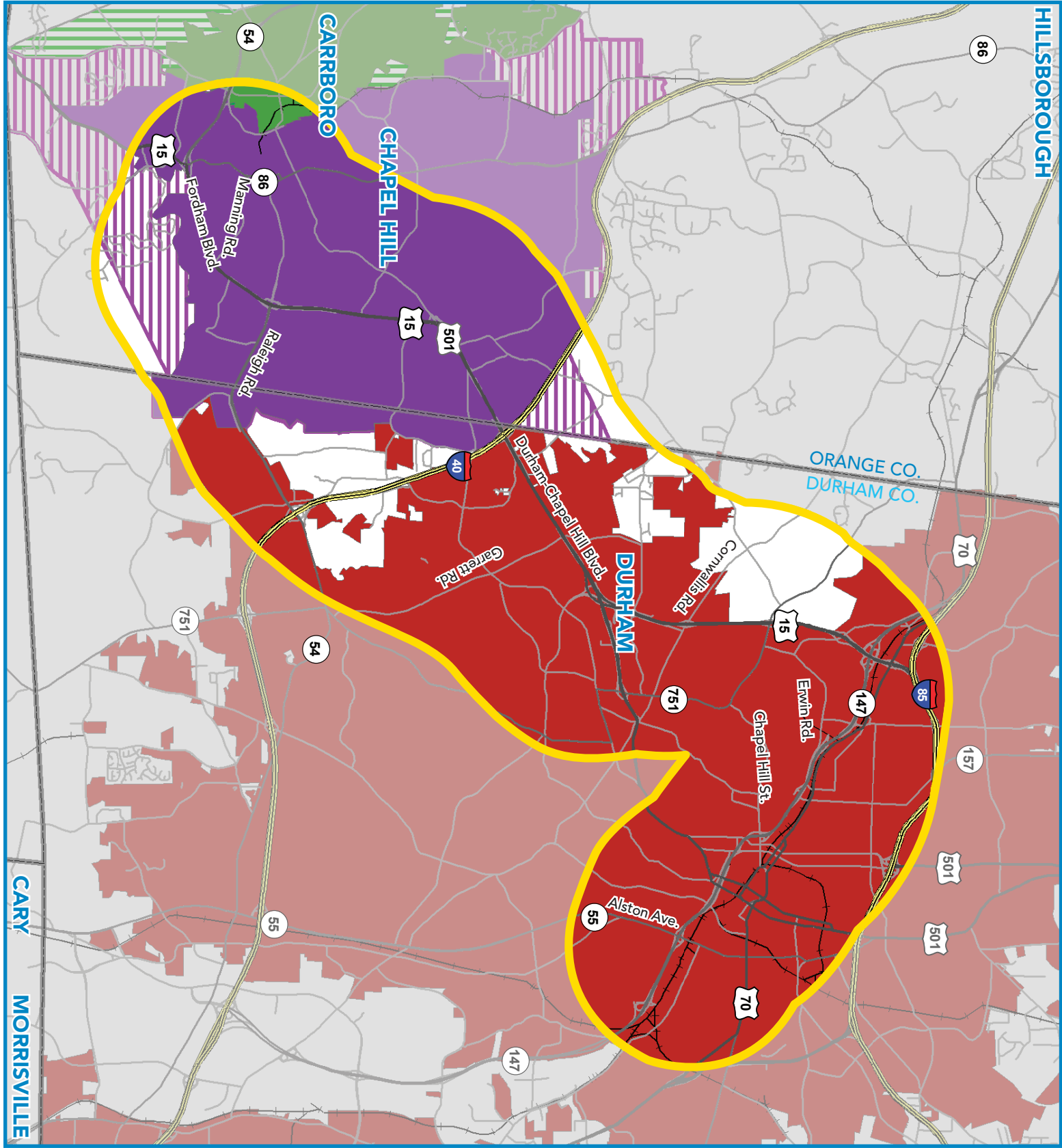
- Study Area
- NC Triangle Region
- CAMPO Boundary
- DCHC Boundary
- Interstate
- US Route
- NC Route
- Local Road
- Railroad



FIGURE 1-2
DURHAM-ORANGE
CORRIDOR AA
STUDY AREA



APRIL 2012



1.2. Background and History

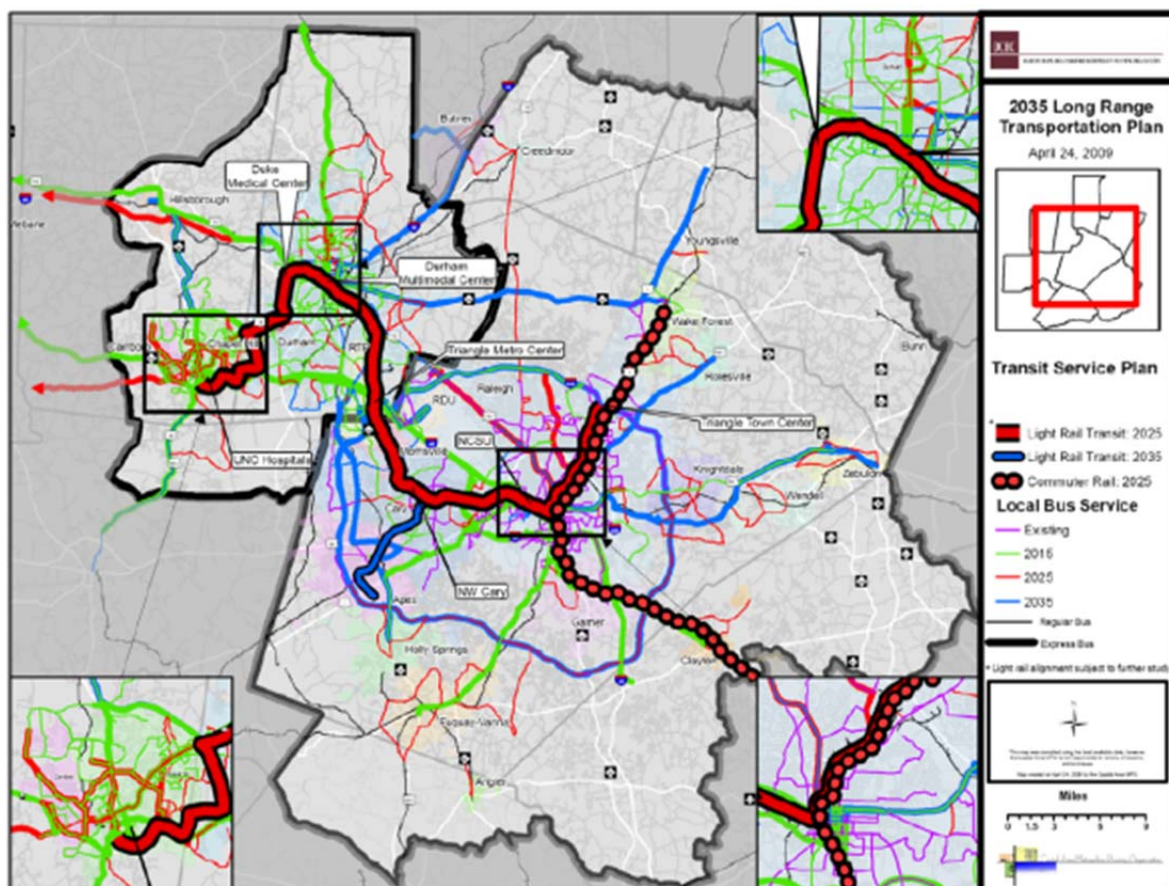
Planning for fixed-guideway transit in the Triangle Region began over 20 years ago, and a number of transit studies have been conducted to advance major transit investments in the area. In recent years, however, three important advancements have been made to bring the implementation of a transit investment in the Durham-Orange Corridor closer to reality.

First, Triangle Region stakeholders have collaborated to restructure the vision for a regional transit system. Between 2007 and 2009, system-wide planning for future fixed-guideway transit corridors was conducted through a cooperative regional planning effort. The Durham-Orange Corridor was identified as one future rail transit corridor in the Region. Recommendations from this planning process were jointly adopted by the region's two MPOs as the transit element of the Triangle Region's 2035 Long Range Transportation Plan (LRTP), as shown in Figure 1-3.

Second, the three counties (Wake, Durham, and Orange) are now enabled to fund transit investments through local sales tax initiatives. In 2009, House Bill 148 was passed to enable local funding for transit projects through a 1/2 percent sales tax contribution, subject to referenda.

And third, between spring and fall of 2010, all fixed-guideway transit corridors in the 2035 LRTP were analyzed to determine implementation priorities. The Durham-Orange Corridor was identified as a priority fixed-guideway corridor to carry forward into an AA process.

Figure 1-3 2035 LRTP Transit Element



1.2.1. Relationship to Previous and Ongoing Studies

The Durham-Orange Corridor AA builds on these previous initiatives, and Triangle Transit is coordinating closely with ongoing studies within the Durham-Orange Corridor Study Area. Table 1-1 details these previous and ongoing studies.

Table 1-1 Previous and Ongoing Transportation Studies in the Study Area

Plan/Sponsor	Year	Description and Recommendation	Status
US 15/501 Phase I Major Investment Study	1998	Addressed transportation in the US 15/501 corridor between Chapel Hill and Durham. Studied reasonable and feasible transit/highway alternative combinations and compared the general level of investment. Recommended alternative transportation investment strategies for further study.	Recommended a set of transit and highway improvements for further study.
US 15/501 Phase II Major Investment Study	2001	Studied recommended transit alignments and technologies recommended from the US 15/501 Phase I Major Investment Study. Identified a locally preferred alternative corridor alignment but was not conclusive about a specific transit technology.	Further study of appropriate transit technologies was recommended. Planning efforts have assumed future transit within the identified locally preferred alternative corridor.
Regional Rail Project EIS/PE/Triangle Transit	2003-2006	Recommends DMU commuter rail service extending from Duke Medical Center through Durham, Morrisville, Cary, Raleigh, and terminating at Spring Forest Road in north Raleigh. Would operate in existing freight corridors.	Triangle Transit withdrew project from FTA New Starts program in August 2006 due to inability to meet cost-effectiveness standards.
Regional Transit Vision Plan/Special Transit Advisory Commission (STAC)	2007-2008	Recommends major regional transit capital investments, including enhanced bus service, local circulators, and over 50 miles of fixed-guideway transit. Also recommended pursuit of local transit tax.	STAC recommendations became the baseline for the transit element of the MPO's Joint 2035 (LRTP).
North Carolina Rail Road (NCR) Capacity Study	2008	Study finds it feasible for commuter and freight train services to share existing NCR tracks but estimates significant capital infrastructure investments would be required to limit negative impacts on existing freight service.	Study outlines several next steps, including ridership study and detailed environmental studies. Recommends further analysis of the markets for commuter rail service would need to be completed to determine which segment(s) could be operated as an independent route.
Transit Element of the Joint LRTP/Durham-Chapel Hill-Carrboro MPO and Capital Area MPO	2009	Recommends phased implementation of regional transit investments through 2035.	Jointly adopted by two MPOs. Implementation of fixed-guideway and bus transit service recommendations require detailed technical and financial analysis.

Plan/Sponsor	Year	Description and Recommendation	Status
House Bill 148 – Congestion Relief and Intermodal 21st Century Transportation Fund/North Carolina State Legislature	2009	Enables Wake, Durham, and Orange counties to hold referenda for a local 1/2 percent sales tax option to help fund local public transportation projects. Annual vehicle registrations may also be increased up to \$10 to fund such projects.	In July 2011, Durham County Commissioners voted to schedule a referendum for November 8, 2011 on the half-cent transit tax in Durham County. In Orange and Wake Counties, potential dates of local sales tax referenda to be determined.
Triangle Regional Transit Program Transitional Analysis/Triangle Transit	Fall 2010	Analyzes and prioritizes fixed-guideway transit corridors from the adopted 2035 Joint LRTP to be studied in further detail in an AA process. One corridor within each of the MPO areas is recommended for more detailed study. Durham-Orange Corridor, which is the subject of this AA report, is identified as a high-priority corridor.	Priority corridors ratified by both MPOs.
North Carolina Railroad Company Commuter Rail Ridership and Market Study/North Carolina Railroad Company	May 2010	Analyzes viability of commuter rail service along a 143-mile section of the NCRR corridor between Greensboro and Goldsboro. Study finds that the Triangle Region has the highest forecasted ridership.	Commuter rail corridor could follow a shared alignment with the Durham-Orange Corridor, if the NCRR corridor is selected as an alignment for the Durham-Orange Corridor fixed-guideway investment.
NC 54-I-40 Corridor Study/ Durham-Chapel Hill-Carrboro MPO	August 2010	Defines a transportation-land use blueprint for the NC 54-I-40 corridor between Chapel Hill and Durham. The articulated vision is to promote community livability by guiding future development into targeted mixed-use areas to reduce trip lengths, enable greater use of nonauto travel options, and provide location-efficient choices for housing and transportation.	A key objective of the plan is to develop land use and transportation strategies to complement a proposed regional light rail system, as well as interim higher capacity transit alternatives, including expansion of fixed-route bus service. Land use strategy focuses on compact, mixed-use development of four station areas. Transportation strategy includes phased multimodal recommendations that include geometric improvements at intersections, creation of shared-use path along NC 54, a Bus Rapid Transit network, expanded local bus service, and additional park and ride lots.
Southeast High Speed Rail–Richmond, VA, to Raleigh, NC, Tier II DEIS/NCDOT Rail Division and Virginia DOT Rail Division	Ongoing	Proposes implementation of approximately 162 miles of high speed rail as part of an overall plan to extend high speed passenger rail service from the Northeast Corridor (Boston to Washington, DC) southward through Virginia to Charlotte, North Carolina.	The project is in the final EIS phase, which is scheduled for completion in late 2011.

Plan/Sponsor	Year	Description and Recommendation	Status
Wake County Corridor Alternatives Analysis/Triangle Transit	Ongoing	Identifies the preferred alignment, mode, and station locations for a fixed-guideway service connecting northeast Raleigh with northwest Cary.	Also part of the TRTP, the project schedule is concurrent with the Durham-Orange Corridor AA.
Durham-Wake Corridor Alternatives Analysis/Triangle Transit	Ongoing	Evaluates feasibility of commuter rail against other fixed-guideway alternatives to connect Durham and Wake counties.	Also part of the TRTP, the project schedule closely aligns to the Durham-Orange Corridor AA.

1.3. Public and Stakeholder Involvement

Triangle Transit has implemented a multifaceted public involvement plan for the purposes of educating, notifying, and engaging the public throughout the AA process. The plan defined goals for outreach, strategies, and ways to communicate project information and meetings. The public involvement process complies with legislation and guidance for persons with disabilities, persons with limited English proficiency, and environmental justice. Major elements of the public involvement process include:

- **Public Workshops** Three series of public workshops were held throughout the project's duration in localities throughout the region. To date, more than 1,100 people have attended 19 public workshops, and the program has received more than 500 comments.
 - The first set of workshops was held to explain the need for regional transit planning and the AA process. Dates and venues of these sessions were:
 - June 28, 2010, at the Raleigh Convention Center, Raleigh
 - June 30, 2010, at the Durham Public Library, Durham
 - July 6, 2010, at Cary Town Hall, Cary
 - July 7, 2010, at Chapel Hill Town Hall, Chapel Hill
 - July 14, 2010, at Knightdale Town Hall, Knightdale
 - July 15, 2010, at The Halle Center for the Cultural Arts, Apex
 - Goals for the second set of workshops were to present and gather public input on the best performing corridor identified as part of the Transitional Analysis, including the Durham-Orange Corridor, and to introduce conceptual alignments. Dates and venues of the second workshops were:
 - September 14, 2010, at the Chavis Community Center, Raleigh
 - September 15, 2010, at Wake Forest Town Hall, Wake Forest
 - September 16, 2010, at the Carrboro Century Center, Carrboro
 - September 21, 2010, at the Durham Station Transportation Center, Durham
 - September 22, 2010, at Morrisville Town Hall, Morrisville
 - September 23, 2010, at the Garner Historic Auditorium, Garner
 - The detailed alternatives in this document were presented for public comments at the third round of workshops in March 2011. Dates and venues were as follows:
 - March 22, 2011, at Triangle Town Center, Raleigh
 - March 23, 2011, at Durham Station Transportation Center, Durham
 - March 24, 2011, at William and Ida Friday Center, Chapel Hill
 - March 28, 2011, at Mt. Peace Baptist Church, Raleigh

- March 29, 2011, at Cary Senior Center, Cary
 - March 30, 2011, at McKimmon Center @ NCSU, Raleigh
 - March 31, 2011, at The Research Triangle Park Foundation, RTP
- **Targeted Communication with Stakeholder Groups** Triangle Transit determined that stakeholder groups like the elderly, current transit users, and African American and Latino communities were specific groups that needed to be engaged in public involvement. Phone calls and e-mails to these groups resulted in the distribution of an additional 60 outreach kits containing materials from the first round of public workshop in English and Spanish. In addition, special efforts were made to encourage meeting attendance, including distributing information cards at transit centers and raffling off transit passes.
 - **Public Involvement Steering Committee** Triangle Transit invited 40 transportation professionals and public affairs specialists from municipalities and planning organizations in the Triangle to serve on the Public Involvement Steering Committee. The Steering Committee meets monthly to review primary messages and advise on public involvement opportunities and resources at their disposal.
 - **MPO Coordination** The Technical Advisory Committee (TAC) and the Technical Coordinating Committee (TCC) for both CAMPO and DCHC-MPO function as the technical and policy committees for the AA process. These committees are consulted on a regular basis to provide feedback and input on project development.
 - **Elected Officials Coordination** A group comprised of local government officials from the region's three counties, representatives of the region's two MPOs, and the chair of the Triangle Transit Board of Directors meet on a regular basis to collect information and provide feedback.
 - **Other Outreach** The public has many ways to gather information and provide input on the AA outside of the public workshops, including the project Web site (www.ourtransitfuture.com), a project hotline for telephone calls, a postal service mailing address, interior bus ads, news stories, and an e-mail inbox dedicated to the project. The project has also incorporated social media outlets, including Facebook, Twitter, YouTube, and Flickr, as well as blog posts and print and broadcast ads.

1.4. Organization of the AA Document

The remaining chapters of this report are organized as follows:

Chapter 2: This chapter describes existing and future conditions in the corridor. The analysis focuses on how the communities along the corridor are expected to evolve over the next several decades and the implications that existing and future trends will have on transportation demand and mobility.

Chapter 3: This chapter describes the overall project purpose and the “Need for the Action” related to the proposed transit investment in the Durham-Orange Corridor. It also describes major goals and objectives used to guide the development and evaluation of alternatives.

Chapter 4: This chapter summarizes the process used in the definition and evaluation of conceptual and detailed alternatives. It also demonstrates the relationship of the alternatives evaluation process to the Purpose and Need of the project.

Chapter 5: This chapter presents the development of alternatives, the alternative screening criteria, and the process used to eliminate alternatives from further consideration. It details the performance of each alternative with respect to established evaluation criteria and concludes with the recommendation of a LPA. The chapter concludes with a description of endorsements of the LPA by local and regional governing bodies.

Chapter 6: This chapter describes the next steps needed to advance the LPA through the overall project development and approval/implementation process. The purpose of this chapter is to summarize the federally guided project development process and highlight known issues related to the LPA that will require further analysis and refinement.

2. Existing and Future Conditions

This chapter describes existing and future conditions in the corridor and provides an overview of current and projected demographic and travel characteristics within the Study Area. It focuses on how the communities along the corridor are expected to evolve over the next several decades and the implications that existing and future trends will have on transportation demand and mobility. The information in this chapter provides the framework for determining the extent of transportation problems and needs in the corridor.

2.1. Population and Employment

This section describes existing and forecast demographics in the Study Area, Durham County, Orange County, and the Triangle Region as a whole.¹ The purpose of this section is to understand the magnitude of expected growth and the geography of where people will live and work. This demographic information provides an important building block for effectively developing and evaluating transportation investment alternatives.

TAZs are areas delineated by transportation officials for calculating traffic-related data and usually consist of one or more census tracts, blocks, or block groups.

Socioeconomic data for 2005 and 2035 adopted by CAMPO and DCHC-MPO were extracted from the region's travel demand model for the traffic analysis zones (TAZ) comprising the Study Area, which are depicted in Figure 2-1.² Population and employment density data presented in this section were calculated as persons per square mile and jobs per square mile, respectively.

¹ In the demographic analysis, Orange County is limited to the portion included in the DCHC-MPO Subregion.

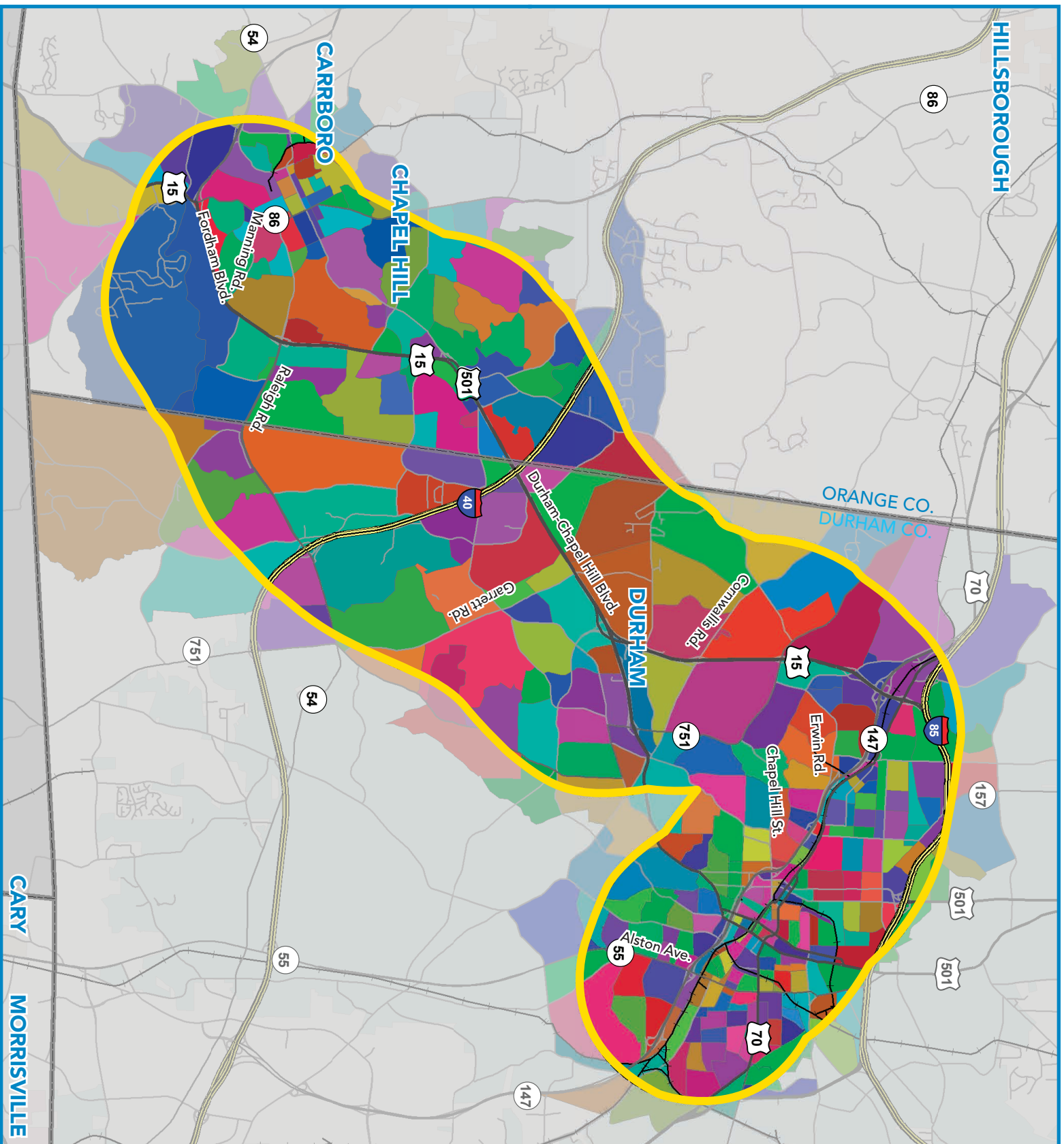
² Population and employment figures for the Study Area include portions of TAZs that cross the Study Area boundary. The actual population and employment of the Study Area may be lower than the numbers presented in this section

FIGURE 2-1
STUDY AREA
TRAFFIC ANALYSIS
ZONES (TAZs)

LEGEND

- Study Area
- Interstate
- US Route
- NC Route
- Local Road
- Railroad

NOTE: Colors illustrate geography of TAZs only.

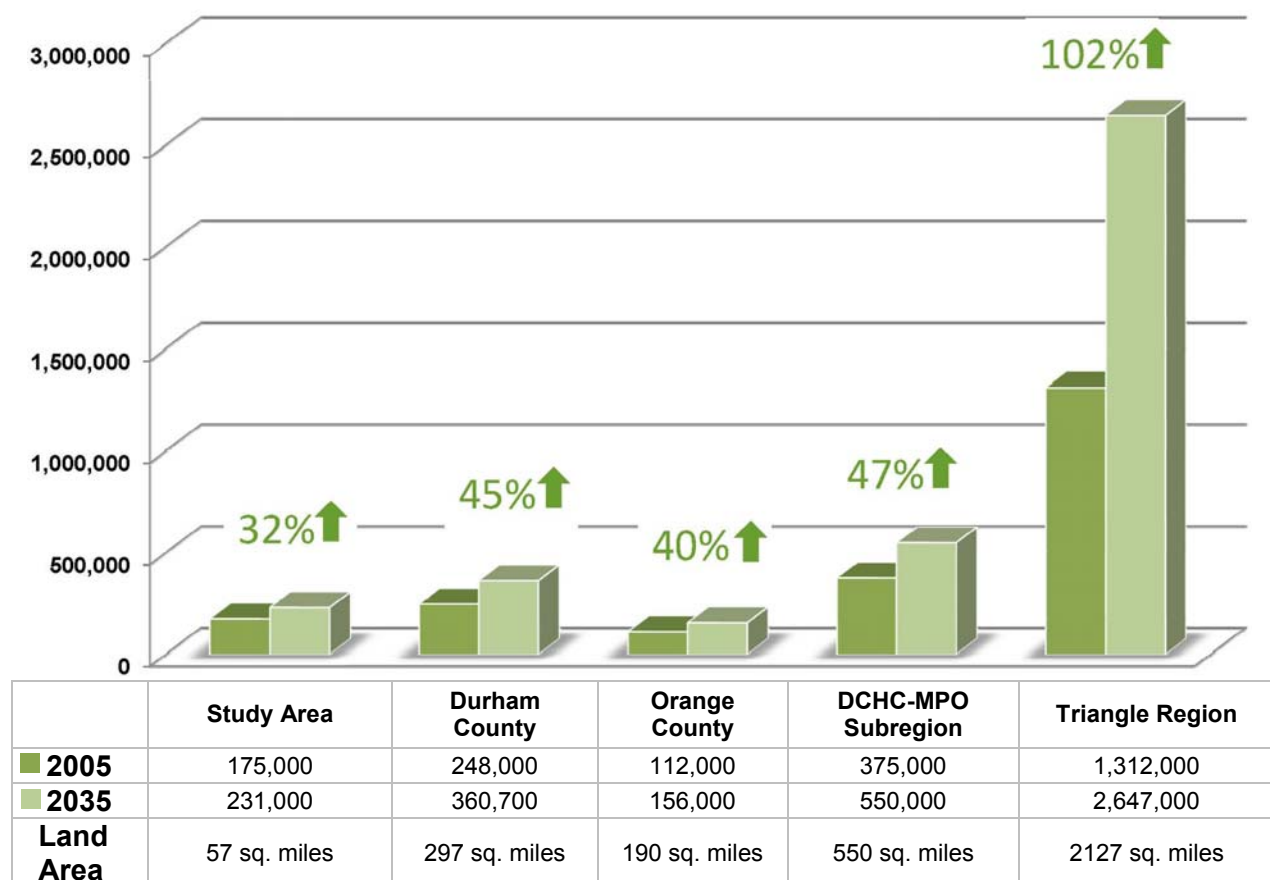


2.1.1. Population

The Triangle Region as a whole has experienced tremendous population growth in recent decades, and this trend is expected to continue through 2035. Table 2-1 presents the population for the Study Area, Durham County, Orange County, the DCHC-MPO Subregion, and the Triangle Region for 2005 and 2035.³ Home to 1.3 million people in 2005, the Triangle Region is forecast to reach just over 2.6 million by 2035, an average annual increase of 4.5 percent. As noted in the 2035 LRTP, this growth trend is consistent with a larger national trend, where two-thirds of all population growth is predicted to occur in “megaregions,” the fastest-growing of which are located in Sunbelt areas like the Triangle.⁴

While population forecasts in many U.S. metropolitan regions are being reevaluated due to the recent economic recession and sluggish recovery, population growth has continued at a rapid pace in the Triangle Region. In fact, U.S. Census Bureau estimates indicate that for the period of July 2008 to June 2009, in the midst of the deepest economic recession in generations, the Durham-Chapel Hill Metropolitan Statistical Area (MSA) increased in population by 2.1 percent. This places the MSA 27th among 366 census-defined areas, and eighth among metropolitan areas of at least 500,000 people. This data clearly reflects the enduring economic strength and attractiveness of the Region, and confirms the reasonability of the Region’s long-term population forecasts.

Table 2-1 Existing and Forecast Population



³ Source is the Triangle Regional Model. Model base year is 2005 and forecast year is 2035.

⁴ 2035 Long Range Transportation Plan, CAMPO and DCHC-MPO.

Steady growth is expected in the DCHC-MPO Subregion. By 2035, the region is expected to be home to an additional 174,000 residents; 32 percent of these new residents, or just over 56,000 people, will be located within the Study Area. With 32 percent of the Subregion's population growth concentrated in only 10 percent of the land area, the Study Area will clearly be the most heavily traveled corridor in Durham and Orange County in 2035. Reasons for this growth include the area's strong economic base driven by the Research Triangle Park (RTP); the educational institutions of Duke University and the University of North Carolina (UNC) at Chapel Hill and their respective hospital centers; proximity to Raleigh-Durham International Airport; and a diversity of residential settings that offer a high quality of life. The Durham-Orange Corridor Study Area contains Duke University and UNC; the portion of the corridor in southwest Durham is close to RTP.

Existing and forecasted population density in the Study Area is an important consideration, as it illustrates transit ridership potential in densely populated locations. Figure 2-2 illustrates the population density of the Study Area in 2005 and 2035. Growth will be concentrated within Chapel Hill and the westernmost sections of Durham closest to Chapel Hill and Interstate-40 (I-40). Much of this growth can likely be attributed to increased residential development for employees and students at UNC to keep pace with rising student enrollment; in 2007 the University had just over 28,000 matriculated students and by 2017 total enrollment is projected to reach 33,000 students, a net increase of 17.3 percent.⁵ Moving toward Durham, increased residential development, including the proposed Leigh Village, which is envisioned as a potential Suburban Transit District in Durham's future land use plans, is also likely to absorb some of this residential growth, as well as commercial development. Downtown Durham is also continuing to evolve. While already home to a significant number of jobs in government, hospitality, and banking, several new development projects from \$10 to \$200 million are in the pipeline, and downtown's renaissance is spurring infill development in adjacent neighborhoods as well.

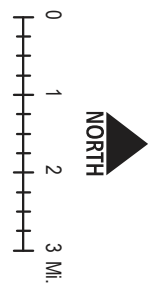
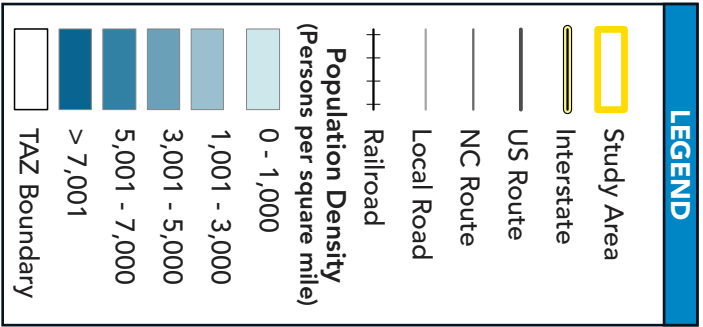
Transit-Dependent Populations Transit-dependent populations were identified in the Study Area using an index that identifies the percent of the total population that is younger than 18 years old, is older than 65 years old, lives in a zero-car household, or has incomes below the poverty level within the Study Area relative to Durham-Orange County.⁶ Figure 2-3 indicates that a significant percentage of the Study Area contains concentrations of transit-dependent persons equal to or slightly greater than Durham and Orange County as a whole. The highest concentrations of transit-dependent persons are located mostly around downtown Durham, along the NC 55 corridor, and in south Carrboro and northern Chapel Hill (near the I-40 corridor). The areas with high concentrations of transit-dependent persons in downtown Durham include the area surrounding Duke University, Duke Medical Center, the Veterans Affairs (VA) Medical Center, and the areas south of NCCU, north of I-85 between US 501 and US 501 Business, and north of NC 98 and west of US 70. These areas contain student populations (who may not have cars), families with children, and persons with incomes below the poverty level. The areas north and south of Chapel Hill have a higher population of people younger than 17 years of age.

Transit-dependent riders rely on transit as their primary mode of transportation. Typical demographic groups include persons who do not own at least one vehicle, youth, seniors, and persons below the poverty level.

⁵ Space Planning for the Master Plan, University of North Carolina at Chapel Hill, November 2008.

⁶ Methodology adapted from the Environmental Justice Index found in NCHRP Report 532, "Effective Methods or Environmental Justice Assessment." Transportation Research Board, 2004.

FIGURE 2-2
 EXISTING (2005) AND
 FORECAST (2035)
 POPULATION DENSITY



APRIL 2012

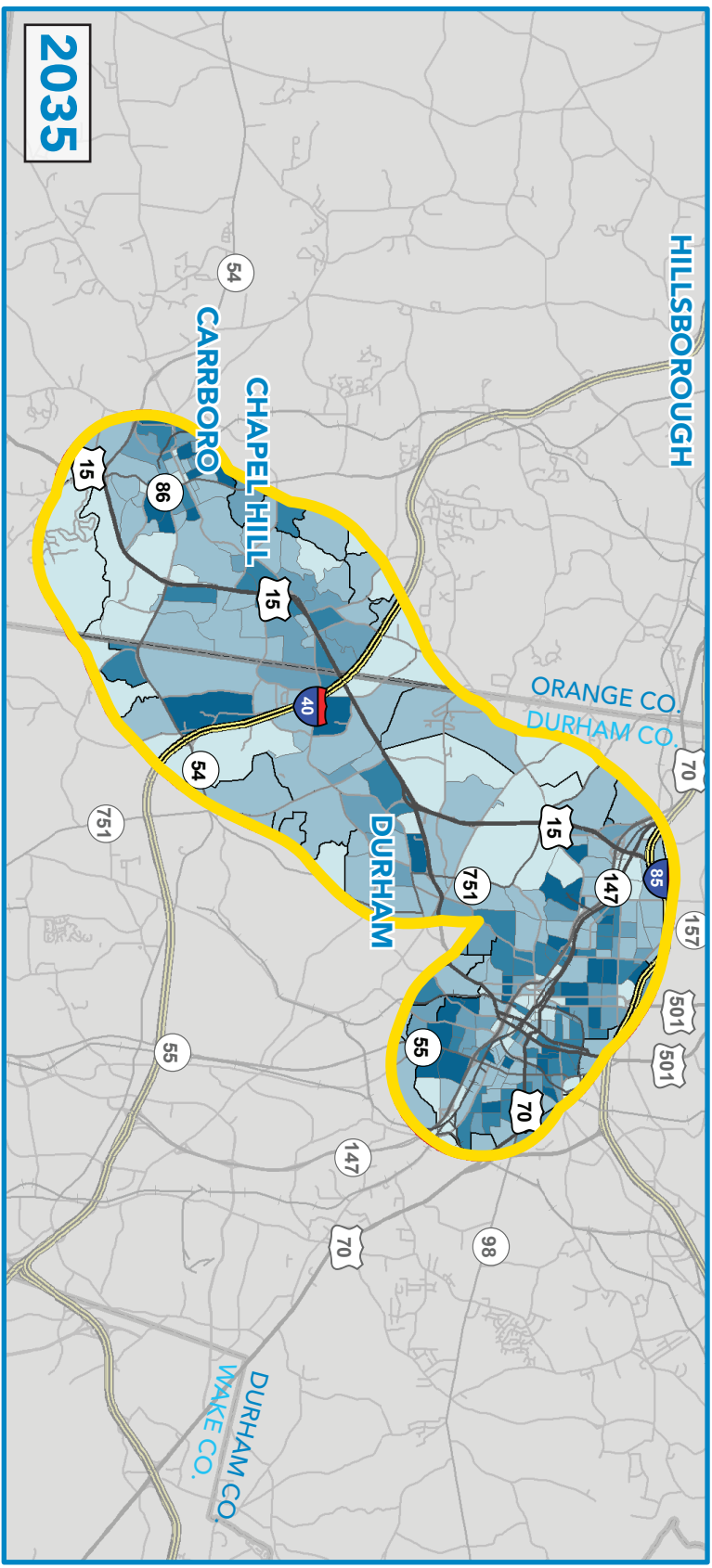
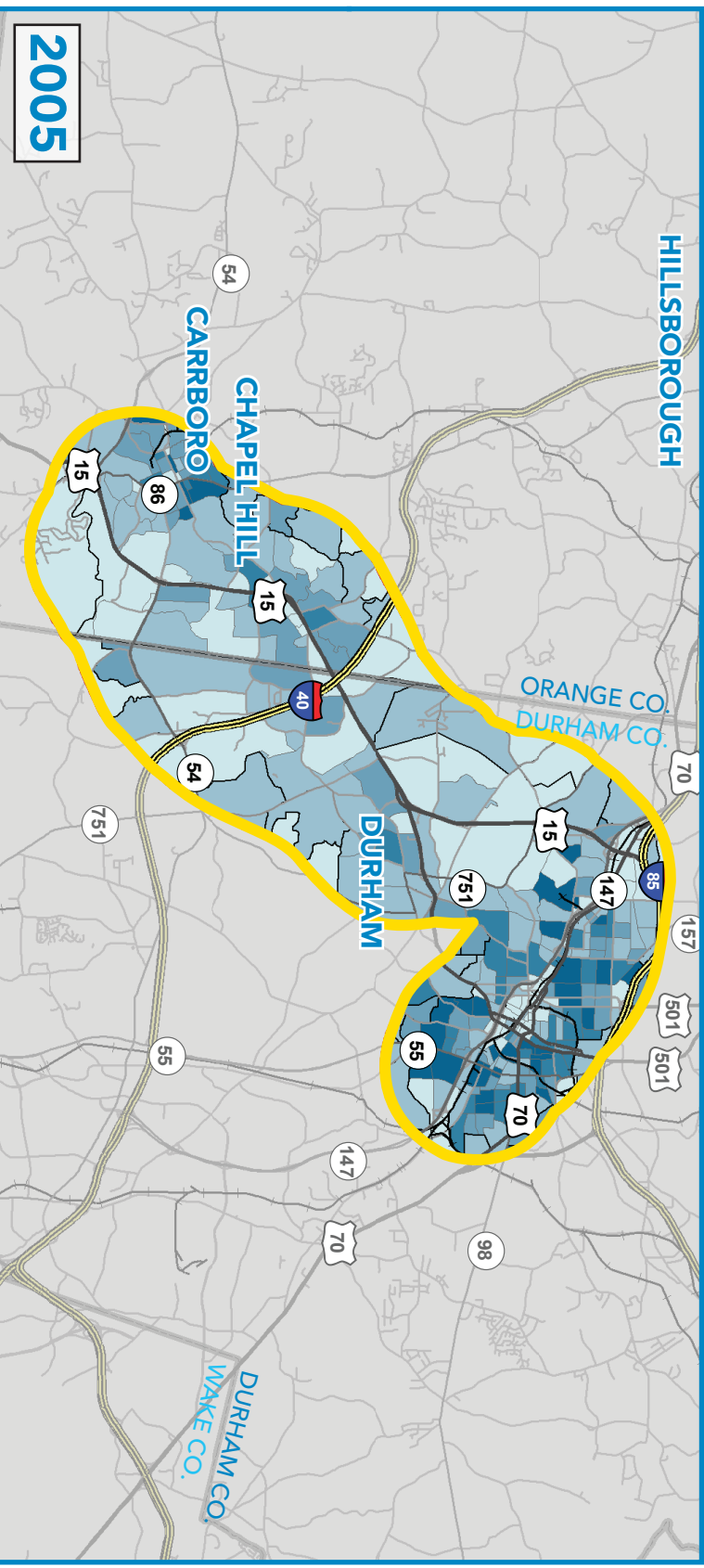
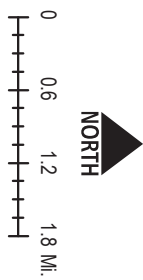
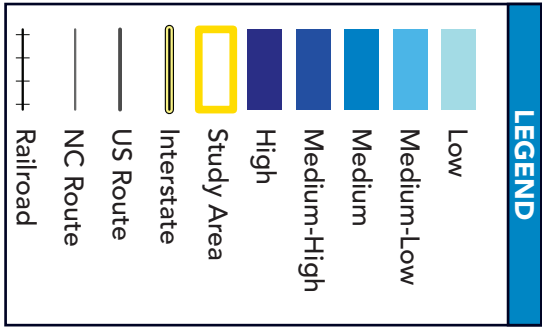
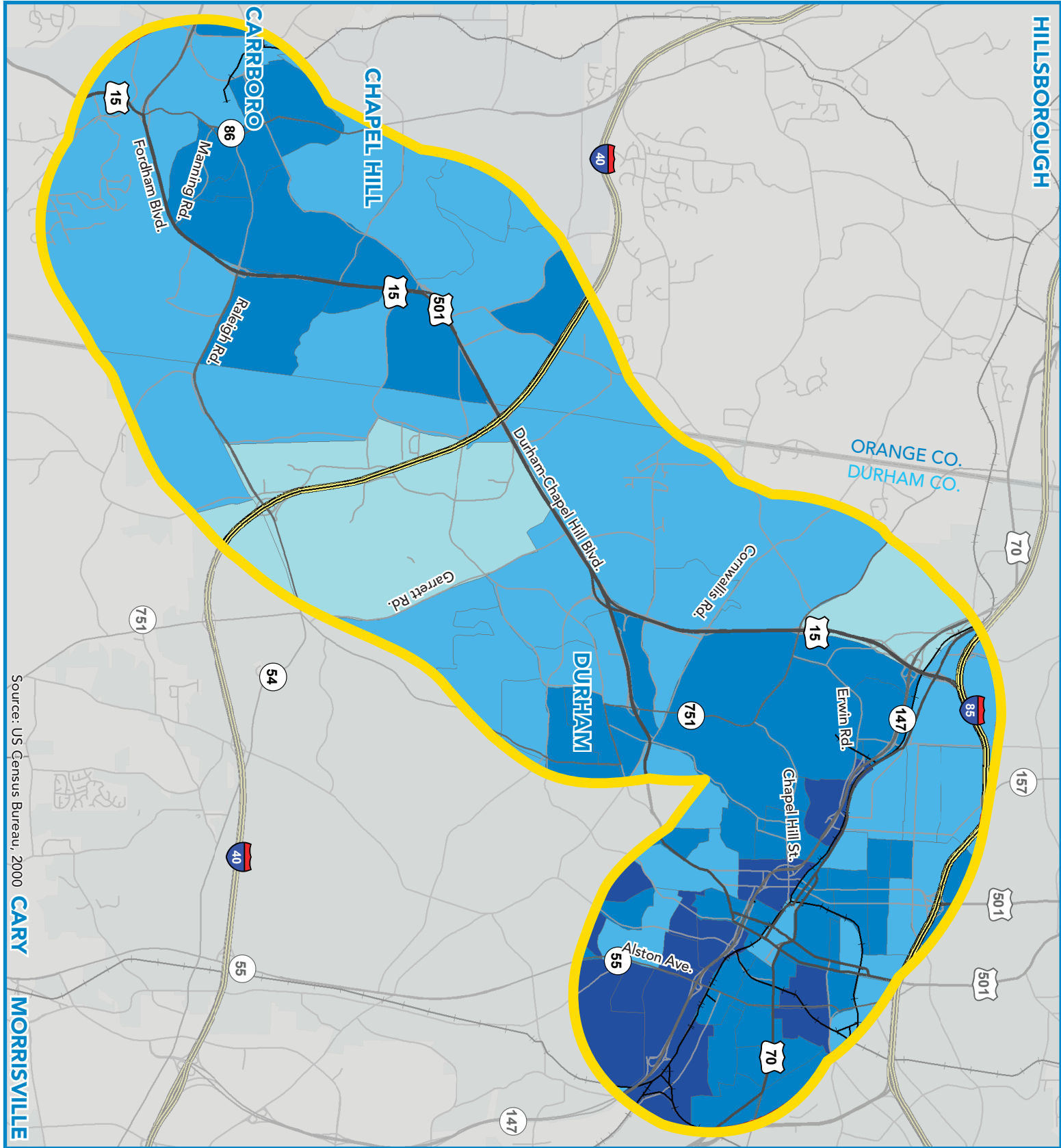


FIGURE 2-3
TRANSIT-DEPENDENT
POPULATIONS
(2000)



APRIL 2012



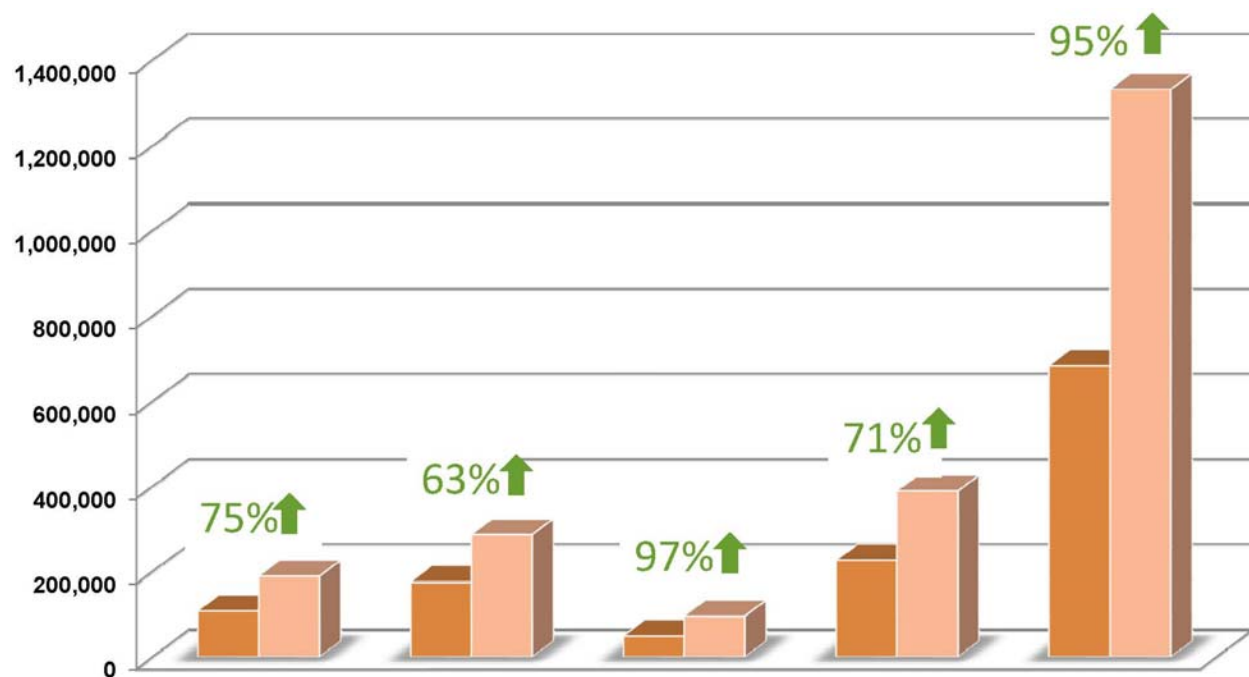
2.1.2. Employment

The Triangle Region economy is driven by major universities and their associated medical centers, the RTP, and the North Carolina State Government. As noted in Section 2.1.1, despite the challenging economic climate, the region's economy has proven resilient and the growth has continued to be substantial. Table 2-2 presents the existing and forecasted employment growth in the Durham-Orange Corridor Study Area, Durham and Orange Counties, the DCHC-MPO Subregion, and the Triangle Region.

The region's strong economic position is forecast to remain strong through 2035 with the addition of approximately 649,000 jobs. Nearly 25 percent of this job growth is expected to occur in the DCHC-MPO Region, which will add an additional 161,439 jobs. The fastest growth is expected in Orange County, which will nearly double over 2005 levels, adding 47,530 new jobs.

Job growth within the DCHC-MPO Region will be highly concentrated within the Durham-Orange Corridor Study Area. By 2035, the Durham-Orange Corridor Study Area will add 80,812 new jobs, accounting for slightly over 50 percent of the new jobs in the MPO Subregion, concentrated in only 10 percent of the land area in the DCHC-MPO Subregion. The Study Area includes two of the largest employers in the Triangle - Duke University and UNC-Chapel Hill. In addition to the core campuses with thousands of students, faculty, and staff, both universities offer major quaternary (highly-specialized) care medical centers with over 15,000 employees each.

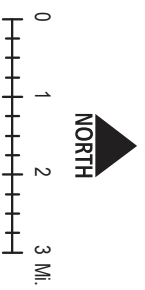
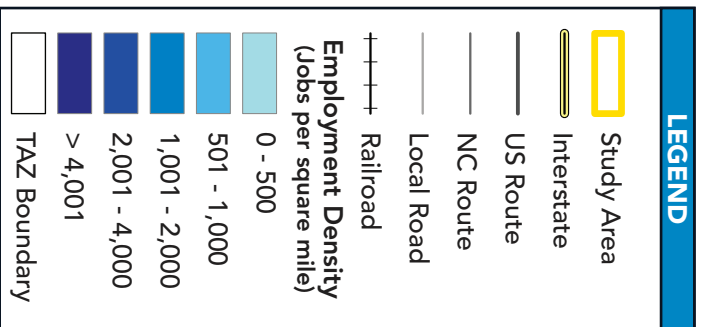
Table 2-2 Existing and Forecast Employment



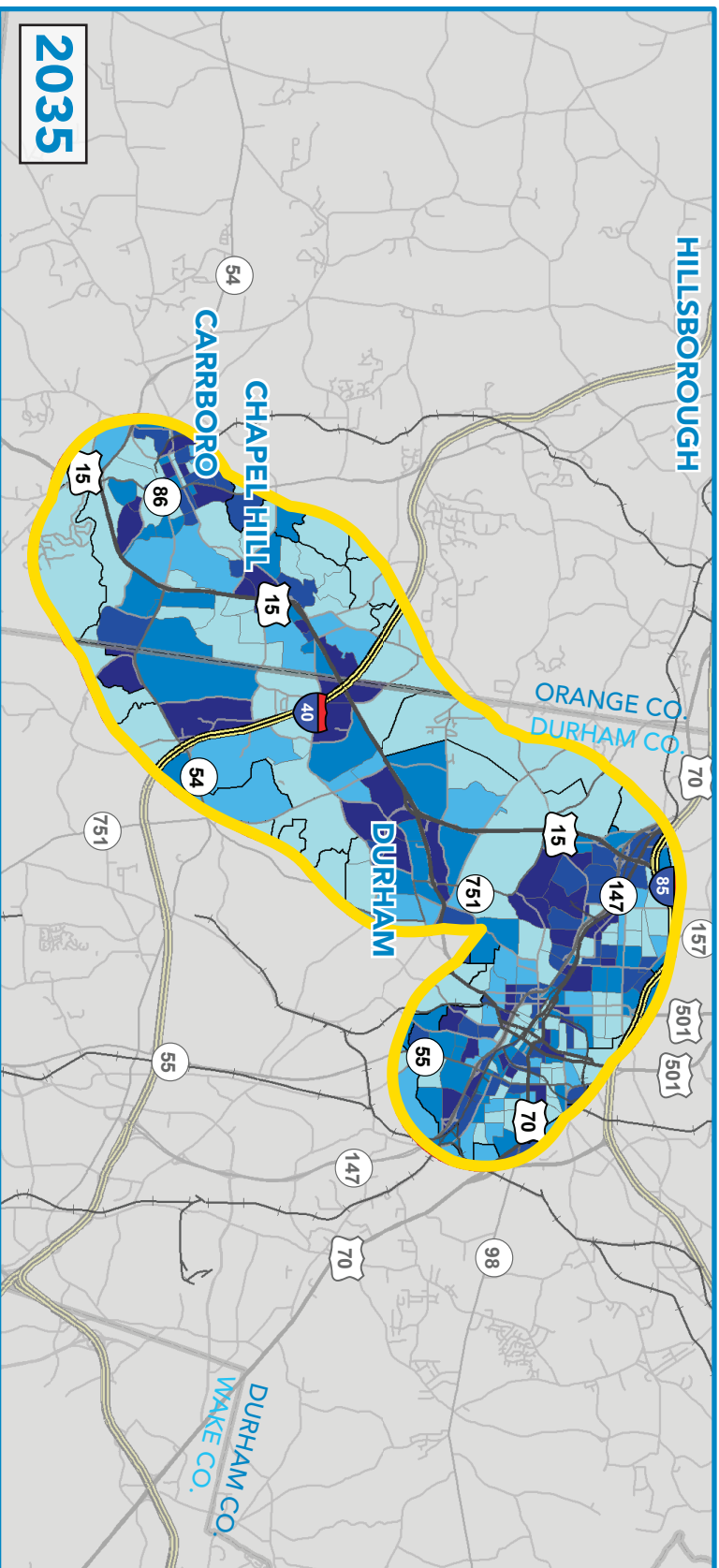
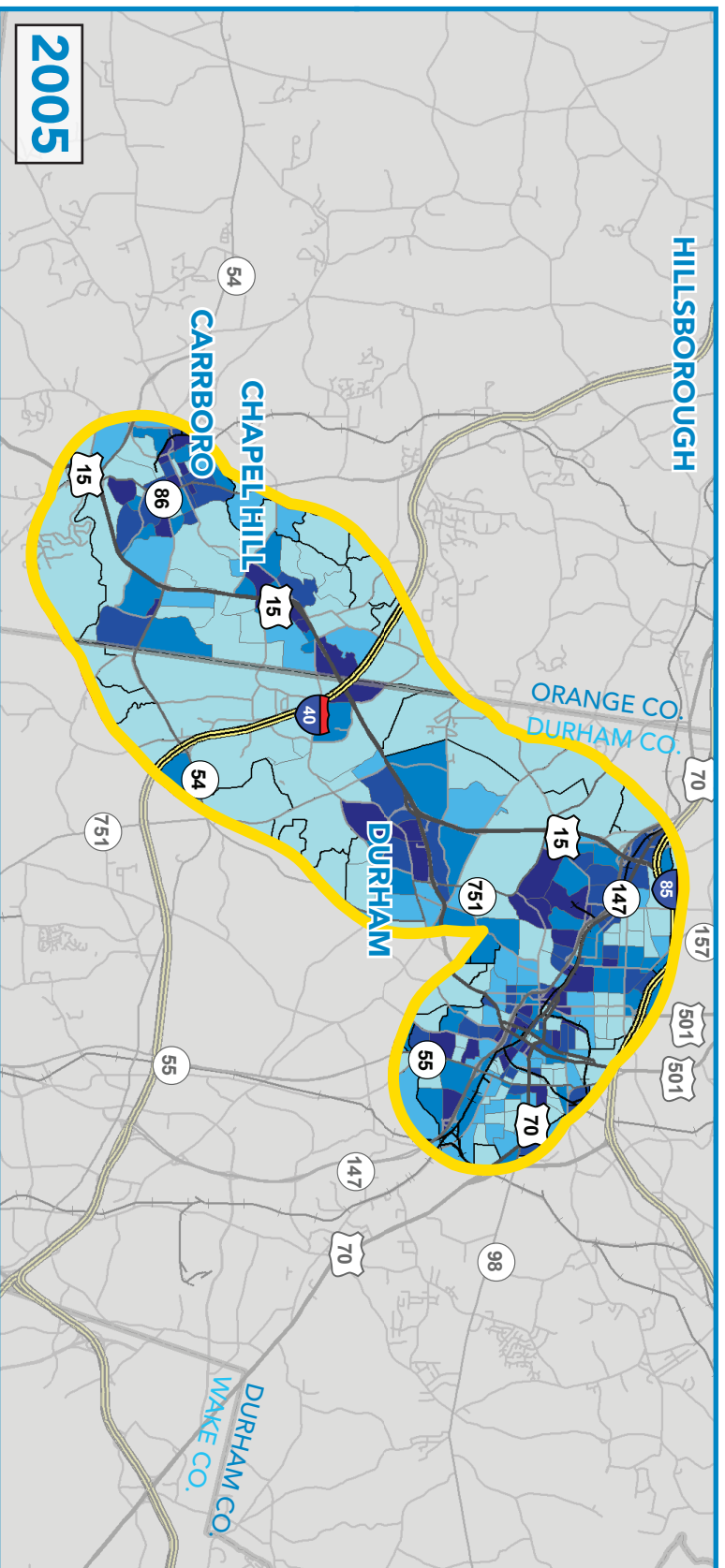
	Study Area	Durham County	Orange County	DCHC-MPO Subregion	Triangle Region
2005	108,000	176,000	49,000	227,200	683,000
2035	189,000	287,000	96,000	389,000	1,332,000
Land Area	57 sq. miles	297 sq. miles	190 sq. miles	550 sq. miles	2127 sq. miles

Existing and forecasted employment density in the Study Area illustrates the transit ridership potential in the corridor. As shown in Figure 2-4, while the two universities and downtown Durham provide three strong employment anchors and all anticipate additional jobs, significant employment growth is also anticipated in the center of the corridor near the NC 54/I-40 interchange and just east of NC 15-501/I-40 interchange.

FIGURE 2-4
EXISTING (2005) AND
FORECAST (2035)
EMPLOYMENT
DENSITY



APRIL 2012



2.2. Land Use

This section describes existing and planned land uses within the Study Area. The purpose of this section is to understand land use patterns and policies as they relate to transportation needs and as they are influenced by transportation investments. Land use patterns that are compatible with transit will promote the success of transit service by facilitating greater ridership and better access to the system. Land uses are described and illustrated by major category. This section also describes high intensity activity centers in the Durham-Orange Corridor.

2.2.1. Existing Land Use

The Durham-Orange Corridor extends 17 miles, beginning in southwest Chapel Hill and encompassing the UNC campus, downtown Chapel Hill, suburban areas along NC 54, US 15-501, NC 147 (Durham Freeway), I-40, Duke University, and downtown Durham. Table 2-3 summarizes the amount of land area by land use type. Figure 2-5 shows existing land use within the Study Area.

Table 2-3 Summary of Land Uses in Study Area by Category

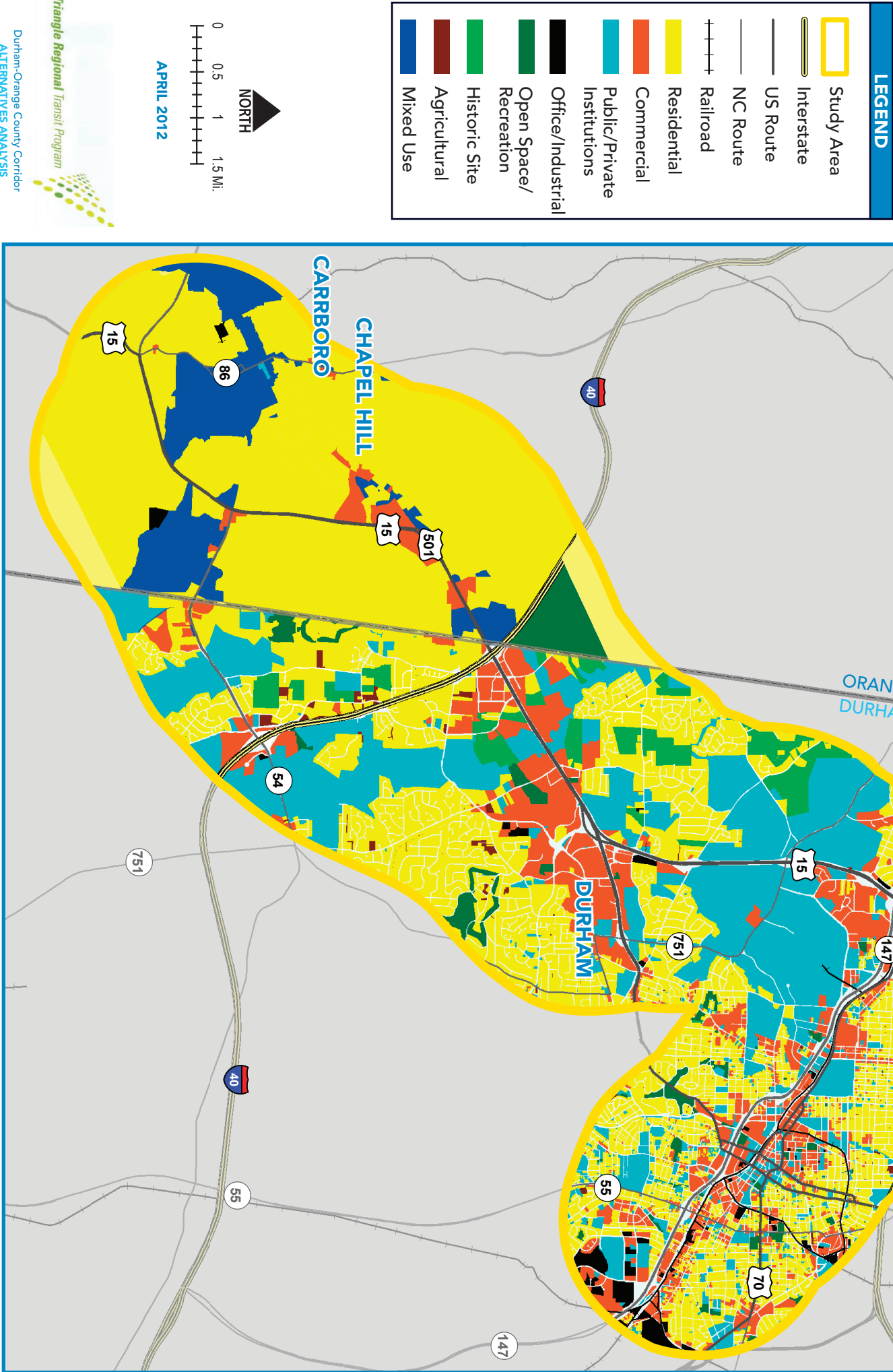
Land Use Category	Area (in Acres)
Residential	17,568
Commercial	4,175
Mixed Use	1,471
Industrial	432
Open Space/Recreation	1,206
Public/Private Institutions	9,730
Agricultural	967
Vacant	169

Source: Durham City/County Planning Department, Town of Chapel Hill, URS. Land uses in table do not include streets and railroad right-of-way, which total 864 acres.

The dominant features of southwest Chapel Hill are Southern Village, the UNC Hospitals, and the NC 54/US 15-501 Bypass. Southern Village is a large-scale smart-growth inspired residential development that contains its own town center, school, church, and a park and ride lot. The NC 54/US 15-501 Bypass provides access to Carrboro, the UNC Hospitals, and the southern edge of the UNC campus, which includes the Dean Smith Center and Kenan Memorial Stadium, key activity centers within the campus. Downtown Chapel Hill is located to the north of the UNC campus and is a mix of retail and services catering to the university population. A variety of residential housing types exist both on campus and in the areas surrounding the campus to the east and west, as well as north of the downtown. The NC 54 corridor, which leads east of the campus toward I-40, contains several mixed-use commercial developments, office complexes, Meadowmont (a 435-acre mixed-use community), the Friday Center (a UNC-operated convention/conference center) and park and ride lot, and numerous residential complexes.

The highway corridors leading from Chapel Hill into Durham include I-40, NC 54, and US 15-501. These contain a mix of suburban employment areas and special activity centers such as New Hope Commons and South Square. Further north and east along the Study Area is Duke University, Duke University Medical Center, and the VA Medical Center. The corridor then serves the medium-density mixed-use portion of Durham west of the downtown core, including the East Campus of Duke University and the

FIGURE 2-5
EXISTING LAND USE
IN THE STUDY AREA

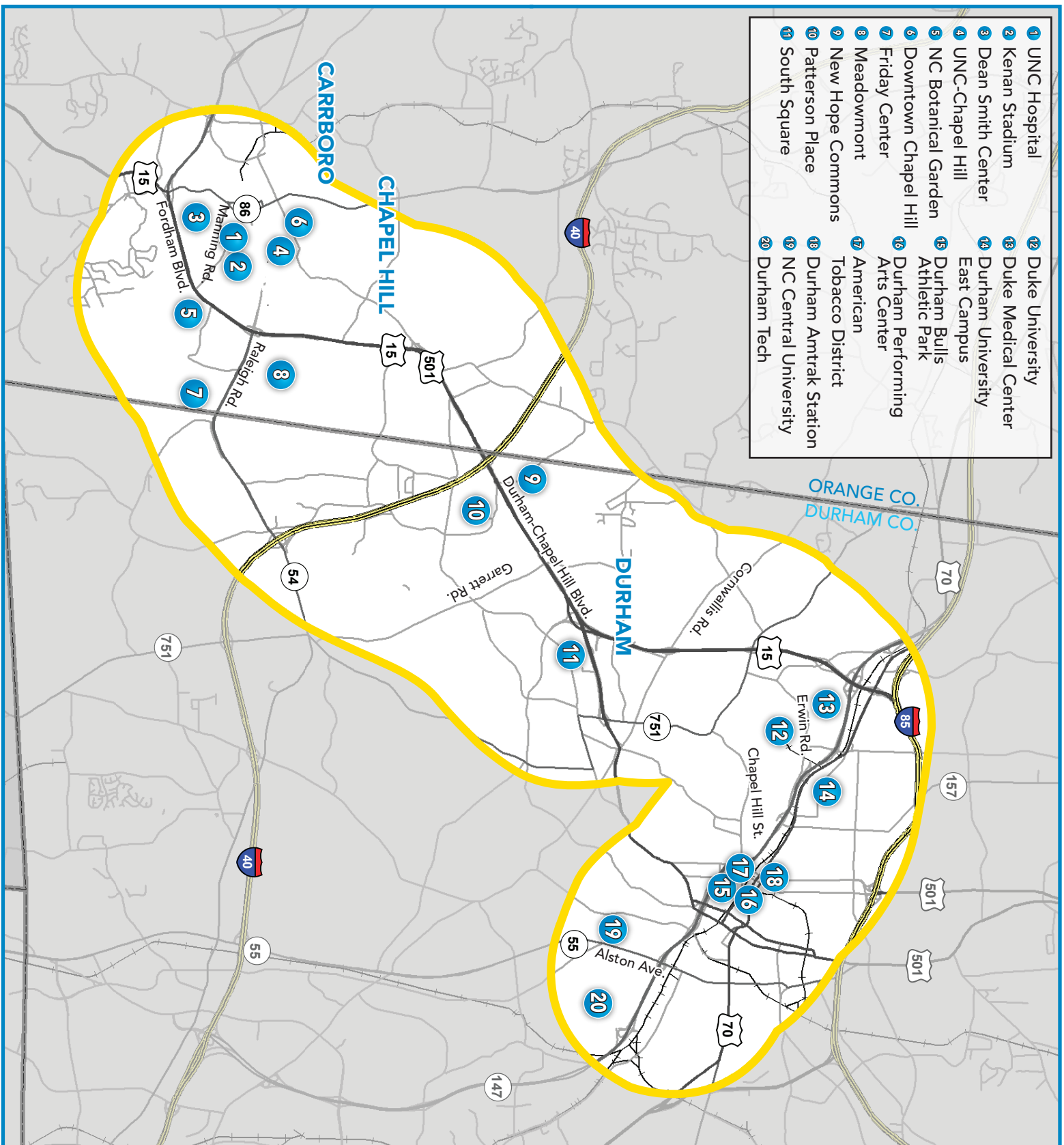
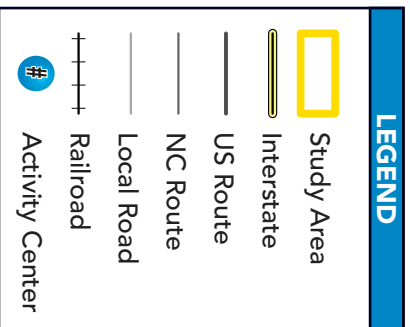


adjoining commercial area along Ninth Street. The area east of Duke University is downtown Durham; it includes the multimodal transit center, major employment concentrations, and activity centers. NC 147 is a major commuter highway that abuts the southern portion of downtown Durham and provides a link to I-40, I-85, and US 15-501. The Study Area continues to the Alston neighborhood southeast of downtown and slightly north of NCCU and west of Durham Technical Community College.

Activity centers within the Durham-Orange Corridor include a number of higher education facilities, employment centers, mixed-use areas, and retail and entertainment destinations. The locations of many of these activity centers are shown on Figure 2-6. A brief description of each major activity center follows.

- **UNC Hospitals:** Under the auspices of UNC Healthcare, UNC Hospitals operate several hospitals in Chapel Hill: North Carolina Memorial Hospital, North Carolina Children's Hospital, North Carolina Women's Hospital, North Carolina Cancer Hospital, and North Carolina Neurosciences Hospital, as well as the UNC Medical School. Combined employment for the hospitals is nearly 8,000.
- **University of North Carolina at Chapel Hill (UNC):** The current student enrollment at this public research university focusing on the liberal arts is over 28,000, and the total number of faculty and staff is just over 12,000. The school claims the title as the oldest public university in the US. Major destinations within the UNC campus include Kenan Football Stadium and the Dean Smith Center.
- **Downtown Chapel Hill:** Located immediately adjacent to the UNC campus, the central focus of downtown Chapel Hill is Franklin Street, which is largely comprised of businesses that cater to the needs of the students, faculty, and visitors, and features bookstores, gift shops, restaurants, bars, and other retail businesses.
- **NC Botanical Gardens:** As part of the UNC campus, the Botanical Gardens aim to promote the conservation of plant species through education and research. The gardens occupy approximately 700 acres.
- **Friday Center:** The Friday Center is UNC-Chapel Hill's center for continuing education, offering adult learner courses and a continuing education conference facility. The conference center hosts more than 600 events with more than 50,000 participants annually.
- **Meadowmont:** Meadowmont, named for a Georgian Revival Estate, is an interconnected community featuring townhomes, condominiums, and single-family homes. The community also has a swim club, a 70 acre Town Park, and an elementary school.
- **New Hope Commons:** New Hope Commons is a large retail development located north of the I-40/US 15-501 Interchange. It is home to a variety of retail stores, including Wal-Mart, Best Buy, Barnes and Noble, and numerous other smaller stores and restaurants.
- **Patterson Place:** Patterson Place is a mixed-use development located east of the I-40/US 15-501 interchange. It includes apartments, condominiums, a Home Depot, Kohl's Department Store, a Duke Medicine facility, and a number of other restaurants and smaller retail stores.
- **South Square:** South Square is a large retail destination located between Chapel Hill and downtown Durham, with a variety of stores including Target, Sam's Club, K-Mart, and numerous small retail businesses and restaurants.

FIGURE 2-6
ACTIVITY
CENTERS IN THE
STUDY AREA



- **Duke University:** Duke is a private research university with more than 13,000 students enrolled in its undergraduate and graduate programs of study and over 9,000 faculty and staff.
- **Duke University Medical Center:** Duke University Medical Center is a large teaching hospital affiliated with Duke University and is a part of a larger Duke University Health System that provides a network of hospitals and medical services throughout the larger region. Other hospitals operated under the Duke University Health System include the Duke Children's Hospital and Health Center and the Durham Regional Hospital. The Duke University Medical System has over 9,000 employees and the Duke University Health System as a whole has nearly 14,000 employees.
- **Veterans Affairs (VA) Medical Center:** Founded in 1953, the Medical Center serves veterans in central and eastern North Carolina. The medical center offers extended care and rehabilitation services, mental health services, social work, and specialty care related to the needs of veterans.
- **Downtown Durham:** Centered to the north of the NC 147 (Durham Freeway), downtown Durham is home to several key destinations that include the Durham Bulls Athletic Park, the Durham Performing Arts Center, and the American Tobacco District (and entertainment complex). In addition, many public services, businesses, restaurants, and retail outlets are located here. Employment in Downtown Durham is estimated to be approximately 13,500.
- **Durham Amtrak/Transit Station:** The Durham Amtrak/Transit Station is the transfer station that provides service for Amtrak, Greyhound, Durham Area Transit Authority (DATA), and Triangle Transit services. It also provides access to the Durham Bulls Athletic Park and the American Tobacco District.
- **North Carolina Central University:** A public university that is also a historically African-American college, NCCU currently has an enrollment of more than 8,000 students.
- **Durham Technical Community College:** A technical college was initially founded in 1957 as the Durham Industrial Education Center. The university currently has an enrollment of more than 5,000 students.

2.2.2. Planned Land Use

Planning for fixed-guideway transit service has matured over the past decade, and the geographic extent, service type, and implementation timeframe have changed. Local jurisdictions, however, have had the foresight to anticipate the implementation of regional transit service. While the specifics of the proposed service have evolved, these jurisdictions have held fast to the importance of incorporating regional transit into their land use plans and regulations. Current local planning policies call for managing and focusing new growth into higher density mixed-use developments with a mutually supportive transit system.

The City/County of Durham and Town of Chapel Hill land-use plans encourage mixed-use transit supportive development. Durham City/County land-use plans call for coordinating the location of higher intensity/high-density residential and nonresidential developments proximate to public transportation. Access to employment, with less dependence on single-occupancy vehicles, is an important land use planning consideration for all communities within the corridor. The suburban area between Durham and Chapel Hill, currently served almost entirely by a highway corridor, is recognized by Chapel Hill and Durham planners as a major opportunity to manage growth in mixed-use centers served by a multimodal transportation network. Redevelopment and revitalization of the downtown cores and adjacent mixed-use neighborhoods are also key policies for local jurisdictions.

Chapel Hill and Durham both have included transit-oriented development concepts and/or ordinances into their respective planning documents. The intent behind transit-oriented development standards is to concentrate high-density residential developments and connect the various activities centers.

Relevant land use and transportation plans are listed and summarized in Table 2-4.

Table 2-4 Land Use and Transportation Plans and Policies

Plan/Sponsor	Adoption Year	Overview	Relationship to Transit Plans
Town of Chapel Hill/Town of Carrboro/Orange County			
Joint Planning Agreement/Orange County, Town of Chapel Hill, Town of Carrboro	1987	The agreement designates a Joint Planning Area adopted by Chapel Hill, Carrboro, and Orange County where coordinated planning for Land Uses on the Urban/Rural fringe would occur, including the preservation of a Rural Buffer into which water/sewer would not be extended.	By limiting residential growth in watershed and rural areas in Orange County, greater pressure for residential growth is focused on redeveloping within the towns in southern Orange County, close to the highest levels of existing and planned transit service.
Downtown Chapel Hill Small Area Plan/Town of Chapel Hill	March 2000	The plan sets the goal of maintaining downtown Chapel Hill as the focal point for all civic and cultural functions. The plan also identifies aesthetic requirements and changes in land use that will promote and support existing businesses, as well as keep the area attractive for new businesses.	Supports development of a regional fixed-guideway rail system and transit stops that will serve downtown. Also discusses the need to systematically study and evaluate the need for, and possible locations of, a bus system transfer facility in downtown Chapel Hill.

Plan/Sponsor	Adoption Year	Overview	Relationship to Transit Plans
Planning for Chapel Hill's Future: The Comprehensive Plan/Town of Chapel Hill	May 2000	The plan has the overarching goal of conserving and enhancing those elements that define Chapel Hill's special community character and the heritage of Chapel Hill's historic neighborhoods. The plan also cites the importance of coordination between UNC and the UNC Hospitals.	The plan defines changes that need to be made to reduce auto dependency and develop a more balanced system. Relevant planning concepts recommended in the plan include integrated land use and transportation planning, as well as increased use of local and regional fixed and non-fixed route transit, including an expanded park and ride system.
Chapel Hill and Carrboro 2035 Long Range Transit Plan/Town of Chapel Hill, Town of Carrboro, University of North Carolina at Chapel Hill	September 2009	Study assess the impact of future growth in population, employment, and travel demand; identified the role of public transit in mitigating future congestion and potential roadway expansions; and suggested land use policies and guidelines that support and complement the viability of the transit system.	Plan recommends introduction of higher capacity transit service along six gateway corridors; expansion of local bus service to support gateway services; and further study of impact of parking policies and land use policies to support transit growth. Plan anticipates implementation of regional light rail transit connecting gateways at NC 54 and US 15-501.
Town of Chapel Hill Bicycle and Pedestrian Plan (4 th ed.)/Town of Chapel Hill	2005	Plan objectives as related to transit are: 1) to identify locations for improved facilities or engineering improvements that connect neighborhoods to existing schools, activity centers, recreational facilities and transit stops; and 2) close gaps between existing facilities and facilitate travel between neighborhoods and key employment, shopping, and recreation.	References connections to transit stops as part of the overall objectives.

Plan/Sponsor	Adoption Year	Overview	Relationship to Transit Plans
Carrboro Vision 2020/Town of Carrboro	December 2000	The plan calls for safe and adequate flow of bus, auto, bicycle, and pedestrian traffic within and around Carrboro. Recognizes that the public transit system serves to encourage non-auto travel and reduce congestion on existing roads. The Town's Land Use Ordinance and economic development policies both address traffic flow in this expanding municipality.	Recommends Carrboro collaborate with Chapel Hill and other regional entities in a comprehensive transportation plan. Recommends seamless connections among all the region's public transit systems, shorter routes, and more frequent service. Also recommends Carrboro support a passenger rail connection between the Horace Williams property, through Carrboro's downtown, and the main campus of the UNC.
Orange County Comprehensive Plan/Orange County	November 2008	The Plan serves to guide the county's growth and development through the year 2030 by addressing the multitude of issues facing the county, ranging from land use, to economic development, to housing, to public facilities, to environmental protection and beyond.	Calls for increasing bus service and designating public transportation nodes throughout the county with facilities to accommodate pedestrians.
City of Durham/Durham County			
Fayetteville Street Historic District Preservation Plan/City of Durham	August 2000	The Plan presents the history and need for the district as well the goal, policies, and recommendations needed to maintain and reestablish the historic context of the neighborhood and preserve its architectural integrity and cultural significance.	Supports efforts to create a more pedestrian- and transit-friendly atmosphere in and around the district. Discusses proposed transit station for Alston Avenue several blocks from the district potentially offering an opportunity to refocus on more pedestrian-friendly amenities.
Southwest Durham – Southeast Chapel Hill Collector Street Plan/DCHC-MPO	April 2007	Guides collector street location and design in a variety of land use types and densities, and development of the safest roadways and highest level of service possible while achieving the goal of connectivity.	Qualitative measures for the study include access function, mobility function, and transit routing. In addition, Study Area for the plan encompasses a substantial portion of the Durham-Orange Corridor.
Durham Ninth Street Plan/City of Durham	November 2008	This small area plan focuses on an important business area that supports Duke University. The plan seeks to strengthen the area by encouraging more efficient land uses and improving transportation options.	Identifies the need to improve transit services, reroute US 70 Business, improve pedestrian facilities, and evaluate parking issues.

Plan/Sponsor	Adoption Year	Overview	Relationship to Transit Plans
Central Durham Gateways Plan/City of Durham	August 2009	Plan recommends broad design improvement concepts aimed at developing an overall identity and sense of place for key gateways and corridors leading into Central Durham which include: Duke Cameron Corridor, Duke University Western Gateway, Duke & VA Hospitals Gateway, Duke University Eastern Gateway, Downtown Gateway, NCCU/East Durham Gateway, and Durham Tech/Research Park Gateway.	The Durham-Orange Corridor AA Study Area includes all of the gateways identified in the plan and the plan also assumes rail stations at Erwin Square and Alston Avenue along the existing rail corridor in Downtown Durham.
Durham Comprehensive Plan/Durham City-County	October 2009 Updated	The plan provides a guide for accommodating future growth, sets parameters for where growth should occur and what areas should be preserved, establishes a variety of land uses and community types, and establishes a method for separating conflicting land uses.	Identifies the need for compact neighborhoods around regional transit stations that would be characterized by higher intensity and mixed land uses, exceptional pedestrian and bicycle accessibility, interconnections with local transit services, a network of urban open spaces, and community design appropriate to their intensity and location.
University Plans			
UNC Campus Master Plan Update/UNC	March 2006 Updated	The Plan emphasizes historic preservation, an environmental strategy, and open space planning. Focusing on these key areas, the Plan devises ways to improve the streetscape and pedestrian safety, maximize land use efficiency, accommodate growth, and improve transportation options.	The parking plan developed for the 2001 Plan assumed that fixed-guideway transit (rail or bus) would enter the campus from Durham or RTP and connect to other local transit services. A transit corridor was dedicated for this purpose. The corridor starts at Fordham Boulevard, just east of Mason Farm Road, and terminates in the area of the UNC Hospitals.

Plan/Sponsor	Adoption Year	Overview	Relationship to Transit Plans
Carolina North Plan/UNC	September 2007	Carolina North is a proposed research and mixed-use academic campus that will cover 250 acres, approximately 2 miles north of the existing UNC campus. The Plan presents the vision and need for the development and outlines the plan development process. It presents planning concepts that are defined by several key characteristics that include supporting transit-oriented development; providing appropriate local connections for bike, pedestrian, transit, and roadways; and designing for efficient land use with appropriate density.	The development is conceived as a transit-oriented campus. The plan acknowledges fixed-guideway transit serving the main UNC campus and downtown Chapel Hill from Durham via the US 15-501 corridor and from the east along I-40/NC 54, and notes the critical need for regional transit.
Duke University Master Plan – Action Plan/Duke University	2010 Update	The focus of the Action Plan is on improving the landscaping of the existing campus grounds and to beautify and protect the existing grounds.	Addresses relatively minor changes to parking facilities, roads, and pedestrian facilities on and near the campus.
North Carolina Central University 2007 Campus Master Plan Update/North Carolina Central University	2007	The Plan develops strategies and an implementation plan for addressing projected growth and meeting several goals and objectives such as reorganizing campus into coherent precincts, redirecting growth within a neighborhood context, addressing campus parking shortage, and addressing traffic on Fayetteville Street.	Highlights the need for existing Durham Area Transportation Authority Route 14, which currently serves as the Campus Shuttle, to directly serve the proposed Cecil Street Parking Garage. Next steps include continued coordination with the City of Durham and Durham Area Transportation Authority to enhance transit access for the campus community.

2.3. Transportation Network

This section examines the existing and planned transportation system within the Study Area. The purpose of this section is to describe the roadway, rail, and transit facilities that comprise the transportation network and to understand travel patterns within this network to highlight specific mobility issues to be addressed in the AA study.

2.3.1. Interstate and Highway Network

This section provides a description of the existing and planned interstate and highway network that parallels and bisects the corridor and describes the primary function of these major roadways in the region. It includes a discussion of recent and planned improvements.

I-40 I-40 is a major east-west interstate facility with full control of access that extends across the U.S. from the east coast of North Carolina to California. I-40 traverses the whole state providing a connection to the coast, the mountains, and other interstates. I-40 crosses through the core of the Triangle Region and RTP and provides the primary highway access to the Triangle Region from the east and west for local and regional traffic. The 2009-2015 State Transportation Improvement Program has several planned projects to improve I-40. TIP project I-4744 is currently under construction to re-sign and widen I-40 from SR 1728 (Wade Avenue) to east of I-440/US 64. Construction is scheduled to be completed in the summer of 2011. TIP project I-3306 is programmed to add lanes to I-40 from I-85 in Orange County to NC 147 (Buck Dean Freeway) in Durham County. TIP project I-5111 is programmed to add lanes to I 40 from I-440/US 64 (Exit 301) to the US 70 Clayton Bypass.

The Durham-Orange Corridor parallels I-40 in Chapel Hill between NC 54 and US 15-501, before crossing I-40 south of US 15-501.

NC 147 (Durham Freeway) NC 147 is north-south North Carolina highway facility with full control of access currently spanning from SR 2028 (T.W. Alexander Drive) south of I-40, to I-85 in Durham. Construction is currently in progress to extend NC 147 to NC 540 (Western Wake Expressway) to form the Triangle Expressway (TIP project U-4763B), which will become a toll road from NC 540 to I-40. NC 147 mostly serves local traffic, providing a highway connection between Durham and I-40 through RTP.

The Durham-Orange Corridor crosses NC 147 near Duke University and parallels NC 147 to NC 55 (Alston Avenue).

East End Connector (Proposed) The proposed East End Connector (TIP project U-0071) will provide a direct connection from NC 147 (Durham Freeway) to US 70 (Miami Boulevard) east of downtown Durham and improve US 70 from Pleasant Drive to north of NC 98 (Holloway Street). The project is still in development, with four alternatives being considered for the alignment. The proposed East End Connector will serve mostly local traffic.

The Durham-Orange Corridor crosses all four alternatives east of downtown Durham.

2.3.2. Arterial Network

This section provides a description of the existing and planned arterial network that traverses the Study Area and characterizes general arterial patterns and access. It includes a discussion of recent and planned improvements.

US 70 Business US 70 Business splits from US 70 east of downtown Durham, continues through Durham, and reconnects with US 70 west of the Orange County line. US 70 Business traverses the middle of downtown Durham serving local traffic. The Durham-Orange Corridor parallels US 70 in downtown Durham.

US 15-501 US 15 is a north-south U.S. highway that extends from South Carolina to New York. US 501 is a north-south U.S. highway that extends from South Carolina to Virginia. US 15 and US 501 are joined together, entering the project Study Area from the south, and then joining with I-85 northwest of downtown Durham before splitting north of downtown. US 501 continues north on Duke Street and US 15 continues north and remains joined with I-85. Within the project Study Area, US 15-501 functions as a link between Durham and Chapel Hill. TIP project U-4012, which is under construction and nearing completion, added a northbound and southbound lane between Mt. Moriah Road and SR 1116 (Garrett Road) and added an additional right-turn lane in the southeast quadrant of the interchange at I-40 (Exit 270). TIP project U-5304 is planned to add sidewalks, wide outside lanes, and transit accommodations on US 15-501 from NC 86 (South Columbia Street) to SR 1742 (Ephesus Church Road). TIP project U 2807, which is currently unfunded, is programmed as a major corridor upgrade from I-40 to the US 15-501/US 15-501 Business split near South Square. US 15-501 is identified in the Strategic Highway Corridor initiative as part of Corridor 39 (Sanford to Durham) and as a facility needing upgrades.

The Durham-Orange Corridor parallels US 15-501 from Mason Farm Road to NC 54 in Chapel Hill and from I-40 to south of NC 147 in Durham.

US 15-501 Business US 15-501 Business branches from US 15-501 west of downtown Durham and continues through downtown Durham to I-85/US 15 where US 15 Business ends and US 501 Business continues north on Roxboro Street. The Durham-Orange Corridor crosses US 15-501 Business east of where it splits with US 15-501 near South Square and in downtown Durham, north of NC 147 (Durham Freeway).

NC 54 NC 54 is an east-west North Carolina route with no control of access that extends from Raleigh to Burlington and travels through Cary, Morrisville, RTP, and Chapel Hill. NC 54 serves local and some regional traffic in the Triangle and provides an alternate route to I-40 for drivers traveling between Chapel Hill, RTP, and Raleigh. The Durham-Orange Corridor parallels NC 54 from Mason Farm Road to I-40 in Chapel Hill.

NC 55 NC 55 is a north-south North Carolina route that extends from Oriental to Durham. NC 55 crosses through the western Triangle area, including Durham, RTP, Morrisville, Cary, and Apex, serving mostly local traffic within the project Study Area. TIP project R-2906, which is currently unfunded, is planned to widen NC 55 to multilane from US 64 in Wake County to SR 1121 (Cornwallis Road) in Durham County. TIP project U-3308 will replace the railroad bridges and widen NC 55 (Alston Avenue) to a four-lane divided facility from NC 147 to US 70 Business/NC 98 (Holloway Street). The Durham-Orange Corridor terminates east of NC 55 (Alston Avenue) in downtown Durham.

SR 1320 (Erwin Road) Erwin Road is a secondary road beginning at NC 751 (Cameron Boulevard) traveling along the west and north sides of Duke University West Campus to NC 147 where it turns into Ninth Street. Erwin Road is five-lane facility that serves local traffic in Durham. The Durham-Orange Corridor includes Erwin Road.

2.3.3. 2035 LRTP Roadway Projects

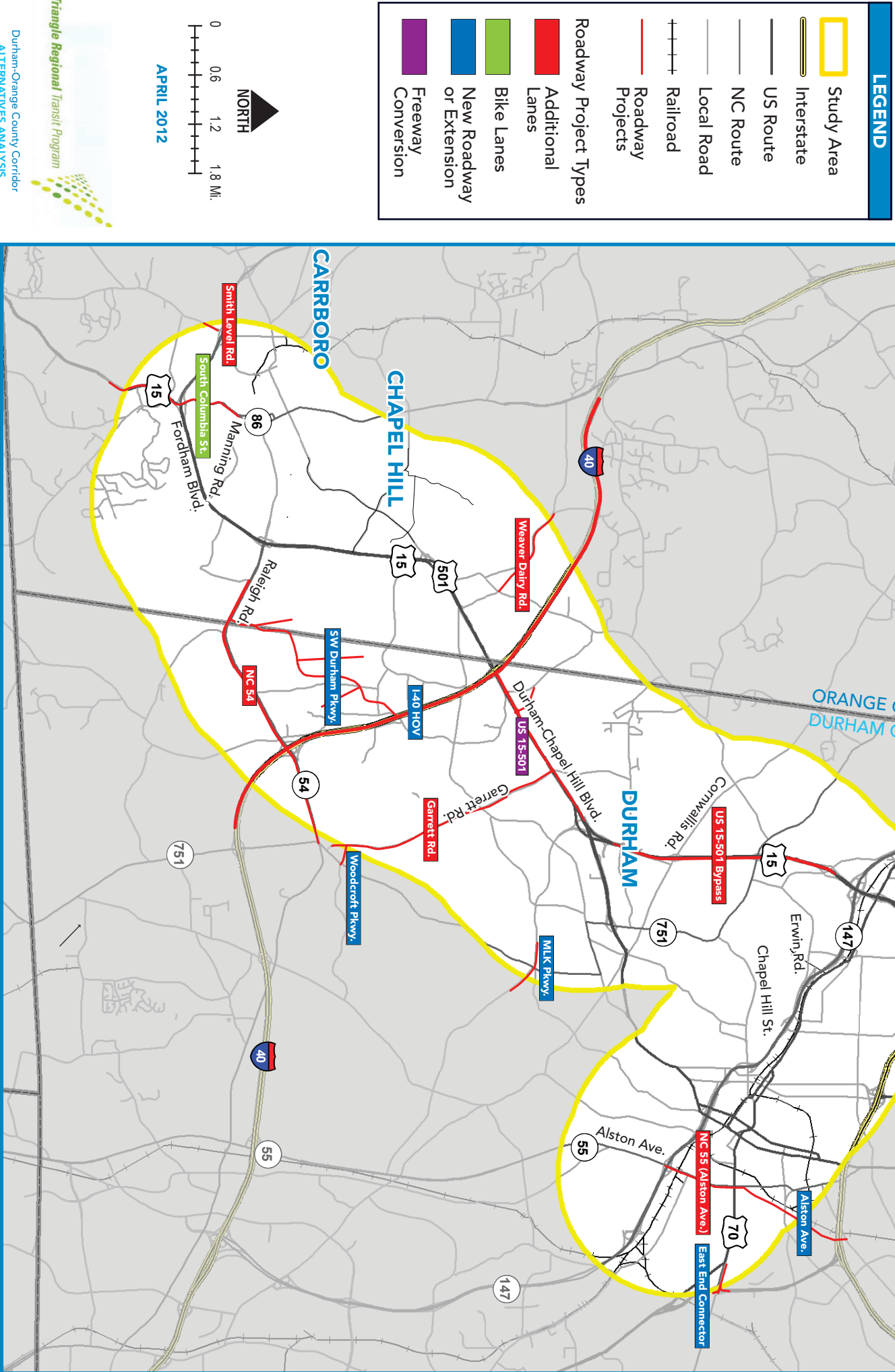
Table 2-5 and Figure 2-7 summarize the programmed roadway improvement projects in the current fiscally constrained 2035 LRTP that are located within the Durham-Orange Corridor Study Area.

Table 2-5 2035 LRTP Roadway Projects in Durham-Orange Corridor

Road Name	Project Limits	Completion Year
Project Type: Add Lanes		
I-40	US 15-501 to NC 86	2035
US 15-501 Bypass	Pickett Rd to Morreene Rd	2035
NC 54	I-40 Interchange to NC 55	2025
NC 55 (Alston Ave)	NC 147 to NC 98	2017
NC 54	I-40 to Barbee Chapel Rd	2025
Garrett Rd	NC 751 to US 15-501	2025
Weaver Dairy Rd	NC 86 to Erwin Rd	2017
Hillandale Rd	I-85 to Carver St	2011
SW Durham Pkwy	Watkins Rd (Old Chapel Hill Rd) to US 15-501	2017
Smith Level Rd	Rock Haven Rd to NC 54 Bypass	2017
Project Type: Upgrade (freeway conversion)		
US 15-501	Bypass to I-40	2035
Project Type: Upgrade (bike lanes)		
South Columbia St	NC 54 to Manning Dr	2017
Project Type: New Roadway		
I-40 HOV	Wake County Line to US 15-501	2035
East End Connector (EEC)	NC 147 to US70 E; US 70: EEC to NC 98	2017
Alston Ave Extension	Holloway St to Old Oxford/Roxboro	2035
MLK Pkwy (NC 55 interchange)	NC 55 to Cornwallis Rd connector	2035
SW Durham Dr	Meadowmont Dr to I-40	2025
SW Durham Pkwy	US 15-501 to Mt Moriah Rd	2025
Woodcroft Pkwy Extension	Garrett Rd to Hope Valley Rd	2025

Source: 2035 Long Range Transportation Plan, CAMPO and DCHC-MPO

FIGURE 2-7
 2035 L RTP
 ROADWAY PROJECTS
 IN DURHAM-ORANGE
 CORRIDOR



2.3.4. Transit Service Network

This section provides a description of the existing transit service network that traverses the Study Area.

Overview Chapel Hill Transit (CHT), Duke University Transit (Duke Transit), DATA, and Triangle Transit collectively provide a range of local, express, circulator, and regional fixed-route bus service throughout the Project Study Area. CHT and Duke Transit are the primary transit providers of the two largest universities in the Study Area, and Duke Transit is the sole major private transit provider, with service limited to the Duke University community. In 2008, CHT, DATA, and Triangle Transit combined operated 2.3 million vehicle service hours for fixed-route bus service with annual ridership reaching 12.1 million.⁷

In the Triangle Region as a whole, most transit trips originate or terminate within urban centers. Primary trip purposes for transit in the Triangle include home-based university (HBU) (38 percent), home-based work (HBW) (28 percent), and non-home-based (NHB) (23 percent). Reflective of this pattern, transit coverage in the Study Area, as illustrated in Figure 2-8, is highly concentrated within downtown Durham, near Duke University, and in Chapel Hill. In the area between downtown Durham and the Town of Chapel Hill, the density of service coverage decreases, with transit provided primarily by Triangle Transit.

Passenger transit facilities within the Study Area include Durham Station Transportation Center, the central hub for DATA, and several park and ride lots serving work and university trips. In general, the agency providers vary in the level of services provided, as shown in the summary of transit services in Table 2-6.

Future bus transit service improvements programmed in the LRTP focus on increased service frequencies, expanded evening and weekend service hours, new technology, and new circulator services connecting destinations within employment centers. A detailed description of existing regional and local bus service within the Study Area follows.

Chapel Hill Transit (CHT) serves the Town of Chapel Hill and has cooperative agreements to provide transit service to the Town of Carrboro (which is directly adjacent to Chapel Hill) and UNC. In total, CHT operates 33 local and express bus routes and demand-response shared-ride service within Orange and Chatham counties. The CHT service area spans 25 square miles and includes nine park and ride lots, five of which are restricted to university students and employees. The radial network extends from downtown Chapel Hill and the UNC campus. In 2008, CHT operated nearly 164,000 vehicle revenue hours, accommodating 6.3 million passenger trips, the highest of the transit providers serving the Durham-Orange Corridor Study Area.

Fixed-route service is provided seven days a week; 25 routes operate weekdays, eight routes operate Saturdays, and two routes provide limited Sunday service. In addition, late-night “safe ride” service is provided Thursday, Friday, and Saturday nights during the academic year. CHT also operates Triangle Transit Route 420.

⁷ National Transit Database, 2009. Duke University is not required to report data to NTD.

Table 2-6 Comparison of Study Area Transit Providers

	CHT	DATA	Duke Transit	Triangle Transit
Service Delivery	Directly Operated	Private Contract	Directly Operated/ Private Service	Directly Operated
Service Span				
Weekdays	5:00am – 1:15am	5:30am – 12:30am	7:00am – 2:00am	6:00am – 11:15pm
Saturday	8:00am – 6:30pm	5:30am – 12:30am	8:00am – 4:00am	7:00am – 7:00pm
Sunday	10:30am – 11:30pm (Reduced Service)	6:30am – 7:30pm	8:00am – 12:00am	No Service
Fare Structure				
Base Adult One-Way Fare	Free/\$3.00 ³	\$1.00	Free	\$2.00/\$2.50 ²
Elderly/Disabled	Free	\$0.50	Free	\$1.00/\$1.25 ²
Children	Free	Free/\$0.25 ⁴	Free	Free
Transfers	Free	\$1.00	Free	Free/\$0.50 ²
Regional Day Pass	\$4.00/\$2.00 ¹	\$4.00/\$2.00 ¹	\$4.00/\$2.00 ¹	\$4.00/\$2.00 ²
Regional 5-Day Pass	\$17.00/\$8.50 ¹	\$17.00/\$8.50 ¹	\$17.00/\$8.50 ¹	\$17.00/\$8.50 ²
Regional 31-Day Pass	\$68.00/\$34.00 ¹	\$68.00/\$34.00 ¹	\$68.00/\$34.00 ¹	\$68.00/\$34.00 ²
1-Day Pass	-	\$2.00/\$1.00 ¹	-	\$5.00 ² /\$2.50 ¹
5-Day Pass	-	\$8.50/\$4.25 ¹	-	-
Monthly Pass	\$65.00 ³	\$36.00/\$18.00 ¹	-	\$85.00 ² /\$42.50 ¹
Weekly Pass	-	\$12.00/\$6.00 ¹	-	--
Multi-Ride Pass	-	-	-	\$20.00

Source: GoTriangle.org, Chapel Hill Transit, Durham Area Transit Authority, Duke University Transit, Triangle Transit, November 2010 | 1Elderly/disabled fare | 2Triangle Transit Express Route Fare | 3PX = Pittsboro Express Route | 4Students – Age 12-17

CHT directly serves a number of activity centers within the Study Area, including UNC, UNC Hospitals, the Friday Center, and Meadowmont. In addition, CHT has four park and ride lots in Chapel Hill open to the general public, three of which are located within the Study Area. In addition, five UNC Commuter Alternative Program (CAP) lots offer permit parking for university employees and students to supplement the limited on-campus parking supply; four of these lots are located within the Study Area.

All CHT routes traverse the project Study Area for at least a portion of their trip. Recent data indicates that, on average, 17,177 passenger trips start (boardings) and 300 passenger trips end (alightings) in the Study Area. Combined, these trips comprise nearly 84 percent of average daily weekday boardings and alightings in the system as a whole.⁸ Table 2-7 lists CHT routes directly serving the Study Area weekdays

⁸ Chapel Hill Transit, November 2010.

FIGURE 2-8
TRANSIT SERVICE
ROUTE MAP

Study Area

Chapel Hill

Transit Routes

DATA

Transit Routes

Duke

Transit Routes

Triangle

Transit Routes

Interstate

US Route

NC Route

Local Road

Railroad

Transit Centers

Study Area

Chapel Hill

Transit Routes

DATA

Transit Routes

Duke

Transit Routes

Triangle

Transit Routes

Interstate

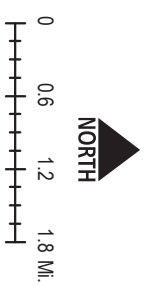
US Route

NC Route

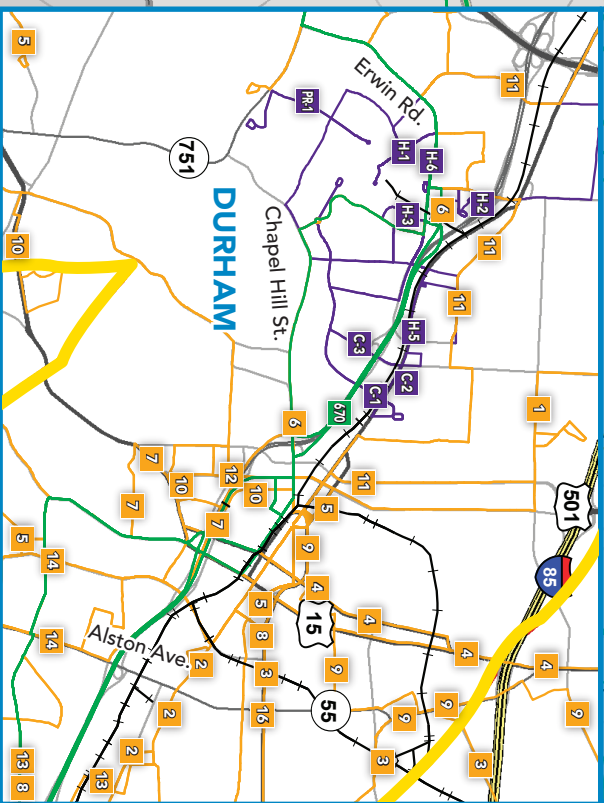
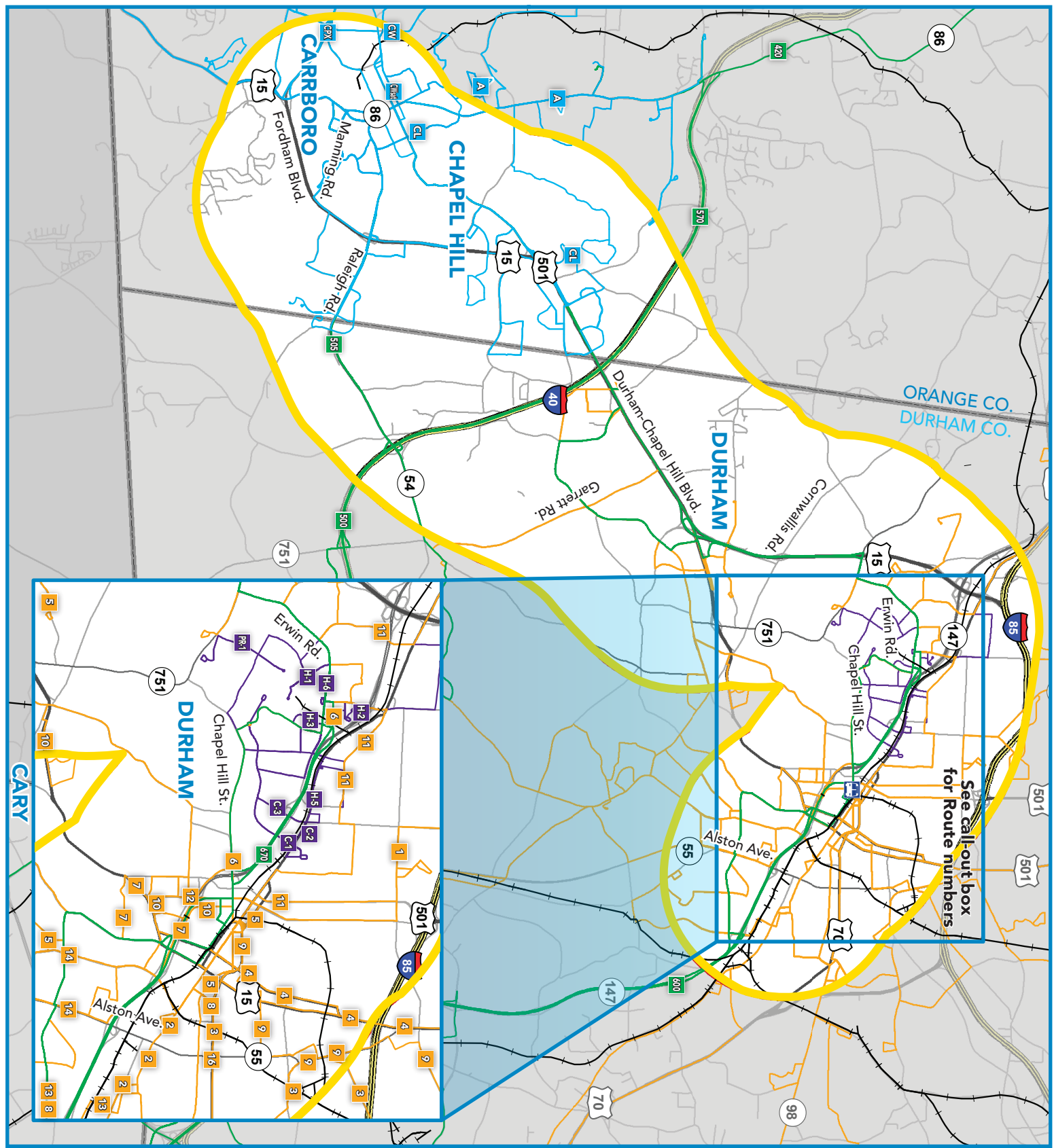
Local Road

Railroad

Transit Centers



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(there are some route variations during the weekend); routes completely contained within the Study Area are italicized.

Table 2-7 CHT Routes Serving Durham-Orange Corridor Study Area

Route #	Route Name	Peak Headway
A	Martin Luther King Jr Blvd/Northside	20 min
CCX	Chatham County Express	15 min
CL	<i>Colony Lake/Sage Road/UNC Hospitals</i>	<i>51 min</i>
CM	Carrboro/Merritt Mill Rd/Family Medicine	45 min
CPX	Carrboro Plaza Express	15 min
CW	Carrboro/Weaver St	30 min
D	<i>Culbreth Road/Franklin St/Eastowne</i>	<i>20 min</i>
DX	UNC/Old Durham/Old Sterling/Sage	40 min
F	Colony Woods/Franklin St/McDougle School	26 min
FCX	<i>Friday Center Express</i>	<i>5 min</i>
G	Booker Creek/Briarcliff via University Mall/UNC Hospitals	25 min
HS	Chapel Hill High School/Rogers Rd/ Morris Grove Elementary/ Downtown	55 min
HU	<i>UNC Hospital/NC Botanical Garden/ 54 Park & Ride/Hedrick Building</i>	<i>10 min</i>
J	Carrboro/Downtown Chapel Hill/Jones Ferry Rd	15 min
JFX	Carrboro/Downtown Chapel Hill/Jones Ferry Rd	15 min
N	Estes Park/UNC Hospitals/Family Medicine	15 min
NS	Eubanks Rd/Southern Village	10 min
NU	PR Lot/UNC Hospitals	20 min
PX	Pittsboro Express	14 min
420*	Hillsborough-Chapel Hill	26 min
RU	<i>Campus Reverse Shuttle/Law School</i>	<i>15 min</i>
S	<i>South Campus/NC 54 East Park & Ride</i>	<i>10 min</i>
T	Martin Luther King Jr Blvd/UNC Hospital	30 min
U	<i>Campus Shuttle - UNC/Downtown</i>	<i>15 min</i>
V	Southern Village/Meadowmont	30 min

Source: Chapel Hill Transit, November 2010| *Triangle Transit route operated by CHT

Duke University Transit Duke Transit is the only major private transit service provider in the Durham-Orange Corridor Study Area. Duke Transit operates a core network of 12 local bus routes that can be classified into three service types. “Campus” routes operate during the academic year and connect East, Central, North (Trent), and West Duke University campuses. “To and From Campus” routes connect campus to adjacent areas, including satellite parking. This service category includes one regional bus route, the Robertson Scholars bus, which links Duke and UNC. Students, staff, faculty, and visitors can ride campus buses at no charge. Lastly, six “Hospital” routes connect surface and garage parking to Hospital North, Hospital South, and administrative buildings. To and From Campus and Hospital routes operate year-round.

All Duke Transit routes, as listed in Table 2-8, are completely contained within the project Study Area.

Table 2-8 Duke Transit Routes Serving Durham-Orange Corridor Study Area

Route #	Route Name	Peak Headway
C-1	East-West Weekday	3-6 min
C-1/Smith	East-West via Smith Warehouse	18 min
C1-CC	East-Science Dr Class Change	45 min
C-2	East-Central-West	10 min
C-5	Duke Bull City Express	<i>Night Service Only</i>
PR-1	Bassett - Circuit - Research to Entry 11	24 min
H-1	Parking Garage 3 - Hospital North - Hospital South Entry 11	10 min
H-2	Parking Garage 3 to Hospital North Only	10 min
H-3	Hillsborough Rd - North - South Hospitals	20 min
H-5	Mill Shuttle	20 min
H-6	LaSalle Overflow Lot - Research Dr - North Hospital	12 min
LaSalle	LaSalle Loop	30 min

Source: http://parking.duke.edu/buses_vans/bus_sched/index.php, accessed November 2010

Durham Area Transit Authority DATA provides fixed-route bus service and paratransit within the City of Durham and Durham County, covering a service area of 93 square miles. In 2008, DATA operated over 170,000 vehicle revenue hours, accommodating 4.9 million passenger trips.⁹ Effective October 1, 2010, Triangle Transit manages DATA services, overseeing operations, service planning, and marketing. Under a separate contract with the City of Durham, First Transit, Inc., manages and operates the fixed-route service.

DATA directly serves a number of activity centers within the Study Area, including South Square, Duke University, Duke Medical Center, Durham Athletic Park, Durham Performing Arts Center, North Carolina Central University, and City Hall Plaza.

All 17 routes in the DATA system traverse the Durham-Orange Corridor Study Area for some portion of their trip. On average, nearly 76 percent of the 21,951 daily passenger trips in the system as a whole started (16,657 boardings) and just over 74 percent ended (16,333 alightings) within the Study Area.¹⁰ Table 2-9 lists DATA routes directly serving the Study Area; routes that are contained within the Study Area are italicized.

⁹ National Transit Database, 2009.

¹⁰ DATA Average Daily Boardings and Alightings from January 2009 through Sept 2010, accessed November 2010.

Table 2-9 DATA Routes Serving Durham-Orange Corridor Study Area

Route #	Route Description	Peak Headway
1	Northgate Mall and North Pointe	30 min
2	East Durham and Highway 70	30 min
3	Holloway Street and The Village	30 min
4	Durham Regional Hospital and N Roxboro Rd	30 min
5	Fayetteville St and South Square	30 min
6	<i>Duke University and VA Hospital</i>	<i>30 min</i>
7	Fayetteville Rd and Streets of Southpoint	30 min
8	McDougal Terrace and Durham Tech	30 min
9	Dearborn Dr and Durham Regional Hospital	30 min
10	Woodcroft and New Hope Commons	30 min
11	Duke University and Hillsborough Rd	30 min
12	Highway 55 and Highway 54	60 min
13	<i>Durham Tech and The Village</i>	<i>60 min</i>
15	Alston Ave and Brier Creek	60 min
16	Southern High School and The Village	60 min
17	Snow Hill Rd and Horton Rd	60 min

Source: Durham Area Transit Authority, November 2010

Triangle Transit Triangle Transit operates 14 regional, five express, and four RTP shuttle bus routes over a 1,525-square-mile service area spanning Wake, Durham, and Orange counties. In addition to fixed-route services, Triangle Transit provides paratransit service and leases 15-passenger vans to commuters who have one end of their trip in the region. In 2008, Triangle Transit operated nearly two million vehicle revenue hours, accommodating 939,000 passenger trips.¹¹

Primarily a commuter service, Triangle Transit has several park and ride lots across the region, four of which are located within the Study Area. Activity centers served within the Study Area include Duke University Medical Center, the Durham VA Medical Center, South Square, New Hope Commons, downtown Chapel Hill, and UNC Hospitals.

The majority of Triangle Transit's routes directly serving the Study Area perform well relative to the system as a whole. On average, approximately 37 percent of the 4,335 daily passenger trips in the system as a whole started (1,612 boardings) and 38 percent ended (1,647 alightings) within the Study Area.¹² Top performing routes in the system include the peak-hour express services traveling from Durham to Raleigh and from Raleigh to Chapel Hill.¹³ Table 2-10 lists the Triangle Transit Routes within the Durham-Orange Corridor Study Area.

¹¹ National Transit Database, 2009.

¹² Triangle Transit Average Daily Boardings and Alightings March 15, 2010, through June 30, 2010, accessed November 2010. Route 420, which is operated by CHT, is included in the CHT passenger trip counts.

¹³ Triangle Transit Short-Range Transit Plan, 2008.

Table 2-10 Triangle Transit Routes Serving Durham-Orange Corridor Study Area

Route #	Route Description	Peak Headway
CRX	Chapel Hill-Raleigh Express	30 min
400	Durham-New Hope Commons-Chapel Hill	30 min
Shuttle 42	RTP Shuttle (RTC, IBM, and RTP Headquarters)	30 min
405	Durham-Chapel Hill	30 min
DRX	Durham-Raleigh Express	30 min
100	Raleigh-Airport-RTC	30 min
700	Durham-RTC	30 min
420	Hillsborough-Chapel Hill	24-45 min

Source: Triangle Transit, November 2010

2.3.5. Railroad Network

This section describes the railroad infrastructure within the corridor, including ownership, number of tracks, passenger and freight activity, railroad facilities, roadway crossings, bridges, and a general description of railroad conditions. It also includes a discussion of recent and planned improvements. Figure 2-9 identifies the railroad/roadway crossings, overpasses, and bridges in the region.

Description of Existing Rail Corridor From UNC Hospitals, the existing rail corridor within the Durham-Orange Corridor parallels Mason Farm Road to NC 54 and extends to the east along NC 54 to I-40. The corridor then turns north and follows I-40 to US 15-501, at which point the rail corridor turns and parallels US 15-501 to the Duke University Campus, turns to the east and then continues through downtown, paralleling NC 147 to west of NC 55 (Alston Avenue) where the rail corridor ends.

No rail corridor exists between Chapel Hill and Durham; however, the existing rail corridor between Ninth Street and NC 55 (Alston Avenue) currently has eight public crossings and six overpasses/bridges.

Existing Freight Rail Service CSX Transportation operates freight on the rail line that terminates in Durham and connects to another CSX Transportation line in Apex and a short leg that extends into downtown Durham north of NC 147. The North Carolina Railroad (NCR) corridor, which stretches from Morehead City through Raleigh to Charlotte, is used and maintained by Norfolk Southern based on a trackage rights agreement. Norfolk Southern operates freight trains through the corridor and stipulates that passenger trains not impede the flow of their freight trains.

Existing Passenger Rail Service Amtrak operates two passenger trains on the NCR section of the corridor, the Carolinian from Selma to Charlotte and the Piedmont from Raleigh to Charlotte. A total of six passenger trains run daily, including the recently added midday service on the Piedmont.

FIGURE 2-9
RAILROAD/ROADWAY
CROSSINGS,
OVERPASSES AND
BRIDGES

LEGEND

 Study Area

 Interstate

 US Route

 NC Route

 Local Road

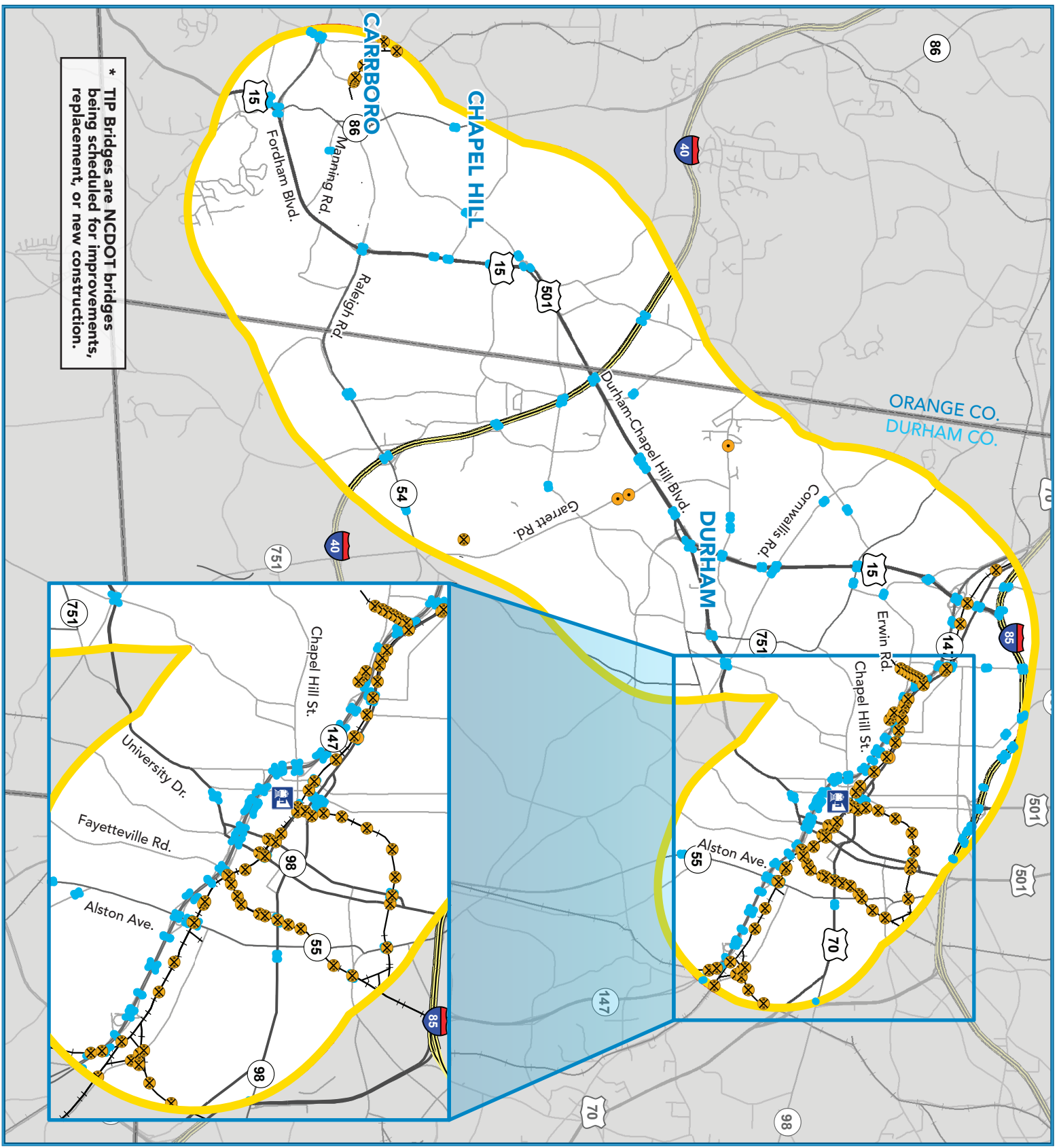
 Railroad

 Railroad Crossings

 TIP Bridges*

 DOT Bridges

 Amtrak Station

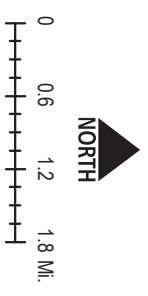
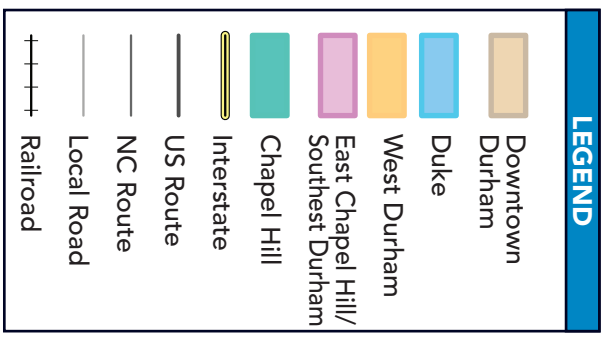


2.4. Travel Demand

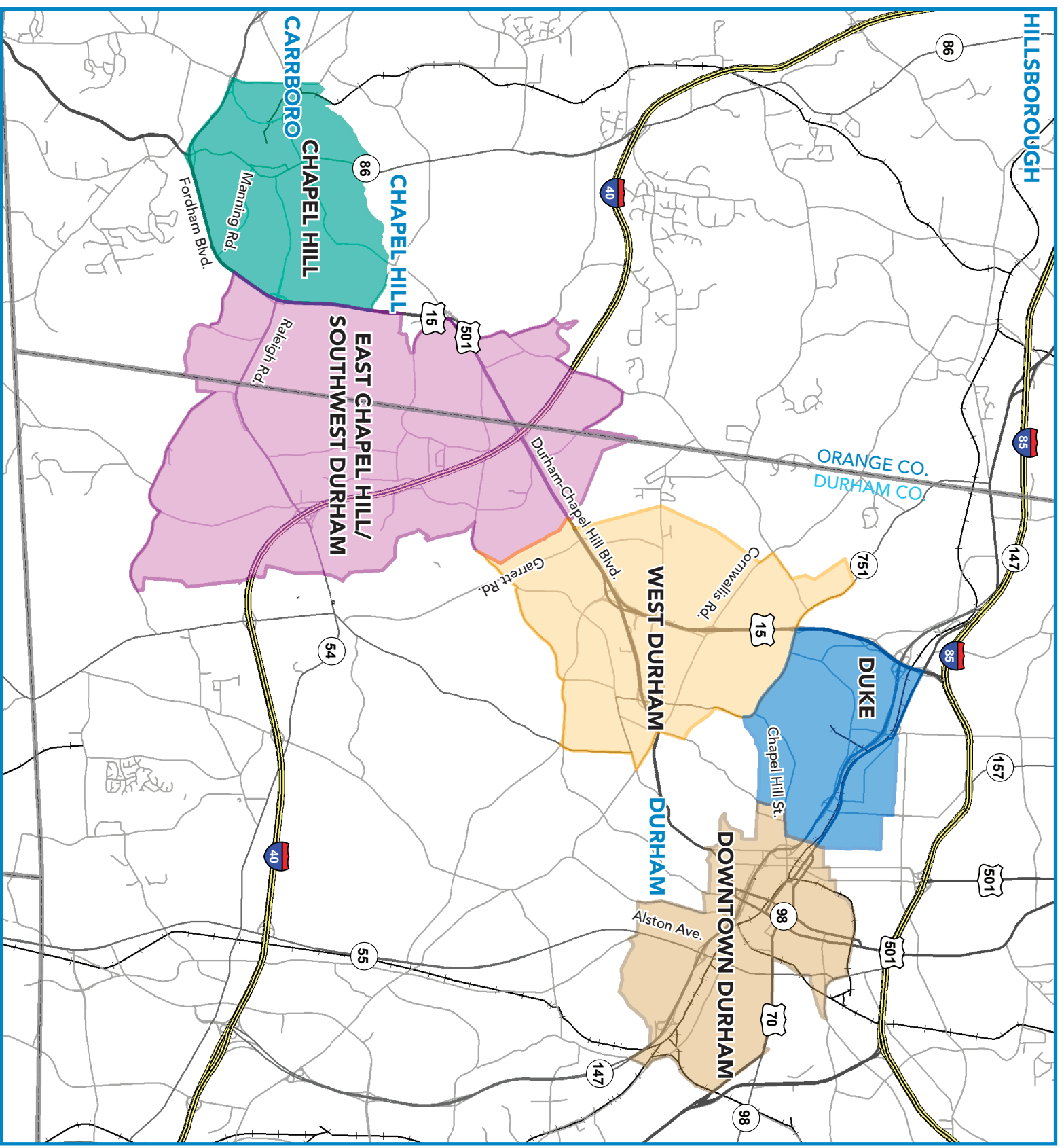
This section contains information on travel demand, daily trips, and daily trip patterns for the region, the MPO Subregion, and the Study Area. Because a trip from downtown Chapel Hill to downtown Durham is only approximately an 11-mile trip by automobile, TAZs for the Study Area were grouped into five subareas, which are shown on Figure 2-10, in order to better understand the travel demand within the Study Area and for comparison to the region and the MPO. The activity centers in each subarea are described in more detail under land use in Section 2.2. The five subareas of the Study Area are as follows:

- | | |
|---------------------------------|--|
| (1) Chapel Hill: | Includes UNC, UNC Hospitals, downtown Chapel Hill, and the area west of US 15-501 |
| (2) East Chapel Hill/SW Durham: | Includes the area enclosed by and immediately adjacent to US 15-501, the Friday Center, and mixed-use developments such as East 54, Meadowmont, and Leigh Village |
| (3) West Durham: | Includes mainly low-density retail, such as South Square, with some residential areas |
| (4) Duke: | Includes Duke University, Duke University Medical Center, the Durham VA Medical Center, and surrounding neighborhoods |
| (5) Downtown Durham: | Includes NCCU, the Durham Central Business District (CBD), the Durham Performing Arts Center, the American Tobacco Company, the Durham Bulls Athletic Park, and areas to the east around Alston Avenue |

FIGURE 2-10
DURHAM-ORANGE
CORRIDOR
SUBAREAS



APRIL 2012



2.4.1. Total Daily Trips and Trips Produced Within the Study Area

Total Daily Trips The Triangle Regional Model was used to obtain 2005 and 2035 total daily motorized person trip data for the Triangle Region (combined CAMPO and DCHC-MPO Subregions), the DCHC-MPO Subregion, and the Study Area. They are summarized in Table 2-11. All three geographic levels show an increase in daily person trips between 2005 and 2035. The data shows a 59 percent increase in daily person trips for the Study Area, a 62 percent increase for the MPO Subregion, and a 101 percent increase for the Triangle Region.

Relative to the region as a whole, the Study Area has a significantly greater level of trip intensity. In 2005, the Study Area had over three times the number of trips per square mile than the Triangle Region, and this trend is expected to continue into the future. In 2035, trip activity in the Durham-Orange Corridor will continue to be more highly concentrated, with over 12,000 trips per square mile in the Study Area, as compared to just under 5,000 trips per square mile for the Triangle Region.

Table 2-11 Total Daily Person Trips

	2005		2035		Change in Total Trips	Change in Trips per Square Mile	Percent Change in Total Trips and Trips per Square Mile
	Total Trips	Trips per Square Mile	Total Trips	Trips per Square Mile			
Triangle Region (CAMPO and DCHC-MPO Subregions)	5,028,723	2,365	10,115,359	4,757	5,086,636	2,392	101%
DCHC-MPO Subregion	1,697,678	3,087	2,756,730	5,012	1,659,052	1,926	62%
Study Area (all five subareas)	430,000	7,544	685,000	12,018	255,000	4,474	59%

Source: Triangle Regional Model | Data presented in the table is based on the Triangle Regional Model V4.

Trips Produced Within the Study Area The travel patterns in the corridor subareas are presented as productions and attractions to demonstrate the directional characteristics of trips. Table 2-12 shows the number of daily trips produced from within the Study Area (all five subareas). Table 2-12 shows the current and projected daily trips produced within the Study Area, with destinations (or points where trips are attracted to) either within or outside of the Study Area. In 2005, approximately 53 percent of the trips produced within the study area were attracted to points within the Study Area, compared with 58 percent projected for 2035.

In 2035, an additional 167,000 trips produced within the Study Area are forecast to be attracted to areas within the Study Area, an increase of 73 percent over a 30-year period. In the same time period, trips produced within the Study Area attracted to places outside the Study Area will increase by 44 percent, slightly more than half of the growth internal-to-the-Study Area trip growth. As Table 2-11 shows, the relatively compact Study Area, at only 10 percent of the land area in the DCHC-MPO Subregion will increase from roughly 7,500 trips per square mile in 2005 to over 12,000 trips per square mile in 2035, an increase of approximately 4,500 trips per square mile. The number of trips per square mile in the MPO Subregion at large in 2035 will rise to just over 5,000 trips per square mile.

In summary, the increase in the intensity of tripmaking within the Study Area over the next 30 years will be greater than the full Subregion tripmaking intensity in 2035. These findings indicate a greater potential for a transit investment to serve trips within the Durham-Orange Corridor.

Table 2-12 Daily Trips Produced within the Study Area

Destination Area (or point attracted to)	2005	2035		
	Trips	Trips	Additional Trips	Percent Change
Within the Study Area	230,000	397,000	+167,000	73%
Outside of the Study Area	200,000	288,000	+88,000	44%
Total	430,000	685,000	+255,000	59%

Source: Triangle Regional Model Source: Triangle Regional Model | Data presented in the table is based on the Triangle Regional Model V4.

2.4.2. Trip Patterns within the Study Area

A large percentage of daily trips produced within the Study Area have destinations within the Study Area for both 2005 and 2035. To better understand the daily trip patterns within the Study Area, a matrix was developed to show the number of daily trips between and within the subareas. Table 2-13 and Table 2-14 present daily trips and percent daily trips in 2005 and 2035 respectively, and Figure 2-11 and Figure 2-12 graphically illustrate trips between subareas in 2005 and 2035.

As shown in Table 2-13 and Table 2-14, the number of trips produced by and attracted to subareas is expected to increase significantly over a 30-year period, but the general travel patterns between subareas will remain relatively unchanged between 2005 and 2035.

Table 2-13 2005 Daily Trip and Percentage of Trip Productions and Attractions by Subarea

		Attracted To					
		Chapel Hill	East CH/SW Durham	West Durham	Duke	Downtown Durham	Outside of Study Area
Produced By	Chapel Hill	45,000 (46%)	8,000 (8%)	2,000 (2%)	2,000 (2%)	1,000 (1%)	39,000 (40%)
	East CH/SW Durham	8,000 (9%)	17,000 (21%)	8,000 (9%)	4,000 (5%)	2,000 (3%)	43,000 (52%)
	West Durham	2,000 (3%)	5,000 (8%)	15,000 (24%)	8,000 (12%)	4,000 (7%)	30,000 (47%)
	Duke	1,000 (1%)	2,000 (2%)	5,000 (6%)	40,000 (42%)	10,000 (11%)	36,000 (38%)
	Downtown Durham	1,000 (1%)	1,000 (1%)	4,000 (5%)	15,000 (17%)	19,000 (20%)	52,000 (57%)
	Outside of Study Area	66,000 (1%)	50,000 (1%)	52,000 (1%)	95,000 (2%)	80,000 (2%)	4,264,000 (93%)

Source: Triangle Regional Model | Data presented in the table is based on the Triangle Regional Model V4.

Table 2-14 2035 Daily Trip and Percentage of Trip Productions and Attractions by Subareas

		Attracted To					
		Chapel Hill	East CH/SW Durham	West Durham	Duke	Downtown Durham	Outside of Study Area
Produced By	Chapel Hill	57,000 (42%)	15,000 (11%)	5,000 (3%)	3,000 (2%)	2,000 (2%)	55,000 (40%)
	East CH/SW Durham	14,000 (9%)	42,000 (27%)	13,000 (8%)	7,000 (4%)	6,000 (3%)	75,000 (48%)
	West Durham	3,000 (3%)	10,000 (11%)	21,000 (23%)	10,000 (11%)	9,000 (10%)	36,000 (41%)
	Duke	1,000 (1%)	4,000 (3%)	7,000 (6%)	43,000 (35%)	25,000 (21%)	42,000 (34%)
	Downtown Durham	1,000 (1%)	3,000 (2%)	8,000 (4%)	27,000 (15%)	60,000 (33%)	81,000 (45%)
	Outside of Study Area	106,000 (1%)	105,000 (1%)	71,000 (1%)	123,000 (1%)	189,000 (2%)	8,788,000 (94%)

Source: Triangle Regional Model | Data presented in the table is based on the Triangle Regional Model V4.

In terms of 2035 daily trips, the highest inter-subarea activity occurs bidirectionally between the Duke and Downtown Durham subareas. The Duke subarea produces 25,000 daily trips that are attracted to the Downtown Durham subarea. Conversely, the Downtown Durham subarea produces 27,000 daily trips that are attracted to the Duke subarea. Such high volumes between these subareas is most likely due to the high population density pockets combined with high employment density pockets within each subarea. Major daily trip attractors within these subareas include the downtown Durham CBD, Duke University, Duke University Medical Center, NCCU, and Durham Technical Community College.

While the Duke and Downtown Durham subareas have the highest amount of bidirectional daily trips, all subareas have a large percentage of daily trips being attracted to either the originating subarea or one of the other subareas, as shown in Figure 2-11 and Figure 2-12. These results are expected given that the Town of Chapel Hill and the City of Durham include many activity centers and their proximity fosters strong travel demand between the two cities.

The flows in Figure 2-11 and Figure 2-12 are determined by the locations of productions and attractions of trips in the Study Area. Productions are typically associated with households and attractions with employment. In a typical urban corridor where most households are located in more suburban locations and employment is concentrated in the city center or CBD, the flow of trips would indicate an imbalanced peak period flow between the suburban area and the central city; more trips would flow from the suburban area to the central city in the morning peak period than in the reverse direction. However, Figure 2-12 shows that the daily trip flows are more balanced between the various subareas in the corridor in 2035, as noted below:

- Chapel Hill to/from East Chapel Hill/Southwest Durham subareas: 14,000/15,000
- East Chapel Hill/Southwest Durham to/from West Durham subareas: 13,000/10,000
- West Durham to/from Duke subareas: 10,000/7,000

- Duke to/from Downtown Durham subareas: 25,000/27,000
- West Durham to/from Downtown Durham subareas: 9,000/8,000

The impact that this may have on the ridership for a potential fixed-guideway transit investment is that both travel directions may contribute significantly to a project's ridership.

FIGURE 2-11
TRAVEL PATTERNS
BETWEEN
SUBAREAS (2005)

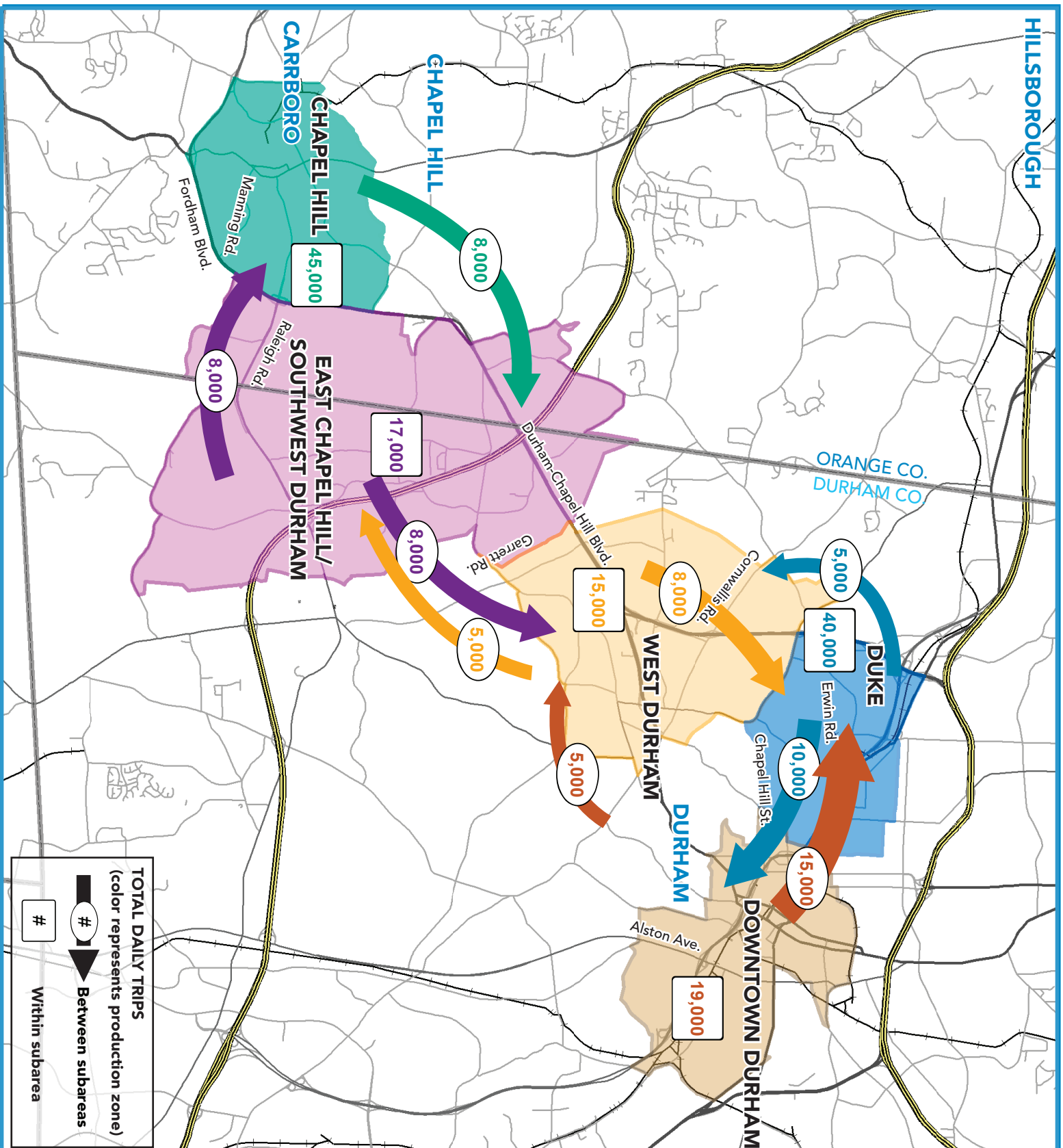
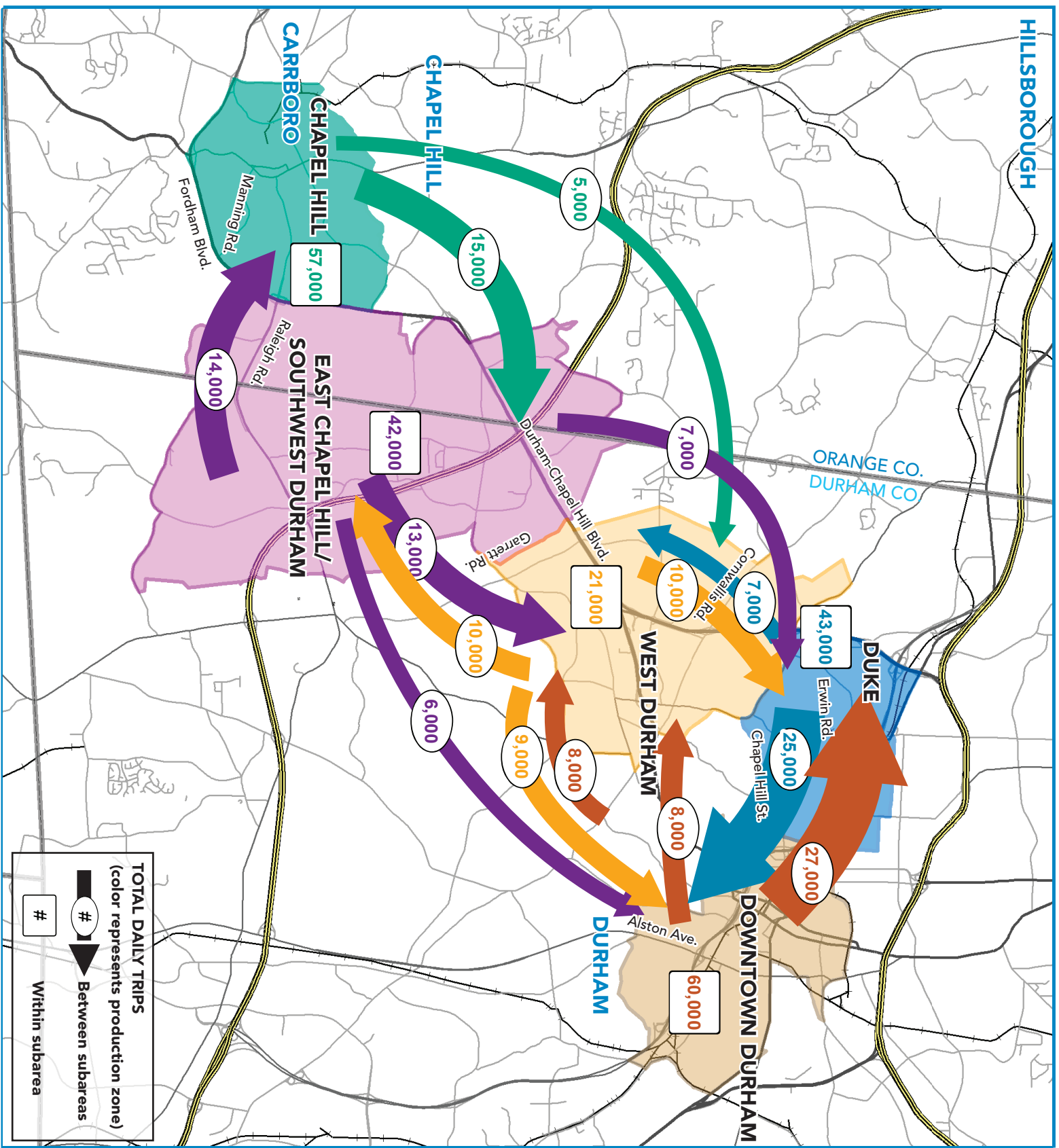


FIGURE 2-12
TRAVEL PATTERNS
BETWEEN
SUBAREAS (2035)



2.5. Levels of Congestion

This section describes traffic operations along the major roadways in the Durham-Orange Corridor. The purpose of this section is to review the measures of effectiveness that indicate the quality of traffic operations and to present the results of the analysis. Major roadways analyzed include NC 54, US 15-501, NC 147 (the Durham Freeway), and Erwin Road.

US 15-501 from NC 86 to the US 15-501/US 15-501 Business split southwest of Durham is classified as an expressway with at-grade signalized and unsignalized intersections. US 15-501 from the US 15-501/US 15-501 Business split to NC 147 is classified as a freeway, with access provided onto and off of US 15-501 only at interchanges. NC 54, from US 15-501 (Fondham Boulevard) to I-40, is classified as an arterial with at-grade signalized and unsignalized intersections. NC 147 is classified as a freeway with access provided onto and off of NC 147 only at interchanges. Erwin Road is classified as an arterial with at-grade signalized and unsignalized intersections.

2.5.1. Volume to Capacity Ratios

Volume to capacity (V/C) ratios were obtained from the Triangle Regional Model in order to understand traffic operations for the major roadways within the Durham-Orange Corridor. V/C ratios were reviewed for the base year (2005) and the future year (2035) in both the morning (AM) and evening (PM) peak hours. The segments considered “under capacity” exhibit a V/C ratio less than 0.9. The segments considered “at capacity” exhibit a V/C ratio between 0.9 and 1.1. The segments considered “over capacity” exhibit a V/C ratio greater than or equal to 1.1.

The volume to capacity ratio (V/C) is a ratio of roadway demand (volume of traffic) to roadway supply (traffic carrying capacity of the roadway) that is used to illustrate the level of congestion on a given roadway segment.

As summarized in Figure 2-13 and Figure 2-14, many roadway segments that serve the primary travel markets within the Durham-Orange Corridor would be operating at or over capacity in either the AM and/or PM peak periods by 2035. In addition to these segments projected to be congested in the peak hours, other segments could experience the effects of that congestion as queues on congested road segments extend upstream into segments that are not projected to be congested themselves.

FIGURE 2-13
2035 A.M. PEAK HOUR
VOLUME/CAPACITY
(V/C) RATIOS

LEGEND

Study Area

A.M. V/C
Over Capacity

A.M. V/C
At Capacity

A.M. V/C
Under Capacity

Railroad

NORTH

0

0.6

1.2

1.8 Mi.

APRIL 2012

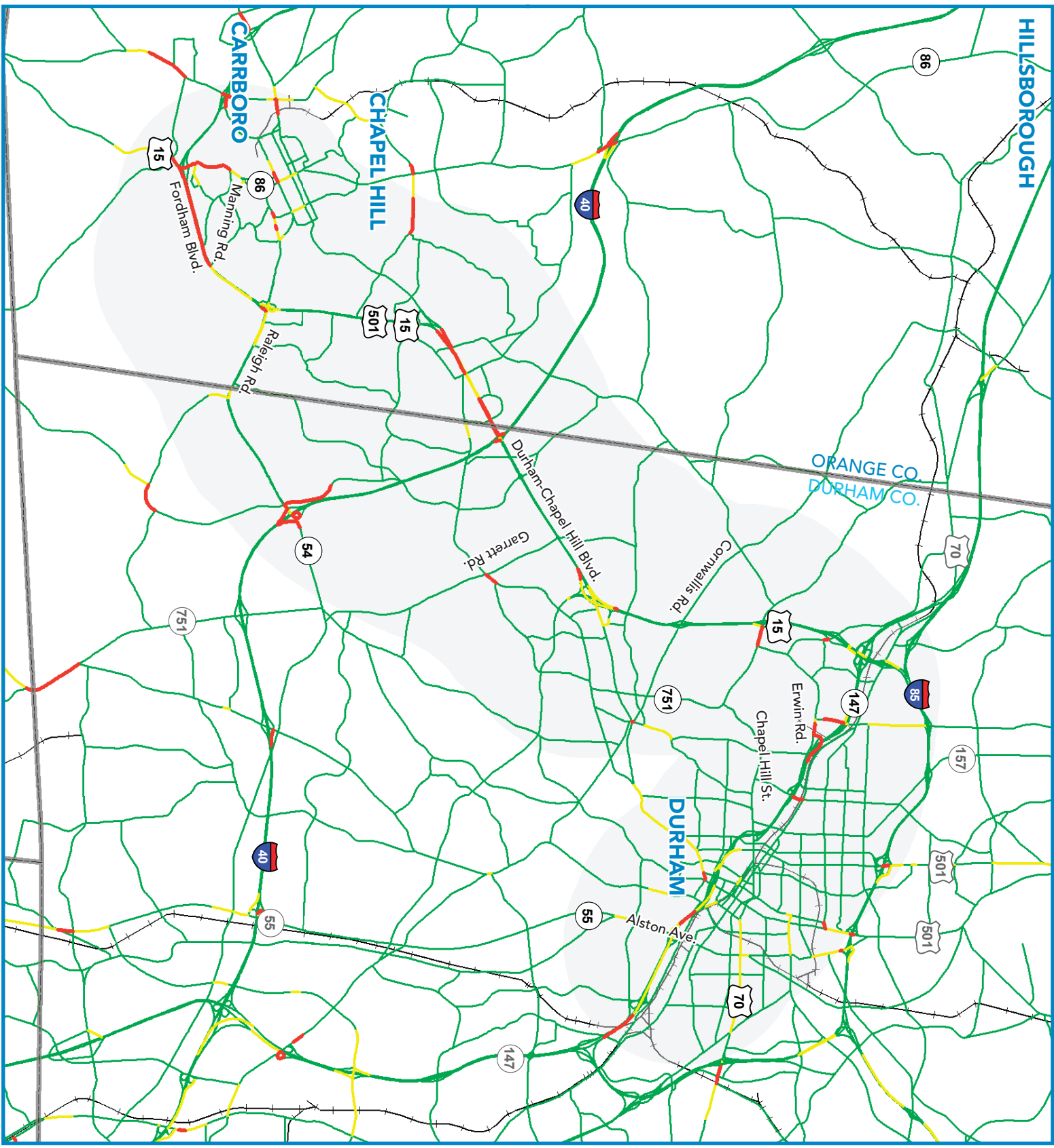
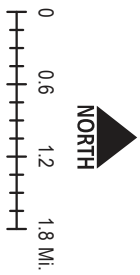
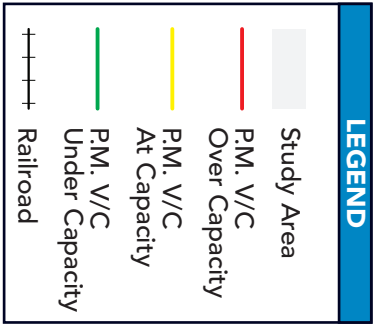


FIGURE 2-14
 2035 P.M. PEAK HOUR
 VOLUME/CAPACITY
 (V/C) RATIOS



APRIL 2012

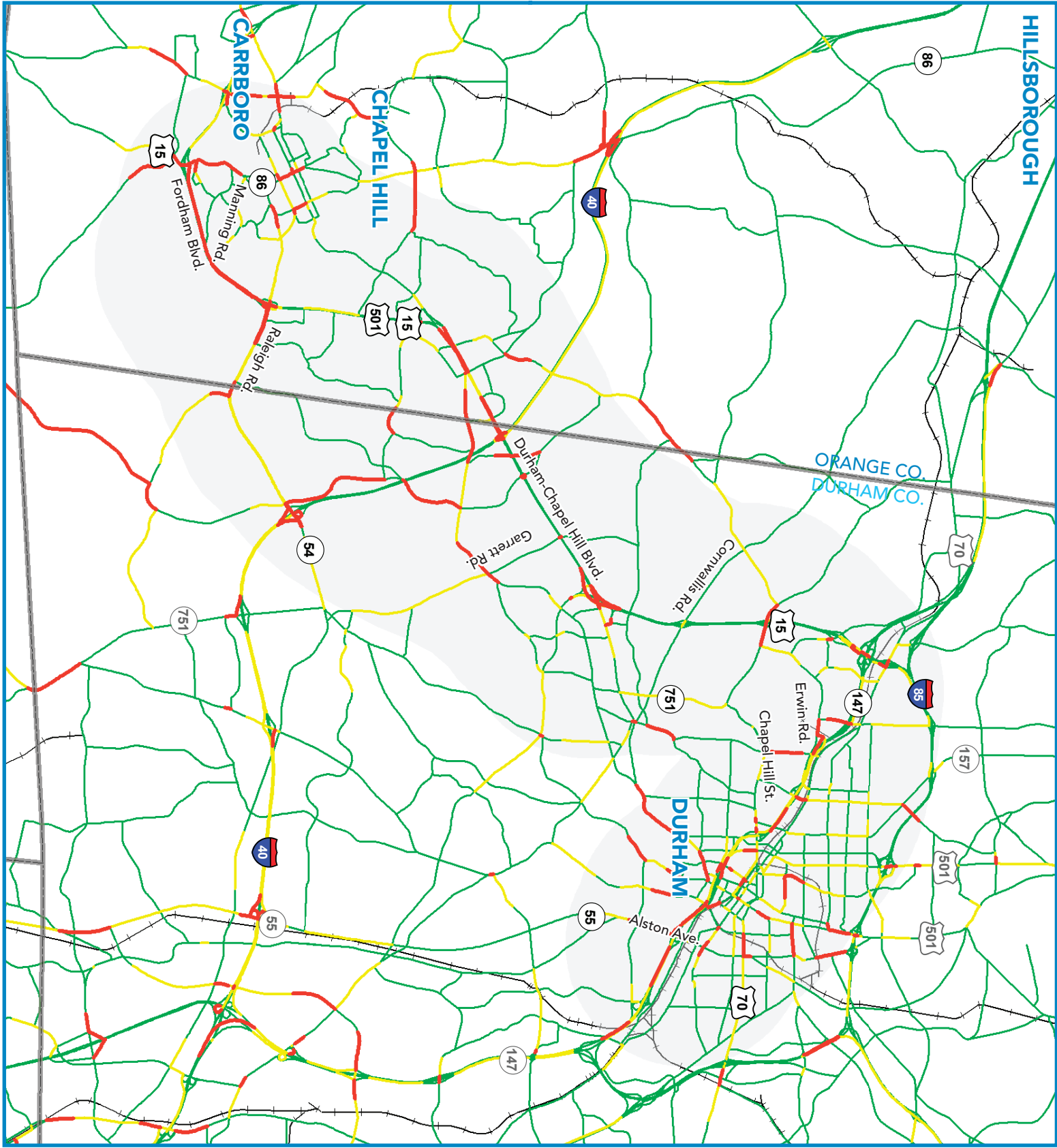


Table 2-15 2035 Segments or Areas with V/C Ratios at or over Capacity

Roadway	Segment or Area	V/C Ratio (AM Peak Hour)	V/C Ratio (PM Peak Hour)
US 15-501	From NC 86 to NC 54	1.12	1.16
	From NC 54 to I-40	1.39	1.89
	US 15-501 interchange with US 15-501 Business	1.59	1.44
	US 15-501 interchange with NC 147 (Durham Freeway)	0.91	1.23
NC 54	From US 15-501 to I-40	1.10	1.31
I-40	East of NC 54	0.83	1.02
	West of US 15-501	0.72	0.93
NC 147 (Durham Freeway)	East of US 15-501	0.79	1.15
Erwin Rd	From US 15-501 (in Chapel Hill) to near South LaSalle St West of Duke University	0.68	1.34
		0.86	1.03
	From Fulton St to West Main St	1.22	1.29

Source: Triangle Regional Model | Data presented in the table is based on the Triangle Regional Model V4.

Roadways with high levels of congestion that serve the travel patterns previously identified within the corridor represent the greatest opportunity for travel time savings using fixed-guideway transit.

2.5.2. Vehicle Miles Traveled and Vehicle Hours Traveled

Daily vehicle miles traveled (VMT) and daily vehicle hours traveled (VHT) are additional measures used to analyze congested conditions for roadways and how those conditions change over time. VMT and VHT were derived from the Triangle Regional Model for the Triangle Region (combined CAMPO and DCHC-MPO Subregions), the DCHC-MPO Subregion, and for the Study Area, and are shown in Table 2-16 and Table 2-17.

Table 2-16 Daily Vehicles Miles Traveled (VMT)

	2005		2035		Change in Total VMT	Change in VMT per Square Mile	Percent Change in Total VMT and VMT per Square Mile
	Total VMT	VMT per Square Mile	Total VMT	VMT per Square Mile			
Triangle Region (CAMPO and DCHC-MPO Subregions)	37,898,756	17,822	73,861,276	34,734	35,962,520	16,912	5%
DCHC-MPO Subregion	25,012,126	45,478	51,472,776	93,140	6,929,458	48,112	65%
Study Area (all five subareas)	5,225,000	91,667	9,040,000	158,596	1,588,000	66,930	55%

Source: Triangle Regional Model | Data presented in the table is based on the Triangle Regional Model V4.

Table 2-17 Daily Vehicle Hours Traveled (VHT)

	2005		2035		Change in Total VMT	Change in VMT per Square Mile	Percent Change in Total VMT and VMT per Square Mile
	Total VMT	VMT per Square Mile	Total VMT	VMT per Square Mile			
Triangle Region (CAMPO and DCHC-MPO Subregions)	814,486	383	1,826,903	859	1,012,417	476	124%
DCHC-MPO Subregion	537,890	978	1,317,244	2,395	171,076	1,417	73%
Study Area (all five subareas)	129,000	2,263	297,000	5,211	54,000	2,947	73%

Source: Triangle Regional Model | Data presented in the table is based on the Triangle Regional Model V4.

While the size of the Study Area is approximately 10 percent of the DCHC-MPO Subregion, the Study Area accounts for over 20 percent of the total subregion VMT and VHT. As noted in Section 2.4.1, the Study Area is attracting a disproportionate level of auto travel from outside the Durham-Orange Corridor. In 2005, the Study Area had more than five times the VMT and VHT per square mile than the Triangle Region and more than twice as much VMT and VHT per square mile than found in the DCHC-MPO Subregion. This trend is forecast to continue into 2035.

An increase of VMT can be the result of an increase in travel or an increase in travel distances. An increase of VHT can also be the result of an increase in travel distances or an increase in congestion. The data above show an anticipated 55 percent increase in VMT in the Study Area between 2005 and 2035, compared to a 95 percent increase in the region and a 65 percent increase in the DCHC-MPO Subregion. The data also show an anticipated 73 percent increase in VHT in the Study Area over the same time period, compared to a 124 percent increase in the region and 73 percent increase in the MPO area.

It is not surprising that the MPO Subregion and Triangle Region would have higher increases in VMT and VHT than the Study Area since the Study Area is already densely developed and is not expected to experience the same rate of growth as other areas of Durham and Orange counties. The higher increase in VHT for the Study Area as compared to the corresponding VMT means that congestion is expected to increase in the Study Area between 2005 and 2035.

2.5.3. System Speed

Table 2-18 shows the system average speeds for the region (combined CAMPO and DCHC-MPO Subregions), the DCHC-MPO Subregion, and for the Study Area. These are calculated by dividing the VMT by the VHT (from Table 2-16 and Table 2-17) to calculate miles per hour. Average speeds are expected to decrease substantially from 2005 to 2035, which is indicated because VHT is expected to increase faster than VMT. This is especially apparent in the Study Area where speeds are anticipated to decrease more than in the MPO Subregion.

Table 2-18 System Average Speed (Miles per Hour)

	2005	2035	Change	% Change
Triangle Region (CAMPO and DCHC-MPO Subregions)	46.5	40.4	-6.1	-13.1%
DCHC-MPO Subregion	45.4	43.4	-2.1	-4.6%
Study Area (all five subareas)	39.0	35.0	-4.1	-10.4%

Source: Triangle Regional Model | Data presented in the table is based on the Triangle Regional Model V4.

2.6. Air Quality

Transportation-air quality conformity ("conformity") is a way to ensure that federal funding and federal approvals go to transportation projects that are consistent with air quality goals. Conformity applies to long range transportation plans, transportation improvement programs, and to projects funded or approved by the Federal Highway Administration or the FTA in nonattainment areas or maintenance areas.

Areas that do not meet or previously have not met air quality standards for ozone, carbon monoxide, particulate matter, or nitrogen dioxide are known as "**nonattainment areas**" or "**maintenance areas**," respectively.

Air quality conditions in the Triangle Region presently conform to the state and national ambient air quality standards. The entire Triangle Region, except for Harnett County, is currently designated as a maintenance area for the 8-hour ozone standard; the effective date of this designation was December 26, 2007. In addition, Durham and Wake Counties are maintenance areas for carbon monoxide.

The TRTP, which includes the Durham-Orange Corridor AA, is currently included in the 2035 LRTP and the 2009-2015 Transportation Improvement Program. The resulting LPA will have significant potential to further improve air quality conditions in the Triangle Region, depending upon the type of transit and the alignment. Transit related air quality benefits are based on the number of new transit trips, which result in a reduction in regional vehicle miles travelled. Air quality benefits are quantified as a reduction in tons of emissions.

2.7. Summary

A detailed description of the existing and future corridor conditions has been presented in this chapter. Projected growth in population, employment and travel demand has been illustrated for both the larger region and for the study corridor. It is very clear that the Triangle Region, the Durham-Chapel Hill area, and the study corridor between downtown Durham and the UNC Hospitals in Chapel Hill will experience substantial growth over the next 25 years. The existing transportation system of roads and local bus service will not be sufficient to serve the resulting travel demand, particularly in the study corridor where a significant amount of the population and employment growth will occur. Nor will the existing transportation system be effective in shaping the land use patterns towards more efficient, mixed-use and higher density developments.

Unlike many urban areas that have large concentrated central business districts (CBD) or downtowns that have proposed new fixed guideway transit systems, the Durham-Orange corridor consists of multiple activity centers of significant size and mixes of land use throughout the entire length of the corridor. This will result in transit travel demand that will occur in a more balanced flow throughout the corridor and will take place throughout the day and days of the week. This is different than many transit corridors that are designed primarily to serve the peak period directional flows between a more suburban area and concentrations of employment in the CBD.

3. Purpose and Need

This chapter describes the overall Purpose and Need related to the proposed transit investment in the Durham-Orange Corridor. Defining the Purpose and Need for a transportation investment is a critical first step in the AA process. A sound project Purpose and Need and supporting goals and objectives guide the alternatives development and evaluation process.

3.1. Purpose of the Proposed Action

The purpose of a proposed high-capacity transit investment in the Durham-Orange Corridor is to provide a transit solution that addresses the following needs:

- Need to enhance mobility
- Need to expand transit options between Durham and Chapel Hill
- Need to serve populations with high propensity for transit use
- Need to foster compact development

3.2. Need for the Proposed Action

This section provides a detailed description of the challenges within the Durham-Orange Corridor that shape the needs identified for a major transit investment. Each need, and its related challenges, represents an opportunity for a transit investment that can enhance mobility, capture untapped markets, and support desired development patterns.

3.2.1. Need to Enhance Mobility

By 2035, the MPO Subregion will be home to an additional 174,000 residents; 32 percent of whom will be located within the Study Area. The forecast rate of population growth in Durham and Orange counties (47 percent between 2005 and 2035) is relatively modest compared with neighboring Wake County, largely due to an already densely developed area and firm growth management policies. While population growth in the DCHC-MPO Subregion will not keep pace with the rest of the Triangle region, employment growth is expected to remain strong. Much of this job growth will be concentrated in the Durham-Orange Corridor, which is forecast to add approximately 81,000 new jobs, comprising almost half the jobs in the DCHC-MPO Subregion in 2035.

These new residents and jobs will generate increased travel demand. By 2035, the corridor's projected growth is expected to generate 255,000 additional daily trips, many of which will be made on local roadways. Challenges to accommodating this growth within the current and planned transportation network are described below.

Challenge: Capacity of Roadway System Cannot Accommodate Increased Travel Demand

Even with implementation of all roadway projects programmed in the 2035 LRTP, the capacity of the transportation system will not keep pace with the increase in traffic volumes. Coupled with the already developed nature of the corridor and existing congestion, the added travel demand will intensify pressure on the Study Area's increasingly burdened roadway infrastructure. To this end, average speeds in the Durham-Orange Corridor are expected to decrease from 39 mph to 35 mph between 2005 and 2035.

Regional and local planners in the Durham-Orange Corridor recognize the need to develop transportation alternatives to expanding the roadway network in response to increased travel demand. Adopted plans call for a new approach to transportation planning that moves away from the auto-centric model of adding lanes and roadway infrastructure, to a multimodal system that provides a high-quality and high-capacity transit option to driving in congested corridors.

Challenge: Limited Capacity and Availability of Transit Service

Because existing transit service has several limits in its ability to offer a desirable transportation choice, travel options are limited. Within the Durham-Orange Corridor, the existing bus network is concentrated in downtown Durham and Chapel Hill. The urban cores of Durham and Chapel Hill, combined with Downtown Raleigh, attract roughly 87 percent of transit trips and produce nearly two-thirds (64 percent) of transit trips in the Triangle Region as a whole. The university transit providers offer the most frequent services, with average peak headways of 18 minutes for Duke Transit and 22 minutes for CHT. DATA and Triangle Transit operate at much lower frequencies, with peak headways averaging 30 minutes on most routes. In off-peak hours, time increments between buses stretch to 60 minutes or more, often with some routes completely removed from service. These headways translate into two trips per hour during peak service times and up to four during off-peak, restricting not only the availability of the service but the maximum capacity that the line can accommodate.

"Day travel to and from work is important, but so is leisure..."

- Public Comment
AA Round 2 Meetings

While CHT in Chapel Hill and Duke Transit and DATA in Durham provide good transit coverage for trips within each of the downtown areas, few bus connections exist between the two urban centers or to and from the residential areas and suburban-style retail developments between downtown Chapel Hill and downtown Durham. Triangle Transit Routes 400 and 405 connect UNC Hospitals in Chapel Hill and Durham Station Transportation Center at 30 minute headways during the peak period and 60 minute headways off-peak. This regional service primarily serves commuter weekday travel and has limited weekend service. In addition, student travel between the two leading educational institutions in the Durham-Orange Corridor is served by Duke Transit, which operates the Robertson Scholars bus service between Duke and UNC. While these bus routes offer some service to commuters and students, they are not viable alternatives to the auto for traveling to and from retail, entertainment, and restaurant venues in Durham and Chapel Hill or points in between.

3.2.2. Need to Expand Transit Options between Durham and Chapel Hill

The benefits of transit are well documented in regional planning documents. Perhaps the most comprehensive discussion is in the Regional Transit Vision Plan, which notes benefits such as addressing air quality problems and reducing pressure on natural systems, reducing the rate of growth in congestion, and providing health and environmental benefits.¹⁵ In addition, as discussed in more detail in Section 3.2.3, Duke University and UNC could benefit from increased connections between their leading research centers and hospital centers.

¹⁵ Regional Transit Vision Plan, Special Transit Advisory Commission (STAC), 2007-2008.

Table 3-1 shows that CHT and DATA, which are concentrated in the urban centers of Chapel Hill and Durham, respectively, carry a higher number of trips per capita than systems in comparable metropolitan areas. While these systems have strong utilization relative to their peers, Triangle Transit, which provides regional transit services, provides far fewer trips per capita than peer regions, indicating a lower utilization of travel services connecting urban centers in the entire Triangle Transit system. Overall, transit trips between Durham and Chapel Hill represent a small percentage of all trips in the Study Area and the overall region. This indicates that when given the option, people tend to select the private automobile over transit, particularly for intra-jurisdictional trips. Critical to the realization of transit benefits is a transit network that offers a practical and convenient alternative to the automobile outside of the urban cores of the two cities and that attracts riders by choice, not necessity. Meeting this need requires addressing the following challenges.

Table 3-1 Transit Trips per Capita Comparison

Metropolitan Area	Transit Provider	Service Population	Annual Unlinked Trips	Trips per Capita*
Durham, NC	CHT	71,069	6,328,221	89.04
Durham, NC	DATA	187,000	4,872,936	26.06
Raleigh, NC	TTA	1,002,876	939,297	0.94
Charlotte, NC	Charlotte Area Transit System (CATS)	696,837	19,896,809	28.55
Richmond, VA	Greater Richmond Transit Company (GRTC Transit System)	449,572	13,595,343	30.24
Dayton, OH	Greater Dayton Regional Transit Authority	559,062	7,132,392	12.76
Nashville, TN	Metropolitan Transit Authority	573,294	9,701,697	16.92
Greensboro, NC	Greensboro Transit Authority	235,262	3,744,101	15.91
Indianapolis, IN	Indianapolis and Marion County Public Transportation	791,926	958,9851	12.11
Louisville, KY	Transit Authority of River City (TARC)	754,756	15,175,774	20.11

*Trips per capita was derived from service population and annual unlinked trips as provided in the 2009 NTD reports for the individual agencies.

Source: National Transit Database, 2009.

Challenge: Existing Buses Operate in Mixed Traffic along Increasingly Congested Roadways

Currently, buses operate in mixed traffic conditions and are thus subject to congestion, traffic signals, and accident delays. Service providers, however, are able to maintain fairly consistent on-time performance through continuous and coordinated bus service planning. As shown in Table 3-2, service providers currently experience only limited schedule adherence issues. On-time performance for Triangle Transit, for example, represents January to June 2010 data. In August 2010, Triangle Transit consolidated the various routes operating between the two transit centers into two routes, the 400 and the 405. In the near term, the new service structure will address some of the on-time performance issues, but moving forward, traffic volumes on US 15-501, the primary through-route for these buses, is forecast to exceed capacity through 2035. With this increase in congestion, bus travel times will inevitably become even less reliable for riders. For all service providers, buses operating in mixed traffic are likely to experience decreasing service reliability as roadway congestion continues to worsen in the future.

Table 3-2 Summary of On-time Performance by Transit Provider

Transit Provider*	Percent Trips On-time**	Period
CHT	95%	January 2009 – December 2009
DATA	94%	October 2009 – September 2010
Triangle Transit***	81%	January – June 2010

*Source: Chapel Hill Transit, Durham Area Transportation Authority, and Triangle Transit | *Data not available for Duke University. | **On-time for all providers was defined as arriving within 5 minutes of scheduled arrival time. | ***Data for Triangle Transit averages performance of the routes that traversed the Durham-Orange Study Area. System-wide performance was slightly higher at 85%.*

Challenge: Bus Travel Offers No Travel Savings over Auto

Conventional buses tend to make frequent stops and operate in mixed traffic conditions, thereby slowing travel times and offering no travel time savings over the automobile. As discussed in the Travel Demand section, auto travel speeds are expected to decrease, indicating higher levels of delay for buses that further preclude any true reductions in travel time. Table 3-3 summarizes current conditions for sample trips in the Study Area for three different trip lengths: for the entire corridor (from UNC to Downtown Durham), from the Gateway Station to Downtown Durham, and from UNC Hospitals to the Leigh Village Station area. These sample trips illustrate what is problematic with much of the area's transit service: not only does transit fail to provide a travel time savings, but bus travel generally takes longer than auto travel due to less direct routing between key destinations, bus stops, and, in some cases, transfers. The sample trip between Chapel Hill and Durham, which has a total travel time of approximately one-half hour by car, has a nearly 1 hour and 10 minute total travel time by bus on a typical weekday. On a weekend, that same trip by transit will take just over one and one-half hours because of a longer walk to access to the bus due to the reduced frequency in CHT transit service. Sample trips between the Gateway Station area and Downtown Durham and trips between UNC Hospitals and the Leigh Village Station area reveal a similar lack of time savings for transit trips.

Table 3-3 Sample Trips on Transit Versus Auto

	Auto	Transit (Weekday)	Transit (Weekend)
Trip Origin Destination Departure Time	UNC to Downtown Durham Apartment Complex (<i>Chapel Hill</i>) Durham Performing Arts Center (<i>Durham</i>) 3:30 PM		
Travel Time: In-Vehicle	23 min	51 min	41 min
Travel Time: Out-of-Vehicle*	10 min	18 min	50 min
Travel Time: Total	33 min	69 min	92 min
Transit Providers Accessed	N/A	3 (CHT,DATA,TTA)	2 (DATA,TTA)
Trip Origin Destination Departure Time	Gateway Station to Downtown Durham 5130 Old Chapel Hill Road (<i>Durham</i>) Durham Performing Arts Center (<i>Durham</i>) 3:30 PM		
Travel Time: In-Vehicle	15 min	32 min	25 min
Travel Time: Out-of-Vehicle*	10 min	33 min	37 min
Travel Time: Total	25 min	65 min	62 min
Transit Providers Accessed	N/A	1 (TTA)	1 (DATA)
Trip Origin Destination Departure Time	UNC Hospitals to Leigh Village Station 3239 Manning Drive (<i>Chapel Hill</i>) 2920 Rutgers Place (<i>Chapel Hill</i>) 3:30 PM		
Travel Time: In-Vehicle	11 min	15 min	12 min
Travel Time: Out-of-Vehicle*	10 min	26 min	26 min
Travel Time: Total	21 min	41 min	38 min
Transit Providers Accessed	N/A	1 (TTA)	1 (TTA)

Source: Transit times calculated using GoTriangle Trip Planner, <http://www.gotriangle.org/>; Auto times calculated using Google Maps <http://maps.google.com/maps?hl=en&tab=wl> | *Transit out-of-vehicle time includes walk access to bus, wait times transfers, walk time to final destination, and initial wait time which is calculated as half of the headway and capped at 15 minutes. Auto out-of-vehicle time estimates walk access to vehicle at start of trip and walk to destination at end of trip.

Challenge: Lack of Premium Service that Can Attract Choice Riders

The Durham-Orange Corridor Study Area is currently served by conventional bus transit, which traditionally does not offer a level of service or amenities that attract choice riders. An attractive transit option should provide reliable and competitive travel times and convenient and comfortable service and ideally offer a reduction over the cost of driving, including fuel and parking costs. This is illustrated in the findings from a recent community resident survey conducted by CHT. The majority of survey respondents (79 percent) live in households where there are no persons over the age of 16 who would be dependent on public

Choice Riders are transit users who have the option of using an automobile for their trip.

transportation or rides from friends or relatives. Close to 50 percent rarely or never use public transportation in Chapel Hill or Carrboro and an additional 17 percent only use the system a few times per year. When asked why they do not ride free public transportation in Chapel Hill, nearly 78 percent of residents surveyed noted that they just prefer to drive (44 percent) and/or the bus just takes too long compared to travel by car (34 percent). Convenience of bus stop locations to origins and destinations, travel times, and service frequency were generally regarded as factors that could encourage more utilization of public transportation.¹⁶

The most recent CHT on-board survey demonstrates that when transit service is a competitive alternative to the automobile, choice riders are more likely to select transit as their travel mode. The majority of respondents (64 percent) had access to a vehicle for their trip to or from UNC, but opted to ride the bus because parking was too expensive (58 percent) or hard to find (46 percent). Parking constraints are due to strict UNC policies that limit the availability of low-cost parking options and, in tandem with CHT park and ride services, transform the bus service into a more convenient option for students, employees, and visitors who could otherwise drive to the university campus or hospital.

Restricted parking is only one factor in a traveler's decision to use transit. Even if parking policies similar to those employed by UNC were instituted outside of Chapel Hill, buses would still be subject to operating on increasingly congested roadways and would, therefore, not offer competitive travel times. Longer transit trips and increased service unreliability, due to increasing congestion, is a particular hindrance for passengers transferring between transit providers.

Ultimately, longer travel times and schedule uncertainty will likely continue to deter choice riders from using transit, particularly for non-work trips in the Study Area. Without a high-quality transit option that can realistically offer benefits over driving, the automobile is and will continue to be the only available or convenient mode of travel for most trips, particularly between Chapel Hill and Durham.

3.2.3. Need to Serve Populations with High Propensity for Transit Use

The Durham-Orange Corridor Study Area is heavily populated with transit-dependent and college student populations. These two demographic populations comprise a substantial portion of the transit market. Meeting their travel needs is critical and is discussed in more detail below.

Challenge: Limited transit service for university travel markets

University trips represent a significant portion of travel within the Triangle Region and within the Study Area. The walkable nature of the universities, combined with limited, costly parking and free student bus passes make university students, faculty, staff, and visitors a population that is likely to use transit, if the right service is provided. CHT, for example, has policies in place to encourage commuters to use park and ride services, and their comprehensive service is free, providing a financially viable alternative to driving.

In the Triangle Region as a whole, university-related transit trips comprised nearly 60 percent of total transit trips. Of the four providers within the Study Area, CHT, UNC's public transit service, carried the highest number of trips in 2008 in the Durham-Orange Study Area and the Triangle Region as a whole.¹⁷

¹⁶ Chapel Hill Transit, Passenger and Rider Survey, June 2010.

¹⁷ National Transit Database, 2009.

As to be expected, the purpose of most CHT trips, as revealed by Triangle Regional Model, is home-based university (HBU - 51 percent), with nearly 14 percent being non-home-based (NHB) trips. For Duke University, which caters to the Duke Community, primary purposes were NHB (42 percent), HBU (33 percent), and home-based work (HBW - 22 percent). NHB trips are comprised primarily of university trips; this indicates that riders may travel to campus for initial activities and make additional trips on transit. During the same period, nearly 20 percent of Triangle Transit travel was HBU, and DATA was 8 percent HBU.

The density of trips associated with students and employees of these universities combined with policies to limit parking on these campuses represents an opportunity to serve not only a growing travel market with a major transit investment, but also to the long-term economic vitality of the region.

Challenge: Limited transit service for transit-dependent populations

Areas within the Study Area that have high concentrations of transit-dependent populations, including downtown Durham and parts of Chapel Hill, are served to some degree by transit. However, in downtown Durham particularly, services are infrequent and traveling along increasingly congested roadways makes the service largely unreliable for work travel. In addition, having only two bus routes that connect Durham and Chapel Hill, which offer reduced service during off-peak periods, hampers the mobility of transit-dependent populations who live between the two urban centers and also limits the options for connecting workers to the wealth of jobs that are typically concentrated in downtowns.

3.2.4. Need to Foster Compact Development

Current local planning policies within the Durham-Orange Corridor call for managing and focusing new growth into higher density mixed-use developments with a mutually supportive transit system. Both the Town of Chapel Hill and the City of Durham desire to create higher density and more transit supportive land use and development within the Durham-Orange Corridor, from the UNC Hospitals to the eastern portion of urban Durham. This corridor has and is expected to experience significant growth. There is a strong desire to create more compact, pedestrian-friendly mixed-use developments and build on the economic engines of downtown Durham, UNC, Duke University, and their extensive medical facilities. A strong interest exists in providing additional mobility choices for the highly educated creative class in a more pedestrian-friendly mixed-use development. Redevelopment efforts in downtown Durham are focused on creating more compact, mixed-use, and mixed-income development supported by and generating demand for increased transit services.

Challenge: Existing Transit Infrastructure Not Supportive of Land Use Plans

Existing transit infrastructure is limited to traditional bus service, which has virtually no influence on land use and development patterns and presents little opportunity for integrated land use and transit planning consistent with local plans. Within the City of Durham, growth is limited by an adopted Urban Growth Boundary, and within that boundary, the City has established a series of development Tiers to guide new development and redevelopment into distinctive and appropriate development patterns. A key element of achieving the desired land use patterns is the provision of regional fixed guideway transit, which has been incorporated into long-range plans for the City. Much of the land within the Durham-Orange Corridor has been designated as Suburban Transit Areas or Compact Neighborhood Areas. The intent of these designations is to encourage transit, bicycle, and pedestrian-oriented uses and discourage auto-oriented and low-intensity uses. In addition to desiring “24-hours” places through mixed-use development, Compact Neighborhood Area policies seek to “provide for a variety of housing

types to encourage density and the diversity within communities required to achieve efficient use of infrastructure and to generate a foundation of support for neighborhood centers and transit.”¹⁸

Like Durham, the Town of Chapel Hill limits growth to an adopted Urban Services Boundary and has been largely successful at avoiding sprawling development patterns. Given that much of the land within the City is built out, growth management policies focus on infill and redevelopment opportunities. A key strategy is the designation of existing and planned mixed-use districts that both enhance community identity and reduce dependence on automobiles. Several neighborhood-scale mixed-use centers have been established within the Durham-Orange Corridor, as well as a recognized larger Development Opportunity area at the I-40 gateway. Land use policies alone will not achieve the compact mixed-use development pattern desired by the Town; however, in conjunction with high quality transit connections between these mixed-use centers, the Town will be closer to meeting its land use and multimodal transportation goals.

Contrary to these local planning objectives, the flexibility in the delivery of conventional bus services fails to provide the permanency in routing and stop placement necessary to shift current development patterns. In addition, the level of service commensurate with conventional bus service is not competitive with private automobile travel, increasing the demand for existing lower density growth patterns that are more conducive to the automobile. A fixed-guideway system, however, can strategically channel and focus future growth, provide a viable transit option appropriate for high-density development, and solidify the commitment of local governments to realizing articulated visions for growth.

Without a mutually supportive transit system, compact development patterns will be more difficult to achieve. The unparalleled resiliency of the Region’s economic track record paired with the tremendous growth predicted for the Study Area clearly demonstrate the mobility challenges that lay ahead. However, when this economic growth engine is combined with the Durham and Chapel Hill urban growth boundaries as well as long-term planning goal, the combination provides a powerful channelizing force in support of a major transit investment.

Challenge: Existing Transit Infrastructure Does Not Support Long-term Economic Development

It is widely recognized that a more compact and accessible residential, employment, and cultural environment, interconnected via a high-quality fixed-guideway transit system, will allow Chapel Hill and Durham to accommodate projected growth and create a world-class environment. The Durham-Orange Corridor contains major employment engines for the region, including Duke University and Medical Center and UNC. Existing traditional bus service, however, is not viewed by existing or potential area employers as a major public investment in the region’s economy, which is critical for stimulating long-term private sector development interest and investment. A focus for the corridor communities is on enhancing economic opportunities for existing businesses and continuing to attract new businesses. A high-quality fixed-guideway transit investment can be a catalyst for targeted economic development in existing and proposed station areas, enhancing the economic health and vitality of communities. A Dallas, Texas, study found that over an eight-year period ending in 2007, \$4.26 billion in new

¹⁸ Durham Comprehensive Plan, Land Use Element, Policy 2.3.4d

development projects were initiated along the DART rail network.¹⁹ A similar study in Portland, Oregon, identified \$1.9 billion of development along the region's light rail lines.²⁰ Closer to home, Charlotte's LYNX Blue Line opened in 2007; it is estimated that between 2005 and 2011, the area's first light rail line will have spurred \$228.2 million in new development.²¹

A transit system that provides good access to regional employment centers is also more likely to simulate higher land value premiums. Fifteen separate studies in major U.S. cities, most undertaken during the 1990s and early 2000s, found that transit access generally corresponds with higher residential and commercial property values. While the value premium was varied due to local market conditions, the transit impact was measurable and significant, ranging from 2 percent to 45 percent for residential properties, 9 percent to 120 percent for office properties, and 1 percent to 167 percent for retail locations.²² It is, therefore, reasonable to assume that providing a high-quality fixed-guideway transit investment in the Durham-Orange Corridor will encourage further private investment and resulting economic benefits in the area.

Enhanced connectivity between UNC and Duke University can contribute to increased economic competitiveness of the region and, as discussed under the need to support the university travel market, transit linking the two universities is limited. Perhaps the greatest example of the byproduct of collaboration between universities is RTP. Created in 1959, the world renowned research and development center was formed through a partnership between local governments and UNC, Duke University, and North Carolina State University, the latter of which is not located within the Study Area. UNC and Duke University help provide a strong connection for cutting edge research between academics and practitioners. The graduates from these universities supply the businesses located in RTP with a strong pool of employees to work in the high-tech industries, thus contributing to the overall region's competitiveness in the national and world markets. Furthermore, this cooperative effort between the universities has also strengthened the direct connections between the universities, which has driven the need for improved access between the respective campuses and related research arms (e.g., medical centers). Demonstrating the need for connecting service, Duke Transit recently instituted the Robertson Scholars bus, which links Duke and UNC, in order to facilitate cooperation between the two universities and encourage students, faculty, and staff to take advantage of the educational, cultural, and social offerings on both campuses.²³ Similar to other fixed-route bus services in the Durham-Orange Corridor, the new bus operates in mixed traffic and is subject to prevailing roadway conditions. A fixed-guideway transit investment will build on this new service and provide a more viable transit alternative.

¹⁹ Clower, Terry L. et al. *Assessment of the Potential Fiscal Impacts of Existing and Proposed Transit-Oriented Development in the Dallas Rapid Transit Service Area*. Center for Economic Development and Research, University of North Texas. November 2007.

²⁰ Hack J. "Regeneration and Spatial Development: A Review of Research and Current Practice." IBI Group. 2002.

²¹ John M. Muth, P.E., Interim CEO/Public Transit Director, Charlotte Area Transit System. August 14, 2009. 2009 Charlotte Regional Transportation Summit.

²² Fogarty, Nadine. et al. *Capturing the Value of Transit, Center for Transit-Oriented Development*. November 2008.

²³ Source: Robertson Scholars: Express Bus, <http://www.robertsonscholars.org/index.php?type=static&source=68>, accessed December 3, 2010.

3.3. Goals and Objectives

This section lists a set of goals that are directly linked to the Needs listed in Section 3.2. The goals are derived from the Needs and serve as targets for the proposed solutions. This section also provides specific objectives to fulfill the goals. Based on these stated Needs, a set of Goals and Objectives is used to develop and evaluate transit improvement alternatives, as listed in Table 3-4.

Table 3-4 Durham-Orange Corridor Goals and Objectives

Goals	Objectives
Goal 1: Improve mobility through and within the study corridor.	- Minimize future vehicular congestion. - Provide a competitive and reliable option to auto use. - Serve regional trips as well as trips between and within major activity centers.
Goal 2: Increase transit efficiency and quality of service.	- Maintain or improve travel times between existing and planned activity centers. - Provide convenient and accessible transit services for employment and non-employment trips. - Improve and expand transit access for transit-dependent persons.
Goal 3: Improve transit connections.	- Complement existing and planned transportation systems, plans, and infrastructure. - Develop a seamless interface with other local and regional transit systems.
Goal 4: Support local and regional economic development and planned growth management initiatives.	- Develop transit investments that help focus development near activity centers. - Maximize the potential for economic development consistent with regional and local plans and policies.
Goal 5: Foster environmental stewardship.	- Minimize adverse impacts to the natural and built environment. - Utilize and enhance existing and underutilized transportation rights-of-way. - Maintain or improve regional and corridor air quality.
Goal 6: Provide a cost-effective transit investment.	- Maximize capital and operating cost-effectiveness and efficiency. - Meet FTA cost-effectiveness standards.

4. Evaluation Process and Criteria

This chapter summarizes the process used in the definition and evaluation of alternatives. It also demonstrates the relationship of the evaluation process to the Purpose and Need of the project.

4.1. Summary of Alternatives Analysis Process

The Durham-Orange Corridor AA includes a two-step alternatives development and evaluation process comprised of the following:

Conceptual Definition and Evaluation Alternatives: The first level of screening focuses on developing distinct Build Alternatives for detailed evaluation. Conceptual transit technology and alignment alternatives defined at this level of evaluation include recommendations by previous studies and suggestions from stakeholder and public input. The list of alternatives are screened to identify the most reasonable alignment and technology alternatives that address the project's Purpose and Need and should be advanced for more detailed study.

Detailed Definition and Evaluation of Build Alternatives: Detailed alternatives defined at this level of evaluation include combined alignment and transit technologies alternatives remaining after the conceptual screening as well as potential station locations. The alternatives are subjected to a detailed evaluation of ridership, cost, economic development, and environmental analysis. The intent of the evaluation is to recommend a LPA that includes a preferred alignment, transit technology, and station location.

As the alternatives proceed through these levels, they are defined and evaluated at an increasing level of detail. Planning and conceptual design work is completed at each stage that will more clearly specify the physical and operational characteristics of each alternative at each level.

4.2. Evaluation Criteria

The evaluation criteria at each level relate to the six project goals presented in Section 3.3. The criteria evolve through each level, starting with broad, qualitative measures for the conceptual screening and becoming more focused at the detailed level by using both qualitative and quantitative measures. The evaluation criteria for each level of evaluation are presented in Table 4-1.

Table 4-1 Summary of Evaluation Criteria

Goals	Conceptual Screening Criteria	Detailed Evaluation Criteria
Goal 1: Improve mobility through and within the study corridor. Goal 2: Increase transit efficiency and quality of service. Goal 3: Improve transit connections.	Potential transit ridership (<i>Population and Employment Concentrations/ Suitability of Transit Mode</i>)	2035 Ridership Forecasts - Transportation Operations (<i>Traffic Impacts/Travel Times</i>) - Expansion Potential
Goal 4: Support local and regional economic development and planned growth management initiatives.	- Consistency with existing plans and studies - Community support	- Economic Development Potential - Public and Agency Support
Goal 5: Foster environmental stewardship.	Irresolvable environmental impacts	Environmental Impacts (<i>Property, Visual, Wetland and Stream, Section 4(f) Resource, Air Quality, and Construction Impacts</i>)
Goal 6: Provide a cost-effective transit investment.	Technical and financial feasibility	Cost

5. Alternatives Considered

This chapter presents previous studies that have informed the development of alternatives, defines alternatives considered, alternatives considered, the alternative screening criteria, and the process used to eliminate alternatives from further consideration. It details the performance of each alternative with respect to established evaluation criteria and concludes with the recommendation of a LPA. The purpose of this chapter is to fully document the analysis and evaluation of alternatives and to understand the degree to which each alternative would satisfy the Purpose and Need of the project.

5.1. Planning Context

Planning for fixed-guideway transit in the Durham-Orange Corridor has evolved through a decade of integrated land use and transportation planning efforts. Two studies in particular, the US 15-501 Phase I Major Investment Study completed in 1998 and the US 15-501 Phase II Major Investment Study completed in 2001, have already examined and screened a large number of alternatives within the Durham-Orange Corridor. In addition, local jurisdictions have incorporated the findings from these studies into planning efforts. Therefore, the starting point for the development of Build Alternatives is the recommendation from these documents. This section presents the findings most relevant to the definition of alternatives presented in subsequent sections and summarizes the adoption of the recommendations by local governments.

5.1.1. US 15-501 Phase I Major Investment Study (MIS), 1998

The US 15-501 Phase I Major Investment Study (MIS) evaluated a broad range of transportation strategies to improve mobility between the Duke University/Hospital area in Durham and the UNC Hospital/University area in Chapel Hill. The objective of the first phase of the MIS was to identify reasonable and feasible transit and/or highway investment strategies to be carried forward for more detailed study in the second phase of the MIS.

The evaluation process included development of a range of initial study concepts, screening of stand-alone alternatives, refinement of selected concepts into combination alternatives, and evaluation of selected alternatives/strategies and recommendations for the next phase of development.

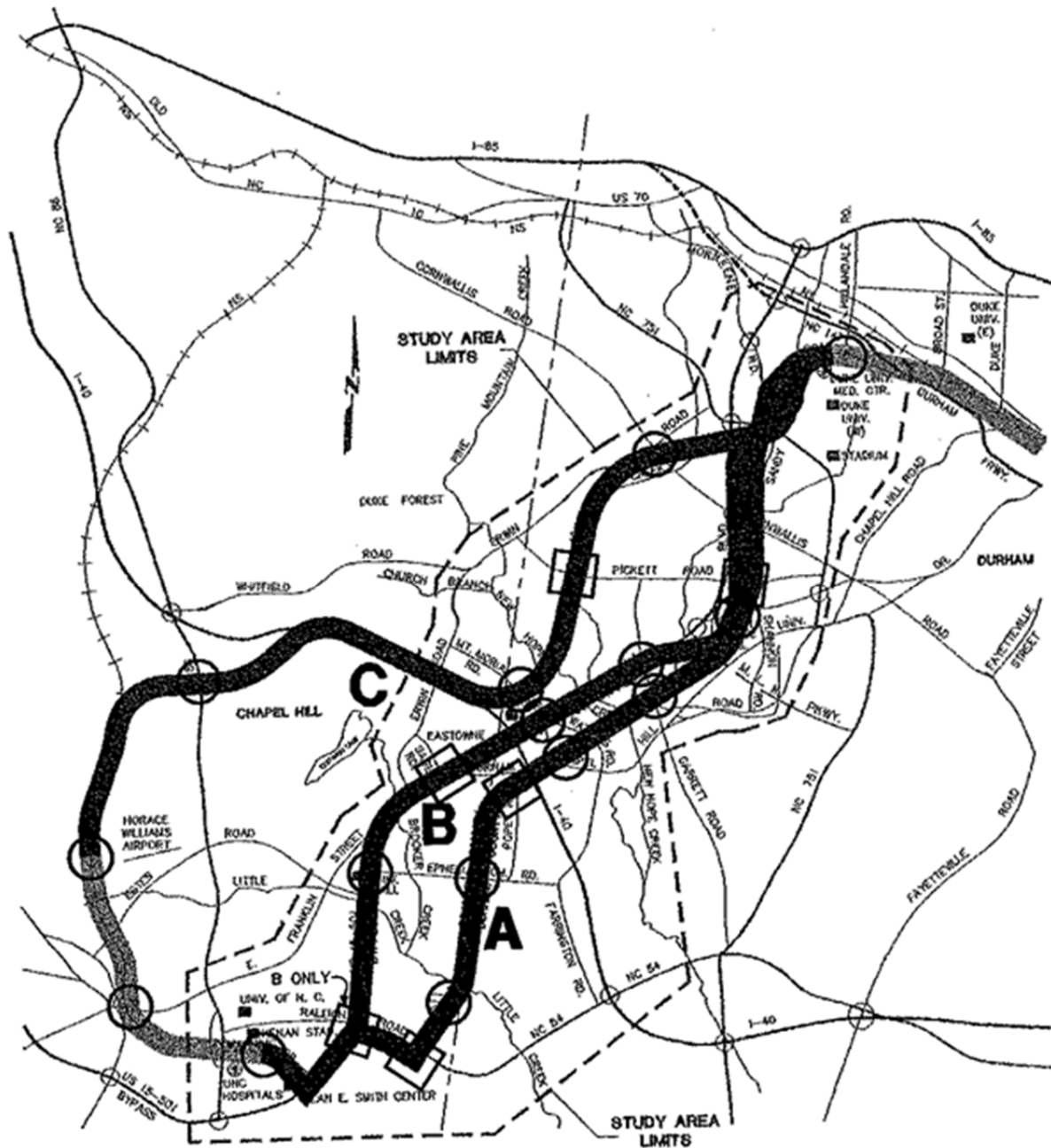
Identification of Initial Study Concepts & Screening of Stand-alone Alternatives

Initial study concepts identified included highway improvements along 15-501 and parallel roadways, a number of travel demand management (TDM) strategies, transit service improvements, and capital investments in transit. These study concepts were evaluated as stand-alone alternatives and “tested” for critical fatal flaws.

The stand-alone alternatives included three alternative rail alignments, Alignments A, B, and C, which are shown in Figure 5-1. Alignment A was adapted from the Triangle Fixed-guideway Study, which was a four-phase study with the primary goal of developing consensus regarding the desirability, feasibility, and location of a regional fixed-guideway transit system. Alignment A generally ran to the east and north of US 15-501 between Duke University Hospital and UNC Hospitals. Alignments A and B had the same termini, but Alignment B was generally contained within the US 15-501 right-of-way between Garrett Road and Manning Drive. North of Garrett Road, Alignment B was similar to Alignment A. Alignment C generally ran to the north and west of US 15-501, with a portion along the existing Norfolk Southern Railroad north of Chapel Hill, providing direct access to the Horace Williams property from Durham as well as downtown Carrboro. Alignment C was eliminated during the initial fatal flaw analysis

because it presented natural and social impacts that were “likely to be serious.” The alignment runs through Duke Forest and could result in substantial residential displacements through Carrboro and Downtown Chapel Hill.

Figure 5-1 US 15-501 Phase I MIS: Corridors A, B, and C



Source: US 15-501 Phase I Major Investment Study (MIS), 1998

The stand-alone alternatives carried forward from the initial screening included:

- No-Build Alternative
- TDM strategies
- Upgrading of US 15-501 to Freeway on both sides of I-40 and only on Durham side of I-40
- Rail Alignments A & B
- High Occupancy Vehicle (HOV) lane
- Busway on proposed rail alignment A

To minimize capital costs, rail alignments A and B were carried forward assuming the use of “regional rail” transit. The use of the diesel multiple unit eliminated costs associated with electrification and was consistent with the technology under consideration for regional rail operations connecting Duke University to Raleigh at the time of the study.

Development & Evaluation of Combination Alternatives The stand-alone alternatives/investment strategies that were carried forward in the study, including the two fixed-guideway alignments (A and B), were then synthesized, as appropriate, into nine distinct combination alternatives for further refinement and evaluation. Table 5-1 shows which physical improvements and investment strategies were combined for each alternative.

Table 5-1 US 15-501 Phase I MIS Alternatives

Physical Improvements / Investment Strategies	Combination Alternatives								
	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H	Alt. I
No-Build	X								
Best TDM Strategies		X	X	X					
Rail Alignment A (to the east and south of US 15-501)			X	X	X				
Rail Alignment B (within US 15-501 right-of-way to Garrett Rd. and Manning Dr., similar to Rail Alignment A north of Garrett Rd.)						X			
At-Grade Expressway on US 15-501 from Franklin St. to S. Square				X	X		X		
Freeway on US 15-501 from I-40 to S. Square					X		X	X	X
HOV on US 15-501									X
Busway Alignment A (to the east and south of US 15-501)							X		
Intensified Land Uses			X						

The nine combination alternatives carried forward were evaluated using a number of evaluation measures. Evaluation criteria included the following:

- Transportation service and mobility effectiveness: change in vehicle miles traveled (VMT) and vehicle hours traveled (VHT) in the Study Area and transit ridership
- Community and environmental impacts: displacement of residences and businesses, impacts to wetlands, historic sites, creek crossings, and noise impacts
- Financial issues: construction and right-of-way costs, vehicle capital costs, and transit operating and maintenance costs
- Input from the public, resource agencies, policy leaders, and the Technical Steering Committee

Through evaluation of the combination alternatives, the following physical improvements and investment strategies were eliminated from further consideration:

- Intense land use around stations: This strategy was eliminated because it did not present a critical difference in transit ridership in the Phase 1 analysis and, while important, essentially addressed a “background” issue. It was recommended that one set of land use data be used for the Phase 2 analysis and that local governments continue to focus on land use in local planning efforts.
- At-grade expressway on US 15-501 north of I-40: The evaluation revealed that the marginal benefit gained in traffic operations did not justify the significant capital expense of building an HOV facility on US 15-501. This was largely due to the limited length of the corridor and the propensity for shorter trips.
- Busway as ultimate technology for fixed-guideway: Rail was retained as the preferred fixed-guideway technology due to its long-term capacity and operating efficiency, higher potential for coordination with the regional rail system from Durham to Raleigh, and the potential for rail to influence land development decisions.

Recommendations for Phase II MIS

Based on screening results and further refinement of the combination alternatives, the study recommended the following physical improvements and investment strategies be carried forward into the US 15-501 Phase II MIS:

- No-Build Alternative
- TSM Alternative comprising all TDM strategies evaluated as part of the combination alternatives
- Capital-Intensive Build Alternative combining the following transit and highway improvements:
 - Upgrade of US 15-501 to a freeway with a sub-option for an at-grade widening of the roadway from Franklin Street to I-40
 - Construction of fixed-guideway transit facility from Duke University to UNC Hospitals in Alignment A. A sub-option would be to investigate a facility along Alignment B or some combination of both Alignments A and B
- US 15-501 as Freeway with Enhanced Bus Service Alternative

In addition to the above alternatives, the study team recommended that the following physical improvements be included as part of all alternatives:

- Construction of “circulation roads” at the US 15-501/I-40 interchange
- Pedestrian and bicycle facility improvements

Refinement of Alternatives Carried Forward from Phase I MIS

Following completion of the Phase I MIS, the busway concept, which was eliminated from further consideration in Phase I, was revisited by the Phase I MIS Steering Committee and Policy Oversight Committee. The study team recommended that a more detailed evaluation of both rail and busway technologies be evaluated prior to selection of the preferred transit technology.

In addition, while results of the Phase I MIS indicated that construction of a fixed-guideway transit facility from Duke to UNC Hospitals along either Alignment A or B would be feasible, Alignment A was favorable in terms of cost and potential ridership. Therefore, Alignment A, which is referred to as Corridor A in the US 15-501 Phase II MIS, was carried forward for more detailed analysis and refinement.

5.1.2. US 15-501 Phase II MIS, 2001

While the Phase I MIS identified all reasonable and feasible highway and transit alternatives, the Phase II MIS focused on refining transit alternatives through more detailed engineering studies and additional public input.

The Phase II MIS developed rail and busway alignments using the Phase I MIS Alignment A (referred to as Corridor A in the Phase II MIS) as a starting point. The study defined alternate alignment options, compared the benefits and disadvantages of each option, and recommended refinements to Alignment A recommended in the Phase I MIS. Extensive public involvement efforts and station area planning workshops informed the transit alignment evaluation and refinement process.

Identification and Screening of Alternative Alignments

The identification and screening of initial alignments by segment is described below.

Duke Area: Seven initial alternative alignment concepts within three corridors (Campus Drive/Anderson Street to University Road, Erwin Road, and NC 147/Durham Freeway) were developed. Three of the alignments were eliminated because they were considered nonviable, and the remaining alignments were carried forward for additional analysis.

South Square to Meadowmont: Four additional alignments were developed due to the desire to attract future transit-oriented development and due to the potential conflicts with proposed US 15-501 road improvements. These alignments were screened based on a number of evaluation criteria and refined into one alignment, and then compared to Corridor A. While the Phase II alignment required more relocations, the more southerly alignment provided a greater opportunity for transit-oriented development.

Meadowmont to Gateway: The Phase I MIS Corridor A, the future Southwest Durham Drive, along with two additional alignments (Western and Eastern), were studied in the Ephesus Church/George King Road area. All three had relatively equal environmental and community impacts; however, Corridor A had better ridership potential and was located in a previously established transportation corridor.

Friday Center to US 15-501/Fordham Boulevard: Between the Friday Center and US 15-501, Corridor A, as carried forward from the Phase I MIS, ran south of NC 54 through underutilized land. Following completion of the Phase I MIS and prior to the start of the Phase II study, additional development occurred within Corridor A and construction of a fixed-guideway would result in impacts to a parking structure, parking lots, and accessibility to office buildings. To avoid impacts, the feasibility of developing an alternative transit alignment within or immediately adjacent to the NC 54 right-of-way was explored. Issues that arose during the evaluation included insufficient median width along NC 54, environmental impacts to natural meadowland areas and additional costs associated with widening NC 54, traffic operations conflicts, visual aesthetic issues, and difficulty siting the Friday Center Station. Based on the analysis, it was determined that Corridor A remain the preferred transit alignment in this segment due to the higher costs and increased traffic conflicts associated with developing a new alignment within or adjacent to NC 54.

UNC Area: Six alternative concepts along two alignments (Raleigh Road and US 15-501/Fordham Boulevard) were developed to compare with Corridor A. The three concepts along Raleigh Road were eliminated during public workshops due to the orientation of future rail expansion and poor circulation. The remaining concepts were combined into three UNC-area station concepts with an additional busway/mixed traffic (BMT) study to identify the optimal BMT alignment through the UNC area. Manning Drive was identified as the preferred alignment for BMT.

Development of Alternatives

Based on the results of the initial alignment screening, alternative technologies were identified and combined with the alignments to form ten discrete Build Alternatives that were carried forward for more detailed evaluation, along with a No-Build alternative. Alternative technologies included Diesel Multiple Units (DMU), light rail transit (LRT), and buses operating in exclusive guideways and/or mixed traffic. The Build Alternatives are listed in Table 5-2. Maps are provided in Appendix A. In general, all rail and exclusive busway Build Alternatives follow the same refined Phase I Corridor A south of Cameron Boulevard and north of Manning Drive. The only variation in alignments for the following alternatives occurs in the Duke University and UNC areas.

Table 5-2 US 15-501 Phase II MIS Alternatives

Transit Technology Alternative	Alignment Description
DMU Alt. 1	Begins at proposed Ninth Street Station and follows “Western” alignment adjacent to the NCRR along US 15-501, entering UNC with a southern alignment.
LRT Alt. 1	Begins at the Ninth Street Station and follows Erwin Road around the Duke Medical Station, turning south into an exclusive guideway segment following the original Corridor A and ultimately entering UNC with a southern alignment. Also assumes TTA ¹ Phase I Regional Rail DMU connection to Duke Medical from Ninth Street using the existing coal spur right-of-way.
LRT Alt. 2	Identical to LRT Alt. 1, without the TTA Phase I Regional Rail DMU connection to Duke Medical.
LRT Alt. 3	Identical to DMU Alt. 1, but with the technology transfer to TTA Phase I Regional Rail DMU occurring at Hillsborough Road Station.
Bus (Exclusive Busway) Alt. 1	Identical to LRT Alt. 1.
Bus (Exclusive Busway) Alt. 2	Begins at Ninth Street Station and enters into an exclusive guideway along Erwin Road near Cameron Boulevard, ultimately entering UNC using “Diamond Lanes” on Manning Drive.
Bus (Exclusive Busway) Alt. 3	Identical to LRT Alt. 3.
Bus (Exclusive Busway) Alt. 4	Similar to Bus Alt. 3, but includes the same “Diamond Lane” concept as Bus Alt. 2.
BMT (Busway/Mixed Traffic) Alt. 1	Hybrid of on-street operation and exclusive busway. but BMT Alt. 1 has fewer segments of exclusive guideway.
BMT (Busway/Mixed Traffic) Alt. 2	Similar to BMT Alt. 1, but has more segments of exclusive guideway.

¹ After completion of the MIS study, Triangle Transit Authority (TTA) changed its brand to Triangle Transit.

Evaluation of Alternatives

The following criteria were used to evaluate the alternative transit technologies and alignments described in Table 5-2:

- Transportation services and mobility: transit coverage, effectiveness, relative traffic/pedestrian conflicts
- Modeling forecasts: increase in transit ridership, new service system boardings
- Community impacts: residential and business displacements, neighborhoods affected, community-sensitive lands affected, relative visual impacts
- Environmental impacts: historic sites, wetlands, new river/creek crossings
- Financial issues and impacts: right-of-way costs, utility relocation, construction costs, vehicle capital costs, total capital costs, transit operation and maintenance costs, transit cost effectiveness
- Physical data: miles of improvements, structures, at-grade intersections, number of stations

The matrix that presents the detailed results of the alternatives evaluation from the Phase II MIS study is presented in Appendix B.

US 15-501 Phase II MIS Observations and Recommendations

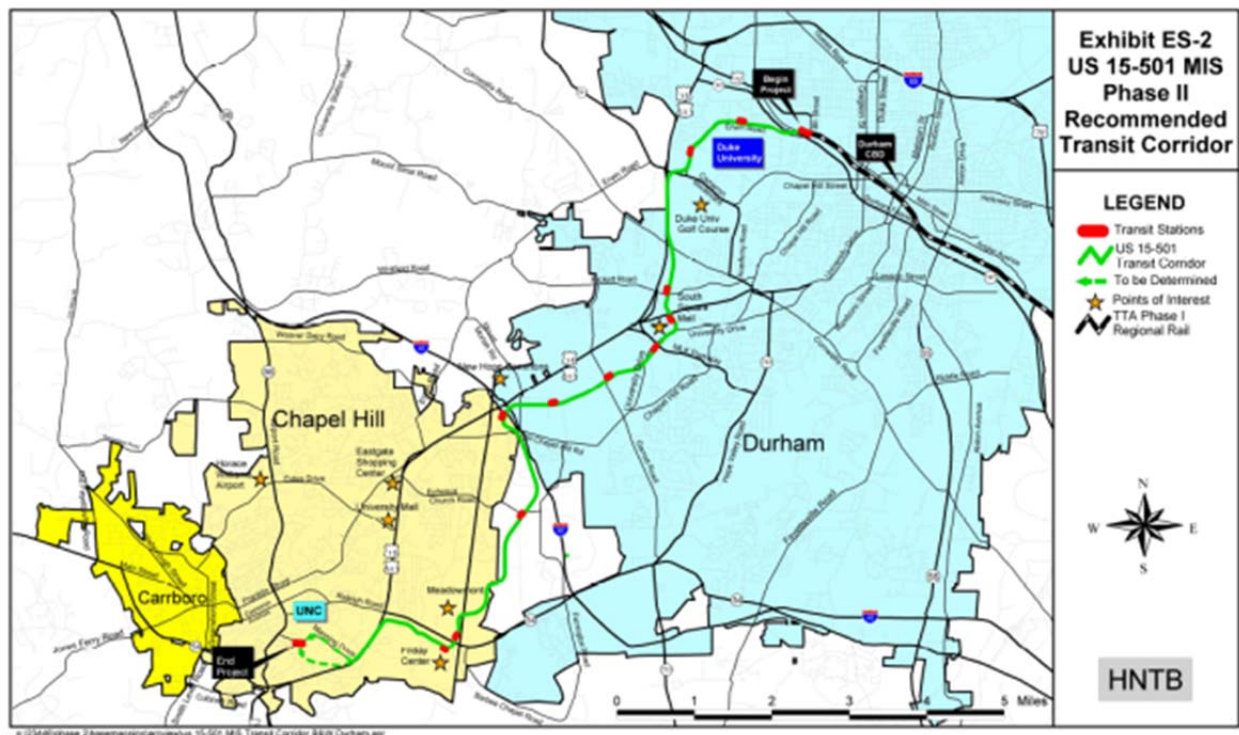
Technology: No determination was made regarding a preferred technology. Due to a possible over-projection of the 2025 future transit base network in the regional travel forecast model, the Phase II MIS Policy Oversight Committee recommended a reevaluation of the future base network and its assumptions prior to finalizing a decision on a specific technology.

Alignment: As previously mentioned, the Phase I MIS Corridor A was further refined in the Phase II MIS to encourage transit friendly development consistent with future land use plans and projected development. All the exclusive guideway alternatives shared the same transit corridor alignment in the area between Cameron Boulevard and Fordham Boulevard.

In general, variations in the fixed-guideway alignment only occurred in the vicinity of the universities. Within the Duke area, the consensus of the Policy Oversight and Technical Committee was that the benefits of a transit corridor along Erwin Road directly serving the University and Duke Medical Center was more desirable than a “Western Alignment” along the NC 147/NCRR corridor in which two cemeteries would be impacted. The Ninth Street Station was also confirmed as a technology transfer point. Within the UNC area, the Policy Oversight Committee did not select a preferred alignment, but deferred the decision to future discussions between the Town of Chapel Hill and the University.

The US 15-501 Phase II Recommended Transit Corridor is shown in Figure 5-2.

Figure 5-2 US 15-501 Phase II Recommended Transit Corridor



Source: US 15-501 Major Investment Study (MIS) Phase II, 2001

5.1.3. Adoption of US 15-501 Phase II MIS Recommended Transit Corridor

The US 15-501 Phase II Recommended Transit Corridor has become an integral component of many planning efforts in Durham and Orange counties. This section summarizes steps taken since the Phase II MIS towards formal adoption and implementation of the recommended transit alignment.

Preservation of Right-of-Way

An objective of the Phase II MIS was to define a transit corridor that could be protected through the development review process to preserve right-of-way for fixed-guideway service in the corridor. Preservation of right-of-way along the fixed guideway alignment has been an important initiative for the City of Durham, the Town of Chapel Hill and both Universities. To date, several areas have been dedicated and reserved along the Phase II MIS recommended transit alignment, including sections along Erwin Road near the Duke Medical Center, north of South Square and along the entire corridor through the Meadowmont community.

UNC-Chapel Hill, while not having an officially adopted policy, has recognized and identified a transit corridor in the campus Master Plan, which follows the Phase II MIS recommended transit alignment from UNC Hospital to Fordham Boulevard and along the Finley Golf Course.

A comprehensive list with locations of right-of-way areas can be found in Table 5-3 and seen in Figure 5-3.

Table 5-3 Durham-Orange Dedicated or Reserved Right-of-Way

No.	Designation	Location Description	ROW (ft)
1	Dedication ¹	Hock Office Tower on Erwin Rd. (E of Douglas St.)	20
2	Dedication	Crosland Development on Erwin Rd. (E of Downing St.)	20
3	Reservation ²	Lakeview Development on Erwin Road (b/w Lasalle St. and Downing St.)	20
4	Reservation	Apartment Complex on the N side of Pickett Rd., opposite Tower Blvd. (along western side, adjacent to the Herald-Sun building)	60
5	Reservation	Patterson Place Phase II Project, along the north side of McFarland Dr.	20
6	Reservation	Entirely through Meadowmont along proposed Transit Corridor	50
7	Reservation	From NC 54/Friday Center Rd. intersection, along Finley Golf Course, terminating at Fordham Blvd.	50
8	In Development*	Expected right-of-way designation as part of Riso Center expansion	Unknown
9	Reservation	Fordham Blvd. to Manning Dr. along Mason Farm Rd.	50

1 Dedication indicates that the right-of-way has been set aside through formal adoption of development plans.

2Reservation indicates that the property owner has agreed not to encroach upon the right-of-way with the development of building or other structures, but the land remains under private ownership.

Adoption by Local Governments

The Phase II MIS recommended that the preferred transit alignment be incorporated into thoroughfare plans and local land use policies (i.e., zoning changes, establishment of public facilities, planning of parks and recreational areas, and issuing building permits). Several land use and transportation plans have since been undertaken using this fixed-guideway transit alignment. A summary of efforts that include the recommended alignment as a component of adopted policy plans are summarized below. Note that many of these plans are also summarized in the Durham-Orange Corridor Alternative Analysis Purpose and Need Report.

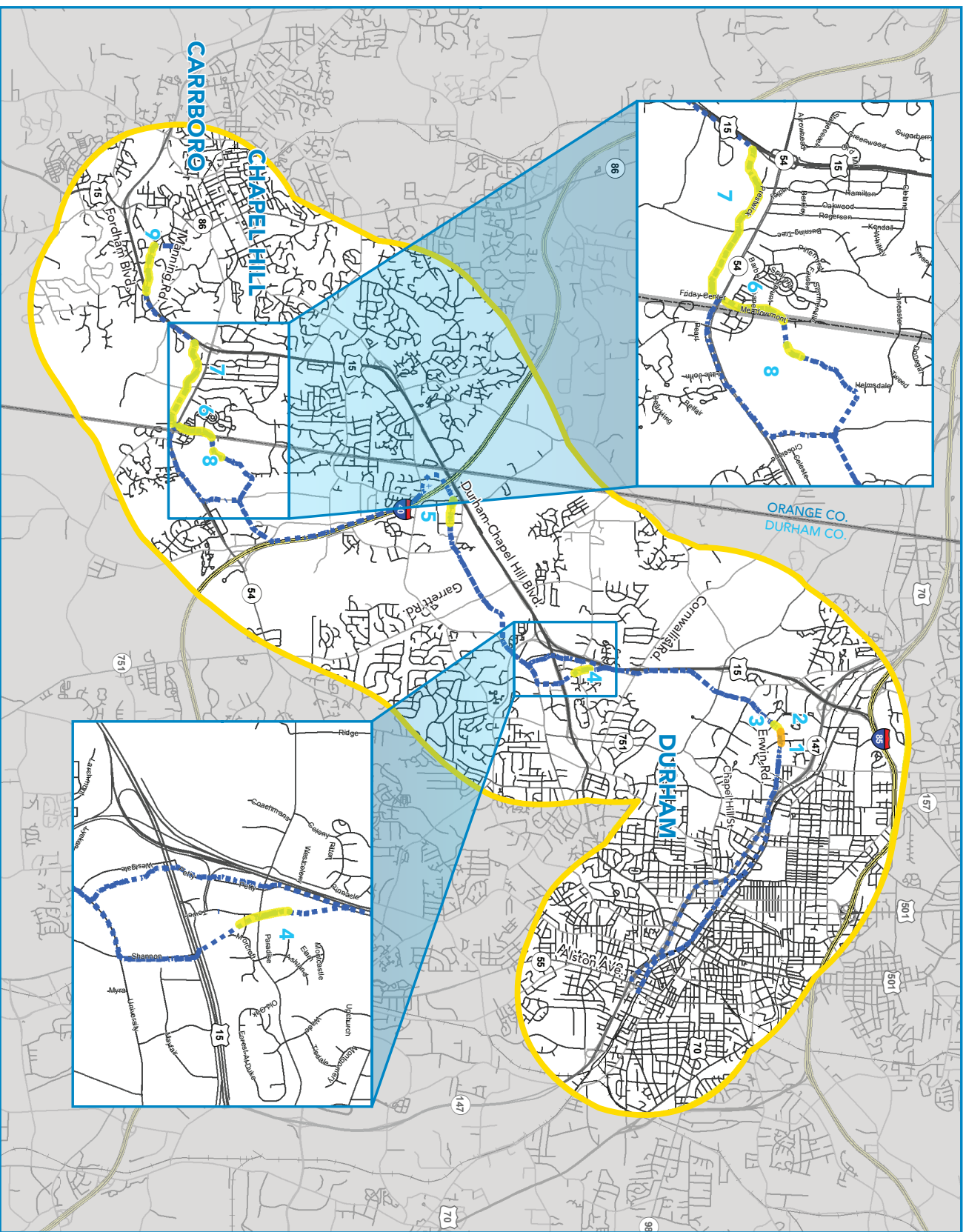
2035 LRTP The adopted 2035 LRTP, developed as a joint effort between DCHC MPO and CAMPO, recommended rail transit utilizing the Phase II MIS Recommended Transit Corridor.

Durham City and County Comprehensive Plan Land use decisions have been made based on the adopted 2035 LRTP transit alignment, which is referenced in the Durham City and County Comprehensive Plan. This plan, adopted in February 2005 and amended in January 2009, states that the “City and County shall support planning for and protection of the transit corridors identified in the most recently adopted version of the Triangle Transit Authority’s Regional Transit Plan.” Furthermore, it mandates that the “City-County Planning Department and the City Public Works Department shall review development proposals in relation to the adopted Regional Transit Plan, and shall seek dedication or reservation of right-of-way along designated transit corridors in conformance with the that Plan.”

The Comprehensive Plan also designates most areas along the transit alignment as either Compact Neighborhood Development areas or Suburban Transit Areas, both of which allow for higher densities and require development to be transit, bicycle, and pedestrian oriented.

LEGEND

-  Study Area
-  Conceptual Alignment
-  Dedicated ROW
-  Reserved ROW
-  Interstate
-  US Route
-  NC Route
-  Local Road
-  Railroad



Southwest Durham/Southeast Chapel Hill Collector Street Plan (CSP) The Transportation Advisory Committee (TAC) for the DCHC MPO adopted the Southwest Durham/Southeast Chapel Hill Collector Street Plan in April 2007. The plan (Figure 5-4) includes the recommended transit alignment and transit circulation, and future transit facilities were a large component in the development of the recommended plan. Better connectivity and accessibility to existing and future transit facilities were closely considered, with dense development expected near proposed transit stations.

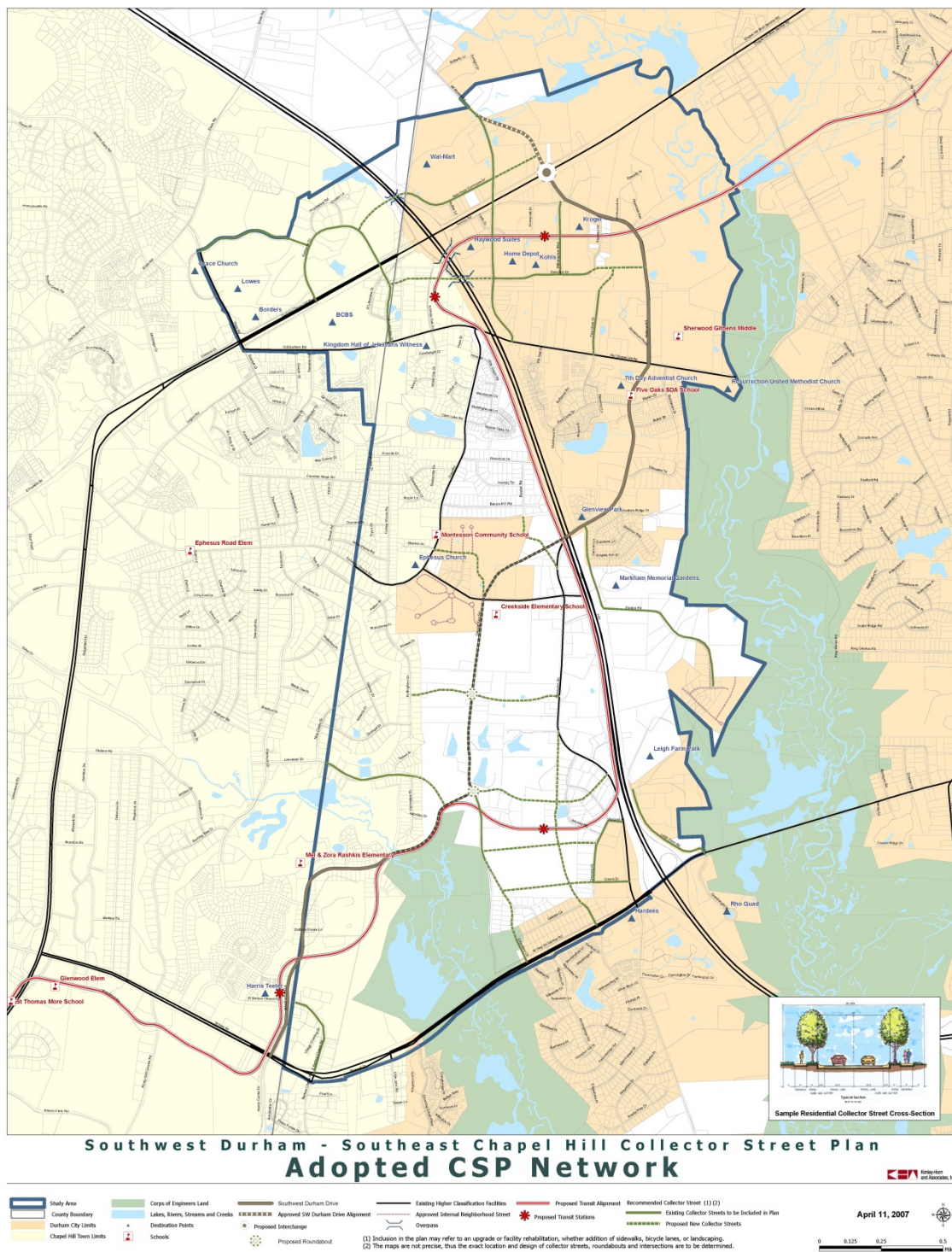
Planning for Chapel Hill's Future: The Comprehensive Plan Because this plan was adopted in 2000, prior to completion of the Phase II MIS, it does not explicitly discuss the recommended transit alignment. The plan does, however, acknowledge its potential implementation by noting the "potential fixed-guideway corridor and potential corridor extensions."

NC 54 Corridor Study The plan, currently under development at the time of publication, references the recommended transit alignment and assumes a number of station overlay areas.

UNC Campus Update The UNC Campus Update acknowledges previous fixed-guideway transit planning. The plan also calls for preservation of a transit corridor starting at Fordham Boulevard just east of Mason Farm Road and terminating in the area of the UNC Hospitals.

Hillsborough Community Connectivity Plan While not directly on the alignment of the proposed transit corridor, future plans for Hillsborough include the mapped transit alignment and recommend future transit stops in the Town.

Figure 5-4 Adopted Southwest Durham/Southeast Chapel Hill CSP Network



Source: Southwest Durham/Southeast Chapel Hill Collector Street Plan (CSP), April 2007

5.1.4. TRTP Durham to Chapel Hill Corridor Alignment West of I-40 White Paper

In 2010, at the request of the Town of Chapel Hill, the Triangle Regional Transit Program (TRTP) project team considered two alignment alternatives to the US 15-501 Phase II recommended transit alignment. The results are documented in a white paper that is provided in Appendix D.

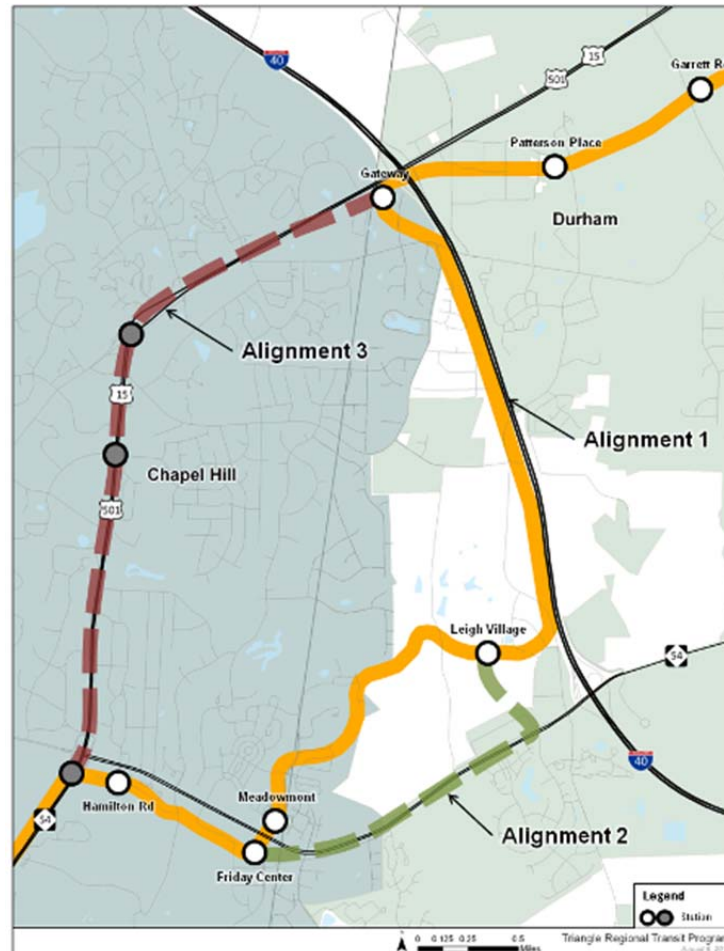
Alignments considered, as depicted in Figure 5-5, are as follows:

- Alignment 1 is the Phase II MIS recommended transit alignment, which is adopted in the 2035 LRTP.
- Alignment 2 closely parallels the NC 54 roadway corridor and is considered to be broadly within the adopted alignment in the 2035 LRTP. Alignment 2 was proposed to avoid crossing the Natural Heritage Area and federally owned land that is associated with the Lake Jordan drainage area, and which is traversed by NC 54 east of Meadowmont.
- Alignment 3 remains on US 15-501/US 15-501 Bypass (Fordham Boulevard) between the proposed Gateway and Hamilton Road station and is outside of the adopted alignment. The Town requested the alignment be considered since: (a) over 10 years had elapsed since the adopted alignment was initially selected and (b) redevelopment along the US 15-501 corridor within Chapel Hill had become a higher priority for the Town.

Following an evaluation of the three alignments, the adopted alignment (Alignment 1) was retained as the preferred routing for the following reasons:

- Transportation and land use plans completed subsequent to the US 15-501 Phase II MIS, as described above, have been prepared and adopted assuming Alignment 1 as the major fixed-guideway transit corridor that includes regionally adopted transit stations.
- A number of land development projects have been completed or are in development based on the adopted alignment and local government land use and transportation plans that reference the alignment.
- The NC 54 corridor has significantly higher population and employment projections for the forecast year of 2035, suggesting higher ridership potential.
- Demonstrated demand for increased park and ride services in the NC 54 corridor and identification of future park-and-ride facility at Leigh Village.
- Limited opportunities for larger park-and-ride facilities in the US 15-501 corridor to serve commuters from the Durham area.
- Potential for expansion of existing bus service in the NC 54 corridor through creation of feeder routes, lowering the burden of CHT on the Town of Chapel Hill's budget, and reducing CHT operating costs through re-deployment of vehicles to other corridors and reduction in the number of buses operating during peak periods.

Figure 5-5 Alignment Options



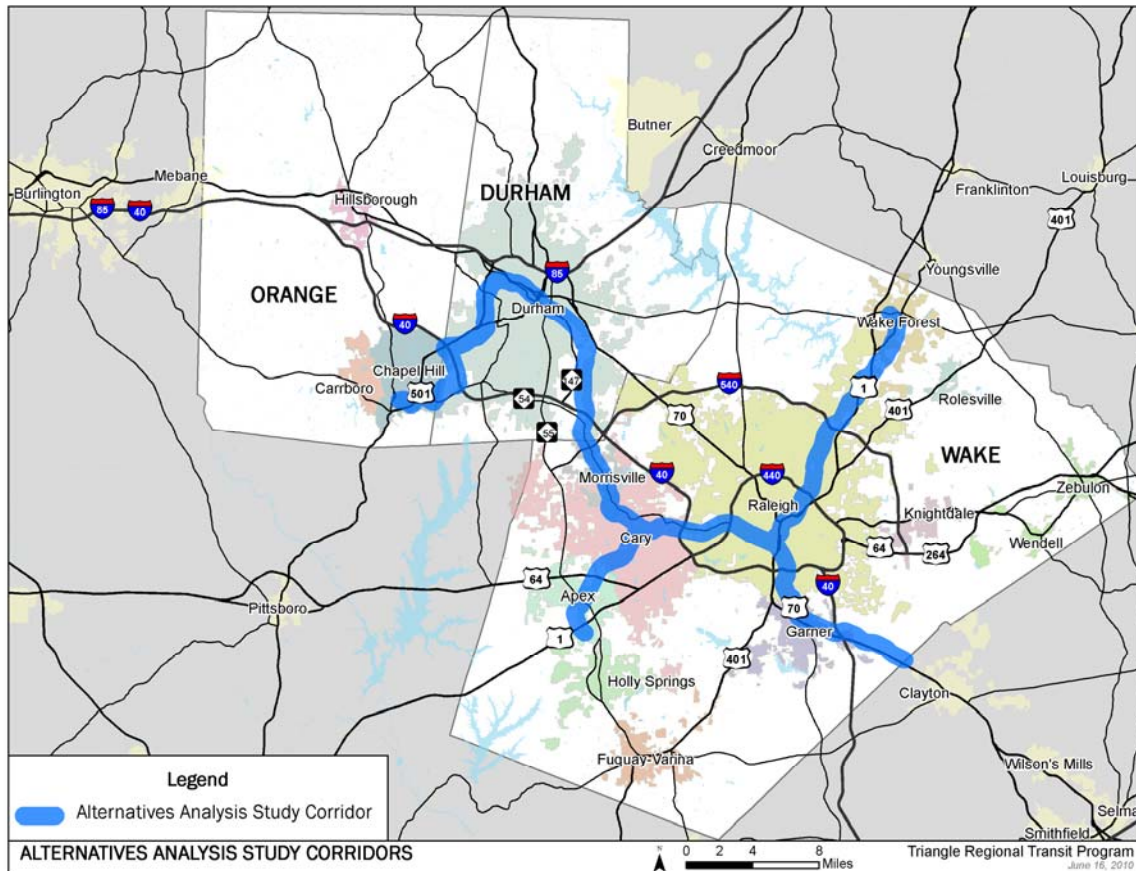
5.1.5. Relevance of US 15-501 MIS Recommendation to Definition of Alternatives

Because the US 15-501 Phase II Major Investment Study extensively analyzed and compared potential fixed-guideway alignments in the Durham-Orange Corridor and concluded with a recommended alignment that has since been adopted by the MPOs and the jurisdictions within the corridor, the recommended transit alignment from this previous study was carried forward into the AA as the base alignment for all Build alternatives between UNC Hospitals and Duke Medical Center, as described in detail in Section 5.2.4.

Triangle Regional Transit Program Transitional Analysis, 2010

The primary purpose of the Transitional Analysis was to define the corridor(s) for inclusion in subsequent Alternatives Analysis studies. The starting point for defining corridors was the adopted 2035 Joint Long Range Transportation Plans (LRTPs) of the region's two Metropolitan Planning Organizations (MPOs). In this region, the two MPOs have adopted a joint LRTP, and the transit element of that LRTP is considered the system plan for transit in the region (Figure 5-6). The Transitional Analysis functioned as the bridge between the system plan in the LRTP and the more focused and detailed study performed in this AA.

Figure 5-6 Transitional Analysis Study Corridors (Derived from 2035 LRTP)



Source: Triangle Regional Transit Program Transitional Analysis, Triangle Transit, 2010

For the Transitional Analysis, the system plan was broken down into a set of smaller corridors that were evaluated in order to recommend a limited number of priority corridors to move forward into the AA process. For the purposes of Transitional Analysis, a corridor consisted of a relatively wide band up to one mile wide with major activity centers identified.

Corridors

Using the 2035 Joint LRTP, as well as input from Triangle Transit, both MPO's, and other stakeholders, eighteen corridors were created for screening: 11 for Wake County, 6 for Durham and Orange Counties, and 1 commuter rail-style corridor for Durham and Wake Counties.

The identification of corridors was widely communicated to elected officials as well as various cities and organizations, including the Town of Cary, Town of Chapel Hill and University of North Carolina representatives, the owners and tenants of the Research Triangle Park, the Wake County Municipalities, the Wake County Technical Committee, the Durham-Orange County Technical Committee and the Public Involvement Steering Committee set up for this project.

Evaluation Criteria

The corridors were evaluated by the consulting team using the following criteria, which were developed in consultation with Triangle Transit, DCHC-MPO, and CAMPO.

Mobility

- Number of daily total trips in corridor (2035)
- Number of daily transit trips in corridor (2035)
- Transit passenger miles traveled (PMT) for rail (2035)
- Relative peak hour corridor travel times for rail and highway travel (2035)

Socioeconomic

- Population and density within a mile-wide corridor (2005 and 2035)
- Number and density of low-income households within a mile-wide corridor (2000)
- Number and density of minority households within a mile-wide corridor (2000)
- Number and density of jobs within a mile-wide corridor (2005 and 2035)

Land Use

- Supports Transit Oriented Development (TOD) (Existing master plans consistent with TOD concepts, level of public sector support and private interest)
- Activity centers served (employment, retail, major institutions, mixed use, special attractions)
- Planned developments in corridor (pipeline development and private sector development plans)

Financial

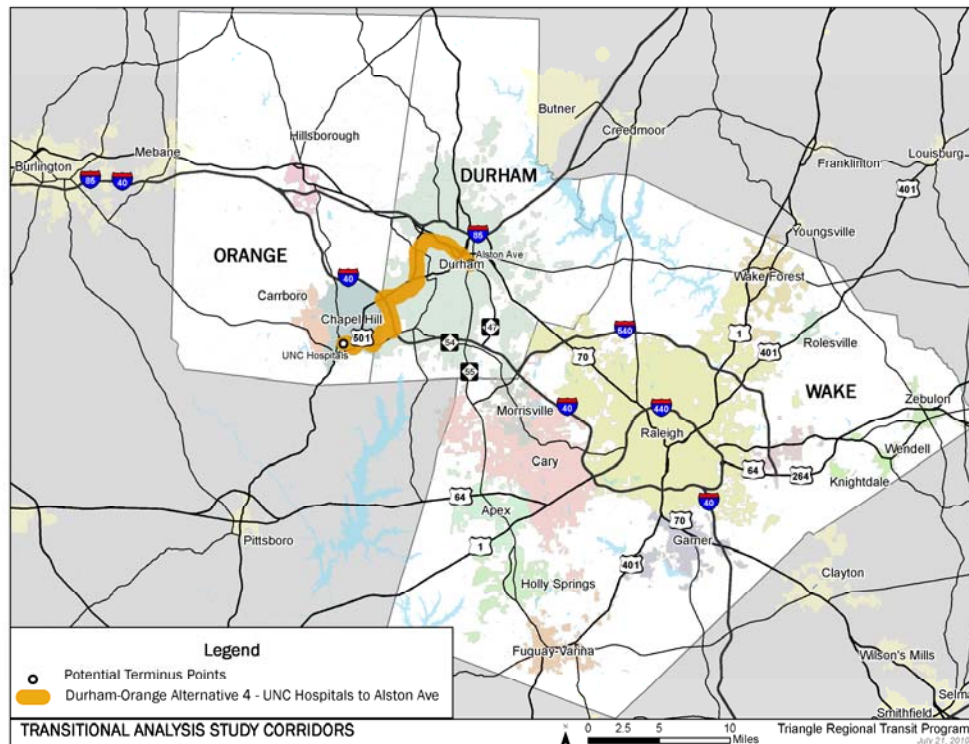
- Total capital cost (2010 Dollars)
- Capital cost per mile (2010 Dollars)
- Capital cost per weekday transit trip
- Capital cost per weekday transit passenger mile traveled
- Total Operating and Maintenance (O&M) cost (2010 Dollars)
- O&M cost per weekday transit trip
- Annual O&M cost per weekday transit passenger mile traveled

Results

Six corridors in Durham and Orange counties were evaluated. Primary discriminators between the alternatives include mobility and cost-effectiveness. Results of the analysis indicate that Durham-Orange Alternatives 4 (from UNC Hospitals to Alston Avenue), was the overall highest performer. Primary differentiators between the alternatives include mobility, socio-economics, and cost-effectiveness. Figure 5-7 illustrates the recommended corridor.

In September 2010, the corridors and evaluation process were presented at six public workshops that were held at various locations throughout the region. In October 2010, the DCHC-MPO ratified Alternative 4, the corridor UNC Hospitals to Alston Avenue, for further study in an AA. This corridor therefore became the starting point for defining fixed-guideway transit alignment and vehicle technology alternatives.

Figure 5-7 Durham-Orange Alternative 4 – UNC Hospitals to Alston Avenue



Source: Triangle Regional Transit Program Transitional Analysis, Triangle Transit, 2010

5.2. Conceptual Alternatives Development and Evaluation

The US 15-501 Phase I and II MIS have provided an enormous amount of information related to feasibility, costs, and ridership that are taken into account as Conceptual Alternatives are developed and reviewed within the AA process, as presented in Section 5.1. If these studies have examined and rejected a significant alternative as being too costly, infeasible, or inefficient, the project team has considered this information and used it in defining a set of “reasonable” conceptual alternatives. Thus, the focus of the conceptual definition and evaluation of alternatives was to refine the alignment recommended in the US 15-501 MIS and identify the most reasonable modes for the Build Alternatives carried forward as alternatives for detailed evaluation. The No-Build and TSM Alternatives were automatically advanced to the Detailed Evaluation of Alternatives (and are defined in Section 5.3.1).

5.2.1. Conceptual Alternatives Evaluation Criteria

The list of conceptual transit technology and alignment alternatives was evaluated relative to their ability to support the project goals and objectives. The evaluation criteria were primarily qualitative in nature and their purpose was to eliminate conceptual transit technology and alignment alternatives that do not support project goals and objectives. All six goals and their related evaluation criteria and measures used to screen the alternative transit technologies and alignments are presented in Table 5-4.

Table 5-4 Conceptual Alternatives Evaluation Criteria

Goals	Evaluation Criteria	Measure
Goal 1: Improve mobility through and within the study corridor. Goal 2: Increase transit efficiency and quality of service. Goal 3: Improve transit connections.	Potential transit ridership	Qualitative review of suitability of the mode or alignment in meeting travel needs.
Goal 4: Support local and regional economic development and planned growth management initiatives.	Consistency with existing plans and studies	Qualitative review of adopted local and regional plans to determine consistency of alternatives with existing (1) mobility, (2) land use and development plans, and (3) economic development goals and policies.
	Community support	Results from public and agency stakeholder meetings.
Goal 5: Foster environmental stewardship.	Irresolvable environmental impacts	Qualitative assessment of potential impacts on sensitive environmental issues and conditions within the Corridor Study Area. Examples could include impacts to natural and cultural resources and environmental justice populations and any known "fatal flaws."
Goal 6: Provide a cost-effective transit investment.	Technical and financial feasibility	Examination of design and constructability issues to determine whether (1) a conceptual mode or alignment has any known engineering fatal flaws, or (2) a conceptual mode or alignment has a much greater complexity than those that provide a similar transportation function (such as greater construction difficulty or right-of-way needs).

The conceptual alternatives evaluation was conducted as a two-step process. The first step was a transit technology (mode) evaluation. Transit technologies were evaluated and screened for their ability to meet the criteria listed above. At this level of analysis, each alternative was rated as "Pass/Fail" in their ability to meet the evaluation criteria. The second step evaluated conceptual alignments for their ability to meet the criteria listed above. The results of the two-step conceptual alternatives evaluation process was a list of recommended alternatives to be carried forward into a more detailed evaluation.

5.2.2. Definition of Conceptual Transit Technology Alternatives

Because a preferred transit technology was not selected through the course of the previous MIS studies, alternative modes were considered and evaluated in the definition and evaluation of conceptual alternatives for this AA. Through stakeholder and public involvement, the project team identified five potential high-capacity transit modes for the Durham-Orange Corridor: Bus, Bus Rapid Transit (BRT), Streetcar, Light Rail Transit (LRT), and Commuter Rail. Other transit technologies, such as Maglev or Heavy Rail, are not included in this analysis since it was determined that none of these alternative technologies would be able to address the full Purpose and Need of the proposed investment.

Table 5-5 provides a comparison of transit technology characteristics and a general overview of the guideway, vehicles, propulsion/suspension, stops/stations, costs, and operations for each proposed mode follows. A summary of basic bus technology is included as a baseline comparison, as this would be the mode in the No-Build and TSM alternatives.

A brief summary of the transit technology alternatives considered follow the table. Additional information on technology characteristics may be found in the Conceptual Alternatives Technical Report (Triangle Transit, 2011).

Table 5-5 Transit Technology Comparison

Typical Characteristics	Bus	Bus Rapid Transit	Modern Streetcar	Light Rail Transit	Commuter Rail
Service Type	Regional, urban	Regional, urban	Urban, circulator	Regional, urban	Regional, intraurban
Vehicles	Standard, Articulated	Standard, Articulated	Articulated, Single	Articulated, multiple unit	Single, Bi-level
Vehicles per Set (Train or Consist)	1	1	1 - 2	1 - 4	3 - 12
Seated Capacity per Vehicle	Standard: 40	Standard: 40	30-44	32 - 90	Standard: 56 - 88
	Articulated: 65	Articulated: 65			Bi-level: 124 - 136
Guideway	Mixed traffic	Exclusive right-of-way (busway or transitway), dedicated travel lane in-street	Mixed traffic	Fixed-guideway in exclusive right-of-way or dedicated travel lane in-street	Fixed-guideway in exclusive right-of-way, completely separate from automobile traffic
Propulsion (Power Supply)	Diesel or alternative fuel	Diesel or alternative fuel	Electric with overhead catenary wire	Electric with overhead catenary wire	Electric, diesel-electric, or dual-mode locomotive engine pulling multiple push-pull passenger cars
Suspension	Rubber tire on pavement	Rubber tire on pavement	Steel wheel on steel rail	Steel wheel on steel rail	Steel wheel on steel rail
Stop/Station Spacing	$\frac{1}{10}$ - $\frac{1}{4}$ mile	$\frac{1}{4}$ to 2 miles	$\frac{1}{4}$ mile	$\frac{1}{4}$ - 2 miles	2 - 10 miles
Operating Speed	25 - 45 mph	55 - 65 mph	8-12 mph	20-65 mph	30-60 mph
Route Length	Varies	2 - 40 miles	2 - 10 miles	5 - 20 miles	20 - 100 miles
Maximum Grade	10% to 13%	10% to 13%	9%	7%	4%
Capital Cost per Mile	< \$1 million	\$25-55 million	\$12-25 million	\$80+/- million	\$8-25 million, dependent on whether additional track is needed

Bus

Buses are rubber-tired vehicles that generally operate on roadways in mixed traffic and are the most widely utilized transit mode. Buses are the most flexible form of transit. They can operate in mixed traffic or in exclusive guideways and offer unparalleled routing flexibility. In addition, the vehicles are adaptable to a variety of fuels. New bus systems have lower capital costs than other modes. While systems are flexible, they have limited capacity and relatively slow travel times and speeds.



Triangle Transit, Regional Bus

Bus Rapid Transit

Bus Rapid Transit (BRT) is an enhanced bus system that blends the flexibility and relatively lower cost of buses with the efficiency of rail. BRT systems typically feature high-frequency, all-day service, exclusive right-of-way, level boarding, off-board fare payment, distinctive stations or stops, a quality image and unique identity, and application of Intelligent Technology Systems (ITS).

Relative to rail modes, flexibility is a primary advantage of BRT systems. Vehicles can travel in both dedicated and nondedicated rights-of-way and smoothly transition between the types of guideways. Other benefits include improved operating speeds and reliability due to elimination of various types of delay, as well as moderate to high vehicle capacities at a lower cost than rail. Compared with conventional bus, however, BRT yields higher capital costs and has somewhat less flexible routing. Operating in mixed traffic can compromise the travel times of BRT, thereby reducing the reliability benefits inherent in systems that run in exclusive guideways.



Eugene, OR, Bus Rapid Transit

Streetcar

Streetcar systems consist of electrically powered rail vehicles operated in one to three car sets. Vehicles usually share travel lanes with other traffic. Streetcars complement pedestrian-friendly development and activity and, in recent years, have reemerged as a high-quality transit alternative to support compact and higher-density development in cities that cannot afford, or do not have sufficient demand for larger rail systems.



Seattle, WA, Streetcar showing Overhead Wire

There are two classifications of streetcars: "heritage" and "modern."

The primary difference between the two is the vehicle design. Heritage streetcars preserve the look and feel of trolleys dating back to the early 1900s, while modern streetcars incorporate the advanced technology of light rail transit, enabling quieter and smoother running vehicles. The following discussion is limited to the modern streetcar because this type allows faster boarding due to its low-floor design; it also has a higher capacity.

Streetcars are best used in dense urban centers, particularly where parking is scarce; they are well suited to circulation and short trips. Vehicles can serve constrained station areas and streets, and negotiate sharp turns and narrow rights-of-way. Streetcars are not designed for long distances and corridors requiring high capacities or high speeds. Similar to buses, operating in mixed traffic can slow travel speeds and times.

Light Rail Transit

Light Rail Transit (LRT) is typically an electrically powered, at-grade rail mode featuring high-capacity vehicles. LRT is suitable for medium-distance trips in suburbs and between central business districts and other major activity centers.

LRT technology offers flexibility in alignment. Vehicles may operate in mixed traffic or in an exclusive right-of-way, and in a variety of transit envelopes, including at-grade, elevated, or in a tunnel. The distance of a typical LRT corridor is between 5 and 20 miles. Because LRT typically operates high-frequency peak, off-peak, and weekend service, market forces generally respond to this high level of transit access by focusing high-density development around stations.



Charlotte, NC, Light Rail Transit

Commuter Rail

Commuter Rail Transit (CRT) service is typically provided between a central city and adjacent suburbs using railroad passenger cars. Trips served are mainly daily work trips, and service is generally concentrated in the morning and afternoon peak hours (though limited midday and evening service is often provided on many systems). Stations typically have park-and-ride and bus access.



Dallas, TX, Commuter Rail Train at Union Station

CRT typically provides service between suburbs to urban centers for the purpose of reaching activity centers and employment destinations. Designed primarily to meet the needs of regional commuters in the AM and PM peak travel times, commuter rail service also occurs at lower frequencies than LRT. The distance of a typical commuter rail corridor is also longer than that of light rail, ranging from 20 to 80 miles.

5.2.3. Conceptual Transit Technology Alternatives Evaluation Results

Table 5-6 summarizes the results for the evaluation of modal alternatives. Conventional bus is not included because it was automatically carried forward as the mode for the No-Build and TSM alternatives in the Detailed Evaluation of Alternatives and is a supporting element of each Build Alternative. Receiving a “fail” in at least one category automatically eliminated an alternative from further consideration. An explanation of the recommendation provided for each mode follows the table.

Table 5-6 Transit Technology Evaluation Results

Goals	Evaluation Criteria	BRT	Streetcar	LRT	CRT
Goal 1: Improve mobility through and within the study corridor. Goal 2: Increase transit efficiency and quality of service. Goal 3: Improve transit connections.	Potential transit ridership	Pass	Fail	Pass	Fail
Goal 4: Support local and regional economic development and planned growth management initiatives.	Consistency with existing plans and studies	Pass	Pass	Pass	Pass
	Community support	Pass	Pass	Pass	Pass
Goal 5: Foster environmental stewardship.	Irresolvable environmental impacts	Pass	Pass	Pass	Pass
Goal 6: Provide a cost-effective transit investment.	Technical and financial feasibility	Pass	Pass	Pass	Fail
Final Recommendation		Advance	Eliminate	Advance	Eliminate

Transit Technology Alternatives Eliminated

Based on the results of the analysis, Streetcar and CRT were eliminated from further consideration. Factors contributing to the recommendation to eliminate technology alternatives are discussed below.

Streetcar

Streetcar was eliminated from further consideration because the mode does not sufficiently enhance mobility, increase transit efficiency, or improve transit connections throughout the project corridor. Specifically, streetcar did not meet the following goals:

Goals 1 through 3: Streetcars operate in mixed traffic and, similar to conventional bus, are subject to prevailing roadway conditions. While vehicles offer a higher level of comfort and accommodate a higher number of passengers per vehicle than conventional bus, there is no improvement in reliability or travel speeds, which are two considerable attributes for attracting choice transit riders. The fixed guideway limits the ability of the streetcar to avoid sudden traffic disruptions such as accidents. Thus, in some cases, streetcar may yield higher end-to-end travel times than buses. Streetcar was also not advanced because the mode is most suitable for travel within urban cores where there are high populations and employment densities and stops are closely spaced. While the mode could be appropriate within Chapel Hill and downtown Durham, it does not provide the appropriate level of service for the lower density development patterns in between the two areas. The mode will not offer competitive travel times and speeds necessary to address the Purpose and Need for the project.

CRT

CRT was not advanced into the detailed evaluation of alternatives because it will not enhance mobility within the corridor as effectively as other transit technologies, is limited in the level of service provided to high need populations, and is cost prohibitive. Specifically, CRT did not meet the following goals:

Goals 1 through 3: While CRT will provide shorter end-to-end travel times than existing service and high speeds that are competitive with the private automobile, the commuter service is limited to peak times and thus will not offer an overall improvement in the availability of transit in the corridor. In addition, the travel demand in the corridor is not unidirectional and will require similar levels of services both into and out of Chapel Hill and Durham. CRT stations are also generally spaced between 3 and 5 miles apart, and will, therefore, not be able to serve the high levels of intra-subarea travel that are better served by other transit technologies that operate between more closely spaced stations.

Goal 6: CRT presents the highest capital costs of the modes under consideration. Similar to LRT, it will require new trackage for the length of most of the proposed alignment. Since CRT cannot safely run in roadway sections, it will require a completely separate right-of-way, which is not physically practical when considering the areas to be served and the existing built environment. The operating grade limitation of 4 percent for CRT vehicles and coaches will also yield an impractical alignment, given the terrain of the corridor and considering the multitude of grade separations that are necessary to mitigate traffic impacts when crossing high-capacity roadways. This will result in an elevated structure through Duke University, which is completely unacceptable to the University, as stated in coordination meetings. At UNC, an elevated structure will also be required, as in some locations grades approach 6 percent, exceeding the CRT operating grade limitation. The height and scale of this type of structure, relative to the scale of the surrounding environment, would not be prudent and would be unacceptable to UNC.

Transit Technology Alternatives to Advance

Based on the outcome of the technology analysis, two vehicle technology options were advanced for detailed analysis: BRT and LRT.

BRT

BRT is a reasonable mode for the Durham-Orange Corridor because it supports all of the stated goals and objectives for the project. The separate right-of-way will likely attract higher ridership and will provide travel times and speeds that compete with the automobile and are not subject to increasingly congested roadway conditions in 2035. Service can run at high frequencies in both directions all day and offer improved reliability. Vehicles offer higher capacities, better performance, and a stronger image than conventional buses. In addition, the low-floor vehicles with multiple doors coupled with off-board fare payment options increase overall comfort and ease for boarding passengers. As BRT offers many of the same benefits as rail and operates in a separate right-of-way, it does offer some support to existing plans and studies that assume implementation of a higher capacity service in the Durham-Orange Corridor. BRT will offer a cost-effective investment and ongoing operating costs will be similar to existing levels of service.

LRT

LRT is a reasonable modal alternative for the Durham-Orange Corridor. Similar to BRT, LRT right-of-way offers great reliability, as well as easy and rapid access by boarding passengers. In addition to all of the benefits of BRT, LRT offers quieter vehicles, and the steel wheels on rail offer a slightly greater level of comfort for passengers over rubber-tired vehicles on streets. LRT is environmentally friendly because it does not emit exhaust fumes. The system offers a higher capacity than BRT and, unlike CRT, is pedestrian friendly and can run in-street. It can also offer frequent stops, providing a level of service that balances the needs of persons traveling from end-to-end with those travelling high-demand intra-subarea trips. Although the service will require construction of tracks, it does not require the full control of access necessary for CRT systems, yielding a lower investment cost. In addition, LRT systems in

general have a high safety record. Benefits of LRT systems in other cities, as discussed in Section 3, have generated substantial economic benefits and can support the compact development patterns called for in local plans. In addition, the technology directly supports the Regional Transit Vision Plan, which specifically recommended LRT between Chapel Hill/Carrboro and downtown Durham.

5.2.4. Definition of Conceptual Alignment Alternatives

As previously noted, the recommended transit alignment from the US 15-501 Phase II Major Investment Study was carried forward into the AA as the base alignment for all Build alternatives between UNC Hospitals and Duke Medical Center. The base alignment and conceptual alignment alternatives are described below.

Base Alignment

The alignment begins at UNC Hospitals on the southern portion of the UNC campus in Chapel Hill, with a possible extension north into downtown Chapel Hill. From UNC Hospitals, the line runs east along Fordham Boulevard and NC 54 in Chapel Hill, passing by UNC's Friday Center, and through the Meadowmont development to the proposed Leigh Village development in southwest Durham. From Leigh Village, the alignment runs north on the west side of, and parallel to, I-40 until the interchange of I-40 and US 15-501, where it heads northeast through the Patterson Place development. From Patterson Place, the alignment continues northeast, crossing Garrett Road and Martin Luther King, Jr. Boulevard and traversing the South Square commercial area. Going north from South Square, the alignment runs along the east side of US 15-501 and turns east along Erwin Road to the Duke Medical Center. Alignment alternatives east of the Duke Medical Center to the end-of-line are described as Alignment C1 and C2 below.

Alignment Alternatives

Since completion of the US 15-501 Phase II MIS, either (1) new development, (2) transit technology considerations, or (3) more detailed environmental information than was used warrant the need to consider alternate routes to specific segments of the base alignment. These conceptual alignment alternatives, along with the general location, are described below and illustrated in Figure 5-8.

A. UNC Hospitals

The UNC Hospitals area is the western terminus of the project corridor and is generally defined as the southern campus area between the UNC Hospitals, Manning Drive and Fordham Boulevard. Alternatives were conceptualized in this area to accommodate the possible future extension of the proposed transit system to the west through Chapel Hill and into Carrboro. Destinations in the area include the UNC Hospitals, the Dean E. Smith Center, student housing, and other academic buildings on campus.

A1. Mason Farm Alternative The Mason Farm alternative begins at the UNC Hospital Dogwood Parking Deck and travels southeast along Mason Farm Road by the Odum Village, before rejoining the base alignment near the Mason Farm Road/Fordham Boulevard intersection. This alternative is identified in the UNC Campus Master Plan and having the alignment terminate at the Dogwood Parking Deck is an imperative set forth by the university.

A2. Hibbard Drive Alternative The Hibbard Drive alternative begins at the UNC Hospital Jackson Parking Deck, near the intersection of Manning Drive and Hibbard Drive, and travels south through Odum Village, before turning southeast along Mason Farm Road. Alternative A2 rejoins the base alignment near the Mason Farm Road/Fordham Boulevard intersection.

B. Meadowmont

The Meadowmont area is generally defined as the area along NC 54, from the US 15-501 split to Friday Center Drive/Meadowmont Lane intersection. Several alternatives were conceptualized in this area due to several destinations including: Meadowmont Subdivision, the Finley Golf Course and the Friday Center.

B1. Finley Golf Course Alternative The Finley Golf Course alternative follows the same route east along Prestwick Road, and continues east along the edge of the golf course across Finley Golf Course Road, before turning northeast towards NC 54 after the golf course. Alternative B1 rejoins the base alignment in the vicinity of the Friday Center Drive/Meadowmont Lane intersection.

B2. NC 54 Alternative The NC 54 alternative travels east along Prestwick Road by the Finley Golf Course, turns northeast at Finley Golf Course Road towards NC 54 and runs along NC 54 before rejoining the base alignment in the vicinity of the Friday Center Drive/Meadowmont Lane intersection.

C. Leigh Village

The Leigh Village area is generally defined as the area around NC 54, George King Road and Farrington Road. Several alternatives were conceptualized in this area due to the future development of the Leigh Village planned community, and potential impacts to wetlands associated with the water supply watershed of Lake Jordan.

C1. Meadowmont Lane Alignment The Meadowmont Lane alignment follows Meadowmont Lane north along the Durham/Orange County Line, before turning northeast across a wetland area and skirting federally owned land that is also associated with the Lake Jordan drainage area. The alignment then crosses George King Road before connecting with Farrington Road. Alternative C1 rejoins the base alignment slightly north of Rutgers Place.

C2. George King Road Alignment The George King Road alignment runs from the vicinity of the Friday Center Drive/Meadowmont Lane intersection along NC 54 and turns north along George King Road; it then turns northeast before rejoining the base alignment at Farrington Road slightly north of Rutgers Place.

C3. Farrington Road Alignment The Farrington Road alignment is similar to the George King Road alignment, C2; however, it continues east along NC 54 past George King Road, turning north onto Farrington Road. Alternative C3 rejoins the base alignment slightly north of Rutgers Place.

D. South Square

The South Square area is generally defined as the area bordered by Westgate Drive, University Drive, Shannon Road, and Tower Boulevard. Alternatives were conceptualized in this area due to the complexity of accessing the South Square Shopping Center and crossing Durham-Chapel Hill Boulevard.

D1. Westgate Drive Alignment The Westgate Drive alignment travels east along University Drive before turning north along Westgate Drive, crossing Durham-Chapel Hill Boulevard and paralleling US 15-501 along Petty Road/Western Bypass, and then rejoins the base alignment just north of Pickett Road.

D2. Durham-Chapel Hill Connector Alignment The Durham-Chapel Hill Connector alignment travels east along University Drive, turns north along Westgate Drive, and crosses Durham-Chapel Hill Boulevard. It then travels east along Durham-Chapel Hill Boulevard, turns north and runs along Tower Boulevard, and rejoins the base alignment just north of Pickett Road.

D3. Shannon Road Alignment The Shannon Road alignment travels east along University Drive, past Westgate Drive, before turning north along Shannon Road, crossing Durham-Chapel Hill Boulevard and following US 15-501 along Tower Boulevard, before rejoining the base alignment just north of Pickett Road.

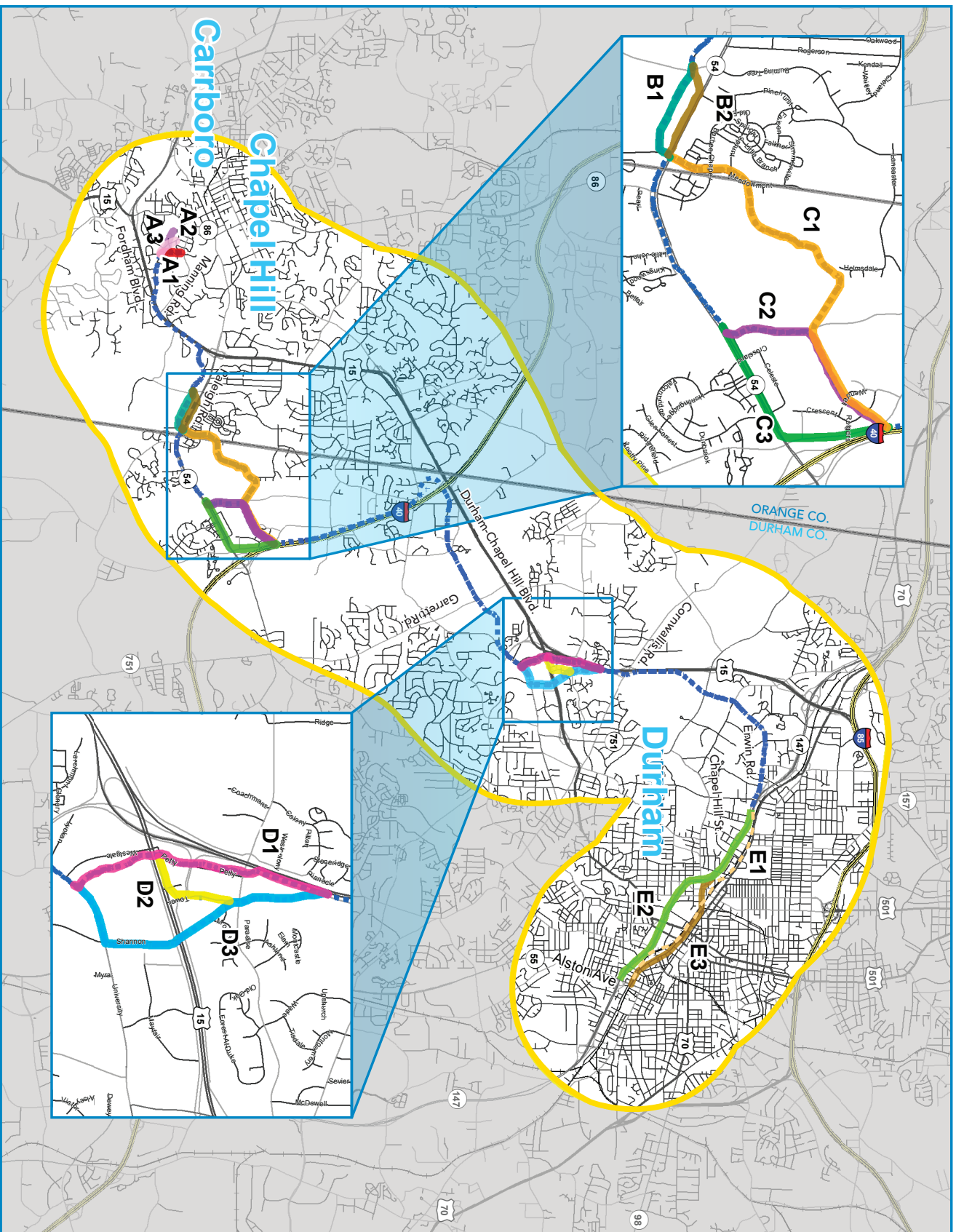
E. Downtown Durham

The Downtown Durham area is the area between Duke Medical Center and Alston Avenue. An alternative was developed to study an alignment alternative off the existing rail right-of-way through downtown Durham.

E1. Railroad Alignment The Railroad alignment is considered part of the base alignment in the Durham-Orange Corridor. This alignment alternative begins east of Duke Medical Center where the alignment crosses NC 147 (Durham Freeway) and enters the NCRR right-of-way. The alignment runs east through downtown Durham on a parallel track within the NCRR right-of-way to Alston Avenue, with a possible extension to Briggs Avenue.

E.2 NC 147 Alignment The NC 147 alignment separates from the base alternative east of the Duke Medical Center where the alignment enters NC 147 (Durham Freeway). This alternative follows NC 147 to Alston Avenue, with a possible extension to Briggs Avenue.

FIGURE 5-8
DURHAM-ORANGE
CONCEPTUAL ALIGNMENTS



5.2.5. Conceptual Alignment Alternatives Evaluation Results

Table 5-7 summarizes the results for the evaluation of conceptual alternative alignments.

The base alignment and alignment alternatives were presented to the public for consideration and comment during a series of open-house style workshops held September 14-23, 2010. The public had no substantial opposition to any of the conceptual alignments presented.

Table 5-7 Conceptual Alignment Evaluation Results

Goals	Evaluation Criteria	Base Align-ment	LRT/BRT										LRT	BRT	
			A1*	A2	A3	B1	B2*	C1*	C2	C3	D1	D2			D3*
Goal 1: Improve mobility through and within the study corridor. Goal 2: Increase transit efficiency and quality of service. Goal 3: Improve transit connections.	Potential transit ridership														
	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Goal 4: Support local and regional economic development and planned managed growth initiatives.	Consistency with existing plans and studies	Pass	Fail	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Pass	Pass	Pass	Pass	Pass
	Community support	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Goal 5: Foster environmental stewardship.	Irresolvable environmental impacts	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
Goal 6: Provide a cost-effective transit investment.	Technical and financial feasibility	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Pass	Fail	Pass	Pass	Pass
Final Recommendation for Advancement (Yes, No)		Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes

*These alignment alternatives are included as part of the base transit alignment recommended from the US 15-501 Phase II MIS.

Alignment Alternatives Eliminated

Alignments A2, C3, and D2 were eliminated from further consideration. Factors contributing to their elimination are presented below.

UNC Hospitals Alignment A2: Hibbard Drive Alternative

The UNC Hospitals A2 Alternative was not advanced into the detailed evaluation of alternatives because it is not consistent with local plans and studies and planned infrastructure improvements.

Goal 4: This alignment is not consistent with the UNC Master Plan and is not acceptable to the university.

Leigh Village Alignment C3: Farrington Road Alternative

The Leigh Village C3 alignment was not advanced into the detailed evaluation of alternatives because it is not consistent with local plans and studies and planned infrastructure improvements.

Goal 4: This alignment, in addition to C2, was developed to provide an alternative that avoids and minimizes potential impacts to wetlands associated with the water supply watershed of Lake Jordan and also to federally owned land that is also associated with the Lake Jordan drainage area. However, past and ongoing planning studies, such as the Southwest Durham/Southeast Chapel Hill Collector Street Plan adopted in April of 2007, focus on an alignment that crosses undeveloped property northwest of the NC 54/I-40 interchange, locally known as the Leigh Village area, designated for higher density mixed-use development. The draft NC 54/I-40 Corridor Study (August 2010), an integrated transportation and land use study, also assumes a transit alignment that follows the DCHC-MPO adopted alignment from the US 15-501 Phase II MIS study.

Goal 6: The North Carolina Department of Transportation is planning modifications to the NC 54/I-40 interchange that will present potential conflicts and design complications that are not present with the other Leigh Village subarea alternative alignments.

South Square Alignment D2: Durham-Chapel Hill Connector Alternative

The South Square D2 alignment was not advanced into the detailed evaluation of alternatives because of its problematic technical feasibility as compared with similar alignments in this area.

Goal 6: The D2 alignment will require undesirable tight curves in elevated tracks. Portions of alternative alignments D1 and D3 are also on elevated structure, but tight turning radii will not be required. Tight turns on structure are technically feasible, but are not desirable because of added capital costs and increased travel times from the train slowing to safe operating speeds around corners.

Alignment Alternatives to Advance

Based on the outcome of the evaluation of alignment alternatives, the Base Alignment and Alignment Alternatives A1 at UNC Hospitals, B1 and B2 at Meadowmont, C1 and C2 at Leigh Village, D1 and D3 at South Square, and E1 and E2 in downtown Durham were carried forward for detailed analysis.

UNC Hospitals Alignment A1: Hibbard Drive Alternative

The Hibbard Drive alternative alignment is part of the base alignment and is the western terminus area of the Durham-Orange Corridor. This alignment follows the recommended alignment from the US 15-501 Phase II MIS and is consistent with the UNC-Chapel Hill Campus Master Plan. This alternative supports all the stated goals and objectives for the project.

Meadowmont Alignment B1: Finley Golf Course Alternative; Alignment B2: NC 54 Alternative

Both alignments B1 and B2 were advanced for detailed evaluation as they met the goals and objectives of the project. Differentiation between each alternative requires a more rigorous evaluation in the detailed evaluation stage.

The Finley Golf Course alignment alternative, B1, is part of the base alignment and follows the recommended alignment from the US 15-501 Phase II MIS, which passes behind the buildings that front the south side of NC 54 and passes through the Friday Center parking lot. By passing behind the buildings along NC 54, this alignment avoids driveway conflicts. Note that in the detailed analysis of alternatives, at-grade and elevated options will be evaluated where the alignment passes through the Friday Center parking lot and crosses Friday Center Drive to join Leigh Village alignment alternative C2. Of the two alignment alternatives, B1 allows for a better transition and approach to joining alignment alternative C1, which has an elevated crossing of NC 54 into Meadowmont.

The NC 54 alignment alternative, B2, deviates from the base alignment in the vicinity of Finley Golf Course Road and shifts to the north to follow within the eastbound or southern right-of-way of NC 54. This alignment will have an at-grade driveway crossing of an office building and will not have direct access to the Friday Center parking lot. Alignment B2 crosses Friday Center Drive at-grade to join Leigh Village alignment alternative C2.

Leigh Village Alignment C1: Meadowmont Lane Alternative

Leigh Village alignment alternative C1 is part of the base alignment and follows the recommended alignment from the US 15-501 Phase II MIS and supports all of the stated goals and objectives for the project. This alignment will traverse a portion of the Meadowmont community and pass close to residences. Potential impacts to the community are possible from the presence of a fixed-transit guideway; however, there are no obvious substantial impacts from alignment C1. Potential community impacts will be evaluated further in the detailed analysis.

The alignment will bridge wetlands associated with the water supply watershed of Lake Jordan and will skirt the edge of federally owned land that is also associated with the Lake Jordan drainage area. These issues are not considered a fatal flaw in the evaluation of conceptual alternatives, but will be studied in more detail for quantitative impacts to wetlands, floodplains, and federal land in the next tier of evaluation.

Leigh Village Alignment C2: George King Road Alternative

Leigh Village alignment alternative C2 supports all of the stated goals and objectives for the project. This alignment was developed to provide an alternative that will avoid and minimize potential impacts to the wetlands associated with the water supply watershed of Lake Jordan and also to federally owned land that is associated with the Lake Jordan drainage area. As an avoidance and minimization alternative that meets the project Purpose and Need, C2 will be advanced for detailed evaluation.

South Square Alignment D1: Westgate Drive Alternative; Alignment D3: Shannon Road Alternative

Both alignment alternatives D1, Westgate Drive Alternative, and D3, Shannon Road Alternative, were advanced for further consideration as they support the stated goals and objectives of the project. Both of the alignments serve the South Square subarea, which contains a mix of multifamily residences, retail, and entertainments businesses. Alignment alternative D3 is part of the base alignment and is the longer of the two, and as such it will likely require more elevated structure than D1, and thus be more costly.

However, D3 has the potential to attract higher ridership. Differentiation between each alternative requires a more rigorous evaluation in the detailed evaluation stage.

Downtown Durham Alignment E1: NCRR Right-of-way Railroad Alternative; Alignment E2: NC 147 Alternative

Both alignment alternatives E1 and E2 support the stated goals and objectives of the project and were advanced for detailed evaluation. The Railroad Alternative is considered part of the base alignment in the Durham-Orange Corridor. As noted above, the base alignment satisfies the goals of the project, meets the Purpose and Need for the project, and should be advanced for detailed evaluation.

The E2 alternative alignment will be outside of, but adjacent to, the rail corridor on NC 147 through downtown Durham. While the alignment is somewhat removed from the downtown core, it will still serve the area; however, the degree to which it could effectively do so depends on the mode or technology that will be matched with this alternative. BRT, for example, will have greater flexibility to access station locations closer to downtown destinations than LRT. To determine the viability of the E2 alternative for BRT, it was advanced for detailed evaluation.

5.2.6. Summary of Conceptual Alternatives Evaluation Results

Table 5-8 summarizes the conceptual alternatives eliminated from further study or advanced into detailed evaluation based on the results of the conceptual transit technology and alignment evaluation.

Both LRT and BRT Build Alternatives follow the Base Alignment along with any of the alignment alternatives being carried forward between UNC Hospitals and Duke Medical Center (A1, B1, B2, C1, C2, D1, D3). East of Duke Medical Center, however, the LRT Build Alternative will be located within the NCRR right-of-way (C1) and the BRT Build Alternative will follow NC 147 (Durham Freeway).

Table 5-8 Summary of Conceptual Alternatives Evaluation

Alignment	Transit Technology	
	LRT	BRT
Base Alignment	✓	✓
UNC Hospitals Alignment Alternatives		
A1. Hibbard Drive Alignment	✓	✓
A2. Mason Farm Alignment	✗	✗
A3. UNC Southern Alignment	✓	✓
Meadowmont Alignment Alternatives		
B1. Finley Golf Course Alignment	✓	✓
B2. NC 54 Alignment	✓	✓
Leigh Village Alignment Alternatives		
C1. Meadowmont Lane Alignment	✓	✓
C2. George King Road Alignment	✓	✓
C3. Farrington Road Alignment	✗	✗
South Square Alignment Alternatives		
D1. Westgate Drive Alignment	✓	✓
D2. Durham-Chapel Hill Connector Alignment	✗	✗
D3. Shannon Road Alignment	✓	✓
Downtown Durham Alignment Alternatives		
E1. NCRR Right-of-Way Alignment	✓	✗
E2. NC 147 Alignment	✗	✓
E3. NC147 and Pettigrew Street Alignment	✗	✓

5.3. Detailed Alternatives Development and Criteria

The Conceptual Evaluation of Alternatives advanced the most reasonable transit technology and alignment alternatives that address the project's Purpose and Need. For the Detailed Evaluation of Alternatives, these alternatives were combined into two discrete Build Alternatives – LRT and BRT. The BRT Alternative was divided into two alternatives to take advantage of the flexibility offered by BRT operations: BRT-High and BRT-Low. The BRT-High Alternative generally follows the same fixed-guideway alignment and operations as the LRT Alternative, while the BRT-Low Alternative alignment more closely follows existing roadways with less aerial structures. The BRT-High Alternative is primarily exclusive running while the BRT-Low Alternative includes more mixed-traffic segments.

The Detailed Evaluation of Alternatives screened the Build Alternatives to identify the LPA that will be compared against the No-Build and TSM Alternatives in the Final Definition of Alternatives. This section defines the detailed evaluation criteria and documents the process used to evaluate the No-Build, TSM, and Build Alternatives under consideration.

5.3.1. Definition of Detailed Alternatives

No-Build Alternative

The No-Build Alternative includes all highway and transit facilities identified in the fiscally constrained 2035 Long-Range Transportation Plan (LRTP), with the exception of the comprehensive system-wide rail transit network, part of which is the subject of this AA. The No-Build Alternative is used as a starting point to provide a comparison of all Build Alternatives in terms of costs, benefits, and impacts.

Roadway Improvements

Table 2-5 summarized the programmed roadway improvement projects in the current fiscally constrained 2035 LRTP that are located within the Durham-Orange Corridor Study Area.

Bus Network

The No-Build Alternative includes all fixed-route bus service (BRT, regional, express, and local) that is currently programmed in the 2035 LRTP. BRT routes in the No-Build network refer to planned CHT services. Table 5-9 identifies the routes within the Durham-Orange Corridor Study Area and includes a description of each route and headway.

Table 5-9 No-Build Alternative Bus Network

Route Number	Description	Programmed Headway	
		Peak	Off-Peak
BRT*/Express Bus/Regional Bus			
CHT BRT-1*	CHT BRT-1 I40-Rsmry-UNC	10	20
CHT BRT-3A*	CHT BRT-3A I40-US15-UNC	15	30
CHT BRT-3B*	CHT BRT-3B I40-ElzbtH-UNC	15	30
CHT BRT-3C*	CHT BRT-3C I40-Carolina N	15	30
CHT BRT-5*	CHT BRT-5 I40 to UNC	15	30
CHT 8	CHT Base 8 UNC Exp	10	20
CHT 9	CHT Base 9 Mason Farm Exp	15	30
CHT BRT-6	CHT BRT-6 from Carolina N	15	30
CHT BRT-7	CHT BRT-7 to UNC	15	30
CHT BRT-7A	CHT BRT-7a from Carolina N	15	30
CHT BRT-8	CHT BRT-8 to UNC	15	30
CHT BRT-8A	CHT BRT-8a from Carolina N	15	30
CHT CPX	CHT CPX:UNC-CarrboroP&R	15	30
CHT FCX	CHT FCX:Pttstor-	15	30

Route Number	Description	Programmed Headway	
		Peak	Off-Peak
	FridayCntr		
CHT HUX	CHT HUX:HedrickBldg-UNCHosp	15	30
CHT JFX	CHT JFX:JonesFerry-Ptsboro	15	30
CHT PX	CHT MOD 20 Pitt. Exp	15	N/A
CHT NUX	CHT NUX: PRLot-UNCHosp	15	30
N/A	DCHC B1 Roxboro to Durham	30	60
N/A	TTA Butner-Durham	30	N/A
N/A	DCHC B10 Durham-Capital Blvd	30	60
N/A	DCHC B2 Butner-Durham	30	60
N/A	DCHC B3 Mebane-Duke	30	60
N/A	DCHC B6 Alamance to CH	30	N/A
N/A	Durham-NorthDurham	30	N/A
TTA 500	TTA 500 EB:Chap Hill-Raleigh	15	30
TTA 550	TTA 550 WB:Raleigh-Chapel; Hill	15	30

Route Number	Description	Programmed Headway	
		Peak	Off-Peak
N/A	TTA Burlington-Duke	30	N/A
N/A	TTA Butner-Durham	30	N/A
N/A	TTA PersonCo-Durham	30	N/A
TTA 420	TTA 420:Hillsb-Chap Hill	15	30
TTA 402/403	TTA ChapelHill-RTP-402-403	30	60
TTA 412/413	TTA ChapelHill-RTP-412/413	30	60
Feeder/Local			
N/A	Chapel Hill Circulator	10	20
CHT A	CHT A:MLKBlvd-Weiner	15	30
CHT 1	CHT Base 1 Carr N	15	30
CHT 3	CHT Base 3 Estes-Carrboro	15	30
CHT 4	CHT Base 4 Laurel Hills	15	30
N/A	CHT Carr 1A Feeder	15	30
CHT CL	CHT CL: WldnGrnflid-UNCHosp	15	30
CHT CM	CHT CM:FamPrac-JonesFerry	15	30
CHT CW	CHT CW:Ptsboro-JonesFerry	15	30
CHT D	CHT D:Prvdnce-SmithLevel	15	30
N/A	CHT Eubanks Station 1A Feeder	15	30
CHT F	CHT F:ColonyWds-McDougle	15	30
CHT G	CHT G:Briarcliff-BookerCrk	15	30
N/A	CHT Gateway Feeder 1	15	30
N/A	CHT Gateway Feeder 2	15	30
N/A	CHT Gateway Feeder 3	15	30
CHT HS	CHT HS:VarsityTh-Hghsch	15	30
N/A	CHT HW 1A Feeder	15	30
CHT J	CHT J:SGrnsboro-RockCrkApt	15	30
CHT M	CHT M:CrestCole-UnivMall	15	30
N/A	CHT Meadowmont Feeder 2	15	30
N/A	CHT Meadowmont Feeder 3	15	30

Route Number	Description	Programmed Headway	
		Peak	Off-Peak
N/A	CHT Meadowmont Feeder	15	30
N/A	CHT MOD 8-1	15	30
N/A	CHT MODV	30	60
CHT N	CHT N:FamPract-EstsPrkApt	15	30
CHT NS	CHT NS:Eubanks-SVillage	15	30
CHT RU	CHT RU LP:counter clock loop	15	30
CHT S	CHT S:HedrickBldg-UNCHosp	15	30
CHT T	CHT T:UNCHosp-ECHHghSch	15	30
CHT U	CHT U LP:clockwise loop	15	30
CHT V	CHT V:SVillage-Meadowmont	15	30
DATA 10-8	DATA 10-8:NewHopeCmn-DrhmTech	30	60
DATA 10-8	DATA 10-8:Woodcroft-DrhmTech	30	60
DATA 11-9	DATA 11-9:Bennett-DRHosp	15	30
DATA 12	DATA 12:TTATerm-Downtown	30	N/A
DATA 13	DATA 13:Fayette-Birchwood	30	60
DATA 1-3	DATA 1-3:Hillndal-Guess-MdInd	30	60
DATA 1-3	DATA 1-3:Hillndal-Point-MdInd	30	60
DATA 14	DATA 14 LP:NCCUShuttle	15	30
DATA 15	DATA 15:BrierCreek-Dtn	15	N/A
DATA 15	DATA 15 Willowdale	60	60
DATA 16	DATA 16:Dtn-MineralSprng	30	60
DATA 17	DATA 17 Feeder Eno Loop	60	60
DATA 17	DATA 17 Feeder	60	60
DATA 17	DATA 17 Horton-Davinci SEB	30	60
DATA 17	DATA 17:Horton-Treyburn	15	30
DATA 17	DATA 17 Roxboro-Davinci SB	30	N/A
DATA 18	DATA 18 Feeder	30	60

Route Number	Description	Programmed Headway	
		Peak	Off-Peak
DATA 19	DATA 19 Feeder	30	60
DATA 20	DATA 20 UniDr-RTP	15	30
DATA 2-4	DATA 2-4:Angier-Horton	15	30
DATA 25	DATA 25 DurReg-DukeMed	30	60
DATA 27	DATA 27 Ngate-RTP W	30	60
DATA 30	DATA 30 Duke Hospital	30	60
DATA 3-1	DATA 3-1:MdInd-Point-Hillndal	15	30
DATA 4-2	DATA 4-2:Horton-Angier	15	30
DATA 5-6	DATA 5-6:Emerald-HV-Cameron	15	30
DATA 6-5	DATA 6-5:Cnstitutn-Crnw-Emrld	15	30
DATA 7	DATA 7:Downtown-Southpoint	15	30
DATA 7SP	DATA 7SP Southpoint Mall	60	60
DATA 8-10	DATA 8-10:DrhmTech-NewHopeCmn	15	30
DATA 8-10	DATA 8-10:DrhmTech-Woodcroft	15	30
DATA 9-11	DATA 9-11:DRHosp-Bennett	15	30
N/A	DATA Bethesda	30	60
N/A	DATA Dtech-Snow	30	60
N/A	DATA Dtown Terminal Feeder	30	60
N/A	DATA Dtown Terminal Shuttle	15	30
N/A	DATA Durham XT SEB	30	60
N/A	DATA Holoway/The Village	30	60
N/A	DATA Joyner-Club-Duke	30	60
L1	DATA L1 NDP: Carver to RDU SB	60	60
L5	DATA L5 Mt Moraih-NC 54 WB	60	60
L6	DATA L6 Morehead-Cornwallis SB	30	60
L7	DATA L7 Avondale-Chapel Hill St WB	30	60
L8	DATA L8 Hillsbor N-Hillsbor S SB	30	60

Route Number	Description	Programmed Headway	
		Peak	Off-Peak
L9	DATA L9 Renaissance-Hopson WB	30	60
N/A	DATA Meridian Pkwy Feeder	30	60
N/A	DATA NC98 - US70 - Miami	30	60
N/A	DATA Riddle Station Feeder	30	60
N/A	DATA S Square Feeder	30	60
N/A	DATA S Square Shuttle	60	60
N/A	DATA Treyburn SB	60	60
N/A	DATA Treyburn Station Feeder	30	60
N/A	DATA Woodcroft Feeder	30	60
N/A	DCHC B9 Old Farrington to CH	10	20
N/A	DCHC B11 N Raleigh to Duke WB	30	60
N/A	DCHC B12 W Wake fwy to Duke	30	60
N/A	DCHC B13 Apex to Durham	30	60
N/A	DCHC B14 US70 to W Wake pkwy	30	60
N/A	DCHC B8 Pittsboro to UNC NB	30	60
DUKE C1	DUKE C1:WCampus-ECampus	10	20
DUKE C2	DUKE C2:ECampus-WCampus	10	20
DUKE C3	DUKE C3:EastCampus-SciDr	10	20
DUKE C6	DUKE C6:Ecampus-Chapel	30	60
DUKE EW via Central	Duke E/Cent./W	10	N/A
DUKE H1	DUKE H1:Entry11-PG3	10	20
DUKE H2	DUKE H2:HospNorth-PG3	10	20
DUKE H3	DUKE H3:HillsbghRd-HospN	10	20
DUKE H5	DUKE H5:HockPlaza-MillBldg	10	20
DUKE H6	DUKE H6:Ent11-LaSalleLot	10	20
DUKE M1	Duke Med 1	60	60

Route Number	Description	Programmed Headway	
		Peak	Off-Peak
DUKE M3	Duke Med 3	10	N/A
DUKE M4	Duke Med 4	30	60
DUKE PR1	DUKE PR1:BassettDr-Ent11	10	20
N/A	Duke Science Loop CCW	15	30
N/A	Duke Student Park	15	30
N/A	Duke Villa	10	20

Source: Triangle Regional Model v4 enhanced. | *BRT routes in the No-Build bus network refer to services planned by Chapel Hill Transit (CHT)

Transportation System Management (TSM) Alternative

The TSM Alternative is required for inclusion in the AA by the FTA when federal funds are sought for capital improvements. The primary purpose of the TSM Alternative is to develop an enhanced and robust bus network in the Durham-Orange Corridor that provides a level of transit service and capacity roughly equivalent to that of a fixed-guideway improvement. The intention is to compare the efficiency and cost-effectiveness of a significant bus network in the corridor with fixed-guideway improvements to determine the impact on transit ridership, travel time, and other measures.

The TSM Alternative includes enhanced bus service within the corridor along with improved local bus service feeding the express routes and TDM strategies that encourage a reduction in total trips (in particular drive-alone trips) and trip delays compared to the No-Build Alternative. The highway network for the TSM Alternative is assumed to be the same as the No-Build Alternative, which is taken from the 2035 LRTP and previously listed in Table 2-5. However, the TSM Alternative also includes minor, low-cost improvements to roadways as they relate to the bolstered bus transit system.

The backbone of the TSM Alternative would be a new bus route operating between UNC Hospitals and east Durham, covering a distance of approximately 19 miles from Chapel Hill to Durham and approximately 19.5 miles from Durham to Chapel Hill and including 17 stops. Buses would operate at 10-minute headways in the peak periods and 20-minute headways in the off-peak periods. Travel time between the UNC Hospitals in Chapel Hill and Alston Avenue in Durham is estimated to be 57 minutes. The high-frequency bus route would closely follow that of the other Build Alternatives, as described below.

Technology

The TSM Alternative assumes operation of standard (35 to 44 seated passengers) or articulated (65 to 70 seated passengers) buses. These can be either diesel or alternatively fueled (compressed natural gas and hybrid-electric) vehicles.

Alignment

As illustrated in Figure 5-9, the TSM Alternative begins at the same western terminus as the LRT and BRT alternatives, UNC Hospitals, and ends at Alston Avenue in East Durham. The buses would use Manning Drive on the UNC campus from the Hospitals complex and southern part of Main Campus to the Fordham Boulevard intersection (NC 54/US 15-501 Bypass) and then follow Fordham Boulevard to the interchange with NC 54. The route would then use NC 54 in an easterly direction to the intersection of NC 54 and Farrington Road where it would then head north on Farrington Road, serving the Leigh Village location. It would continue north on Farrington Road to the intersection with Ephesus Church Road where it would turn left on Ephesus Church Road continuing to the intersection with Pope Road, turning right on Pope Road and continuing north to Old Chapel Hill Road. The route would proceed in a westerly direction on Old Chapel Hill Road to East Lakeview Drive (serving the Gateway area) where it would then head north to Durham-Chapel Hill Boulevard (US 15-501).

At this point the route would continue northeasterly on Durham-Chapel Hill Boulevard to the South Square commercial area of Durham. In the South Square area, the route would use Martin Luther King Jr. Parkway, University Drive, Shannon Road, and Tower Boulevard to serve the South Square activity center. From Tower Boulevard, the route would continue north on US 15-501 to the interchange with Cameron Boulevard where it would head easterly to the intersection with Erwin Road. From here the route would follow Erwin Road through the Duke and VA Hospital medical center area. It would continue on Erwin Road to the intersection with Main Street in the Ninth Street area.

From the intersection of Erwin Road, Ninth Street, and Main Street, the route follows Main Street through downtown Durham to the east side of Durham, terminating at Alston Avenue in east Durham.

The proposed TSM route through Durham and Orange counties would serve similar activity centers as the Build Alternatives, as shown on Figure 5-9. These would include Chapel Hill, UNC and UNC Hospitals, Friday Center and the NC 54 Corridor, Leigh Village, Gateway (I-40/US 15-501), South Square, Duke University and Duke Hospitals, Downtown Durham, and NCCU and Durham Technical Community College.

Bus Stops and Park and Ride Locations

The TSM Alternative includes a total of 17 bus stops, with feeder bus connections available at all stops. Eight of these bus stops would have park-and-ride lots to manage travel demand and enhance access to transit in the corridor. These park-and-ride lots would be located at:

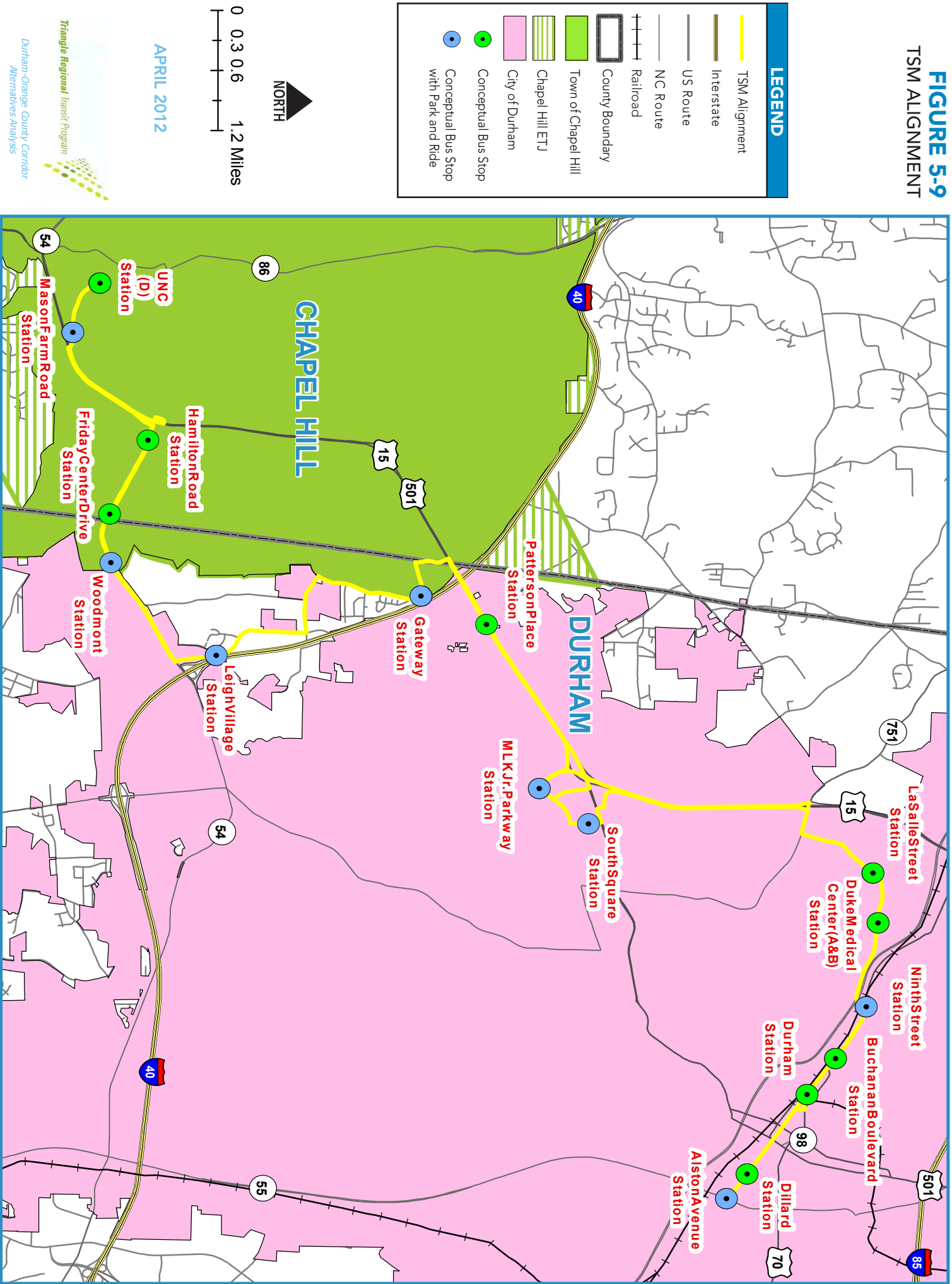
- Mason Farm, on UNC South Campus
- Woodmont (limited number of spaces)
- Leigh Village
- Gateway
- Martin Luther King, Jr. Parkway (limited number of spaces)
- South Square (limited number of spaces)
- Ninth Street (limited number of spaces)
- Alston Avenue

Bus Network

The TSM Alternative includes improvements and enhancements to bus transit service within the Durham-Orange Corridor, including local feeder bus routes to major activity centers and bus terminals from the surrounding areas. While the cost of the bus improvements is modest compared to a fixed-guideway transit system, the TSM Alternative could involve substantial capital and operations cost increases. The proposed bus transit improvements under the TSM Alternative include the following general improvements:

- Restructuring bus routes to address transportation needs and better serve travel markets in the corridor
- Providing both express and local bus service within the study corridor
- Increasing the use of higher-capacity buses, e.g., articulated buses
- Adding park-and-ride facilities and expanding existing facilities
- Traffic signalization improvements including signal timing, synchronization, and bus prioritization
- Timed bus transfers

FIGURE 5-9
TSM ALIGNMENT



Modifications to the programmed 2035 LRTP (or the No-Build Alternative) bus network were identified by station travel shed along the TSM alignment. If a route would duplicate or compete with the TSM service, then it was removed from the bus network. For each travel shed, a set of feeder bus routes was identified that provides access to the bus stop from the various activity centers in the travel shed that are beyond the acceptable walking distance from the bus stop (usually about one-third of a mile). The feeder buses serve both residential activities and commercial/employment centers. These routes were then compared to the programmed bus network contained in the 2035 LRTP. If no route in the LRTP provided the same service as the proposed feeder route then a new route was added. If an existing route provided essentially the same service as the feeder route, then the existing route was modified as necessary to match the proposed feeder route. Table 5-10 reflects these changes from the No-Build Alternative.

Table 5-10 TSM Alternative Bus Network Changes from the No-Build Alternative

Route Number	Description	TSM Headway		Change from No-Build Alternative
		Peak	Off-Peak	
BRT/Express Bus/Regional Bus				
TTA 420	TTA 420:Hillsb-Chap Hill	N/A	N/A	Route removed
Feeder/Local				
N/A	Mason Farm Road to 15-501	20	40	Route added
N/A	Mason Farm Road to Jones Ferry Park N Ride	20	40	Route added
N/A	Seawell School to UNC Hospital	20	40	Route added
N/A	Leigh Village Circulator	20	40	Route added
N/A	Gateway to Pinehurst / Burning Tree	20	40	Route added
N/A	Gateway to Legion to Estes / Willow	20	40	Route added
N/A	Gateway to Whitfield / Turkey Farm	20	40	Route added
N/A	Gateway to Farrington	20	40	Route added
N/A	Leigh Village to 751 / Fayetteville	20	40	Route added
N/A	Leigh Village to Renaissance to Fayetteville / Chancellors Ridge	20	40	Route added
N/A	Leigh Village to NC 54 / Revere	20	40	Route added
N/A	Leigh Village to MLK via Garrett	20	40	Route added
N/A	Leigh Village to MLK via Roxboro and MLK	20	40	Route added
N/A	MLK to Garrett / Pickett	20	40	Route added
N/A	South Square to Erwin / Randolph	20	40	Route added
N/A	South Square to James / Nation	20	40	Route added
N/A	South Square to Durham Station	20	40	Route added
N/A	South Square to La Salle	20	40	Route added
N/A	Alston Circulator via Fayetteville and Riddle	20	40	Route added
N/A	Alston to Briggs / Lawson	20	40	Route added
N/A	Alston to US 70	20	40	Route added
N/A	Durham Station to La Salle	20	40	Route added
N/A	Ninth to Broad / Carver	20	40	Route added
N/A	Ninth to Guess / Horton	20	40	Route added
N/A	Alston to Clayton / Freeman	20	40	Route added
N/A	Alston to Club / Geer (Wal-Mart)	20	40	Route added
CHT 4	CHT Base 4 Laurel Hills	N/A	N/A	Route removed
CHT NS	CHT NS:Eubanks-SVillage	N/A	N/A	Route removed
CHT S	CHT S:HedrickBldg-UNCHosp	N/A	N/A	Route removed
CHT V	CHT V:SVillage-Meadowmont	N/A	N/A	Route removed
DUKE C6	DUKE C6:Ecampus-Chapel	N/A	N/A	Route removed

Source: URS Corporation Consultant Team, 2011.

Roadway Improvements

The TSM Alternative includes all of the “committed” roadway projects as contained in the 2035 LRTP and included in the No-Build Alternative. These improvements are listed in Table 2-5. In addition, the TSM Alternative includes a variety of low-cost improvements to roadways specifically aimed at improving bus travel times and minimizing time in congestion. These low-cost improvements include:

- Bus-only shoulder on both sides of Fordham Boulevard between Manning Drive and NC 54.
- Capacity improvements along NC 54, between Fordham Boulevard and I-40, consistent with an ongoing study and planning for that corridor; improvements may include superstreet configurations, additional travel lanes, and other intersection improvements.
- Signal improvements for the intersection of NC 54 and Farrington Road, including signal phasing improvements and additional dedicated turn lanes.
- Signal improvements for the intersection of US 15-501 and East Lakeview Drive/Eastowne Drive, including signal phasing improvements and additional dedicated turn lanes.

Transportation Demand Management (TDM)

The TSM Alternative also assumes further developed TDM strategies to encourage transit use, discourage drive-alone commuting, reduce the number of daily trips, and reduce trip delay. Triangle Transit in cooperation with other transit providers, the North Carolina Department of Transportation, the two regional MPOs, and the Triangle J Council of Government managed the preparation of the *Triangle Region 7-Year Long Range TDM Plan* in 2007. The Plan provides a framework and strategies to achieve a 25 percent reduction in the growth of vehicle miles traveled in the Triangle Region by 2015, encouraging commuters to use different modes of travel such as mass transit, carpooling, biking, telecommuting, and vanpooling. The Plan outlines a TDM program that includes an emphasis on TDM marketing, branding, and outreach, and is designed to maximize the efficiency of numerous existing TDM programs and encourage new alternative mode users. TDM action items include enhancements to existing programs as well as the creation of new programs. While it is assumed that these changes would occur as part of the TSM Alternative, they are not incorporated into the travel demand model.

The TDM programs, which have been implemented, include the following:

- The Share the Ride NC Ridematch Service (STRNC), which provides referrals to possible rideshare partners. There are 14,337 registered commuters in the STRNC program in the Triangle alone.
- The GoTriangle.org door-to-door Trip Planner, which provides advice on the best public transportation connection to destinations within the Triangle region. DATA, Capital Area Transit, CHT, North Carolina State University (NCSU) Wolfline, Cary Transit, and Triangle Transit regional services are included. In 2011, all trip planning information was added to Google for *on-the-go* trip planning.
- The Triangle Transit Vanpool Program includes 86, 12- and 7-passenger vans which are owned and serviced by Triangle Transit and leased to groups of commuters who pay a low monthly fare based on the shared cost of their commute. Currently there are 75 active vanpools in the Triangle.
- The Emergency Ride Home program, which is a service designed to encourage the use of alternative transportation to the worksite by providing employees with a free back-up taxi ride home in the event of an emergency or unplanned schedule change.

- The GoTriangle TDM Financial Incentives Program, which is designed to (1) motivate single occupancy vehicle (SOV) travelers to try an alternative mode of transportation and reward them for doing so; (2) motivate existing non-SOV travelers to continue using their mode of transportation and reward them for doing so; and (3) establish a tool to track region-wide participation in alternative modes of transportation that are often difficult to otherwise track.

LRT Alternative

The LRT Alternative would operate light rail vehicles between UNC Hospitals and east Durham, covering a distance of approximately 17.1 miles. The LRT would operate at 10-minute frequencies during peak hours and 20-minute frequencies during off-peak hours. LRT travel time is estimated to be 35 minutes between the UNC Hospitals Station in Chapel Hill and the Alston Avenue/NCCU Station in east Durham.

The alignment would be double-tracked throughout, with one track for each direction. The alignment would primarily run at-grade in a dedicated right-of-way parallel to existing roadways, with elevated sections throughout to mitigate potential traffic impacts or impacts to environmental features as needed. A total of 17 stations are proposed for the LRT Alternative. Conceptual plans and typical sections of the LRT Alternative are provided in Volume 2: Detailed Definition of Alternatives, Conceptual Plan, and Profile Drawings.

Technology

The proposed transit technology for the LRT Alternative is modern 70% low-floor light rail vehicles, with a seating capacity of 228 (3-car train with 76 seats per car), operating on dedicated tracks with power supplied from an overhead catenary system. The image to the right is an example of a 70% low floor light rail vehicle from Phoenix.

Alignment

A description of the LRT Alternative alignment is provided by subarea—beginning at the westerly end in Chapel Hill at UNC Hospitals and moving east through Meadowmont/Woodmont, South Square, western Durham, and terminating in east Durham (Figure 5-10) at Alston Avenue. The LRT Alternative includes the “base alignment” and alignment alternatives advanced from the Evaluation of Conceptual Alternatives in the UNC Chapel Hill, Meadowmont/Woodmont, and South Square subareas. Alignment alternatives advanced from the Conceptual Evaluation of Alternatives are herein referred to as “alignment options.”

UNC Chapel Hill The LRT alignment begins in Chapel Hill at UNC Hospitals on the southern portion of the UNC campus, with a possible extension north into downtown Chapel Hill and the Town of Carrboro. There are two alignment options under consideration for the UNC Hospitals area – UNC Hibbard Drive and UNC Southern Alignment.



UNC Hibbard Drive Alignment Option (A1). The UNC Hibbard alignment option (A1) begins at-grade adjacent to the UNC Hospitals Jackson Parking Deck, southwest of the intersection of Manning and Hibbard Drives. The alignment travels south through an existing developed site, transitioning to an aerial structure due to a steep decrease in grade, and continuing through Odum Village before turning southeast and dropping back to grade north of Mason Farm Road. Alignment option A1 continues heading eastward, parallel to Mason Farm Road, and rejoins the base LRT alignment near the Mason Farm Road and Fordham Boulevard intersection.

UNC Southern Alignment Option (A3). The UNC Southern alignment option (A3) begins on the south side of the Genetic Medicine Research Building, located south of the Dogwood Parking Deck, and continues eastward, running at-grade along a new east-west roadway to be constructed (by others) south of the Genetic Medicine Research facility and adjacent to an existing chiller plant. The alignment option continues east, leaving the new roadway and crossing the Mason Farm Road and Hibbard Drive intersection and traversing Odum Village on a new alignment through developed land. The alignment option then heads eastward, joining the base LRT alignment near the Mason Farm Road and Fordham Boulevard intersection.

Friday Center From the UNC Chapel Hill subarea, the LRT Alternative runs east along the edge of the sidewalk north of, and roughly parallel to, Mason Farm Road. Just east of Baity Hill Drive, the LRT Alternative transitions to an aerial structure, turning slightly to run just north of and adjacent to Fordham Boulevard. The aerial structure continues past the Fordham Boulevard and Manning Drive intersection, crossing Fordham Boulevard after the Old Mason Farm Road intersection at a skew and continuing east along an undeveloped area that is south of and parallel to Fordham Boulevard. The alignment then returns to grade, running adjacent Fordham Boulevard along the south side of the roadway.

The alignment turns east behind Glenwood Elementary School, moving away from Fordham Boulevard and running parallel with Prestwick Road, south of NC 54. The alignment continues around the north side of the Finley Golf Course, heading east to UNC's Friday Center.

Meadowmont/Woodmont From Friday Center, the LRT alignment enters the Meadowmont/Woodmont subarea, where there are two alignment options.

Meadowmont Lane Alignment Option (C1). The Meadowmont Lane alignment option (C1) heads north, crossing NC 54 on aerial structure, entering Meadowmont Village and transitioning to at-grade, crossing Barbee Chapel Road, Sprunt Street, and Meadowmont Lane. The alignment then follows Meadowmont Lane north along the Durham/Orange County Line, before transitioning to an aerial structure and turning northeast across wetlands associated with Little Creek (about 500 feet in length) and skirting Federally-owned property associated with the Lake Jordan water supply watershed (the 500 feet of wetlands plus another 500 feet). The alignment returns to grade, heading east and crossing George King Road before turning north and connecting with Farrington Road and joining the LRT base alignment.

George King Road Alignment Option (C2). The George King Road alignment option (C2) continues the alignment south of and parallel to NC 54, crossing Friday Center Drive either at-grade or on an aerial structure and paralleling NC 54 to the south of the roadway. Future traffic studies and additional coordination with NCDOT will determine the necessary profile. The alignment returns to grade before crossing Barbee Chapel Road and continues following NC 54 before transitioning back to an aerial structure. The alignment turns north and crosses NC 54 at George King Road. After crossing NC 54, the alignment returns to grade along George King Road before turning northeast and rejoining the base LRT alignment at Farrington Road slightly north of Rutgers Place.

Leigh Village and Patterson Place Leaving the Meadowmont/Woodmont subarea, the LRT alignment moves into the proposed Leigh Village development in southwest Durham at-grade. From Leigh Village, the alignment runs north on the west side of, and parallel to, I-40. The design allows for approximately 29 feet between the I-40 shoulder and eastern rail centerline, allowing for future widening of traffic lanes if necessary. The alignment continues north along I-40 to serve the Gateway development before turning eastward and transitioning to an aerial structure to cross I-40 just west of the interchange of I-40 and US 15-501. The alignment continues northeast, crossing Mt. Moriah Road and transitioning to an at-grade alignment just west of the McFarland Drive and Witherspoon Boulevard intersection. The alignment continues northeast, serving the Patterson Place development.

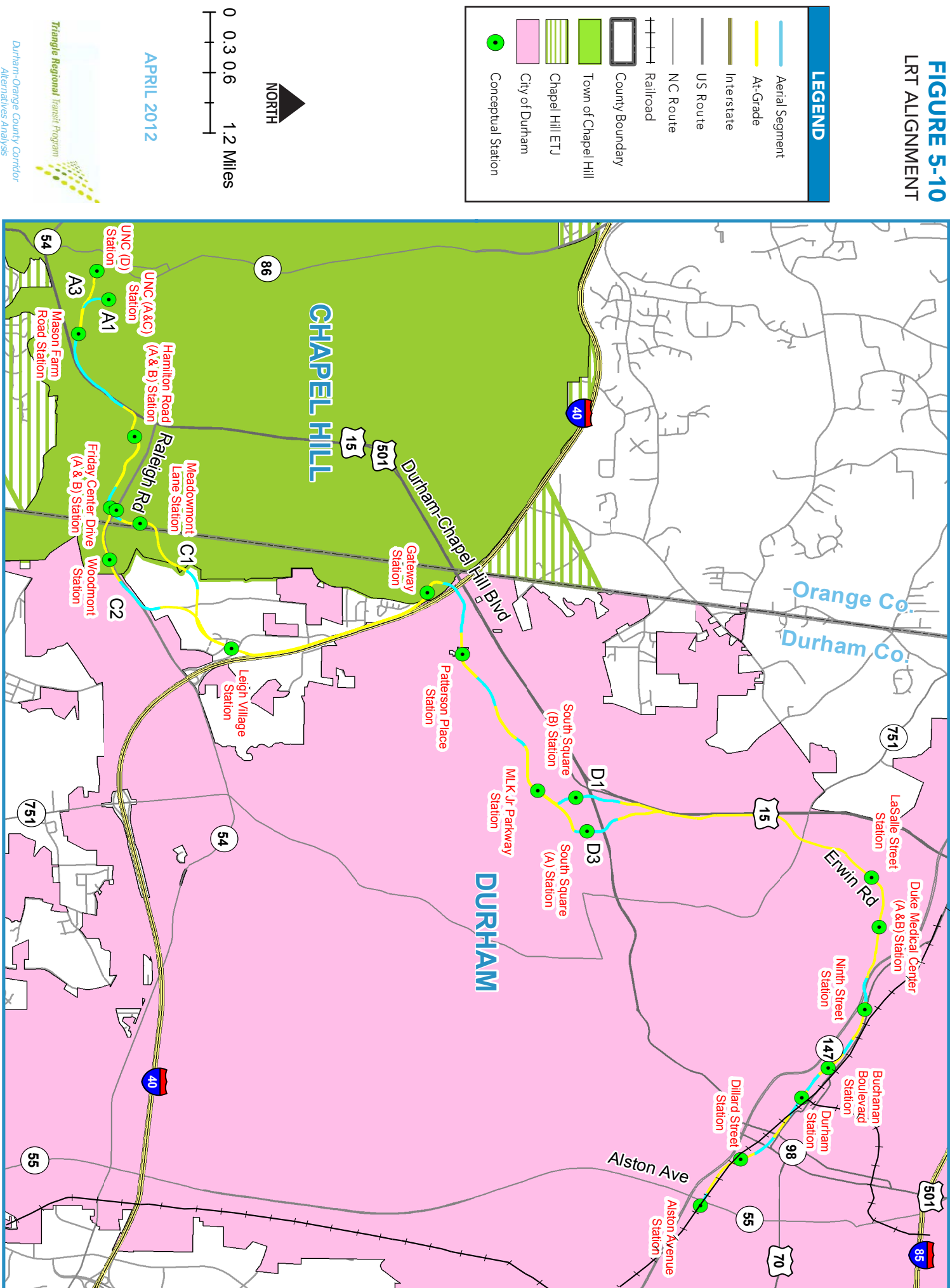
South Square From Patterson Place, the alignment continues northeast, transitioning to an aerial structure to cross New Hope Creek. The alignment returns to street level, crossing Garrett Road and running aerial for a short segment to cross Sandy Creek and then returning to grade, running north, adjacent to the west side of University Drive. The alignment crosses Martin Luther King, Jr. Parkway and there are two alignment options for serving the South Square commercial area. The alignment options serve the west or east side of South Square on an aerial structure.

Westgate Drive Alignment Option (D1). One alignment option, the Westgate Drive alignment option (D1), travels along the west side of the South Square development. The alignment travels east along University Drive before turning north to run along a developed area that runs parallel to Westgate Drive along the east side of the roadway, immediately transitioning to an aerial structure. The alignment travels north on the aerial structure through the South Square development, crossing Durham-Chapel Hill Boulevard and the US 15-501 access ramps before returning to grade. The alignment continues north, paralleling US 15-501 along Petty Road/Western Bypass, which would be realigned as part of this alternative, before rejoining the LRT base alignment just north of Pickett Road.

Shannon Road Alignment Option (D3) The other alignment option, the Shannon Road alignment option (D3), serves South Square from the east. The alignment travels east along University Drive, past Westgate Drive, and turns north at Shannon Road, immediately transitioning to an aerial structure to run along a developed area, parallel to Shannon Road along the east side of the roadway. The alignment travels north on the elevated alignment through the South Square development, crossing Durham-Chapel Hill Boulevard and returning to grade before crossing Pickett Road and rejoining the base LRT alignment north of Pickett Road.

Downtown Durham to East Durham North of Pickett Road, the LRT alignment parallels US 15/501 to a point north of Cornwallis Road where it then turns east to cross Cameron Boulevard at-grade and transition into the median of Erwin Road. Erwin Road would be reconstructed from a 5-lane section to 4-lane section as part of this alternative. The continuous dual left turn lane between Cameron Boulevard and 15th Street/Anderson Street would be removed and replaced by dedicated left turn lanes at the intersections. The LRT alignment runs along Erwin Road, serving Duke University and Duke Medical Center. East of Duke Medical Center, the alignment exits the median of Erwin Road, moving to the north of the roadway and transitioning to an aerial structure to cross NC 147. The LRT alignment enters the NCR rail corridor at-grade. A new set of parallel tracks would be constructed in the rail corridor 26 feet from the existing freight rail tracks for the light rail service. The LRT alignment remains in the rail corridor until the eastern end-of-line at Alston Avenue.

FIGURE 5-10
LRT ALIGNMENT



Station Locations

The LRT Alternative includes 17 station locations. The development and full evaluation of stations are documented in the Station Evaluation (Appendix E). The average spacing of the LRT stations is approximately one mile. At the southeasterly end of the corridor and in the downtown Durham area, the stations are more densely spaced, whereas in some of the less densely developed segments, the stations are located much further apart. This variance in station spacing is a reflection of the existing general land development patterns and densities.

The UNC, Meadowmont/Woodmont, and South Square stations have two distinct station options evaluated in the Detailed Evaluation of Alternatives. The options correspond to alignment options in these subareas. Remaining stations may have design configuration options that will be discussed in more detail in the Final Definition of Alternatives.

Table 5-11 summarizes the proposed station locations for the LRT Alternative. Station locations along the LRT alignment are shown in Section 4 of Appendix E, which includes the conceptual LRT station layouts.

Conceptual station locations are identified during the AA process. These locations will be refined over the course of the project development process including the PE/DEIS/FEIS and even in early stages of Final Engineering (FE). There are numerous reasons for refining station locations throughout the process including changes in land use planning, developments, environmental impacts, stakeholder and citizen input. In addition, there could be right-of-way and access issues such as traffic, parking, pedestrian wayfinding, and bus/rail interface considerations that may lead to station location refinement. It is also possible that station locations could be modified or removed based on subsequent cost-benefit analysis in optimizing system costs with ridership.

Stakeholder and public involvement are integral to the station location and design process. Throughout the project development process citizens and stakeholders will continue to have multiple opportunities to offer input on design options and station location decisions. Decisions on precise station locations and designs are finalized during the Final Engineering phase.

Summary of Station Selection Process

Station locations were developed through stakeholder involvement and parallel engineering and planning studies. Intensive workshops were held in October and December 2010 and January 2011. Participants included staff from the municipal and county governments within the study area, as well as the MPOs and other organizations with an interest or responsibility for planning in those areas. The public also provided input on station locations at the March 2011 public workshops.

The initial and alternative locations were based primarily on previous studies, including the *Phase 1 Regional Rail FEIS* (2002) and the *US 15-501 MIS* (2001), as well as changes, additions, or deletions made by local governments subsequent to those studies or in the early phases of the AA prior to the initiation of station workshops.

See the Station Evaluation (Appendix E) for more information.

Table 5-11 Proposed LRT Station Locations

Station Name	Location	Features	Service Area	Long Walk, P/R, and Bus Transfer Markets
UNC Station	<i>Alignment Option A1 – UNC (A) / UNC (C) - SW of the Manning Drive & Hibbard Drive intersection on fully developed area.</i>	- Walk-up 4 feeder bus routes (curbside) - At-grade platform	- UNC Hospital complex - UNC South Campus	- UNC North Campus - Town of Chapel Hill (Bus) - Town of Carrboro (Bus)
	<i>Alignment Option A3 – UNC (D) – Along a new east-west roadway to be constructed south of the Genetic Medicine Research facility.</i>	- Walk-up 4 feeder bus routes (curbside) - At-grade platform	- UNC Hospital complex - Purefoy Rd Neighborhood	- UNC South Campus - UNC North Campus - Town of Chapel Hill (Bus) - Town of Carrboro (Bus)
Mason Farm Road Station	NW of the Mason Farm Road and Baity Hill Drive intersection, at the south end of the UNC campus	300-space park-and-ride 2 feeder bus bays (curbside) - At-grade platform	- Dean E. Smith Center - Ernie Williamson Athletic Center - UNC Housing along Mason Farm Rd	- UNC South Campus - Town of Carrboro (Bus) - Chatham County Residents (Park/Riders)
Hamilton Road Station	<i>Hamilton Road (A) - SW of the Hamilton Road and Prestwick Road intersection at the NW corner of the UNC Finley Golf Course</i>	- Walk-up - At-grade platform	- East 54 development - Fresh Market Shopping Center - Glen Lennox Neighborhood	- Oaks neighborhood - NC Botanical Garden - Greenwood Neighborhood
	<i>Hamilton Road (B) - East of the Hamilton Road and Prestwick Road intersection between the Prestwick Road and the UNC Finley Golf Course</i>	- Walk-up - At-grade platform	- East 54 development - Fresh Market Shopping Center - Glen Lennox Neighborhood	- Oaks neighborhood - NC Botanical Garden - Greenwood Neighborhood
Friday Center Drive Station	<i>Options A and B – SW of the Raleigh Road and Friday Center Drive intersection on a fully developed site. The station would be a walk-up station. Option A aligns with Alignment Option C1 to Meadowmont. Option B Aligns with Alignment Option C2 to Woodmont.</i>	- Walk-up - Option A – Aerial platform - Option B - At-grade platform or aerial platform	- Friday Center Complex - Commercial Development south of NC 54 - Finley Forest Neighborhood	Meadowmont Village
Meadowmont Lane (A) / Woodmont (B) Station	<i>Alignment Option C1 - Meadowmont Lane West side of Meadowmont Lane, between Barbee Chapel Road and Sprunt Street.</i>	- Walk-up - At-grade platform	Meadowmont Village	- The Oaks neighborhood - Friday Center

Station Name	Location	Features	Service Area	Long Walk, P/R, and Bus Transfer Markets
Meadowmont Lane (A) Woodmont (B) Station	<i>Alignment Option C2- George King Road</i> Between NC 54 and Stancel Drive, east of Barbee Chapel Road.	200-space park-and-ride - At-grade platform	Proposed commercial and office development adjacent to station	- South Chapel Hill Park/Riders - Chatham County Park/Riders
Leigh Village Station	SE of the Farrington Road and Wendell Road intersection, west of I-40.	1,000-space park-and-ride 7 feeder bus bays - At-grade platform	Proposed Leigh Village TOD	- Morrisville Park/Riders - Cary Park/Riders - Raleigh Park/Riders - Durham Park/Riders
Gateway Station	NE of the Old Chapel Hill Road and White Oak Drive intersection.	500-space park-and-ride 7 feeder bus bays - At-grade platform	Proposed Gateway TOD	- North Chapel Hill (Bus) - Downtown Chapel Hill (Bus) - Town of Carrboro (Bus)
Patterson Place Station	East of the McFarland Road and Sayward Drive intersection.	- Walk-up - At-grade platform	- Existing and Future Commercial Developments to West - Sayward Drive neighborhood	- Five Oaks neighborhood - Northwest Durham County (P/R)
MLK Jr. Parkway Station	North side of University Drive between MLK Jr. and Lyckan Parkways.	300-space park-and-ride 5 feeder bus bays - At-grade platform	- Larchmont Apts - Area Commercial/Retail Development	- Knollwood neighborhood - Valley Run neighborhood - South Durham Park/Riders
South Square Station	<i>South Square (A) - Alignment Option D3</i> Along east side of Shannon Road, directly NE of Shannon Road and Auto Drive intersection.	300-space park-and-ride 6 feeder bus bays - Elevated platform	Existing and Future redeveloped commercial uses	South Durham Park/Riders
	<i>South Square (B) - Alignment Option D1</i> Along east side of Westgate Drive, south of Durham-Chapel Hill Boulevard	300-space park-and-ride 6 feeder bus bays - Elevated platform	Existing and Future redeveloped commercial uses	South Durham Park/Riders
LaSalle Street Station	Median of Erwin Road at LaSalle Street.	- Walk-up 5 feeder bus bays (curbside) - At-grade platforms	- Duke University campus - Campus Walk apartments - Area Commercial and Residential buildings	American Village (Bus)

Station Name	Location	Features	Service Area	Long Walk, P/R, and Bus Transfer Markets
Duke Medical Center Station – Option A and B	Option A - Median of Erwin Road on the west side of Fulton Street Option B - West side of Flowers Drive and east side of Trent Drive	- Walk-up - At-grade platforms	- Duke Hospital - VA Hospital - Adjacent medical office and commercial uses	Duke West Campus
Ninth Street Station	In the railroad ROW, west of Ninth Street, directly south of the freight and commuter rail tracks.	200-space park-and-ride 4 feeder bus bays - Elevated platform	- Old West Durham - Duke East Campus - Trinity Height 9th St Business District	- Walltown neighborhood - Watts/Hilldale (Bus, Park and Ride)
Buchanan Boulevard Station	In the railroad right-of-way, east of Buchanan Boulevard, directly south of the existing rail tracks.	- Walk-up - At-grade platform	- Trinity Park - Duke East Campus - Brightleaf Square	- West End neighborhood - Morehead Hill neighborhood - Lakewood Park neighborhood (Bus)
Durham Station	In the railroad right-of-way between Duke Street and Chapel Hill Street, directly south of the existing rail corridor. Adjacent to the Amtrak and across the street from the Durham Station Transportation Center.	300-space park-and-ride (shared) - Intermodal facility - At-grade platform	- Durham Station Transportation Center - Amtrak Station - Downtown Loop - Bulls Ballpark - American Tobacco District - Future redevelopment areas	- Old North Durham - Duke Park (Bus, Park/Ride)
Dillard Street Station	In the railroad ROW, east of Dillard Street, directly south of the existing rail corridor.	- Walk-up - At-grade platform	- East Downtown - DPAC - Cleveland-Holloway neighborhood - Future redevelopment areas	- East Durham - Albright neighborhoods (Bus)
Alston Avenue Station	In the railroad ROW, east of Alston Avenue, directly south of the existing rail corridor.	500-space park-and-ride 4 feeder bus bays - At-grade platform	- NE Central Durham - NCCU	- North Durham - Durham Technical Community College - North Raleigh (Park and Ride)

Source: Station Evaluation Technical Report, URS Corporation Consultant Team, 2011.

Bus Network

The feeder bus service network is a key component of the LRT Alternative. Modifications to the programmed 2035 LRTP (or the No-Build Alternative) bus network were identified by station travel shed along the LRT alignment. If a route would duplicate or compete with the LRT service, then it was removed from the bus network. For each travel shed, a set of feeder bus routes was identified that provides access to the station from the various activity centers in the travel shed that are beyond the acceptable walking distance from the station (usually about one-third of a mile). The feeder buses serve both residential activities and commercial/employment centers. These routes were then compared to the programmed bus network contained in the 2035 LRTP. If no route in the LRTP provided the same service as the proposed feeder route then a new route was added. If an existing route provided essentially the same service as the feeder route, then the existing route was modified as necessary to match the proposed feeder route. Table 5-12 reflects these changes from the No-Build Alternative.

Table 5-12 LRT Bus Network Changes from the No-Build Alternative

Route Number	Description	Headway		Change from No-Build Alternative
		Peak	Off-Peak	
BRT*/Express Bus/Regional Bus				
CHT BRT-5*	CHT BRT-5 I40 to UNC	N/A	N/A	Removed
CHT FCX	CHT FCX:Pttstor-FridayCntr	N/A	N/A	Removed
CHT HUX	CHT HUX:HedrckBldg-UNCHosp	N/A	N/A	Removed
TTA 550	TTA 550 WB:Raleigh-Chap Hill	15	30	Terminates at Friday Center instead of Downtown Chapel Hill
N/A	TTA Burlington-Duke	30	N/A	Terminates at Duke Medical Center instead of Durham Station
TTA 402/403	TTA ChapelHill-RTP-402/403	30	60	Terminates at Leigh Village instead of Downtown Chapel Hill
TTA 412/413	TTA ChapelHill-RTP-412/413	30	60	Terminates at Leigh Village instead of Downtown Chapel Hill
Feeder/Local				
N/A	Mason Farm Road to 15-501	20	40	Added
N/A	Mason Farm Road to Jones Ferry Park N Ride	20	40	Added
N/A	Seawell School to UNC Hospital	20	40	Added
N/A	Leigh Village Circulator	20	40	Added
N/A	Gateway to Pinehurst / Burning Tree	20	40	Added
N/A	Gateway to Legion to Estes / Willow	20	40	Added
N/A	Gateway to Whitfield / Turkey Farm	20	40	Added
N/A	Gateway to Farrington	20	40	Added
N/A	Leigh Village to 751 / Fayetteville	20	40	Added
N/A	Leigh Village to Renaissance to Fayetteville / Chancellors Ridge	20	40	Added
N/A	Leigh Village to NC 54 / Revere	20	40	Added
N/A	Leigh Village to MLK via Garrett	20	40	Added

Route Number	Description	Headway		Change from No-Build Alternative
		Peak	Off-Peak	
N/A	Leigh Village to MLK via Roxboro and MLK Blvd	20	40	Added
N/A	MLK to Garrett / Picket	20	40	Added
N/A	South Square to Erwin / Randolph	20	40	Added
N/A	South Square to James / Nation	20	40	Added
N/A	South Square to Durham Station	20	40	Added
N/A	South Square to La Salle	20	40	Added
N/A	Alston Circulator via Fayetteville and Riddle	20	40	Added
N/A	Alston to Briggs / Lawson	20	40	Added
N/A	Alston to US 70	20	40	Added
N/A	Durham Station to La Salle	20	40	Added
N/A	Ninth to Broad / Carver	20	40	Added
N/A	Ninth to Guess / Horton	20	40	Added
N/A	Alston to Clayton / Freeman	20	40	Added
N/A	Alston to Club / Geer (Wal-Mart)	20	40	Added
CHT 4	CHT Base 4 Laurel Hills	N/A	N/A	Removed
CHT S	CHT S:HedrickBldg-UNCHosp	N/A	N/A	Removed
CHT V	CHT V:SVillage-Meadowmont	N/A	N/A	Removed
DATA 10-8	DATA 10-8:NewHopeCmn-DrhmTech	N/A	N/A	Removed
L5	DATA L5 Mt Moriah-NC 54 WB	N/A	N/A	Removed
N/A	DCHC B11 N Raleigh to Duke WB	N/A	N/A	Terminates at Alston Ave instead of Duke Medical Center

Source: URS Corporation Consultant Team, 2011. | *BRT routes in the LRT bus network refer to services planned by Chapel Hill Transit (CHT).

BRT-High Alternative

The BRT-High Alternative would operate BRT service between UNC Hospitals and east Durham, covering a distance of approximately 17.1 miles. The BRT would operate at 10-minute frequencies during peak hours and 20-minute frequencies during off-peak hours. Travel time is estimated to be 39 minutes between the UNC Station in Chapel Hill and the Alston Avenue Station in Durham.

Following roughly the same alignment as the LRT, the alignment would primarily run at-grade in a dedicated running way, parallel to existing roadways, with elevated sections throughout to mitigate potential traffic impacts or impacts to environmental features as needed. Similar to LRT, a total of 17 stations are proposed.

Technology

The BRT-High Alternative assumes low-floor, articulated BRT vehicles with a capacity (seated and standing) of 100.

Alignment

The BRT-High generally follows the LRT Alternative from UNC Hospitals in Chapel Hill to Ninth Street in Durham with minor differences in width (Figure 5-11). The alignment assumes elevated structure and capital improvements in many of the same locations as LRT.



Downtown Durham to East Durham The BRT-High alignment enters downtown Durham similarly to the LRT Alternative; however, between Ninth Street and the end-of-line at Alston Avenue, the BRT-High alignment deviates from the LRT alignment which runs in the NCRR corridor. BRT-High would not operate in the NCRR corridor because during the Special Transit Advisory Commission's (STAC) deliberations, representatives of CSX Transportation (CSX) and Norfolk Southern Corporation (NS) stated that they would not accept the operation of busway/HOV lanes in any railroad corridor in which they operated. NCRR advised the STAC that they too would not support busway/HOV lanes in the NCRR corridor. Therefore, the BRT-High alignment is proposed to run along Pettigrew Street. Existing Pettigrew Street is technically within the 200-foot railroad right-of-way but is currently utilized by vehicular and bus traffic. The BRT-High would operate similar to conventional bus in mixed traffic along Pettigrew Street, but would transition to exclusive running along a new Pettigrew Street connection to be constructed as part of this project between Campus Drive and Duke Street. More research is needed to ascertain if the City has easements and/or rights to make this connection versus whether NS would allow its construction since this connection is located within the railroad right-of-way (as is most of the existing Pettigrew Street.)

The Special Transit Advisory Commissions (STAC) is a 38-member broad-based citizen group appointed by the Triangle Region's two Metropolitan Planning Organizations (MPOs) to assist in joint development of a plan for a regional transit system and draft the transit element of the 2035 LRTP. The STAC's recommendations are documented in the Regional Transit Vision Plan.

This section would have stations at Ninth Street, Buchanan Boulevard, the Durham Station Transportation Center, Dillard Street, and Alston Avenue. The route from Pettigrew Street to the Durham Transportation Center would be via a one-way couplet in mixed traffic. The eastbound direction would follow S. Gregson Street south to E. Chapel Hill Street and north back to Pettigrew Street. The westbound direction would follow W. Chapel Hill Street to Duke Street. From the Durham Station Transportation Center, the BRT-High alignment follows Pettigrew Street in mixed traffic to Alston Avenue.

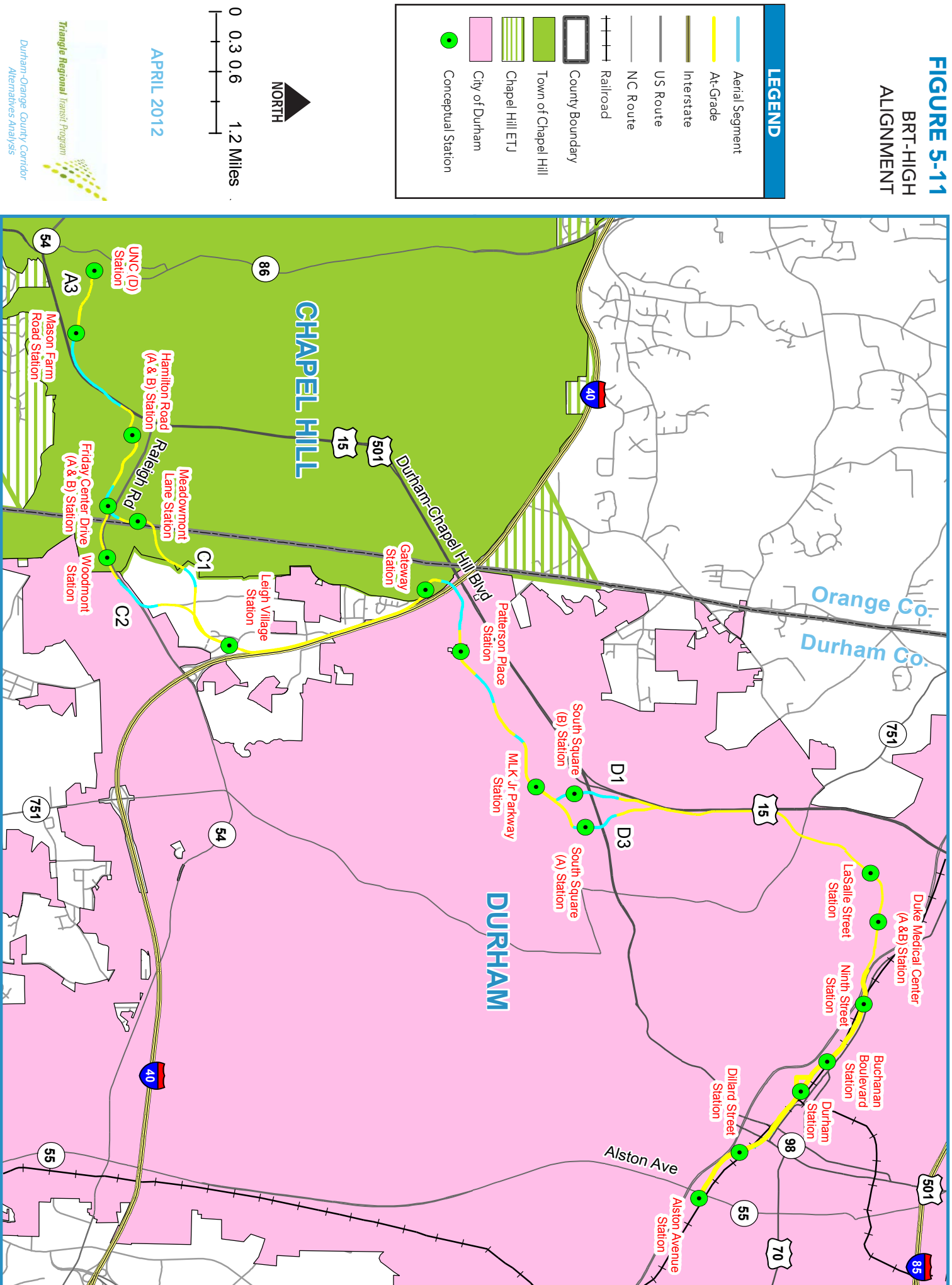
Station Locations

BRT-High would generally have the same station locations and features described under LRT.

Bus Network

Bus service modifications from the No-Build Alternative are identical to those changes described for the LRT Alternative, as previously listed in Table 5-12.

FIGURE 5-11
BRT-HIGH
ALIGNMENT



BRT-Low Alternative

The BRT-Low Alternative would operate BRT service between UNC Hospitals and east Durham, covering a distance of 17.7 miles. BRT-Low would operate at 10-minute frequencies during peak hours and 20-minute frequencies during off-peak hours. Travel time is estimated to be 44 minutes between the UNC Hospitals in Chapel Hill and Alston Avenue in Durham.

Similar to the BRT-High Alternative, the BRT-Low Alternative would operate primarily in an exclusive running way from Chapel Hill through west Durham and operate in mixed-traffic in downtown Durham to east Durham. However, the alternative is designed to be a lower cost alternative and thus includes additional alignment segments following existing roadways. A total of 18 stations are proposed for the BRT-Low Alternative. Conceptual plans and typical sections of the BRT-Low Alternative are provided in Volume 2: Detailed Definition of Alternatives, Conceptual Plan, and Profile Drawings.

Technology

The BRT-Low Alternative would use the same vehicle technology as the BRT-High: low-floor, articulated BRT vehicles with a capacity (seated and standing) of 100.

Alignment

The BRT-Low alignment is similar to the BRT-High alignment but would deviate from the BRT-High alignment in the following three segments: Hamilton Road Station to Leigh Village Station (BRT-Low Alternative 1), Gateway Station to MLK Jr. Parkway Station (BRT-Low Alternative 2), and Shannon Drive to Pickett Road (BRT-Low Alternative 3). Figure 5-12 shows the BRT-Low alignment. These BRT-Low alignments are described below.

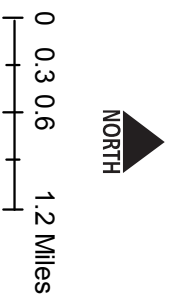
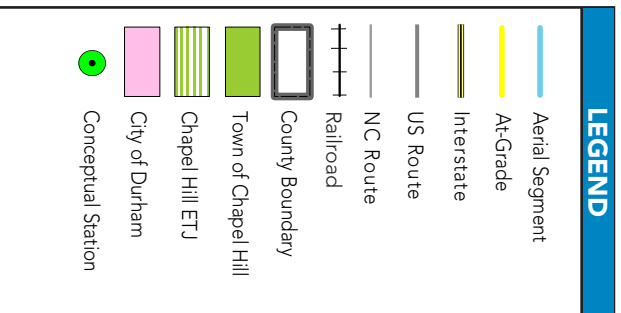
BRT-Low Alternative 1 - Hamilton Road Station to Leigh Village Station (including Meadowmont/Woodmont Subarea)

The BRT-Low alignment would use new lanes in each direction along NC 54 from Hamilton Road to George King Road. Current planning studies for NC 54 are likely to recommend adding capacity to the roadway. BRT-Low, along with local and regional bus operations, could make use of these added bus-only lanes. The BRT-Low guideway would leave Hamilton Road Station and join with Hamilton Road running in mixed traffic for this short block. The eastbound lane would be built on the south side of NC 54 and the westbound lane on the north side. The southbound movement at the intersection of Hamilton Road and NC 54 would be a controlled at-grade movement through a modified signal control system.

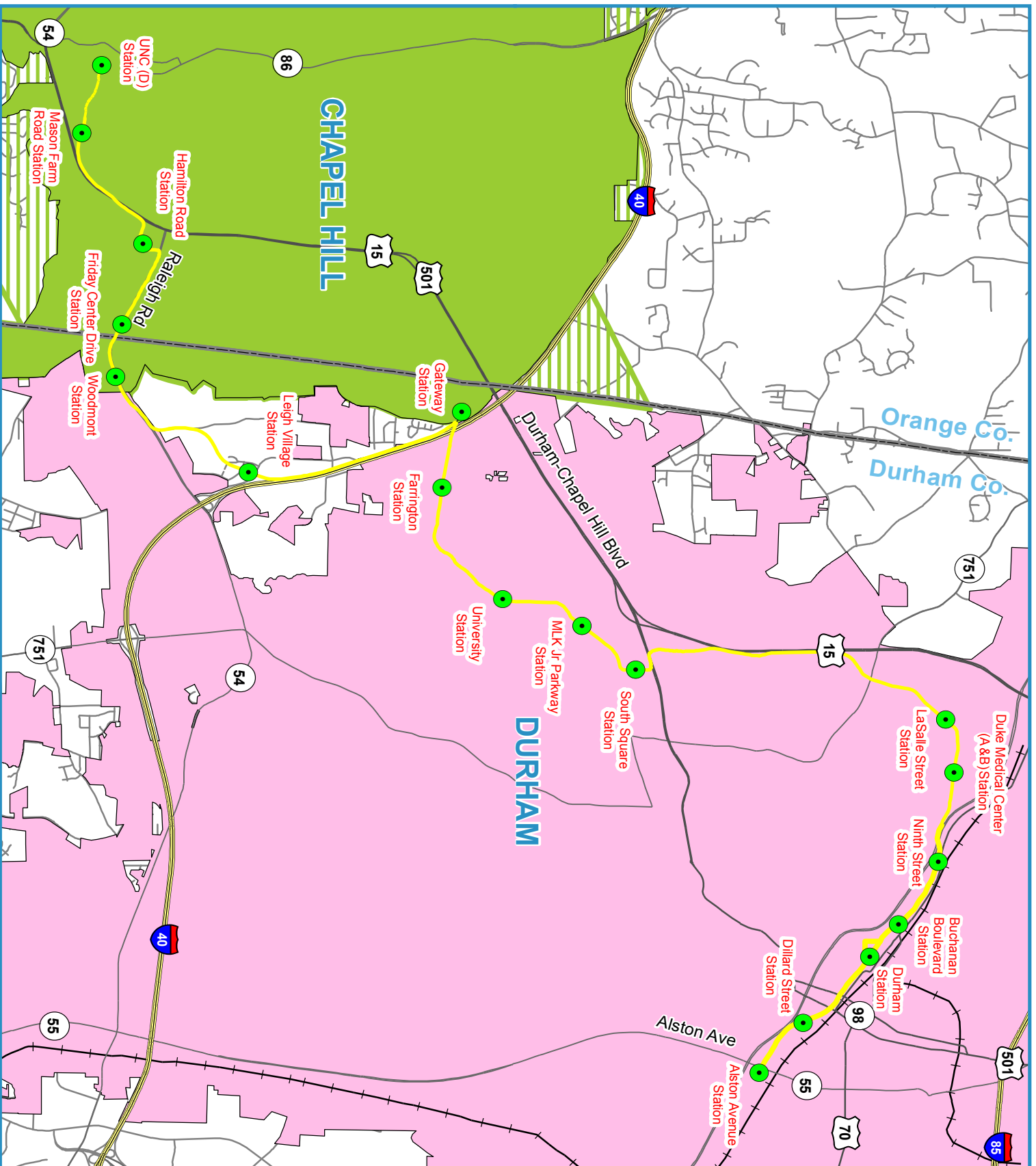
For the westbound lane, additional at-grade crossings would occur at Barbee Chapel Road, Friday Center Drive, and George King Road. The eastbound lane would transition to aerial structure for the crossing of NC 54 and return to grade on the north side of NC 54 where it would rejoin the south/westbound guideway and continue on to Leigh Village as with the LRT and BRT-High Alternatives.

There would be two side platforms on each side of NC 54. The Friday Center Drive Station would be aligned with the pedestrian underpass to allow for grade-separated pedestrian movements across NC 54. The other station (replicating the Woodmont LRT stop) would be at the Little John Road intersection. A new traffic signal would be introduced at Little John Road to allow for pedestrian movements associated with the two split platforms.

FIGURE 5-12
BRT-LOW
ALIGNMENT



APRIL 2012



BRT-Low Alternative 2 - Gateway Station to MLK Jr. Parkway Station

The BRT-Low alignment would follow Old Chapel Hill Road and University Drive for its entire length between the Gateway Station and MLK Jr. Parkway Station. Like NC 54, one lane would be built on each side of Old Chapel Hill Road and University Drive. The existing Old Chapel Hill Street Bridge over I-40 would be widened to accommodate the added lanes.

BRT-Low Alternative 3 - Shannon Drive to Pickett Road (includes South Square Subarea)

The BRT-Low alignment through this segment continues the proposed guideway along the west and north side of University Drive to Shannon Drive. The option places a lane in each direction on Shannon Drive to Durham-Chapel Hill Boulevard running at-grade instead of elevated as with the BRT-High option. From Shannon Drive, the lanes would turn west along Durham-Chapel Hill Boulevard, with one lane on each side of the street. The alignment would then turn north, entering Tower Road and would operate in mixed traffic for the short length of Tower Road.

Station Locations

The station locations would be the same as BRT-High except along Old Chapel Hill Road, where the BRT-Low would have two alternate stations in place of a Patterson Place Station. Table 5-13 describes station locations for BRT-Low along the BRT-Low Alternative segments. Appendix E includes the conceptual BRT station layouts.

Table 5-13 BRT-Low Station Locations

Station Name	Location	Features	Service Area	Long Walk, P/R, and Bus Transfer Markets
Friday Center Drive	West of the Friday Center Drive/Meadowmont Lane intersection with NC 54	- Walk-up station - At-grade, side platform on either each side of Old Chapel Hill Road - Bus pullouts	- Friday Center Complex - Commercial Development south of NC 54 - Finley Forest Neighborhood	Meadowmont Village
Woodmont	Vicinity of Downing Creek Parkway	200-space park-and-ride - At-grade, side platform on either each side of Old Chapel Hill Road	Proposed commercial and office development adjacent to station	South Chapel Hill Park/Riders
Farrington Road Station	West of the Old Chapel Hill Road and Farrington Drive intersection	- Walk-up station - At-grade, side platform on either each side of Old Chapel Hill Road - Bus pullouts	- Multi-family residential north and south of Old Chapel Hill Rd - Middle School on north side of Old Chapel Hill Rd east of SW Durham Rd	- Five Oaks - Rose Garden
University Place Station	At the University Drive and University Place intersection	- Walk-up station - At-grade, side platform on either each side of Old Chapel Hill Road - Bus pullouts	- Multi-family residential west of University Drive - Office buildings in University Place on east side of University Drive	- University Place Apartments - University Place Office Complex
South Square Station	South Square (A) Along east side of Shannon Road, directly NE of Shannon Road and Auto Drive intersection.	300-space park-and-ride 6 feeder bus bays - At-grade platform	Existing and Future redeveloped commercial uses	South Durham Park/Riders

Bus Network

Bus service modifications from the No-Build Alternative are identical to those changes described for the LRT and BRT-High Alternative, as previously listed in Table 5-12. Minor feeder bus route modifications would also be made to accommodate the alignment variations for the BRT-Low Alternative.

Operating Plans

Operating plans were developed for the purpose of developing ridership forecasts and cost estimates for the Build Alternatives. The final operating plan will be developed for the Build Alternative advanced as the LPA.

Service Levels

Table 5-14 summarizes the operating statistics for the Build Alternatives as assumed in the ridership forecasts and cost estimates for the Detailed Evaluation of Alternatives. The operating hours and days for the Build Alternatives would be 18 hours per day, seven days per week, and 365 days per year. Service hours could be extended later into the evening or early morning hours for special events as needed.

Table 5-14 Summary of Service Characteristics for Build Alternatives

Period	Hours	TSM Headway	LRT Headway	BRT-High BRT-Low Headway
AM Peak	6:00AM – 9:00 AM	10 minutes	10 minutes	10 minutes
Mid-day	9:00 AM – 3:30 PM	20 minutes	20 minutes	20 minutes
PM Peak	3:30 PM – 7:00 PM	10 minutes	10 minutes	10 minutes
Evening	7:00 PM – 12:00 AM	20 minutes	20 minutes	20 minutes
Off-Peak	6:00 AM – 12:00 AM	20 minutes	20 minutes	20 minutes

Source: URS Corporation Consultant Team, 2011.

End-to-End Operating Characteristics

Table 5-15 summarizes the route miles, average speed, and trip time for the Build Alternatives from end-to-end.

Table 5-15 End-to-End Operating Characteristics

Alternative	Route Miles	Average Speed	Travel Time
TSM	18.9 EB /19.4 WB	20.0 mph	57 minutes
LRT	17.1 miles	29.6 mph	35 minutes
BRT-High	17.1 miles	26.7 mph	39 minutes
BRT-Low	17.7 miles	24.5 mph	44 minutes

Source: URS Corporation Consultant Team, 2011.

Station-to-Station Distance, Speed, and Travel Time

Table 5-16 shows the route miles, average speed, and total trip time between stations for LRT and BRT Alternatives.

Table 5-16 Station-to-Station Operating Characteristics

Segment (Station to Station)	LRT Alternative			BRT-High Alternative			BRT-Low Alternative		
	Route Miles	Avg.Speed (mph)	Trip Time (mins)	Route Miles	Avg.Speed (mph)	Trip Time (mins)	Route Miles	Avg. Speed (mph)	Trip Time (mins)
UNC – Mason Farm Road									
Alignment Option A1									
UNC – Mason Farm Road	0.5	22.2	1.4	0.5	20.6	1.5	0.5	20.6	1.5
Alignment Option A3									
UNC – Mason Farm Road	0.6	20.6	1.8	0.6	19.5	1.9	0.6	19.5	1.9
Mason Farm Road – Hamilton Road	1.3	31.7	2.5	1.3	30.2	2.6	1.3	30.2	2.6
Hamilton Road – Friday Center Drive	0.8	21.9	2.2	0.8	20.9	2.3	0.8	20.9	2.3
Friday Center Drive – Leigh Village									
Alignment Option C1									
Friday Center Drive – Meadowmont Lane	0.3	17.9	1.1	0.3	16.5	1.2	--	--	--
Meadowmont Lane – Leigh Village	1.7	38.1	2.7	1.7	36.2	2.8	--	--	--
Alignment Option C2									
Friday Center Drive – Woodmont	0.5	24.5	1.2	0.5	21.4	1.3	0.5	21.4	1.3
Woodmont – Leigh Village	1.7	35.4	2.8	1.7	33.3	3.0	1.7	33.3	3.0
Leigh Village – Gateway	2.1	41.7	2.9	2.1	39.9	3.1	2.1	39.9	3.1
Gateway – Patterson Place	1.0	25.6	2.3	1.0	24.6	2.4	--	--	--
Patterson Place – MLK Jr. Parkway	1.7	36.6	2.8	1.7	35.1	2.9	--	--	--
Gateway – Farrington Drive	--	--	--	--	--	--	0.9	21.4	2.5
Farrington Drive – University Place	--	--	--	--	--	--	0.8	21.4	2.2
University Place – MLK Jr. Parkway	--	--	--	--	--	--	1.4	22.0	3.8
MLK Jr. Parkway – LaSalle Street									
Alignment Option D1									
MLK Jr. Parkway – South Square (B)	0.4	14.5	1.6	0.4	14.0	1.7	--	--	--
South Square (B) – LaSalle Street	3.0	36.4	5.0	3.0	35.5	5.1	--	--	--
Alignment Option D3									
MLK Jr. Parkway – South Square (A)	0.6	20.3	1.9	0.6	19.4	2.0	0.6	19.4	2.0
South Square (A) – LaSalle Street	3.0	36.2	4.9	3.0	35.3	5.0	3.2	28.0	6.9
LaSalle Street – Duke Medical Center	0.5	19.6	1.4	0.5	18.6	1.5	0.5	18.6	1.5
Duke Medical Center – Ninth Street	0.9	20.6	2.6	0.9	19.9	2.7	0.9	19.9	2.7
Ninth Street – Buchanan Boulevard	0.7	29.9	1.4	0.7	19.5	2.1	0.7	19.5	2.1
Buchanan Boulevard – Durham Station	0.4	27.9	1.1	0.4	16.7	1.3	0.4	16.7	1.3
Durham Station – Dillard Street	0.7	31.0	1.6	0.7	20.1	2.2	0.7	20.1	0.7
Dillard Street – Alston Avenue	0.8	22.2	1.6	0.8	22.3	2.3	0.8	22.3	0.8

Source: URS Corporation Consultant Team, 2011, Volume 3, Section C Travel Times and Distance Calculations

Fleet Size

Two sets of cost estimates were developed for LRT, BRT-High, and BRT-Low to provide an understanding of the differences in scale of operations and maintenance (O&M) costs related to operating the fixed-guideway alternatives with a peak hour passenger capacity of 1,500 passengers (Scenario 1) and service with a peak hour passenger capacity of 800 passengers (Scenario 2). Table 5-17 summarizes the fleet characteristics for the Build Alternatives based on both operating scenarios.

Table 5-17 Build Alternatives Fleet Characteristics

	LRT		BRT-High and BRT-Low		TSM
	1500 pax/hr	800 pax/hr	1500 pax/hr	800 pax/hr	
Total Number of Vehicles in Fleet	15 cars	10 cars	27 buses	15 buses	16 buses
Total Number of Vehicle in Peak Service	12 cars	8 cars	22 buses	12 buses	13 buses
Peak Service Consist Size	1-and 2-car trains	1-car trains	10 buses	NA buses	NA
Off-Peak Service Train Consist Size	1-car trains	1-car trains	8 buses	NA	NA

Source: URS Corporation Consultant Team, 2011.

Storage Yard and Maintenance Facility

An important infrastructure component of a fixed-guideway transit investment in the Durham-Orange Corridor is a rail operations and maintenance facility (ROMF) to accommodate LRT and BRT vehicles and repairs for all transit system wayside equipment.

For the TSM, BRT-High, and BRT-Low Alternatives, vehicles would be stored, serviced, and repaired at one or more existing CHT, DATA, and/or Triangle Transit bus storage and maintenance facilities that would be expanded. Any necessary expansions would be funded as part of the capital costs for the proposed project. The CHT facility is located on Eubanks Road. The DATA bus maintenance facility is located northeast of downtown Durham in the vicinity of Fay Street and East Greer Street. The Triangle Transit facility is located along I-540, west of RDU Airport on Nelson Road in Durham.

For the LRT Alternative, the Project Team assessed potential LRT storage yard and maintenance facility sites within the Durham-Orange Corridor. Four sites were chosen for evaluation: Leigh Village, Farrington, Patterson, and Cornwallis (Figure 5-13). These sites were chosen because they have sufficient acreage and length to accommodate the required functions, grading that could accommodate a rail yard, and adjacent land uses and access that could be compatible with a LRT yard and maintenance facility operation. The following basic functions were identified as requirements for each of the sites:

- Storage of 15 LRT cars which includes 3 spares. Each LRT car was assumed to be a low-floor articulated unit between 90 and 95 feet in length and up to 9 feet in width.
- Storage tracks to be double ended and capable of storing trains in one, two or three car lengths.
- Storage tracks will have paved access areas between alternating storage tracks for access to vehicles for cleaning and inspection. Designs are based on 20-foot track centers where access areas are provided allowing 11-foot clearance between vehicles and 15-foot track centers in unpaved areas where catenary poles would be placed between tracks.

- Rail access to and from the mainline in either direction with crossovers between the mainline tracks located on the mainline at either end of the yards.
- Maintenance of Equipment (MOE) activities.
- Transportation Employee (TE) activities to be provided for:
 - Maintenance of Way (MOW) and Signals, Power, and Communications functions
 - Traction power Substation (TPSS)

Conceptual layouts developed for each site are provided in Volume 2: Detailed Definition of Alternatives, Conceptual Plan and Profile Drawings. The conceptual layouts have only been prepared to the level sufficient to identify the basic ability of the site to accommodate the required functions.

Evaluation of the four sites is based on size, access (rail and roadway), land use compatibility, and potential for adverse environmental effects. Table 5-18 summarizes the results of this preliminary evaluation.

Since the most productive and affordable segment of the Durham-Orange corridor has yet to be identified, all of the storage yard and maintenance facility alternatives are recommended to be carried forward and reviewed after selection of the LPA. It is likely that more than one alternative will be advanced with the LPA for more rigorous study in the PE/Draft Environmental Impacts Statement (DEIS) phase of the project.

LEGEND

- At-Grade
- Aerial Segment
- Interstate
- US Route
- NC Route
- Local Road
- LRT Maintenance Facility Options

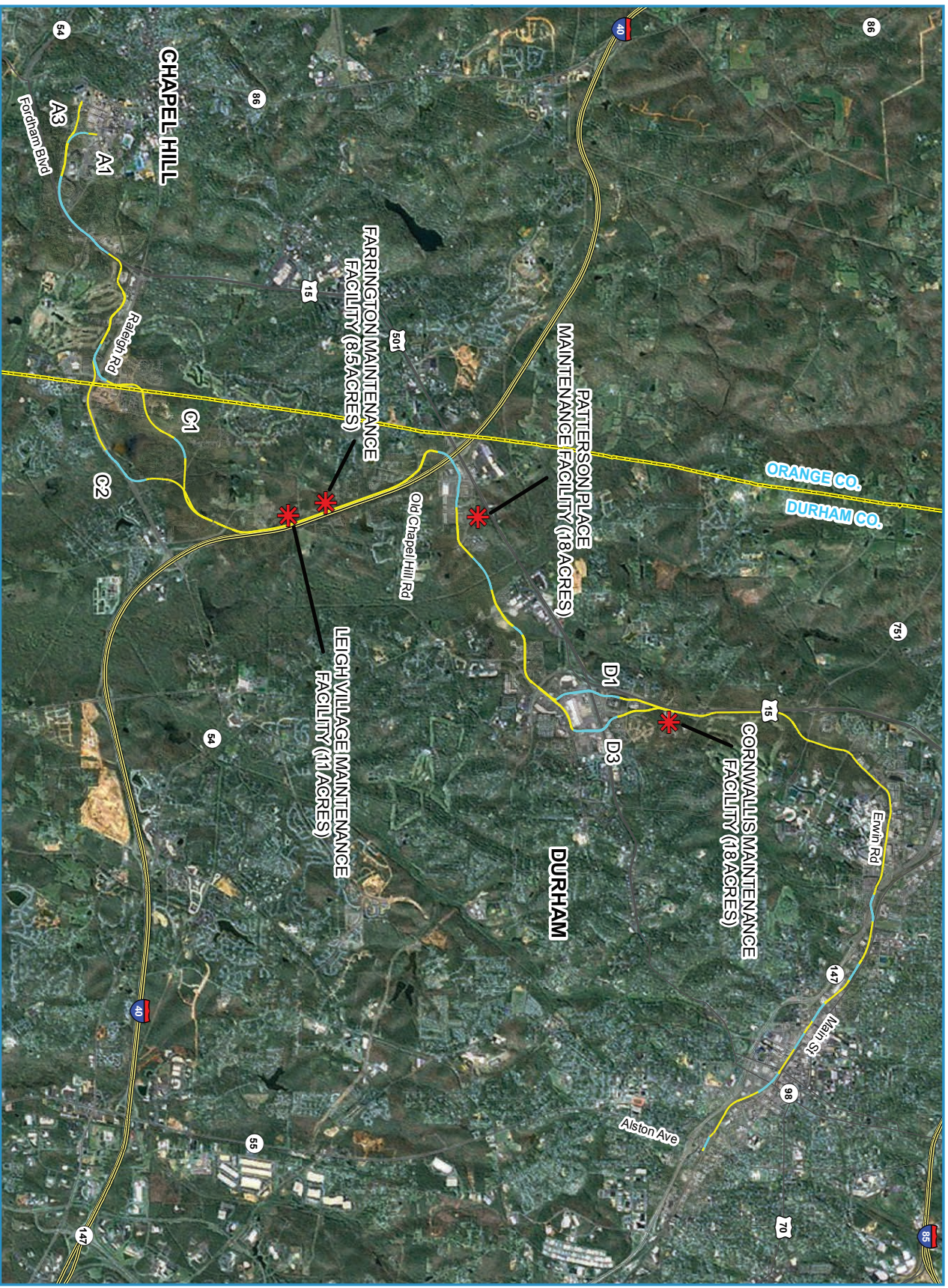


Table 5-18 Summary of LRT Maintenance Sites

Candidate Site	Size	Access	Land Use Compatibility	Environmental Effects
Leigh Village	Adequate size (approximately 13.5 acres)	- Good roadway access - Excellent bidirectional access	- Bound on one side by I-40 - Adjacent rural residential land uses; acquisition of multiple residences would be required - Opportunity for natural buffers to screen site from view	Potential noise impacts to surrounding residences
Farrington	Adequate size (approximately 12.4 acres)	- Good roadway access - Excellent bidirectional access	- Bound on one side by I-40 and Farrington Road on the other providing for separation of land uses - Adjacent rural residential land uses; acquisition of multiple residences would be required - Opportunity for natural buffers to screen site from view	Potential noise impacts to surrounding residences
Patterson	Adequate size (approximately 12 acres)	- Good roadway access - Off-line site requiring approximately 1,400 feet of access track - Excellent bidirectional access	- Bound on one side by I-40 and Farrington Road on the other providing for separation of land uses - Undeveloped land and well-buffered from adjacent land uses - Opportunity for natural buffers to screen site from view	- Potential impacts to 2 possible Section 4(f) resources - Potential visual impacts from the New Hope Creek trail
Cornwallis	Adequate size (approximately 14 acres)	- Good roadway access - Excellent bidirectional access	- Bound on one side by US 15/501 and on the other providing for separation of land uses - Consistent with existing industrial use of site. - Adjacent to institutional land uses (schools, church) - Opportunity for natural buffers to screen site from view	Potential noise impacts to adjacent institutional land uses

Source: LRT Maintenance & Storage Yard Facility Assessment, URS Corporation Consultant Team, May 2011.

5.3.2. Detailed Evaluation Criteria

Like the Conceptual Alternative evaluation process, detailed evaluation criteria relate to the six project goals. Table 5-19 presents all six goals and their related evaluation criteria and measures used to screen the detailed alternatives.

Table 5-19 Build Alternatives Evaluation Criteria

Goals	Evaluation Criteria	Measure
Goal 1: Improve mobility through and within the study corridor. Goal 2: Increase transit efficiency and quality of service. Goal 3: Improve transit connections.	Ridership	Evaluates alternatives based on the ability to serve potential transit riders and major activity centers within the Study Area. - Ridership Forecasts: Estimates 2035 end-to-end boardings for LRT, BRT-High, and BRT-Low. - System-wide Transit Trips: Estimates 2035 daily transit trips within the Triangle region.
	Transportation Operations	Evaluates alternatives based on the ease of operating LRT or BRT service. - Traffic Impacts: Measures impacts to roadway and intersection conditions - Travel Times: Measures overall end-to-end travel times.
	Expansion Potential	Evaluates ability of alternatives to serve travel markets beyond the existing termini of the corridor with future extensions.
Goal 4: Support local and regional economic development and planned growth management initiatives.	Economic Development Potential	Evaluates ability of the alternatives to positively impact economic development. Also considers transit oriented development (TOD) potential.
	Public and Agency Support	Evaluates alternatives based on results of public and agency stakeholder meetings.
Goal 5: Foster environmental stewardship.	Environmental Impacts	Considers environmental impacts associated with constructing and operating BRT or LRT service. Includes: - Property Acquisitions - Visual Impacts - Wetland and Stream Impacts - Section 4(f) Resources Impacts - Air Quality Impacts - Construction Impacts
Goal 6: Provide a cost-effective transit investment.	Cost	Considers costs associated with the construction of the Build Alternatives. - Capital Costs - Operating & Maintenance Costs

Source: URS Corporation Consultant Team, 2011

5.3.3. Detailed Evaluation Results

This section summarizes the evaluation of the three fixed-guideway alternatives by evaluation criterion. A full summary table (Table 5-43) is presented at the end of this section. Solid, half-filled, and open circles are used to rate the performance of alternatives relative to one another. The ratings for the circles are as follows:

● = High Performing

◐ = Medium Performing

○ = Low Performing

Ridership, travel time, and costs for the TSM are included for informational purposes. The TSM will be evaluated against the LPA in the Final Definition of Alternatives.

Ridership

The measure of total daily riders reflects the usefulness and attractiveness of the high capacity transit system as a primary mode choice on a daily basis.

Summary of Ridership Forecasting Methodology

Alternatives Modeled The LRT, BRT-High, and BRT-Low Alternatives were modeled using the TRM Version 4 Enhanced (TRM4E.2) model. Four alternatives were modeled for LRT, based on combinations of the alignment options at UNC Chapel Hill (A1 and A3), Meadowmont/Woodmont (C1 and C2), and South Square (D1 and D3). These combinations were developed to illustrate the relative difference of the alignment options on LRT ridership. It is expected that the relative difference in ridership for the alignment options for LRT would be proportional to the relative differences under BRT-High, and BRT-Low. Therefore, modeling one alternative combination for both the BRT-High and BRT-Low was deemed sufficient to provide information to decision-makers for the selection of the preferred technology and alignment. BRT-High and BRT-Low were modeled using the combination of alignment options A3, C2, and D3.

The TSM Alternative is considered primarily against the modeled LRT, BRT-High, and BRT-Low Alternatives that combine alignment options A3, C2, and D3. Ultimately, once an LPA is selected for carrying forward, a refined TSM Alternative (Baseline Alternative) can be developed specifically to serve the same markets as the LPA. It is anticipated that the performance of this Baseline Alternative relative to the LPA will be comparable to the performance of the TSM Alternative presented in this report relative to the modeled LRT, BRT-High, and BRT-Low Alternatives that combine alignment options A3, C2, and D3.

Fixed-Guideway Bonus There are a number of attributes of mode choice that are not incorporated into the ridership forecasting model because they are qualitative in nature and/or difficult to quantify (“unincluded attributes”). These unincluded attributes can impact potential user perceptions of transit modes and include such factors as service reliability, station and vehicle amenities, and passenger comfort and convenience. The ridership forecasting model is sensitive to changes in travel time—which is divided into out-of-vehicle travel time (OVTT) and in-vehicle travel time (IVTT). OVTT represents time to access the LRT or BRT mode, which can include walking, driving, waiting, and bus transfers. IVTT represents time spent onboard the LRT or BRT vehicle. Therefore, to account for the unincluded attributes, a fixed-guideway bonus was applied to the IVTT for the LRT, BRT-High, and BRT-Low Alternatives. For the LRT and BRT-High Alternatives, both of which are assumed to provide the highest quality and level of service, a 15-minute travel time savings bonus was assumed. A high-investment BRT differs substantially from other types of bus service in that it provides almost all of the amenities of a rail-based service including a fixed-guideway, substantial stations, and other passenger amenities. These characteristics provide the same level of benefit on a BRT service as in an LRT system. BRT-Low features more sections operating in mixed-traffic and cross-traffic, potentially lowering the attraction of the service. To account for this difference in the design of the BRT-Low Alternative, an 8-minute travel time bonus was used.

Interlining In addition to the alignment difference between the BRT-High and the BRT-Low Alternatives, the BRT-High and BRT-Low projections also account for the interlining of local bus routes. Interlining refers to the ability of local bus routes, including feeder bus services to utilize the BRT running way for a portion of their trip. It is an accepted practice for BRT systems and allows more transit users to benefit from the guideway investment. The following should be noted about the ridership forecasts involving the interlining routes:

- Every interlined route stops at every BRT station when on the BRT busway.
- The combination of routes running on the guideway results in a higher frequency of service at guideway stations.
- While most of the interlining bus passengers would take advantage of the one-seat interlined bus ride through the BRT guideway, a small number would transfer at the BRT stations and is a part of the BRT route ridership as well.
- If a passenger is on the bus on the busway, it is counted in the interline ridership number, even if that passenger does not get off the bus on the busway. The same is true for those who transfer from one interlined route to another.

Figure 5-14 and Figure 5-15 depict the feeder bus routes for LRT and the feeder bus routes together with interlining bus routes for BRT.

Uncertainties in Forecasts

In discussions throughout the model calibration and validation process, the FTA has emphasized the importance of considering sources of uncertainty in performing the forecasting. It is desirable to avoid internalizing uncertainties within the forecasts. Rather than produce a single forecast that assumes the answer is known to every potential uncertainty, ideally a series or range of forecasts could be produced that can communicate the uncertainties to the decision-makers for consideration.

To that end, as part of the study, descriptions of a variety of potential sources of uncertainty in the forecasts and discussions about those uncertainties and their potential effects on the ridership forecasts were developed. Table 5-20 presents a listing of these uncertainties as present in the forecasts developed using the TRM4E.2.

Table 5-20 Potential Forecasting Uncertainties with Triangle Regional Model

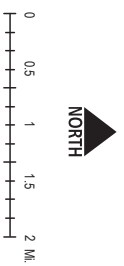
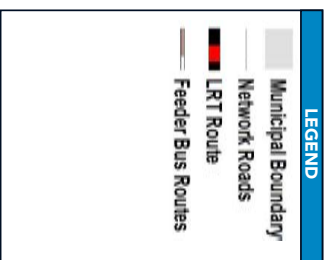
Uncertainties	Discussion	Potential Impact
1. Gasoline price (long-term effects of increasing gasoline price on transit ridership)	Studies have shown a positive relationship between increases in gasoline prices and transit ridership levels. Rail ridership tends to be more sensitive to changes in gasoline prices than bus ridership. Based on the literature review, the long-term elasticity of transit ridership was suggested to be in the range 0.2 to 0.4 (Litman 2011), meaning that a 10% increase in gasoline price could result in a 2% to 4% increase in transit ridership. Over very long periods of time, technology and spatial distribution patterns may adjust to account for price changes and these potential effects are not incorporated.	Significant increases in gasoline prices could result in considerable increase in the estimated rail ridership. For example, doubling the gasoline price could potentially lead to a 20% to 40% increase in rail ridership.
2. University trips (fare-free transit services in three major universities in the region)	Fare-free bus services for Chapel Hill, Duke, and NCSU are in the corridors today. University-related trips account for close to 60% of all transit trips in the region. Home-based university trips were currently estimated to be around 10% of rail trips, with below 10% for the Durham-Orange corridor. University-related trips can also be part of the non-home-based trips. Due to model limitations, it was assumed that rail trips are all paid trips, including student trips. This could tend to understate usage of the guideway services by this market. Based on the literature review, the long-term ridership elasticity with respect to fare was suggested to be -0.6 to -0.9 (Litman 2011), meaning that 10% decrease in fare could result in a 6% to 9% increase in transit ridership.	Provision of (fare-free or discounted) student rail passes could potentially increase the rail ridership versus what the model reports.

Uncertainties	Discussion	Potential Impact
3. Representation of fixed-guideway ridership	Fixed-guideways tend to attract proportionally more riders than standard buses. As typical of a region without an operating fixed-guideway, the region's travel demand model was developed and calibrated on transit surveys of the current bus users, potentially under-representing the attractiveness of a fixed-guideway service to riders if one were introduced to the market. As one aspect of this, the model, as currently calibrated, represents a traveler's drive access behavior to local and express buses, but fixed-guideway services typically attract more riders using drive access. Therefore, the model likely inadequately accounts for attractiveness of drive access to the fixed-guideways. For example, light rail systems used to calibrate the FTA Aggregate Rail Ridership Forecasting II model show the percentage of park and ride access ranging from 19% to 48%, averaging around 30%. In this phase of study, drive access was estimated to be around 20% for the Durham-Orange Corridor (at the low end of the range). A 15 minute fixed-guideway bonus has been applied to the LRT and BRT-High options and a 8-minute fixed-guideway bonus has been applied to the BRT-Low option to help account for the attractiveness attributes of LRT or BRT that are otherwise not included in the model. The actual attractiveness of the fixed-guideway option may be different from what is represented by the bonus used.	The fixed-guideway bonuses employed in this study help account for attributes of attractiveness of these modes that are otherwise unaccounted for in the model. However, if these bonuses overstate the actual attractiveness, the resulting ridership could be lower than what is forecast. (See Ridership Forecasting Methodology – Fixed-Guideway Bonus discussion for more information on the fixed-guideway bonus) An experimental model approach, based on a study of rail ridership in Charlotte, was tested and calibrated as part of a sensitivity analysis to help explore the potential contribution of “choice riders” to ridership of fixed-guideway services. Using the experimental approach increased the forecast share of choice riders in the rail ridership composition and the proportion of drive access to rail. If more choice riders are attracted to the fixed-guideway services, higher ridership and higher park-and-ride-based ridership could result than what is forecast by the TRM V4E.2
4. Integration of feeder buses with background bus system and bus transfers to rail	Efforts have been made to integrate the transit system in the long-range plan transportation with a potential feeder bus system. However, the eventual transit system with a proposed guideway could be different from what was assumed in the model, because of changes in cost and other factors. Bus transfers to the rail were projected to play an important role in the rail ridership composition, accounting for nearly one third of the total ridership.	Reductions in the feeder buses that are assumed in the model, in terms of service frequencies and service areas, would decrease the bus transfers to the proposed rail.
5. Socioeconomic growth over the next 25 years along the corridor	A high growth of population and employment was assumed in the region's L RTP over the next 25 years. The Triangle region is currently projected to double its 2005 population and employment by 2035. The 30-year growth was projected to be lower in the proposed rail corridors, with 70-80% employment growth and 30-40% population growth in the Durham-Orange Corridor.	Too optimistic socioeconomic forecasts are often cited as a major reason for over-estimation of rail ridership in the US rail program. Lower growth could lead to lower ridership.

Uncertainties	Discussion	Potential Impact
6. Representation of parking constraints	There is a lack of parking constraints in the region's model, although an auto-intercept component was used to represent park-and-ride behavior around the UNC-Chapel Hill campus. Lack of parking capacity constraints may lead to more auto access transit trips forecast than could be accommodated.	Without sensitivity to parking pricing and demand-supply relationship, the model estimates may result in biased estimates for drive access trips, either upward or downward.
7. Historical ridership forecasts	FTA studies (2003, 2007) indicate systematic over-estimation of ridership for New Starts projects, but these recent projects are significantly more accurate than earlier projects.	"New" New Starts projects are shown to have higher uncertainties in the ridership forecasts than those projects extending the existing fixed-guideway services.
8. Model sensitivity to walk access	Representation of walk access from a transportation analysis zone (TAZ) is affected by the TAZ size. When a TAZ is big, the distance from a TAZ centroid to a proposed station may be too large to walk. However, a part of the big TAZ may be walkable to the station.	Given the refinements, the model could still underestimate walk access to proposed rail stations, where adjacent TAZs are big and especially transit-oriented developments are planned near the proposed stations.

FIGURE 5-14

LRT Alternative,
Non Interlining
Feeder Bus Routes



APRIL 2012

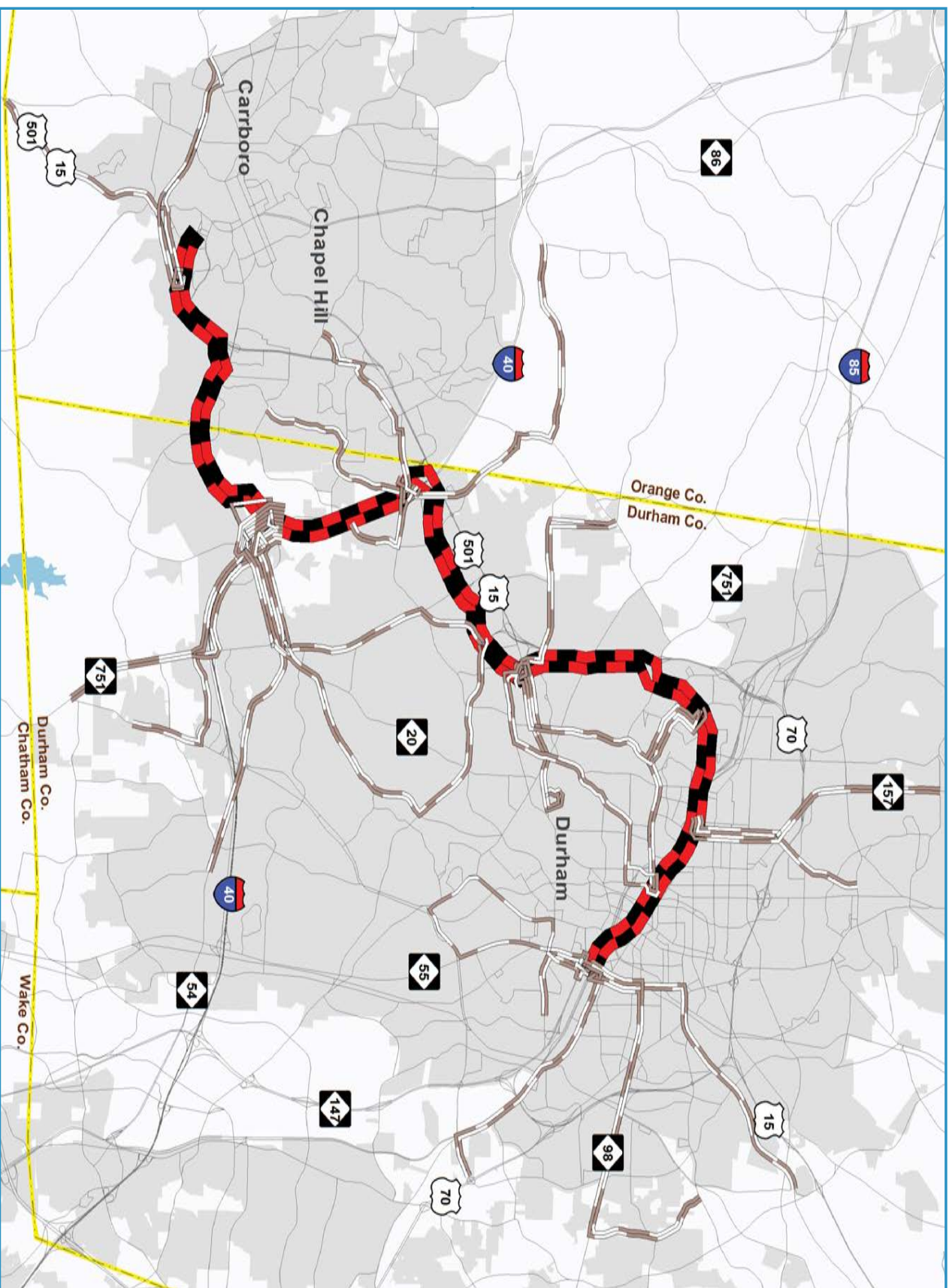
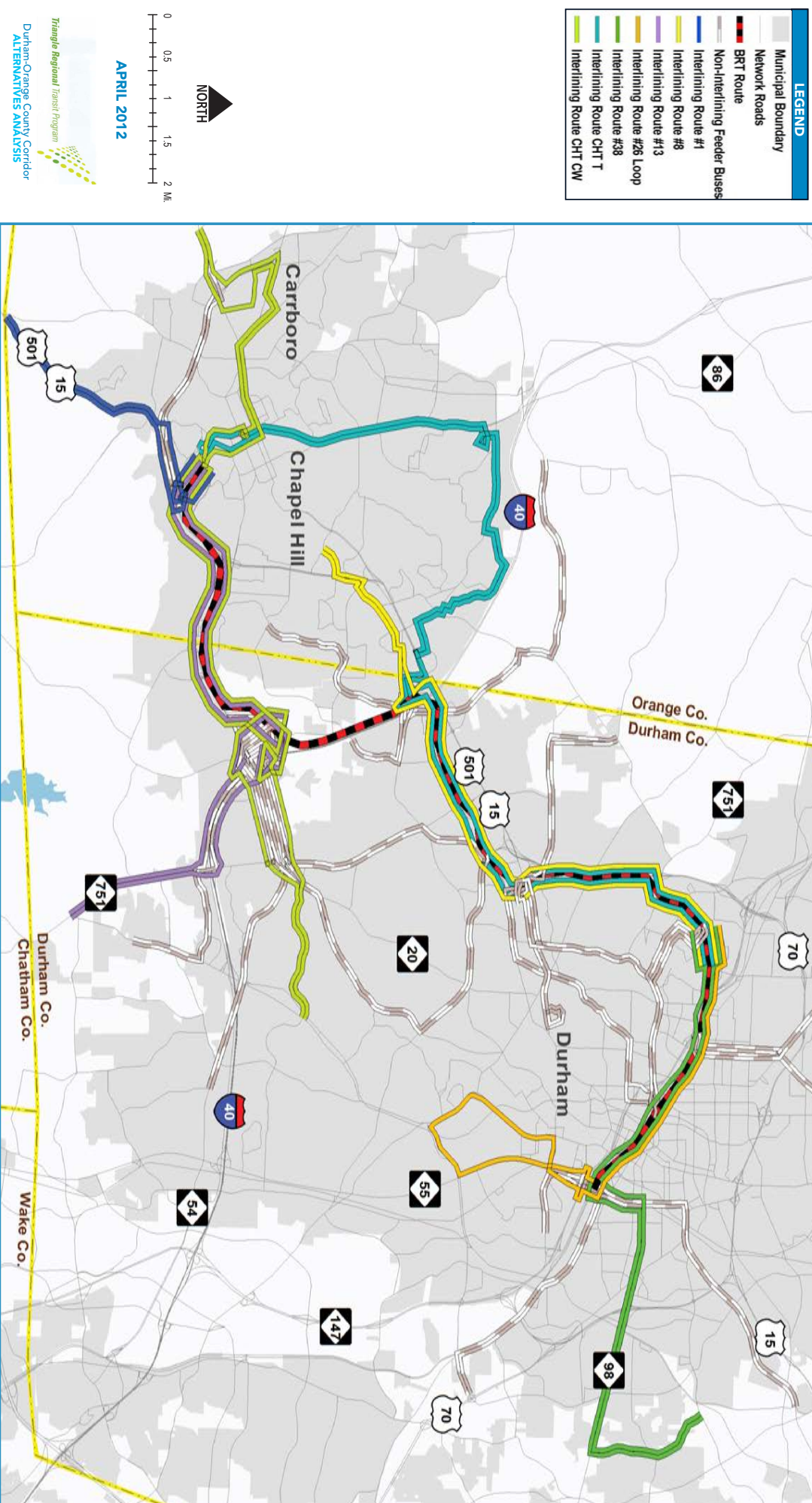


FIGURE 5-15
 BRT Alternative,
 Interlining and
 Non Interlining
 Feeder Bus Routes



Ridership Forecast Results

LRT 2035 daily boardings for LRT vary between 11,000 and 12,800 boardings per day depending on the combination of alignment options used. Ridership is affected by a number of factors including destinations served, travel time, and cost. The relatively small variation in ridership between the LRT alternatives modeled is expected given that the alignment options generally serve the same primary activity centers within the corridor. The modeled alternative that combines alignment options A1 (UNC Hibbard Drive), C2 (George King Road), and D3 (Shannon Road), is forecast to have the highest ridership of the LRT alternatives. The lowest ridership combination is expected to be A3 (UNC Southern), C1 (Meadowmont Lane), and D1 (Westgate Drive).

Ridership variations between the alignment options under consideration in UNC Chapel Hill, Meadowmont/Woodmont, and South Square are discussed below.

- **UNC Chapel Hill:** A station level ridership comparison of the alternatives modeled shows that alignment option A1 could attract up to an additional 800 daily riders over alignment option A3. Alignment option A1, UNC Hibbard Drive, is closer to the center of UNC Main Campus and Hospitals as well as major employment and student centers than alignment option A3. While the station on alignment option A3 could still attract riders through transfers from feeder bus service, the additional distance between the proposed station locations on alignment option A1 and alignment option A3 substantially increases the walk distance from UNC area activity centers, thereby significantly reducing the number of walking trips.
- **Meadowmont/Woodmont:** A station level ridership comparison of the modeled LRT Alternatives shows that alignment option C2 has up to 300 additional boardings over alignment option C1. This difference in station level ridership is a result of the differences between Meadowmont and Woodmont station areas and the model's sensitivity to these differences. First, projected 2035 number of households and employment in the traffic analysis zones (TAZ) served by the stations is larger in the TAZ serving the Woodmont station (1,189 households and 1,486 employment) than for the Meadowmont station (587 households and 763 employment). Second, the Woodmont station area has about 500 more students than the Meadowmont station area; Woodmont also has a non-student population of similar magnitude as Meadowmont, but with smaller household sizes. Being modeled as a part of no-car and low-income groups, students are more likely to take transit than higher-income residents with cars.

The travel demand model may underestimate walk access to stations from nearby transit-oriented developments. While the Woodmont Station, which would serve the proposed Hillmont development and adjacent area by means of walk access, is also accessible by park-and-ride and bus transfers, the Meadowmont Station relies heavily on walk-to-transit trips without a park-and-ride access. Meadowmont Village was conceived as a TOD and offers a well-developed urban street grid, a highly walkable landscape, mixed-use developments, and multifamily housing within the one-half mile station catchment area. A recent study completed by leading TOD scholars (Reid Ewing and Robert Cervero) indicates that urban form and connectivity have a considerably more powerful influence on transit usage than land use mix or even density. Meadowmont's higher intersection density per square mile and sidewalk coverage per mile of roadway further substantiates its potential for attracting a substantial number of walk-to-transit trips. Because of these similar characteristics, the Meadowmont Station ridership is potentially underrepresented.

Recent experience from Charlotte, NC sheds light on the extent to which ridership forecasting models could underestimate walk-access-to-transit trips. Of the approximately 6,000 daily rail trips that were under-predicted by the model used to forecast ridership for the Charlotte LYNX Blue Line, more than 4,000 were walk-to-transit trips.

- **South Square:** A station level ridership comparison of the modeled LRT alternatives shows that alignment option D3 can attract up to 650 additional boardings over alignment option D1. Alignment option D3, Shannon Road, presents higher ridership than alignment option D1, Westgate Drive, because it is not constrained by US 15-501 and is more centrally located to serve existing developments and the planned University Marketplace development southeast of the station location.

For the purpose of comparing ridership between Build Alternatives, the LRT ridership forecast that combines alignment options A3, C2, and D3 is used. As previously noted, variations in ridership projections for the alignment options modeled in LRT would be expected to be proportional to the variations between these options (when applicable) for BRT-High and BRT-Low.

BRT-High For the BRT-High Alternative, the guideway users include riders on the proposed BRT route operating exclusively on the guideway and riders traveling on interlined buses that use the BRT guideway (See Page 3-3 for more information on interlining). It should be noted that the combination of routes thus running on the guideway results in a very high perceived frequency of service at guideway stations. The BRT route is forecast to have 5,700 daily boardings, while the interlined buses using the BRT guideway are estimated to have 11,900 boardings per day (includes only boardings and alightings within the guideway). As noted under the Ridership Forecasting Methodology, while most of the 11,900 bus passengers would take advantage of the one-seat interlined bus ride through the BRT guideway, a small number (less than 10%) would transfer at the BRT stations and is a part of the BRT route ridership as well. With interlined buses included, the total daily boardings are 17,600.

BRT-Low Similarly for the BRT-Low Alternative, the guideway users include riders on the proposed BRT route operating exclusively on the guideway, which is forecast to have 4,600 daily boardings, and riders traveling on interlined buses using the BRT guideway, which is estimated to be 11,700 boardings per day (includes only boardings and alightings within the guideway). Like BRT-High, while most of the 11,700 bus passengers would take advantage of the one-seat interlined bus ride through the BRT guideway, a small number (less than 10%) would take transfers at the BRT stations and is a part of the BRT route ridership as well. Again, guideway stations would see a very high perceived frequency of service due to the combination of routes running on the guideway. With interlined buses included, the total daily boardings are 16,300.

TSM The ridership forecast for TSM Alternative is 3,200 boardings per day.

Summary of Daily Boardings

Table 5-21 provides the forecast daily boardings for 2035.

Table 5-21 Forecast 2035 Daily Boardings

Alternative	Daily Boardings	Rating (not including interlined buses for BRT)**	Rating (including interlined buses for BRT)
TSM	3,200	-	-
LRT	12,000	●	●
BRT-High	BRT route: 5,700 Interlined buses: 11,900*	○	●
BRT-Low	BRT route: 4,600 Interlined buses: 11,700*	○	●

Source: Triangle Regional Model v4 enhanced. | *Boardings on interlined buses include bus routes using the BRT guideway. | **Daily boardings for BRT-High and BRT-Low routes without interlined buses could potentially be higher as the model estimated the ridership assuming interlined buses. The BRT numbers thus do not account for passengers that would transfer from feeder buses to BRT if the feeder buses were not sharing the BRT guideway.

As shown in Table 5-21, boardings are highest for the service provided under the LRT alternative. However, the total transit boardings (inclusive of interlined buses) for the BRT alternatives are significantly higher than those for the LRT alternative. This is a direct result of the ability of the BRT Alternatives to accommodate the interlining of local and feeder routes onto the BRT fixed-guideway. Riders arriving at guideway stations see an effective frequency of service under the BRT Alternatives that is much higher than what equivalent riders see under the LRT Alternatives. One of the reasons that the boardings for the BRT routes that only use the guideway is lower than the LRT alternatives, despite having the same basic level of service (10 minute headways during the peak period and 20 minute during the off peak), is that some of the trips that under the LRT alternative would have transferred from the feeder bus routes to the LRT routes would now make the trip using the interlined feeder bus routes. In fact, the number of bus transfers for the LRT routes (5,500) is roughly double the bus transfers to the BRT only routes (2,400).

The BRT-High route itself is forecast to attract more ridership than the BRT-Low route primarily due to the combination of a faster end-to-end running time and a higher assumed fixed-guideway bonus. All three proposed fixed-guideway projects resulted in a substantial increase in ridership over the TSM Alternative.

Summary of System-wide Transit Ridership

Measures used by FTA to rate a project's justification—including mobility improvements and cost effectiveness—take into account the ridership increases and travel time savings enjoyed by the system as a whole as a result of the project's implementation, not only those benefits for the project alone. Therefore, another output of the ridership modeling process was the measurement of each alternative's impact on the total future regional or system-wide transit ridership that is expected to be operational in 2035, as shown in Table 5-22.

Table 5-22 Forecast 2035 Daily System-Wide Transit Trips

Alternative	Daily Transit Trips (System-wide)	Increase in Daily Transit Trips over No-Build (System-wide)	Rating
TSM	133,300	+8,300	-
LRT	140,500-141,600	+15,500	●
BRT-High	142,800	+17,800	●
BRT-Low	141,100	+16,100	●

Source: Triangle Regional Model v4 enhanced.

Because there were multiple alignment options modeled for the LRT alternative, the total transit trips is shown as a range from 140,500 to 141,600 daily trips. The BRT-High Alternative is expected to have between 1,200 to 2,300 more daily transit trips than the LRT alternatives and 9,500 more daily transit trips than the TSM Alternative. The BRT-Low alternative has approximately the same number of daily transit trips as the LRT alternatives and 7,800 more daily transit trips than the TSM Alternative. Results also indicate that the LRT, BRT-High, and BRT-Low Alternatives would add between 15,500 and 17,800 new riders to the regional transit system.

Transportation Operations

The evaluation of transportation operations is divided into two parts: Traffic Impacts and Travel Times.

Traffic Impacts

A detailed traffic operations analysis was conducted for the LRT Alternative (Triangle Transit Durham-Orange Corridor Traffic Results Report, January 2011, appended by reference). A total of 86 intersections along the corridor were evaluated for the 2035 No-Build and Build analysis. A third scenario was included to evaluate mitigation, at a conceptual level, for the intersections with increased delay. Traffic impacts of the BRT-High and BRT-Low Alternatives were assessed relative to the results of the LRT evaluation.

LRT The results of the traffic analysis showed that the LRT Alternative could be implemented without substantial effects on corridor traffic operations. In general, the implementation of LRT would result in minor increases in delay, which could be minimized or eliminated through design and minor mitigation measures.

Specific considerations for the alignment options under consideration are summarized by subarea.

- UNC Chapel Hill:** Neither alignment option A1 nor alignment option A3 is projected to degrade significantly traffic operations within the southern portions of the UNC campus. As the Durham-Orange Corridor Traffic Results Report details, alignment option A1 results in no change in the levels of service along the campus intersections studied along Manning Drive and Mason Farm Road. Similarly, alignment option A3 is expected to have a negligible traffic impact at these intersections. Alignment options A3 and A1 require a new at-grade crossing near or through the Mason Farm Road and Hibbard Drive intersection. Based on the projected volumes at that intersection, LRT could be sufficiently accommodated at that intersection. Access to existing and future land uses must be maintained and would be accommodated by LRT. Alignment option A3 also would not significantly impact the future street network and building layout proposed in the most recent UNC Master Plan.

- **Meadowmont/Woodmont:** Alignment option C1 would have a lesser effect on traffic operations than alignment option C2. Alignment option C1 would include a grade separated crossing of NC 54 and four new at-grade LRT crossings along Meadowmont Lane, while alignment option C2 would include two new at-grade LRT crossings along NC 54 at Friday Center Drive and East Barbee Chapel Road, both of which are high volume intersections. Based on an evaluation of the overall NC 54 corridor, including 17 intersections, alignment option C1 resulted in 11 intersections in the subarea experiencing an increase in delay; while the remaining six intersections are predicted to either remain the same or see decreases in delay. Under alignment option C2, delays are expected to increase at 15 of the 17 intersections in the subarea; the remaining two intersections are predicted to either remain the same or see decreases in delay. The delays associated with alignment option C2 at the intersections of NC 54 with Friday Center Drive and East Barbee Chapel Road show potential substantial increases in delay depending on assumptions made for roadway configurations and land uses post implementation. The analysis will need to be evaluated during a future stage of the project development process once there is more certainty regarding the future configuration along the NC 54 corridor.
- **South Square:** Alignment options D1 and D3 are projected to have similar effects on traffic. Under alignment option D1, 10 of the 15 intersections in the subarea would experience an increase in delay; the remaining five would remain the same. Alignment option D3 would result in an increase in delay for 13 of the 15 intersections. Alignment option D1 would affect fewer intersections and would likely result in slightly better traffic operations; however, neither alignment option would significantly impact the future street network.

A detailed evaluation of the section of the LRT alignment that is proposed to run along Erwin Road was undertaken due to Erwin Road being a high volume roadway with existing congestion and substantial right-of-way constraints. The implementation of LRT along the corridor would require the reconstruction of the roadway from NC 751 (Cameron Boulevard) to east of Anderson Street with numerous specific design features to optimize the traffic operations along the corridor. Based on the detailed traffic and design evaluation, the configuration along the Erwin Road corridor would include the following elements.

- The two-way center turn lane along the corridor from NC 751 (Cameron Boulevard) to east of Anderson Street would be replaced by a raised median where the trackbed would be located to improve safety and traffic operations along the corridor.
- The Erwin Road/Emergency Drive intersection would be converted to a signalized intersection.
- The Erwin Road/Trent Drive intersection would be expanded to include exclusive right turn lanes on the eastbound and westbound approaches to the intersection as well as dual left turn lanes from northbound Trent Drive to Erwin Road.
- The Erwin Road/Flowers Drive intersection would be converted to a right-in/right-out intersection on both the north and south sides of Erwin Road.
- The Erwin Road/Anderson Street intersection would be expanded to include dual left turn lanes from eastbound Erwin Road to Anderson Street and an exclusive right turn lane from northbound Anderson Street to Erwin Road.

- In addition, to mitigate the potential effects of eliminating the westbound Erwin Road right turn lane to Fulton Street, consideration should be given during future stages of the project development process to modifying the Trent Drive/Elba Street intersection to allow for improved connectivity by allowing northbound left turns onto Elba Street.

The following improvements to the Erwin Road area are based on the Duke University Health Systems Improvement Plans. These improvements are assumed to be in place by 2035 regardless of the implementation of the LRT, and are not included in the cost estimation calculations for the LRT project.

- The Erwin Road/LaSalle Street intersection would be modified to include a southbound right turn lane from LaSalle Street to Erwin Drive.
- The Erwin Road intersection at the Eye Care Center/VA Medical Center would be converted to a signalized intersection, with the northbound and southbound Eye Care Center/VA Medical Center approaches receiving exclusive left turn lanes.
- The Erwin Road/Fulton Street would be modified to include dual left turn lanes from eastbound Erwin Road to northbound Fulton Street and the elimination of the westbound Erwin Road right turn lane to Fulton Street due to the right-of-way constraints at the intersection.
- The Erwin Road/Trent Drive intersection would be expanded to include dual left turn lanes from northbound Trent Drive to Erwin Road.

Based on the configuration detailed above, none of the intersections studied within the Erwin Road corridor would result in a significant degradation in the level of service.

BRT-High The BRT-High Alternative follows the same alignment as LRT from Chapel Hill through west Durham. In general, the operations of the BRT are assumed to result in comparable traffic impacts as LRT.

The design approach to traffic signal operation is to try to achieve a timed progression for the predominate movement in each of the AM and PM peak service hours. The reason for this is to have the LRT wait at a station and then proceed on the normal green phase to the next station with the knowledge that it will hit all green signals between the two stations (i.e. LaSalle Station to Fulton Station or Fulton Station to the Ninth St. Station). With BRT, there could be delay in the operations if there is bunching of the buses, especially when considering the interlining of buses with the dedicated service. More studies would be needed to ascertain if this is an issue.

For parallel street running, like along NC 54, it is preferable that the control of the cross street be managed with crossing gate protection for LRT. Whereas for BRT, the cross streets are assumed to be signalized. This is necessary to control the right-turn movements along NC 54 so that automobiles do not cross in front of buses on the parallel roadway operating in both directions. Whereas the LRT controls the right-turn lane movements with crossing gates, the BRT system would control this movement either by an additional dedicated signal for the existing right-turn pockets (which exist at each intersection along the NC 54 route alignment) or by a second set of signals for the busway itself, which would be operated in conjunction with the NC 54 traffic signal. The latter is considered a safer means of controlling this movement. Again, the timing of the crossing gates or the timing of the traffic signals should be coordinated with the transit operations so that a vehicle leaving Woodmont Station, for

instance, would hit all green/crossing gate down phases I as it proceeds to Friday Center or to Leigh Village. The transit vehicle would use the station to dwell until the next green phase of the nearby intersection occurs, thereby avoiding the need for preemption. Again, this would be the predominant movement since it is recognized that it is difficult to have progressive signal timing occur in both directions. Since crossing gates have longer advance down time requirements than the stopping distance of a BRT vehicle, the timing of the LRT operation needs to be closely adhered to or delay in LRT operations could occur. With bus bunching, similar delays could also occur. In either case, the through movements of the parallel street are unaffected since the normal signal operation is not affected because no preemption is assumed.

In downtown Durham, the alignment for the BRT-High Alternative differs from the LRT Alternative. For BRT, every street crossing would be at-grade, whereas LRT has grade separation occurring at Erwin Road, Campus Drive, Gregson Street, Chapel Hill Street, Roxboro Street, and Alston Avenue. With more grade separations, there are fewer chances of traffic impact for LRT than BRT if more green time is needed along Pettigrew Street than exists today. A more detailed analysis would be needed to fully evaluate the specific impacts of BRT operations in the downtown area.

Therefore, the BRT-High Alternative could be implemented with no worse traffic impacts than with the LRT Alternative. However, as expansion occurs, there is a higher potential to have more travel time impacts to BRT operation than the LRT operation given the nature of more random vehicle movements over standard headway movements for LRT. With the current ridership projections, single car LRT trains are all that is needed. Hence, the LRT system can triple in capacity to three vehicle train sets, without a decrease in headway time. This is not the case for BRT and this could be considered an impact.

BRT-Low The BRT-Low Alternative largely follows the same alignment as BRT-High. Where the alignment is common to the BRT-High Alternative, traffic impacts are anticipated to be the same.

The BRT-Low Alternative travels along Old Chapel Hill Road through signalized intersections with Farrington Road/Southwest Durham Drive and Garrett Road and then continues along University Drive passing through signals at Old Chapel Hill Road at University Place before rejoining the BRT-High alignment in the South Square subarea. Since the BRT-Low Alternative includes widening of the existing cross-section to provide a single exclusive BRT lane in each direction, capacity is provided for the movement of individual buses with only a minor impact to the general purpose traffic as a result of transit priority signal phasing.

In addition, prior traffic analyses indicated that University Avenue has adequate capacity with downstream signalized intersections (Snowcrest Trail, Martin Luther King, Jr. Parkway, Lyckan Parkway, Westgate Drive, and Shannon Road) all operating at an acceptable level of service in 2035. Although detailed analysis is necessary to determine the specific impacts, the Old Chapel Hill Road and University Place, signals are expected to operate at similarly acceptable levels of service in the future given the comparable volumes and lane configurations. Adjacent intersections studied along Old Chapel Hill Road were generally operating at an acceptable level of service in 2035, with the exception of Garrett Road, which was projected to operate at a decreased level of service during both peak periods. Given the modest impact of BRT to normal signal operations, a substantial degradation of operations at this location is not expected.

One area of concern along Old Chapel Hill Road is at the intersections of cross streets that are not currently signalized such as Pin Oak Drive, Five Oaks Drive, Buchanan Drive, Everwood Drive, Jean

Avenue, Grapevine Trail, and Scottish Lane along with over a dozen driveways to homes and residential communities. The single BRT lane is comprised of a 4-foot buffer/landscaped area, then a 2 foot shoulder, a 12 foot lane and another 4 foot shoulder (total paved width of 18 feet as seen in the cross sections in Volume 2) for a total distance of 22 feet. This is a significant setback from the edge of the shoulder on Old Chapel Hill Road. Thus, safety is a concern if the cross traffic stop bar was merely moved back to outside of the BRT lane. Signals are also considered necessary to control the right-turn movements from Old Chapel Hill Road. Unrestricted cross traffic automobiles could encroach upon the BRT lane in their approach to turning left or right onto Old Chapel Hill Road. This would interfere the BRT movement and potentially require stop signs be placed at each of these intersections. This would significantly impact the BRT operations. Or, each of these low volume intersections would be signalized to allow for efficient safe operations. Most parallel frontage road type street crossings do treat such cross traffic as two movements versus a single cross traffic movement. Unless new right-hand drop lanes are added at intersections, the restricted right hand turn movements when BRT vehicles are present would impact traffic on Old Chapel Hill Road.

Therefore, based on this planning level assessment, the BRT-Low Alternative is expected to have a substantial impact to traffic operations along the Old Chapel Hill Road/University Drive corridor associated with traffic movements either for the BRT or for through traffic movements on Old Chapel Hill Road given the multitude of these occurrences. Table 5-23 provides a relative rating for traffic impacts for each of the fixed-guideway Build Alternatives.

Table 5-23 Traffic Impacts Rating

Alternative	Rating
LRT	●
BRT-High	●
BRT-Low	◐

Source: URS Corporation Consultant Team, 2011

Travel Time

The total travel time from one end of the high-capacity transit route to the other should be competitive with automobile travel. The greater the travel time savings, the greater the benefit to passengers and the more riders the transit system is likely to attract. Travel times were developed for all Build Alternatives under consideration. Table 5-24 summarizes the end-to-end travel times for the Build Alternatives and assigns a relative rating for each alternative.

LRT The total end-to-end travel time for the LRT Alternative ranges from 34.6 to 34.8 minutes. This indicates that the alignment options under consideration at UNC Chapel Hill (A1, A3), Meadowmont/Woodmont (C1, C2), and South Square (D1, D3) do not present differences in travel time sufficient enough to affect the overall attractiveness of the service. Therefore, travel time is not a differentiating criterion for the alignment options.

For purposes of comparing the LRT Alternative to the BRT-High, BRT-Low, and TSM Alternatives at the corridor level, the LRT travel time range is averaged to 35 minutes. The LRT Alternative is the most time-competitive of the Build Alternatives under consideration, providing travel time savings of 22 minutes over the TSM Alternative and up to 5 minutes over the BRT Alternatives.

BRT-High The BRT-High Alternative would have the second lowest travel time at 39 minutes, providing a 19-minute improvement in travel time over the TSM Alternative and 5 minutes over the BRT-Low Alternative. This travel time estimate assumes that BRT-High will be permitted to run along the existing and proposed Pettigrew Street which is within the NCRR corridor. If the alignment is not permitted to operate within the rail corridor, alternate alignment options could increase travel times by 3 to 4 minutes.

BRT-Low At 44 minutes, BRT-Low provides the least competitive travel time, yet provides a 14-minute improvement over the TSM Alternative. Similar to BRT-High, the BRT-Low travel time could increase 3 to 4 minutes if the alternative is not permitted to operate within the NCRR corridor from downtown Durham to east Durham.

Table 5-24 End-to-End Travel Times for Build Alternatives

Alternative	End-to-End Travel Time	Rating
TSM	57 minutes	-
LRT	35 minutes	
BRT-High	39 minutes	
BRT-Low	44 minutes	

Source: URS Corporation Consultant Team, 2011.

Expansion Potential

The Project Team analyzed expansion potential of each alternative by assessing the ease of future extensions beyond the proposed termini at UNC Hospitals and Alston Avenue. At the western end of the Durham-Orange Corridor (UNC Chapel Hill), all three fixed-guideway alternatives (LRT, BRT, and BRT-High) have two dedicated alignment options: A1 or A3. At the eastern end (downtown Durham to east Durham), LRT runs on exclusive track within the NCRR rail corridor and BRT-High and BRT-Low operate in mixed-traffic along Pettigrew Street.

LRT For LRT at the UNC Chapel Hill terminus, future expansion potential for alignment option A1 would be difficult because of concerns over emergency access to the UNC hospitals and concerns over impacts to existing utility infrastructure. Extending LRT beyond the alignment option A1 terminus is possible based on a review of the infrastructure location and based on traffic and train signaling operations that could be employed on Manning Drive. The station option for alignment option A1 (UNC Station – Option A, per the UNC campus master plan) precludes extension of the corridor north and west into downtown Chapel Hill and beyond to Carrboro due to physical constraints. Accommodating a future extension would require the station location to be shifted to station location Option C. This station location would require new buildings that are proposed in the UNC Master Plan be constructed west of the LRT station. This is not acceptable to the Town of Chapel Hill staff and to the UNC at Chapel Hill (per an email to Triangle Transit dated January 24, 2011). As noted in the conceptual evaluation of alternatives, alignment option A3, and the corresponding station option (UNC Station – Option D), was developed as an alternative to alignment option A1 as it would allow for the future extension of both LRT and BRT (High and Low) service on Columbia Street. No substantial engineering challenges would prohibit future extensions of the LRT alignment. Therefore, for LRT, alignment option A3 presents the more favorable option for future extensions at the UNC Chapel Hill end-of-line.

For LRT in east Durham, there are no major engineering issues that preclude future extensions either within or outside of the rail corridor.

BRT-High and BRT-Low Future extensions for BRT-High and BRT-Low for both alignment options at UNC Chapel Hill (A1 and A3) and in east Durham are substantially less expensive since there is no need to electrify the line. The cost to implement either BRT or LRT in an exclusive alignment is considerable for either LRT or BRT technology given the right-of-way required.

Since the extension to downtown Chapel Hill and the Town of Carrboro is envisioned to be a mixed traffic operation, both technologies are suited for such an expansion.

For the eastern end-of-line in Durham, this is a different scenario. Expansion of LRT in the rail corridor is straightforward, but expansion of BRT is not. Pettigrew Street does not continue past Ellis Road, and the alignment would most likely involve the use of NC 147, with the BRT entering at Briggs Avenue. It is recognized that the LRT alignment extension could utilize the NCRRT rail corridor or new location alignment, pending additional land use planning and coordination with decision makers. However, considering that the Wake Corridor AA study has determined that BRT is not a competitive technology choice, the expansion of BRT to the Wake Corridor LRT system would require systems connectivity planning and a seat exchange between the two systems.

For these reasons, the BRT options are rated lower than the LRT option since ultimate regional connectivity and compatibility is desired. However, an expanded BRT system could ultimately connect to an expanded Wake County LRT system with a required transfer at a common station area. If this is deemed an acceptable solution to decision-makers, then the ratings for Expansion Potential would become similar.

Table 5-25 summarizes the ratings for expansion potential at end-of-line.

Table 5-25 Expansion Potential Ratings

Alternative	Rating
LRT	●
BRT-High	◐
BRT-Low	◑

Source: URS Corporation Consultant Team, 2011

Public and Agency Support

Public Support Between June 2010 and March 2011, 19 public workshops were held supporting work of the Project Kickoff, Transitional Analysis, and Alternatives Analysis. Over 1,100 people attended the workshops. In the first round of six workshops, in June 2010, the public was introduced to the corridors under study. In the second round of six workshops, in September 2010, the public was introduced to a further look at the study corridors, including technologies under consideration and maps of initial alignment alternatives.

The detailed alternatives in this document were presented for public comments at the third round of workshops in March 2011:

March 22, 2011	Triangle Town Center	Raleigh
March 23, 2011	Durham Station Transportation Center	Durham
March 24, 2011	William and Ida Friday Center	Chapel Hill
March 28, 2011	Mt. Peace Baptist Church	Raleigh
March 29, 2011	Cary Senior Center	Cary
March 30, 2011	McKimmon Center at NCSU	Raleigh
March 31, 2011	The Research Triangle Park Foundation	RTP

A Public Involvement Plan was prepared defining goals for outreach, strategies, and ways to communicate project information and meetings. The intensive public outreach included print and broadcast ads, the use of Facebook and Twitter, the project website at www.ourtransitfuture.com, e-mail notifications, interior bus ads, news stories, and blog posts.

In the third round of public workshops, 205 comments were received from the public workshops, website, e-mail, mail and telephone. A small percentage of these comment forms related directly to the Durham-Orange Corridor and the alternatives under consideration. Comments summarized in this section may not fully capture public sentiments regarding the Build Alternatives.

At the corridor level, comments received reflected general support for the LRT Alternative over both the BRT-High and BRT-low options. The Meadowmont/Woodmont subarea generated the most interest among attendees. The majority of comments received for the subarea expressed or implied support for alignment option C1 Meadowmont Lane. However, it should be noted that there were a very limited number of specific comments on the C1 versus C2 alternatives (15 total). The comments did not indicate a clear preference for the alignment options in UNC Chapel Hill and South Square.

Agency Support On August 29th and 30th, 2011, the DCHC-MPO held two public meetings presenting the results of the alternatives analysis. The LPA recommended a preferred corridor from Chapel Hill to Durham, as well as a preferred technology, LRT.

Table 5-26 Public and Stakeholder Support Rating

Alternative	Public Support Rating	Agency Support Rating
LRT		
BRT-High		
BRT-Low		

Source: URS Corporation Consultant Team, 2011

Economic Development Potential

The Project Team evaluated economic development potential by alternative, addressing bigger picture land use, economic development, and job issues. These issues include supporting and enhancing employment and household growth and economic activity to the region.

LRT Significant evidence exists regarding LRT's ability to support transit oriented development (TOD) and provide economic benefits. North Carolina's first LRT line, the Blue Line, has been a catalyst for almost \$1.5 billion of new or planned development along Charlotte's South Corridor, a formerly underutilized railroad corridor. Within less than three years of operation, daily transit ridership exceeded 2020 forecast levels and now averages about 15,000 trips per day. The Blue Line corridor has also experienced 10 million square feet of new development since 2007, when the line opened. While much of the development has been concentrated in Center City Charlotte, a considerable amount of new development has also occurred in the South End area, where the Blue Line's connection to downtown has spurred condominium and apartment development. The City of Charlotte set the stage for TOD through targeted infrastructure investments in streets, streetscape, and sidewalks.

Communities outside of North Carolina and similar in makeup to the Triangle Region that have also experienced such positive economic benefits include the following:

- Dallas, Texas: office and retail space in some light rail station areas rent for 40 percent more than market rates; studies found land values for retail and office properties near DART stops rose faster than comparable properties without transit²⁴. Dallas is similar to the Triangle Region in terms of its polycentric spatial orientation with respect to Fort Worth, strong population growth, and public policy support for TOD (public investment in infrastructure and financial and regulatory incentives). Some of the successful TODs that have been built in the Dallas region include Eastside Village in Plano, South Side on Lamar, and Mockingbird Station.

Portland, Oregon: More than \$8 billion of new development has occurred in light rail station areas. A study of MAX Blue Line light rail station areas found that development occurring after light rail investment has an average development density or Floor Area Ratio (FAR) of 0.65 more than the average FAR for development outside of station areas. This means that for every 1,000 square feet of land area developed, station area parcels realized an additional 650 square feet of building area. The rate of development within Blue Line station areas was 69 percent higher than elsewhere within a one-mile corridor extending along the light rail alignment. Low and moderate value lots within Blue Line station areas redeveloped at twice the redevelopment rate reported for low value lots outside of station areas²⁵.

Similarities to the Triangle Region include: Portland's higher education institutions, growing population, and supportive policies for TOD. Support from the public sector has included tax abatements for development at station area sites as well as regulations that favor TOD, such as minimum densities, parking maximums, design requirements, and rezoning to allow only TOD-appropriate uses. It should be noted that the Portland metropolitan area has implemented some of the most supportive TOD policies in the country, which has played an important role in achieving these outcomes. Examples of the successful TOD projects that have been constructed in the Portland region include Center Commons, The Round, and Orenco Station.

²⁴ TCRP Report 102: Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects. Transportation Research Board

²⁵ Livable Portland, Land Use Transportation Initiatives, Tri-Met, November 2010

- Santa Clara County, California: premiums were found for commercial properties near light rail stations of over 20%²⁶. The Santa Clara County area is similar to the Triangle Region in terms of its strong university presence (University of San Jose, Stanford, and UC Santa Cruz), research and development based economy (Silicon Valley), growing population, and public policy support for TOD.
- St. Paul-Minneapolis, Minnesota: the Hiawatha Light Rail Line supported an estimated 6.7 million square feet of new development since the line opened in 2004. Much of the development is concentrated in the downtown, where public policies support revitalizing the downtown riverfront and warehouse district.
- Denver, Colorado: A total of 7.8 million square feet of new development has occurred along the Southeast Corridor since its opening in 2006. Properties near light rail stations have experienced faster absorption and higher occupancy rates than properties not located at transit stations.

The preceding case studies show that light rail transit enhances opportunities for TOD, and that the resulting TOD can achieve rental rate premiums and higher land values over non light-rail served properties. Impressive levels of development have been constructed along many light rail lines across the nation. Developers have exhibited documented interest in constructing TOD at light rail stations, as they see the value in the transportation advantage afforded by light rail.

BRT-High and BRT-Low Few case studies are available to quantify the economic development potential for BRT systems in the United States. Therefore, the Project Team has reviewed the emerging literature on this mode to gain some qualitative understanding of how BRT might relate to transit supportive development. According to the Transportation Research Board, full-featured BRT systems can experience a level of TOD similar to that of LRT²⁷. Full-featured systems are those with “dedicated running ways, attractive stations and bus stops, distinctive easy-to-board vehicles, off-vehicle fare collection, use of ITS technologies, and frequent all-day service” with midday headways of 15 minutes or less and peak headways of 10 minutes or less. The economic experiences of the following communities that have most of the features described above are described here:

- **Pittsburgh, Pennsylvania:** The Port Authority of Allegheny County reports \$302 million in new and improved development along the East Busway. Opened in 1983, this dedicated busway links downtown Pittsburgh with eastern communities. Pittsburgh’s similarities to the Triangle Region include: university presence and supportive public policies for TOD.
- **Cleveland, Ohio:** The Euclid Corridor BRT is expected to experience increased residential and non-residential investment over the next three decades, and development is already occurring. The Euclid Corridor contains mostly high-density development in downtown, University Circle and East Cleveland. Since opening in 2008, \$87.3 million in investment has occurred in Midtown, which would not reach its development potential without BRT. The price of land is rising as

²⁶ Reference: TCRP Report 102: Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects. Transportation Research Board

²⁷ Reference: TCRP Report 90: Bus Rapid Transit – Volume 1: Case Studies in Bus Rapid Transit; Transportation Research Board.

developers purchase land in Midtown. Cleveland is similar to the Triangle Region in terms of its universities (Case Western, Cleveland State University), its health care facilities (the Cleveland Clinic) and supportive public policies for TOD.

The Transportation Research Board's findings highlight the need for a full-featured system to optimize economic development potential. This means that to the degree that BRT can mimic light rail transit in terms of attractive design, positive image, operating speed, and reliability (and surpass LRT in flexibility) the more likely BRT will mimic LRT's ability to support TOD. Thus, the ability of BRT to yield economic benefits hinges on the ability of the system to meet the more robust performance standards of the advanced, top quality, highly successful BRT systems found in South America, which come closer to mimicking LRT in operation. Unfortunately, most BRT systems in the United States include significant compromises in design that reduce the performance, speed, and efficiency of the service.

On May 26, 2011, the Institute for Transportation and Development Policy released a report titled "Recapturing Global Leadership in Bus Rapid Transit: A Survey of Select U.S. Cities." Using a 100-point system to score the various components of BRT, from speed-supporting improvements such as off-board fare collection and dedicated running ways, to cosmetic improvements such as better branding and bus station amenities, the ITDP found that there was no significant project in the US that their system rated above a grade of 63, in this case, the Cleveland project mentioned above. This compares with a score of 93 for Bogota, Columbia's "Transmilenio" system or a score of 89 for Guangzhou, China's BRT system. In short, there has not been a BRT system in the United States built that approaches a top-level standard in terms of performance. Without such a system in the United States to assess, statements about the ability of high-quality BRT to help focus economic development similar to LRT remain speculative from either a positive or negative point of view.

Additionally, there is a perceived mode bias for rail in the United States, and the degree to which this bias can be compensated for by BRT that is more like LRT (i.e., reduced headways, potential "one seat" travel, branding, and time savings) is not known.

Table 5-27 compares LRT and BRT modes and ranks them in terms of their ability to offer various economic benefits. While there is less research on the economic effects of BRT, available research and recent case studies indicate that the magnitude of its impacts will likely not reach those of LRT. Because of the limited, documented evidence available for BRT systems to influence development, developer interest, and enhance regional competitiveness and induce growth, LRT is given the most favorable rating of the three alternatives. In addition, LRT is rated more favorably because available case studies show that it has stimulated development at a higher rate and in a shorter time span than the documented cases of BRT.

Table 5-27 Summary of Potential Economic Benefits

Economic Benefits	Alternative		
	LRT	BRT-High	BRT-Low
Documented Ability to Influence Compact Development*	High	Moderate	Low
Proven Developer Interest	High	Low	Low
Ability to Stimulate Capital Infusion of Dollars from Outside Region	High	Moderate	Low
Rating	●	◐	○

Source: URS Corporation Consultant Team, 2011 | *LRT has a more robust history than BRT in terms of supporting compact development, but recent BRT systems in the U.S. have demonstrated its ability to be a catalyst for compact development.

BRT-Low is generally assigned the lowest rating of the three alternatives since the system is designed to balance exclusive running operations similar to an LRT with increased mixed-traffic operations that are more closely aligned with conventional buses. These design changes are likely to reduce further the economic potential of the system.

TOD Potential at Stations A TOD Assessment Report was conducted to supplement the AA as both a primer and an interactive analytical planning tool focusing on the assessment of existing conditions influencing performance trends for TOD development potential surrounding each of the proposed station sites (Draft TOD Assessment Report, May, 2011, Volume 4). A total of 19 qualitative criteria were assessed. Criteria included land area, vicinity land use compatibility, site development density and diversity, market conditions and developer interest, access and connection to adjacent vicinity, ability to phase development, and community support. Stakeholder input for the TOD assessment was coordinated with the Station Planning Process described in Section 2.1 of Appendix E. The highest performing stations included Leigh Village, Gateway, Patterson Place, Ninth Street, Durham Station, and Dillard Street Station. Additional detail may be found in the Durham-Orange Corridor TOD Assessment Report. For this analysis, TOD potential was not found to be a differentiator between alignment options based on the location of proposed stations relative to existing and planned development.

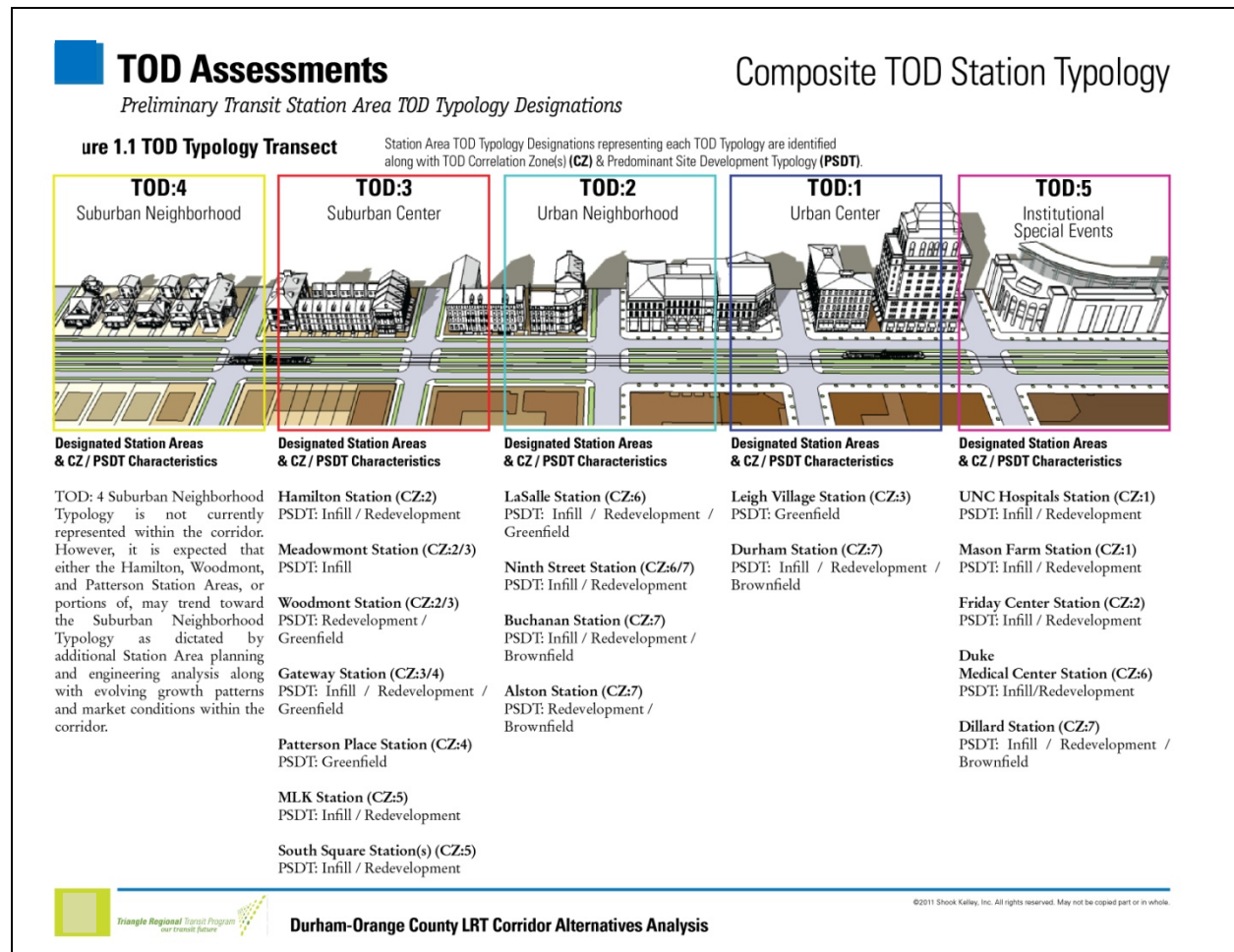


EXHIBIT 1 STATION TYPOLOGIES

Initially, as shown on Exhibit 1, stations were divided into the following 5 different categories or typologies, based on their location and characteristics: Urban Center, Urban Neighborhood, Suburban Center, Suburban Neighborhood and Institutional. The performance levels for each typology included densities and floor area ratio (FAR), form and scale of buildings, parking strategies, types of land uses and activities. Stations were ranked based on expected TOD capacity and potential for improvement using a total of 19 qualitative criteria which included: land availability and ownership structure; compatibility with surrounding land uses; community support; market and developer interest; ability to phase development; access to parks and open space; grid street network, walkability and accessibility; traffic volumes and transit services within station areas; access and connectivity beyond station areas; public policies supporting TOD; mixed-use; parking reduction and growth in employment and households. Stakeholder input for the TOD Assessment was coordinated with the Station Planning Process. As shown on Exhibit 2, the highest performing stations included Leigh Village, Ninth Street, Buchanan, Downtown Durham, and Dillard. Additional details may be found in the Durham-Orange Corridor TOD Assessment Report.

TOD Assessments

Preliminary TOD Corridor Assessment

Key Findings

Corridor Trend

The Composite Corridor trend of the Durham-Orange County Corridor - AA is characterized as "Medium/High" with median rating of 2.5 based upon resulting composite of site assessments for Station Areas with all-inclusive rating analysis.

Corridor Characteristics

Solid moderate to high combined performance ratings for TOD development potential are expected in a relatively even distribution pattern west to east along the Corridor.

The highest ratings are clustered around the downtown Durham Station within the eastern end of the Corridor, and include the adjacent sequence of Station Areas including Ninth Street, Buchanan, and Dillard.

The Leigh Village Station Area, located toward the western end of the Corridor, is also highly rated for TOD development potential.

The remaining majority of Station Areas exhibit strong trends for certain moderate and possible high performance for TOD development potential.

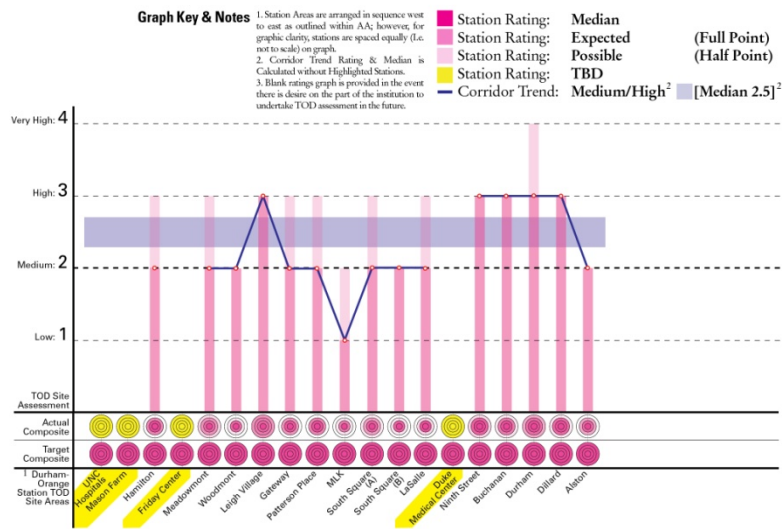
MLK is the only Station Area within the Corridor rated low in performance for TOD development potential.

Although not included within this report, both the Duke Medical Center Station toward the east and the UNC Hospitals Station in the western end of the Corridor are expected to contain potential for TOD development opportunities defined by respective campus and institutional district plans for enrollment and expansion.

Summary

The Station Areas identified with greater combined performance ratings relative to their context are expected

Composite Corridor Assessment



Map 20.1 Corridor Trend for TOD Development Potential

to stimulate and sustain TOD development potential within the Corridor.

These results may be used to assist local governments in identifying existing strengths and weaknesses within the Corridor, and to highlight opportunities for future specific and focused TOD planning initiatives and improvements that would enhance the Corridor's TOD potential.

Exhibit 2 TOD Potential Corridor Assessment Summary

For this analysis, TOD potential was not found to be a differentiator among LRT alignment options based on the location of proposed stations relative to existing and planned development.

Environmental impacts

Property Acquisitions

Property acquisitions include the potential acquisition of properties and the displacement of owners and tenants that would be associated with the fixed-guideway Build Alternatives. For the purposes of this analysis, property that has been reserved or dedicated as outlined in the Conceptual Alternatives Report has not been included as a property acquisition. In addition, the three parcels owned by Triangle Transit in downtown Durham were not included in property acquisition calculations.

LRT The LRT Alternative would, to some degree, require acquisition of private property outside of the public right-of-way at the Friday Center and in the Meadowmont/Woodmont and South Square subareas. No private property impacts are required for the alignment in the UNC Chapel Hill subarea because land adjacent to both alignment options (A1 and A3) has been dedicated for transit. From downtown Durham to east Durham, the LRT alignment operates within the existing rail corridor and would not require property acquisitions.

In total, full or partial property acquisitions for the LRT Alternative would range from 54 to 73 parcels, depending on the alignment options selected at UNC Chapel Hill, Meadowmont/Woodmont, and South Square. Along the base alignment near the Friday Center, three parcels would require full acquisition. No other full property acquisitions are anticipated for the alignment itself. Property impacts for the station park and ride lots have not been quantified since specific sites have not been determined. Partial property acquisitions along the base alignment are concentrated near Patterson Place (14), Leigh Village (4), and Gateway (7).

Within the Meadowmont/Woodmont subarea, alignment option C1, Meadowmont Lane, would require partial acquisitions of 4 properties as compared to a total of 14 parcels for alignment option C2 George King Road. The partial property acquisition along alignment option C2 also include right-of-way for a new access road to be constructed for the properties adjacent to George King Road as part of the project. Alignment option C1 has fewer impacts due to the reservation of right-of-way.

In the South Square area, alignment option D3, Shannon Road, is expected to have substantially more impacts than alignment option D1, Westgate Drive.

Table 5-28 summarizes property impacts for the base LRT alignment and the alignment alternatives under consideration in UNC Chapel Hill, Meadowmont/Woodmont, and South Square.

Table 5-28 Summary of LRT Property Impacts

LRT Alignment Alternatives	No. of Private Property Acquisitions* (Full or Partial)
Base Alignment <i>(see call-out box to right)</i>	34
<i>UNC Chapel Hill</i>	
Alignment Option A1 – Hibbard Drive	0
Alignment Option A3 – UNC Southern	0
<i>Meadowmont/Woodmont</i>	
Alignment Option C1 - Meadowmont Lane	8
Alignment Option C2 – George King Road	21
<i>South Square</i>	
Alignment Option D1 – Westgate Drive	10
Alignment Option D3 – Shannon Road	19

The Base Alignment generally refers to the recommended transit alignment from the US 15-501 Phase II Major Investment Study (MIS) that was carried forward into the AA. It includes the entire LRT Alternative and excludes the alignment options under consideration at UNC Chapel Hill, Meadowmont/Woodmont, and South Square.

Source: URS Corporation Consultant Team, April 2011. | *Property impacts for the station park and ride lots have not been quantified since specific sites have not been determined.

BRT-High The BRT-High Alternative is expected to have the same property impacts as the LRT Alternative from Chapel Hill to west Durham. In the segment of the corridor from Ninth Street in downtown Durham to Alston Avenues in east Durham, the BRT-High Alternative would impact two buildings between Campus Drive and Duke Street. This impact would result from the construction of the new Pettigrew Street connection between these roadways. Although these buildings have been constructed in the railroad right-of-way, the impacts were included in the number of property acquisitions. The rest of the BRT-High alignment through downtown Durham and onto east Durham would operate in mixed-traffic and any proposed roadway widenings would occur within the public right-of-way.

BRT-Low The BRT-Low Alternative would have the same property impacts as the LRT and BRT-High Alternatives in locations where the proposed alignment is the same. Where the BRT-Low deviates from the LRT and BRT-High Alternatives, road widenings for the project could impact adjacent properties. Along George King Road the BRT-Low Alternative would require partial acquisition of roughly 14 properties and adjacent to Old Chapel Hill Road, the alignment would include roughly 53 partial acquisitions. The new BRT-Low guideway would require acquisition of 12 properties north of Leigh Village. The total number of full or partial property acquisitions for BRT-Low is 107.

Table 5-29 summarizes property acquisitions and provides relative ratings for the build alternatives.

Table 5-29 Summary of Property Acquisitions

Alternative	No. of Private Property Acquisitions (Full or Partial)	Rating
LRT	52 - 74	⊖
BRT-High	54 - 76	⊖
BRT-Low	107	⊖

Source: URS Corporation Consultant Team, 2011.

Visual Impacts

Visual resources can include parks, open space, wooded areas, and vegetation. Significant view sheds along the corridor include the UNC campus, Meadowmont Village, Duke University, and downtown Durham. The Build Alternatives primarily utilize or are located adjacent to existing rights-of-way that carry vehicles common to urban environments, including buses. There are some segments of existing right-of-way that are adjacent to open space and wooded areas. The overhead catenary system, including the overhead electrical wires and poles, could be considered visually intrusive but would not be out of character with the largely urban and suburban setting. In addition, the construction of the LRT guideway or BRT running-way may cause the removal of some landscaping but not to an extent that would substantially impact visual resources. The highest visual impact potential occurs where there are elevated structures proposed for the alternatives.

LRT The LRT Alternative would add 15,250 to 17,150 feet of aerial structure to the Durham-Orange Corridor, depending on the alignment option selected at UNC Chapel Hill, Meadowmont/Woodmont, and South Square. The structures could potentially impact view sheds in Chapel Hill and Meadowmont Village. The LRT system will also add an overhead catenary system for the length of the corridor.

Potential visual impacts associated with alignment options under consideration in UNC Chapel Hill, Meadowmont/Woodmont, and South Square are discussed below.

- **UNC Chapel Hill:** The Hibbard Drive alignment option (A1), would create a greater visual impact through this area, as it includes 600-feet of aerial structure as it travels south between the intersection of Manning and Hibbard Drives and Mason Farm Road. The UNC Southern alignment option (A3) is entirely at-grade through this area and would therefore result in fewer visual impacts.
- **Meadowmont/Woodmont:** The Meadowmont Lane alignment option (C1) and George King Road Alignment option (C2) both include aerial structures that would create potential visual impacts. Alignment option C1 includes 2,500 feet of aerial structure, while Alignment option C2 includes 2,100 feet of aerial structure that would be visually prominent along the length of NC 54.

- **South Square:** The Westgate Drive alignment option (D1) and the Shannon Road alignment option (D3) both include aerial structures that would create potential visual impacts; however, alignment option D3 includes 900 more feet of aerial structure than alignment option D1 and would therefore create a greater visual impact. Alignment option D1 includes 2,300 feet of aerial structure, while alignment option D3 includes 3,200 feet of aerial structure.

BRT-High The BRT-High Alternative would include 15,250 to 17,150 feet of aerial structure to the Durham-Orange Corridor, depending on the alignment option selected at UNC Chapel Hill, Meadowmont/Woodmont, and South Square. The structures could potentially impact view sheds in Chapel Hill and Meadowmont Village. No overhead catenary system would be needed.

BRT-Low The BRT-Low Alternative would include +/- 7,000 feet of aerial structure to the Durham-Orange Corridor. This will vary depending on the alignment option selected at UNC Chapel Hill and South Square. No overhead catenary system would be needed.

Table 5-30 summarizes potential visual impacts for the Durham-Orange Corridor.

Table 5-30 Summary of Visual Impacts

Alternative	Aerial Structure (feet)	Overhead Catenary System	Visual Impacts Rating
LRT	15,250 - 17,150	Yes	○
BRT-High	15,250 - 17,150	No	◐
BRT-Low	+/- 7,000	No	●

Source: URS Corporation Consultant Team, 2011

LRT and BRT-High Alternatives will have the highest visual impacts of the Build Alternatives.

Wetland & Stream Impacts

Wetlands and streams that are either directly crossed by the fixed-guideway alternatives or within 50 feet of the alignment were identified using available Geographic Information System (GIS) data. Information on water crossings is important to determine if an alignment would have a potentially adverse impact on a stream or other water crossing during construction or operation. Each alignment crosses several major streams, intermittent streams and unnamed creeks. Wetlands are defined by the US Army Corps of Engineers (USACE) and US Environmental Protection Agency (EPA) based on the presence of wetland vegetation, wetland hydrology, and hydric soils. Wetlands are important biological resources that perform many functions, including groundwater recharge, flood flow attenuation, erosion control, water quality improvement, and plant and animal habitat. A review of the National Wetlands Inventory (NWI) Maps, published by the United States Department of the Interior Fish and Wildlife Service, was conducted to determine acreage of wetlands adjacent to the proposed alignments.

LRT The proposed LRT alignment will cross several NWI mapped wetlands and United States Geological Survey (USGS) blue-line streams. These include:

- Little Creek/ Palustrine Forested (PFO) wetland
- Unnamed Tributary (UT) to Little Creek
- New Hope Creek/ PFO wetland

- UT to New Hope Creek (1)
- UT to New Hope Creek (2)
- UT to New Hope Creek (3)
- UT to New Hope Creek (4)
- UT to New Hope Creek (5)
- UT to New Hope Creek (6)
- Sandy Creek 1
- Sandy Creek 2
- UT to Sandy Creek

Most of the proposed crossings occur along existing road rights-of-ways that have crossing structures in place (e.g., culverts or bridges). The proposed alignment may require an extension of these structures. Two proposed LRT crossings of Little Creek and New Hope Creek would require new crossing structures for these streams and associated PFO wetlands.

Table 5-31 summarizes the estimated linear feet of stream and acreage of wetland impacts for the base alignment and the alignment options at UNC Chapel Hill, Meadowmont/Woodmont, and South Square for the LRT alignment (Figure 5-16). Most of the stream and wetland impacts along the base alignment are expected to occur over New Hope Creek near Patterson Place. The alignment will be bridged over the crossings. There are no anticipated stream or wetland impacts in the UNC Chapel Hill subarea. The South Square alignment options will both impact roughly 300 linear feet of streams but will not affect any wetlands.

Table 5-31 Potential Impacts to Streams and Wetlands for LRT Alignment Options

Alignment Options	Streams (linear feet)	Wetlands (acres)
Base Alignment	2,445	3.0
<i>UNC Chapel Hill</i>		
A1 – Hibbard Drive	0	0
A3 – UNC Southern	0	0
<i>Meadowmont/Woodmont</i>		
C1 - Meadowmont Lane	120	<1
C2 – George King Road*	250	<.25
<i>South Square</i>		
D1 – Westgate Drive	300	0
D3 – Shannon Road	300	0

Source: URS Corporation Consultant Team, 2011, estimated using GIS NWI mapping USGS stream mapping data | *Avoids having a new crossing and disturbance to the contiguous Little Creek watershed north of NC 54.

In the Meadowmont/Woodmont subarea, while alignment option C1 would impact less than one acre of wetlands and 120 linear feet of streams, alignment option C2 would impact less than one-quarter acre of wetlands and approximately 250 linear feet of streams. Because LRT would operate in the median of George King Road, which crosses the existing wetland, the LRT avoids having a new crossing and disturbance to the contiguous Little Creek watershed north of NC 54. There is, however, a slight encroachment on the edge of the wetlands associated with Little Creek when the alignment turns onto George King Road from NC 54. Accommodating this turn requires a new crossing of the Little Creek wetland area that accounts for the less than one-quarter acre of impact.

Wetland and stream impacts are shown in Figures 5-16a-d as well as Table 5-32.

Additional Study Area

Little Creek and New Hope Creek

In compliance with the National Environmental Policy Act of 1969, as amended, during the PE/DEIS phase of the project development process, the alternatives advanced from the AA process for further study will be subject to more detailed evaluation of environmental impacts. The alignments crossing Little Creek and New Hope Creek were previously selected as part of the preferred alignment developed through the 2001 US 15-501 Major Investment Study (MIS) (as amended) and adopted by the DCHC MPO, Durham and Chapel Hill. Along with the alternative LRT alignments already identified in the AA for crossing the Little Creek area, during PE, reasonable alternative design options including but not limited to a LRT alignment in the New Hope Creek area that is adjacent to the existing US 15-501 right-of-way will also be included in the DEIS to investigate ways to minimize or avoid impacts to environmental resources.

BRT-High The proposed BRT-High Alternative alignment crosses the same or adjacent wetland and stream systems as the LRT alignment. There are no major wetlands and streams that could be impacted within 50 feet of the BRT-High corridor in downtown Durham. Wetland and Stream Impacts for the BRT-High Alternative are identical to LRT.

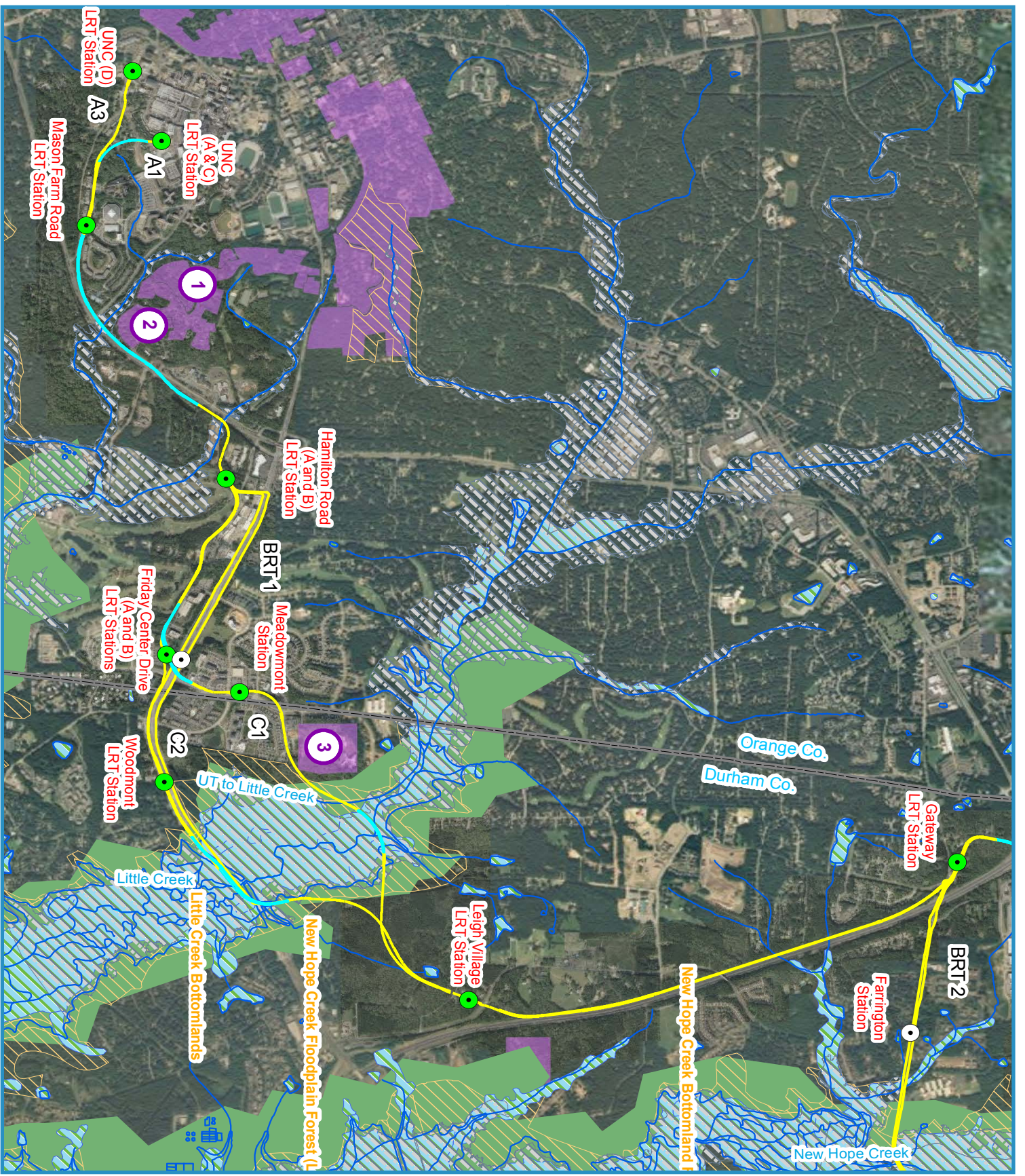
BRT-Low The proposed BRT-Low Alternative alignment also crosses the same or adjacent wetland and stream systems as the LRT alignment. As shown in Table 5-32, within the base alignment, the BRT-Low has fewer impacts because it does not cross the New Hope Creek systems between Gateway and South Square on new structure as it will operate in mixed-traffic. However, the alignment does clip portions of New Hope Creek and the associated wetland along Old Chapel Hill Road, with the total impact to wetlands equating to approximately one acre. Similar to alignment option C2 for the LRT and BRT-High Alternatives, the BRT-Low Alternative will also run along NC 54 where it crosses Little Creek. However, the BRT-Low alignment will require a widening of the existing roadway. The proposed alignment also may require an extension of culvert and bridge structures. The BRT-Low Alternative will thus impact approximately one acre of wetlands in the Little Creek watershed. There are no major wetlands and streams that could be impacted within 50 feet of the BRT-Low corridor in South Square or Downtown Durham subareas. Wetland and Stream Impacts for the BRT-Low are less than the LRT and BRT-High Alternatives.

Table 5-32 Summary of Stream and Wetland Impacts

Alternative	Stream Impacts (linear feet)	Wetlands (acres)	Wetland & Riparian Area Rating
LRT	4,000 – 5,300	3 – 4	
BRT-High	4,000 – 5,300	3 – 4	
BRT-Low	3,600 – 4,800	2	

Source: URS Corporation Consultant Team, 2011, estimated using GIS NWI mapping USGS stream mapping data

FIGURE 5-16a
DURHAM-ORANGE
ENVIRONMENTAL
FEATURES



APRIL 2012

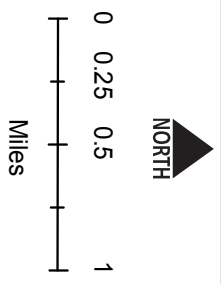


FIGURE 5-16b
DURHAM-ORANGE
ENVIRONMENTAL
FEATURES

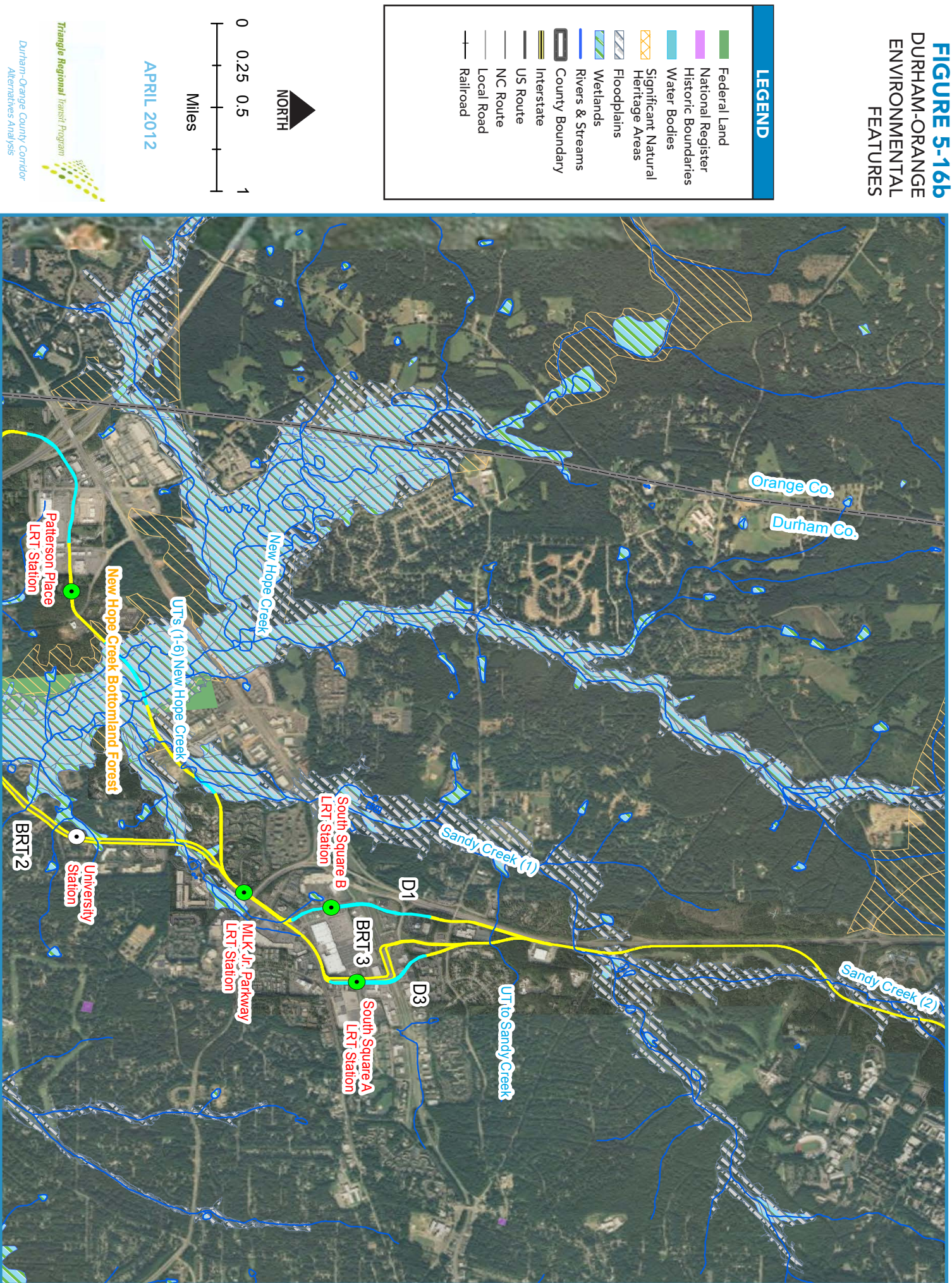
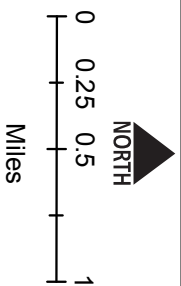
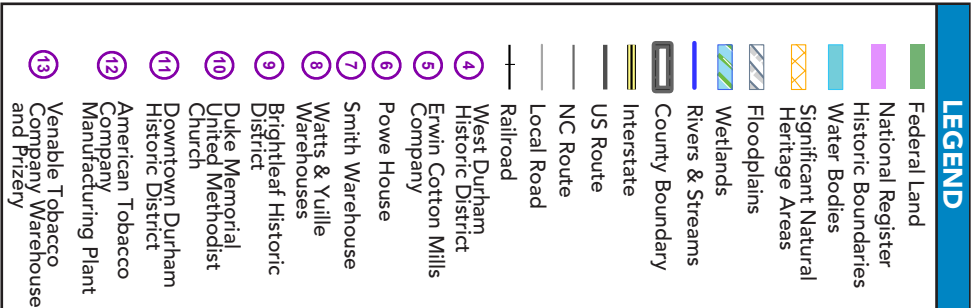


FIGURE 5-16c
DURHAM-ORANGE
ENVIRONMENTAL
FEATURES



APRIL 2012

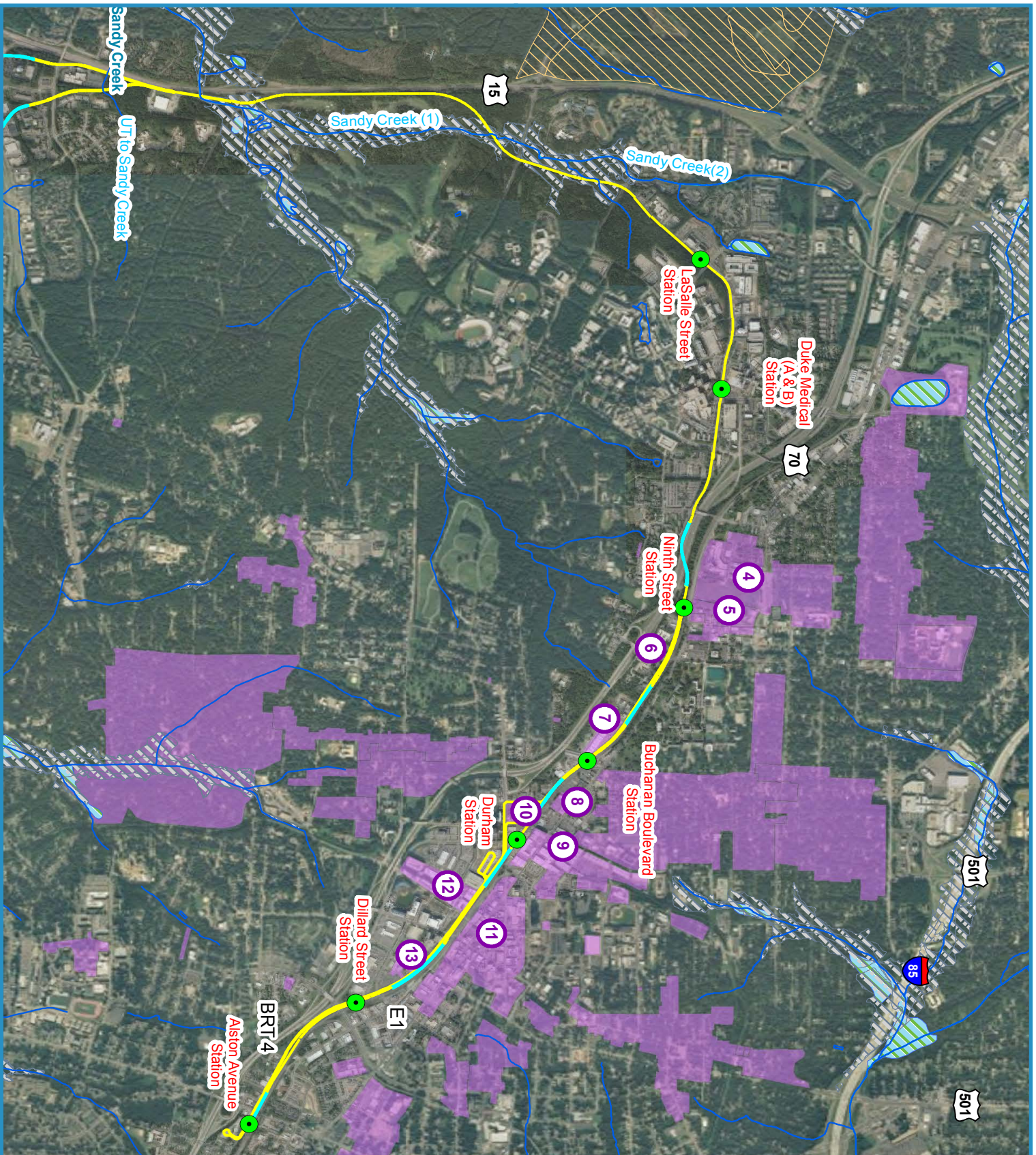
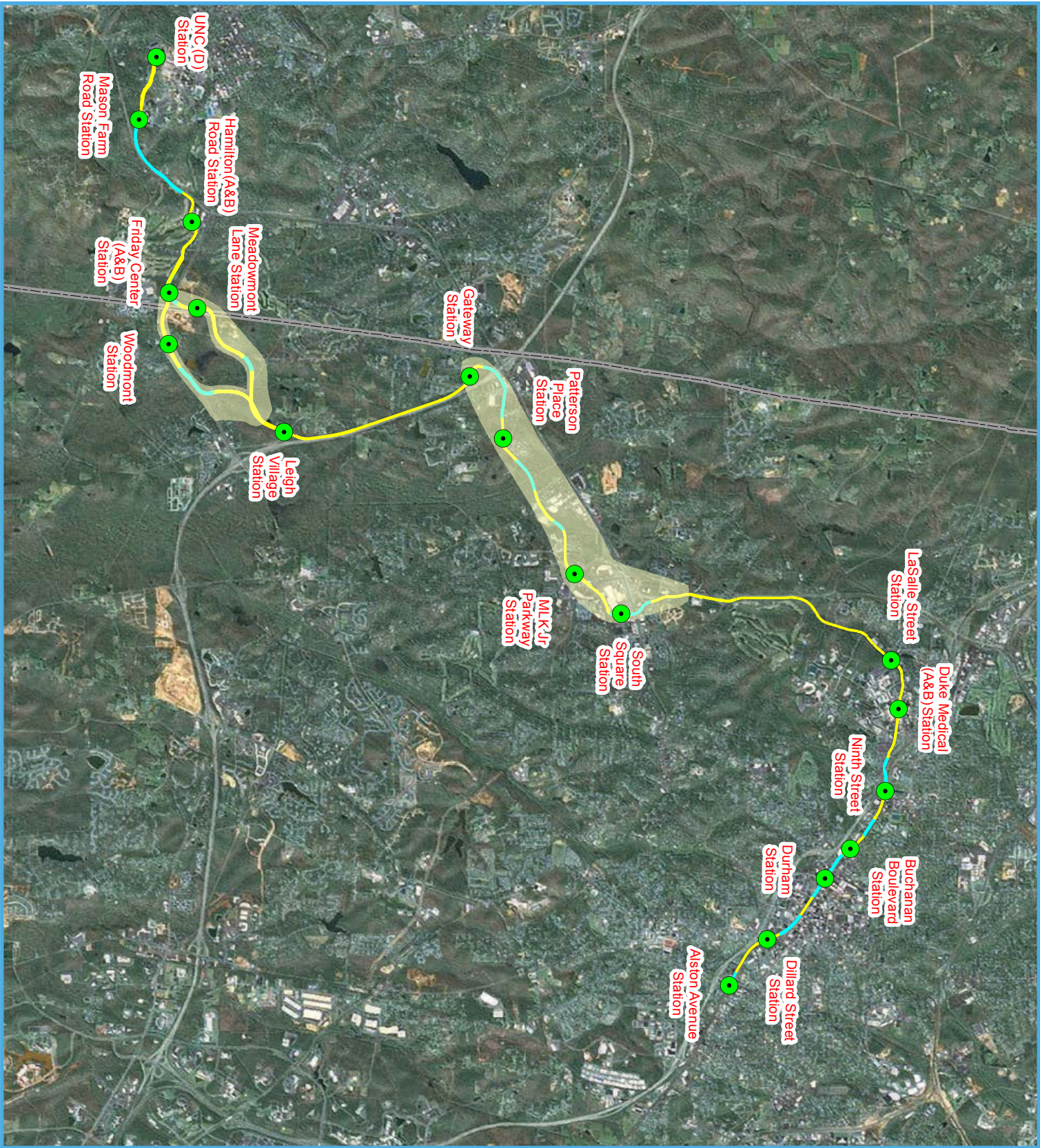
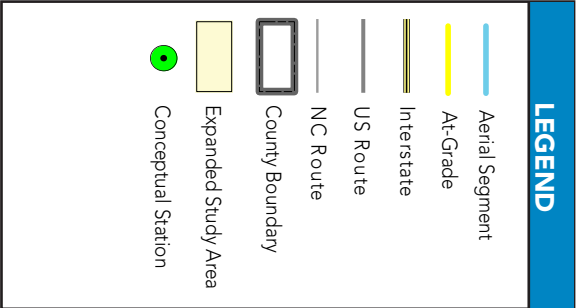


FIGURE 5-16d
DURHAM-ORANGE
EXPANDED STUDY
AREA



APRIL 2012

In total, the LRT and BRT-High alternatives could impact between 4,000 and 5,300 linear feet of streams, depending on the alternatives selected in Meadowmont/Woodmont. Both LRT and BRT-High would also impact approximately 4 acres of wetlands if alignment option C1, Meadowmont Lane, is selected and three acres of wetlands if alignment option C2, George King Road, is selected. BRT-Low would impact approximately 2 acres of wetlands.

BRT-High The proposed BRT-High Alternative alignment crosses the same or adjacent wetlands and streams.

Section 4(f) Resources

According to Title 23 USC 138 (Section 4(f)), the USDOT:

...shall not approve any program or project...which requires the use of any publicly owned land from a public park, recreation area, or wildlife and waterfowl refuge of national, State or local significance as determined by the Federal, State, or local officials having jurisdiction thereof, or any land from an historic site of national, State or local significance as so determined by such officials unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such program includes all possible planning to minimize harm to such park, recreational area, wildlife and waterfowl refuge, or historic site resulting from such use.

Thus potential Section 4(f) resources that are within 50 feet of the alignment were identified using available GIS data.

LRT Section 4(f) resources within 50 feet of the LRT alignment include DCS Hospital School in Durham and the USACE property in the Meadowmont/Woodmont subarea. The LRT alignment crosses adjacent to property owned by Durham County and is preserved as open and recreational space associated with New Hope Creek. Both alignment options C1 and C2 would impact the USACE property and C2 proposes to use existing right of way through the property but may also have impacts. Alignment option C1 passes near the historic Meadowmont Farm property but is outside the 50-foot buffer. There are no Section 4(f) resources within the UNC Chapel Hill or South Square subareas. Numerous historic properties are within the Downtown Durham subarea, four of which are within 50 feet of the LRT alignment.

The Patterson Storage Yard and Maintenance Facility Alternative would directly impact the historic William N. Patterson High School site which is located between SW Durham Road and US 15-501 just north of the North Creek Apartment complex.

BRT-High Potential Section 4(f) resources under BRT-High are identical to LRT, except in downtown Durham. Numerous historic properties are within the Downtown Durham Subarea, six of which are within 50 feet of the BRT-High alignment.

BRT-Low Section 4(f) resources within 50 feet of the BRT-Low Alternative include the DCS Hospital School in Durham and the USACE property in the Meadowmont/Woodmont subarea, and similar to alignment option C2, proposes to use existing right-of-way on NC 54 through the USACE property but may also have impacts. There are no Section 4(f) resources within the UNC Chapel Hill or South Square subareas. Numerous historic properties are within the Downtown Durham Subarea, six of which are within 50 feet of the BRT-Low alignment.

Table 5-33 summarizes potential Section 4(f) resource impacts and provides a summary rating.

Table 5-33 Summary of Potential Section 4(f) Resource Impacts

Alternative	Number of Potential 4(f) Impact Locations	Section 4(f) Ratings
LRT	7	⊖
BRT-High	7	⊖
BRT-Low	8	⊖

Source: URS Corporation Consultant Team, 2011

Air Quality Impacts

Air quality is typically assessed at the regional level. None of the alignments are anticipated to affect regional air quality substantially. All of the alternatives, at a minimum, would maintain existing air quality levels. It is, however, generally accepted that electrically powered LRT vehicles are a greener technology that would be more efficient and provide a slight improvement over diesel or alternatively fueled buses in the immediate service area. Ratings for air quality impacts are provided in Table 5-34.

Table 5-34 Air Quality Impacts

Alternative	Air Quality Ratings
LRT	●
BRT-High	⊖
BRT-Low	⊖

Source: URS Corporation Consultant Team, 2011

Construction Impacts

Impacts to businesses and residents are one of the most challenging elements in the construction of a fixed-guideway transit system. Roadway access, along with services provided for water, sewer, electrical, and communication are vital, and their disruption due to construction should be minimized. Construction impacts, such as noise and vibration, can also occur as a result of the hauling and redistribution of materials and for the delivery of new materials for guideway construction, namely, ballast (LRT), concrete or paving materials (BRT and LRT), rail (LRT), and overhead catenary poles and wiring (for LRT). Other construction materials include drainage pipes and graded materials for base and sub-base for pavements (BRT) and for drainage trenches. This heavy equipment can result in noise and traffic impacts to the surrounding area.

Where the guideway crosses streets at-grade, local automobile traffic can be disrupted and it is common to either close the street and detour the traffic away and around the construction site or to construct the grade crossing in stages without closing the street entirely by detouring traffic locally around the construction zone making use of one-half of the street being crossed. This process is then reversed to build the other half of the street. This necessitates the use of flagman and traffic detour signs. It is a common construction staging requirement that adjacent street crossings cannot be worked on simultaneously to minimize impacts to traffic. Construction detour plans are necessary to be produced and approved by the governing jurisdiction.

Mitigation for construction impacts can be achieved through best management practices and construction phasing. It is common to dictate working hours and limit construction equipment noise levels depending on the sensitivity of the surrounding areas. In some cases, nighttime construction is required to minimize traffic impacts (such as an aerial crossing of an expressway). Other times nighttime construction is prohibited such as in a residential setting. Erosion control and water run-off control during construction is common to all types of guideway construction and is typically mandated by the authority having jurisdiction.

For guideway construction to progress in phases, it is common to make use of the corridor in one area as a staging zone for construction in another and progressing in a linear fashion. A finished guideway zone is a good area for staging construction materials for the next zone thus minimizing the need for additional construction staging areas and for a consistent area for delivery of materials for certain reaches of guideway construction. The materials are then distributed linearly along the guideway corridor as the work progresses. Future station park and ride lots and bus bay areas would also be used for the staging of construction.

LRT, BRT-High, and BRT-Low All three alternatives - LRT, BRT-High, and BRT-Low - would generate construction impacts requiring mitigation. Because each alternative requires the construction of extensive segments of fixed-guideway, and each alignment is roughly the same length, construction impacts are not a differentiating factor between alternatives, as shown in Table 5-35. See Appendix F for more detail regarding construction impacts for each alternative.

Table 5-35 Construction Impacts Ratings

Alternative	Rating
LRT	⊖
BRT-High	⊖
BRT-Low	⊖

Source: URS Corporation Consultant Team, 2011

Cost

Capital Costs

Capital costs include a one-time expenditure to construct the Build Alternatives and purchase vehicles. All of the build alternatives in the Durham-Orange corridor include feeder bus service. The capital costs for the feeder bus service will be calculated upon the selection of the LPA prior to development of the full financial plan, and therefore are not included here. The same basic feeder bus service was used in each alternative and would not materially impact the marginal costs between the alternatives. All capital costs estimates are given in 2011 dollars. More detailed information on the methods and assumption for the development of O&M costs can be found in the Technical Report containing: Durham-Orange Corridor Detailed Evaluation of Alternatives Volume 2 Capital Cost Estimates, Operations and Maintenance Costs Estimates, Travel Time and Distance Calculation, and Ridership Summaries and Station-to-Station Ridership, May 2011.

LRT As shown in Table 5-36, capital costs for the LRT Alternative range from \$1.34 Billion to \$1.40 Billion, depending on the alignment options selected at UNC Chapel Hill, Meadowmont/Woodmont, and South Square. The highest cost combination includes alignment options A1 Hibbard Drive, C1 Meadowmont Lane, and D3 Shannon Road. The lowest cost combination includes alignment options A3 Hibbard Drive, C2 George King Road, and D1 Westgate Drive.

Table 5-36 Capital Costs for LRT Alignment Alternatives

Alternative Alignment Combination	Capital Cost (2011 dollars)
A1, C1, D1	\$1.37B
A3, C1, D1	\$1.37B
A1, C2, D1	\$1.34B
A3, C2, D1	\$1.34B
A1, C1, D3	\$1.40B
A3, C1, D3	\$1.40B
A1, C2, D3	\$1.37B
A3, C2, D3	\$1.37B

Source: URS Corporation Consultant Team, 2011

Factors affecting the cost of the alignment options in UNC Chapel Hill, Meadowmont/Woodmont, and South Square are described below. All costs presented are total project costs inclusive of construction, vehicles, maintenance yard and shops, right-of-way, allocated and unallocated contingencies, project administration and engineering costs, and project reserve. The alignment segment comparison costs do not include the system-wide costs associated with vehicles and maintenance yard and shops.

UNC Chapel Hill: Alignment option A1 Hibbard Drive would cost approximately \$60 million while alignment option A3 Hibbard Drive would cost approximately \$59 million (cost includes tail track). Alignment option A1 is modestly higher in cost because it requires 600 feet of aerial structure while alignment option A3 would be constructed at-grade. Alignment option A3 has over 885 feet more track feet than alignment option A1 which offsets the added cost of the aerial structure.

Meadowmont/Woodmont: Alignment option C1 Meadowmont Lane would cost approximately \$212 million while alignment option C2, George King Road, would cost \$182 million. Meadowmont Lane would cost approximately \$30 million more due to the aerial structure required to cross NC 54 between Meadowmont Village and Friday Center. The aerial crossing of NC 54 requires the Friday Center Drive station be aerial for alignment option C1. The station is at-grade with alignment option C2. Alignment option C1 also requires road crossings/gates.

South Square: Alignment option D1, Westgate Drive, would cost approximately \$219 million while alignment option D3, Shannon Road, would cost \$245 million. Alignment option D3 would cost approximately \$26 million more than alignment option D1 because it requires more aerial structure, 3,200 feet for alignment option D3 when compared to 2,300 feet for alignment option D1. In addition, alignment option D3 is a circuitous route relative to alignment option D1, requiring slightly more guideway and track elements to cover the additional distance. Alignment option D1, Westgate Drive, requires additional crossing protection at two access roads and Shannon Drive. Alignment option D3 also requires purchase of 1.5 more acres of right-of-way easements than alignment option D1.

BRT-High A capital cost estimate was developed for BRT-High assuming alignment options A3 Hibbard Drive, C2 George King Road, and D3 Shannon Road. BRT-High is estimated to cost \$960 million. The cost was derived using the same guideway construction costs as LRT with the following exceptions:

- lower station costs due to less length requirements for the platforms;
- less cost since BRT does not require traction power facilities and overhead distribution system (overhead canopy);
- a train control and signaling system is not required;
- Although included in BRT, there is less cost associated with communications and central control; and
- Different vehicle quantities and costs.

Maintenance yard and shop requirements were assumed to be the same. BRT has more vehicles and storage needs but less component rebuilding requirements.

BRT-Low A capital cost estimate was developed for BRT-Low assuming alignment options (A3, C2, D3). BRT-Low is estimated to cost \$810 million. The difference in cost from BRT High and BRT-Low is based on the differences in guideway construction and fleet requirements.

TSM The TSM Alternative capital costs would be approximately \$85 million, consisting of three miles of single lane pavement, additional left turn lanes and traffic signals, 800 spaces for park and ride lots, 16 bus bays, 16 articulated buses, right-of-way and all associated project administration, engineering, contingencies and project reserves.

Summary Table 5-37 summarizes capital costs for the Build Alternatives. For the purposes of comparison, the costs shown assume alignment options A3, C2, and D3.

Table 5-37 Capital Costs for Build Alternatives

Alternative (Alignments A3, C2, D3)	Capital Cost (2011 dollars)	Rating
TSM	\$85M	-
LRT	\$1.40B	○
BRT-High	\$960M	◐
BRT-Low	\$810M	●

Source: URS Corporation Consultant Team, 2011

The costs for the BRT alternatives are substantially less expensive than the LRT Alternative, \$414 million less for BRT-High Alternative and \$561 million for the BRT-Low Alternative. Although the BRT systems require construction of guideway and aerial structure in many of the same locations as LRT, guideway costs are reduced as described above.

As to be expected, the capital cost of the BRT-Low Alternative is approximately \$147 million less than the BRT-High Alternative. BRT-Low includes more sections operating in mixed-traffic, reducing costs for an exclusive running way. The BRT-Low alignment along Old Chapel Hill Road instead of through Patterson Place is estimated to cost approximately \$99 million or \$112 million less than the LRT alignment and \$73 million less than the BRT-High alignment through this segment. BRT-Low costs also include less real estate acquisition for station areas.

While the cost of the bus improvements is modest compared to a fixed-guideway transit system, the TSM Alternative does involve some capital improvements totaling \$84 million. These improvements include vehicles and spare parts, roadway facility improvements (such as on both sides of Fordham Boulevard, between Manning Drive and NC 54), bus bays, park and ride lots (including real estate acquisition), pedestrian and bike access as well as links to parking, traffic signal improvements, construction costs, and maintenance facility expansion. Additional information on facility improvements and traffic signal improvements is provided in Section 5.3.1.

O&M Costs

The operating and maintenance (O&M) costs project the annual cost of running the new service under the Build Alternatives. All operating cost estimates are provided in 2011 dollars. More detailed information on the methods and assumption for the development of O&M costs can be found in the Technical Report containing: Durham-Orange Corridor Capital Cost Estimates, Operations and Maintenance Costs Estimates, Travel Time and Distance Calculation, and Ridership Summaries and Station-to-Station Ridership, May 2011.

LRT Based on the service plans defined for the LRT Alternative, as defined in Section 5.3.1, the annual O&M costs would be approximately \$14 million in 2011 dollars for a peak hour capacity of 800 passengers per hour and \$15 million in 2011 dollars for a peak hour capacity of 1500 passengers per hour.

BRT-High Based on the service plans defined for the BRT-High Alternative, as defined in Section 5.3.1, the annual O&M costs would be approximately \$11 million in 2011 dollars for a peak hour capacity of 800 passengers per hour and \$13 million in 2011 dollars for a peak hour capacity of 1500 passengers per hour.

BRT-Low Based on the service plans defined for the BRT-Low Alternative, as defined in Section 5.3.1, the annual O&M costs would be approximately \$11 million in 2011 dollars for a peak hour capacity of 800 passengers per hour and \$13 million in 2011 dollars for a peak hour capacity of 1500 passengers per hour.

TSM Based on the service plans defined for the TSM Alternative, as defined in Section 5.3.1; the annual O&M costs would be approximately \$9 million in 2011 dollars.

Table 5-38 summarizes the operating costs under the Build Alternatives.

Table 5-38 O&M Cost Estimates for Build Alternatives (2011 Dollars)

Alternative	Annual O&M Cost (800 pax/hr)	Annual O&M Cost (1500 pax/hr)	Rating
TSM	\$8.89M		-
LRT	\$14M	\$15M	●
BRT-High	\$11M	\$13M	●
BRT-Low	\$11M	\$13M	●

Source: URS Corporation Consultant Team, 2011.

While operating costs for the BRT alternatives are estimated to be substantially lower than the LRT Alternative, long-term, the BRT alternatives' O&M costs will likely escalate higher than LRT costs due to the shorter life span of buses compared to trains, operations (driver) costs, and, potentially, fuel costs. A comparison of cost estimates for the BRT alternatives and the LRT Alternative at peak hour capacities of 800 and 1,500 illustrates the economies of scale that can be seen with LRT. As shown in Table 5-39, if the capacity of the BRT alternatives is increased to 1,500, the O&M costs increase from approximately \$11 million to \$13 million, an approximate difference of \$2 million. Conversely, if the LRT Alternative's capacity is increased from 800 to 1,500, the operating cost increase from approximately \$14 million to \$15 million, an incremental change of roughly \$1 million. A proportional increase in BRT and LRT service would increase O&M costs for BRT by 25 percent change whereas LRT would only require a 6 percent adjustment. This illustrates that LRT can be expanded to accommodate more passengers at a lower cost. Further, BRT would eventually overtake LRT in O&M costs. Based on the magnitude of change illustrated in Table 5-39, this would likely occur near 2,000 passengers per hour. A survey of observed peak hourly volumes for five LRT and three BRT US and Canadian systems revealed volumes ranging from 1,700 to 4500 from 1997 to 2000.²⁸ This data shows that it is common for BRT and LRT systems to operate with these passenger volumes.

Table 5-39 Comparison of O&M Costs for LRT & BRT for Alternate Peak Hour Capacities

Alternative	O&M Cost (800 pax/hr)	O&M Cost (1500 pax/hr)	Change in O&M Cost
LRT	\$14M	\$15M	\$1M
BRT-High	\$11M	\$13M	\$2M
BRT-Low	\$11M	\$13M	\$2M

Source: URS Corporation Consultant Team, 2011

Given this information, BRT is still rated higher for O&M costs as it is projected to have a lower O&M cost given the initial ridership forecasts. However, decision makers should weigh the long-term potential for escalated O&M costs as ridership nears the range more typical of US systems.

5.3.4. Summary of Evaluation Results

The summary of evaluation results focuses first on narrowing down the alignment options under consideration and second on comparing and screening the Build Alternatives to arrive at a LPA recommendation.

Alignment Options. This section summarizes the primary opportunities and constraints of the alignment options under consideration in the UNC Chapel Hill, Meadowmont/Woodmont, and South Square subareas and includes a preliminary recommendation for each subarea.

²⁸ Demery, Jr., Leroy, "Peak-period Vehicle Occupancy Statistics for U.S. and Canadian Rapid Bus and Rapid Rail Services," 2007.

UNC Chapel Hill

Table 5-40 UNC Chapel Hill Alignment Options Opportunities & Constraints

Alignment Option	Opportunities	Constraints
A1 UNC Hibbard Drive	- Substantially higher ridership (up to 800 more daily boardings over A3) due to better walk access from UNC Main Campus and Hospitals - Closer to major employment and student centers	- Potential for more construction impacts due to aerial structure - Aerial structure would also cause more visual impacts - Future expansion potential presents greater engineering challenges. An alternate station location and realignment of Hibbard Drive would be required.
A3 UNC Southern	- Consistent with UNC redevelopment and expansion plans - Future extension to Columbia Street less problematic - Alignment is the preferred option of UNC and Town of Chapel Hill staff - At-grade alignment would lead to fewer construction and visual impacts	- Lower ridership as it is located further from major employment and student centers - Substantially lower walk access

Source: URS Corporation Consultant Team, 2011

UNC Chapel Hill Alignment Option Recommendation: Based on the opportunities and constraints, carry forward alignment option A3 as the preferred alignment option. Both the UNC and Town of Chapel Hill staff support this option and a future extension of the A3 option would resolve the constraint of the extended walking distances to the UNC Campus and downtown Chapel Hill.

Meadowmont/Woodmont

Table 5-41 Meadowmont/Woodmont Alignment Options Opportunities & Constraints

Alignment Option	Opportunities	Constraints
C1 Meadowmont Lane	- Right-of-way has been preserved for transit along this alignment - Serves existing transit oriented development - Greater walk access potential that may not be captured in the existing ridership model; actual could equal or exceed the amount forecasted for C2 - Fewer linear feet of stream are likely to be impacted - Would increase delay at 4 fewer intersections than C2	- Slightly lower ridership within Meadowmont Village - Traffic impacts would need to be studied in greater detail at the intersection of NC 54 with Friday Center Drive and East Barbee Chapel Road - Alignment crosses USACE property
C2 George King Road	- Alignment along NC 54 is placed between NC 54 and the frontage road, Stancel Drive; less impacts during construction - Slightly higher forecast ridership (300 additional passengers) - Potential for less impacts to USACE property as alignment is proposed to use existing right-of-way - Marginally lower capital cost due to the avoidance of the NC 54 aerial crossing at Friday Center - Avoids impacts to existing residential community	- Ridership is forecast based on a proposed office development consisting primarily of office buildings (Hillmont) rather than an existing mixed use development (Meadowmont) - Future traffic studies may require Friday Center Drive to be grade separated thereby increasing costs - Impacts more private properties along George King Road - More linear feet of stream could be impacted - Greater traffic impacts as the option slightly increases delay at 4 additional intersections than C1

Source: URS Corporation Consultant Team, 2011

Meadowmont/Woodmont Alignment Option Recommendation: The project team recommends alignment option C1 be advanced as part of the LPA for the Durham-Orange Corridor. Alignment option C1 serves Meadowmont Village, an existing community that was conceived to be a TOD, offering a well-developed urban street grid, a highly walkable landscape, mixed-use developments, and multifamily housing within the one-half mile station catchment area. Long-term plans for fixed-guideway service within Meadowmont Village is also evidenced by the reservation of right-of-way, which results in fewer private property acquisitions for alignment option C1 relative to alignment option C2. In addition, the ridership potential of Woodmont relies heavily on a proposed development (Hillmont) rather than on an existing community as in the case of Meadowmont.

Still, the impacts to wetlands are a significant issue that must be explored further. Although there is a mitigation alternative identified for alignment option C1 (See drawing C1-04a in Volume 2: Detailed Definition of Alternatives, Conceptual Plan and Profile Drawings), the mitigation alignment option is very circuitous and would entail sharp turns, thus lengthening travel time and decreasing speed. This circuitous alignment and travel time and speed impact was not considered in the ridership modeling so alignment option C1 could experience a decrease in ridership should wetland avoidance at this location be a condition strictly enforced by the USACE. The crossing of wetlands and USACE owned property will require additional coordination to fully vet this issue with the USACE together with continued dialogue with community stakeholders.

Therefore, although alignment option C1 is the preferred alignment, the project team also recommends advancing alignment option C2 through to the PE/NEPA phase in order to provide an opportunity for continued study of the wetlands issue.

South Square

Table 5-42 South Square Alignment Options Opportunities & Constraints

Alignment Option	Opportunities	Constraints
D1 Westgate Drive	- Fewer visual impacts as less aerial structure is required - Lower capital cost due to less aerial structure - Fewer property impacts	- Slightly lower ridership as it presents less opportunity to serve existing development - Does not serve surrounding land uses as well as D3 - Development opportunity and non-highway access is constrained by US 15/501 interchange
D3 Shannon Road	- Higher ridership (up to 650 additional boardings) due to more central location - Better serves surrounding land uses, including existing development and the planned University Marketplace development	- Greater number of property impacts (10 more than D1) - Approximately \$26 million higher capital cost due to 1,100 additional feet of aerial structure - Greater potential for visual impacts due to aerial structure

Source: URS Corporation Consultant Team, 2011

South Square Alignment Option Recommendation: Based on the opportunities and constraints, option D3 is the recommended alignment option. The potential for development for alignment option D3 and the surrounding land uses is, in the opinion of the project team, a very significant factor for the recommendation of D3 above and beyond the constraints cited.

Build Alternatives (Technology Recommendation)

The following observations can be made about each of the detailed alternatives:

- The LRT Alternative has lower ridership (12,000 daily boardings) and higher capital costs (\$1.37B) and O&M costs (\$15M) than the BRT-High and BRT-Low Alternatives. However, the LRT Alternative has better travel times and economic development potential. Another important consideration is that of the comments received the LRT Alternative has a greater degree of public support.
- The BRT-High Alternative has the highest ridership (5,700 daily boardings on the BRT route and 11,900 boardings on the interlined buses), moderate capital costs (\$960M) and the lowest O&M costs (\$11M) of the three alternatives. However, economic development potential and degree of public support are not as competitive as the LRT Alternative.
- The BRT-Low Alternative has the second highest ridership (4,600 daily boardings on the BRT route and 11,700 boardings on the interlined buses), lowest capital cost (\$810M) and second lowest O&M costs (\$11M). Like the BRT-High Alternative however, the economic development potential is not as competitive as the LRT Alternative and public support is lacking.
- The BRT-High and BRT-Low Alternatives have longer end-to-end travel times than the LRT Alternative. The LRT Alternative, with a travel time of 35 minutes, is 3 minutes faster than BRT-High Alternative and 8 minutes faster than BRT-Low Alternative. This travel time difference could increase by 3 to 4 minutes if the BRT Alternatives are not permitted to operate within the NCRR corridor (see downtown Durham to East Durham - BRT Alternative 4 under Section 5.3.1).

- All three alternatives would increase system-wide transit trips in the region by a comparable amount. Measures used by the FTA to rate a project's justification—including mobility improvements and cost effectiveness—take into account the ridership increases and travel time savings enjoyed by the system as a whole as a result of the project's implementation, not only those benefits for the project alone. This is significant because it demonstrates that although BRT has higher boardings due to the interlining of feeder bus routes which make it difficult to isolate the performance of BRT alone and likely inflates its ridership potential, LRT ultimately provides a comparable increase in transit ridership for the system as a whole.
- The LRT and BRT-High Alternatives have similar environmental impacts, although LRT fares marginally worse in terms of visual impacts because it requires overhead catenary wire. While the BRT-Low Alternative requires a higher number of property acquisitions, it generally presents fewer visual and construction impacts than LRT and, to a lesser extent, BRT-High because more of the alignment is at-grade and follows existing roadways. In terms of air quality, however, it is generally accepted that electrically powered LRT vehicles are a greener technology that would be more efficient and provide a slight improvement over diesel or alternatively fueled BRT vehicles in the immediate service area.

Table 5-43 summarizes the evaluation of detailed alternatives.

Table 5-43 Summary of Detailed Alternatives Evaluation

Evaluation Criteria	Measure	LRT Alternative	BRT-High Alternative	BRT-Low Alternative
Ridership	2035 Ridership forecasts (without interlining on BRT)*	●	○	○
	2035 Ridership forecasts (with interlining on BRT)	◐	●	●
	2035 System-wide transit ridership	●	●	●
Transportation Operations	Traffic impacts	●	●	◐
	Travel times	●	◐	◐
Expansion Potential	Ability for alignment to be extended in future	●	◐	◐
Stakeholder Support	Public and agency support**	●	◐	◐
	Economic development potential	●	◐	○
Environmental Impacts	Property acquisitions	◐	◐	○
	Visual impacts	○	◐	●
	Wetland and stream impacts	◐	◐	●
	Section 4(f) resources impacts	◐	◐	◐
	Air quality impacts	●	◐	◐
	Construction impacts	◐	◐	◐
Cost	Capital costs	○	◐	●
	Operating costs	◐	●	●

*Daily boardings for BRT-High and BRT-Low routes without interlined buses could potentially be higher as the model estimated the ridership assuming interlined buses. The BRT numbers thus do not account for passengers that would transfer from feeder buses to BRT if the feeder buses were not sharing the BRT guideway. **Note agency support has not been evaluated at the time of this report. Ratings only include public support.

The BRT-High and BRT-Low Alternatives clearly rate well in their ability to meet the first three project goals. Both BRT Alternatives outperform the LRT Alternative in their ability to meet Goal 1: Improve mobility through and within the study corridor, Goal 2: Increase transit efficiency and quality of service, and Goal 3: Improve transit connections. The end-to-end travel time for the BRT Alternatives is slightly longer than the LRT Alternative; however, travel time does not seem to be a major differentiator with regard to passenger preference, as ridership on the BRT-High and BRT-Low Alternatives exceeds that of the LRT Alternative, even with a longer travel time. Additionally, while BRT-Low would result in marginally worse traffic impacts than LRT and BRT-High, traffic impacts is also not a major differentiator among the Build Alternatives.

Each of the three alternatives – LRT, BRT-High, and BRT-Low also meet Goal 5: Foster environmental stewardship; however, the use of fossil fuels by buses makes LRT a more sustainable and desirable technology over the long term. And, while each would result in limited impacts to the natural and built environments, environmental impacts have not proven to be a major differentiator between the alternatives.

From a cost perspective, the BRT-High and BRT-Low Alternatives best meet Goal 6: Provide a cost-effective transit investment by providing a lower capital cost investment and O&M costs within the planning horizon for the proposed project. In terms of capital costs, while LRT presents substantially higher costs than BRT, the cost of the LRT Alternative is still within the range of affordability as detailed in the Financial Plan being prepared for Durham, Orange, and Wake Counties. For O&M costs, decision makers must also consider that in the long-term, the O&M costs of the BRT Alternatives will likely escalate higher than those of the LRT Alternative due to the shorter life span of buses compared to trains, operations (driver) costs, and, potentially, fuel costs. Ultimately the decision of whether BRT or LRT is a cost-effective technology choice will depend largely on ridership. Currently, the BRT Alternatives do have slightly higher forecasted boardings but, as peak hourly volumes reach the range more comparable to existing LRT and BRT systems, LRT can meet the increased demand at a lower capital and O&M investment than BRT.

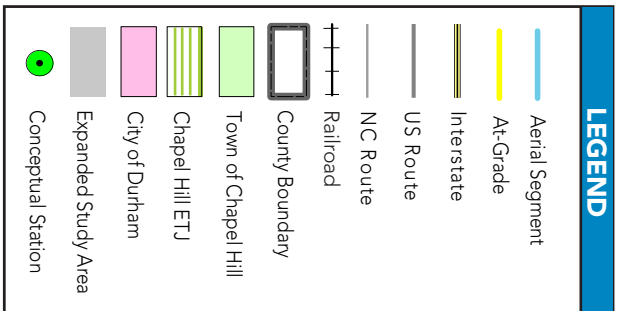
While the BRT Alternatives are competitive regarding most project goals, the LRT Alternative clearly surpasses the BRT Alternatives under Goal 4: Support local and regional economic development and planned growth management initiatives. The LRT Alternative has demonstrated public support and a proven record of producing local and regional economic development benefits by enhancing and focusing growth within LRT corridors. LRT enhances opportunities for TOD, and the resulting TOD can achieve rental rate premiums and higher land values over non-light rail served properties. Impressive levels of development have been constructed along LRT lines in many examples across the nation. As evidenced by the dollars of investment with LRT corridors such as the Charlotte Blue Line, developers are interested in constructing transit oriented development at LRT stations, as they see the value in the transportation advantage afforded by LRT. Further, in support of planned growth management initiatives, LRT's proven ability to focus growth would, in the long run, have a more substantial impact on mobility because the land use impacts will result in more choices that can reduce impacts to the highway system.

Build Alternative/Technology Recommendation: The ultimate choice of technology to carry forward is a major decision and could be considered a business decision beyond and above all else. Local and regional stakeholders place a high level of importance on economic development potential and focusing growth within the proposed transit corridor through TOD. LRT can bolster economic development and focus growth and the potential development dollars are not insignificant. The LRT Alternative alone can fully address the stated Purpose and Need for a fixed-guideway investment in the Durham-Orange Corridor; it can enhance mobility, expand transit options between Durham and Chapel Hill, serve populations with high propensity for transit use, and foster compact development. Therefore, the recommended Build Alternative (and technology) is the LRT Alternative.

5.3.5. LPA Recommendation

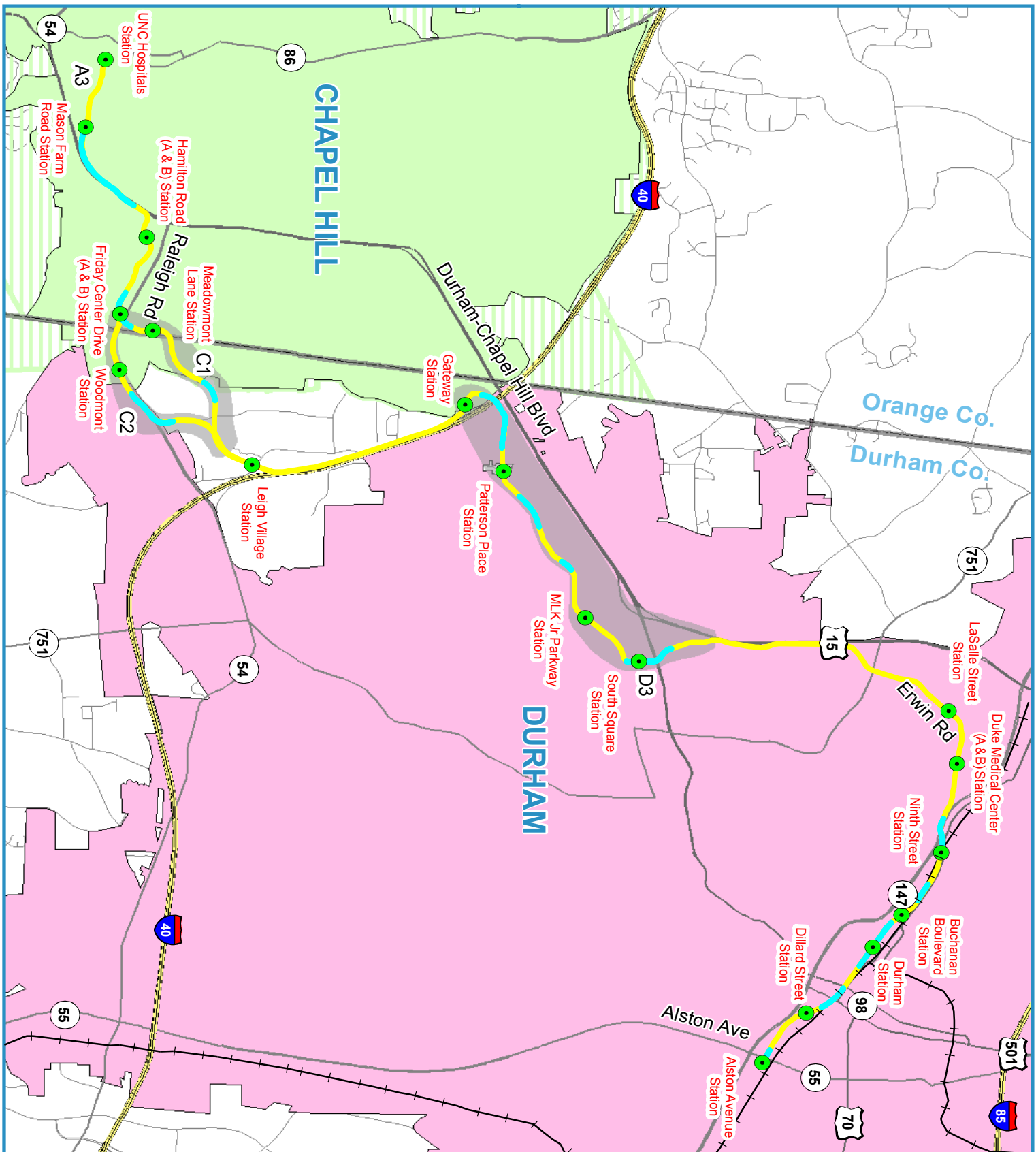
The Durham-Orange Detailed Definition of Alternatives published in July 2011, for reasons presented in the preceding subsections recommended advancing the LRT Alternative as the LPA with alignment options A3, C1, and D3 and the associated station locations. It was also recommended that the alignment option C2 be carried forward for further study in the PE/DEIS phase based on potential impacts to wetlands and USACE owned property associated with the C1 Alternative. Figure 5-17 shows the recommend LPA presented in the Detailed Definition of Alternatives.

FIGURE 5-17
DURHAM-ORANGE
RECOMMENDED
LOCALLY PREFERRED
ALTERNATIVE (LRT)



0 0.3 0.6 1.2 Miles

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5.4. Additional Evaluation and Endorsement of the LPA

Since publication of the Detailed Evaluation of Alternatives and the recommended LPA in July, 2011, the public, Orange and Durham County Commissioners, Chapel Hill Town Council, Durham City Council, and the DCHC MPO have conducted public hearings, reviewed and considered the recommended LPA. DCHC MPO, in conjunction with Triangle Transit, have held public workshops and received comments on the Detailed Definition of Alternatives which presented the recommended LPA. Comments received were considered by local officials and the DCHC MPO prior to selection and adoption of the LPA.

Numerous comments were received on the recommended LPA (see Appendix C). The primary issues identified in the comments were related to alignment option C1 and C2, with the majority of comments in opposition to the C1 alignment. The primary reasons for the opposition included potential impacts to the Meadowmont community and impacts to natural resources associated with Little Creek, including wetlands, floodplains, US Army Corps owned lands, and the Little Creek Bottomland and Slopes Significant Natural Heritage Area. Several comments were also received regarding potential impacts to natural resources from the portion of the proposed alignment that crosses New Hope Creek and Sandy Creek between the proposed Patterson Place station and MLK station locations. In response to these comments, an addendum to the July 2011 Draft Detailed Definition of Alternatives Report was prepared and has since been incorporated into this Alternatives Analysis Final Report.

The events and activities relevant to the selection of the LPA are as follows:

DCHC MPO Approves Durham County Bus and Rail Investment Plan - The Transportation Advisory Committee (TAC), which is the policy-making board of the DCHC MPO, approved the Durham County Bus and Rail Investment Plan at their June 22, 2011 meeting. The Investment Plan provides funding for bus service expansion and a fixed guideway transit system that serves Durham and Orange Counties using LRT.

Durham BOCC Approves Durham County Bus and Rail Investment Plan - At their June 27, 2011 meeting, the Durham Board of County Commissioners (BOCC) approved the Investment Plan and scheduled a referendum on a one-half cent sales tax for public transportation.

Public Review and Comment on Durham-Orange AA - The DCHC MPO released the Durham-Orange Detailed Definition of Alternatives Report from the AA for public comment. The MPO held two public workshops on August 29 and 30, 2011, in Chapel Hill and Durham, respectively. The recommended LPA was presented at these meetings.

Sales Tax Referendum Passes - Durham County residents voted on a referendum for a one-half cent sales tax for public transportation improvements included in the Durham County Bus and Rail Investment Plan. The vote passed on November 8, 2011.

DCHC MPO Conducts Public Hearing - The DCHC MPO TAC conducted a public hearing at their meeting on January 11, 2012. Citizens addressed TAC members to express their preferences regarding the D-O LRT project. Note that the Durham-Wake county rail transit corridor was also discussed at this meeting.

DCHC MPO Selects Locally Preferred Alternative - The DCHC MPO TAC approved a Locally Preferred Alternative for the Durham-Orange County rail transit corridor at their meeting on February 8, 2012. The recommended LPA was adopted with the modification that both the C1 and C2 alignment options be carried forward for further study in the Meadowmont and Woodmont station areas with a preference

for C2. Note that a Locally Preferred Alternative for the Durham-Wake county rail transit corridor was also approved at this meeting. See Figure 5-18.

A summary of Resolutions and comments received during the public comment period and during the public hearing are included in Appendix C.

5.5. Final Alternatives Recommended for Study

Based on this evaluation and the LPA adoption by the DCHC MPO on February 8, 2012, the final recommendations for alternatives to be carried forward for study in the Draft Environmental Impact Statement are:

- No Build
- TSM (required by FTA for comparison to “Build” alternatives and referred to as the “Baseline” alternative in the New Starts evaluation process)
- LRT between UNC Hospitals and Alston Avenue/North Carolina Central University (NCCU) Station

No-Build Alternative

The No-Build Alternative is used as a starting point to provide a comparison of all Build Alternatives in terms of costs, benefits, and impacts. The No-Build Alternative includes all highway and transit facilities identified in the fiscally constrained 2035 Long-Range Transportation Plan (LRTP), with the exception of the comprehensive system-wide rail transit network, part of which will be the subject of the DEIS.

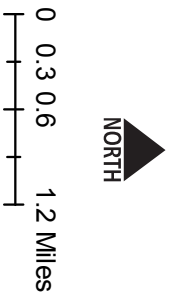
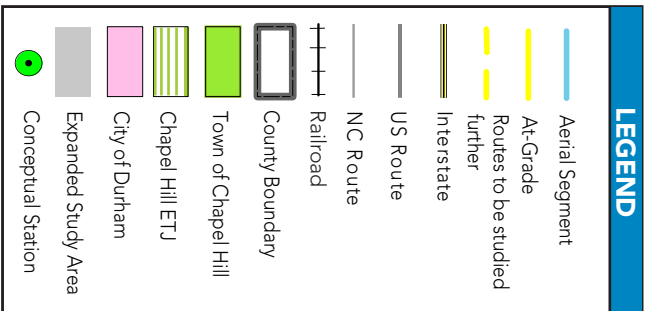
TSM Alternative

The primary purpose of the TSM Alternative, also known as the “best bus” alternative, is to develop an enhanced and robust bus network in the Durham-Orange Corridor that provides a level of transit service and capacity roughly equivalent to that of a fixed-guideway improvement. The TSM Alternative is required for inclusion in the DEIS by the FTA when federal funds are sought for capital improvements. The intention is to compare the efficiency and cost-effectiveness of a significant bus network in the corridor with fixed-guideway improvements to determine the impact on transit ridership, travel time, and other measures.

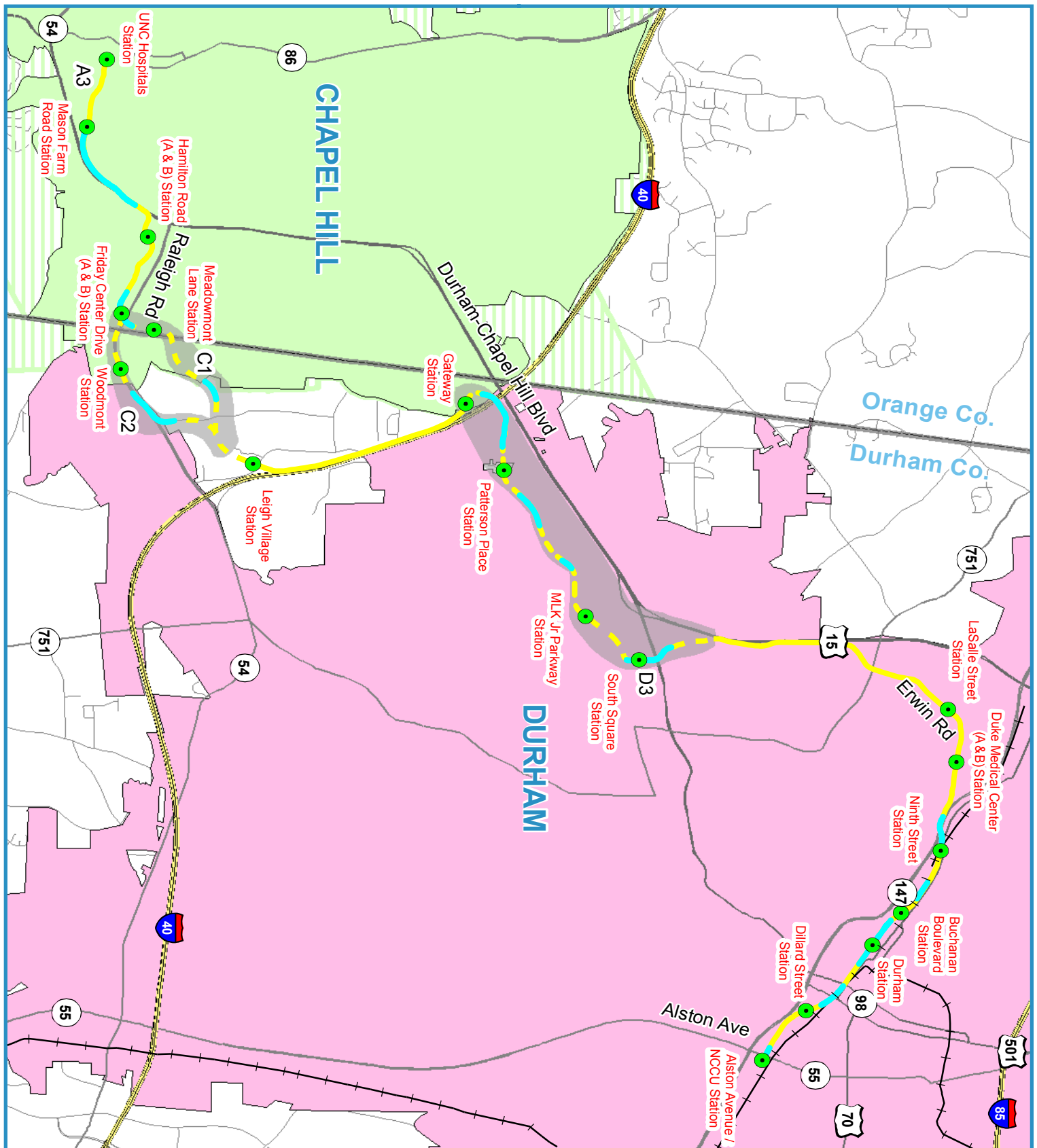
The TSM Alternative includes enhanced bus service within the corridor, along with improved local bus service feeding the express routes and TDM strategies that encourage a reduction in total trips (in particular drive-alone trips) and trip delays compared to the No-Build Alternative. The highway network for the TSM Alternative is assumed to be the same as the No-Build Alternative, which is taken from the 2035 DCHC MPO LRTP. However, the TSM Alternative also includes minor, low-cost improvements to roadways as they relate to the bolstered bus transit system.

The backbone of the TSM Alternative would be a new bus route operating between UNC Hospitals and east Durham, covering a distance of approximately 19 miles from Chapel Hill to Durham and includes 17 stops. Buses would operate at 10-minute headways in the peak periods and 20-minute headways in the off-peak periods. Travel time by bus between the UNC Hospitals in Chapel Hill and Alston Avenue/NCCU in east Durham is estimated to be 57 minutes. The high-frequency bus route would closely follow that of the LRT Build Alternative, as described below.

FIGURE 5-18
DURHAM-ORANGE
ADOPTED
LOCALLY PREFERRED
ALTERNATIVE (LRT)



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Light Rail Transit (LRT) Build Alternative –Locally Preferred Alternative

As selected by the DCHC MPO on February 8, 2012, the LPA includes light rail transit service between UNC Hospitals and east Durham, covering a distance of approximately 17 miles. The LRT would operate at 10-minute frequencies during peak hours and 20-minute frequencies during off-peak hours. LRT travel time is estimated to be 35 minutes between the UNC Hospitals Station in Chapel Hill and the Alston Avenue/NCCU Station in east Durham.

The alignment, which would be double-tracked throughout, (one track for each direction of travel), would operate primarily at-grade in a dedicated right-of-way parallel to existing roadways, with elevated sections throughout to mitigate potential traffic impacts or impacts to environmental features as needed. A total of 17 stations are proposed for the LRT Alternative. Station location refinements for stations such as Hamilton Road and Duke Medical Center will occur during the PE/EIS phase of the project, described in Section 6. During this phase, station layouts and designs will also be prepared.

The specific location of the LPA alignment is uncertain in two areas:

1. Crossing of Little Creek between Meadowmont Village and the proposed Leigh Village development: Alternatives C1 and C2
2. Crossing of New Hope Creek and Sandy Creek between Patterson Place and South Square: Alternative alignments generally south of Durham-Chapel Boulevard.

For the purposes of avoiding and minimizing impacts to sensitive environmental resources in these locations, practicable and reasonable alignment options in these locations will be studied in the DEIS. The results of the detailed environmental evaluation required by NEPA in the DEIS will provide a scientific and factual basis upon which to evaluate the suitability of these alternatives. Both locations include ecologically sensitive stream and wetland areas important to the conservation of natural resources.

- Little Creek (Alignment options C1 and C2): Because of potential environmental and community impacts, and comments received during the AA process, both alignment options C1 and C2 will be studied in the DEIS. The crossing of ecologically sensitive wetlands associated with Little Creek and US Army Corps of Engineer (USACE) owned property to the east of Meadowmont Village, as well as potential impacts to neighborhoods in Meadowmont and along NC 54 (Woodmont/Downing Creek), warrants additional study, coordination with the regulatory agencies, and continued dialogue with community stakeholders to fully evaluate the issues before an alignment option can be selected.
- New Hope Creek: Because of the ecologically sensitive wetlands associated with New Hope and Sandy Creeks and potential impacts to nature trails and publically owned lands, reasonable alternative design options including but not limited to a LRT alignment in the New Hope Creek area that is adjacent to the existing US 15-501 right-of-way will also be studied in the DEIS to investigate ways to minimize or avoid impacts to environmental resources.

6. Next Steps

This section describes the work that is currently underway and the next steps needed to advance the LPA through the overall project development and approval/implementation process. The purpose of this section is to summarize the federally guided project development process and highlight the resolution of known issues related to the LPA that will require further analysis and refinement.

6.1. FTA Project Development Process

The LRT alternative has been officially selected by the DCHC MPO. After it has been adopted into the region's financially-constrained long-range transportation plan, the project team will prepare an application for entry into the FTA's New Starts process and request approval to begin the PE/EIS phase of the project development process. The project team will work with the FTA throughout the preparation of the New Starts application to ensure compliance with FTA requirements and recommendations. Some required elements of the application, including conducting an Alternatives Analysis, ridership forecasting, capital and operating costs, and land use and development analyses, have been undertaken in anticipation of pursuing New Starts funding and can be used to support the New Starts application. Additional application preparation tasks will include the following:

- Refining cost estimates
- Updating transit forecasts
- Quantifying auto and transit travel time savings for the region
- Developing a project finance plan
- Documenting future transit-supportive development plans
- Demonstrating the technical and management capacity to undertake the PE/EIS phase of project development

Concurrent with the preparation of the New Starts application, scoping activities have been initiated for the environmental review process that is required by the National Environmental Policy Act of 1969 (NEPA). After receiving approval to enter New Starts, the project will move into the PE phase of project development. This approval by FTA signals that the project is eligible to be considered for future federal funding support. In the PE/EIS phase, more detailed design and engineering will be conducted to refine project costs and support preparation of an EIS. Following completion of PE and the EIS, Triangle Transit will request FTA permission to conduct Final Design. In Final Design, the engineering is completed, and negotiations, agreements and construction plans are finalized. As that work is being completed, Triangle Transit will work with FTA to negotiate a Full Funding Grant Agreement, which formally commits federal funding for the project.

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6.2. Issues for Further Analysis and Refinement

Over the course of the AA, selection of the LPA, and scoping of the EIS process, the following issues were identified for further analysis or coordination:

- Evaluation of project-related environmental impacts and development of mitigation measures for unavoidable impacts.
- Study of alignment options in the US 15/501 Corridor between the proposed Patterson Place and MLK stations to avoid and minimize impacts to wetlands, streams, floodplains, ecologically sensitive resources, public lands and recreation areas associated with New Hope Creek and Sandy Creek.
- Further study of the C1 and C2 alignment options between Friday Center and Leigh Village to evaluate community impacts and to avoid and minimize impacts to wetlands, streams, floodplains, ecologically sensitive resources, gamelands and federally-owned lands associated with Little Creek.
- Refinement of station locations such as Hamilton Road, Patterson Place, Duke Medical Center.
- Development of station layouts and designs.
- Further evaluation of traffic and transportation impacts, particularly at LRT/street at-grade crossings.
- Evaluation of possible rail operations and maintenance facility locations.
- Coordination and development of agreements with North Carolina Railroad (NCRR) and Norfolk Southern Railroad (NS) and North Carolina Department of Transportation, as well as other state and local government agencies.
- Refinement of ridership estimates.
- Development of preliminary engineering drawings.
- Refinement of capital and operating and maintenance costs.
- Additional issues as identified during the scoping process.