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**DURHAM – CHAPEL HILL-CARRBORO
METROPOLITAN PLANNING ORGANIZATION
TECHNICAL COORDINATING COMMITTEE (TCC)**

AGENDA

**October 5, 2010
2:00 p.m.**

**City Council Committee Room
2nd floor Durham City Hall**

- 1. Preliminaries**
- 2. Adjustments to the Agenda**
- 3. Public Comments**

ACTION ITEMS

**4. Triangle Regional Transit Program - Transitional Analysis
(Attachments 4, 4A)
Patrick McDonough, Triangle Transit**

The Triangle Transit has released a draft Transitional Analysis that presents quantitative evaluation data on the eighteen passenger rail corridors being considered in the Triangle. The report identifies two passenger rail corridors for further evaluation in the Alternatives Analysis phase: UNC-Chapel Hill hospitals to Alston Ave. in Durham; and, northeast Cary to the Northeast Regional Center in Raleigh. The contents of this draft report are currently being presented to the public for their input through a series of workshops throughout the region.

Attachment 4 and 4A are copies of the Transitional Analysis Executive Summary and full report, respectively. The full report includes appendices of White Papers” discussing commuter rail to Hillsborough and Zebulon, and a rail transit line extension to Carrboro. Additional information on the Triangle Regional Transit Program is available at www.ourtransitfuture.com.

The TCC discussed this report in its draft form at their September 22, 2010 meeting. The TCC did develop any recommendations to the TAC because members wanted to receive input or direction from the TAC at the Joint TAC meeting between CAMPO and DCHC MPO.

TCC Action: Discuss the Transitional Analysis and make a recommendation to the TAC.

**5. Draft 2011 – 2020 STIP
(Attachment 5, 5A, 5B)
Andy Henry, LPA Staff**

The North Carolina Department of Transportation (NCDOT) released the draft Fiscal Year 2011-2020 State Transportation Improvement Program (STIP) in early August. At their August and September meetings, the TAC received a copy of the FY 2011-2020 STIP for the DCHC MPO, several documents comparing the draft STIP with the FY2009-2015 STIP, the One-on-One meeting notes for the FY09-15 STIP process, and a schedule for approving the MPO's Metropolitan Transportation Improvement Program (MTIP).

One-on-One meetings among MPO and NCDOT staff and members are being scheduled for November 2010. The TCC reviewed draft One-on-One agendas at their meeting on September 22nd and provided some comments. However, the TCC requested that the TIP subcommittee meet to provide more detailed review and comments of the agenda. The TIP subcommittee will meet immediately before the October 5th TCC meeting to develop a recommendation to the TCC.

Attachment 5 provides a comparison of the FY2009-2015 and FY2011-2010 STIPs, and Attachments 5A and 5B are One-on-One meeting agendas for Division 5 and 7, respectively, including discussion points and text. These documents have been substantially edited since the September 22nd TCC meeting to include TCC and staff comments.

TCC Action: Review comparison document and One-on-One meeting agenda and make recommendation to TAC.

Adjourn

Next meeting: October 27, 2010

Triangle Regional Transit Program



Transitional Analysis Report
REVISED DRAFT
Executive Summary
September 24, 2010

Original Draft Dated September 2, 2010

Prepared for: Triangle Transit
Prepared by: URS Team



EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

Triangle Transit has commissioned a major study to initiate fixed-guideway transit service within Wake, Durham, and Orange counties of North Carolina. The Triangle Regional Transit Program (TRTP) is a collaborative framework for developing an efficient and sustainable regional transportation system that addresses the Triangle's critical need for improved connectivity and mobility choices while promoting its economic prosperity, job growth, and an enhanced quality of life. While previous transportation plans for the region have recommended the introduction of fixed-guideway transit, this study is significant due to the passage of HB 148 by the North Carolina General Assembly, which authorizes Durham, Orange, and Wake counties to hold referenda that, if passed, would allow each county to levy a ½ percent sales tax increase to fund improvements in public transportation.

The studies being conducted over the next year will recommend which transit corridors should initially be built. Planning work being undertaken includes two phases:

- Phase 1: A system-level Transitional Analysis, which is the subject of this report, will define and prioritize up to three transit corridors from the adopted 2035 Joint Long Range Transportation Plan (LRTP) to be studied in further detail in the Phase 2 Alternatives Analysis process. Given the geography of the region, including three counties and two Metropolitan Planning Organizations (MPOs), it is anticipated that one corridor within each of the MPO areas will be carried forward into the Alternatives Analysis process. A third commuter rail corridor spanning the region is possible as an early implementation project, with potential collaboration with the North Carolina Railroad and NCDOT.
- Phase 2: Triangle Transit will conduct Alternatives Analysis studies for up to three priority corridors to evaluate and screen alternative alignments, modes and station locations within each corridor. The Alternatives Analysis process will conclude with the selection and MPO adoption of a Locally Preferred Alternative for each of the priority corridors. The Alternatives Analysis process is a requirement of the Federal Transit Administration (FTA) for a fixed-guideway project to be eligible for federal funds.

It is unlikely that all fixed-guideway transit corridors in the LRTP can be implemented in the near-term, even with a sales tax increase. It is expected that corridors not included in the Phase 2 Alternatives Analysis studies would be implemented in later phases. Fixed-guideway transit projects would also be complemented by improvements and expansion to regional and local bus services so that all communities in the region have improved transit access. Improvements to bus service could begin soon after the referendum if voters approve a ½ percent sales tax increase.

The primary purpose of the Transitional Analysis is to define the corridor(s) for inclusion in the Alternatives Analysis studies. The Transitional Analysis acts as the bridge between the system plan in the LRTP and the more focused and detailed study performed in an Alternatives Analysis.

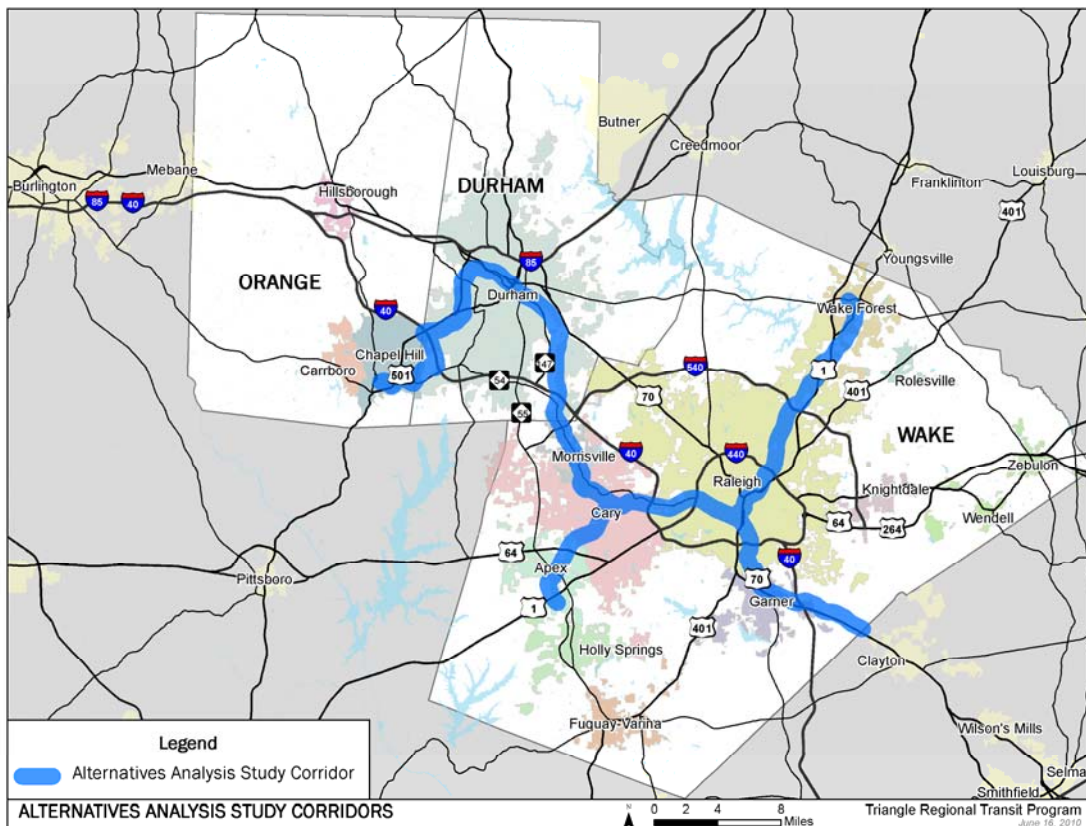


For the Transitional Analysis, the system plan has been broken down into a set of smaller corridors that have been evaluated in order to recommend a limited number of priority corridors to move forward into the Alternatives Analysis process. This Transitional Analysis applies a set of evaluation criteria and measures to each corridor for evaluation and prioritization of the corridors. For the purposes of this analysis, a corridor consists of a relatively wide band up to one mile wide with major activity centers identified. Examples of activity centers include the Northeast Regional Center (NERC), Downtown Raleigh, NC State Fairgrounds, Cary, Research Triangle Park (RTP), Downtown Durham, and Gateway East. In the detailed Alternatives Analysis, the exact number and locations of stations will be identified, as well as the exact alignment of the planned service, the termini, and the type of vehicles.

CORRIDORS

Using the 2035 Joint LRTP for both the CAMPO and the DCHC-MPO (see Figure ES.1), as well as input from Triangle Transit, both MPO's, and other stakeholders, 12 corridors were identified in Wake County and 6 were identified in Durham and Orange counties.

Figure ES.1 Transitional Analysis Study Corridors



The study corridors were presented to the CAMPO, the DCHC-MPO and to elected officials. The identification of corridors was also widely communicated to various cities, towns, counties, and organizations. The Wake County Technical Committee, the Durham-Orange County Technical Committee, and the Public Involvement Steering Committee, which were established



for this project, were also presented with the corridors. All known stakeholders attended one of these presentations. Comments received from stakeholders have been considered and incorporated into this Transitional Analysis.

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. Where applicable, the evaluation year is noted in parentheses.

Mobility

- Number of daily total trips in corridor (2035) (normalized as daily total trips/mile)
- Number of daily transit trips in corridor (2035) (normalized as daily transit trips/mile)
- 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

- Public sector/regulatory support - Existing comprehensive plans consistent with the concepts of compact, mixed-used development near public transportation, or transit-oriented development (TOD); allowable densities and flexibility of zoning districts
- Activity centers served (employment, retail, institutions, mixed use, special attractions)
- Development potential – future TOD potential considering potential household and employment density and future growth

Financial

- Total capital cost (2010 dollars)
- Capital cost per mile (2010 dollars)
- Capital cost per weekday transit trip (2010 dollars, 2035 ridership)
- Capital cost per weekday transit passenger mile traveled (2010 dollars, 2035 PMT)
- Total Operating and Maintenance (O&M) cost (2010 dollars)
- O&M cost per weekday transit trip (2010 dollars, 2035 ridership)
- Annual O&M cost per weekday transit passenger mile traveled (2010 dollars, 2035 PMT)



Public Input

Citizens and project stakeholders will be provided an opportunity to review and comment on the evaluation criteria and the draft results of the corridor analysis. This information will be presented at a series of six public workshops that will be held between September 14 and September 23, 2010.

RESULTS

Each of the corridors was evaluated based on the above criteria. This section presents the results of this evaluation for the Wake County corridors and for the corridors in Durham and Orange counties. As stated in Chapter 5, all of the criteria that were evaluated in this study were developed by the consulting team in partnership with Triangle Transit, DCHC-MPO, and CAMPO. All criteria may be useful or informative regarding any given corridor, and as such all results of the analysis have been included in Chapter 6 of this document. However, some criteria do not meaningfully distinguish between separate corridors, and are not included in the summary performance of each corridor. Tables ES.1 and ES.2 summarize the evaluation criteria that were most helpful in distinguishing between corridors.

Wake County

Twelve corridors in Wake County were evaluated and the results can be seen in Table ES.1. A summary of the findings is also presented.

Conclusions

Results of the analysis indicate that Wake Alternatives 9 (from Downtown Cary to the Northeast Regional Center) and 10 (from the State Fairgrounds to the Northeast Regional Center) are the overall highest performers. A summary of the evaluation follows:

- Wake Alternatives 9 and 10 have the highest daily rail trip estimates on a per mile basis, with 394 and 402 rail trips per mile respectively. The comparatively stronger ridership is a reflection of the large concentrations of people living within the vicinity of the corridors and the number of dense employment nodes – including downtown Raleigh, NERC, and Cary – that are served by both corridors.
- The corridor alternatives serving the segment from downtown Raleigh to the NERC have the highest levels of future household and employment densities. These include Wake 8 (Northwest Cary to NERC), Wake 9 (Downtown Cary to NERC), Wake 10 (State Fairgrounds to NERC), and Wake 11 (Downtown Raleigh to NERC).
- The jurisdictions in the region have adopted strong policies supportive of transit-oriented development in the planned transit corridors. This is a direct result of the ongoing comprehensive planning process that incorporates the LRTP into the comprehensive plans for the cities, towns, and counties in the region. The analysis of the land use plans and policies and Zoning by Right illustrate that the potential for higher densities of population, households, and employment is relatively strong in all of the proposed corridor alternatives. It then becomes the issue of identifying the best performing corridors. In an effort to summarize the economic and demographic factors, a Relative Future Density/Growth (RDFG) Factor was formulated and normalized on a per mile



basis. In this analysis, the Wake Alternatives 8 through 11 have the highest factors and Wake 11 performs the best. Wake 7 (TMC to NERC) and the regional corridor, Wake 12 (Duke Medical to Downtown Raleigh), also perform well but have factors just under Wake 8.

- From a cost perspective, Wake Alternatives 9 and 10 are relatively expensive to build when compared to other corridors on a cost per mile basis. Wake Alternatives 9 and 10 would cost \$65M per mile and \$67M per mile respectively. The higher cost, as compared with other corridors, can be attributed to more expensive infrastructure needs related to limited right-of-way and required infrastructure improvements, particularly in the vicinity of downtown Raleigh. On a per mile basis, longer corridors can spread out the costs associated with these infrastructure upgrades. Unlike other corridors however, Wake Alternative 9, which is 16 miles and Wake Alternative 10, which is 12 miles, are not long enough to spread out the costs of the infrastructure improvements required in the vicinity of downtown Raleigh.
- Although they are higher on a capital cost per mile basis than other corridors, Wake Alternatives 9 and 10 perform relatively well in terms of cost effectiveness due to their strong ridership. The capital cost per transit trip for Wake Alternative 9 is approximately \$54 per trip and the capital cost per transit trip for Wake Alternative 10 is approximately \$55 per trip.

While Wake Alternatives 9 and 10 are the overall strongest performers among the Wake corridors, Wake Alternative 8, which extends the transit line an additional two miles from downtown Cary to NW Cary, is not significantly far behind in performance. A terminal station in downtown Cary could be problematic due to limited property available for locating an end-of-line park and ride. A relatively short extension to NW Cary, therefore, may improve the feasibility of this corridor by providing more opportunities to locate a park and ride and related transit infrastructure and potentially increasing ridership. Given that this is a high-level screening process and that Wake Alternatives 8 and 11 are not significantly lower performing than Wake Alternatives 9 and 10, consideration should be given to performing the detailed analysis on Wake Alternative 8 which incorporates all of the alignments coincident to Wake Alternatives 9, 10, and 11.

The detailed Alternatives Analysis can fine tune this larger corridor in looking at the most optimal, best-fit initial starter line that may involve cutting back on the alignments at both ends to arrive at the most effective corridor for New Starts funding. This is in recognition of Federal funding capacity and that most starter lines initially constructed are in the 10-12 mile range. Extensions from the initial line would start the full build-out process consistent with funding availability.

Table ES.1 Evaluation Criteria Summary (Wake County)

Study Corridor	Corridor Length (mi) / Total Cost M\$ (2010)	Mobility		Socioeconomic				Land Use		Financial			
		Total In Corridor Trips per Mile (2035)	Rail Trips/Mile (2035)	Population Density (2035)	Employment Density (2035)	Low Income Population Density (2000)	Minority Population Density (2000)	Supports Transit Oriented Development, Zoning by Right	Relative Future Density / Growth Factor	Capital Cost (2010)	Capital Cost per Mile (2010 Dollars, 2035 Ridership)	Capital Cost per Weekday Transit Trip (2010 Dollars, 2035 Ridership)	Operating & Maintenance Cost/ Weekday Transit Trip (2010 Dollars, 2035 Ridership)
Wake Alternative 1 (UNC Hospitals to Wake Forest)	59/\$3,500	⊖	⊖	○	○	⊖	⊖	⊖	○	○	●	●	●
Wake Alternative 2 (Triangle Metro Center to Wake Forest)	33/\$1,900	⊖	○	⊖	○	○	○	⊖	⊖	⊖	●	⊖	⊖
Wake Alternative 3 (Veridea to Wake Forest)	33/\$2,000	⊖	○	⊖	○	○	○	⊖	⊖	○	●	⊖	⊖
Wake Alternative 4 (Downtown Cary to Wake Forest)	25/\$1,500	⊖	○	⊖	⊖	○	○	⊖	⊖	⊖	●	⊖	⊖
Wake Alternative 5 (State Fairgrounds to Wake Forest)	20/\$1,200	⊖	○	⊖	⊖	○	○	⊖	⊖	⊖	●	○	○
Wake Alternative 6 (Downtown Raleigh to Wake Forest)	17/\$1,000	⊖	○	⊖	⊖	○	○	⊖	⊖	●	⊖	○	○
Wake Alternative 7 (Triangle Metro Center to NERC)	24/\$1,500	⊖	●	⊖	⊖	○	○	⊖	⊖	⊖	●	●	●
Wake Alternative 8 (Northwest Cary to NERC)	18/\$1,100	●	●	●	●	⊖	⊖	●	●	⊖	⊖	●	⊖
Wake Alternative 9 (Downtown Cary to NERC)	16/\$1,000	●	●	●	●	⊖	⊖	●	●	●	⊖	●	●
Wake Alternative 10 (State Fairgrounds to NERC)	11/\$780	●	●	●	●	⊖	⊖	●	●	●	○	●	⊖
Wake Alternative 11 (Downtown Raleigh to NERC)	8/\$580	●	⊖	●	●	⊖	⊖	●	●	●	○	○	⊖
Wake Alternative 12 (Duke Medical to Downtown Raleigh)	29/\$1,700	⊖	○	⊖	⊖	⊖	⊖	⊖	⊖	⊖	●	⊖	⊖
Summary of Evaluation Criteria and Rankings													
High Performer	= ●	>22,060 Trips/Mile	>363.5 Trips/Mile	> 3.9 Households/Acre	>13.3 Jobs/Acre	>0.61 Persons/Acre	>1.61 Persons/Acre	Considers the # of stations and allowable densities within jurisdiction	>0.9	<1052	<\$62.0 M/Mile	<\$56.9/Trip	<\$9.9/Trip
Average Performer	= ⊖	18,452- 22,060 Trips/Mile	311.3-363.5 Trips/Mile	2.9- 3.9 Households/Acre	10.3- 13.3 Jobs/Acre	0.38- 0.61 Persons/Acre	1.04- 1.61 Persons/Acre		>0.5-0.89	1052-1925	\$62.0 - \$66.3 M/Mile	\$56.9-66.4/Trip	\$9.9-12.1/Trip
Low Performer	= ○	<18,452 Trips/Mile	<311.3 Trips/Mile	<2.9 Households/Acre	<10.3 Jobs/Acre	<0.38 Persons/Acre	<1.04 Persons/Acre		<0.50	>1925	>\$66.3 M/Mile	>\$66.4/Trip	>\$12.1/Trip

Note: The breakpoints for the bins are ±0.5 standard deviations from the mean. Data results are given in greater detail in Chapter 6.



Durham-Orange Counties

Six corridors in Durham and Orange counties were evaluated and the results can be seen in Table ES.2. A summary of the findings follows the table.

Conclusions

Results of the analysis indicate that Durham-Orange Alternatives 4 (from UNC Hospitals to Alston Avenue), 5 (from UNC Hospitals to Gateway) and 6 (from Gateway to Alston Avenue) are the overall highest performers (note that Alternatives 5 and 6 are subsets of Alternative 4). Primary discriminators between the alternatives include mobility, socio-economics and cost-effectiveness, as discussed here:

- Durham-Orange Alternatives 4 and 5 have the highest daily rail trip estimates on a per mile basis, with 394 and 399 rail trips per mile respectively. This primarily reflects the high employment at UNC and UNC Hospitals, Duke University and Duke Medical Center, and downtown Durham. Several significant mixed-use developments also exist or are planned within the corridor.
- Durham-Orange Alternatives 4 and 6, both of which terminate at Alston Avenue, are the most effective at reaching transit-dependent populations.
- The jurisdictions in the region have adopted strong policies supportive of transit-oriented development in the planned transit corridors. This is a direct result of the ongoing comprehensive planning process that incorporates the LRTP into the comprehensive plans for the cities, towns, and counties in the region. The analysis of the land use plans and policies and Zoning by Right illustrate that the potential for higher densities of population, households, and employment is relatively strong in all of the proposed corridor alternatives. It then becomes the issue of identifying the best performing corridors. In an effort to summarize the economic and demographic factors, a Relative Future Density/Growth (RDFG) Factor was formulated and normalized on a per mile basis. In this analysis, DO 6 (Gateway to Alston Avenue) has the highest factor of the Durham-Orange corridors. The regional corridor, DO 2 (Duke Medical to Downtown Raleigh) also performs well, but is just under DO 6 and slightly better than DO 4 (UNC Hospitals to Alston Avenue).
- From a cost perspective, Durham-Orange Alternatives 4 and 5 are relatively more expensive to build compared to other corridors (\$68M per mile and \$66M per mile respectively). This is because these corridors are primarily on new alignment that requires more right-of-way acquisition and infrastructure improvements than alternative corridors that use existing railroad right-of-way (e.g., Durham-Orange Alternatives 1 and 2).
- Although they are higher on a capital cost per mile basis than other corridors, Durham-Orange Alternatives 4 and 5 perform better in terms of cost effectiveness due to their strong ridership. The capital cost per transit trip for Durham-Orange Alternative 4 and 5 is approximately \$55 and \$53 per transit trip, respectively.

Durham-Orange Alternative 4 is the combination of Durham-Orange Alternatives 5 and 6, and hence, advancing this longer corridor allows for the most optimal starter line analysis for submission for Federal funding.



Durham-Orange Alternative 2 (from Duke Medical Center to Downtown Raleigh) was average in terms of socio-economic and strong in land-use factors, but not strong in terms of mobility and costs. Cost-effectiveness would improve if costs could be reduced. The ridership may have been low in part because the ridership model assumed light rail-type service rather than commuter rail-type service, which may be more appropriate for this corridor. For this initial study, costs assumed light rail transit, which is significantly more expensive than commuter rail, which uses primarily existing infrastructure. If connecting the region is a high priority over maximizing the potential for federal funds, then consideration should be given to this alternative. However, if federal funds are achieved with the other, better performing corridors as noted above, then full build out towards Wake Forest and Chapel Hill will occur sooner. If these corridors fail to be competitive for federal funds, then the decision can be revisited on which corridor to advance into preliminary engineering. The opportunity for Federal funding will become evident relatively soon after the New Starts submittal in the fall of 2011.



Table ES.2 Evaluation Criteria Summary (Durham-Orange Counties)

Study Corridor	Corridor Length (mi) / Total Cost M\$ (2010)	Mobility		Socioeconomic				Land Use		Financial			
		Total In Corridor Trips per Mile (2035)	Rail Trips/Mile (2035)	Population Density (2035)	Employment Density (2035)	Low Income Population Density (2000)	Minority Population Density (2000)	Supports Transit Oriented Development, Zoning by Right	Relative Future Density / Growth Factor	Capital Cost (2010)	Capital Cost per Mile (2010 Dollars, 2035 Ridership)	Capital Cost per Weekday Transit Trip (2010 Dollars, 2035 Ridership)	Operating & Maintenance Cost/ Weekday Transit Trip (2010 Dollars, 2035 Ridership)
Durham-Orange Alternative 1 (UNC Hospitals to Wake Forest)	59/\$3,500	⊖	⊖	○	○	⊖	⊖	⊖	○	○	●	●	●
Durham-Orange Alternative 2 (Duke Medical to Downtown Raleigh)	29/\$1,700	⊖	○	⊖	⊖	⊖	⊖	⊖	⊖	⊖	●	⊖	⊖
Durham-Orange Alternative 3 (UNC Hospitals to Triangle Metro Center)	26/\$1,600	○	⊖	○	○	●	●	●	○	⊖	⊖	⊖	⊖
Durham-Orange Alternative 4 (UNC Hospitals to Alston Ave)	17/\$1,200	○	●	○	⊖	●	●	●	⊖	⊖	○	●	●
Durham-Orange Alternative 5 (UNC Hospitals to Gateway)	7/\$470	○	●	○	○	⊖	○	⊖	○	●	⊖	●	⊖
Durham-Orange Alternative 6 (Gateway to Alston Ave)	10/\$750	●	⊖	⊖	●	●	●	⊖	●	●	○	○	○
Summary of Evaluation Criteria and Rankings													
High Performer	= ●	>22,060 Trips/Mile	>363.5 Trips/Mile	> 3.9 Households/Acre	>13.3 Jobs/Acre	>0.61 Persons/Acre	>1.61 Persons/Acre	Considers the # of stations and allowable densities within jurisdiction	>0.9	<1052	<\$62.0 M/Mile	<\$56.9/Trip	<\$9.9/Trip
Average Performer	= ⊖	18,452 - 22,060 Trips/Mile	311.3-363.5 Trips/Mile	2.9 - 3.9 Households/Acre	10.3 - 13.3 Jobs/Acre	0.38 - 0.61 Persons/Acre	1.04 - 1.61 Persons/Acre		>0.5-0.89	1052-1925	\$62.0 - \$66.3 M/Mile	\$56.9-66.4/Trip	\$9.9-12.1/Trip
Low Performer	= ○	<18,452 Trips/Mile	<311.3 Trips/Mile	<2.9 Households/Acre	<10.3 Jobs/Acre	<0.38 Persons/Acre	<1.04 Persons/Acre		<0.50	>1925	>\$66.3 M/Mile	>\$66.4/Trip	>\$12.1/Trip

Note: The breakpoints for the bins are ±0.5 standard deviations from the mean. Data results are given in greater detail in Chapter 6.



Regional Corridor

The current LRTP prepared by both the CAMPO and the DCHC-MPO includes a regional rail system that is comprised of both light rail transit (LRT) and commuter rail service, with the majority of the system being LRT, to be implemented in stages. This systems plan includes the provision of LRT service between Raleigh and Durham and between Durham and Chapel Hill. There is an overlap in the LRT plans and the commuter rail plans from downtown Raleigh to the Northeast Regional Center (in the location of Capital Boulevard and I-540). The purpose of the Transitional Analysis is to select which segments or corridors of the LRT system should be implemented first with the full system to be constructed in future phases. It is not practical or financially feasible to construct the entire LRT system as a single project and only the most effective segments or corridors should be initiated first, particularly if funding is to be requested from the Federal Transit Administration (FTA) under the New Starts program.

The Transitional Analysis examined a total of 16 corridors, including those that connected the two MPO regions and those that were entirely within either the CAMPO region or the DCHC-MPO region. The corridor alternatives were evaluated in the context of all day, frequent service that is typical of a LRT system. By contrast, a commuter rail system provides service only during the AM and PM peak period trips using a lower frequency of service (typically every 30-60 minutes). While LRT must operate on exclusive tracks, commuter rail can, and typically does, operate on tracks shared with freight and other intercity passenger rail service. In the Triangle Region, the term "express rail" has been identified to include the combination of existing AMTRAK passenger rail, existing and expanded NCDOT passenger rail service between Raleigh and Charlotte, and the additional commuter rail service during the peak periods.

The initial findings of the Transitional Analysis indicate that the corridor alternatives that operate in Wake County from Cary through downtown Raleigh and to the Northeast Regional Center (NERC) perform the best in terms of ridership, riders per mile, and cost per rider. This set of corridor alternatives is followed in performance by those that operate from UNC Hospitals to downtown Durham. The corridor alternative that connects Durham to Raleigh, passing through the Research Triangle Park, performed below both of the previous sets of alternatives. While the provision of LRT service between Durham and Raleigh is not the most cost-effective alternative for initial implementation, the early connection of these two major areas in the region can be provided by commuter rail or express rail service that can be implemented with lower costs than either of the LRT projects. Future extensions of the LRT systems in Wake and Durham counties would connect the two areas with LRT as identified in the LRTP. The major investments in commuter rail would not be wasted because the tracks could continue to be used by other freight and intercity passenger rail service (including the potential High Speed Rail service) and the vehicles could be moved to extensions of the commuter rail service to the areas on the edges of the region serving the downtowns of Raleigh and Durham.

For these reasons, an additional special Alternatives Analysis study will be prepared that evaluates commuter rail service versus LRT. The LRT service would connect the ends of the two initial LRT systems in Wake and Durham counties versus commuter rail service that extends from downtown Durham to east of Clayton using the existing NCR alignment. This will allow informed decisions to be made on whether early implementation of commuter rail service is worth the investment. If requested, we could also compare LRT service from Durham to Raleigh against commuter rail service from Durham to Raleigh with the assumption that the Wake County and Durham County LRT systems are not implemented.



Other Considerations

With the analysis of corridor performance, rail transit extensions to the Research Triangle Park, Wake Forest, Apex, and points beyond would not be carried forward for further consideration in the more detailed Alternatives Analysis studies. This does not, however, mean that service to these areas would be eliminated; it simply recognizes that they will be studied in greater detail at a later time. These extensions are truly noteworthy as the system expands, but the purpose of this first set of Alternative Analysis studies is to focus on the most effective corridors for initial transit investment and implementation. This is the formula other cities have used to develop and implement system-wide extensions.

Therefore, for those areas of the region that are not directly considered for initial detailed study in the Alternatives Analysis, additional studies have either been conducted or are recommended as follows:

- Extension of LRT to Garner: Technical memorandum detailing the future extension of the rail transit service from Raleigh to Garner.
- Extensions of commuter rail to Wake Forest and Apex: Technical memoranda analyzing implementation of commuter rail service to Wake Forest and Apex. (This has been suggested by CAMPO as a viable alternative). Considerations could include the following: termini, freight track alignments, operations, and cost.
- Extension of commuter rail service to Hillsborough and Zebulon: There have been requests to include extensions to both Hillsborough and to Zebulon in the study. The purpose of the Transitional Analysis is to determine the priority corridors for early implementation, but not preclude future extensions. White papers further discussing these two extensions are included as Appendix A and B.
- Extension to Carrboro: Project stakeholders from the municipality of Carrboro, Orange County and the DCHC-MPO, as well as citizens from Carrboro have indicated an interest in studying a rail transit connection to Carrboro. Per stakeholder comments, a draft white paper technical study providing an overview of the strategic issues that need addressing to extend rail transit to Carrboro was prepared and is presented in Appendix C.

When completed, the memoranda will be included as Appendices to this Transitional Analysis before it is finalized. These memoranda, along with the results of the Alternatives Analysis process can be used by both the CAMPO and the DCHC-MPO as input to the updates of their respective long range transportation plans.

NEXT STEPS

On September 29, 2010 there will be a special joint meeting of the Durham-Chapel Hill-Carrboro MPO and the Capital Area MPO to review and comment on the corridors for study in the Alternatives Analysis.

Triangle Regional Transit Program



Transitional Analysis Report
REVISED DRAFT

September 24, 2010

Original Draft Dated September 2, 2010

Prepared for: Triangle Transit
Prepared by: URS Team



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APPENDICES

Appendix A - White Paper Study of Commuter Rail to Zebulon

Appendix B – White Paper Study of Commuter Rail to Hillsborough

Appendix C – White Paper Study of Future Extension to Carrboro Implementation Analysis



EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

Triangle Transit has commissioned a major study to initiate fixed-guideway transit service within Wake, Durham, and Orange counties of North Carolina. The Triangle Regional Transit Program (TRTP) is a collaborative framework for developing an efficient and sustainable regional transportation system that addresses the Triangle's critical need for improved connectivity and mobility choices while promoting its economic prosperity, job growth, and an enhanced quality of life. While previous transportation plans for the region have recommended the introduction of fixed-guideway transit, this study is significant due to the passage of HB 148 by the North Carolina General Assembly, which authorizes Durham, Orange, and Wake counties to hold referenda that, if passed, would allow each county to levy a ½ percent sales tax increase to fund improvements in public transportation.

The studies being conducted over the next year will recommend which transit corridors should initially be built. Planning work being undertaken includes two phases:

- Phase 1: A system-level Transitional Analysis, which is the subject of this report, will define and prioritize up to three transit corridors from the adopted 2035 Joint Long Range Transportation Plan (LRTP) to be studied in further detail in the Phase 2 Alternatives Analysis process. Given the geography of the region, including three counties and two Metropolitan Planning Organizations (MPOs), it is anticipated that one corridor within each of the MPO areas will be carried forward into the Alternatives Analysis process. A third commuter rail corridor spanning the region is possible as an early implementation project, with potential collaboration with the North Carolina Railroad and NCDOT.
- Phase 2: Triangle Transit will conduct Alternatives Analysis studies for up to three priority corridors to evaluate and screen alternative alignments, modes and station locations within each corridor. The Alternatives Analysis process will conclude with the selection and MPO adoption of a Locally Preferred Alternative for each of the priority corridors. The Alternatives Analysis process is a requirement of the Federal Transit Administration (FTA) for a fixed-guideway project to be eligible for federal funds.

It is unlikely that all fixed-guideway transit corridors in the LRTP can be implemented in the near-term, even with a sales tax increase. It is expected that corridors not included in the Phase 2 Alternatives Analysis studies would be implemented in later phases. Fixed-guideway transit projects would also be complemented by improvements and expansion to regional and local bus services so that all communities in the region have improved transit access. Improvements to bus service could begin soon after the referendum if voters approve a ½ percent sales tax increase.

The primary purpose of the Transitional Analysis is to define the corridor(s) for inclusion in the Alternatives Analysis studies. The Transitional Analysis acts as the bridge between the system plan in the LRTP and the more focused and detailed study performed in an Alternatives Analysis.

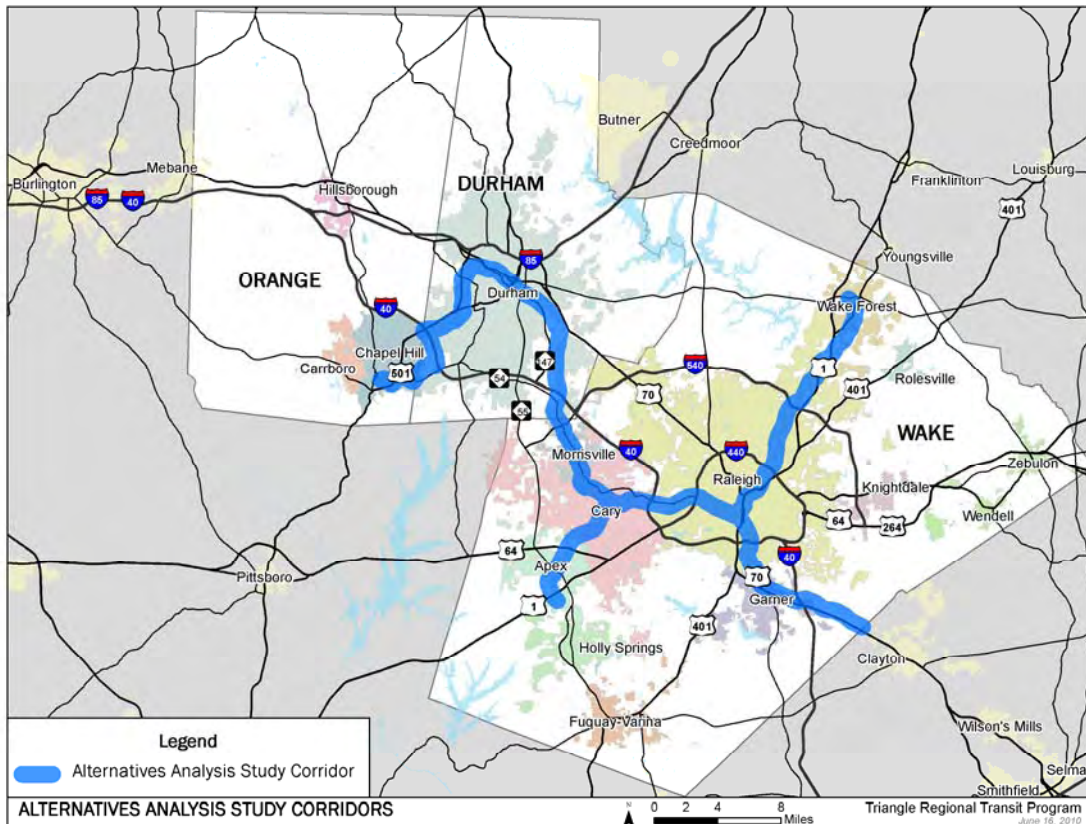


For the Transitional Analysis, the system plan has been broken down into a set of smaller corridors that have been evaluated in order to recommend a limited number of priority corridors to move forward into the Alternatives Analysis process. This Transitional Analysis applies a set of evaluation criteria and measures to each corridor for evaluation and prioritization of the corridors. For the purposes of this analysis, a corridor consists of a relatively wide band up to one mile wide with major activity centers identified. Examples of activity centers include the Northeast Regional Center (NERC), Downtown Raleigh, NC State Fairgrounds, Cary, Research Triangle Park (RTP), Downtown Durham, and Gateway East. In the detailed Alternatives Analysis, the exact number and locations of stations will be identified, as well as the exact alignment of the planned service, the termini, and the type of vehicles.

CORRIDORS

Using the 2035 Joint LRTP for both the CAMPO and the DCHC-MPO (see Figure ES.1), as well as input from Triangle Transit, both MPO's, and other stakeholders, 12 corridors were identified in Wake County and 6 were identified in Durham and Orange counties.

Figure ES.1 Transitional Analysis Study Corridors



The study corridors were presented to the CAMPO, the DCHC-MPO and to elected officials. The identification of corridors was also widely communicated to various cities, towns, counties, and organizations. The Wake County Technical Committee, the Durham-Orange County Technical Committee, and the Public Involvement Steering Committee, which were established



for this project, were also presented with the corridors. All known stakeholders attended one of these presentations. Comments received from stakeholders have been considered and incorporated into this Transitional Analysis.

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. Where applicable, the evaluation year is noted in parentheses.

Mobility

- Number of daily total trips in corridor (2035) (normalized as daily total trips/mile)
- Number of daily transit trips in corridor (2035) (normalized as daily transit trips/mile)
- 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

- Public sector/regulatory support - Existing comprehensive plans consistent with the concepts of compact, mixed-used development near public transportation, or transit-oriented development (TOD); allowable densities and flexibility of zoning districts
- Activity centers served (employment, retail, institutions, mixed use, special attractions)
- Development potential – future TOD potential considering potential household and employment density and future growth

Financial

- Total capital cost (2010 dollars)
- Capital cost per mile (2010 dollars)
- Capital cost per weekday transit trip (2010 dollars, 2035 ridership)
- Capital cost per weekday transit passenger mile traveled (2010 dollars, 2035 PMT)
- Total Operating and Maintenance (O&M) cost (2010 dollars)
- O&M cost per weekday transit trip (2010 dollars, 2035 ridership)
- Annual O&M cost per weekday transit passenger mile traveled (2010 dollars, 2035 PMT)



Public Input

Citizens and project stakeholders will be provided an opportunity to review and comment on the evaluation criteria and the draft results of the corridor analysis. This information will be presented at a series of six public workshops that will be held between September 14 and September 23, 2010.

RESULTS

Each of the corridors was evaluated based on the above criteria. This section presents the results of this evaluation for the Wake County corridors and for the corridors in Durham and Orange counties. As stated in Chapter 5, all of the criteria that were evaluated in this study were developed by the consulting team in partnership with Triangle Transit, DCHC-MPO, and CAMPO. All criteria may be useful or informative regarding any given corridor, and as such all results of the analysis have been included in Chapter 6 of this document. However, some criteria do not meaningfully distinguish between separate corridors, and are not included in the summary performance of each corridor. Tables ES.1 and ES.2 summarize the evaluation criteria that were most helpful in distinguishing between corridors.

Wake County

Twelve corridors in Wake County were evaluated and the results can be seen in Table ES.1. A summary of the findings is also presented.

Conclusions

Results of the analysis indicate that Wake Alternatives 9 (from Downtown Cary to the Northeast Regional Center) and 10 (from the State Fairgrounds to the Northeast Regional Center) are the overall highest performers. A summary of the evaluation follows:

- Wake Alternatives 9 and 10 have the highest daily rail trip estimates on a per mile basis, with 394 and 402 rail trips per mile respectively. The comparatively stronger ridership is a reflection of the large concentrations of people living within the vicinity of the corridors and the number of dense employment nodes – including downtown Raleigh, NERC, and Cary – that are served by both corridors.
- The corridor alternatives serving the segment from downtown Raleigh to the NERC have the highest levels of future household and employment densities. These include Wake 8 (Northwest Cary to NERC), Wake 9 (Downtown Cary to NERC), Wake 10 (State Fairgrounds to NERC), and Wake 11 (Downtown Raleigh to NERC).
- The jurisdictions in the region have adopted strong policies supportive of transit-oriented development in the planned transit corridors. This is a direct result of the ongoing comprehensive planning process that incorporates the LRTP into the comprehensive plans for the cities, towns, and counties in the region. The analysis of the land use plans and policies and Zoning by Right illustrate that the potential for higher densities of population, households, and employment is relatively strong in all of the proposed corridor alternatives. It then becomes the issue of identifying the best performing corridors. In an effort to summarize the economic and demographic factors, a Relative Future Density/Growth (RDFG) Factor was formulated and normalized on a per mile



basis. In this analysis, the Wake Alternatives 8 through 11 have the highest factors and Wake 11 performs the best. Wake 7 (TMC to NERC) and the regional corridor, Wake 12 (Duke Medical to Downtown Raleigh), also perform well but have factors just under Wake 8.

- From a cost perspective, Wake Alternatives 9 and 10 are relatively expensive to build when compared to other corridors on a cost per mile basis. Wake Alternatives 9 and 10 would cost \$65M per mile and \$67M per mile respectively. The higher cost, as compared with other corridors, can be attributed to more expensive infrastructure needs related to limited right-of-way and required infrastructure improvements, particularly in the vicinity of downtown Raleigh. On a per mile basis, longer corridors can spread out the costs associated with these infrastructure upgrades. Unlike other corridors however, Wake Alternative 9, which is 16 miles and Wake Alternative 10, which is 12 miles, are not long enough to spread out the costs of the infrastructure improvements required in the vicinity of downtown Raleigh.
- Although they are higher on a capital cost per mile basis than other corridors, Wake Alternatives 9 and 10 perform relatively well in terms of cost effectiveness due to their strong ridership. The capital cost per transit trip for Wake Alternative 9 is approximately \$54 per trip and the capital cost per transit trip for Wake Alternative 10 is approximately \$55 per trip.

While Wake Alternatives 9 and 10 are the overall strongest performers among the Wake corridors, Wake Alternative 8, which extends the transit line an additional two miles from downtown Cary to NW Cary, is not significantly far behind in performance. A terminal station in downtown Cary could be problematic due to limited property available for locating an end-of-line park and ride. A relatively short extension to NW Cary, therefore, may improve the feasibility of this corridor by providing more opportunities to locate a park and ride and related transit infrastructure and potentially increasing ridership. Given that this is a high-level screening process and that Wake Alternatives 8 and 11 are not significantly lower performing than Wake Alternatives 9 and 10, consideration should be given to performing the detailed analysis on Wake Alternative 8 which incorporates all of the alignments coincident to Wake Alternatives 9, 10, and 11.

The detailed Alternatives Analysis can fine tune this larger corridor in looking at the most optimal, best-fit initial starter line that may involve cutting back on the alignments at both ends to arrive at the most effective corridor for New Starts funding. This is in recognition of Federal funding capacity and that most starter lines initially constructed are in the 10-12 mile range. Extensions from the initial line would start the full build-out process consistent with funding availability.

Table ES.1 Evaluation Criteria Summary (Wake County)

Study Corridor	Corridor Length (mi) / Total Cost M\$ (2010)	Mobility		Socioeconomic				Land Use		Financial			
		Total In Corridor Trips per Mile (2035)	Rail Trips/Mile (2035)	Population Density (2035)	Employment Density (2035)	Low Income Population Density (2000)	Minority Population Density (2000)	Supports Transit Oriented Development, Zoning by Right	Relative Future Density / Growth Factor	Capital Cost (2010)	Capital Cost per Mile (2010 Dollars, 2035 Ridership)	Capital Cost per Weekday Transit Trip (2010 Dollars, 2035 Ridership)	Operating & Maintenance Cost/ Weekday Transit Trip (2010 Dollars, 2035 Ridership)
Wake Alternative 1 (UNC Hospitals to Wake Forest)	59/\$3,500	⊖	⊖	○	○	⊖	⊖	⊖	○	○	●	●	●
Wake Alternative 2 (Triangle Metro Center to Wake Forest)	33/\$1,900	⊖	○	⊖	○	○	○	⊖	⊖	⊖	●	⊖	⊖
Wake Alternative 3 (Veridea to Wake Forest)	33/\$2,000	⊖	○	⊖	○	○	○	⊖	⊖	○	●	⊖	⊖
Wake Alternative 4 (Downtown Cary to Wake Forest)	25/\$1,500	⊖	○	⊖	⊖	○	○	⊖	⊖	⊖	●	⊖	⊖
Wake Alternative 5 (State Fairgrounds to Wake Forest)	20/\$1,200	⊖	○	⊖	⊖	○	○	⊖	⊖	⊖	●	○	○
Wake Alternative 6 (Downtown Raleigh to Wake Forest)	17/\$1,000	⊖	○	⊖	⊖	○	○	⊖	⊖	●	⊖	○	○
Wake Alternative 7 (Triangle Metro Center to NERC)	24/\$1,500	⊖	●	⊖	⊖	○	○	⊖	⊖	⊖	●	●	●
Wake Alternative 8 (Northwest Cary to NERC)	18/\$1,100	●	●	●	●	⊖	⊖	●	●	⊖	⊖	●	⊖
Wake Alternative 9 (Downtown Cary to NERC)	16/\$1,000	●	●	●	●	⊖	⊖	●	●	●	⊖	●	●
Wake Alternative 10 (State Fairgrounds to NERC)	11/\$780	●	●	●	●	⊖	⊖	●	●	●	○	●	⊖
Wake Alternative 11 (Downtown Raleigh to NERC)	8/\$580	●	⊖	●	●	⊖	⊖	●	●	●	○	○	⊖
Wake Alternative 12 (Duke Medical to Downtown Raleigh)	29/\$1,700	⊖	○	⊖	⊖	⊖	⊖	⊖	⊖	⊖	●	⊖	⊖
Summary of Evaluation Criteria and Rankings													
High Performer	= ●	>22,060 Trips/Mile	>363.5 Trips/Mile	> 3.9 Households/Acre	>13.3 Jobs/Acre	>0.61 Persons/Acre	>1.61 Persons/Acre	Considers the # of stations and allowable densities within jurisdiction	>0.9	<1052	<\$62.0 M/Mile	<\$56.9/Trip	<\$9.9/Trip
Average Performer	= ⊖	18,452- 22,060 Trips/Mile	311.3-363.5 Trips/Mile	2.9- 3.9 Households/Acre	10.3- 13.3 Jobs/Acre	0.38- 0.61 Persons/Acre	1.04- 1.61 Persons/Acre		>0.5-0.89	1052-1925	\$62.0 - \$66.3 M/Mile	\$56.9-66.4/Trip	\$9.9-12.1/Trip
Low Performer	= ○	<18,452 Trips/Mile	<311.3 Trips/Mile	<2.9 Households/Acre	<10.3 Jobs/Acre	<0.38 Persons/Acre	<1.04 Persons/Acre		<0.50	>1925	>\$66.3 M/Mile	>\$66.4/Trip	>\$12.1/Trip

Note: The breakpoints for the bins are ±0.5 standard deviations from the mean. Data results are given in greater detail in Chapter 6.



Durham-Orange Counties

Six corridors in Durham and Orange counties were evaluated and the results can be seen in Table ES.2. A summary of the findings follows the table.

Conclusions

Results of the analysis indicate that Durham-Orange Alternatives 4 (from UNC Hospitals to Alston Avenue), 5 (from UNC Hospitals to Gateway) and 6 (from Gateway to Alston Avenue) are the overall highest performers (note that Alternatives 5 and 6 are subsets of Alternative 4). Primary discriminators between the alternatives include mobility, socio-economics and cost-effectiveness, as discussed here:

- Durham-Orange Alternatives 4 and 5 have the highest daily rail trip estimates on a per mile basis, with 394 and 399 rail trips per mile respectively. This primarily reflects the high employment at UNC and UNC Hospitals, Duke University and Duke Medical Center, and downtown Durham. Several significant mixed-use developments also exist or are planned within the corridor.
- Durham-Orange Alternatives 4 and 6, both of which terminate at Alston Avenue, are the most effective at reaching transit-dependent populations.
- The jurisdictions in the region have adopted strong policies supportive of transit-oriented development in the planned transit corridors. This is a direct result of the ongoing comprehensive planning process that incorporates the LRTP into the comprehensive plans for the cities, towns, and counties in the region. The analysis of the land use plans and policies and Zoning by Right illustrate that the potential for higher densities of population, households, and employment is relatively strong in all of the proposed corridor alternatives. It then becomes the issue of identifying the best performing corridors. In an effort to summarize the economic and demographic factors, a Relative Future Density/Growth (RDFG) Factor was formulated and normalized on a per mile basis. In this analysis, DO 6 (Gateway to Alston Avenue) has the highest factor of the Durham-Orange corridors. The regional corridor, DO 2 (Duke Medical to Downtown Raleigh) also performs well, but is just under DO 6 and slightly better than DO 4 (UNC Hospitals to Alston Avenue).
- From a cost perspective, Durham-Orange Alternatives 4 and 5 are relatively more expensive to build compared to other corridors (\$68M per mile and \$66M per mile respectively). This is because these corridors are primarily on new alignment that requires more right-of-way acquisition and infrastructure improvements than alternative corridors that use existing railroad right-of-way (e.g., Durham-Orange Alternatives 1 and 2).
- Although they are higher on a capital cost per mile basis than other corridors, Durham-Orange Alternatives 4 and 5 perform better in terms of cost effectiveness due to their strong ridership. The capital cost per transit trip for Durham-Orange Alternative 4 and 5 is approximately \$55 and \$53 per transit trip, respectively.

Durham-Orange Alternative 4 is the combination of Durham-Orange Alternatives 5 and 6, and hence, advancing this longer corridor allows for the most optimal starter line analysis for submission for Federal funding.



Durham-Orange Alternative 2 (from Duke Medical Center to Downtown Raleigh) was average in terms of socio-economic and strong in land-use factors, but not strong in terms of mobility and costs. Cost-effectiveness would improve if costs could be reduced. The ridership may have been low in part because the ridership model assumed light rail-type service rather than commuter rail-type service, which may be more appropriate for this corridor. For this initial study, costs assumed light rail transit, which is significantly more expensive than commuter rail, which uses primarily existing infrastructure. If connecting the region is a high priority over maximizing the potential for federal funds, then consideration should be given to this alternative. However, if federal funds are achieved with the other, better performing corridors as noted above, then full build out towards Wake Forest and Chapel Hill will occur sooner. If these corridors fail to be competitive for federal funds, then the decision can be revisited on which corridor to advance into preliminary engineering. The opportunity for Federal funding will become evident relatively soon after the New Starts submittal in the fall of 2011.



Table ES.2 Evaluation Criteria Summary (Durham-Orange Counties)

Study Corridor	Corridor Length (mi) / Total Cost M\$ (2010)	Mobility		Socioeconomic				Land Use		Financial			
		Total In Corridor Trips per Mile (2035)	Rail Trips/Mile (2035)	Population Density (2035)	Employment Density (2035)	Low Income Population Density (2000)	Minority Population Density (2000)	Supports Transit Oriented Development, Zoning by Right	Relative Future Density / Growth Factor	Capital Cost (2010)	Capital Cost per Mile (2010 Dollars, 2035 Ridership)	Capital Cost per Weekday Transit Trip (2010 Dollars, 2035 Ridership)	Operating & Maintenance Cost/ Weekday Transit Trip (2010 Dollars, 2035 Ridership)
Durham-Orange Alternative 1 (UNC Hospitals to Wake Forest)	59/\$3,500	⊖	⊖	○	○	⊖	⊖	⊖	○	○	●	●	●
Durham-Orange Alternative 2 (Duke Medical to Downtown Raleigh)	29/\$1,700	⊖	○	⊖	⊖	⊖	⊖	⊖	⊖	⊖	●	⊖	⊖
Durham-Orange Alternative 3 (UNC Hospitals to Triangle Metro Center)	26/\$1,600	○	⊖	○	○	●	●	●	○	⊖	⊖	⊖	⊖
Durham-Orange Alternative 4 (UNC Hospitals to Alston Ave)	17/\$1,200	○	●	○	⊖	●	●	●	⊖	⊖	○	●	●
Durham-Orange Alternative 5 (UNC Hospitals to Gateway)	7/\$470	○	●	○	○	⊖	○	⊖	○	●	⊖	●	⊖
Durham-Orange Alternative 6 (Gateway to Alston Ave)	10/\$750	●	⊖	⊖	●	●	●	⊖	●	●	○	○	○
Summary of Evaluation Criteria and Rankings													
High Performer	= ●	>22,060 Trips/Mile	>363.5 Trips/Mile	> 3.9 Households/Acre	>13.3 Jobs/Acre	>0.61 Persons/Acre	>1.61 Persons/Acre	Considers the # of stations and allowable densities within jurisdiction	>0.9	<1052	<\$62.0 M/Mile	<\$56.9/Trip	<\$9.9/Trip
Average Performer	= ⊖	18,452 - 22,060 Trips/Mile	311.3-363.5 Trips/Mile	2.9 - 3.9 Households/Acre	10.3 - 13.3 Jobs/Acre	0.38 - 0.61 Persons/Acre	1.04 - 1.61 Persons/Acre		>0.5-0.89	1052-1925	\$62.0 - \$66.3 M/Mile	\$56.9-66.4/Trip	\$9.9-12.1/Trip
Low Performer	= ○	<18,452 Trips/Mile	<311.3 Trips/Mile	<2.9 Households/Acre	<10.3 Jobs/Acre	<0.38 Persons/Acre	<1.04 Persons/Acre		<0.50	>1925	>\$66.3 M/Mile	>\$66.4/Trip	>\$12.1/Trip

Note: The breakpoints for the bins are ±0.5 standard deviations from the mean. Data results are given in greater detail in Chapter 6.



Regional Corridor

The current LRTP prepared by both the CAMPO and the DCHC-MPO includes a regional rail system that is comprised of both light rail transit (LRT) and commuter rail service, with the majority of the system being LRT, to be implemented in stages. This systems plan includes the provision of LRT service between Raleigh and Durham and between Durham and Chapel Hill. There is an overlap in the LRT plans and the commuter rail plans from downtown Raleigh to the Northeast Regional Center (in the location of Capital Boulevard and I-540). The purpose of the Transitional Analysis is to select which segments or corridors of the LRT system should be implemented first with the full system to be constructed in future phases. It is not practical or financially feasible to construct the entire LRT system as a single project and only the most effective segments or corridors should be initiated first, particularly if funding is to be requested from the Federal Transit Administration (FTA) under the New Starts program.

The Transitional Analysis examined a total of 16 corridors, including those that connected the two MPO regions and those that were entirely within either the CAMPO region or the DCHC-MPO region. The corridor alternatives were evaluated in the context of all day, frequent service that is typical of a LRT system. By contrast, a commuter rail system provides service only during the AM and PM peak period trips using a lower frequency of service (typically every 30-60 minutes). While LRT must operate on exclusive tracks, commuter rail can, and typically does, operate on tracks shared with freight and other intercity passenger rail service. In the Triangle Region, the term "express rail" has been identified to include the combination of existing AMTRAK passenger rail, existing and expanded NCDOT passenger rail service between Raleigh and Charlotte, and the additional commuter rail service during the peak periods.

The initial findings of the Transitional Analysis indicate that the corridor alternatives that operate in Wake County from Cary through downtown Raleigh and to the Northeast Regional Center (NERC) perform the best in terms of ridership, riders per mile, and cost per rider. This set of corridor alternatives is followed in performance by those that operate from UNC Hospitals to downtown Durham. The corridor alternative that connects Durham to Raleigh, passing through the Research Triangle Park, performed below both of the previous sets of alternatives. While the provision of LRT service between Durham and Raleigh is not the most cost-effective alternative for initial implementation, the early connection of these two major areas in the region can be provided by commuter rail or express rail service that can be implemented with lower costs than either of the LRT projects. Future extensions of the LRT systems in Wake and Durham counties would connect the two areas with LRT as identified in the LRTP. The major investments in commuter rail would not be wasted because the tracks could continue to be used by other freight and intercity passenger rail service (including the potential High Speed Rail service) and the vehicles could be moved to extensions of the commuter rail service to the areas on the edges of the region serving the downtowns of Raleigh and Durham.

For these reasons, an additional special Alternatives Analysis study will be prepared that evaluates commuter rail service versus LRT. The LRT service would connect the ends of the two initial LRT systems in Wake and Durham counties versus commuter rail service that extends from downtown Durham to east of Clayton using the existing NCR alignment. This will allow informed decisions to be made on whether early implementation of commuter rail service is worth the investment. If requested, we could also compare LRT service from Durham to Raleigh against commuter rail service from Durham to Raleigh with the assumption that the Wake County and Durham County LRT systems are not implemented.



Other Considerations

With the analysis of corridor performance, rail transit extensions to the Research Triangle Park, Wake Forest, Apex, and points beyond would not be carried forward for further consideration in the more detailed Alternatives Analysis studies. This does not, however, mean that service to these areas would be eliminated; it simply recognizes that they will be studied in greater detail at a later time. These extensions are truly noteworthy as the system expands, but the purpose of this first set of Alternative Analysis studies is to focus on the most effective corridors for initial transit investment and implementation. This is the formula other cities have used to develop and implement system-wide extensions.

Therefore, for those areas of the region that are not directly considered for initial detailed study in the Alternatives Analysis, additional studies have either been conducted or are recommended as follows:

- Extension of LRT to Garner: Technical memorandum detailing the future extension of the rail transit service from Raleigh to Garner.
- Extensions of commuter rail to Wake Forest and Apex: Technical memoranda analyzing implementation of commuter rail service to Wake Forest and Apex. (This has been suggested by CAMPO as a viable alternative). Considerations could include the following: termini, freight track alignments, operations, and cost.
- Extension of commuter rail service to Hillsborough and Zebulon: There have been requests to include extensions to both Hillsborough and to Zebulon in the study. The purpose of the Transitional Analysis is to determine the priority corridors for early implementation, but not preclude future extensions. White papers further discussing these two extensions are included as Appendix A and B.
- Extension to Carrboro: Project stakeholders from the municipality of Carrboro, Orange County and the DCHC-MPO, as well as citizens from Carrboro have indicated an interest in studying a rail transit connection to Carrboro. Per stakeholder comments, a draft white paper technical study providing an overview of the strategic issues that need addressing to extend rail transit to Carrboro was prepared and is presented in Appendix C.

When completed, the memoranda will be included as Appendices to this Transitional Analysis before it is finalized. These memoranda, along with the results of the Alternatives Analysis process can be used by both the CAMPO and the DCHC-MPO as input to the updates of their respective long range transportation plans.

NEXT STEPS

On September 29, 2010 there will be a special joint meeting of the Durham-Chapel Hill-Carrboro MPO and the Capital Area MPO to review and comment on the corridors for study in the Alternatives Analysis.



CHAPTER 1 INTRODUCTION

Triangle Transit has commissioned a major study to initiate fixed-guideway transit service within Wake, Durham, and Orange counties. The Triangle Regional Transit Program (TRTP) is a collaborative framework for developing an efficient and sustainable regional transportation system that addresses the Triangle's critical need for improved connectivity and mobility choices while promoting its economic prosperity, job growth, and an enhanced quality of life. While previous transportation plans for the region have recommended the introduction of fixed-guideway transit, this study is significant due to the passage of HB 148 by the North Carolina General Assembly, which authorizes Durham, Orange, and Wake counties to hold referendums that, if passed, would allow each county to levy a ½ percent sales tax increase to fund improvements in public transportation.

1.1 STUDY PROCESS

The studies being conducted over the next year will recommend which transit corridors should initially be built. Planning work being undertaken includes two phases:

Phase 1: A system-level Transitional Analysis, which is the subject of this report, will define and prioritize up to three transit corridors from the adopted 2035 Joint Long Range Transportation Plan (LRTP) to be studied in further detail in the Phase 2 Alternatives Analysis process. Given the geography of the region, including three counties and two Metropolitan Planning Organizations (MPOs), it is anticipated that one corridor within each of the MPO areas will be carried forward into the Alternatives Analysis process. A third commuter rail corridor spanning the region is possible as an early implementation project, with potential collaboration with the North Carolina Railroad and NCDOT.

Phase 2: Triangle Transit will conduct Alternatives Analysis studies for up to three priority corridors to evaluate and screen alternative alignments, modes and station locations within each corridor. The Alternatives Analysis process will conclude with the selection and MPO adoption of a Locally Preferred Alternative for each of the priority corridors. The Alternatives Analysis process is a requirement of the Federal Transit Administration (FTA) for a fixed-guideway project to be eligible for federal funds.

It is unlikely that all fixed-guideway transit corridors in the LRTP can be implemented in the near-term, even with a sales tax increase. It is expected that corridors not included in the Phase 2 Alternatives Analysis studies would be implemented in later phases. Fixed-guideway transit projects would also be complemented by improvements and expansion to regional and local bus services so that all communities in the region have improved transit access. Improvements to bus service could begin soon after the referendum if voters approve a ½ percent sales tax increase.

1.2 PUBLIC AND STAKEHOLDER INVOLVEMENT

Triangle Transit has developed a comprehensive Public Involvement Plan (PIP) for the project development process. The PIP details how the public and stakeholders will be involved in project development, including:



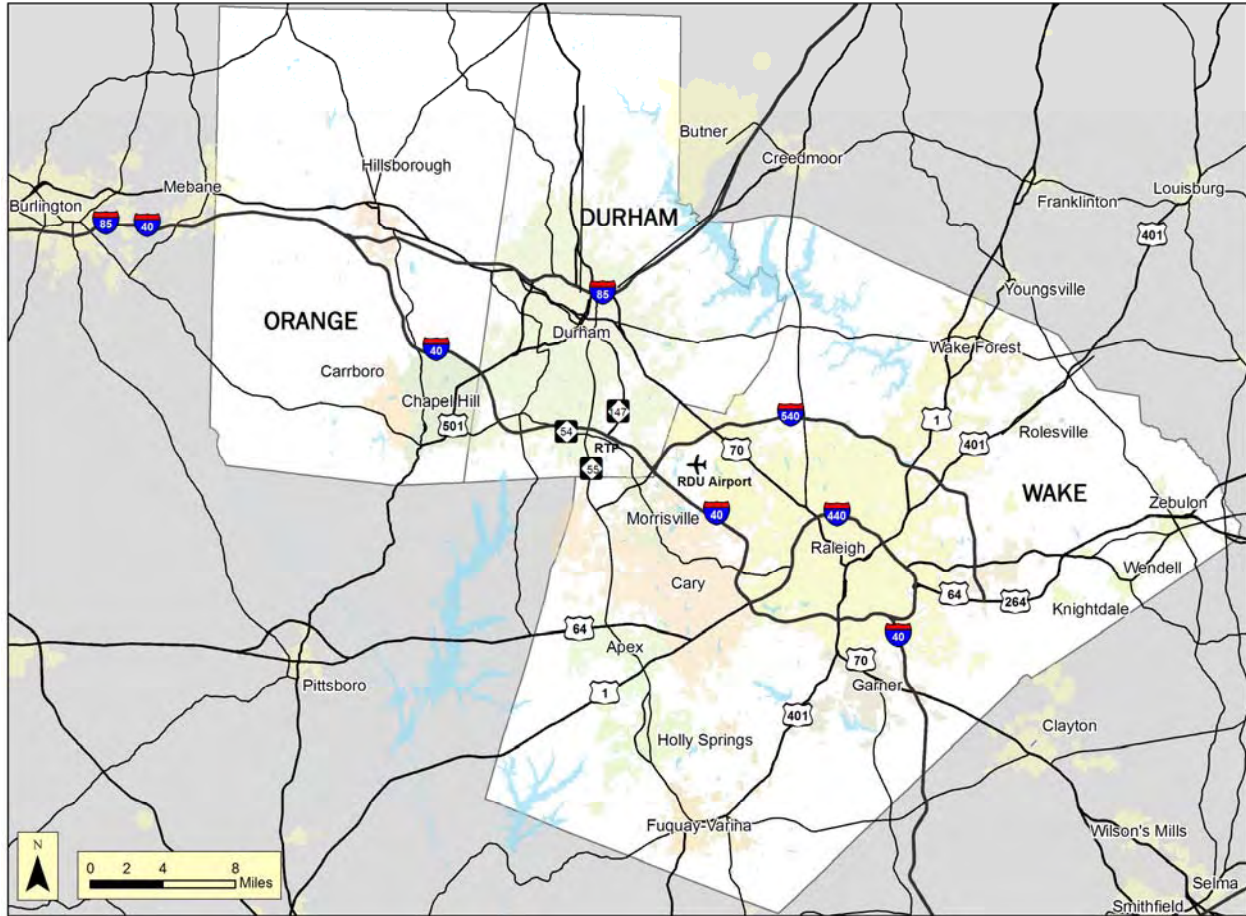
- **Public Workshops** - Three series of public workshops are planned throughout the project's duration in localities throughout the region (six workshops will be held in each of the workshop series). The first set of workshops was held at the end of June and beginning of July 2010, the second was in September 2010, and the third set of workshops is planned for February 2011.
- **Technical and Steering Committees** – A Public Involvement Steering Committee comprised of representatives from the MPOs, Durham, Orange, and Wake counties, and the municipalities of Raleigh, Durham, Chapel Hill, and Cary was formed to guide the public involvement process. The Steering Committee also includes representatives from RDU International Airport, Research Triangle Foundation (RTP), transit agencies, and transit supportive interest groups. Three technical committees, Durham-Orange, Wake, and Raleigh Wye, were formed to inform and receive input on design issues in the respective areas of interest. The technical committees are comprised of representatives from MPOs, the NC Department of Transportation, county and municipal agencies, and universities.
- **MPO Coordination** - The Technical Advisory Committees (TAC) and the Technical Coordinating Committees (TCC) of each of the two MPOs are functioning as the technical and policy committees for the project. These committees will be consulted on a regular basis to provide feedback and input on project development.
- **Elected Officials Coordination** - A group comprised of the mayors of the region's four largest cities, County Commissioners of the region's three counties, representatives of the region's two MPOs, and the chair of the Triangle Transit Board of Trustees meet on a regular basis to consult, collect information, provide feedback, and input on project development.
- **Other Outreach** - The public will have many ways to gather information and provide input on the project outside of the public workshops, including through the project website (www.ourtransitfuture.com), a call-in number (800-816-7817), an e-mail inbox dedicated to the project (info@ourtransitfuture.com), and a mailing address (PO Box 530, Morrisville, NC 27560).

1.3 BACKGROUND

The Triangle Region is unique and complex, with a polycentric urban pattern that includes several sizeable downtowns, four major universities, three major medical centers, and many satellite communities, with travel and economic patterns that link them to the region's core counties of Durham, Orange and Wake (see Figure 1.1). Raleigh-Durham International Airport (RDU) and the Research Triangle Park (RTP) draw traffic to the center of the region.



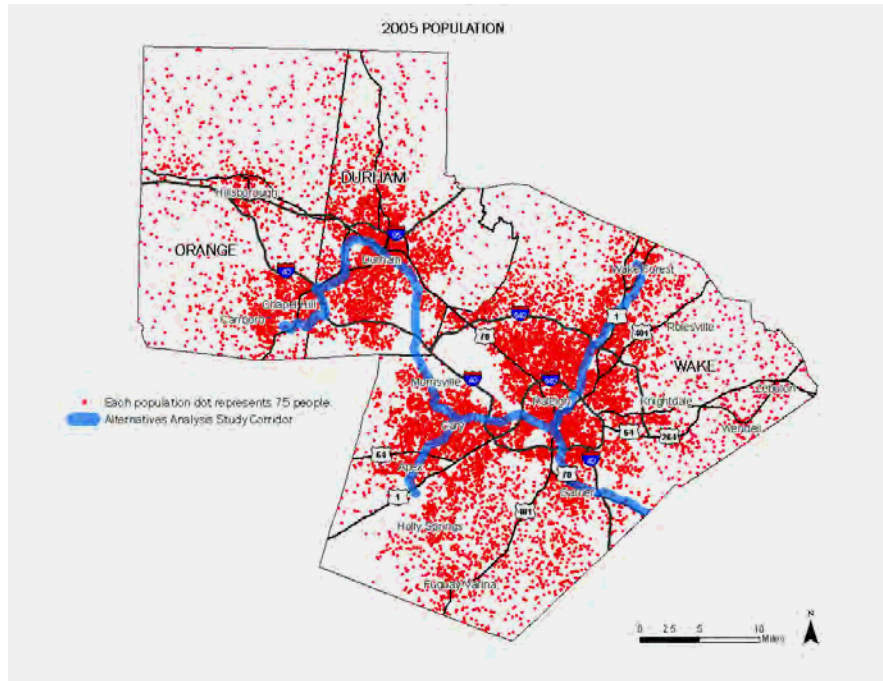
Figure 1.1 The Triangle Region



The Triangle Region has experienced tremendous growth over the last few decades. The region is now home to 1.5 million people, and the population is expected to increase to 2.5 million people by 2035, as illustrated in Figures 1.2 and 1.3. While this growth has yielded many benefits to residents and visitors, it has also strained the region's transportation system. High levels of congestion are now common-place and are anticipated to worsen with time. Significantly increasing highway capacity, in order to accommodate the surge in travel demand, is not sustainable and is no longer an option for environmental, financial, and community reasons. Many elected officials and the general public have come to recognize that a multi-modal transportation system, including improved transit service, is needed if the Triangle is to continue to attract quality jobs and maintain the high quality of life it now enjoys.

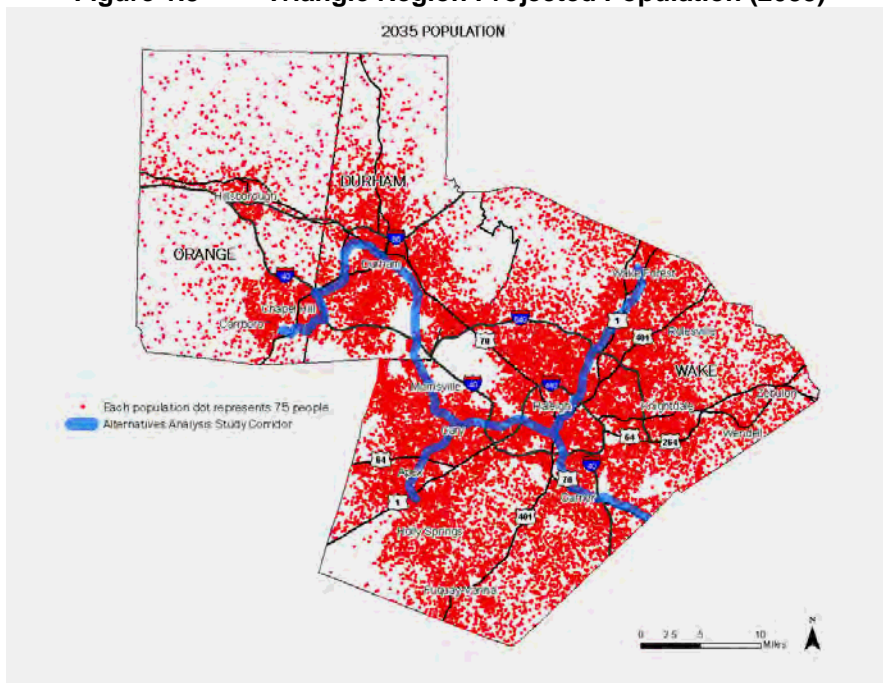


Figure 1.2 Triangle Region 2005 Population



Source: Triangle Region Travel Demand Model

Figure 1.3 Triangle Region Projected Population (2035)



Source: Triangle Region Travel Demand Model



CHAPTER 2 RELATIONSHIP TO PREVIOUS PLANS AND INITIATIVES

Planning for fixed-guideway transit in the Triangle Region began twenty years ago and a number of transit studies have been conducted to advance major transit investments in the area. The Phase 1 Transitional Analysis and Phase 2 Alternatives Analysis studies build on these previous plans and initiatives, as described below.

2.1 REGIONAL RAIL PROJECT

The most advanced planning to date was the Regional Rail Project. In 1998, the FTA authorized Preliminary Engineering (PE) and preparation of an Environmental Impact Statement (EIS) for the Regional Rail Project.

The Regional Rail Project planned for the Triangle Region included 35 miles of separate double track and 16 stations, extending from Duke Medical Center through Durham, Morrisville, Cary, Raleigh and terminating at Spring Forest Road in north Raleigh. The proposed vehicle was an FRA compliant Diesel Multiple Unit (DMU) technology operating in existing freight corridors [North Carolina Railroad (NCR) and CSX]. The Final EIS and Preliminary Engineering were concluded in 2003, with the FTA issuing the environmental Record of Decision (ROD), and subsequently authorizing Triangle Transit to enter the Final Design phase in February 2003.

Midway through the Final Design phase, construction cost estimates dramatically increased and ridership modeling did not reach a level of maturity that would meet the FTA criteria for funding. As a result, the project was scaled back to a 28 mile, 12 station alignment in an attempt to maintain the desired cost-effectiveness for the project. The revised alignment did not include the segment between Duke Medical Center and 9th Street in Durham and the segment north of the Government Center in downtown Raleigh. After numerous attempts to right-size the project, it became apparent that the project would not qualify for a federal Full Funding Grant Agreement (FFGA), and there was not sufficient local funding available to support the project.

Based on the inability to meet FTA's revised project cost-effectiveness and issues with the overall financial plan, Triangle Transit withdrew the Regional Rail Project from the FTA New Starts program in August 2006.

2.2 REGIONAL TRANSIT VISION PLAN

In early 2007, in anticipation of the preparation of the Triangle Region's LRTP, a Special Transit Advisory Commission (STAC) was convened to make recommendations on the future of regional transit in the Triangle. This was a cooperative regional effort of a broad-based citizen group with representatives from throughout the region. In addition to providing the basis for the plan ultimately adopted by the region's two MPOs, the group also considered additional corridors within and beyond the Triangle (including extending service to Raleigh Durham International Airport, commuter rail to Hillsborough and farther west, Fayetteville to the south, and other locations). The conclusion was that these corridors are not immediate priorities for the region as they have poor ridership potential, are dependent on a core system, and are not affordable in the near term in absence of such a core system.

The STAC evaluated updated planning data in a series of 16 meetings over 13 months. Their recommendations to the MPOs included enhanced bus service, local circulators, and 53 miles of fixed-guideway projects. The STAC also recommended that the region pursue a ½ percent

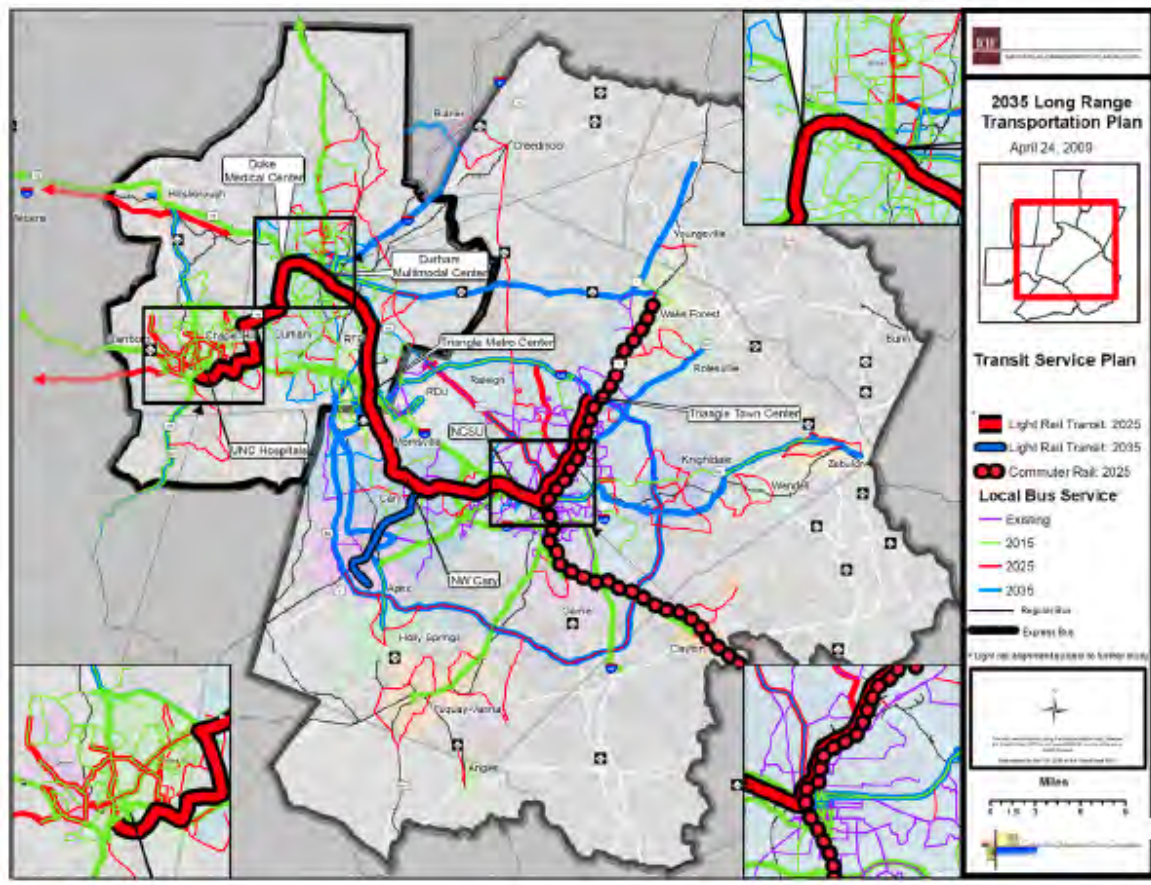


sales tax local funding option in order to advance the implementation of these major transit capital investments. The STAC reported their findings in the Regional Transit Vision Plan, published in May 2008. This became the baseline for the transit element of the MPO's Joint 2035 LRTP.

2.3 JOINT LONG RANGE TRANSPORTATION PLAN

The current transit plan is one element of the LRTP prepared by the region's two MPOs. This joint LRTP was adopted by the Durham-Chapel Hill-Carrboro MPO, representing Durham and Orange counties, on May 13, 2009, and by the Capital Area MPO, representing Wake County, on May 20, 2009. The MPOs' plan has identified a phased implementation of the adopted plan through 2035, but this implementation is not based on detailed analysis or funding availability. Fixed-guideway and bus transit service from the 2035 LRTP is shown below in Figure 2.1.

Figure 2.1 2035 Joint LRTP Transit Service Plan



2.4 NC HOUSE BILL 148

In August of 2009, the NC Legislature passed House Bill 148 that established the Congestion Relief and Intermodal 21st Century Transportation Fund, enabling the five counties in North Carolina with the highest rate of population growth (including the Triangle) to hold referenda for a local ½ 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 without a referendum.



CHAPTER 3 TRANSITIONAL ANALYSIS PROCESS

The primary purpose of the Transitional Analysis is to define the corridor(s) for inclusion in the Alternatives Analysis studies. The starting point for defining corridors is the adopted LRTPs of the region's two 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. The Transitional Analysis acts as the bridge between the system plan in the LRTP and the more focused and detailed study performed in an Alternatives Analysis.

The current LRTP for each MPO contains a rail system plan (shown in Figure 2.1 with planned bus service) that extends from Wake Forest to downtown Raleigh, Cary, the RTP, downtown Durham, Duke Medical Center, Gateway East (Orange/Durham County line), Leigh Village, and the UNC Hospitals. Additional corridors extend from downtown Raleigh to Clayton and from Cary through Apex to the proposed Veridea development located south of US 1 and west of NC 55.

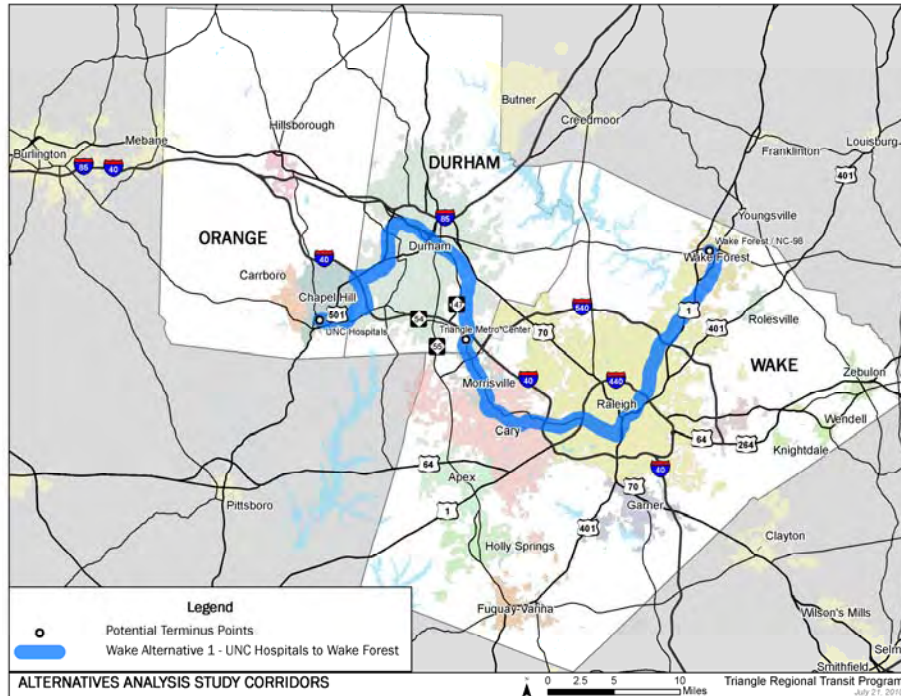
For the Transitional Analysis, the system plan has been broken down into a set of smaller corridors that have been evaluated in order to recommend a limited number of priority corridors to move forward into the Alternatives Analysis process. This Transitional Analysis applies a set of evaluation criteria and measures to each corridor for evaluation and prioritization of the corridors. For the purposes of this analysis, a corridor consists of a relatively wide band up to one mile wide with major activity centers identified. Examples of activity centers include the Northeast Regional Center (NERC), downtown Raleigh, NC State Fairgrounds, Cary, Research Triangle Park (RTP), downtown Durham, and Gateway East. In the detailed Alternatives Analysis, the exact number and locations of stations will be identified, as well as the exact alignment of the planned service, the termini, and the type of vehicles.



4.1 WAKE CORRIDOR ALTERNATIVES

4.1.1 WAKE ALTERNATIVE 1 – UNC HOSPITALS TO WAKE FOREST

Figure 4.2 Wake Alternative 1 – UNC Hospitals to Wake Forest



This 59 mile corridor extends from UNC Hospitals in Chapel Hill north to Durham, then south through the Research Triangle Park to Morrisville, Cary, and Raleigh before turning north to Wake Forest. This corridor would serve the region's four largest cities, the Research Triangle Park, and the region's major research universities. This corridor assumes the construction of rail transit in Durham and Orange counties, from UNC Hospitals to the Triangle Metro Center (TMC), and is used as a baseline comparison to the other Wake alternatives.

Activity Centers

- Urban and Town Centers: Downtowns of Chapel Hill, Durham, Cary, Raleigh, and Wake Forest
- Colleges and Universities: UNC, Duke University, NC Central University, Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: UNC Hospitals, the NC 54 Corridor (including Glenn Lennox, East 54, UNC's Friday Center, Meadowmont, and Leigh Village), Development around I-40 and US 15-501 (including Gateway East, Patterson Place, and South Square), Duke Hospitals, Research Triangle Park, State Fairgrounds Complex, State Government Offices, and the Northeast Regional Center

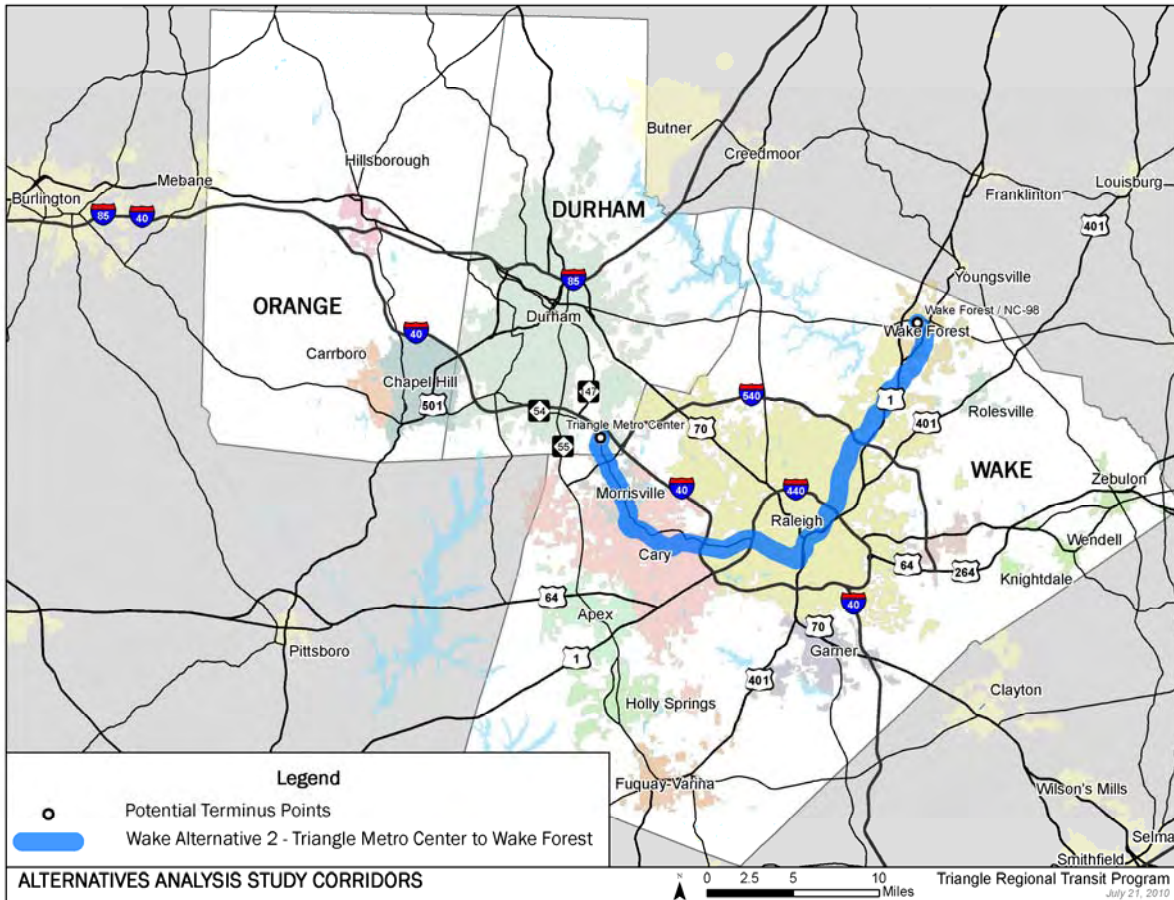
Bus Transit Integration

- Corridor served by CAT, Wolfline, C-Tran, DATA, Chapel Hill Transit, and Triangle Transit



4.1.2 WAKE ALTERNATIVE 2 – TRIANGLE METRO CENTER TO WAKE FOREST

Figure 4.3 Wake Alternative 2 – Triangle Metro Center to Wake Forest



This 33 mile corridor extends from the Triangle Metro Center adjacent to I-40 and Miami Blvd south to Cary before heading east to downtown Raleigh, then turning north and traveling through North Raleigh to downtown Wake Forest. This corridor assumes a complete build-out of rail transit from the Research Triangle Park to Wake Forest. This alternative does not include or assume a rail connection to Durham.

Activity Centers

- Urban and Town Centers: Downtowns of Cary, Raleigh, and Wake Forest
- Colleges and Universities: Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: Research Triangle Park, State Fairgrounds Complex, State Government Offices, and the Northeast Regional Center

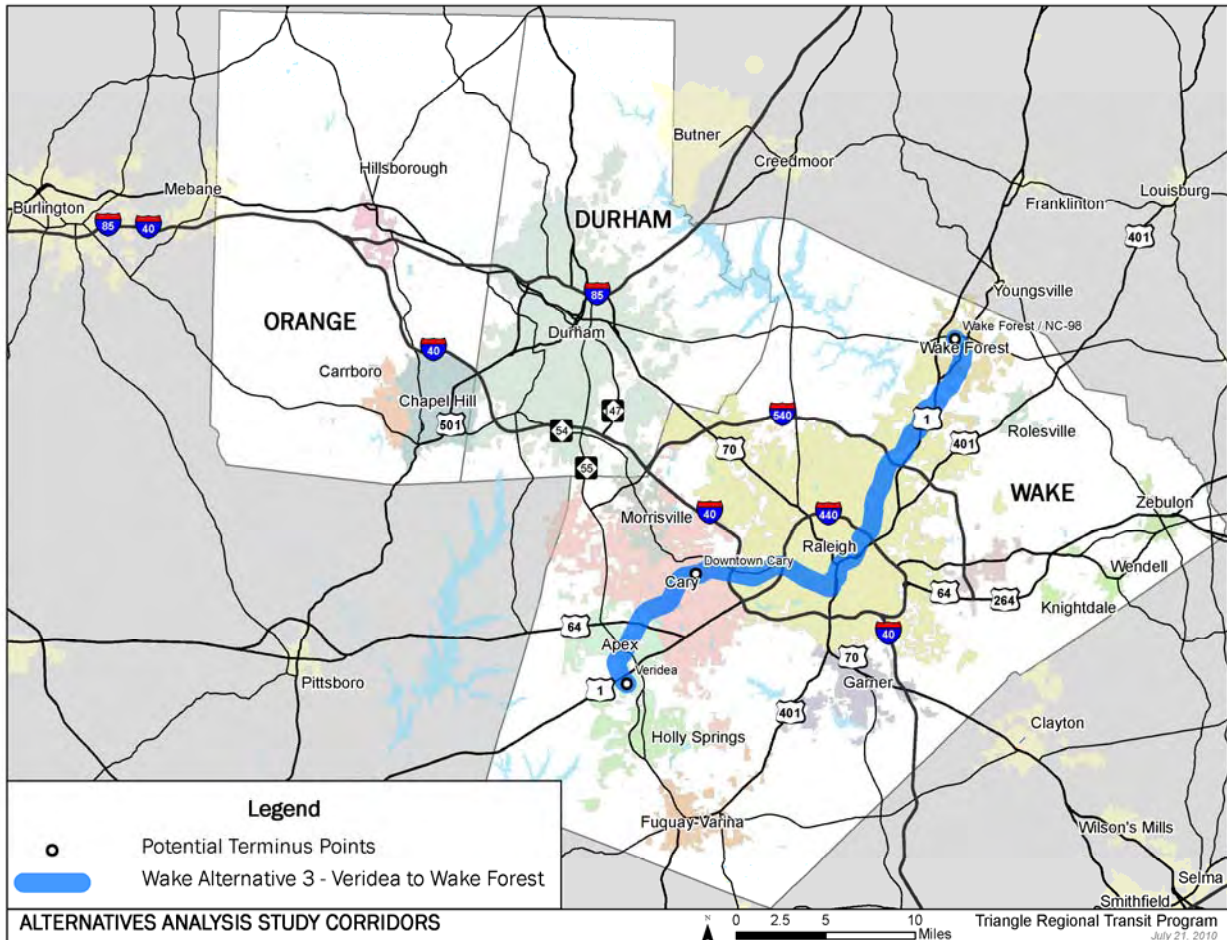
Bus Transit Integration

- Corridor served by CAT, Wolfline, C-Tran, and Triangle Transit



4.1.3 WAKE ALTERNATIVE 3 – VERIDEA TO WAKE FOREST

Figure 4.4 Wake Alternative 3 – Veridea to Wake Forest



This 33 mile corridor serves Apex, Cary, Raleigh, and Wake Forest. This corridor extends from Veridea (a proposed mixed-use development south of central Apex) to Apex, Cary, Raleigh, and Wake Forest.

Activity Centers

- Urban and Town Centers: Downtowns of Apex, Cary, Raleigh, and Wake Forest
- Colleges and Universities: Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: The State Fairgrounds Complex, State Government Offices, and the Northeast Regional Center

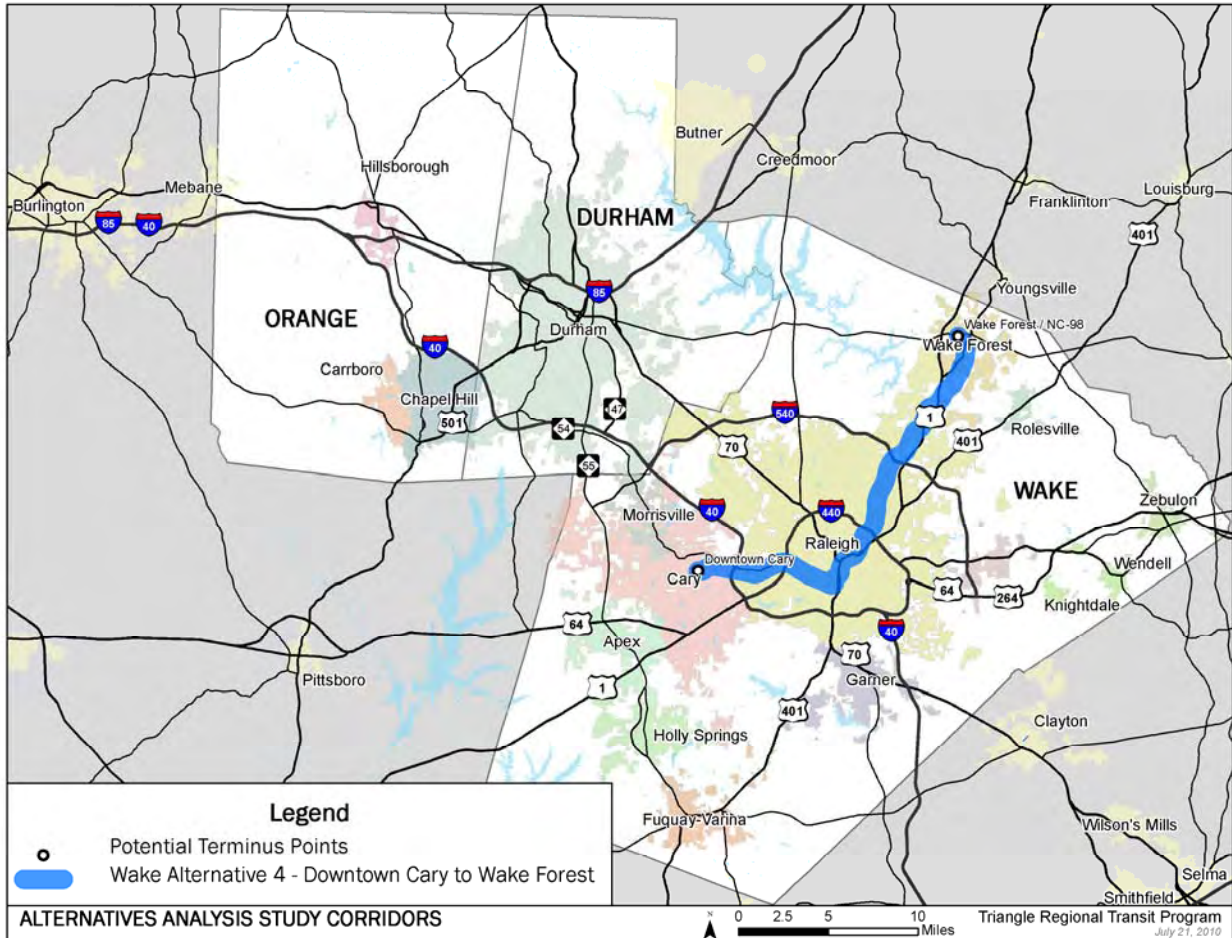
Bus Transit Integration

- Corridor served by CAT, Wolfline, C-Tran, and Triangle Transit



4.1.4 WAKE ALTERNATIVE 4 – DOWNTOWN CARY TO WAKE FOREST

Figure 4.5 Wake Alternative 4 – Downtown Cary to Wake Forest



This 25 mile corridor extends east from downtown Cary to downtown Raleigh before heading north through the Northeast Regional Center to Wake Forest.

Activity Centers

- Urban and Town Centers: Downtowns of Cary, Raleigh, and Wake Forest
- Colleges and Universities: Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: The State Fairgrounds Complex, State Government Offices, and the Northeast Regional Center

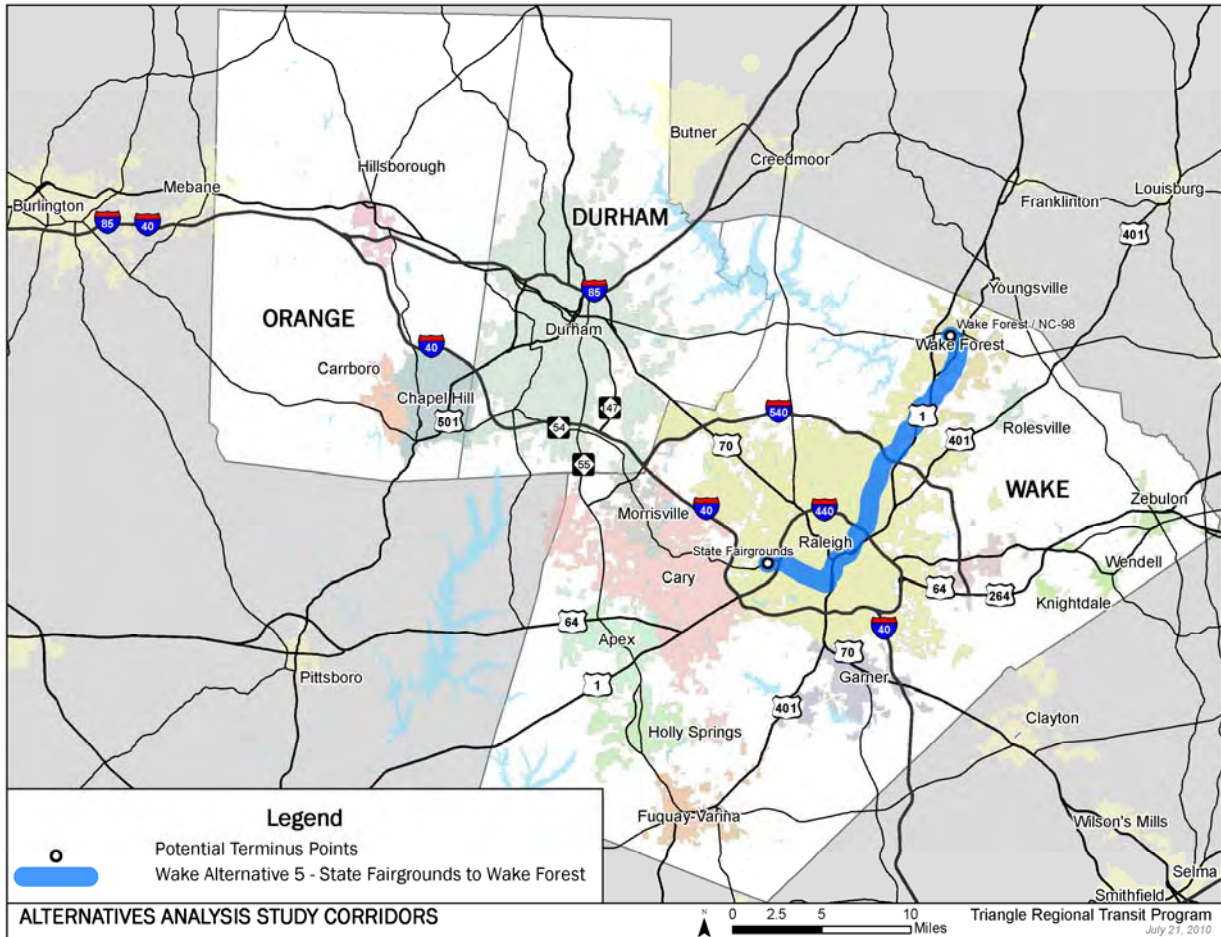
Bus Transit Integration

- Corridor served by CAT, Wolfline, C-Tran, and Triangle Transit



4.1.5 WAKE ALTERNATIVE 5 – STATE FAIRGROUNDS TO WAKE FOREST

Figure 4.6 Wake Alternative 5 – State Fairgrounds to Wake Forest



This 20 mile corridor extends from the State Fairgrounds in West Raleigh through downtown Raleigh, then north to Wake Forest.

Activity Centers

- Urban and Town Centers: Downtowns of Raleigh and Wake Forest
- Colleges and Universities: Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: The State Fairgrounds Complex, State Government Offices, and the Northeast Regional Center

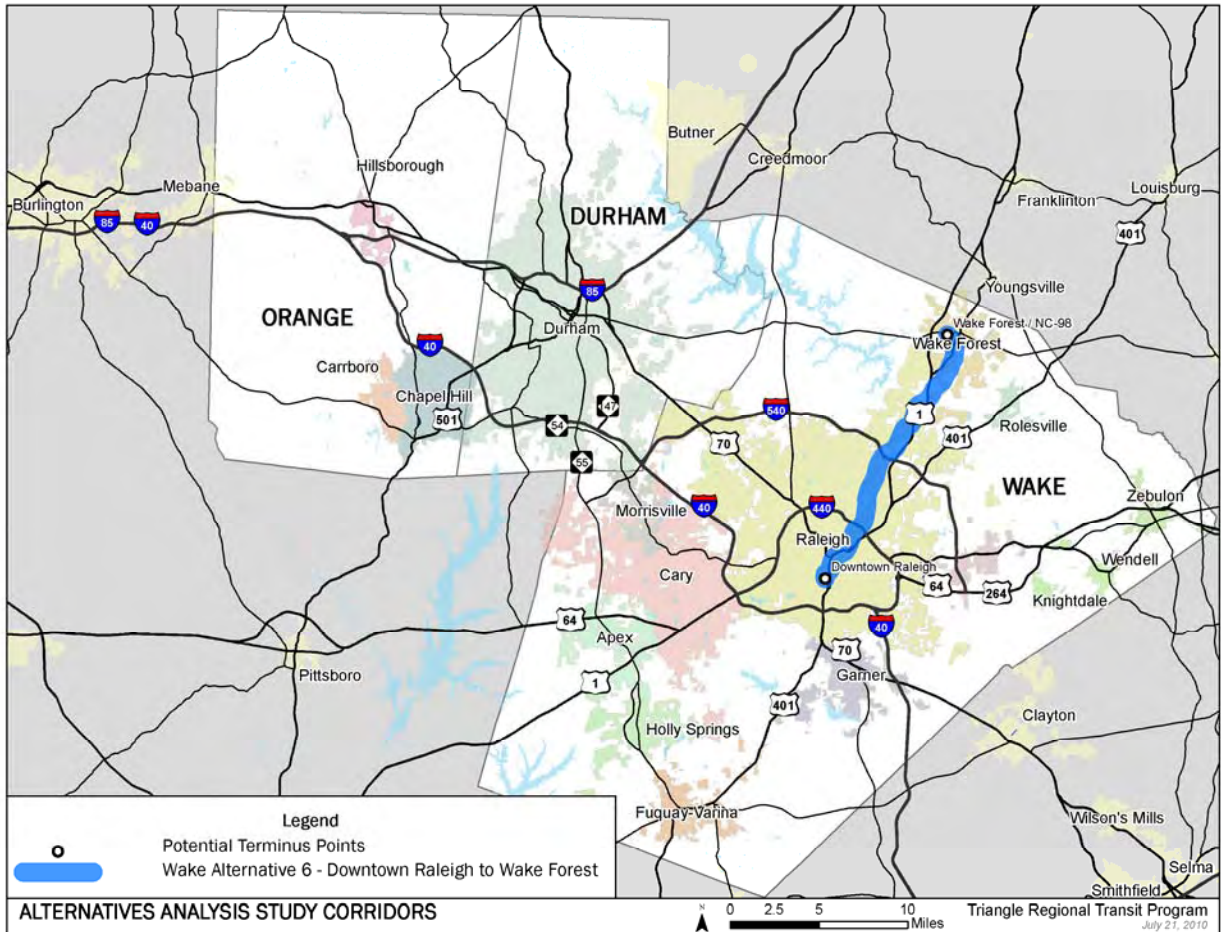
Bus Transit Integration

- Corridor served by CAT, Wolfline, and Triangle Transit



4.1.6 WAKE ALTERNATIVE 6 – DOWNTOWN RALEIGH TO WAKE FOREST

Figure 4.7 Wake Alternative 6 – Downtown Raleigh to Wake Forest



This 17 mile Corridor extends from downtown Raleigh through the Northeast Regional Center (NERC), then North to Wake Forest.

Activity Centers

- Urban and Town Centers: Downtowns of Raleigh and Wake Forest
- Colleges and Universities: Shaw University and Peace College
- Suburban Employment Areas and Special Activity Centers: State Government Offices and the Northeast Regional Center

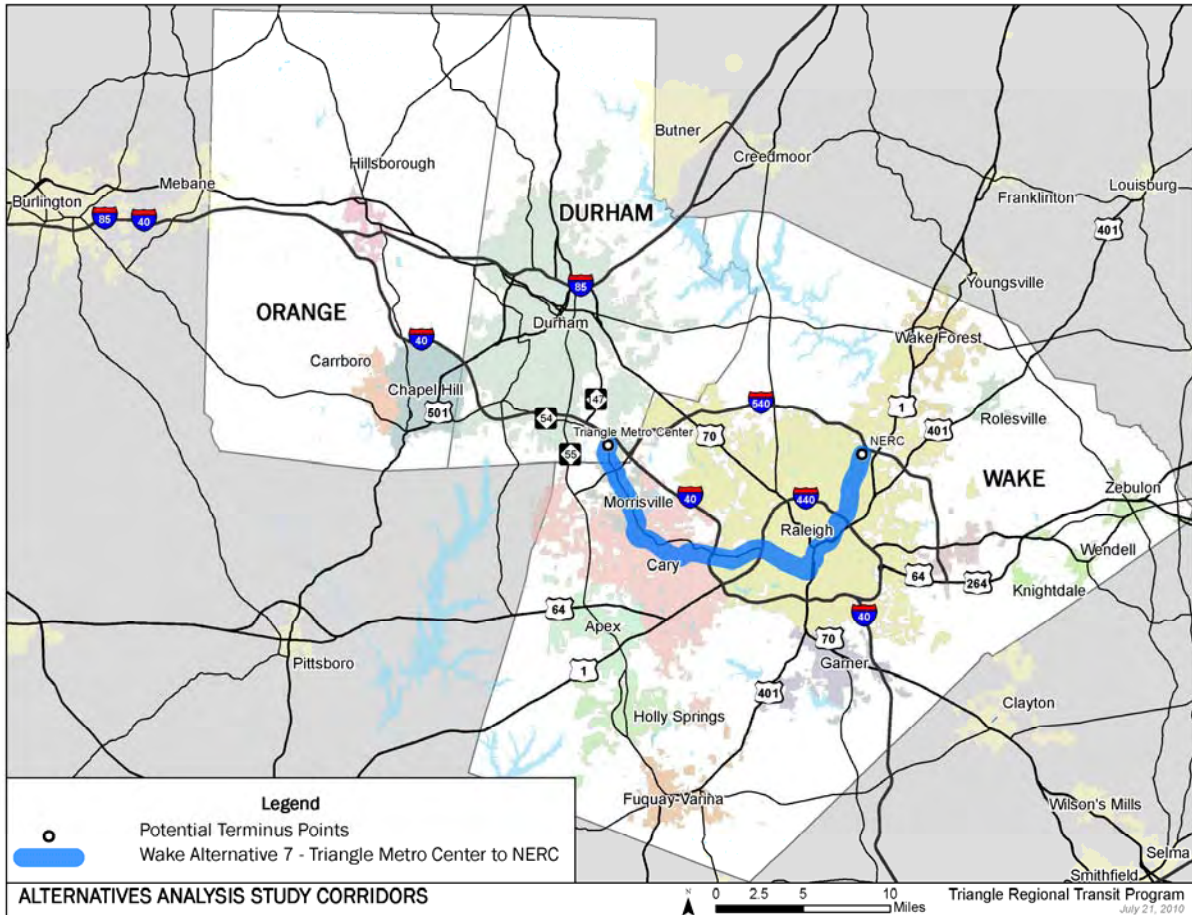
Bus Transit Integration

- Corridor served by CAT and Triangle Transit



4.1.7 WAKE ALTERNATIVE 7 – TRIANGLE METRO CENTER TO NORTHEAST REGIONAL CENTER (NERC)

Figure 4.8 Wake Alternative 7 – Triangle Metro Center to Northeast Regional Center (NERC)



This 24 mile corridor extends from the Triangle Metro Center in the Research Triangle Park (RTP), south through downtown Cary and downtown Raleigh, turning north to the Northeast Regional Center adjacent to I-540.

Activity Centers

- Urban and Town Centers: Downtowns of Cary and Raleigh
- Colleges and Universities: Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: RTP, the State Fairgrounds Complex, State Government Offices, and the Northeast Regional Center.

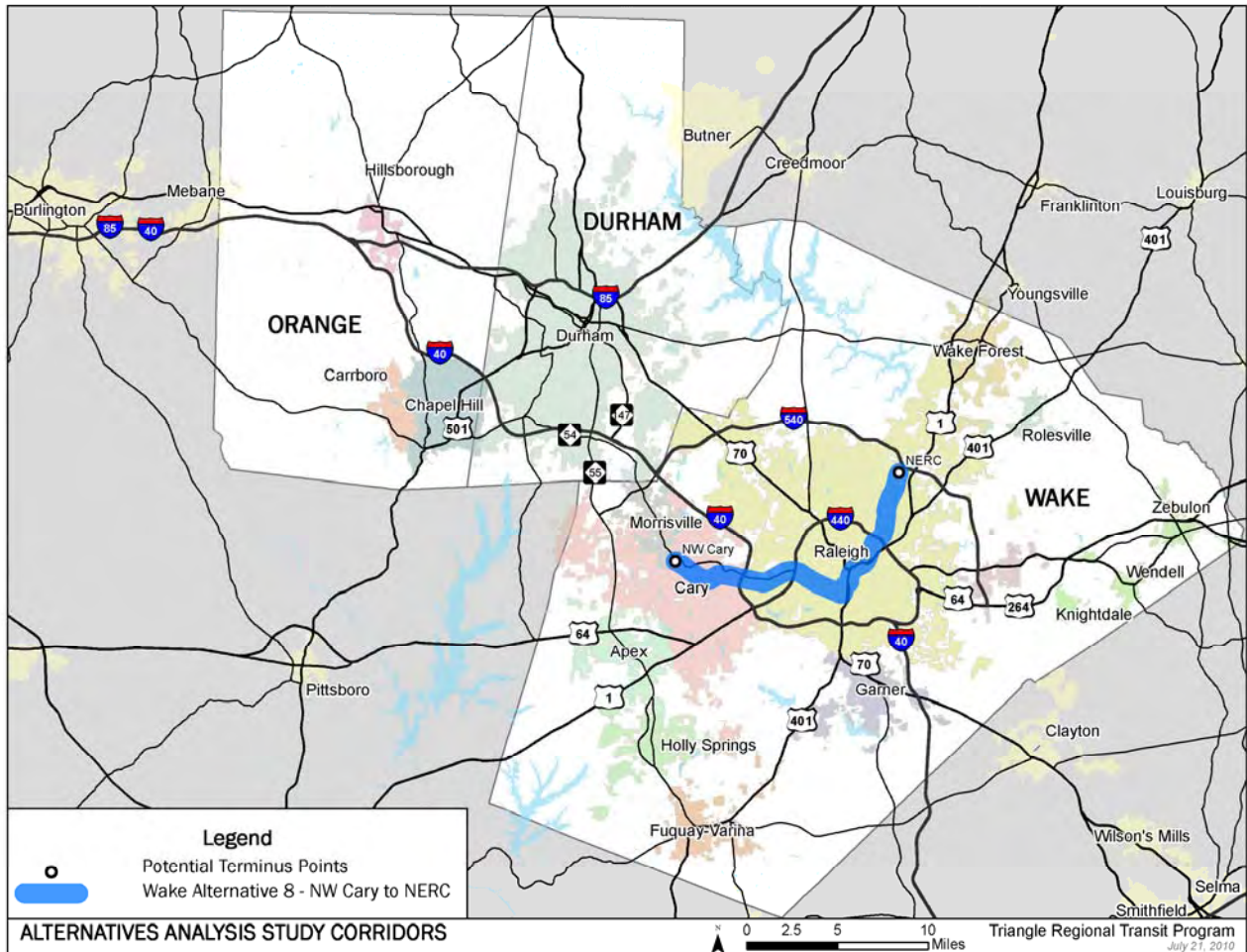
Bus Transit Integration

- Corridor served by CAT, C-Tran, Wolfline, and Triangle Transit



4.1.8 WAKE ALTERNATIVE 8 – NORTHWEST CARY TO NORTHEAST REGIONAL CENTER (NERC)

Figure 4.9 Wake Alternative 8 – Northwest Cary to Northeast Regional Center (NERC)



This 18 mile corridor extends from Northwest Cary through downtown Cary and Raleigh to the Northeast Regional Center adjacent to I-540.

Activity Centers

- Urban and Town Centers: Downtowns of Cary and Raleigh
- Colleges and Universities: Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: The State Fairgrounds Complex, State Government Offices, and the Northeast Regional Center

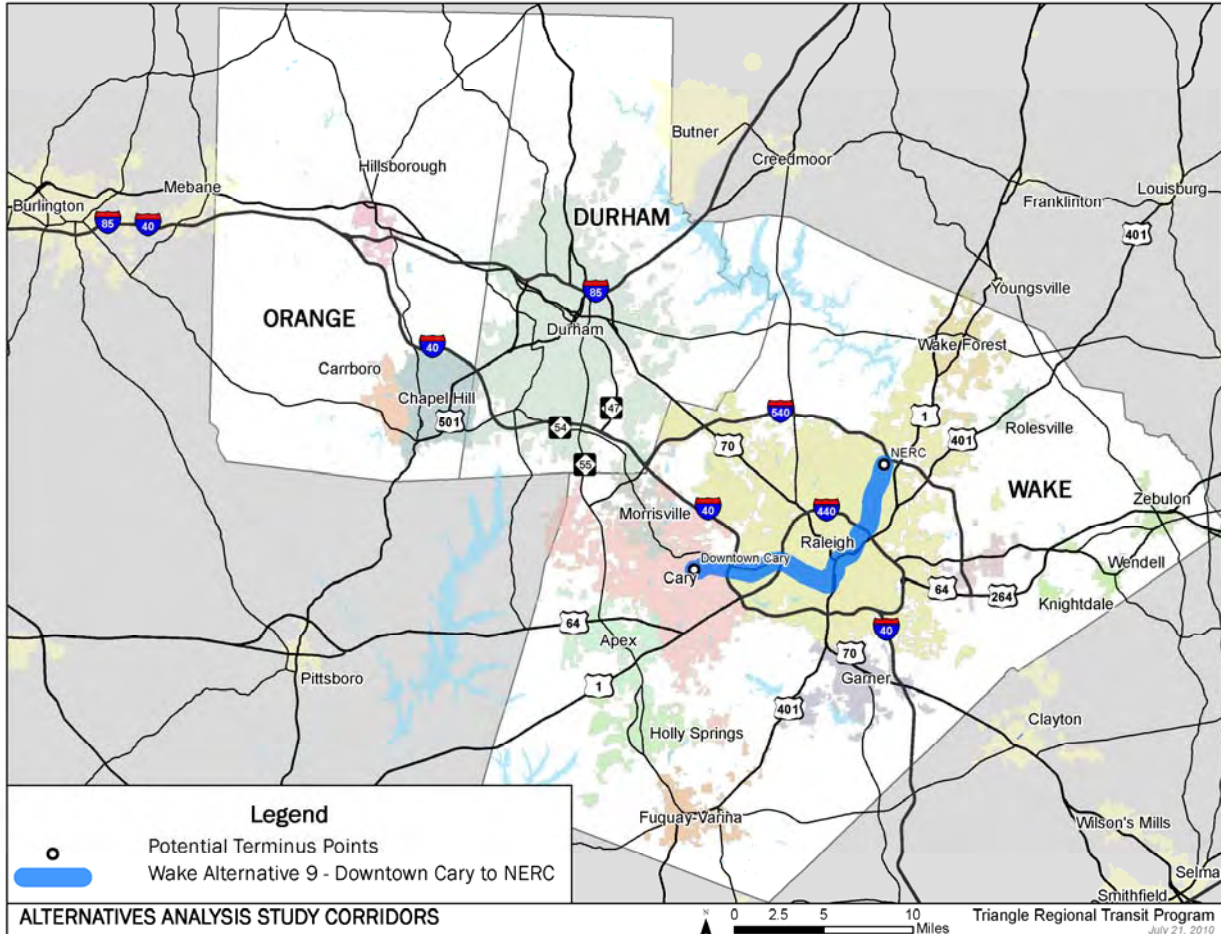
Bus Transit Integration

- Corridor served by CAT, Wolfline, C-Tran, and Triangle Transit



4.1.9 WAKE ALTERNATIVE 9 – DOWNTOWN CARY TO NORTHEAST REGIONAL CENTER (NERC)

Figure 4.10 Wake Alternative 9 – Downtown Cary to Northeast Regional Center (NERC)



This 16 mile corridor extends from downtown Cary to downtown Raleigh, then to the Northeast Regional Center adjacent to I-540.

Activity Centers

- Urban and Town Centers: Downtown Cary and Raleigh
- Colleges and Universities: Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: The State Fairgrounds Complex, State Government Offices, and the Northeast Regional Center

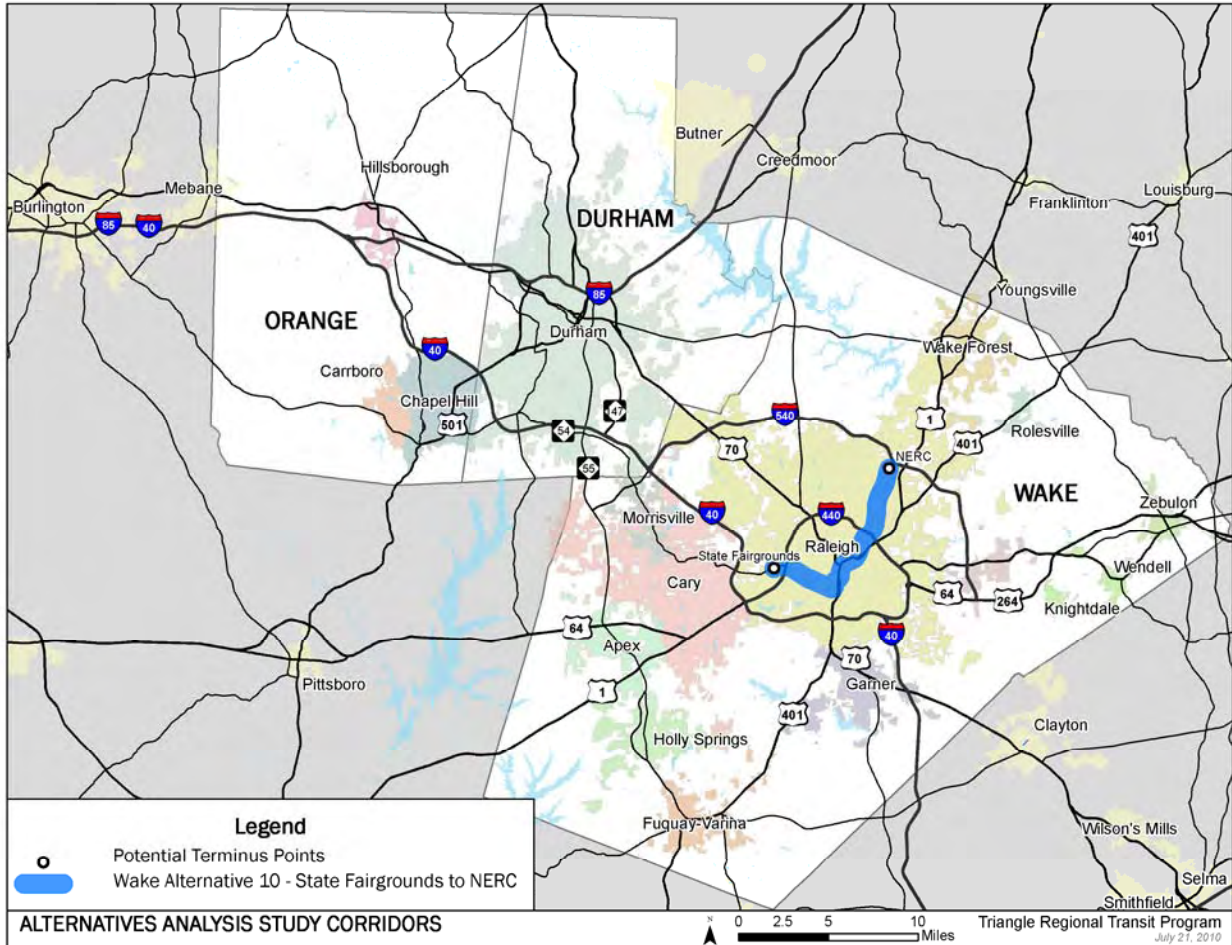
Bus Transit Integration

- Corridor served by CAT, Wolfline, C-Tran, and Triangle Transit



4.1.10 WAKE ALTERNATIVE 10 – STATE FAIRGROUNDS TO NORTHEAST REGIONAL CENTER (NERC)

Figure 4.11 Wake Alternative 10 – State Fairgrounds to Northeast Regional Center (NERC)



This 11 mile corridor extends from the State Fairgrounds through NC State University and downtown Raleigh before turning north to the Northeast Regional Center adjacent to I-540.

Activity Centers

- Urban and Town Centers: Downtown Raleigh
- Colleges and Universities: Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: The State Fairgrounds Complex, State Government Offices, and the Northeast Regional Center

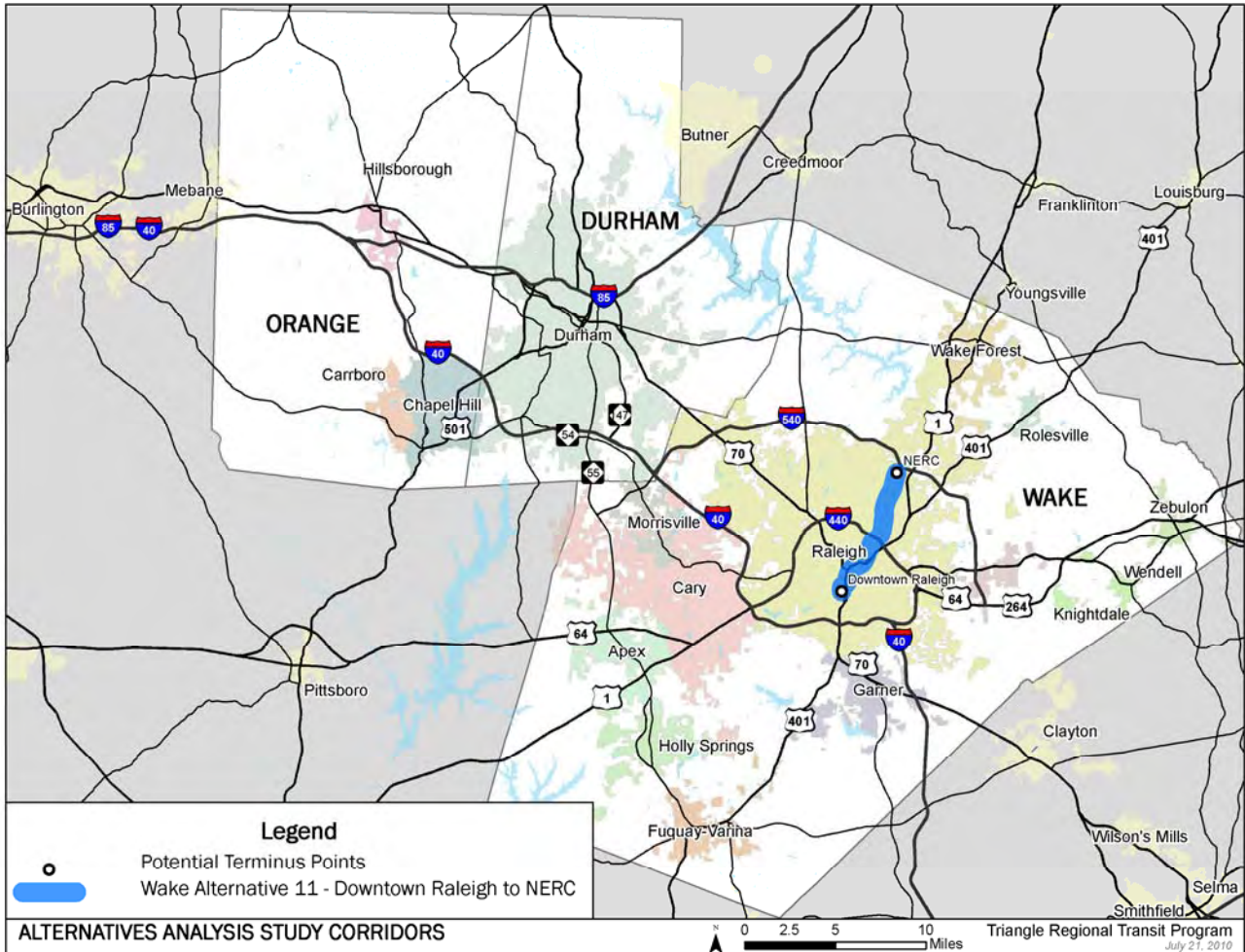
Bus Transit Integration

- Corridor served by CAT, Wolfline, and Triangle Transit



4.1.11 WAKE ALTERNATIVE 11 – DOWNTOWN RALEIGH TO NORTHEAST REGIONAL CENTER (NERC)

Figure 4.12 Wake Alternative 11 – Downtown Raleigh to Northeast Regional Center (NERC)



This 8 mile corridor extends from downtown Raleigh through North Raleigh to the Northeast Regional Center adjacent to I-540.

Activity Centers

- Urban and Town Centers: Downtown Raleigh
- Colleges and Universities: Shaw University and Peace College
- Suburban Employment Areas and Special Activity Centers: State Government Offices and the Northeast Regional Center

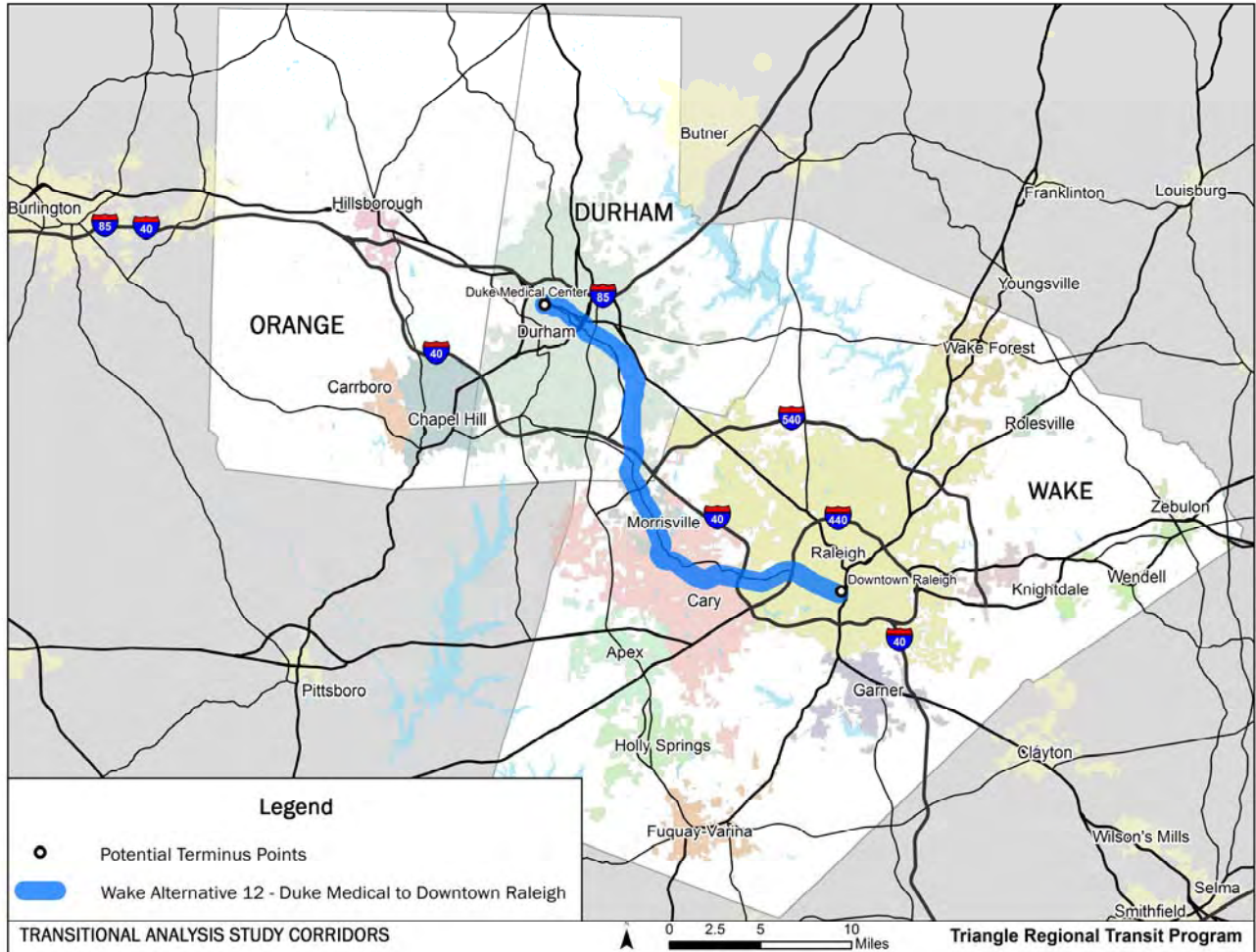
Bus Transit Integration

- Corridor served by CAT and Triangle Transit



4.1.12 WAKE ALTERNATIVE 12 – DUKE MEDICAL TO DOWNTOWN RALEIGH

Figure 4.13 Wake Alternative 12 – Duke Medical to Downtown Raleigh



This 29 mile corridor extends from Duke Hospitals and Duke University through downtown Durham and south through the Research Triangle Park to downtown Cary before turning east to downtown Raleigh. This corridor assumes the construction of rail transit within Wake County from Raleigh to the Research Triangle Park.

Activity Centers

- Urban and Town Centers: Downtowns of Durham, Cary, and Raleigh
- Colleges and Universities: Duke University, NC Central University, Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: Duke Hospitals, Research Triangle Park, State Fairgrounds Complex, and State Government Offices

Bus Transit Integration

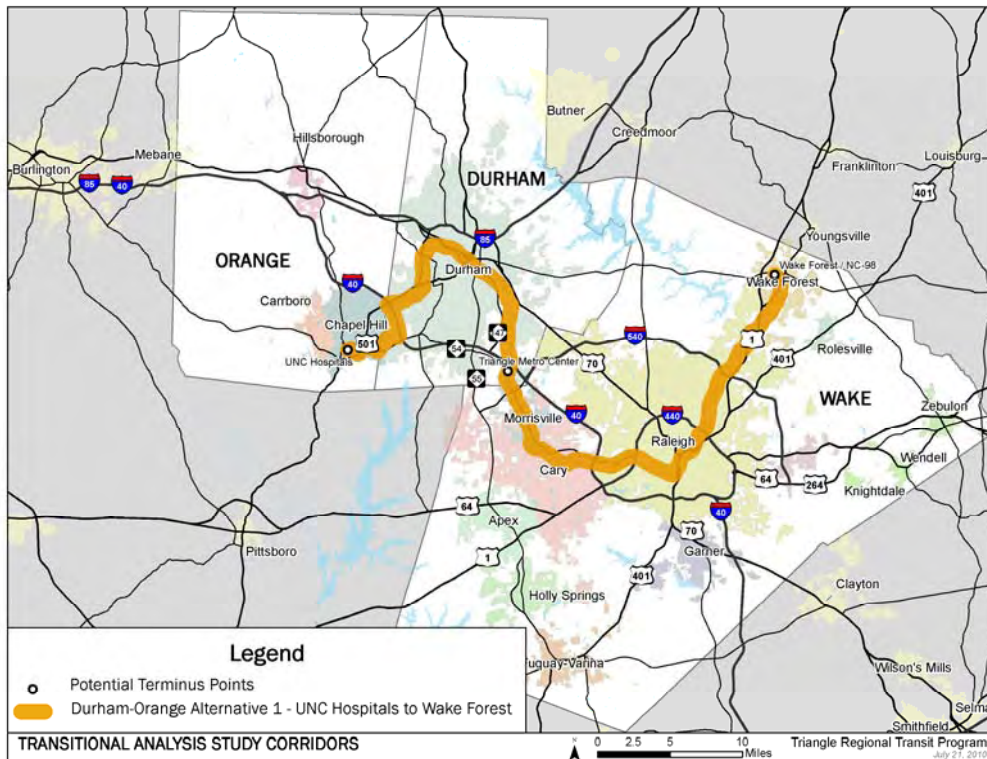
- Corridor is served by DATA, CAT, Wolfline, C-Tran, and Triangle Transit



4.2 DURHAM-ORANGE CORRIDOR ALTERNATIVES

4.2.1 DURHAM-ORANGE ALTERNATIVE 1 – UNC HOSPITALS TO WAKE FOREST

Figure 4.14 Durham-Orange Alternative 1 – UNC Hospitals to Wake Forest



This 59 mile corridor extends from UNC Hospitals in Chapel Hill north to Durham, then south through the Research Triangle Park, Morrisville, Cary, and Raleigh before turning north through Raleigh to Wake Forest. This corridor would serve the region's four largest cities, the Research Triangle Park, and the region's major research universities. This corridor assumes the construction of rail transit within Wake County from Wake Forest to the Triangle Metro Center and is used as a baseline comparison to the other Durham-Orange alternatives.

Activity Centers

- Urban and Town Centers: Downtowns of Chapel Hill, Durham, Cary, Raleigh, and Wake Forest
- Colleges and Universities: UNC Chapel Hill, Duke University, NC Central University, Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: UNC Hospitals, the NC 54 Corridor (including Glenn Lennox, East 54, UNC's Friday Center, Meadowmont, and Leigh Village), Development around I-40 and US 15-501 (including Gateway East, Patterson Place, and South Square), Duke Hospitals, Research Triangle Park, State Fairgrounds Complex, State Government Offices, and the Northeast Regional Center

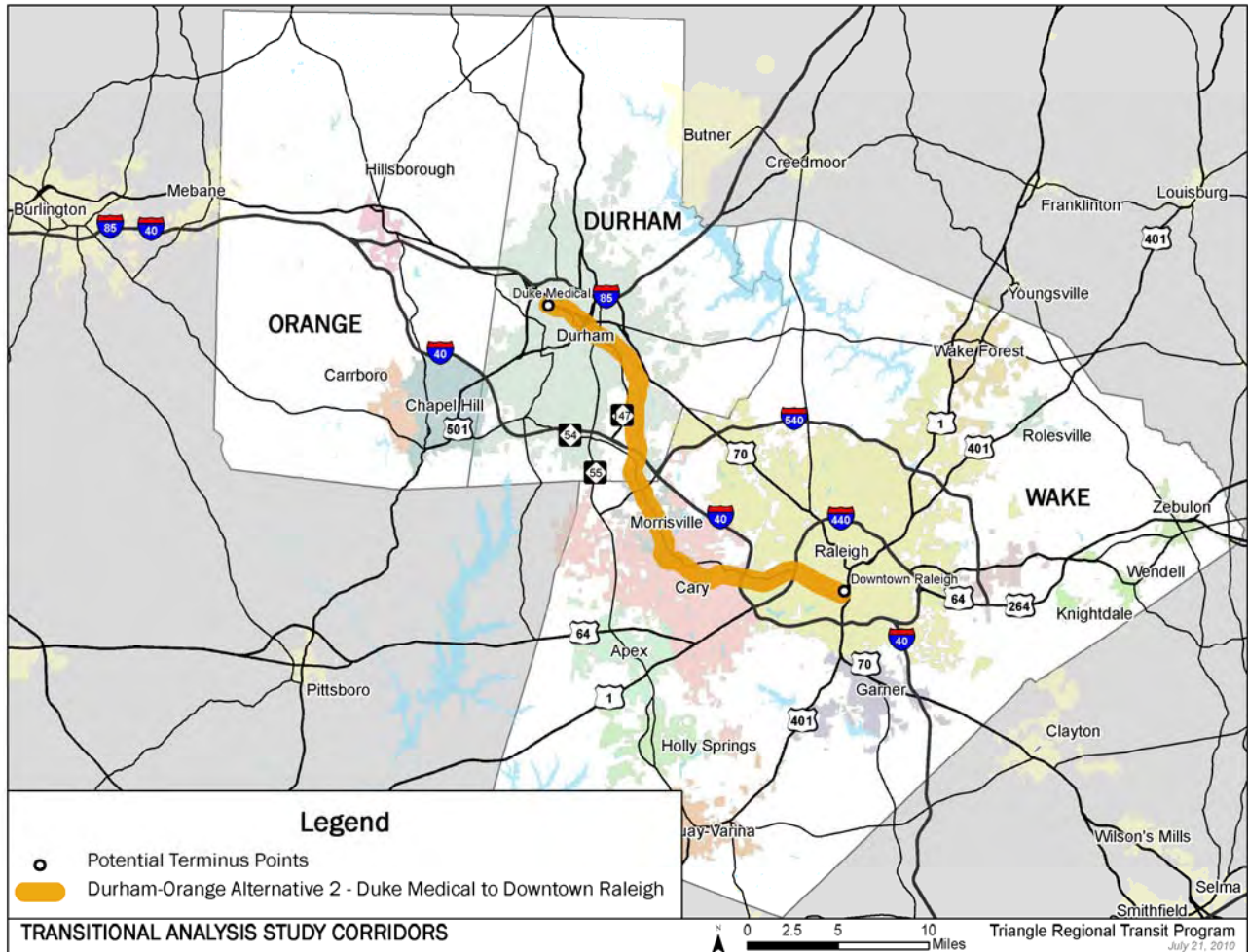
Bus Transit Integration

- Corridor served by Chapel Hill Transit, DATA, C-Tran, Wolfline, CAT, and Triangle Transit



4.2.2 DURHAM-ORANGE ALTERNATIVE 2 – DUKE MEDICAL TO DOWNTOWN RALEIGH

Figure 4.15 Durham-Orange Alternative 2 – Duke Medical to Downtown Raleigh



This 29 mile corridor extends from Duke Hospitals and Duke University through downtown Durham and south through the Research Triangle Park to downtown Cary before turning east to downtown Raleigh. This corridor assumes the construction of rail transit within Wake County from Raleigh to the Research Triangle Park.

Activity Centers

- Urban and Town Centers: Downtowns of Durham, Cary, and Raleigh
- Colleges and Universities: Duke University, NC Central University, Meredith College, NC State University, Shaw University, and Peace College
- Suburban Employment Areas and Special Activity Centers: Duke Hospitals, Research Triangle Park, State Fairgrounds Complex, and State Government Offices

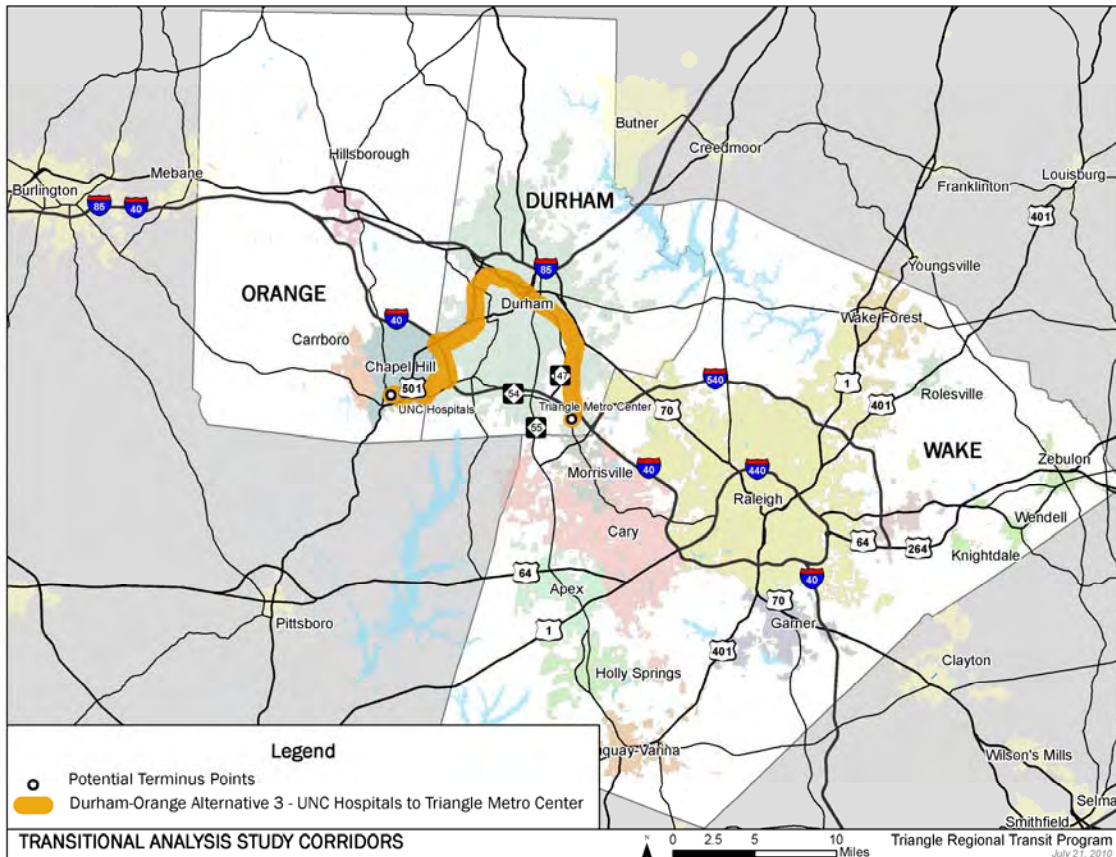
Bus Transit Integration

- Corridor served by DATA, CAT, Wolfline, C-Tran, and Triangle Transit



4.2.3 DURHAM-ORANGE ALTERNATIVE 3 – UNC HOSPITALS TO TRIANGLE METRO CENTER

Figure 4.16 Durham-Orange Alternative 3 – UNC Hospitals to Triangle Metro Center



This 26 mile corridor extends from UNC Hospitals east to NC 54, then North through Duke University to downtown Durham and south to the Research Triangle Park. This corridor represents a complete build-out of the LRTP rail component within Durham and Orange counties, without a connection to Wake County.

Activity Centers

- Urban and Town Centers: Downtowns of Chapel Hill and Durham
- Colleges and Universities: UNC Chapel Hill, Duke University, and NC Central University
- Suburban Employment Areas and Special Activity Centers: UNC Hospitals, the NC 54 Corridor (including Glenn Lennox, East 54, UNC's Friday Center, Meadowmont, and Leigh Village), Development around I-40 and US 15-501 (including Gateway East, Patterson Place, and South Square), Duke Hospitals, and the Research Triangle Park

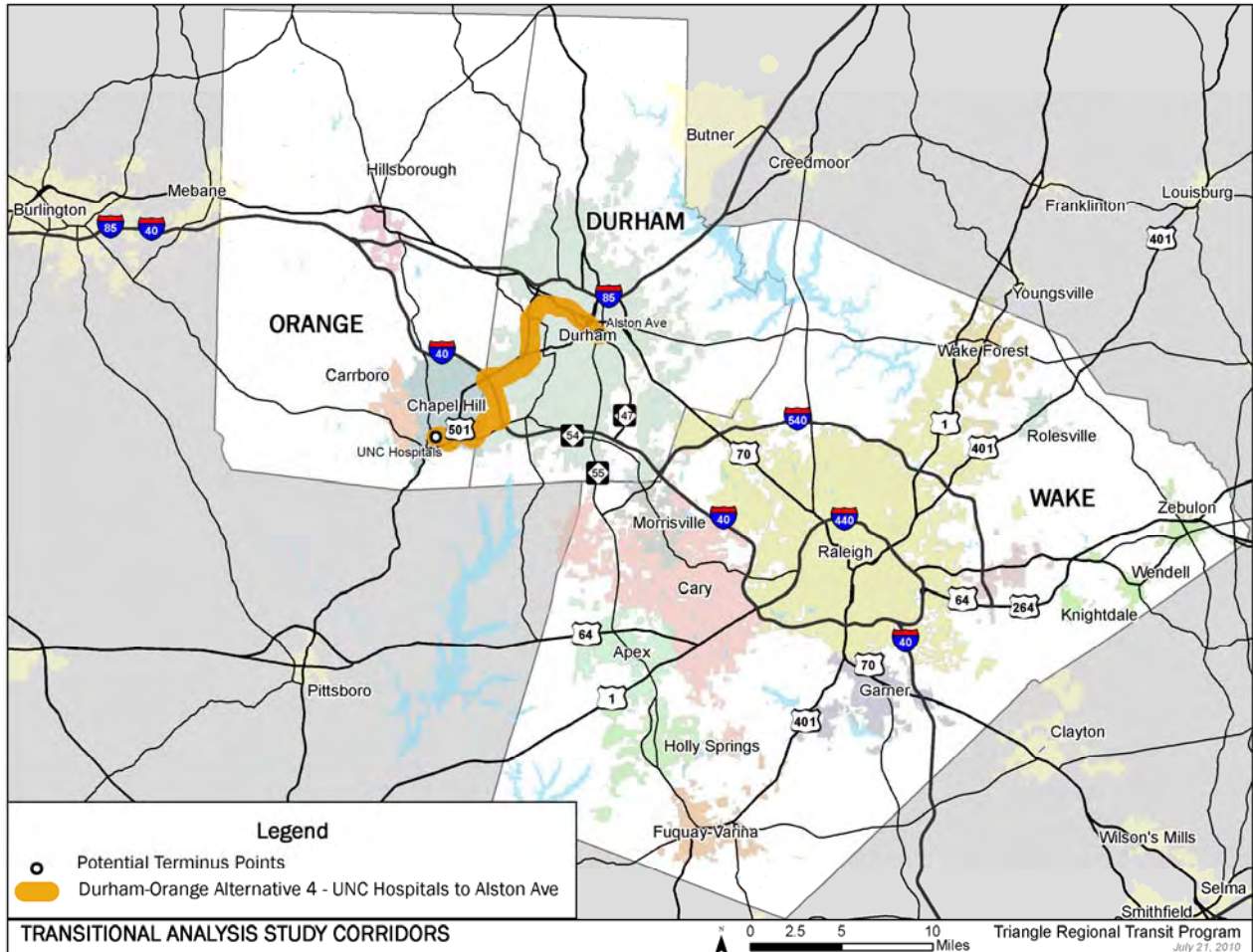
Bus Transit Integration

- Corridor served by Chapel Hill Transit, DATA, and Triangle Transit



4.2.4 DURHAM-ORANGE ALTERNATIVE 4 – UNC HOSPITALS TO ALSTON AVENUE

Figure 4.17 Durham-Orange Alternative 4 – UNC Hospitals to Alston Avenue



This 17 mile corridor extends from UNC Hospitals through the NC 54 corridor, Duke University Hospitals, and downtown Durham to Alston Avenue.

Activity Centers

- Urban and Town Centers: Downtowns of Chapel Hill and Durham
- Colleges and Universities: UNC Chapel Hill, Duke University, and NC Central University
- Suburban Employment Areas and Special Activity Centers: UNC Hospitals, the NC 54 Corridor (including Glenn Lennox, East 54, UNC’s Friday Center, Meadowmont, and Leigh Village), Development around I-40 and US 15-501 (including Gateway East, Patterson Place, and South Square), and Duke Hospitals

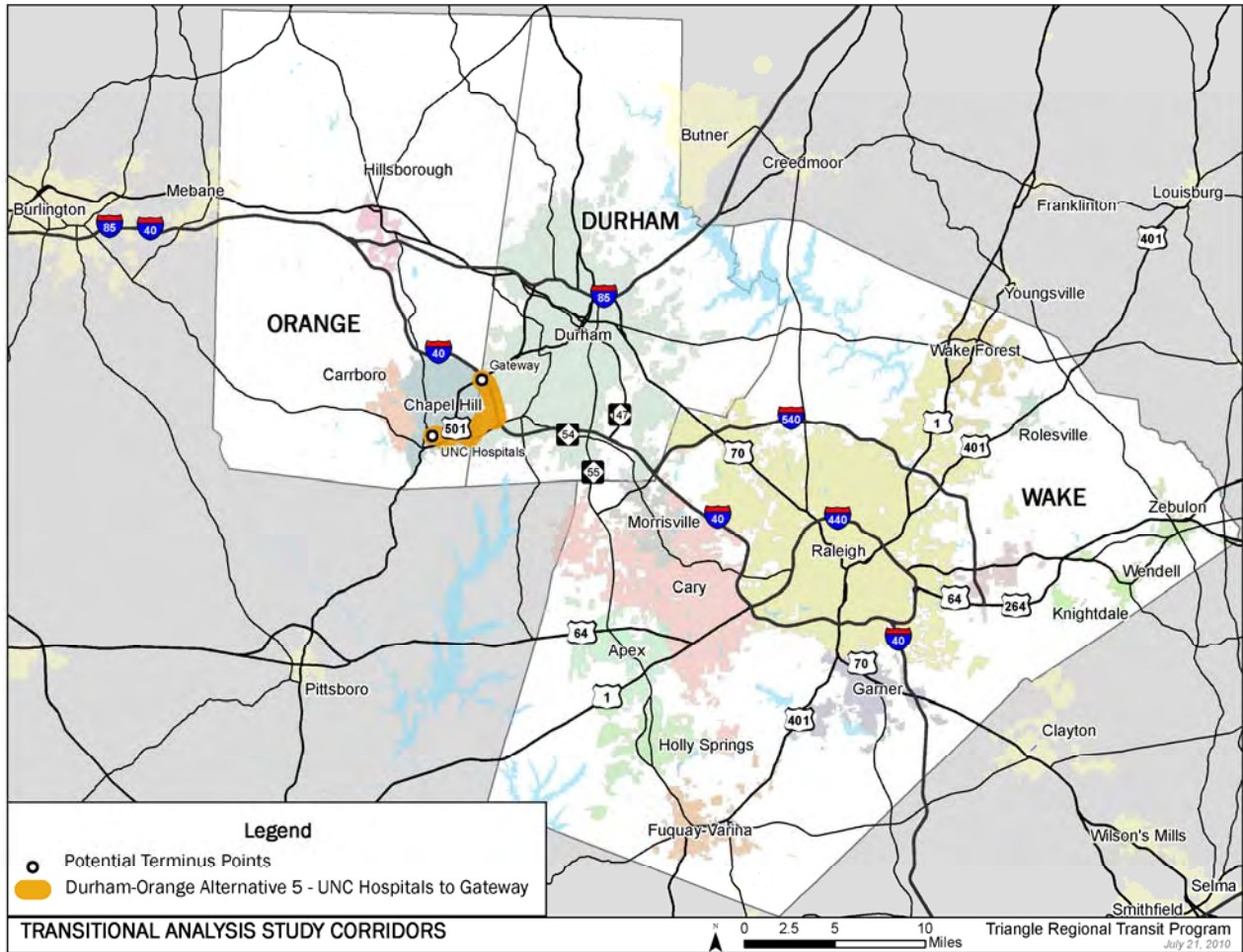
Bus Transit Integration

- Corridor served by Chapel Hill Transit, DATA, and Triangle Transit



4.2.5 DURHAM-ORANGE ALTERNATIVE 5 – UNC HOSPITALS TO GATEWAY

Figure 4.18 Durham-Orange Alternative 5 – UNC Hospitals to Gateway



This 7 mile corridor extends east from UNC Hospitals along the NC 54 corridor then north to the US 15/501 and I-40 interchange at the Gateway developments.

Activity Centers

- Urban and Town Centers: Downtown Chapel Hill
- Colleges and Universities: UNC Chapel Hill
- Suburban Employment Areas and Special Activity Centers: UNC Hospitals, the NC 54 Corridor (including Glenn Lennox, East 54, UNC’s Friday Center, Meadowmont, and Leigh Village), and Gateway East

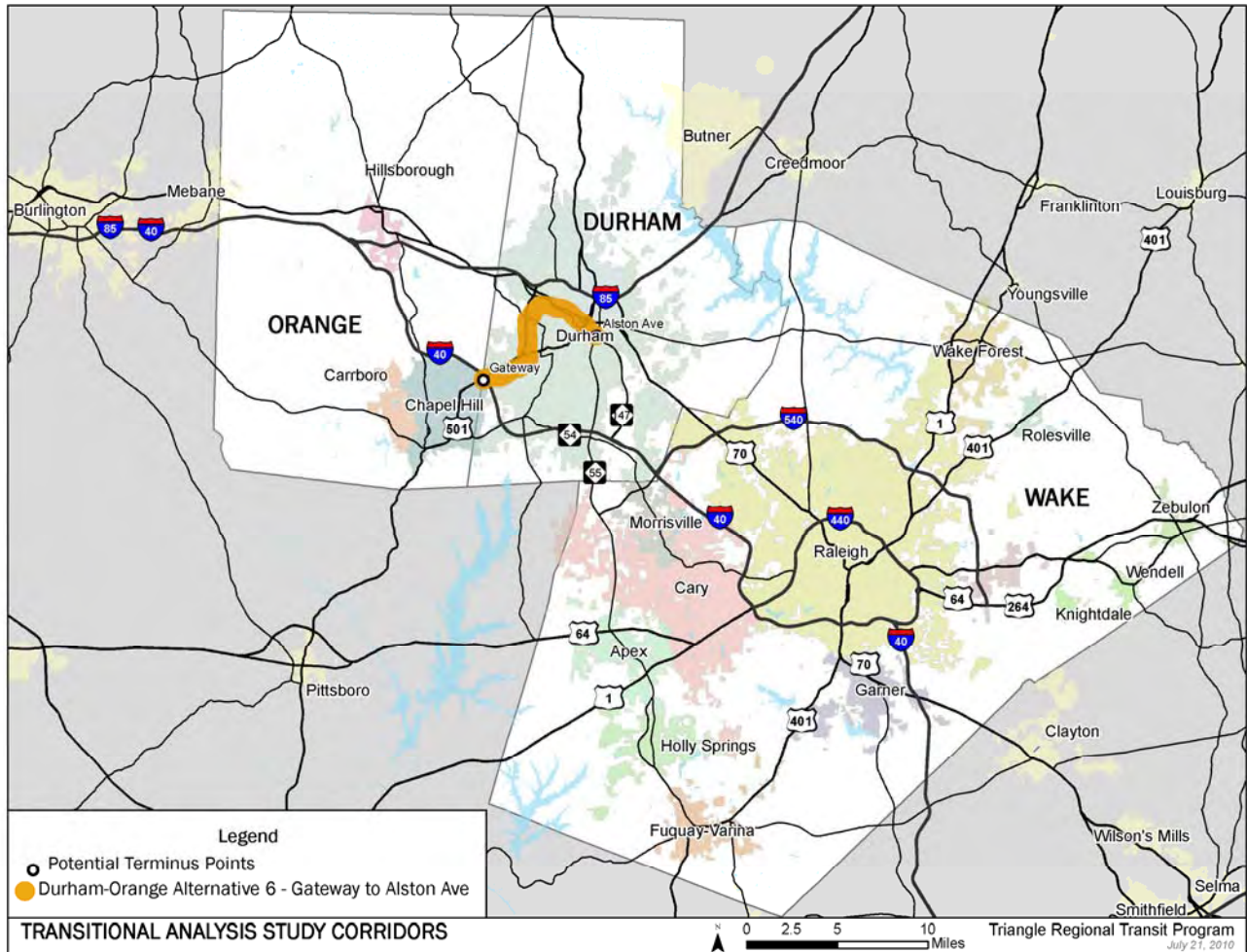
Bus Transit Integration

- Corridor served by Chapel Hill Transit, DATA, and Triangle Transit



4.2.6 DURHAM-ORANGE ALTERNATIVE 6 – GATEWAY TO ALSTON AVENUE

Figure 4.19 Durham-Orange Alternative 6 – Gateway to Alston Avenue



This 10 mile corridor extends from the I-40 and US 15/501 interchange north through Duke University to downtown Durham and Alston Avenue.

Activity Centers

- Urban and Town Centers: Downtown Durham
- Colleges and Universities: Duke University and NC Central University
- Suburban Employment Areas and Special Activity Centers: Development around I-40 and US 15-501 (including Gateway East, Patterson Place, and South Square) and Duke Hospitals

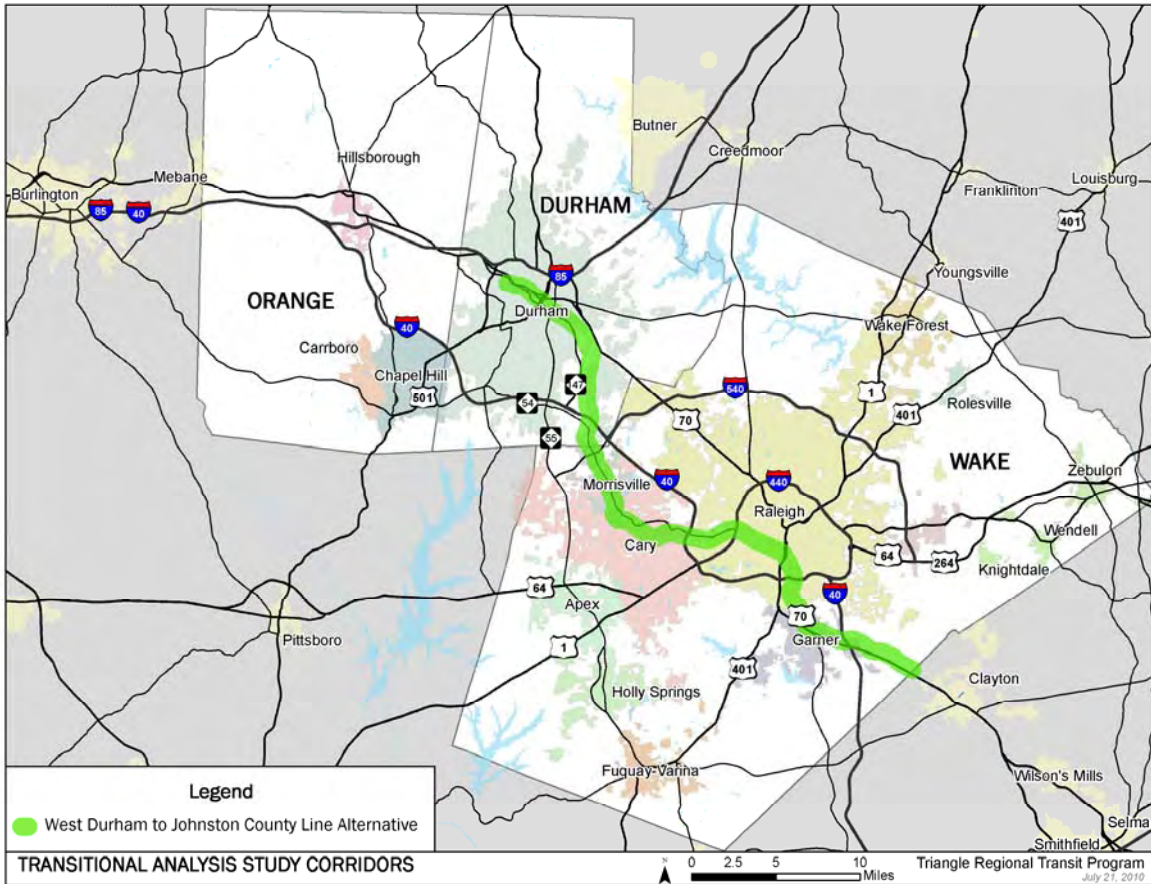
Bus Transit Integration

- Corridor served by Chapel Hill Transit, DATA, and Triangle Transit



4.3 REGIONAL CORRIDOR ALTERNATIVE – WEST DURHAM TO JOHNSTON COUNTY LINE

Figure 4.20 Regional Corridor Alternative – West Durham to Johnston County Line



This 40 mile corridor would consist of commuter rail-type service operating along the NCRR corridor from West Durham to the Wake-Johnston County line. This service would run at peak hours Monday through Friday only with the intent of serving work-based trips to and from the Research Triangle Park as well as Raleigh and Durham.

Activity Centers

- Urban and Town Centers: Downtowns of Durham, Cary, and Raleigh
- Colleges and Universities: Duke University, NC Central University, Meredith College, NC State University, Shaw University and Peace College
- Suburban Employment Areas and Special Activity Centers: Duke Hospitals, Research Triangle Park, the State Fairgrounds Complex, and State Government Offices

Bus Transit Integration

- Corridor served by DATA, CAT, Wolfline, C-Tran, and Triangle Transit



CHAPTER 5 CORRIDOR EVALUATION CRITERIA

The corridors described in Chapter 4 were evaluated by the consulting team using the following criteria, which were developed in consultation with Triangle Transit, DCHC-MPO and CAMPO. Where applicable, the evaluation year is noted in parentheses.

5.1 MOBILITY

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

5.2 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)

5.3 LAND USE

- Public sector/regulatory support - Existing comprehensive plans consistent with the concepts of compact, mixed-used development near public transportation, or transit-oriented development (TOD); allowable densities and flexibility of zoning districts
- Activity centers served (employment, retail, institutions, mixed use, special attractions)
- Development potential – future TOD potential considering potential household and employment density and future growth.

5.4 FINANCIAL

- Total capital cost (2010 Dollars)
- Capital cost per mile (2010 Dollars)
- Capital cost per weekday transit trip (2010 Dollars, 2035 Ridership)
- Capital cost per weekday transit passenger mile traveled (2010 Dollars, 2035 PMT)
- Total Operating and Maintenance (O&M) cost (2010 Dollars)
- O&M cost per weekday transit trip (2010 Dollars, 2035 Ridership)
- Annual O&M cost per weekday transit passenger mile traveled (2010 Dollars, 2035 PMT)

5.5 PUBLIC INPUT

Citizens and project stakeholders will be provided an opportunity to review and comment on the evaluation criteria and the draft results of the corridor analysis. This information will be presented at a series of six public workshops that will be held between September 14 and September 23, 2010.



CHAPTER 6 SCREENING OF CORRIDORS AND SELECTION OF PRIORITY CORRIDORS

6.1 MOBILITY

The Triangle Regional Model (TRM) is a four-step model that utilizes socio-economic data aggregated at a Traffic Analysis Zone (TAZ) geography to estimate travel demand. For this analysis, the TRM was used to estimate future travel demand within each of the study corridors for the year 2035, given all-day, frequent service. The four mobility criteria used to evaluate each corridor are: number of daily person trips in each corridor; number of daily rail transit trips in each corridor; rail transit passenger miles traveled (PMT); and the peak hour corridor travel times for rail and highway travel.

6.1.1 PERSON TRIPS IN CORRIDOR

The number of total daily person trips in each corridor represents the level of travel activity within each corridor, which can be used to make relative comparisons regarding the potential for rail transit ridership in each corridor. Total daily person trips include all trips made within the corridor for all purposes and by all travel modes. For the purpose of this analysis, the corridors are defined as all Traffic Analysis Zones (TAZs) that are partially or wholly within a mile-wide corridor centered on the rail alignment used for the TRM. The four corridors with the highest daily person trips per mile of modeled rail are W8 through W11, which are most focused around NCSU and downtown Raleigh.

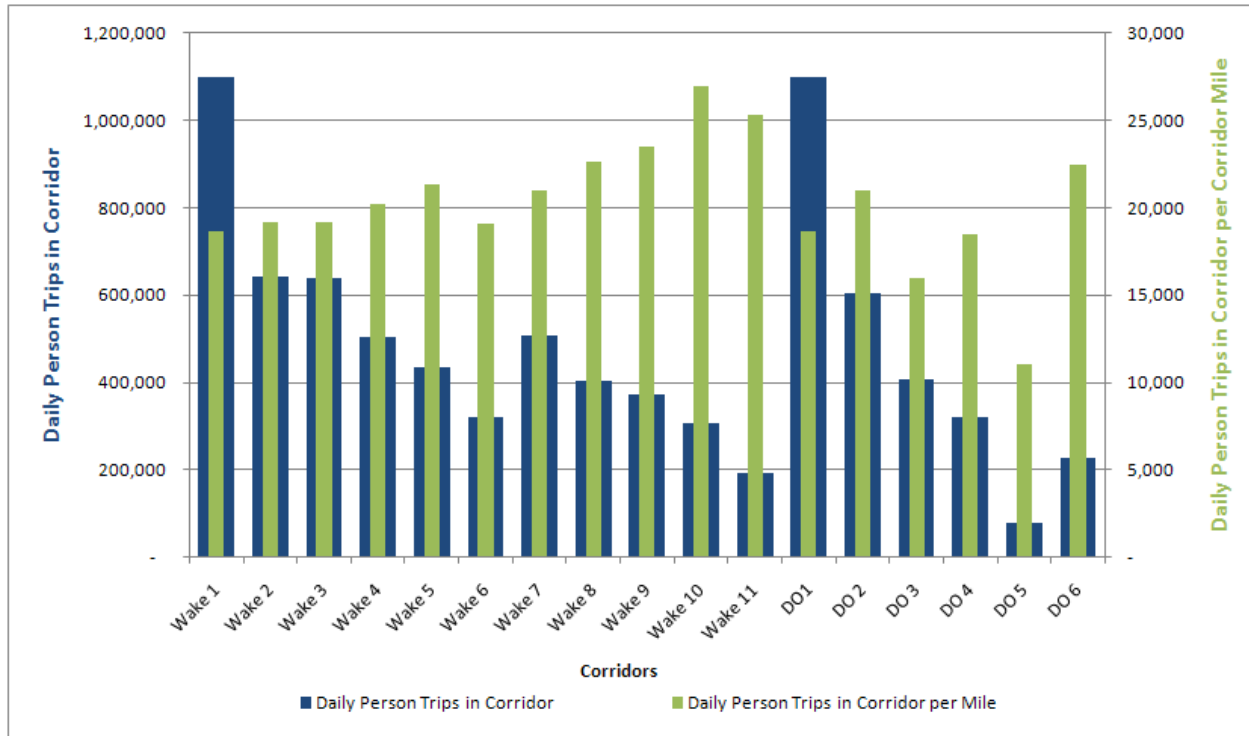
Table 6.1 Daily Person Trips in Corridor (2035)

Corridors	Termini	Length (Miles)	Daily Person Trips in Corridor (2035)	Daily Person Trips in Corridor per Mile (2035)
Wake 1	UNC Hospitals - Wake Forest	59	1,098,547	18,653
Wake 2	TMC - Wake Forest	33	640,569	19,209
Wake 3	Veridea - Wake Forest	33	639,723	19,162
Wake 4	Downtown Cary - Wake Forest	25	503,279	20,172
Wake 5	State Fairgrounds - Wake Forest	20	435,784	21,299
Wake 6	Downtown Raleigh - Wake Forest	17	319,810	19,110
Wake 7	TMC - NERC	24	508,823	20,946
Wake 8	NW Cary - NERC	18	403,853	22,602
Wake 9	Downtown Cary - NERC	16	373,236	23,484
Wake 10	State Fairgrounds - NERC	11	307,082	26,927
Wake 11	Downtown Raleigh - NERC	8	194,093	25,275
Wake 12	Duke Medical - Downtown Raleigh	29	604,028	21,024
DO1	UNC Hospitals - Wake Forest	59	1,098,547	18,653
DO 2	Duke Medical - Downtown Raleigh	29	604,028	21,024
DO 3	UNC Hospitals - TMC	26	407,259	15,942
DO 4	UNC Hospitals - Alston Ave	17	319,870	18,439
DO 5	UNC Hospitals - Gateway	7	79,935	11,030
DO 6	Gateway - Alston Ave	10	226,526	22,429

Note: The data listed in emboldened red are top performers for each respective evaluation criterion.



Figure 6.1 Daily Person Trips in Corridor (2035)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.

6.1.2 RAIL TRIPS IN CORRIDOR

Potential rail station locations were used in the TRM to estimate the demand for rail travel in each corridor. The three corridors with the highest daily rail trip estimates are the longest corridors, as shown in Table 6.2. Thus, the number of daily rail trips per mile is a more informative measure for comparing corridors, as the number of trips is normalized by length. The four corridors with the highest trips per mile are: the State Fairgrounds to the NERC (W10); UNC Hospitals to Gateway (DO5); UNC Hospitals to Alston Avenue (DO4); and Downtown Cary to the NERC (W9), as shown in Table 6.2 and on Figure 6.2.

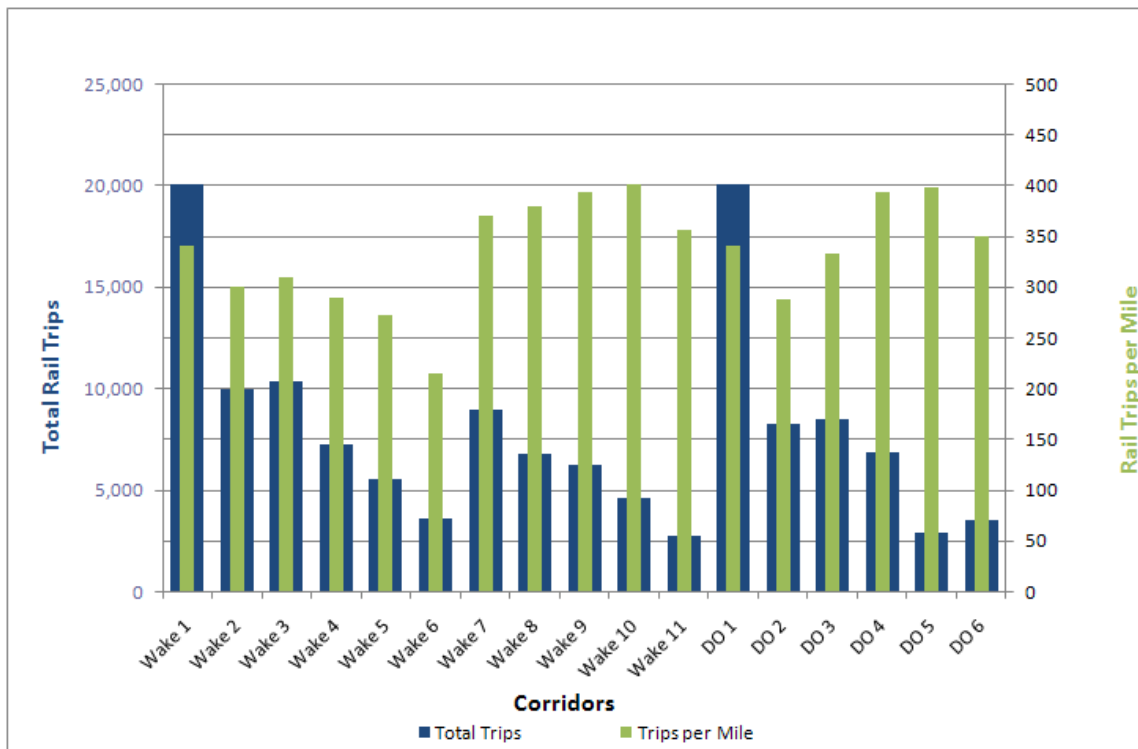


Table 6.2 Daily Rail Transit Total Trips and Trips per Mile (2035)

Corridors	Termini	Length (Miles)	Rail Trips (2035)	Rail Trips per Mile (2035)
Wake 1	UNC Hospitals - Wake Forest	59	20,105	341
Wake 2	TMC - Wake Forest	33	10,010	300
Wake 3	Veridea - Wake Forest	33	10,325	309
Wake 4	Downtown Cary - Wake Forest	25	7,236	290
Wake 5	State Fairgrounds - Wake Forest	20	5,562	272
Wake 6	Downtown Raleigh - Wake Forest	17	3,611	216
Wake 7	TMC - NERC	24	8,986	370
Wake 8	NW Cary - NERC	18	6,791	380
Wake 9	Downtown Cary - NERC	16	6,257	394
Wake 10	State Fairgrounds - NERC	11	4,586	402
Wake 11	Downtown Raleigh - NERC	8	2,732	356
Wake 12	Duke Medical - Downtown Raleigh	29	8,288	288
DO 1	UNC Hospitals - Wake Forest	59	20,105	341
DO 2	Duke Medical - Downtown Raleigh	29	8,288	288
DO 3	UNC Hospitals - TMC	26	8,491	332
DO 4	UNC Hospitals - Alston Ave	17	6,831	394
DO 5	UNC Hospitals - Gateway	7	2,889	399
DO 6	Gateway - Alston Ave	10	3,541	351

Note: The data listed in emboldened red are top performers for each respective evaluation criterion.

Figure 6.2 Daily Rail Transit Total Trips and Trips per Mile (2035)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.



6.1.3 RAIL PASSENGER MILES

The number of daily rail passenger miles traveled (PMTs) estimated for each corridor provides some indication of the potential for reducing private vehicle miles traveled (VMTs) on roadways. The four corridors with the highest PMTs coincide with the longest corridors, as shown in Table 6.3.

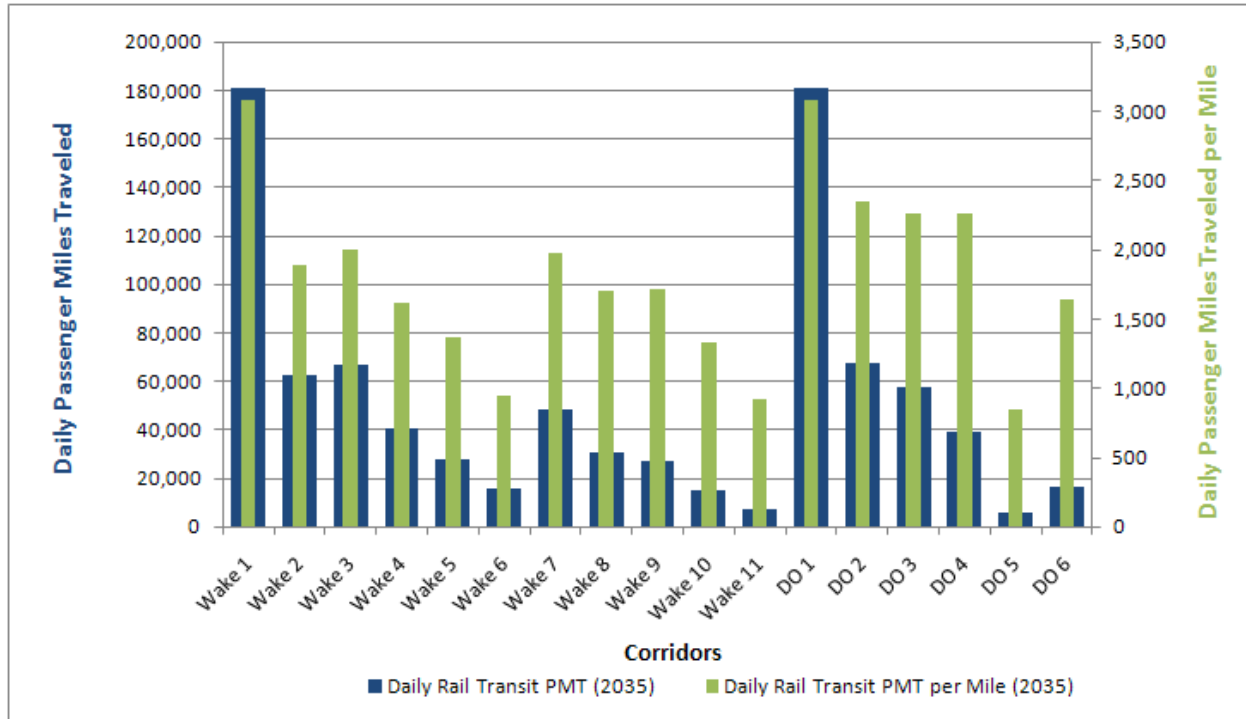
Table 6.3 Rail Transit Passenger Miles Traveled (2035)

Corridors	Termini	Length (Miles)	Rail Transit PMT (2035)	Rail Transit PMT per Mile(2035)
Wake 1	UNC Hospitals - Wake Forest	59	181,253	3,078
Wake 2	TMC - Wake Forest	33	62,886	1,886
Wake 3	Veridea - Wake Forest	33	66,950	2,005
Wake 4	Downtown Cary - Wake Forest	25	40,353	1,617
Wake 5	State Fairgrounds - Wake Forest	20	27,913	1,364
Wake 6	Downtown Raleigh - Wake Forest	17	15,856	947
Wake 7	TMC - NERC	24	48,160	1,983
Wake 8	NW Cary - NERC	18	30,389	1,701
Wake 9	Downtown Cary - NERC	16	27,195	1,711
Wake 10	State Fairgrounds - NERC	11	15,155	1,329
Wake 11	Downtown Raleigh - NERC	8	7,056	919
Wake 12	Duke Medical - Downtown Raleigh	29	67,600	2,353
DO 1	UNC Hospitals - Wake Forest	59	181,253	3,078
DO 2	Duke Medical - Downtown Raleigh	29	67,600	2,353
DO 3	UNC Hospitals - TMC	26	57,691	2,258
DO 4	UNC Hospitals - Alston Ave	17	39,173	2,258
DO 5	UNC Hospitals - Gateway	7	6,126	845
DO 6	Gateway - Alston Ave	10	16,555	1,639

Note: The data listed in emboldened red are top performers for each respective evaluation criterion.



Figure 6.3 Rail Transit Passenger Miles Traveled (2035)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.

6.1.4 PEAK HOUR CORRIDOR TRAVEL TIMES

The peak hour travel time between the termini of each corridor was calculated for rail and highway travel to provide a relative comparison between corridors, as shown in Table 6.4 and on Figure 6.4. This measure provides an indication of travel time benefit for rail (if any) when traveling the entire length of the corridor. The travel time benefit is a function of speed and distance traveled, and as such the more circuitous corridors demonstrate less rail benefit since an automobile provides a more direct route, i.e. shorter travel distance. However, this criterion still provides a baseline for travel time comparison. The four corridors that provide the greatest rail travel time benefit between termini are: Downtown Raleigh to Wake Forest (W6); Downtown Raleigh to NERC (W11); State Fairgrounds to Wake Forest (W5); and State Fairgrounds to NERC (W10).

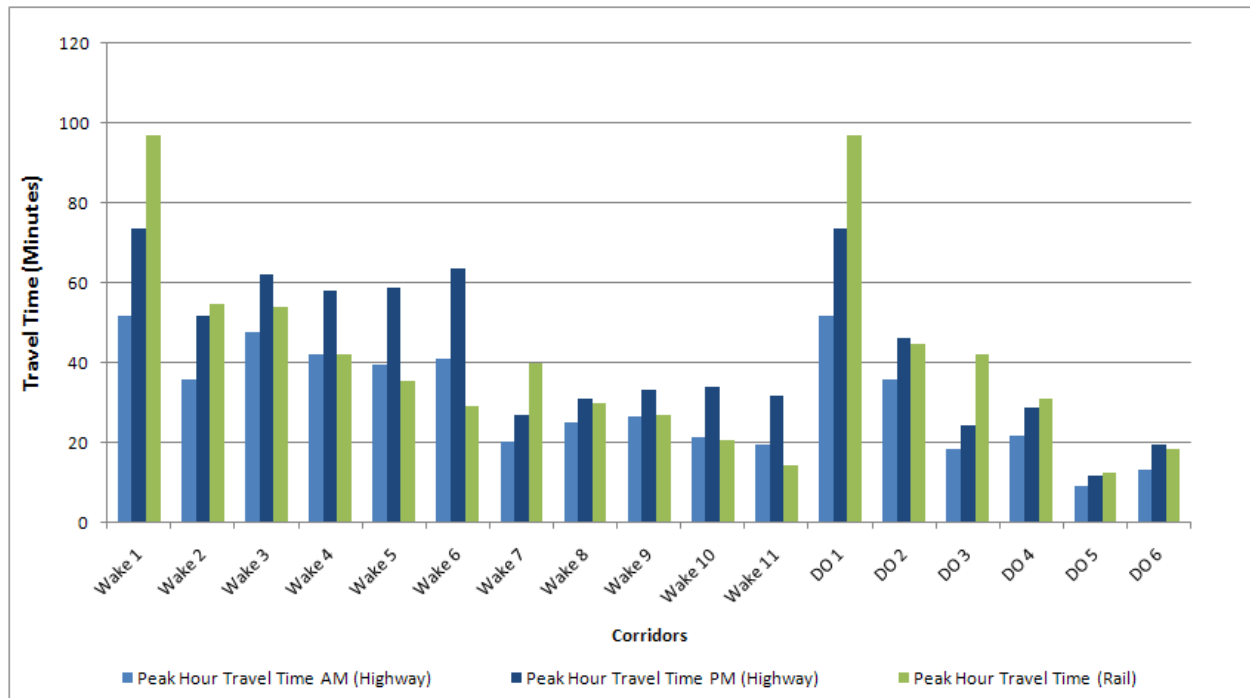


Table 6.4 Peak Hour Travel Times (2035)

Corridors	Termini	Length (Miles)	Peak Hour Travel Time (Rail)	Peak Hour Travel Time AM (Roadway)	Percent Travel Time Savings (AM)	Peak Hour Travel Time PM (Roadway)	Percent Travel Time Savings (PM)
Wake 1	UNC Hospitals - Wake Forest	59	97	52	-87%	74	-32%
Wake 2	TMC - Wake Forest	33	55	36	-52%	52	-6%
Wake 3	Veridea - Wake Forest	33	54	48	-14%	62	13%
Wake 4	Downtown Cary - Wake Forest	25	42	42	1%	58	28%
Wake 5	State Fairgrounds - Wake Forest	20	36	39	10%	59	39%
Wake 6	Downtown Raleigh - Wake Forest	17	29	41	29%	64	54%
Wake 7	TMC - NERC	24	40	20	-96%	27	-48%
Wake 8	NW Cary - NERC	18	30	25	-20%	31	4%
Wake 9	Downtown Cary - NERC	16	27	27	-2%	33	19%
Wake 10	State Fairgrounds - NERC	11	21	21	3%	34	39%
Wake 11	Downtown Raleigh - NERC	8	14	20	27%	32	55%
Wake 12	Duke Medical - Downtown Raleigh	29	45	36	-25%	46	3%
DO 1	UNC Hospitals - Wake Forest	59	97	52	-87%	74	-32%
DO 2	Duke Medical - Downtown Raleigh	29	45	36	-25%	46	3%
DO 3	UNC Hospitals - TMC	26	42	18	-127%	24	-72%
DO 4	UNC Hospitals - Alston Ave	17	31	22	-43%	29	-7%
DO 5	UNC Hospitals - Gateway	7	12	9	-37%	12	-5%
DO 6	Gateway - Alston Ave	10	18	13	-38%	20	6%

Note: The data listed in emboldened red are top performers for each respective evaluation criterion.

Figure 6.4 Peak Hour Travel Times (2035)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.



6.1.5 SUMMARY OF MOBILITY

When looking at all of the mobility measures, it is clear that total corridor trips, total rail trips and rail passenger trips are the highest in the corridors with the longest length. However, when the corridors are further examined using trips per mile, a different picture emerges. All of the measures that are based on passenger miles traveled are highly related to the overall project length and using these measures, the highest performing corridors are those that are the longest in length. The measures that use trips per mile provide the best means to select the most cost effective corridor for initial implementation.

The corridors that perform the best in terms of rail trips per mile are: Wake 9 (Downtown Cary to NERC); Wake10 (State Fairgrounds to NERC); DO 4 (UNC Hospitals to Alston Avenue); DO 5 (UNC Hospitals to Gateway). All of these corridors have approximately 400 rail trips per mile. The regional corridor, DO2/Wake 12 (Duke Medical to Downtown Raleigh) performs at a lower level with less than 300 rail trips per mile.

The corridor travel time measure is less clear in the distinction of the corridors. The purpose of this measure is to see where the corridors are where rail travel time can be competitive with the highway travel time during the peak periods where congestion is expected to occur on the highway system. Many of the longer corridors, Wake 2 (Wake Forest to TMC), for example, is a long "L" shaped corridor and the end-to-end highway trip would not follow the rail alignment, cannot be fairly evaluated by this measure. However, there are several corridor segments where the evaluation is meaningful. The corridor where rail travel time is most competitive with highway times is the north Raleigh corridor segment from downtown Raleigh to both Wake Forest (Wake 5 and Wake 6) and the NERC (Wake 10 and Wake 11) with the rail travel time having as much as a 50% travel time savings over the highway system during the PM peak period. This is logical in that this corridor is one of the most congested highway corridors in the region with major arterials and no major highway improvements planned.

The next best performing corridor by this measure is the regional corridor (DO 2/Wake 12 (Duke Medical to Downtown Raleigh) with the rail travel time during the PM peak period being essentially the same as the highway travel time. This is understandable given that I-40 parallels the corridor that is the most congested highway in the region with congestion delays occurring during both the AM and PM peak periods. The corridors between Durham and Orange County, DO 4 (UNC Hospitals to Alston Avenue), DO 5 (UNC Hospitals to Gateway), and DO6 (Gateway to Alston Avenue) also perform well with PM rail times only slightly higher than the highway travel times.

For these reasons, Wake 9 (Downtown Cary to NERC), Wake10 (State Fairgrounds to NERC), DO 4 (UNC Hospitals to Alston Avenue) and DO 5 (UNC Hospitals to Gateway) all perform best relative to the other corridors in terms of the broad mobility measure.

6.2 SOCIOECONOMIC

As an additional gauge of potential rail ridership in each corridor, an analysis of population, employment, and income was conducted using socio-economic data aggregated at a Traffic Analysis Zone (TAZ) geography for years 2005 and 2035. Similarly, most recent available data from the U.S. Census (2000), aggregated at a Census Block Group (BG) geography, was used to determine the number and density of low-income and minority persons within each corridor. For this analysis, low-income individuals are defined as persons in a household that are below poverty level, based on the following definition from the U.S. Census Bureau: "Families and



persons are classified as below poverty level if their total family income or unrelated individual income was less than the poverty threshold specified for the applicable family size, age of householder, and number of related children under 18 present.” The number and density of low-income and minority persons can be an informative indicator of potential ridership, as many among these populations are considered “transit dependent.” That is, their access to private transportation modes, such as the automobile, is limited.

6.2.1 POPULATION

The four corridors with the highest population and number of households in 2005 are the longest corridors, as shown in Table 6.5. Thus, household density (households/acre) is a more appropriate measure for comparing corridors, as the number of households is normalized by area. In 2005, downtown Durham and downtown Raleigh had the highest household densities of the entire corridor study area, as shown on Figure 6.5. As a result, the corridors concisely focused on these two areas, including DO6, W11, DO4, W9, W10, and W8 had the highest household densities among all of the corridors. From 2005 to 2035, the highest percentage growth is projected between downtown Raleigh and the Northeast Regional Center (NERC). As a result, by 2035 corridors W8, W9, W10, and W11 are projected to have the highest household densities among all of the corridors.

Table 6.5 Population Characteristics (2000 and 2035)

Corridors	Termini	Length (Miles)	Population			Households			Density (Households/Acre)		
			2005	2035	% Change	2005	2035	% Change	2005	2035	% Change
Wake 1	UNC Hospitals - Wake Forest	59	124,467	274,667	121%	39,906	100,333	151%	1.06	2.66	151%
Wake 2	TMC - Wake Forest	33	70,822	178,991	153%	22,037	66,973	204%	1.01	3.08	204%
Wake 3	Veridea - Wake Forest	33	77,005	189,116	146%	24,138	70,633	193%	1.11	3.24	193%
Wake 4	Downtown Cary - Wake Forest	25	60,719	150,618	148%	18,071	55,596	208%	1.10	3.39	208%
Wake 5	State Fairgrounds - Wake Forest	20	50,627	126,797	150%	14,054	45,881	226%	1.04	3.40	226%
Wake 6	Downtown Raleigh - Wake Forest	17	29,535	95,836	224%	12,240	39,886	226%	1.10	3.57	226%
Wake 7	TMC - NERC	24	61,234	158,274	158%	18,499	58,842	218%	1.16	3.69	218%
Wake 8	NW Cary - NERC	18	54,667	139,059	154%	15,964	51,257	221%	1.35	4.32	221%
Wake 9	Downtown Cary - NERC	16	51,131	129,901	154%	14,533	47,465	227%	1.37	4.48	227%
Wake 10	State Fairgrounds - NERC	11	41,039	106,080	158%	10,516	37,750	259%	1.36	4.88	259%
Wake 11	Downtown Raleigh - NERC	8	19,947	75,119	277%	8,703	31,755	265%	1.61	5.89	265%
Wake 12	Duke Medical - Downtown Raleigh	29	69,494	167,516	141%	19,487	58,788	202%	1.04	3.13	202%
DO 1	UNC Hospitals - Wake Forest	59	124,467	274,667	121%	39,906	100,333	151%	1.06	2.66	151%
DO 2	Duke Medical - Downtown Raleigh	29	69,494	167,516	141%	19,487	58,788	202%	1.04	3.13	202%
DO 3	UNC Hospitals - TMC	26	53,681	98,891	84%	17,884	34,590	93%	1.09	2.10	93%
DO 4	UNC Hospitals - Alston Ave	17	48,497	84,113	73%	15,847	28,897	82%	1.41	2.57	82%
DO 5	UNC Hospitals - Gateway	7	15,783	30,374	92%	3,691	8,663	135%	0.75	1.75	135%
DO 6	Gateway - Alston Ave	10	34,769	57,756	66%	12,961	22,095	70%	1.88	3.21	70%

Note: The data listed in emboldened red are top performers for each respective evaluation criterion.



Figure 6.5 2005 Household Density (Households per Acre)

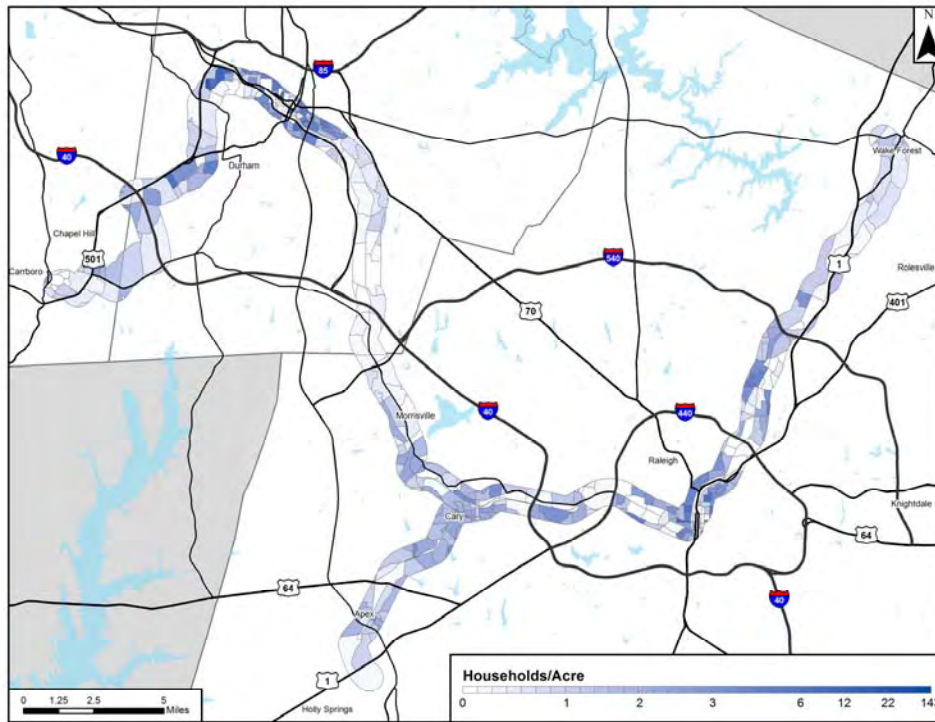


Figure 6.6 2035 Household Density (Households per Acre)

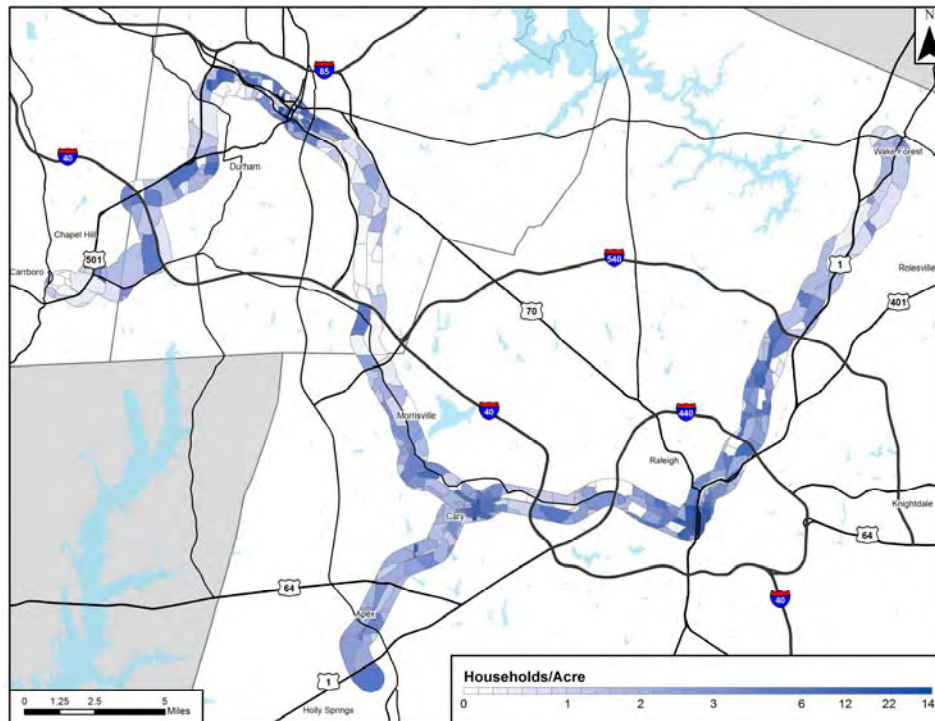
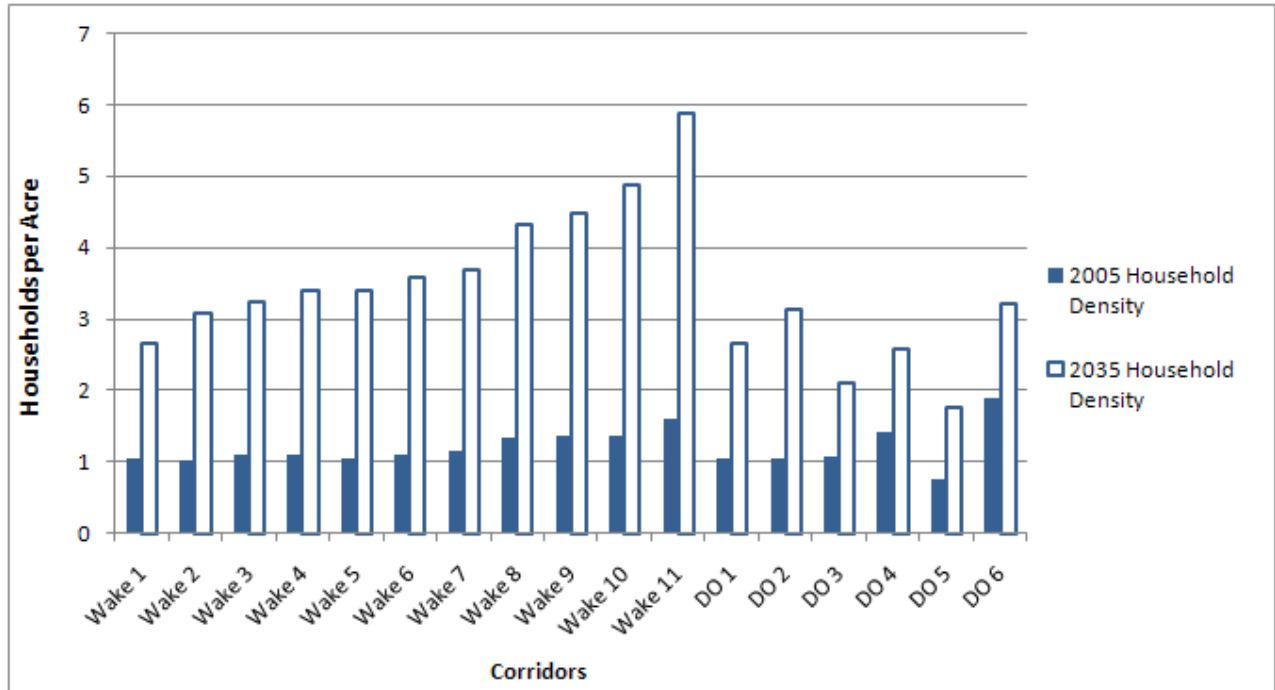




Figure 6.7 Household Density by Corridor (Households per Acre)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.

6.2.2 EMPLOYMENT

As with population, employment density is more appropriate than absolute employment numbers for comparing employment between the study corridors, as the corridors differ greatly in length and area. In 2005, the three corridors most centered on downtown Raleigh (W9, W10, and W11) and the corridor from Gateway to Alston Avenue (DO6) had the highest employment density (employees/acre) among the study corridors, as shown in Table 6.6 and on Figure 6.8. In 2035, these same four corridors are projected to remain highest in employment density, despite the highest percentage growth in the corridors: from TMC to Wake Forest (W2); downtown Raleigh Wake Forest (W6); UNC Hospitals to Alston Avenue (DO4); and UNC Hospitals to Gateway (DO5).



Table 6.6 Employment Characteristics (2005 and 2035)

Corridors	Termini	Length (Miles)	Total Employment			Employment Density (Employees/Acre)		
			2005	2035	% Change	2005	2035	% Change
Wake 1	UNC Hospitals - Wake Forest	59	191,673	361,061	88%	5.1	9.6	88%
Wake 2	TMC - Wake Forest	33	106,579	207,024	94%	4.9	9.5	94%
Wake 3	Veridea - Wake Forest	33	99,095	190,746	92%	4.6	8.8	92%
Wake 4	Downtown Cary - Wake Forest	25	93,451	170,486	82%	5.7	10.4	82%
Wake 5	State Fairgrounds - Wake Forest	20	85,718	150,969	76%	6.3	11.2	76%
Wake 6	Downtown Raleigh - Wake Forest	17	61,897	120,126	94%	5.5	10.8	94%
Wake 7	TMC - NERC	24	101,124	187,575	85%	6.3	11.8	85%
Wake 8	NW Cary - NERC	18	90,466	159,174	76%	7.6	13.4	76%
Wake 9	Downtown Cary - NERC	16	87,997	151,037	72%	8.3	14.2	72%
Wake 10	State Fairgrounds - NERC	11	80,264	131,520	64%	10.4	17.0	64%
Wake 11	Downtown Raleigh - NERC	8	56,443	100,678	78%	10.5	18.7	78%
Wake 12	Duke Medical - Downtown Raleigh	29	127,830	234,467	83%	6.8	12.5	83%
DO 1	UNC Hospitals - Wake Forest	59	191,673	361,061	88%	5.1	9.6	88%
DO 2	Duke Medical - Downtown Raleigh	29	127,830	234,467	83%	6.8	12.5	83%
DO 3	UNC Hospitals - TMC	26	88,340	158,426	79%	5.4	9.6	79%
DO 4	UNC Hospitals - Alston Ave	17	67,392	131,286	95%	6.0	11.7	95%
DO 5	UNC Hospitals - Gateway	7	17,988	38,131	112%	3.6	7.7	112%
DO 6	Gateway - Alston Ave	10	52,619	99,574	89%	7.6	14.4	89%

Note: The data listed in emboldened red are top performers for each respective evaluation criterion.

Figure 6.8 2005 Employment Density (Employees per Acre)

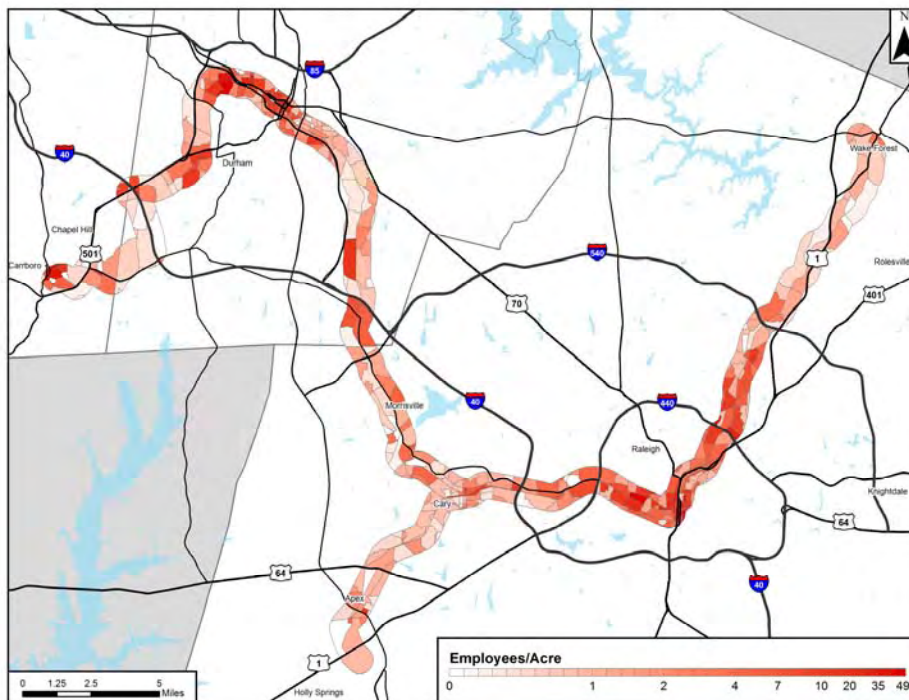




Figure 6.9 2035 Employment Density (Employees per Acre)

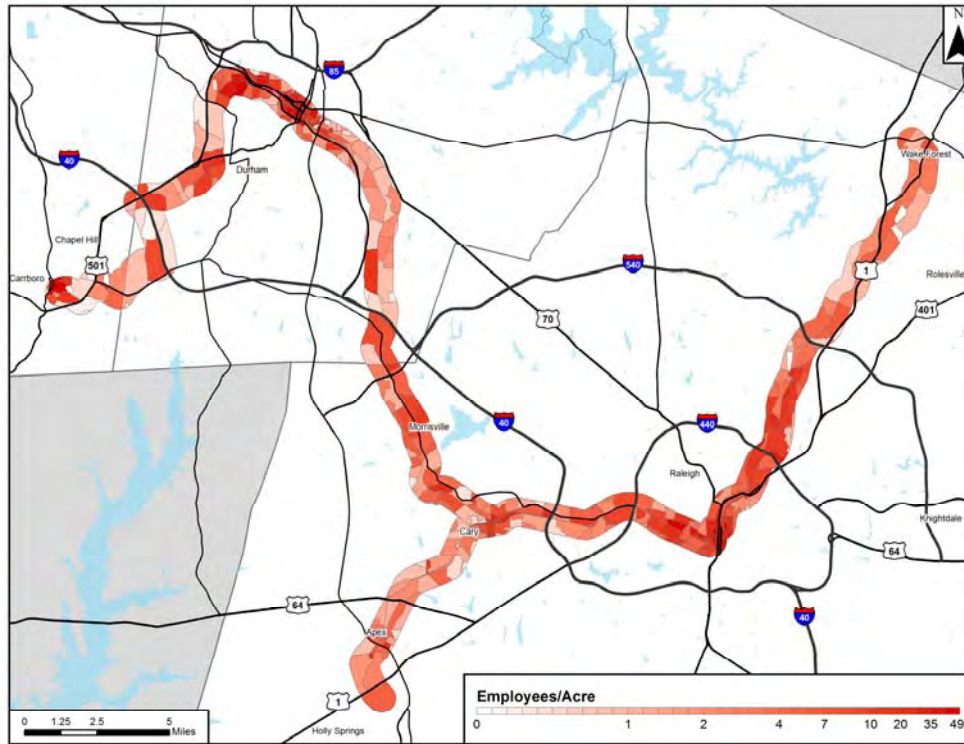
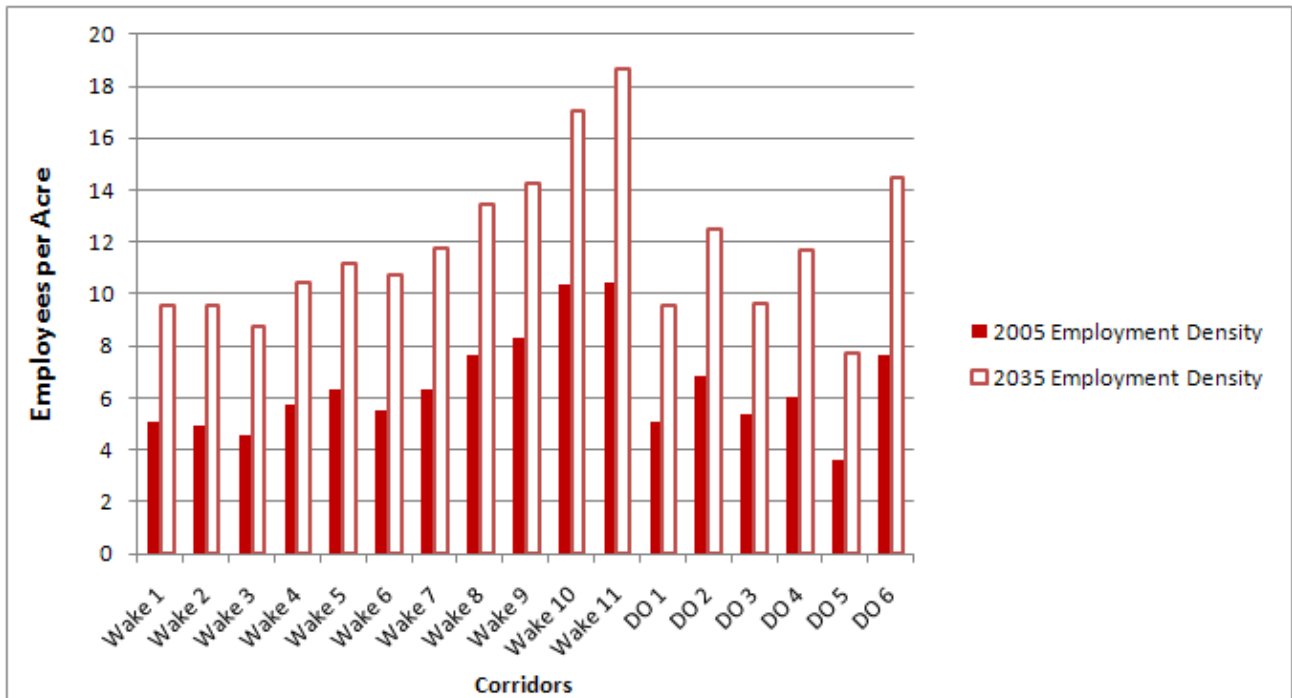


Figure 6.10 2005 and 2035 Employment Density by Corridor (Employees per Acre)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.



6.2.3 INCOME

Comparison of income levels alone is not a good indicator of corridor performance however the comparison of 2005 data and 2035 projections is useful in identifying income trends that may be relevant to trends in poverty. Among all of the study corridors, the corridor between Gateway in Chapel Hill and Alston Avenue in Durham (DO6) had the highest percentage of the population below the poverty level in 2000, the lowest mean income in 2005, and is projected to have the lowest mean income in 2035. Corridors DO2, DO3, and DO4 were also among the four lowest mean incomes in both 2005 and 2035, as shown in Table 6.7. All four of these corridors include the section between Erwin/Morreene Roads and Alston Avenue, which has the most severe levels of poverty among the entire study area, as shown on Figure 6.13. Interestingly, the corridor from UNC Hospitals to Gateway (DO5) had the highest mean income in 2005 by a margin of nearly 30% over the next highest corridor, but ranked among the top four highest corridors in terms of percentage below poverty in 2000. This is likely explained by the large UNC student population within this corridor, with little or no income.

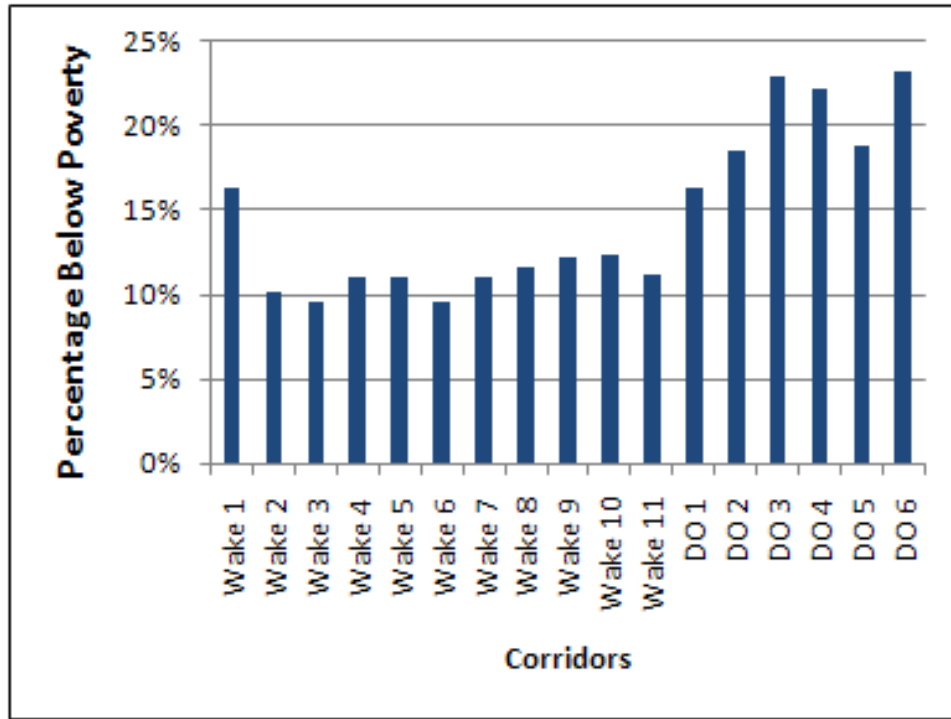
Table 6.7 Income Characteristics

Corridors	Termini	Length (Miles)	Mean Income			Below Poverty	% Below Poverty	Poverty Density (Persons per Acre)
			2005	2035	% Change	2000	2000	2000
Wake 1	UNC Hospitals - Wake Forest	59	\$54,852	\$56,258	3%	17,472	16%	0.46
Wake 2	TMC - Wake Forest	33	\$61,991	\$58,959	-5%	5,770	10%	0.27
Wake 3	Veridea - Wake Forest	33	\$64,059	\$61,092	-5%	5,986	10%	0.27
Wake 4	Downtown Cary - Wake Forest	25	\$58,867	\$57,711	-2%	5,470	11%	0.33
Wake 5	State Fairgrounds - Wake Forest	20	\$57,969	\$57,632	-1%	4,303	11%	0.32
Wake 6	Downtown Raleigh - Wake Forest	17	\$59,238	\$58,741	-1%	2,726	10%	0.24
Wake 7	TMC - NERC	24	\$60,186	\$57,848	-4%	5,398	11%	0.34
Wake 8	NW Cary - NERC	18	\$58,091	\$57,307	-1%	5,296	12%	0.45
Wake 9	Downtown Cary - NERC	16	\$55,809	\$56,121	1%	5,098	12%	0.48
Wake 10	State Fairgrounds - NERC	11	\$53,442	\$55,616	4%	3,931	12%	0.51
Wake 11	Downtown Raleigh - NERC	8	\$54,283	\$56,628	4%	2,354	11%	0.44
Wake 12	Duke Medical - Downtown Raleigh	29	\$50,613	\$53,042	5%	10,596	18%	0.56
DO 1	UNC Hospitals - Wake Forest	59	\$54,852	\$56,258	3%	17,472	16%	0.46
DO 2	Duke Medical - Downtown Raleigh	29	\$50,613	\$53,042	5%	10,596	18%	0.56
DO 3	UNC Hospitals - TMC	26	\$46,067	\$50,084	9%	11,705	23%	0.71
DO 4	UNC Hospitals - Alston Ave	17	\$46,989	\$52,030	11%	10,015	22%	0.89
DO 5	UNC Hospitals - Gateway	7	\$82,011	\$80,635	-2%	2,437	19%	0.49
DO 6	Gateway - Alston Ave	10	\$37,502	\$41,063	9%	7,660	23%	1.11

Note: The data listed in emboldened red are top performers for each respective evaluation criterion.

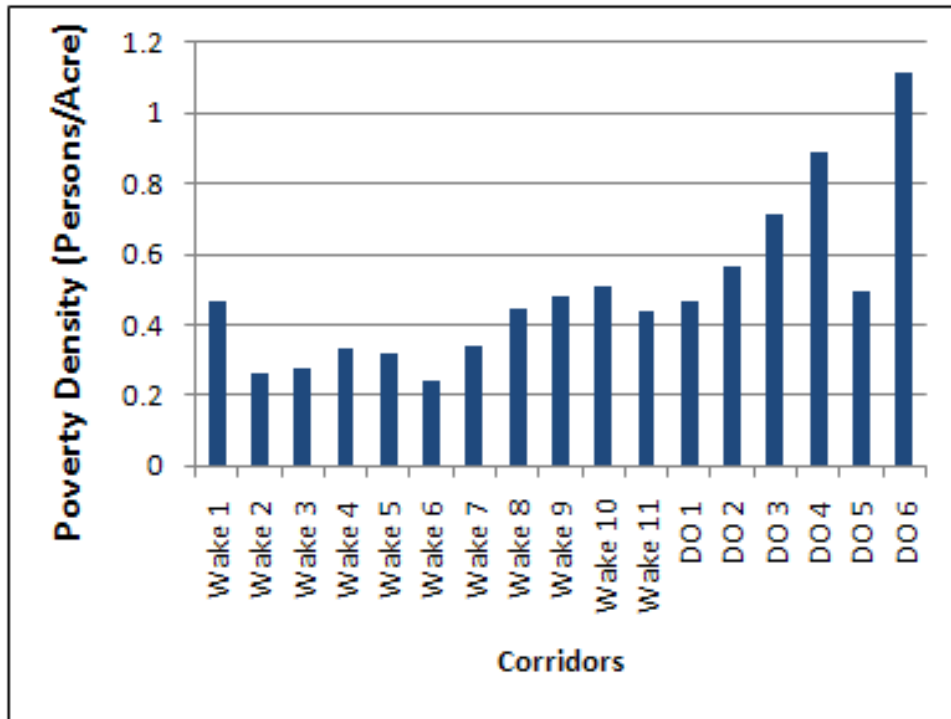


Figure 6.11 Percent Below Poverty Level (2000)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.

Figure 6.12 Density of Persons Below Poverty Level (2000)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.



Figure 6.13 2000 Poverty Density (Persons per Acre)

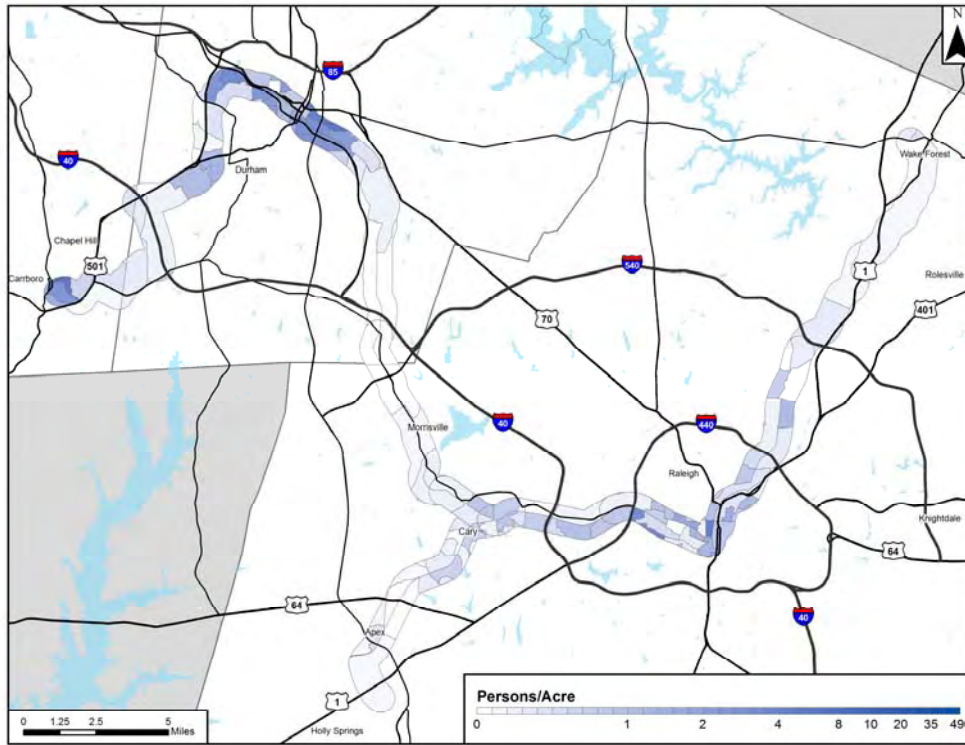
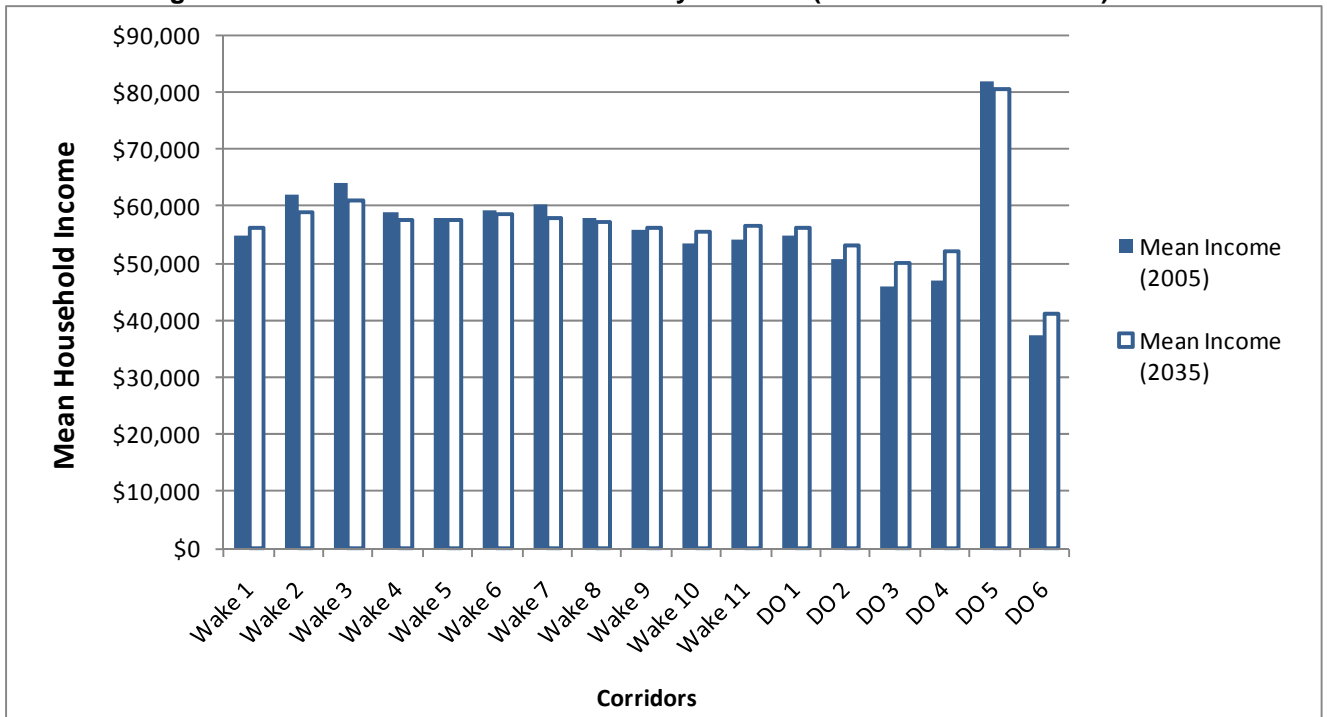


Figure 6.14 Mean Household Income by Corridor (2005 Constant Dollars)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.



6.2.4 MINORITY POPULATION

Among all of the study corridors, the corridor between Gateway in Chapel Hill and Alston Avenue in Durham (DO6) had the highest percentage minority population in 2000. Corridors DO2, DO3, and DO4 were also among the four corridors with the highest percentage minority population, as shown in Table 6.8. All four of these corridors include the section between Erwin/Morreene Roads and Alston Avenue, which has the highest minority population density among the entire study area. Figures 6.15 and 6.16, respectively, graphically show percent minority population and density by corridor. Figure 17 shows minority population density within the overall study corridor

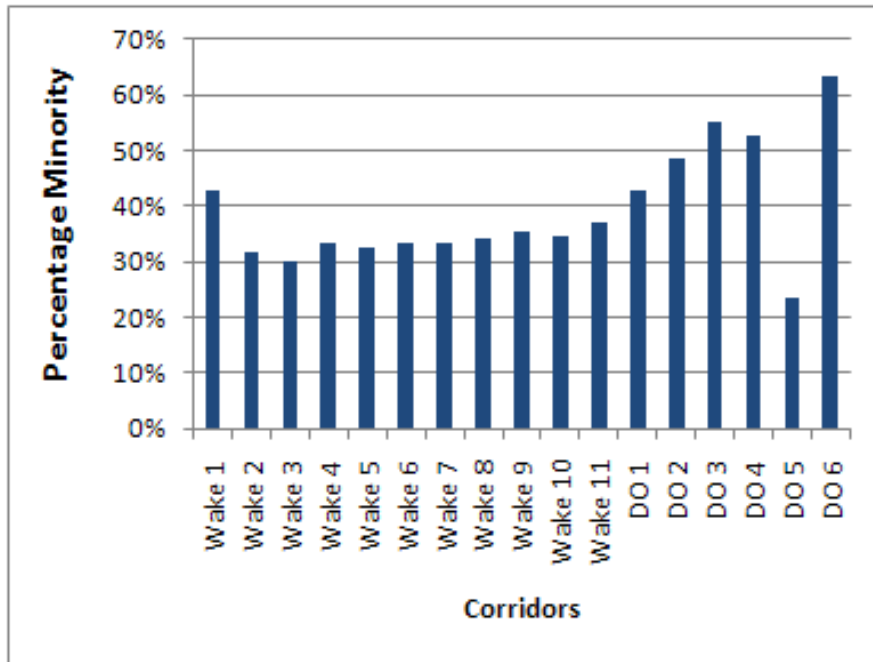
Table 6.8 Minority Population (2000)

Corridors	Termini	Length (Miles)	Minority	%	Minority Density (Persons per Acre)
			2000	2000	2000
Wake 1	UNC Hospitals - Wake Forest	59	46,165	43%	1.22
Wake 2	TMC - Wake Forest	33	18,010	32%	0.83
Wake 3	Veridea - Wake Forest	33	18,937	30%	0.87
Wake 4	Downtown Cary - Wake Forest	25	16,509	33%	1.01
Wake 5	State Fairgrounds - Wake Forest	20	12,694	32%	0.94
Wake 6	Downtown Raleigh - Wake Forest	17	9,434	33%	0.84
Wake 7	TMC - NERC	24	7,761	37%	1.44
Wake 8	NW Cary - NERC	18	16,337	33%	1.02
Wake 9	Downtown Cary - NERC	16	15,670	34%	1.32
Wake 10	State Fairgrounds - NERC	11	14,835	35%	1.40
Wake 11	Downtown Raleigh - NERC	8	11,021	35%	1.43
Wake 12	Duke Medical - Downtown Raleigh	29	27,794	48%	1.48
DO 1	UNC Hospitals - Wake Forest	59	46,165	43%	1.22
DO 2	Duke Medical - Downtown Raleigh	29	27,794	48%	1.48
DO 3	UNC Hospitals - TMC	26	28,184	55%	1.71
DO 4	UNC Hospitals - Alston Ave	17	23,827	53%	2.12
DO 5	UNC Hospitals - Gateway	7	3,067	24%	0.62
DO 6	Gateway - Alston Ave	10	20,989	64%	3.05

Note: The data listed in emboldened red are top performers for each respective evaluation criterion.

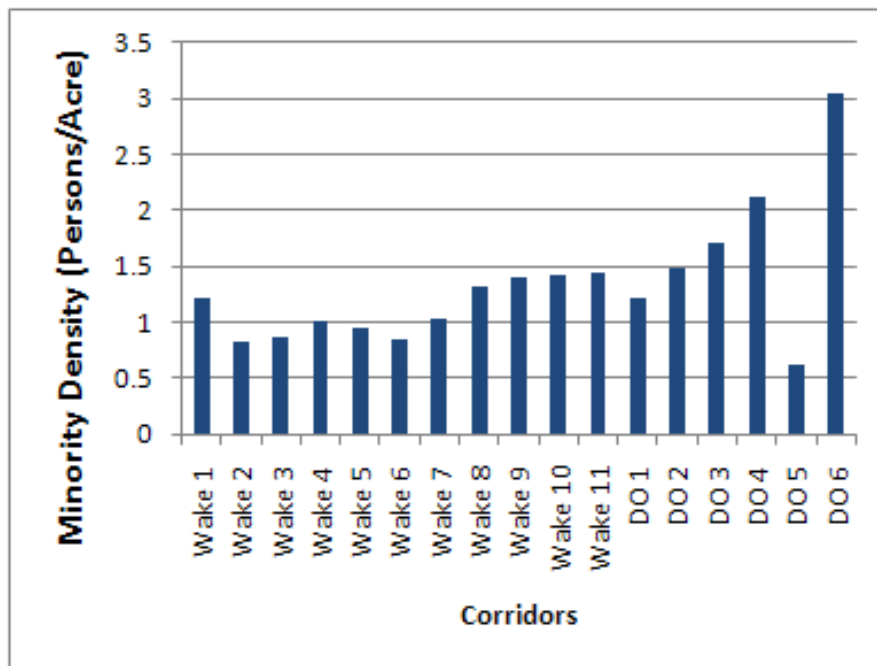


Figure 6.15 Percentage Minority (2000)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.

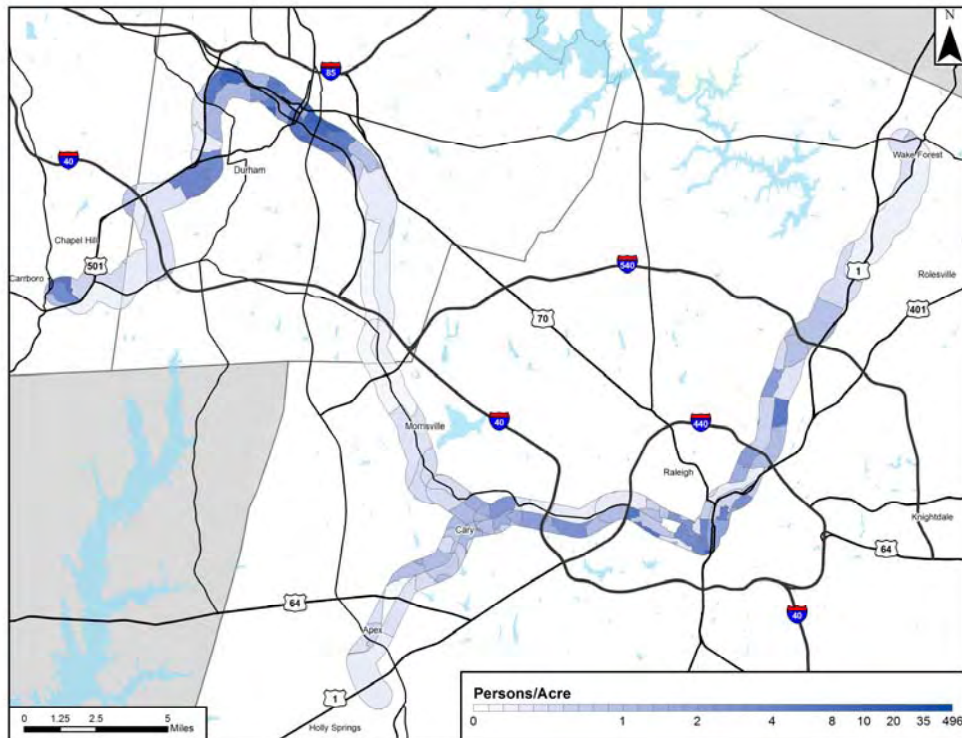
Figure 6.16 Minority Population Density (2000)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.



Figure 6.17 2000 Minority Population Density (Persons per Acre)



6.2.5 SUMMARY OF SOCIOECONOMIC CRITERIA

One of the most significant indicators of transit demand is the amount and density of population and employment served by the service. The more trip makers that live, work, and have other trip destinations within close proximity of the service, particularly fixed guideway service, the higher the likelihood of taking transit. The probability of taking transit decreases as the distance from the service increases and potential riders must use additional modes of access (park and ride, feeder bus, and distribution systems). These higher levels of population and employment density occur predominately in the city center areas.

The corridor alternatives serving the segment from downtown Raleigh to the NERC have the highest levels of future household and employment densities. These include Wake 8 (Northwest Cary to NERC), Wake 9 (Downtown Cary to NERC), Wake 10 (State Fairgrounds to NERC), and Wake 11 (Downtown Raleigh to NERC). The Durham Orange corridors that service the central area of downtown Durham have the highest levels of future households and employment densities. These include DO 6 (Gateway to Alston Avenue) and DO 2/Wake 12 (Duke Medical to Downtown Raleigh). While performing well relative to the Durham Orange corridors, the regional corridor of DO2/Wake 12 household and employment values are largely driven by the ends of the corridor in the downtowns of Durham and Raleigh. The central portion of the corridor largely passing through the Research Triangle Park has relatively low levels of household and employment densities. While the Research Triangle Park has high levels of employment, the actual density of employment is low, due to the large area of the Research Triangle Park. It should be noted that the major university student populations living on campus in dormitories are not included in the household summaries but are accounted for in the ridership estimations through the regional travel demand model.



Since the regional transit system must also provide service to the lower income residents that are likely to be dependent on public transit service, an important measure is the areas of low income or with the dominance of households with income below the poverty level. For all of the corridor areas, the area of east Durham has the highest levels of low income households and the highest numbers of households that are below the poverty levels. This same area also has the highest concentration of minority households, a factor that is important in the selection of the priority corridors. These corridors include DO 6 (Gateway to Alston Avenue), DO 3 (UNC Hospitals to Triangle Metro Center), and DO 4 (UNC Hospitals to Alston Avenue).

6.3 LAND USE

Focusing on forming a stronger link between land use and transportation in order to maximize use of existing and future transportation facilities and reducing demand for new infrastructure is integral to sustainable growth and economic development. This is especially true in the Triangle Region where the historical development pattern has been of low density suburban sprawl. A strong transit system combined with effective land use policies and development regulations is integral to organizing and guiding the projected growth and development toward higher densities along transportation corridors.

The land use analysis presented in this Transitional Analysis follows a broad spectrum approach that is appropriate for evaluation of corridor segments without consideration of specific station locations. A much more rigorous and detailed analysis of land use, transit-oriented development (TOD), and potential for joint development opportunities will occur during Alternatives Analysis, after the preferred corridors have been selected. This will allow for a focused analysis of each preferred corridor where detailed land use analysis will be critical to evaluating alignments and determining station locations.

An analysis of land use within approximately ½ mile from the centerline of the proposed transit corridors was conducted to determine the degree to which current, proposed, and potential development patterns are supportive of transit. To help inform this analysis, interviews and/or correspondence with planning staff from most local jurisdictions and agencies were conducted to elicit information on the future development/redevelopment potential of affected land within their respective jurisdictions. Additionally, the most recent comprehensive and/or transportation plans for each jurisdiction were carefully reviewed.

The land use analysis for the 18 corridors was based on the following three key criteria:

- Public sector/regulatory support
 - Existing comprehensive plans consistent with the concepts of compact, mixed-used development near public transportation, or TOD
 - Allowable densities and flexibility of zoning districts
- Activity centers served
 - Urban centers, including the region's three primary centers (Raleigh, Durham, and Chapel Hill): central business districts
 - Major activity centers, including: colleges and universities (identifying the region's two largest – UNC and NCSU), and suburban employment centers
 - Other special activity centers: fairgrounds, arenas, hospitals



- Development potential
 - Existing (2005) and Projected (2035) Transportation Analysis Zone for household and employment, including absolute and percentage growth over the timeframe
 - Transportation Analysis Zone projected (2035) household and employment density
 - A Relative Future Density/Growth Factor that combined an evaluation of future (2035) household and employment density and growth (2005-2035) relative to the corridor miles provided

6.3.1 PUBLIC SECTOR/REGULATORY SUPPORT FOR TRANSIT-ORIENTED DEVELOPMENT

All of the jurisdictions within the Triangle Regional Transit Program acknowledge and recognize the potential for passenger rail service and the implications for TOD in their most recent long range plans. The jurisdictions vary, however, in the degree to which they allow higher densities and the degree to which they have adopted provisions to facilitate higher densities or have a history of implementing more compact development. Additional communication with planning staff in these jurisdictions confirms their respective commitments to TOD around transit stations in particular and corridors in general, and their intent to ensure land use regulations are transit supportive. In selected cases, provisions have been made to prepare TOD supportive small area plans in the event a transit station should locate within a certain jurisdiction.

In addition to TOD supportive jurisdictional policies, the area's institutional private sector has, to varying degrees, policies that are transit supportive, particularly for employees. Many workers in downtown Raleigh, Durham, and Chapel Hill must pay for parking which encourages more transit use. Parking is provided, however, in suburban employment centers, such as Research Triangle Park.

The major universities and associated medical centers have policies which require commuters wanting to drive and park on the campus to purchase a parking permit, and offer financial or other incentives for using transit or other alternative forms of transportation for commuting. The University of North Carolina at Chapel Hill, North Carolina State University and Duke University all have such policies. UNC-Chapel Hill also has limited the number of parking spaces, so that many employees cannot obtain a permit. Parking for commuting students also is very limited. While many commuters use a combination of park and ride and transit to reach the campus, many others use local or regional transit directly from their homes. For example, at UNC just over 60 percent of all employees drive alone and park on the campus, a much lower ratio than other employment sites in the region. Over 16 percent use transit today, many times the ratio for other locations in the Triangle Region.

These policies are additional to the host municipality TOD policies and actions. The impact of these policies is generally not well captured in the transit ridership projections which are underestimated by the regional travel forecasting model for these locations. The model also does not account for restrictions in parking supply, such as at UNC. That results in likely more transit use and likely more transit supportive development. Therefore, the corridors that have larger urban centers, such as downtown Raleigh- Durham and Chapel Hill and serve the larger universities (UNC and NCSU) are more likely to encourage more transit supportive land use.

While all jurisdictions have adopted transit supportive land use policies, Table 6.9 identifies relevant jurisdictions where a TOD Overlay Zone is specifically provided for in the zoning



ordinance, or a high density flexible district that acknowledges the potential for a transit station and transit supportive development. Zoning by Right indicates the highest amount of currently allowable densities by rezoning code (with the exception of those allowed by small area plans and TOD overlays). Density of Zoning by Right is identified as Low, Medium, or High, under the following criteria:

Low: < 15 units per acre or approximate equivalent of 0.4 FAR (FAR = Sq. Ft. of building/Sq. Ft. of land area)

Medium: 15 to 50 units per acre or approximately 0.4 to 1.5 FAR

High: > 50 units per acre or approximately a 1.5 FAR

Table 6.9 TOD Zoning Summary by Jurisdiction

Planning Jurisdiction	TOD Overlay Zone	High Density Mixed Use District	Density of Zoning by Right
Town of Wake Forest		X	Low
City of Raleigh	X		High
Town of Cary		X	Medium
Town of Apex		X	Low
Town of Morrisville		X	Low
City of Durham/ Durham County		X	High
Town of Chapel Hill	X		Medium
Wake County		X	Low

The proposed 18 corridors pass through varying numbers of jurisdictions and serve multiple transit stations. Table 6.10 identifies high, medium or low alternatives based on the number of stations served within the various jurisdictions, factoring in their currently allowable densities and using the criteria presented above. Alternatives identified as having high densities of Zoning-By-Right contain higher numbers of stations within jurisdictions with the highest allowable densities at this time (Raleigh and Durham).



Table 6.10 TOD Zoning Summary by Alternative Corridor

Alternatives	Termini	Stations	Density of Zoning by Right
Wake 1	UNC Hospitals - Wake Forest	38	Medium
Wake 2	TMC - Wake Forest	20	Medium
Wake 3	Veridea - Wake Forest	20	Medium
Wake 4	Downtown Cary - Wake Forest	15	Medium
Wake 5	State Fairgrounds - Wake Forest	13	Medium
Wake 6	Downtown Raleigh - Wake Forest	11	Medium
Wake 7	NERC - TMC	16	Medium
Wake 8	NW Cary - NERC	12	High
Wake 9	Downtown Cary - NERC	11	High
Wake 10	State Fairgrounds - NERC	9	High
Wake 11	Downtown Raleigh - NERC	7	High
Wake 12	Duke Medical - Downtown Raleigh	16	Medium
DO 1	UNC Hospitals - Wake Forest	38	Medium
DO 2	Duke Medical - Downtown Raleigh	16	Medium
DO 3	UNC Hospitals - TMC	19	High
DO 4	UNC Hospitals - Alston Ave	17	High
DO 5	UNC Hospitals - Gateway	7	Medium
DO 6	Gateway - Alston Ave	11	Medium

Table 6.11 is a short synopsis of TOD-related policies contained in comprehensive plans and zoning documents by jurisdiction.



Table 6.11 TOD Support from Comprehensive Land Use and/or Transportation Plans

Planning Jurisdiction	Local Land Use	Allowable Residential Densities by Zoning	Allowable Non-Residential Densities by Zoning
Town of Wake Forest	"Promote future transit plans by encouraging transit-supportive design features in areas targeted (true compact mixed-use developments) for transit services such as likely station sites." ¹	Zoning Ordinance provides a Traditional Neighborhood Zone, minimum development size is 60 acres. Density is determined at Master Plan approval, building heights cannot exceed 4 stories . Maximum allowable density under conventional R-8 zoning is 10 DU's/acre	Zoning Ordinance provides a Historic Core (RA-HC) Zone that accommodates commercial, office, and residential uses. Maximum height is 4 stories up to 60'. Minimum setbacks are 0 feet (maximum front setback of 5 feet).
City of Raleigh	"Highest density should occur...within close proximity to transit stations." ² "Promote transit-oriented development around planned transit stations through appropriate development regulation, education, station area planning, public-private partnerships, and regional cooperation." ³	Zoning Ordinance provides for a Transit Oriented Development Overlay District (TODOD) that concentrates high density residential development and support services and establishes a broad mix of land uses. Small area plans can be prepared for Transit Station Areas. Downtown Overlay District allows up to 320 DU's/acre .	Zoning Ordinance provides for an Office and Institution-1 Zone with a maximum FAR of 1.0. The FAR of the Office and Institution-1 Zone may be increased in areas subject to the Downtown Overlay District at the approval of the Planning Commission. The Zoning Ordinance also provides for a Transit Oriented Development Overlay District, the minimum FAR of which is that of the applicable adopted transit station area plan.
Town of Cary	"Support multi-modal travel by facilitating imaginative planning for the Town's two station areas on the Triangle Transit Authority light rail line - focusing development at nodes instead of strip commercial development." ⁴	New Land Development Ordinance allows for a High Intensity Mixed Use District (H-MXD): 50 DU's/acre, 90' building height	Land Development Ordinance provides for a Town Center District, which includes an Office and Institution Subdistrict. Maximum height in this subdistrict is 90'. No minimum setbacks for this subdistrict.
Town of Apex	Apex Comprehensive Plan acknowledges the TTA regional rail transit system and the plan for a transit station in Apex.	Zoning Ordinance provides for a Major Employment Center District (MEC-CZ) which encourages development of a flexible mix of uses promotes and expands opportunities for public transportation. Max. residential density in High Density Multifamily District is 14 DU's/acre .	Unified Development Ordinance provides for an Office & Institution Zone, which provides for a maximum height of 60' and minimum setbacks (front, side and rear) of 20'. Maximum built-upon area varies from 65 to 70% based on use.
Town of Morrisville	The Morrisville Land Use Plan has provisions for TOD at the proposed McCrimmon Parkway Station.	Zoning Ordinance provides for a Mixed Use District to accommodate the development of a fully designed project that may incorporate a range of use and provide substantial flexibility from development standards of conventional districts. Max. residential density in conventional districts is 8 DU's/acre .	Zoning Ordinance provides for a Mixed Use District for which there is no maximum height or minimum setbacks. General Business District allows for building heights of 50' with setbacks ranging from 10 to 30 (side to front).
City of Durham/ Durham County	"Development in Suburban Transit Areas shall...ensure that, at build-out, minimum required densities in a transit-supportive form shall be achieved." ⁶	Durham 2020 Comprehensive Plan allows for a Residential Multifamily Compact Neighborhood (RM-CN): 80 DU's/acre, 145' building height	Zoning Ordinance provides for a General Office and Institutional District which allows for moderate to high intensity employment and community service activities. Minimum front and rear setbacks are 35' and side setback minimum of 8'. Maximum height of 90' with 50' side yards. Zoning Ordinance provides for a Central Business District for which there are no minimum setbacks nor height requirements.
Town of Chapel Hill	"a fixed guideway stop...should be combined with other civic, governmental, or mixed-use developments to provide alternatives to the use of the automobile and to enhance the pedestrian-oriented environment." ⁷	Zoning Ordinance provides for a Transit Oriented Development District. Highest allowable residential density in conventional districts is 15 DU's/acre and 0.5 FAR .	Zoning Ordinance provides for a 0.5 FAR in the Transit Oriented Development District.
Wake County	"The Board of Commissioners...endorsed an action agenda for regional public transportation, which included proposals to change land use patterns to support public transportation." ⁹	Zoning Ordinance provides for three flexible districts, Planned Development (PD), Classic Mixed-Use (CMU), and Residential Mixed-Use (RMU). Highest allowable residential density in Zoning Ordinance provides for 4.35 DU's/acre .	Zoning Ordinance provides for a General Business District (GB) for which there is no maximum height, no maximum impervious coverage, and no setbacks when abutting railroad (if not abutting railroad, setbacks are 25' for side and rear and 50' for front and corner).
Orange County	"Coordinate the location of higher intensity / high density residential and non-residential developments with existing or planned locations of public transportation..." "Coordinate land use patterns to facilitate the expanded use of non-auto modes of travel"	Highest allowable residential density in Zoning Ordinance provides for 14 DU's/acre, maximum building height is 45' .	Zoning Ordinance provides for General Commercial-IV (GC-4) Zone, for which there is a maximum height of 45' and no minimum setbacks, and a maximum FAR of 0.566 for planned development and 0.492 for non-planned development.



In terms of support of public policies, all of the jurisdictions provide strong policy support for TOD. The City of Raleigh allows higher density by right than the other jurisdictions with 320 dwelling units per acre in their Downtown Overlay District, followed by Durham which allows 80 dwelling units per acre and 145-foot building heights in a residential multi-family compact neighborhood. Cary and Chapel Hill offer a more mid-range density by right (15 to 50 units per acre approximately a 0.4 to 1.5 FAR). Wake Forest, Wake County, Orange County, Morrisville and Apex offer a lower density by right. Corridor alternatives that have the highest proportion of potential station areas in jurisdictions allowing higher density could be considered as currently providing more transit supportive policies.

6.3.2 ACTIVITY CENTERS SERVED

Activity centers are areas with mixed or multiple land uses or unique facilities that generate and attract person trips. The total number of activity centers served provides a less meaningful comparison because the size and type of those centers varies greatly. For the purposes of this analysis, activity centers are grouped into three major categories with an emphasis on identifying those activity centers of the most transit land use supportive character (pedestrian environment, compact development, limited parking, etc), and largest scale (employees, students, activity generators and attractors, etc):

- Urban Centers
 - Comprised of the urban cores, or downtowns. Downtowns are typified by their relatively high concentrations of employment and a daytime population that commutes into and out of the urban core on a daily basis, five days a week. They are, by their very nature, transit-friendly.
 - The primary urban cores that anchor the region are the downtowns of Raleigh, Durham, and Chapel Hill.
 - Secondary urban cores (in terms of employees, households and activity generators) are the town centers of Wake Forest, Cary and Apex.
- Major Activity Centers
 - Colleges and universities, include: NC State (NCSU), UNC, Duke, NC Central, Meredith College, Shaw University, and Peace College. They are also, by their nature, transit-friendly with a compact, pedestrian-friendly environment, limited parking, and a large number of transit dependent students.
 - The three largest institutions and complexes in this group are NC State University with approximately 31,000 students and 8,000 faculty and staff, and UNC at Chapel Hill and University Hospital with approximately 29,000 students and 7,000 faculty and staff, and Duke University and University Medical facilities with approximately 13,000 students and 1,800 faculty and staff. It is estimated that over half of the students commute to classes at each university.
 - Suburban employment nodes and corridors are generally less transit-friendly in terms of density, pedestrian character, parking provided, and design. These include: Research Triangle Park (RTP), North East Regional Center (NERC), State Government Center, NC 54 Corridor, Gateway, East 54, Glenn Lennox, Meadowmont, Leigh Village, and I-40.



- Special Activity Centers
 - Hospitals: UNC, Duke, Veterans Affairs which are highly concentrated employment centers.
 - Event centers: State Fairgrounds, Carter Finley Stadium, RBC Center, Durham Bulls Athletic Park which vary greatly in terms of attendance and number of event days.
- Primary Transit Supportive Activity Centers — These six centers comprise the urban cores of Raleigh, Durham, and Chapel Hill. Also included are NCSU, the combined Duke University campus and hospital complex, and the combined UNC campus and hospital complex. In all three cases the student and employee populations exceed 30,000, with UNC exceeding 50,000.

Table 6.12 shows the number of activity centers within each of the 18 proposed transit route alternatives by category, and an identification of the number of the Transit Supportive Primary Activity Centers (downtown Raleigh, Durham, and Chapel Hill and UNC, NCSU and Duke) served by a given corridor.

The Wake 1 and Durham/Orange (DO) 1 alternatives serve all 18 identified activity centers and the six primary transit supportive activity centers, and would be considered high performers under this criterion. Alternatives that serve three to four of the primary transit supportive alternative centers would be considered medium performers, and those that serve one to two would be considered low performers, under this criterion.

Table 6.12 Activity Centers within Transit Alternatives

Alternatives	Termini	Urban Centers	Major Activity	Special Activity	Total	Primary Activity*
Wake 1	UNC Hospitals - Wake Forest	5	11	6	22	6
Wake 2	TMC - Wake Forest	3	6	3	12	2
Wake 3	Veridea - Wake Forest	4	5	3	12	2
Wake 4	Downtown Cary - Wake Forest	3	5	3	11	2
Wake 5	State Fairgrounds - Wake Forest	2	4	3	9	2
Wake 6	Downtown Raleigh - Wake Forest	2	5	3	10	2
Wake 7	TMC - NERC	2	6	3	11	2
Wake 8	NW Cary - NERC	2	5	3	10	2
Wake 9	Downtown Cary - NERC	2	5	3	10	2
Wake 10	State Fairgrounds - NERC	1	5	3	9	2
Wake 11	Downtown Raleigh - NERC	1	5	0	6	1
Wake 12	Duke Medical - Downtown Raleigh	3	8	5	12	4
DO 1	UNC Hospitals - Wake Forest	5	11	6	22	6
DO 2	Duke Medical - Downtown Raleigh	3	8	5	16	4
DO 3	UNC Hospitals - TMC	2	6	3	11	4
DO 4	UNC Hospitals - Alston Ave	2	5	3	10	4
DO 5	UNC Hospitals - Gateway	1	3	1	5	2
DO 6	Gateway - Alston Ave	1	3	2	6	2
Mean		2.44	5.89	3.22	11.33	3.19

*Primary transit supportive activity centers: Downtown Raleigh, Durham, Chapel Hill, NCSU, Duke U & Medical, UNC & Medical



6.3.3 FUTURE TRANSIT-ORIENTED DEVELOPMENT (TOD) POTENTIAL

A series of factors were utilized to identify future TOD potential for each corridor alternative by focusing on existing and projected household and employment data and the growth in households and employment. Potential for new TOD is a function of the density of households and employment in the corridor alternative and the growth that is projected. A Relative Future Density/Growth (RFDG) factor was formulated and normalized on a per mile basis to summarize the density and growth factors and adjust for the general level of transit investment required and land area involved.

Table 6.13 and 6.14 respectively show existing and future households and employment by corridor alternative, as well as the projected absolute and percentage growth by corridor alternative. All of these factors have been indexed against the corridor alternative generating the highest households, employment or change in households and employment over the projection period. This measures how each corridor alternative services existing or future households and employment and the absolute or relative change through 2035.

Table 6.15 displays the 2035 projected household and employment densities for the corridor alternatives, plus the estimated number of proposed stations and miles for each corridor alternative.

Table 6.16 calculates a Relative Future Density/Growth (RFDG) Factor for each corridor alternative. This factor combines the prior density factors with the projected growth in households and employment and adjusts for the number of corridor miles. This is a combination of future density and projected growth served relative to the transit investment required and geographic area involved. Subsequent detailed station area and policy analysis would be needed to establish the ability to effectuate and concentrate more transit sensitive development.

Relative Future Density/Growth (RFDG) Factor is a function of projected employment and household density in 2035, projected increases in households and employment from 2005 to 2035, and the number of miles in each alternative. Projection data is taken from the Transportation Analysis Zone data as provided by CAMPO and DCHCMPO. The factor is derived by the following formula:

$$\frac{(2035 \text{ Household Density} + 2035 \text{ Employment Density}) \times (\Delta\text{Households} + \Delta\text{Employment})}{\text{Corridor Miles}} / 100,000$$

Higher densities and growth concentrated within a shorter transit corridor result in a higher factor.

The RFDG Factor is a measure of future density and future growth potential for specific corridors based on current projections for absorbing net new households and employment. Actual growth within specific corridors could be greater or more concentrated if more aggressive TOD policies are adopted and transit stations come into being. RFDG factors exceeding 0.9 would be considered high under this criterion, factors between 0.50 and 0.89 would be considered medium, and factors less than 0.50 would be considered low.



Table 6.13 Existing and Projected Households and Household Alternative Growth by Corridor

Alternatives	Termini	2005 Households	2035 Households	Increase in Households	% HH Increase
Wake 1	UNC Hospitals - Wake Forest	39,906	100,333	60,427	151%
Wake 2	TMC - Wake Forest	22,037	66,973	44,936	204%
Wake 3	Veridea - Wake Forest	24,138	70,633	46,494	193%
Wake 4	Downtown Cary - Wake Forest	18,071	55,596	37,526	208%
Wake 5	State Fairgrounds - Wake Forest	14,054	45,881	31,828	226%
Wake 6	Downtown Raleigh - Wake Forest	12,240	39,886	27,646	226%
Wake 7	TMC - NERC	18,499	58,842	40,343	218%
Wake 8	NW Cary - NERC	15,964	51,257	35,293	221%
Wake 9	Downtown Cary - NERC	14,533	47,465	32,932	227%
Wake 10	State Fairgrounds - NERC	10,516	37,750	27,234	259%
Wake 11	Downtown Raleigh - NERC	8,703	31,755	23,052	265%
Wake 12	Duke Medical - Downtown Raleigh	19,487	58,788	39,301	202%
DO 1	UNC Hospitals - Wake Forest	39,906	100,333	60,427	151%
DO 2	Duke Medical - Downtown Raleigh	19,487	58,788	39,301	202%
DO 3	UNC Hospitals - TMC	17,884	34,590	16,705	93%
DO 4	UNC Hospitals - Alston Ave	15,847	28,897	13,049	82%
DO 5	UNC Hospitals - Gateway	3,691	8,663	4,973	135%
DO 6	Gateway - Alston Ave	12,961	22,095	9,134	70%
Mean		18,218	51,029	32,811	185%



Table 6.14 Existing and Projected Employment and Employment Alternative Growth by Corridor

Alternatives	Termini	2005 Employment	2035 Employment	Increase in Emp.	% Emp. Increase
Wake 1	UNC Hospitals - Wake Forest	191,673	361,061	169,388	88%
Wake 2	TMC - Wake Forest	106,579	207,024	100,445	94%
Wake 3	Veridea - Wake Forest	99,095	190,746	91,651	92%
Wake 4	Downtown Cary - Wake Forest	93,451	170,486	77,035	82%
Wake 5	State Fairgrounds - Wake Forest	85,718	150,969	65,251	76%
Wake 6	Downtown Raleigh - Wake Forest	61,897	120,126	58,229	94%
Wake 7	TMC - NERC	101,124	187,575	86,451	85%
Wake 8	NW Cary - NERC	90,466	159,174	68,708	76%
Wake 9	Downtown Cary - NERC	87,997	151,037	63,040	72%
Wake 10	State Fairgrounds - NERC	80,264	131,520	51,256	64%
Wake 11	Downtown Raleigh - NERC	56,443	100,678	44,235	78%
Wake 12	Duke Medical - Downtown Raleigh	127,830	234,467	106,637	83%
DO 1	UNC Hospitals - Wake Forest	191,673	361,061	169,388	88%
DO 2	Duke Medical - Downtown Raleigh	127,830	234,467	106,637	83%
DO 3	UNC Hospitals - TMC	88,340	158,476	70,136	79%
DO 4	UNC Hospitals - Alston Ave	67,392	131,286	63,894	95%
DO 5	UNC Hospitals - Gateway	17,988	38,131	20,143	112%
DO 6	Gateway - Alston Ave	52,619	99,574	46,955	89%
Mean		96,021	177,103	81,082	85%

**Table 6.15 Projected Household and Employment Densities (2035)**

Alternatives	Termini	Household Density ¹	Employment Density ²	Combined Density
Wake 1	UNC Hospitals - Wake Forest	2.7	9.6	12.26
Wake 2	TMC - Wake Forest	3.1	9.5	12.59
Wake 3	Veridea - Wake Forest	3.2	8.8	12.04
Wake 4	Downtown Cary - Wake Forest	3.4	10.4	13.78
Wake 5	State Fairgrounds - Wake Forest	3.4	11.2	14.60
Wake 6	Downtown Raleigh - Wake Forest	3.6	10.8	14.37
Wake 7	TMC - NERC	3.7	11.8	15.49
Wake 8	NW Cary - NERC	4.3	13.4	17.70
Wake 9	Downtown Cary - NERC	4.5	14.2	18.69
Wake 10	State Fairgrounds - NERC	4.9	17.0	21.84
Wake 11	Downtown Raleigh - NERC	5.9	18.7	24.59
Wake 12	Duke Medical - Downtown Raleigh	3.1	12.5	15.63
DO 1	UNC Hospitals - Wake Forest	2.7	9.6	12.26
DO 2	Duke Medical - Downtown Raleigh	3.1	12.5	15.63
DO 3	UNC Hospitals - TMC	2.1	9.6	11.70
DO 4	UNC Hospitals - Alston Ave	2.6	11.7	14.27
DO 5	UNC Hospitals - Gateway	1.8	7.7	9.45
DO 6	Gateway - Alston Ave	3.2	14.4	17.61

¹households/acre, ²employees/acre

Table 6.16 Relative Future Density/Growth Factor by Transit Corridor Alternative

Alternatives	Termini	Combined Density	Combined $\Delta\uparrow$ HH & Emp.	Corridor Miles	RFDG Factor
Wake 1	UNC Hospitals - Wake Forest	12.26	229,815	59	0.48
Wake 2	TMC - Wake Forest	12.59	145,381	33	0.55
Wake 3	Veridea - Wake Forest	12.04	138,145	33	0.50
Wake 4	Downtown Cary - Wake Forest	13.78	114,561	25	0.63
Wake 5	State Fairgrounds - Wake Forest	14.60	97,079	20	0.71
Wake 6	Downtown Raleigh - Wake Forest	14.37	85,875	17	0.73
Wake 7	TMC - NERC	15.49	126,794	24	0.82
Wake 8	NW Cary - NERC	17.70	104,001	18	1.02
Wake 9	Downtown Cary - NERC	18.69	95,972	16	1.12
Wake 10	State Fairgrounds - NERC	21.84	78,490	11	1.56
Wake 11	Downtown Raleigh - NERC	24.59	67,287	8	2.07
Wake 12	Duke Medical - Downtown Raleigh	15.63	145,938	29	0.79
DO 1	UNC Hospitals - Wake Forest	12.26	229,815	59	0.48
DO 2	Duke Medical - Downtown Raleigh	15.63	145,938	29	0.79
DO 3	UNC Hospitals - TMC	11.70	86,841	26	0.39
DO 4	UNC Hospitals - Alston Ave	14.27	76,943	17	0.65
DO 5	UNC Hospitals - Gateway	9.45	25,116	7	0.34
DO 6	Gateway - Alston Ave	17.61	56,089	10	0.98



6.3.4 SUMMARY OF LAND USE

As noted, the jurisdictions in the region have adopted strong policies supportive of transit-oriented development in the planned transit corridors. This is a direct result of the ongoing comprehensive planning process that incorporates LRTPs into the comprehensive plans for the cities, towns, and counties in the region. The analysis of the land use plans and policies and Zoning by Right illustrate that the potential for higher densities of population, households, and employment is relatively strong in all of the proposed corridor alternatives. It then becomes the issue of identifying the best group of high performing corridors. This is currently based primarily on the existing allowed density and the history of facilitating high density development.

The activity center measure differentiates corridors that connect the greatest number of the region's largest and most transit-friendly activity centers: downtowns of Raleigh, Durham, Chapel Hill, and the area's three largest educational/medical centers (UNC, NCSU, and Duke).

To identify the better performing corridors, a series of economic and demographic factors were utilized focusing on existing and projected household and employment data and the growth in households and employment by corridor. In addition, future density and relative future density/growth factors were examined. Potential for new transit-oriented development is a function of the 2035 density of households and employment in the corridor and the growth that is projected.

In an effort to summarize the economic and demographic factors, a Relative Future Density/Growth (RDFG) Factor was formulated and normalized on a per mile basis. In this analysis, the Wake Alternatives 8 through 11 have the highest factors and Wake 11 performs the best. Wake 7 (TMC to NERC) and the regional corridor, Wake 12 (Duke Medical to Downtown Raleigh), also perform well but have factors just under Wake 8. For the Durham-Orange corridors, DO 6 (Gateway to Alston Avenue) has the highest factor of the Durham-Orange corridors. The regional corridor, DO 2 (Duke Medical to Downtown Raleigh) also performs well but is just under DO 6 and slightly better than DO 4 (UNC Hospitals to Alston Avenue).

6.4 FINANCIAL

An analysis of the capital costs as well as the operating and maintenance costs was conducted in order to determine the most cost-effective corridor segments in the overall rail plan. All costs are given in 2010 dollars. Ridership data is based on 2035 projections from the TRM.

6.4.1 CAPITAL COSTS

Total capital cost provides a basic assessment of the overall capital cost of each corridor. Among the 18 study corridors, the segments traveling from UNC Hospitals to Wake Forest (W1 and DO1) had the highest overall capital cost, as shown in Table 6.15. This is not surprising, as these two alternatives are the longest corridors under consideration. Likewise, the study corridor extending from UNC Hospitals to Gateway (DO5) had the lowest overall capital cost. The capital costs presented are in 2010 dollars and are fully loaded costs including: construction, maintenance facilities, right-of-way, and a 30 percent allocated contingency (design/estimating contingency), a 30 percent allocation for engineering, administrative, and construction management cost; and a 5 percent unallocated contingency (construction contingency).



Table 6.17 Capital Costs (2010 Dollars)

Corridors	Termini	Length ¹ (Miles)	Total Capital Cost (M\$)	Capital Cost per Mile (M\$)	Capital Cost ² per Weekday Rail Trip (\$)	Capital Cost ² per Weekday Passenger Mile (\$)
Wake 1	UNC Hospitals - Wake Forest	57	\$ 3,500	\$61	\$56	\$6
Wake 2	TMC - Wake Forest	32	\$ 1,900	\$59	\$62	\$10
Wake 3	Veridea - Wake Forest	32	\$ 2,000	\$62	\$61	\$9
Wake 4	Downtown Cary - Wake Forest	24	\$ 1,500	\$63	\$66	\$12
Wake 5	State Fairgrounds - Wake Forest	20	\$ 1,200	\$61	\$70	\$14
Wake 6	Downtown Raleigh - Wake Forest	16	\$ 1,000	\$64	\$90	\$21
Wake 7	TMC - NERC	24	\$ 1,500	\$61	\$53	\$10
Wake 8	NW Cary - NERC	18	\$ 1,100	\$62	\$54	\$12
Wake 9	Downtown Cary - NERC	16	\$ 1,000	\$62	\$54	\$12
Wake 10	State Fairgrounds - NERC	12	\$ 780	\$66	\$55	\$17
Wake 11	Downtown Raleigh - NERC	8	\$ 580	\$74	\$69	\$27
Wake 12	Duke Medical - Downtown Raleigh	28	\$ 1,700	\$60	\$65	\$8
DO1	UNC Hospitals - Wake Forest	57	\$ 3,500	\$61	\$56	\$6
DO 2	Duke Medical - Downtown Raleigh	28	\$ 1,700	\$60	\$65	\$8
DO 3	UNC Hospitals - TMC	25	\$ 1,600	\$64	\$61	\$9
DO 4	UNC Hospitals - Alston Ave	17	\$ 1,200	\$69	\$55	\$10
DO 5	UNC Hospitals - Gateway	7	\$ 470	\$66	\$53	\$25
DO 6	Gateway - Alston Ave	10	\$ 750	\$74	\$68	\$15

1 Corridor lengths differ slightly from previous analysis sections due to rounding and design detail used for cost projections.

2 Annual amortized capital cost and annual weekday rail trips/PMTs

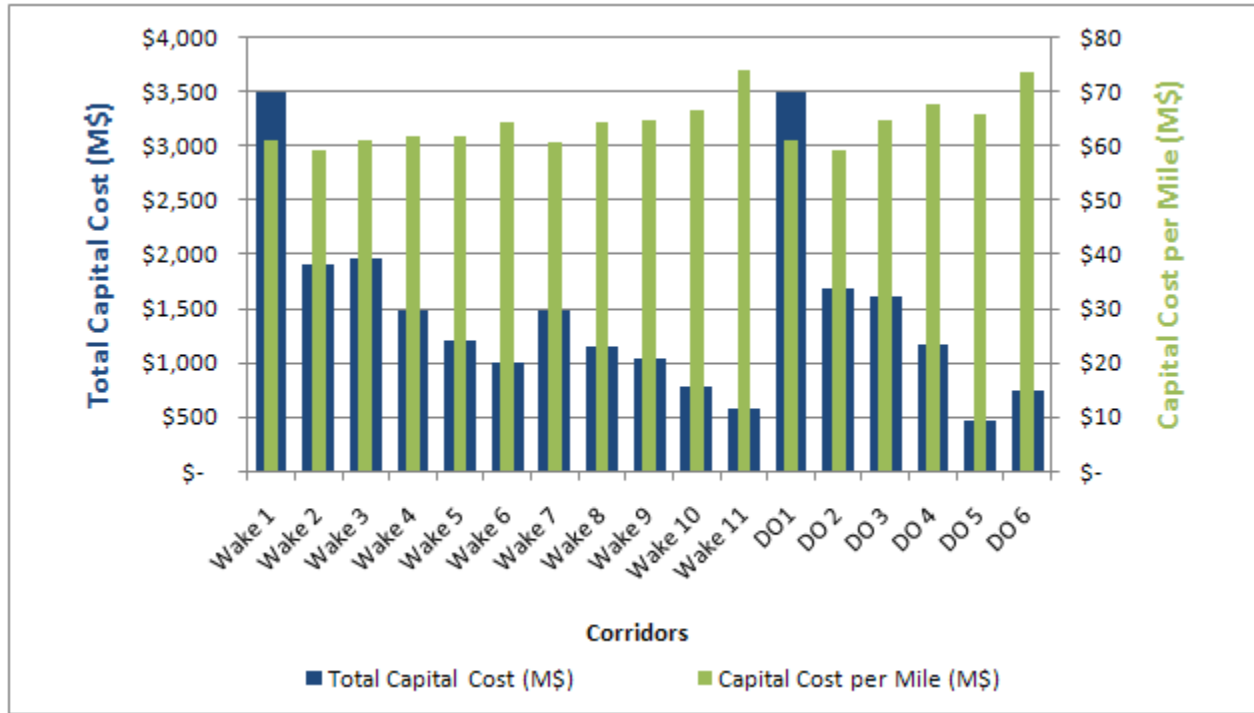
Note: The data listed in emboldened red are top performers for each respective evaluation criterion.

Capital Cost per Mile

The total capital cost per mile provides a good indication of capital costs while controlling for the disparate lengths of each corridor. Among the 18 study corridors, the alternatives extending from the Triangle Metro Center to Wake Forest (W2), Veridea to Wake Forest (W3), TMC to NERC (W7), and Duke Medical to Downtown Raleigh (DO2) had the lowest capital cost per mile, as shown on Figure 6.18. The study corridors extending from Downtown Raleigh to NERC (W11) and Gateway to Alston Ave (DO6) had the highest capital cost per mile, as shown on Figure 6.18.



Figure 6.18 Capital Cost per Mile (2010 Dollars)



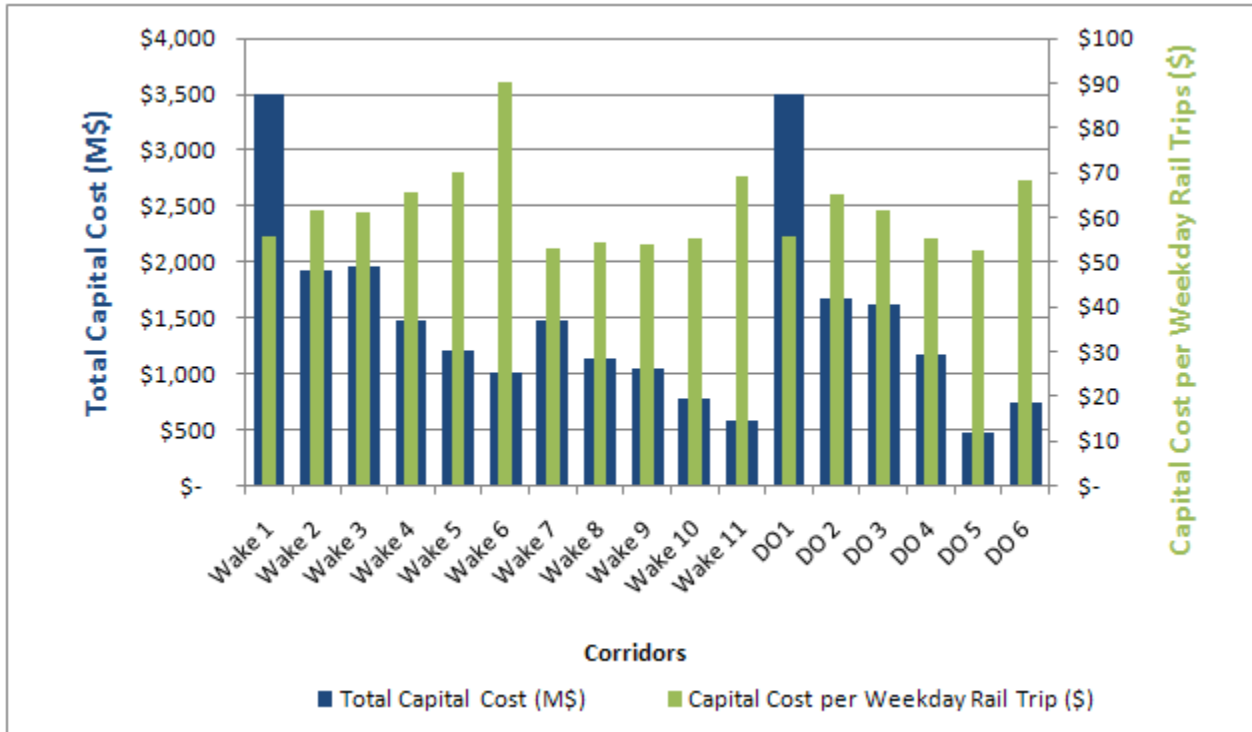
Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.

Capital Cost per Weekday Rail Trip

Capital cost per weekday rail trip is an important measure of cost effectiveness, allowing an evaluation of both ridership and capital cost. Annual capital costs were calculated by amortizing total capital costs over the useful life of each capital expense according to FTA guidelines. Among the 18 study corridors, the alternatives extending from western Wake County to NERC (W7, W8, and W9) and the alternative extending from UNC Hospitals to Gateway (DO5) had the lowest annual capital cost per weekday rail trip. Likewise, the study corridors extending from the State Fairgrounds and Downtown Raleigh to Wake Forest (W5 and W6) as well as the corridor extending from Gateway to Alston Ave (DO6) had the highest annual capital cost per weekday rail trip.



Figure 6.19 Capital Cost per Trip (2010 Dollars)



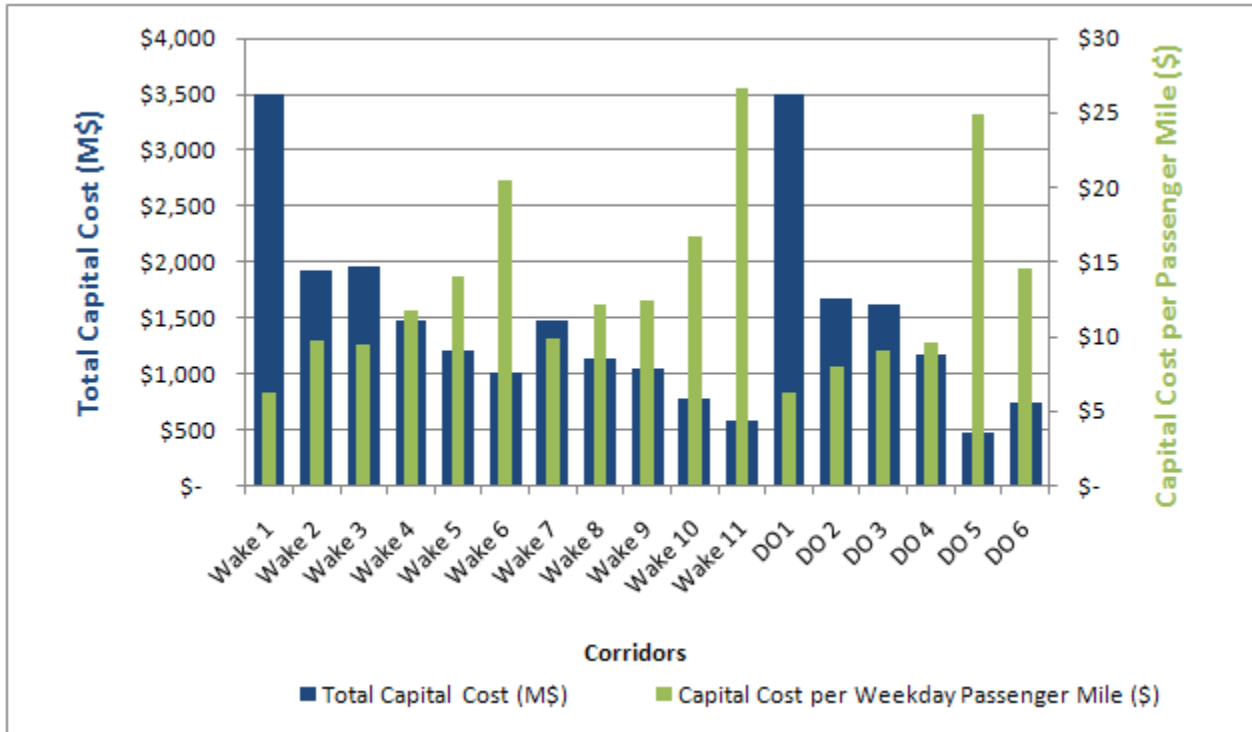
Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.

Capital Cost per Weekday Rail Passenger Mile Traveled

This criterion allows an evaluation of cost vs. ridership while controlling for the lengths of passenger trips. Annual capital costs were calculated by amortizing total capital costs over the useful life of each capital expense according to FTA guidelines. Among the 18 study corridors, the alternatives extending from UNC Hospitals to Wake Forest (W1 and DO1), Duke Medical to Downtown Raleigh (DO2), and UNC Hospitals to Triangle Metro Center (DO3) had the lowest annual capital cost per rail mile traveled. The study corridors extending from UNC Hospitals to Gateway (DO5) and Downtown Raleigh to NERC (W11) had the highest annual capital cost per rail passenger mile traveled.



Figure 6.20 Capital Cost per Passenger Mile Traveled (2010 Dollars)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.

6.4.2 OPERATING AND MAINTENANCE (O&M) COSTS

This criterion provides a basic evaluation of each corridor’s annual operating and maintenance costs. Among the 18 study corridors, the alternatives extending from UNC Hospitals to Gateway (DO5), Downtown Raleigh to NERC (DO11), Gateway to Alston Ave (DO6), and the State Fairgrounds to NERC (W10) had the lowest overall operating and maintenance costs, as shown in Table 6.16. The study corridors extending from UNC Hospitals to Wake Forest (W1 and DO1) had the highest overall O&M costs.

**Table 6.18 Operating and Maintenance Costs (2010 Dollars)**

Corridors	Termini	Length ¹ (Miles)	O&M Cost per Year (M\$)	Annual O&M Cost per Trip (\$)	Annual O&M Cost per Passenger Mile (\$)
Wake 1	UNC Hospitals - Wake Forest	57	\$46	\$9	\$1
Wake 2	TMC - Wake Forest	32	\$28	\$11	\$2
Wake 3	Veridea - Wake Forest	32	\$28	\$11	\$2
Wake 4	Downtown Cary - Wake Forest	24	\$21	\$12	\$2
Wake 5	State Fairgrounds - Wake Forest	20	\$17	\$13	\$2
Wake 6	Downtown Raleigh - Wake Forest	16	\$16	\$18	\$4
Wake 7	TMC - NERC	24	\$22	\$10	\$2
Wake 8	NW Cary - NERC	18	\$17	\$10	\$2
Wake 9	Downtown Cary - NERC	16	\$13	\$9	\$2
Wake 10	State Fairgrounds - NERC	12	\$11	\$10	\$3
Wake 11	Downtown Raleigh - NERC	8	\$8	\$12	\$5
Wake 12	Duke Medical - Downtown Raleigh	28	\$24	\$12	\$1
DO1	UNC Hospitals - Wake Forest	57	\$46	\$9	\$1
DO 2	Duke Medical - Downtown Raleigh	28	\$24	\$12	\$1
DO 3	UNC Hospitals - TMC	25	\$22	\$10	\$2
DO 4	UNC Hospitals - Alston Ave	17	\$16	\$9	\$2
DO 5	UNC Hospitals - Gateway	7	\$8	\$11	\$5
DO 6	Gateway - Alston Ave	10	\$11	\$13	\$3

1 Corridor lengths differ slightly from previous analysis sections due to rounding and design detail used for cost projections.

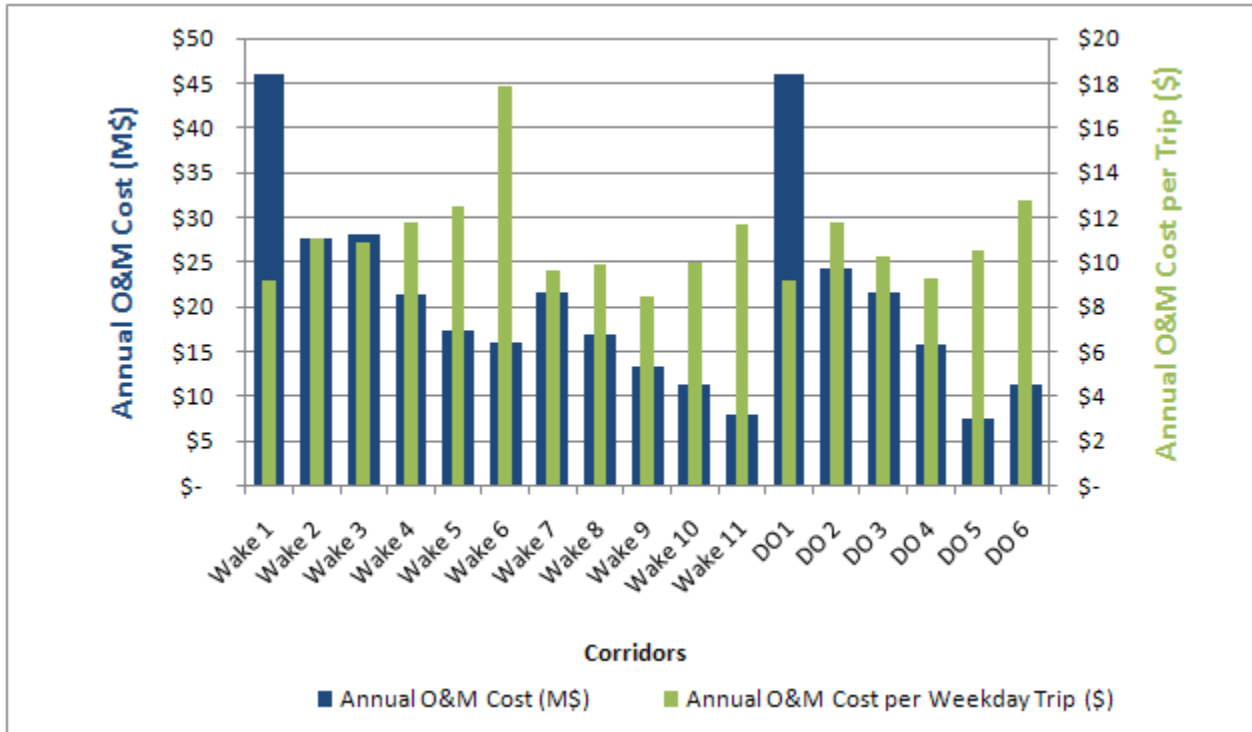
Note: The data listed in emboldened red are top performers for each respective evaluation criterion.

Annual Operating and Maintenance Cost per Weekday Rail Trip

As with section 6.4.3, this criterion is an important measure of cost effectiveness, providing an evaluation of ridership vs. the annual cost necessary to operate and maintain each study corridor. Among the 18 study corridors, the alternatives extending from Downtown Cary to NERC (W9), UNC Hospitals to Wake Forest (W1 and DO1), and UNC Hospitals to Alston Ave (DO4) had the lowest O&M cost per rail trip. The study corridors extending from Downtown Raleigh to Wake Forest (W6) and Gateway to Alston Ave (DO6) had the highest O&M cost per rail trip.



Figure 6.21 Operating and Maintenance Cost per Rail Trip (2010 Dollars)



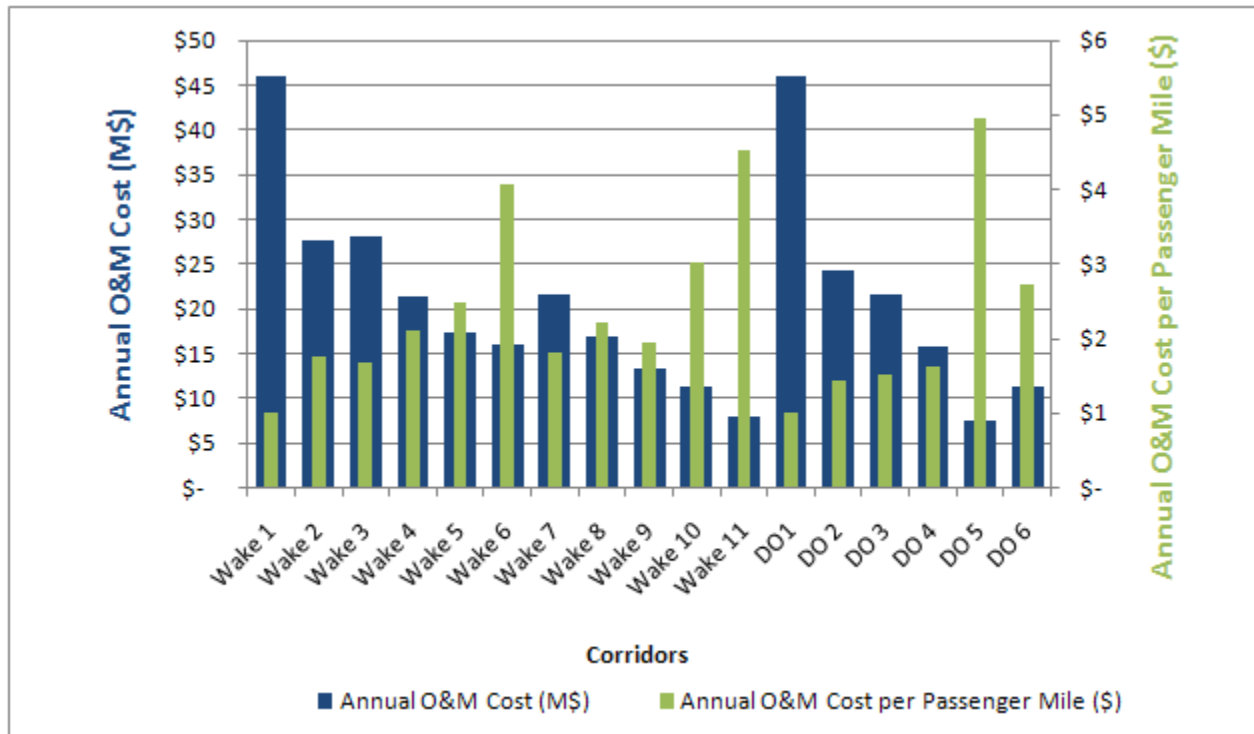
Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.

Annual Operating and Maintenance Cost per Weekday Rail Passenger Mile Traveled

This criterion allows an evaluation of cost vs. ridership while controlling for the lengths of passenger trips. Among the 18 study corridors, the alternatives extending from UNC Hospitals to Wake Forest (W1 and DO1), Duke Medical to Downtown Raleigh (DO2), and UNC Hospitals to Triangle Metro Center (DO3) had the lowest O&M cost per rail passenger mile traveled. The study corridors extending from UNC Hospitals to Gateway (DO5) and Downtown Raleigh to NERC (W11) had the highest O&M cost per rail passenger mile traveled.



Figure 6.22 Operating and Maintenance Cost per Passenger Mile Traveled (2010 Dollars)



Note: Wake 12 is not presented in the Chart as it is the same as DO 2, which is presented.

6.4.3 SUMMARY OF FINANCIAL CRITERIA

As with the ridership measures, the capital and operating costs are directly related to overall project length. The longest corridor alternatives have the highest costs. Additionally the highest capital costs occur in the more built up urban areas with the segment from downtown Raleigh to I-440 in the Highwoods area having the highest costs due to both structures and retaining walls. Since all corridors in Wake County include this segment, the longer the corridor, the more these high costs are averaged out over the longer project length with lower capital costs in the suburban, less developed areas.

One of the most useful measures for project cost effectiveness is capital costs per rider. This is computed on an annual basis with daily weekday ridership expanded to annual ridership and capital costs amortized to an annual basis. Using this measure, the most cost effective corridor alternatives in terms of cost per rider are: Wake 7 (Triangle Metro Center to NERC); Wake 8 (Northwest Cary to NERC); Wake 9 (Downtown Cary to NERC); and Wake 10 (State Fairgrounds to NERC) in Wake County, and DO 4 (UNC Hospitals to Alston Avenue); and DO 5 (UNC Hospitals to Gateway) in Durham Orange counties.

The operating and maintenance cost is primarily impacted by the length of the project, the frequency of service, and the station spacing. At this stage of analysis, the same operating characteristics in terms of speeds and headways were assumed to be the same for all alternatives. While there is less distinction between the alternatives in terms of annual operating and maintenance costs per rider than with the capital costs, there are some corridor alternatives that perform marginally better. The majority of the corridors have operating and maintenance costs ranging from \$9-\$11 per rider with Wake 9 (Downtown Cary to NERC) and



DO4 (UNC Hospitals to Alston Avenue) having the lowest rate of \$9 per rider. It should be noted that the longest corridor, DO 2/Wake 12 (UNC Hospitals to Wake Forest) also has the lower rate of \$9 per rider.



CHAPTER 7 SELECTION OF PRIORITY CORRIDORS

7.1 PURPOSE

The purpose of the Transitional Analysis document is to identify two priority corridors (one in Wake County and one in Durham-Orange counties) to study in more detail in the Alternatives Analysis. The corridors identified and described in Chapter 4 were analyzed, evaluating mobility, socio-economic conditions, land use, and costs. The results of the analysis are described in Chapter 6. Citizens and project stakeholders will be provided an opportunity to review and comment on the evaluation criteria and the draft results of the corridor analysis. This information will be presented at a series of six public workshops that will be held between September 14 and September 23, 2010.

This chapter summarizes the highest performing corridors in Wake and Durham-Orange Counties and recommends two priority corridors to carry forward to the Alternatives Analysis, based solely on the technical analysis performed.

It is recommended that the regional alternative described in Chapter 4, from West Durham to the Johnston County line, be studied further for a possible commuter rail style service.

Each of the corridors was evaluated based on these stated criteria. This section presents the results of this evaluation for the Wake County corridors and for the corridors in Durham and Orange counties. As stated in Chapter 5, all of the evaluation criteria that were evaluated in this study were developed by the consulting team in partnership with Triangle Transit, DCHC-MPO, and CAMPO. All criteria may be useful or informative regarding any given corridor, and as such all results of the analysis have been included in Chapter 6 of this document. However, some criteria do not meaningfully distinguish between separate corridors, and are not included in the summary performance of each corridor. Tables ES.1 and ES.2 summarize the evaluation criteria that were most helpful in distinguishing between corridors.

7.2 WAKE COUNTY

Twelve corridors in Wake County were evaluated, the results of which can be seen in Table 7.1. A summary of the findings and a recommendation are provided below.

7.2.1 MOBILITY

As indicated in Table 7.1, Wake Alternatives 9 and 10 have the highest performance in terms of rail trips per mile.

7.2.2 SOCIOECONOMIC

As indicated in Table 7.1, Wake Alternatives 8, 9, 10, and 11 have the highest population density in 2035. Wake Alternatives 9, 10, and 11 have the highest employment density in 2035. From 2000 U.S. Census data, Wake Alternatives 1, 4, 5, 7, 8, 9, 10, and 11 had the highest density of persons below the poverty level. Similarly, Wake Alternatives 1, 4, 7, 8, 9, 10, and 11 had the highest density of minority persons.



7.2.3 LAND USE

As indicated in Table 7.1, an evaluation of support for transit-oriented development showed good performance levels for Wake Alternatives with Wake 8 through 11 performing the best. For Relative Future Density/Growth (RDFG) Factor, Wake Alternatives 8 through 11 had the highest factors and performed the best.

7.2.4 FINANCIAL

As indicated in Table 7.1, an evaluation of capital cost per mile showed the highest performance for Wake Alternatives 1, 2, 3, 4, 5, and 7. An evaluation of capital cost per weekday trip resulted in the highest performance for Wake Alternatives 1, 7, 8, 9, and 10. Similarly, an evaluation of operating and maintenance cost per weekday transit trip resulted in the highest performance for Wake Alternatives 1, 7, 8, 9, and 10.

7.2.5 CONCLUSIONS

Results of the analysis indicate that Wake Alternatives 9 (from downtown Cary to the Northeast Regional Center) and 10 (from the State Fairgrounds to the Northeast Regional Center) are the overall highest performers. A summary of the evaluation follows:

- Wake Alternatives 9 and 10 have the highest daily rail trip estimates on a per mile basis, with 394 and 402 rail trips per mile respectively. The comparatively stronger ridership is a reflection of the large concentrations of people living within the vicinity of the corridors and the number of dense employment nodes – including downtown Raleigh, NERC, and Cary – that are served by both corridors.
- The corridor alternatives serving the segment from downtown Raleigh to the NERC have the highest levels of future household and employment densities. These include Wake 8 (Northwest Cary to NERC), Wake 9 (Downtown Cary to NERC), Wake 10 (State Fairgrounds to NERC), and Wake 11 (Downtown Raleigh to NERC).
- The jurisdictions in the region have adopted strong policies supportive of transit-oriented development in the planned transit corridors. This is a direct result of the ongoing comprehensive planning process that incorporates the LRTPs into the comprehensive plans for the cities, towns, and counties in the region. The analysis of the land use plans and policies and Zoning by Right illustrate that the potential for higher densities of population, households, and employment is relatively strong in all of the proposed corridor alternatives. It then becomes the issue of identifying the best performing corridors. In an effort to summarize the economic and demographic factors, a Relative Future Density/Growth (RDFG) Factor was formulated and normalized on a per mile basis. In this analysis, the Wake Alternatives 8 through 11 have the highest factors and Wake 11 performs the best. Wake 7 (TMC to NERC) and the regional corridor, Wake 12 (Duke Medical to Downtown Raleigh), also perform well but have factors just under Wake 8.



Table 7.1 Evaluation Criteria Summary (Wake County)

Study Corridor	Corridor Length (mi) / Total Cost M\$ (2010)	Mobility		Socioeconomic				Land Use		Financial			
		Total In Corridor Trips per Mile (2035)	Rail Trips/Mile (2035)	Population Density (2035)	Employment Density (2035)	Low Income Population Density (2000)	Minority Population Density (2000)	Supports Transit Oriented Development, Zoning by Right	Relative Future Density / Growth Factor	Capital Cost (2010)	Capital Cost per Mile (2010 Dollars, 2035 Ridership)	Capital Cost per Weekday Transit Trip (2010 Dollars, 2035 Ridership)	Operating & Maintenance Cost/ Weekday Transit Trip (2010 Dollars, 2035 Ridership)
Wake Alternative 1 (UNC Hospitals to Wake Forest)	59/\$3,500	⊖	⊖	○	○	⊖	⊖	⊖	○	○	●	●	●
Wake Alternative 2 (Triangle Metro Center to Wake Forest)	33/\$1,900	⊖	○	⊖	○	○	○	⊖	⊖	⊖	●	⊖	⊖
Wake Alternative 3 (Veridea to Wake Forest)	33/\$2,000	⊖	○	⊖	○	○	○	⊖	⊖	○	●	⊖	⊖
Wake Alternative 4 (Downtown Cary to Wake Forest)	25/\$1,500	⊖	○	⊖	⊖	○	○	⊖	⊖	⊖	●	⊖	⊖
Wake Alternative 5 (State Fairgrounds to Wake Forest)	20/\$1,200	⊖	○	⊖	⊖	○	○	⊖	⊖	⊖	●	○	○
Wake Alternative 6 (Downtown Raleigh to Wake Forest)	17/\$1,000	⊖	○	⊖	⊖	○	○	⊖	⊖	●	⊖	○	○
Wake Alternative 7 (Triangle Metro Center to NERC)	24/\$1,500	⊖	●	⊖	⊖	○	○	⊖	⊖	⊖	●	●	●
Wake Alternative 8 (Northwest Cary to NERC)	18/\$1,100	●	●	●	●	⊖	⊖	●	●	⊖	⊖	●	⊖
Wake Alternative 9 (Downtown Cary to NERC)	16/\$1,000	●	●	●	●	⊖	⊖	●	●	●	⊖	●	●
Wake Alternative 10 (State Fairgrounds to NERC)	11/\$780	●	●	●	●	⊖	⊖	●	●	●	○	●	⊖
Wake Alternative 11 (Downtown Raleigh to NERC)	8/\$580	●	⊖	●	●	⊖	⊖	●	●	●	○	○	⊖
Wake Alternative 12 (Duke Medical to Downtown Raleigh)	29/\$1,700	⊖	○	⊖	⊖	⊖	⊖	⊖	⊖	⊖	●	⊖	⊖
Summary of Evaluation Criteria and Rankings													
High Performer	= ●	>22,060 Trips/Mile	>363.5 Trips/Mile	> 3.9 Households/Acre	>13.3 Jobs/Acre	>0.61 Persons/Acre	>1.61 Persons/Acre	Considers the # of stations and allowable densities within jurisdiction	>0.9	<1052	<\$62.0 M/Mile	<\$56.9/Trip	<\$9.9/Trip
Average Performer	= ⊖	18,452 - 22,060 Trips/Mile	311.3-363.5 Trips/Mile	2.9 - 3.9 Households/Acre	10.3 - 13.3 Jobs/Acre	0.38 - 0.61 Persons/Acre	1.04 - 1.61 Persons/Acre		>0.5-0.89	1052-1925	\$62.0 - \$66.3 M/Mile	\$56.9-66.4/Trip	\$9.9-12.1/Trip
Low Performer	= ○	<18,452 Trips/Mile	<311.3 Trips/Mile	<2.9 Households/Acre	<10.3 Jobs/Acre	<0.38 Persons/Acre	<1.04 Persons/Acre		<0.50	>1925	>\$66.3 M/Mile	>\$66.4/Trip	>\$12.1/Trip

Note: The breakpoints for the bins are ±0.5 standard deviations from the mean. Data results are given in greater detail in Chapter 6.



- From a cost perspective, Wake Alternatives 9 and 10 are relatively expensive to build when compared to other corridors on a cost per mile basis. Wake Alternatives 9 and 10 would cost \$65M per mile and \$67M per mile respectively. The higher cost, as compared with other corridors, can be attributed to more expensive infrastructure needs related to limited right-of-way and required infrastructure improvements, particularly in the vicinity of downtown Raleigh. On a per mile basis, longer corridors can spread out the costs associated with these infrastructure upgrades. Unlike other corridors however, Wake Alternative 9, which is 16 miles and Wake Alternative 10, which is 12 miles, are not long enough to spread out the costs of the infrastructure improvements required in the vicinity of downtown Raleigh.
- Although they are higher on a capital cost per mile basis than other corridors, Wake Alternatives 9 and 10 perform relatively well in terms of cost effectiveness due to their strong ridership. The capital cost per transit trip for Wake Alternative 9 is approximately \$54 per trip and the capital cost per transit trip for Wake Alternative 10 is approximately \$55 per trip.

While Wake Alternatives 9 and 10 are the overall strongest performers among the Wake corridors, Wake Alternative 8, which extends the transit line an additional two miles from downtown Cary to NW Cary, is not significantly far behind in performance. A terminal station in downtown Cary could be problematic due to limited property available for locating an end-of-line park and ride. A relatively short extension to NW Cary, therefore, may improve the feasibility of this corridor by providing more opportunities to locate a park and ride and related transit infrastructure and potentially increasing ridership. Given that this is a high-level screening process and that Wake Alternatives 8 and 11 are not significantly lower performing than Wake Alternatives 9 and 10, consideration should be given to performing the detailed analysis on Wake Alternative 8 which incorporates all of the alignments coincident to Wake Alternatives 9, 10, and 11.

The detailed Alternatives Analysis can fine tune this larger corridor in looking at the most optimal, best-fit initial starter line that may involve cutting back on the alignments at both ends to arrive at the most effective corridor for New Starts funding. This is in recognition of Federal funding capacity and that most starter lines initially constructed are in the 10-12 mile range. Extensions from the initial line would start the full build-out process consistent with funding availability.

Preliminary Technical Recommendation: Given these considerations, it is initially recommended that Wake Alternative 8, which travels between Northwest Cary and the Northeast Regional Center, be advanced to a detailed Alternatives Analysis.

7.3 DURHAM-ORANGE COUNTIES

The project team evaluated a total of six corridors in Durham and Orange counties, the results of which can be seen in Table 7.2. A summary of the findings and a recommendation are provided below.

7.3.1 MOBILITY

As indicated in Table 7.2, an evaluation of total rail trips per mile resulted in the highest performance for Durham-Orange Alternatives 4 and 5.



7.3.2 SOCIOECONOMIC

As indicated in Table 7.2, an evaluation of population density in 2035 resulted in the highest performance for Durham-Orange 6. An evaluation of employment density in 2035 resulted in the highest performance of Durham-Orange Alternative 6. Durham-Orange Alternatives 3, 4, and 6 demonstrated the highest levels of density for persons below the poverty level and density of minority persons.

7.3.3 LAND USE

As indicated in Table 7.1, an evaluation of support for transit-oriented development showed that all corridors had good performance levels with DO 3 and 4 performing the best. For Relative Future Density/Growth (RDFG) Factor, DO 1, 3, and 5 performed low and DO 2, and 4 had good performance levels and DO 6 performed the best.

7.3.4 FINANCIAL

As indicated in Table 7.2, an evaluation of capital cost per mile resulted in the highest performance for Durham-Orange Alternatives 1 and 2. An evaluation of capital cost per weekday trip resulted in the highest performance for Durham-Orange Alternatives 4 and 5. An evaluation of operating and maintenance costs per weekday transit trip resulted in the highest performance for Durham-Orange Alternatives 1 and 4.

7.3.5 CONCLUSIONS

Results of the analysis indicate that Durham-Orange Alternatives 4 (from UNC Hospitals to Alston Avenue), 5 (from UNC Hospitals to Gateway) and 6 (from Gateway to Alston Avenue) are the overall highest performers (note that Alternatives 5 and 6 are subsets of Alternative 4). Primary discriminators between the alternatives include mobility, socio-economics and cost-effectiveness, as discussed here:

- Durham-Orange Alternatives 4 and 5 have the highest daily rail trip estimates on a per mile basis, with 394 and 399 rail trips per mile respectively. This primarily reflects the high employment at UNC and UNC Hospitals, Duke University and Duke Medical Center, and downtown Durham. Several significant mixed-use developments also exist or are planned within the corridor.
- Durham-Orange Alternatives 4 and 6, both of which terminate at Alston Avenue, are the most effective at reaching transit-dependent populations.



Table 7.2 Evaluation Criteria Summary (Durham-Orange Counties)

Study Corridor	Corridor Length (mi) / Total Cost M\$ (2010)	Mobility		Socioeconomic				Land Use		Financial			
		Total In Corridor Trips per Mile (2035)	Rail Trips/Mile (2035)	Population Density (2035)	Employment Density (2035)	Low Income Population Density (2000)	Minority Population Density (2000)	Supports Transit Oriented Development, Zoning by Right	Relative Future Density / Growth Factor	Capital Cost (2010)	Capital Cost per Mile (2010 Dollars, 2035 Ridership)	Capital Cost per Weekday Transit Trip (2010 Dollars, 2035 Ridership)	Operating & Maintenance Cost/ Weekday Transit Trip (2010 Dollars, 2035 Ridership)
Durham-Orange Alternative 1 (UNC Hospitals to Wake Forest)	59/\$3,500	⊖	⊖	○	○	⊖	⊖	⊖	○	○	●	●	●
Durham-Orange Alternative 2 (Duke Medical to Downtown Raleigh)	29/\$1,700	⊖	○	⊖	⊖	⊖	⊖	⊖	⊖	⊖	●	⊖	⊖
Durham-Orange Alternative 3 (UNC Hospitals to Triangle Metro Center)	26/\$1,600	○	⊖	○	○	●	●	●	○	⊖	⊖	⊖	⊖
Durham-Orange Alternative 4 (UNC Hospitals to Alston Ave)	17/\$1,200	○	●	○	⊖	●	●	●	⊖	⊖	○	●	●
Durham-Orange Alternative 5 (UNC Hospitals to Gateway)	7/\$470	○	●	○	○	⊖	○	⊖	○	●	⊖	●	⊖
Durham-Orange Alternative 6 (Gateway to Alston Ave)	10/\$750	●	⊖	⊖	●	●	●	⊖	●	●	○	○	○
Summary of Evaluation Criteria and Rankings													
High Performer	= ●	>22,060 Trips/Mile	>363.5 Trips/Mile	> 3.9 Households/Acre	>13.3 Jobs/Acre	>0.61 Persons/Acre	>1.61 Persons/Acre	Considers the # of stations and allowable densities within jurisdiction	>0.9	<1052	<\$62.0 M/Mile	<\$56.9/Trip	<\$9.9/Trip
Average Performer	= ⊖	18,452 - 22,060 Trips/Mile	311.3-363.5 Trips/Mile	2.9 - 3.9 Households/Acre	10.3 - 13.3 Jobs/Acre	0.38 - 0.61 Persons/Acre	1.04 - 1.61 Persons/Acre		>0.5-0.89	1052-1925	\$62.0 - \$66.3 M/Mile	\$56.9-66.4/Trip	\$9.9-12.1/Trip
Low Performer	= ○	<18,452 Trips/Mile	<311.3 Trips/Mile	<2.9 Households/Acre	<10.3 Jobs/Acre	<0.38 Persons/Acre	<1.04 Persons/Acre		<0.50	>1925	>\$66.3 M/Mile	>\$66.4/Trip	>\$12.1/Trip

Note: The breakpoints for the bins are ±0.5 standard deviations from the mean. Data results are given in greater detail in Chapter 6.



- The jurisdictions in the region have adopted strong policies supportive of transit-oriented development in the planned transit corridors. This is a direct result of the ongoing comprehensive planning process that incorporates the LRTPs into the comprehensive plans for the cities, towns, and counties in the region. The analysis of the land use plans and policies and Zoning by Right illustrate that the potential for higher densities of population, households, and employment is relatively strong in all of the proposed corridor alternatives. It then becomes the issue of identifying the best performing corridors. In an effort to summarize the economic and demographic factors, a Relative Future Density/Growth (RDFG) Factor was formulated and normalized on a per mile basis. In this analysis, DO 6 (Gateway to Alston Avenue) has the highest factor of the Durham-Orange corridors. The regional corridor, DO 2 (Duke Medical to Downtown Raleigh) also performs well but is just under DO 6 and slightly better than DO 4 (UNC Hospitals to Alston Avenue).
- From a cost perspective, Durham-Orange Alternatives 4 and 5 are relatively more expensive to build compared to other corridors (\$68M per mile and \$66M per mile respectively). This is because these corridors are primarily on new alignment that requires more right-of-way acquisition and infrastructure improvements than alternative corridors that use existing railroad right-of-way (e.g., Durham-Orange Alternatives 1 and 2).
- Although they are higher on a capital cost per mile basis than other corridors, Durham-Orange Alternatives 4 and 5 perform better in terms of cost effectiveness due to their strong ridership. The capital cost per transit trip for Durham-Orange Alternative 4 and 5 is approximately \$55 and \$53 per transit trip, respectively.

Durham-Orange Alternative 4 is the combination of Durham-Orange Alternatives 5 and 6, and hence advancing this longer corridor allows for the most optimal starter line analysis for submission for Federal funding.

Preliminary Technical Recommendation: Since Durham-Orange Alternative 4 is the combination of Durham-Orange Alternatives 5 and 6, it is recommended that Durham-Orange Alternative 4 be advanced to a detailed Alternatives Analysis.

Durham-Orange Alternative 2 (from Duke Medical Center to Downtown Raleigh) was average in terms of socio-economic and strong in land-use factors, but not strong in terms of mobility and costs. Cost-effectiveness would improve if costs could be reduced. The ridership may have been low in part because the ridership model assumed light rail-type service rather than commuter rail-type service, which may be more appropriate for this corridor. For this initial study, costs assumed light rail transit, which is significantly more expensive than commuter rail, which uses primarily existing infrastructure. If connecting the region is a high priority over maximizing the potential for federal funds, then consideration should be given to this alternative. However, if federal funds are achieved with the other, better performing corridors as noted above, then full build out towards Wake Forest and Chapel Hill will occur sooner. If these corridors fail to be competitive for federal funds, then the decision can be revisited on which corridor to advance into preliminary engineering. The opportunity for Federal funding will become evident relatively soon after the New Starts submittal in the fall of 2011.

7.4 REGIONAL CORRIDOR

The current LRTP prepared by both CAMPO and DCHC MPO includes a regional rail system that is comprised of both light rail transit (LRT) and commuter rail service, with the majority of the system being LRT, to be implemented in stages. This systems plan includes the provision



of LRT service between Raleigh and Durham and between Durham and Chapel Hill. There is an overlap in the LRT plans and the commuter rail plans from downtown Raleigh to the Northeast Regional Center (in the location of Capital Boulevard and I-540). The purpose of the Transitional Analysis is to select which segments or corridors of the LRT system should be implemented first with the full system to be constructed in future phases. It is not practical or financially feasible to construct the entire LRT system as a single project and only the most effective segments or corridors should be initiated first, particularly if funding is to be requested from the Federal Transit Administration (FTA) under the New Starts program.

The Transitional Analysis examined a total of 16 corridors, including those that connected the two MPO regions and those that were entirely within either the CAMPO region or the DCHC-MPO region. The corridor alternatives were evaluated in the context of all day, frequent service that is typical of a LRT system. By contrast, a commuter rail system provides service only during the AM and PM peak period trips using a lower frequency of service (typically every 30-60 minutes). While LRT must operate on exclusive tracks, commuter rail can, and typically does, operate on tracks shared with freight and other intercity passenger rail service. In the Triangle Region, the term "express rail" has been identified to include the combination of existing AMTRAK passenger rail, existing and expanded NCDOT passenger rail service between Raleigh and Charlotte, and the additional commuter rail service during the peak periods.

The initial findings of the Transitional Analysis indicate that the corridor alternatives that operate in Wake County from Cary through downtown Raleigh and to the Northeast Regional Center (NERC) perform the best in terms of ridership, riders per mile, and cost per rider. This set of corridor alternatives is followed in performance by those that operate from UNC Hospitals to downtown Durham. The corridor alternative that connects Durham to Raleigh, passing through the Research Triangle Park, performed below both of the previous sets of alternatives. While the provision of LRT service between Durham and Raleigh is not the most cost-effective alternative for initial implementation, the early connection of these two major areas in the region can be provided by commuter rail or express rail service that can be implemented with lower costs than either of the LRT projects. Future extensions of the LRT systems in Wake and Durham counties would connect the two areas with LRT as identified in the LRTP. The major investments in commuter rail would not be wasted because the tracks could continue to be used by other freight and intercity passenger rail service (including the potential High Speed Rail service) and the vehicles could be moved to extensions of the commuter rail service to the areas on the edges of the region serving the downtowns of Raleigh and Durham.

For these reasons, an additional special Alternatives Analysis study will be prepared that evaluates commuter rail service versus LRT. The LRT service would connect the ends of the two initial LRT systems in Wake and Durham counties versus commuter rail service that extends from downtown Durham to east of Clayton using the existing NCRR alignment. This will allow informed decisions to be made on whether early implementation of commuter rail service is worth the investment. If requested, we could also compare LRT service from Durham to Raleigh against commuter rail service from Durham to Raleigh with the assumption that the Wake County and Durham county LRT systems are not implemented.

7.5 OTHER CONSIDERATIONS

With the analysis of corridor performance, rail transit extensions to the Research Triangle Park, Wake Forest, Apex, and points beyond would not be carried forward for further consideration in the more detailed Alternatives Analysis studies. This does not, however, mean that service to



these areas would be eliminated; it simply recognizes that they will be studied in greater detail at a later time. These extensions are truly noteworthy as the system expands, but the purpose of this first set of Alternative Analysis studies is to focus on the most effective corridors for initial transit investment and implementation. This is the formula other cities have used to develop and implement system-wide extensions.

Therefore, for those areas of the region that are not directly considered for initial detailed study in the Alternatives Analysis, additional studies have either been conducted or are recommended as follows:

- Extension of LRT to Garner: Technical memorandum detailing the future extension of the rail transit service from Raleigh to Garner.
- Extensions of commuter rail to Wake Forest and Apex: Technical memoranda analyzing implementation of commuter rail service to Wake Forest and Apex. (This has been suggested by CAMPO as a viable alternative). Considerations could include the following: termini, freight track alignments, operations, and cost.
- Extension of commuter rail service to Hillsborough and Zebulon: There have been requests to include extensions to both Hillsborough and to Zebulon in the study. The purpose of the Transitional Analysis is to determine the priority corridors for early implementation, but not preclude future extensions. White papers further discussing these two extensions are included as Appendix A and B.
- Extension to Carrboro: Project stakeholders from the municipality of Carrboro, Orange County and the DCHC-MPO, as well as citizens from Carrboro have indicated an interest in studying a rail transit connection to Carrboro. Per stakeholder comments, a draft white paper technical study providing an overview of the strategic issues that need addressing to extend rail transit to Carrboro was prepared and is presented in Appendix C.

When completed, the memoranda will be included as Appendices to this Transitional Analysis before it is finalized. These memoranda, along with the results of the Alternatives Analysis process can be used by both the Capital Area MPO and the Durham-Chapel Hill- Carrboro MPO as input to the updates of their respective long range transportation plans.

7.6 NEXT STEPS

On September 29, 2010 there will be a special joint meeting of the Durham-Chapel Hill-Carrboro MPO and the Capital Area MPO to review and comment on the corridors for study in the Alternatives Analysis.



APPENDICES



Appendix A

White Paper Study of Commuter Rail to Zebulon



Transportation Planning
Traffic Engineering

To: Greg Northcutt, Triangle Transit
From: George Alexiou, PE
Date: June 9, 2010
Subject: Raleigh to Eastern Wake County Corridor Rail Service

This memo provides an explanation for not including the eastern Wake County rail corridor as part of the alternatives analysis studies currently being conducted by Triangle Transit in anticipation of a ½ cent sales tax referendum for funding transit improvements in the Triangle region. The potential for passenger rail service in the Raleigh to East Wake County corridor has been considered since 2001, with the creation of the Eastrans Commuter Rail Alliance by the Town of Knightdale as part of its Comprehensive Plan Update process. Since 2001, two additional studies have analyzed the potential viability of this corridor for passenger rail service.

Eastrans Study

In 2003, the Town of Knightdale commissioned a feasibility study for passenger rail service along two corridors, one between Raleigh and Wilson and the other between Raleigh and Goldsboro. This study, called the Eastrans Commuter Rail Feasibility Study (Eastrans Study), included an analysis of the costs and feasibility of providing passenger rail service from Raleigh to Zebulon. However, no ridership projections were done as part of the study, as it was outside of the scope of work. Based primarily on cost, the study concluded that rail service may be feasible and further study was warranted, and that in order to move the project forward, it would need to be included in the Long Range Transportation Plan for the Triangle Region.

STAC Process

The Raleigh to Zebulon corridor was evaluated by the Special Transit Advisory Commission (STAC), a cooperative regional effort of leaders appointed in 2007 by the Capital Area Metropolitan Planning Organization (CAMPO) and the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC) to develop a Regional Transit Vision Plan. This Plan would be the basis for the transit component of the Long Range Transportation Plan. The Raleigh to Zebulon corridor was one of 16 corridors evaluated in terms of feasibility and potential ridership (see Figure 1). Summary findings for all corridors are shown in Table 1. The study determined that the Raleigh to Zebulon corridor did not rank in the top four among the study corridors for any of the studied measures, which included: transit intensity, total daily trips, in-corridor daily trips, in-corridor daily trips per acre, and in-corridor daily trips among households most likely to use transit. Only corridors ranked among the top four were included in the Vision Plan. Based on 2035 projections using the Triangle Regional Model, the number of in-corridor trips per acre is not expected to increase to a level supportive of rail transit (see Figure 2).

Long Range Transportation Plan

The 2035 Long Range Transportation Plan (LRTP) for the region's two MPOs was updated and released in May 2009. The LRTP is a federally-mandated process and document that is used for important transportation investment and programming decisions. Only projects that appear in a Long Range Transportation Plan may be included for funding in the Transportation Improvement Program which is the mechanism for all major funding. Comments from public and private transportation providers were solicited throughout the planning process, and a 42-day public comment period was provided for the proposed plan in accordance with the Public Involvement Procedures adopted by the MPOs.

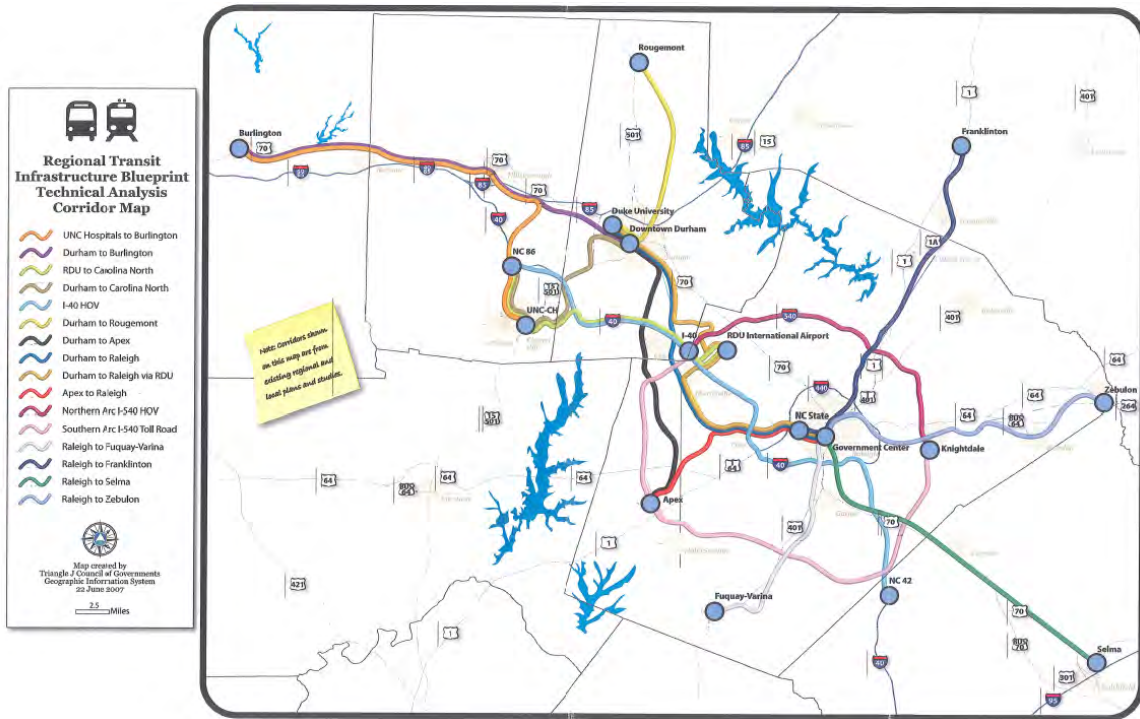
Development of the LRTP took into account the STAC recommendations, and considered rail service in the Raleigh to Zebulon corridor as one of the options for Wake County. However, after analysis, the corridor was not included in the 2035 LRTP (see Figure 3).

Future Studies

Not being included for analysis in the current Triangle Transit study does not imply that the Raleigh to Zebulon corridor has been rejected from future consideration. It is likely that it will continue to be studied for feasibility and addition to a future LRTP. The corridors that are included in the current LRTP are those that have been determined to have a higher feasibility rating and thus a higher chance of receiving funding and being successful in the near-term. Funding constraints simply do not allow all potential rail corridors in the region to be implemented between now and 2035. Recognizing the future potential of the corridor for passenger rail service, the LRTP resolves that the corridor right-of way be preserved for this purpose.

However, both the STAC Vision Plan and 2035 LRTP show improved bus service in the corridor. If the ½ cent sales tax referendum to support transit is successful, express and other forms of bus service can be implemented in the corridor before rail service begins in any of the other corridors. In addition, the City of Raleigh has commenced improvements to enhance bus service in the New Bern Avenue corridor between downtown Raleigh and the WakeMed Raleigh Campus.

Figure 1 STAC Study Corridors



Source: STAC Regional Transit Vision Plan Meeting Notes, July 2007

Table 1 STAC Corridor Statistics


Corridor (Corridors shown in red rank in the top four for one or more transportation measures among the 18 full corridors)	Corridor Length (miles)	Acres in Corridor Travel Market Places	Travel Market Data							Socioeconomic Data			
			Total Trips		In-Corridor Trips			Strata 1&2 In-Corridor Trips		Dwelling Units	Jobs	Activity Intensity Measure	
			Daily Trips	Trips/Acre	Daily Trips	Trips/Acre	Trips/Mile	% on transit	Daily Trips				Trips/Acre
1 Durham to Apex	25	46,016	1,000,000	21	490,000	11	20,000	9,800	110,000	2	88,000	204,000	3
2A Durham to Raleigh via rail line	28	39,261	1,100,000	29	590,000	15	21,000	11,800	200,000	5	73,000	345,000	5
2B Durham to Raleigh via busway	28	37,838	1,000,000	26	510,000	14	18,000	10,200	180,000	5	60,000	296,000	4
3 Durham to Raleigh via US 70	23	37,333	1,000,000	27	460,000	12	20,000	9,200	120,000	3	91,000	227,000	4
4 Durham to Burlington	33	47,802	400,000	8	240,000	5	7,000	4,800	70,000	2	30,000	105,000	1
5 Durham to Chapel Hill	21	22,152	800,000	34	450,000	20	21,000	9,000	140,000	6	57,000	175,000	5
6 Durham to North Durham	19	31,816	400,000	13	210,000	6	11,000	4,200	80,000	2	34,000	100,000	2
7 I-40 HOV	46	89,358	1,000,000	12	360,000	4	8,000	7,200	60,000	1	100,000	203,000	2
8 Northern Arc I-540	26	43,154	600,000	14	170,000	4	6,000	3,400	20,000	0	63,000	95,000	2
9 Raleigh to Apex	17	25,215	800,000	32	330,000	13	19,000	6,600	100,000	4	64,000	148,000	4
10 Raleigh to Franklinton	28	83,568	1,100,000	14	650,000	8	23,000	13,000	140,000	2	94,000	222,000	2
11 Raleigh to Fuquay-Varina	21	45,429	600,000	13	280,000	6	13,000	5,600	60,000	1	60,000	107,000	2
12 Raleigh to Selma	29	42,191	500,000	13	250,000	6	9,000	5,000	50,000	1	52,000	110,000	2
13 Raleigh to Zebulon	27	56,745	900,000	16	430,000	8	16,000	8,600	80,000	1	94,000	161,000	3
14 Chapel Hill to RDU via Metro Center	27	32,357	600,000	18	300,000	9	11,000	6,000	80,000	2	44,000	150,000	3
15 Southern Arc NC-540	44	91,220	1,100,000	12	400,000	4	9,000	8,000	40,000	0	110,000	161,000	2
16 Pittsboro to Chapel Hill	24	75,238	600,000	7	370,000	5	15,000	7,400	60,000	1	56,000	80,000	1
17 Chapel Hill to Burlington	37	56,116	400,000	7	240,000	4	7,000	4,800	50,000	1	34,000	77,000	1
Corridor Segments and Combinations													
10.1 Raleigh to I-540 US1 Sub-Corridor	10	16,297	700,000	45	380,000	23	38,000	7,600	110,000	7	49,000	174,000	6
10.2 Cary to Raleigh to I-540 via US1	17	23,641	900,000	38	440,000	19	24,000	8,800	130,000	5	65,000	208,000	5
2A.1 Durham to Metro Center	11	18,037	400,000	23	220,000	12	20,000	4,400	80,000	5	26,000	155,000	4
2A.2 Raleigh to Metro Center	17	27,775	800,000	28	360,000	13	21,000	7,200	110,000	4	51,000	227,000	4
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5.2 Durham to Patterson Place	8	8,773	300,000	38	180,000	21	23,000	3,600	70,000	8	22,000	99,000	6
Totals for Region covered by Model:		1,676,800	10,700,000								1,100,000	1,330,000	

Notes:

- In-corridor trips are trips that both begin and end within the corridor.
- Peak trips are trips made between 6-10 am and 3-7 pm.
- Strata 1&2 trips are trips made by households without cars and by low-income households with cars.
- The activity intensity measure is based on the 1997 TTA Station Area Development Guidelines and is derived from Activity Levels 2 and 3 in the Station Area Classification System, where about 3.2 jobs are the equivalent of one dwelling unit in "supporting walk-to-transit" terms. It is calculated by the equation: ((dwelling units + (jobs/3.2))/acres). The activity intensity measure for a corridor as a whole is only valuable in comparing the relative intensity of activity among corridors, not for whether or not fixed guideway transit may be feasible in any particular corridor, since activity thresholds only have meaning when applied to the 1/2 mile walk radius around a station area.
- Values are subject to change based on data reviews, revised socioeconomic estimates and changes to the regional travel demand model
- Indicators for sections of a corridor may differ significantly from indicators for a corridor as a whole.
- Corridors to Burlington and Selma include only data for the portions of these corridors within the boundaries of the Triangle Regional Travel Demand Model.

Source: STAC Regional Transit Vision Plan, May 2008

Figure 2 Raleigh to Zebulon Corridor Statistics

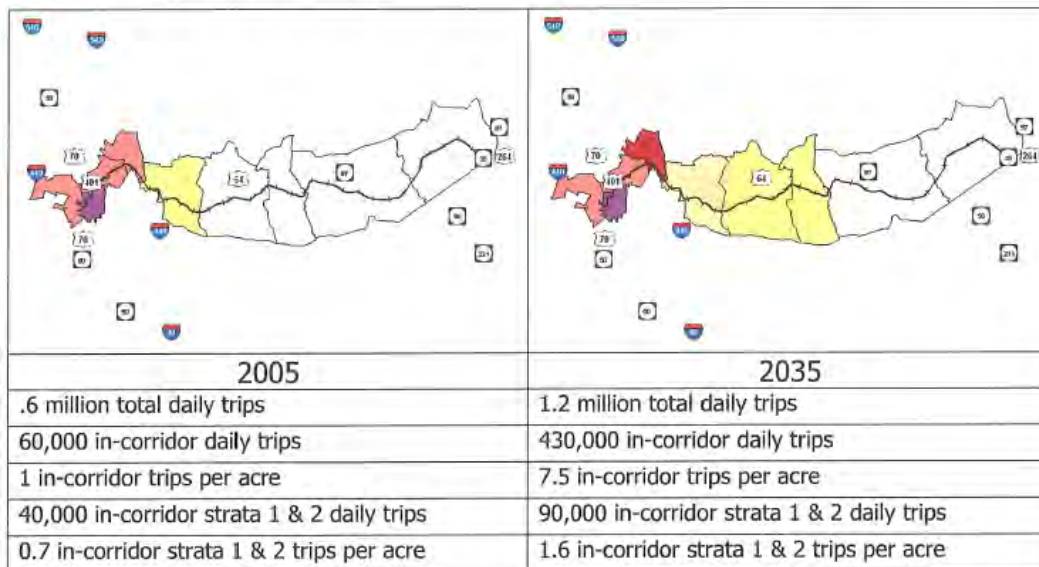


Transit Infrastructure Blueprint Technical Analysis

Examining Land Use, Travel Markets and Costs

Raleigh to Zebulon –27 miles

This document summarizes travel in the Travel Market Places along the corridor for the 2005 "base year" and for 2035; the results are from the Triangle Regional Transportation Model. This information is preliminary and subject to change.



- In-corridor trips are trips that both begin and end in the corridor.
- Strata 1 & 2 trips are trips made by households without cars and low-income households with cars.

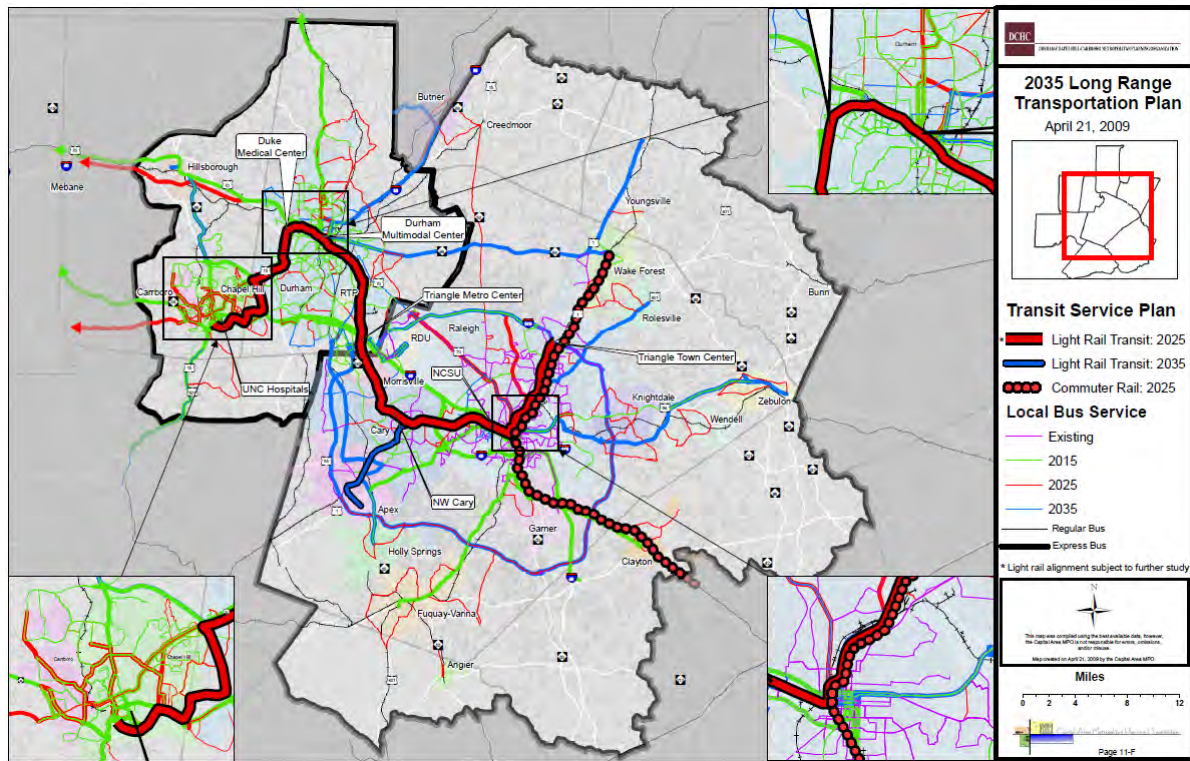
Colors show the number of total daily trips per acre for the Travel Market Places in the corridor:



Total daily trips in the Triangle: 2005 -- 5.5 million; 2035 -- 10.7 million (forecast).

Source: STAC Regional Transit Vision Plan Meeting Notes, July 2007

Figure 3 L RTP Transit Map



Source: CAMPO/DCHC 2035 LRTP, May 2009



Appendix B

White Paper Study of Commuter Rail to Hillsborough



Transportation Planning
Traffic Engineering

To: Greg Northcutt, Triangle Transit
From: George Alexiou, PE
Date: June 25, 2010
Subject: Durham to Hillsborough Corridor Rail Service

This memo provides an explanation for not including the Durham to Hillsborough rail corridor as part of the alternatives analysis studies currently being conducted by Triangle Transit in anticipation of a ½ percent sales tax referendum for funding transit improvements in the Triangle region. Several studies have analyzed the potential viability of the Durham to Hillsborough corridor for passenger rail service.

STAC Process

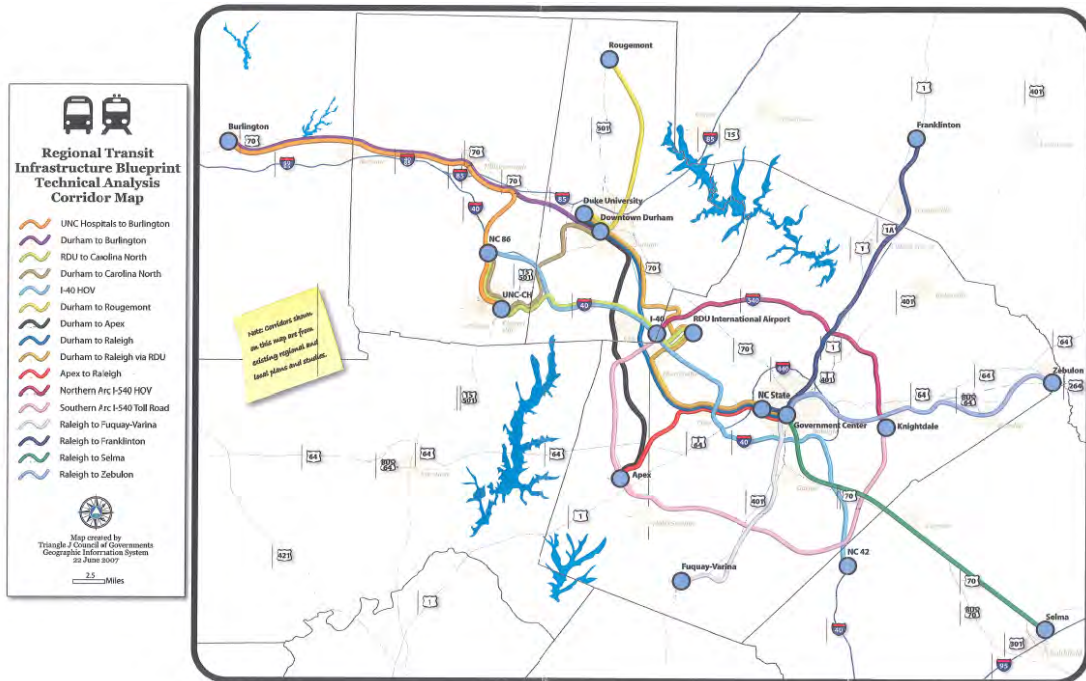
The Durham to Hillsborough corridor was evaluated by the Special Transit Advisory Commission (STAC), a cooperative regional effort of leaders appointed in 2007 by the Capital Area Metropolitan Planning Organization (CAMPO) and the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC) to develop a Regional Transit Vision Plan. This Plan would be the basis for the transit component of the Long Range Transportation Plan. The Durham to Hillsborough corridor was evaluated as part of the Durham to Burlington corridor study, one of 16 corridors evaluated in terms of feasibility and potential ridership (see Figure 1). Summary findings for all corridors are shown in Table 1. The study determined that the Durham to Burlington corridor did not rank in the top four among the study corridors for any of the studied measures, which included: transit intensity, total daily trips, in-corridor daily trips, in-corridor daily trips per acre, and in-corridor daily trips among households most likely to use transit. Only corridors ranked among the top four were included in the Vision Plan. Based on 2035 projections using the Triangle Regional Model, the number of in-corridor trips per acre is not expected to increase to a level supportive of rail transit (see Figure 2).

Long Range Transportation Plan

The 2035 Long Range Transportation Plan (LRTP) for the region's two MPOs was updated and released in May 2009. The LRTP is a federally-mandated process and document that is used for important transportation investment and programming decisions. Only projects that appear in a Long Range Transportation Plan may be included for funding in the Transportation Improvement Program which is the mechanism for all major funding. Comments from public and private transportation providers were solicited throughout the planning process, and a 42-day public comment period was provided for the proposed plan in accordance with the Public Involvement Procedures adopted by the MPOs.

Development of the LRTP took into account the STAC recommendations, and considered rail service from Durham to Hillsborough as one of the options for Durham and Orange Counties. However, after analysis, the corridor was not included in the 2035 LRTP (see Figure 3).

Figure 1 STAC Study Corridors



Source: STAC Regional Transit Vision Plan Meeting Notes, July 2007

Table 1 STAC Corridor Statistics

Socioeconomic and Travel Markets Data -- 2035			Travel Market Data							Socioeconomic Data			
Corridor (Corridors shown in red rank in the top four for one or more transportation measures among the 18 full corridors)	Corridor Length (miles)	Acres in Corridor Travel Market Places	Total Trips		In-Corridor Trips			Strata 1&2 In-Corridor Trips		Dwelling Units	Jobs	Activity Intensity Measure	
			Daily Trips	Trips/Acre	Daily Trips	Trips/Acre	Trips/Mile	if 2% on transit	Daily Trips				Trips/Acre
1 Durham to Apex	25	46,016	1,000,000	21	490,000	11	20,000	9,800	110,000	2	88,000	204,000	3
2A Durham to Raleigh via rail line	28	39,261	1,100,000	29	590,000	15	21,000	11,800	200,000	5	73,000	345,000	5
2B Durham to Raleigh via busway	28	37,838	1,000,000	26	510,000	14	18,000	10,200	180,000	5	60,000	296,000	4
3 Durham to Raleigh via US 70	23	37,333	1,000,000	27	460,000	12	20,000	9,200	120,000	3	91,000	227,000	4
4 Durham to Burlington	33	47,802	400,000	8	240,000	5	7,000	4,800	70,000	2	30,000	105,000	1
5 Durham to Chapel Hill	21	22,152	800,000	34	450,000	20	21,000	9,000	140,000	6	57,000	175,000	5
6 Durham to North Durham	19	31,816	400,000	13	210,000	6	11,000	4,200	80,000	2	34,000	100,000	2
7 I-40 HOV	46	89,358	1,000,000	12	360,000	4	8,000	7,200	60,000	1	100,000	203,000	2
8 Northern Arc I-540	26	43,154	600,000	14	170,000	4	6,000	3,400	20,000	0	63,000	95,000	2
9 Raleigh to Apex	17	25,215	800,000	32	330,000	13	19,000	6,600	100,000	4	64,000	148,000	4
10 Raleigh to Franklinton	28	83,568	1,100,000	14	650,000	8	23,000	13,000	140,000	2	94,000	222,000	2
11 Raleigh to Fuquay-Varina	21	45,429	600,000	13	280,000	6	13,000	5,600	60,000	1	60,000	107,000	2
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Source: STAC Regional Transit Vision Plan, May 2008

Figure 2 Durham to Burlington Corridor Statistics



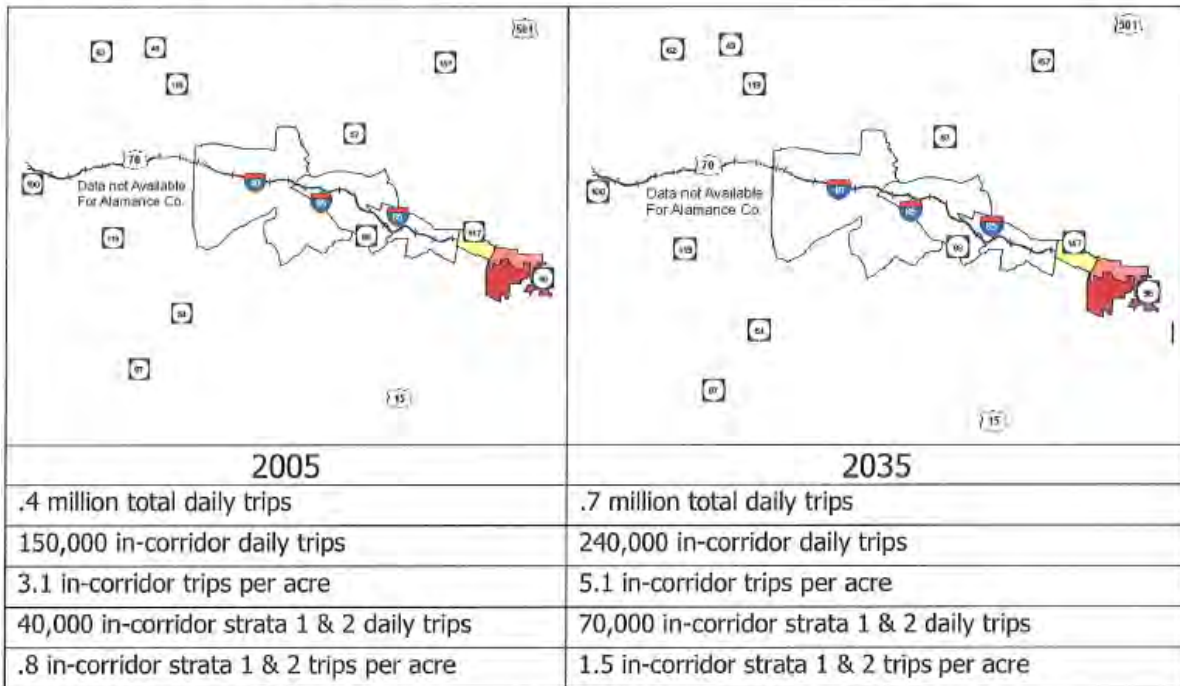
Transit Infrastructure Blueprint Technical Analysis

Examining Land Use, Travel Markets and Costs

Durham to Burlington – 33 miles

Source: STAC Regional Transit Vision Plan Meeting Notes, July 2007

This document summarizes travel in the Travel Market Places along the corridor for the 2005 “base year” and for 2035; the results are from the Triangle Regional Transportation Model. This information is preliminary and subject to change.



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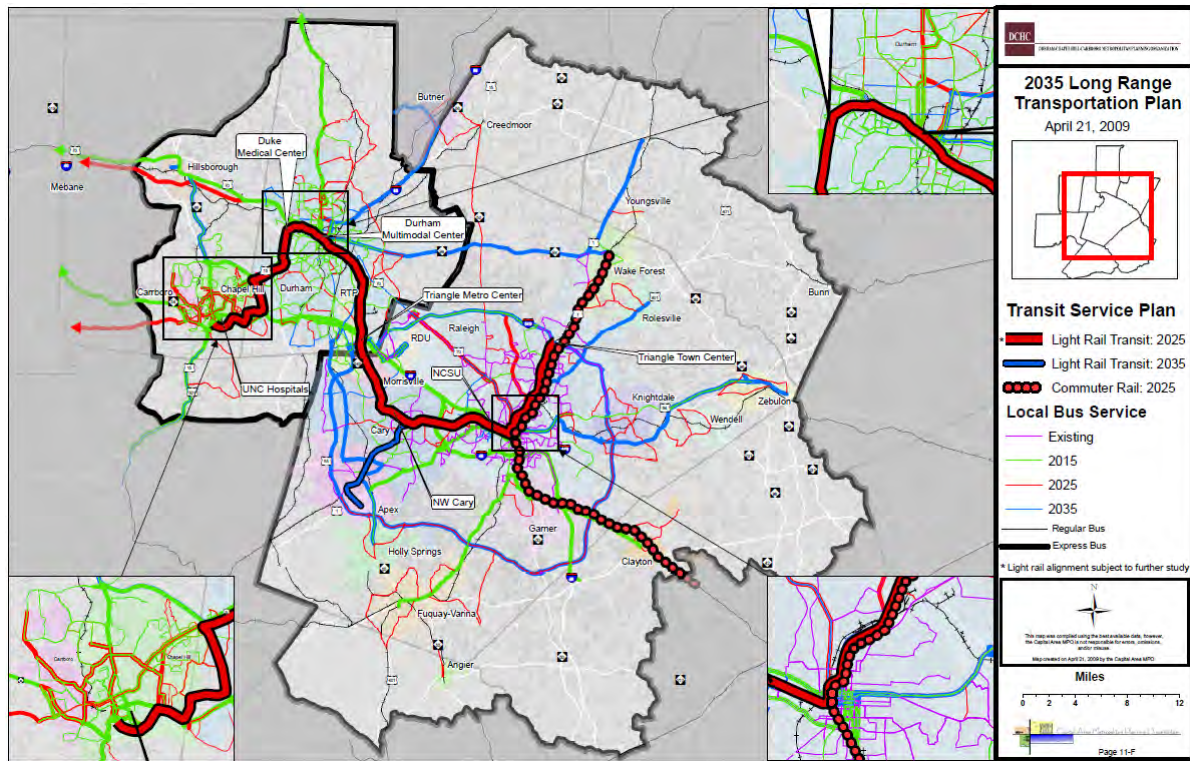
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Total daily trips in the Triangle: 2005 -- 5.5 million; 2035 -- 10.7 million (forecast).

Source: STAC Regional Transit Vision Plan Meeting Notes, July 2007

Figure 3 L RTP Transit Map



Source: CAMPO/DCHC 2035 LRTP, May 2009

NCRR Ridership Study

The North Carolina Railroad (NCRR) published a report in May 2010 with the results of a study that examined potential passenger demand for commuter rail service between Greensboro and Goldsboro along the NCRR corridor, which included the corridor segment between Durham and Hillsborough. Four model years were analyzed (2009, 2012, 2017, and 2022) to determine daily volume and daily boardings at each station. The segment between Durham and Hillsborough is shown highlighted in Figures 4 and 5. Figure 4 shows the total daily segment volume for this corridor, with low ridership volume that declines between subsequent future model years. Figure 5 shows total daily boardings for this corridor in 2017 and 2022 model years, with boardings much lower for these three stops than most other stops along the full study corridor.

Figure 4 Total Daily Segment Volume (each direction)

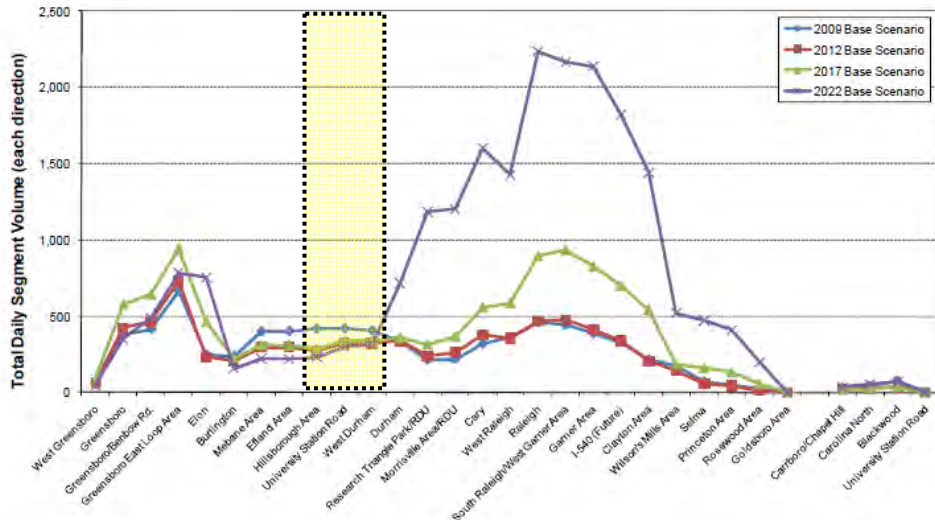
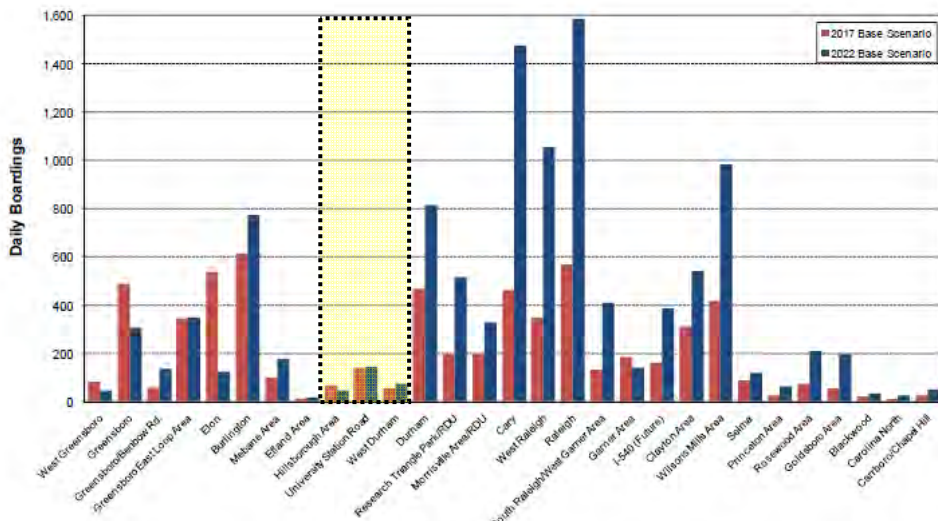


Figure 5 Total Daily Boardings



Source: NCRRC Commuter Rail Ridership & Market Study, May 2010

Future Studies

Not being included for analysis in the current Triangle Transit study does not imply that the Durham to Hillsborough corridor has been rejected from future consideration. It is likely that it will continue to be studied for feasibility and addition to a future LRTP. The corridors that are included in the current LRTP are those that have been determined to have a higher feasibility rating and thus a higher chance of receiving funding and being successful in the near-term. Funding constraints simply do not allow all potential rail corridors in the region to be implemented between now and 2035. Recognizing the future potential of the corridor for passenger rail service, the LRTP resolves that the corridor right-of way be preserved for this purpose.

However, both the STAC Vision Plan and 2035 LRTP show improved bus service in the corridor. If the ½ percent sales tax referendum to support transit is successful, express and other forms of bus service can be implemented in the corridor before rail service begins in any of the other corridors.



Appendix C

White Paper Study of Future Extension to Carrboro Implementation Analysis

TRIANGLE REGIONAL TRANSIT PROGRAM**Future Extension to Carrboro Implementation Analysis****Strategic Issues and Possible Alignments****September 24, 2010****BACKGROUND**

During the first round of public meetings for the Triangle Regional Transit Program in the summer of 2010, the town of Carrboro was the most frequently mentioned municipality among statements of interest for rail extensions beyond the corridors specified in the adopted 2035 LRTP. Additionally, the Carrboro Board of Aldermen also passed a resolution requesting that the Alternatives Analysis process assess the feasibility of extending rail from UNC Hospital to Carrboro.

Further comments from DCHC TAC members at the September 2010 TAC meeting indicated that while the TAC did not recommend expanding the Alternatives Analysis to include Carrboro in this phase of the analysis, that the Town of Carrboro has gone on record numerous times in support of examining how to bring rail to Carrboro, and that a document providing an overview of the strategic issues that need addressing to extend rail to Carrboro would be welcome and appreciated by citizens, elected officials, and members of the DCHC TAC.

This document attempts to provide a high-level view of those issues, and provide a foundation of knowledge upon which the feasibility of rail to Carrboro can be explored in greater detail in the future.

CURRENT RECOMMENDATION FOR RAIL IN ORANGE COUNTY

As the Transitional Analysis portion of the Alternatives Analysis comes to a close, the technical team is recommending that the corridor from Alston Avenue in Durham to UNC Hospital in Chapel Hill be advanced to the next stage of analysis for detailed study. This detailed study phase will compare the performance of Bus Rapid Transit, Light Rail Transit, Traffic System Management (TSM) alternative, and a "No Build" option in the corridor. This paper assumes that any rail connection to Carrboro will be made as an extension of an initial light rail investment that terminates near UNC Hospital.

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KEY STRATEGIC ISSUES

In considering how rail could be extended from UNC Hospital to Carrboro, several key issues need to be addressed. Those issues are:

- What is the most technically feasible way to extend rail past UNC Hospital?
- Where will rail vehicles run between UNC Hospital and Carrboro, and where might stations be placed?
- How will trains reverse direction if Carrboro becomes an end-of-line station?
- How will trains interact with and impact traffic if they run in the street?
- How would an extension to Carrboro be funded?
- What actions need to be taken to further advance planning for rail to Carrboro?

EXTENDING PAST UNC HOSPITAL

If rail is to be extended past UNC Hospital to points north and west, the primary transportation corridor that can fulfill this need is the Pittsboro St/Columbia St pair of roads.

Could light rail cut through the UNC campus instead of using city streets to go north and west? While perhaps technically possible, it would be challenging to move across campus without impacting buildings and other important activities, such as emergency vehicle access to UNC Hospital. Different turning movements for light rail may also be fatally flawed for alignments that cut across campus. Most importantly, UNC has a campus master plan which plans for significant uses in terms of buildings and public spaces to be developed between existing and current buildings under construction.

An in-depth study of alignment alternatives from UNC west and north could explore the tradeoffs of using campus land between UNC Hospital and South Rd to begin moving north and west from the hospital, but this analysis suggests that street-running should be the default approach, with other alignment approaches compared to street-running for cost:benefit analysis.

Light rail trains successfully operate in streets in other cities in the US and abroad, either in their own exclusive lane or in mixed traffic (streetcar operation) with cars, trucks and buses. Figure 1 below shows light rail in Minneapolis, MN in the center of the street operating bidirectionally. (where cars are not allowed to drive on the tracks) Cars drive in the same direction of the train on either side. Figure 2 shows mixed-traffic running (where cars CAN drive on the tracks) in San Francisco.

Figure 1. Center of Street Light Rail Operations in Minneapolis



Figure 2. Mixed Traffic Light Rail Operations in San Francisco, CA



Photo Courtesy of Peter Ehrlich

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The current proposed alignment and station options for initial study in the region's Alternatives Analysis identify two primary potential locations for a UNC Hospital station, which are shown as green and blue platforms in Figure 3 below.

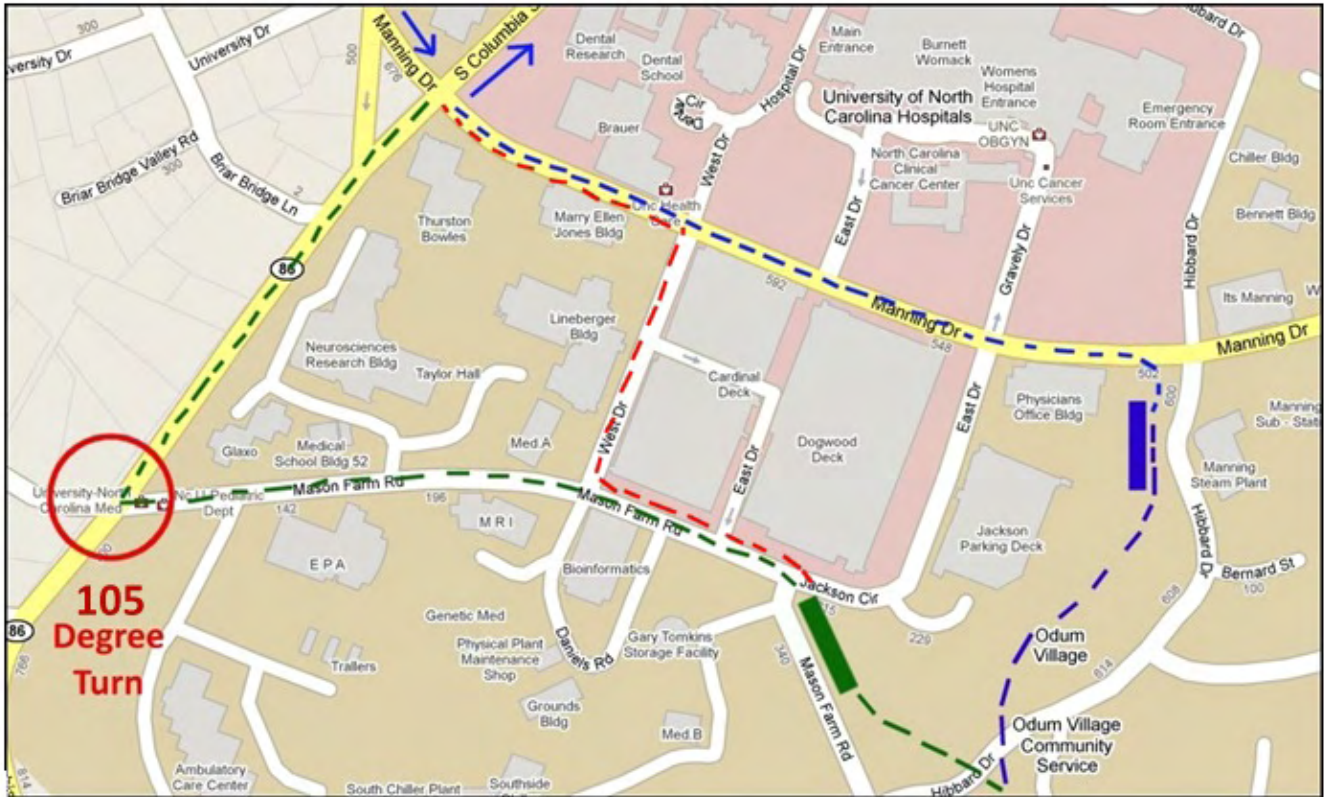
Possible routes north and west from these stations include:

- Mason Farm Rd from Hibbard to South Columbia Street (see Figure 3, green dotted line)
- Mason Farm Rd. from Hibbard to West St to Manning Drive (Figure 3, red dotted line)
- Manning Drive from Hibbard to the South Columbia/Pittsboro/Manning intersection. (Figure 3, blue dotted line).

Given the limitations of right of way of Columbia Street, Pittsboro Street, Franklin Street and Manning Drive, it is envisioned that the light rail extension will operate in mixed traffic thereby not removing any of the existing travel lanes. The light rail will obey all existing traffic signals with no preemption. How to optimize the signal timing is typically something that is investigated in the design phase.

In assessing these two potential alignments, a key constraint is the potential 105-degree turn from Mason Farm Rd onto South Columbia Street. A train's minimum turning radius is preferably kept to 100 feet. Such a radius would severely cut off the corner of the intersection. This turn also has some grade issues. Running in the street typically prohibits the use of superelevation (where the outside rail is higher than the inside rail in a curve) for the tracks, and instead street running employs a flat surface. Both Mason Farm Rd and South Columbia St. slope toward the intersection of the two streets. Introduction of a flat track surface would introduce two grade breaks in each street. If the tracks were superelevated for this sharp curve, the cross section would be in the opposite slope of the street grade compounding this problem. This geometry is an issue for both the rail and street traffic.

Figure 3. Potential Light Rail paths proceeding North and West from UNC Hospital Station Locations



Additional detailed analysis will be needed to further assess either the Manning or Mason Farm alternative.

UNIVERSITY CONCERNS WITH MANNING DRIVE

In meetings with UNC representatives, campus officials voiced particular concerns regarding the following issues:

- Impacts on Pedestrian Bridges over Manning Drive
- Utility impacts under the street
- Emergency Vehicle access to the hospital
- Overall traffic levels on Manning Drive

A brief discussion of each follows.

Discussion: Pedestrian Bridges Over Manning Drive from Parking Decks

Within the area immediately in front of UNC Hospital’s main entrance, there are three pedestrian overpasses that lead from the south side of Manning Drive to the hospital complex on the north side. On-site investigations by URS engineering staff indicated that street-running light rail vehicles will not interfere with the three bridges during construction and operations because URS had them surveyed and they are over 16 feet high, which provides the needed clearance for light rail.

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Discussion: Utilities

If light rail were to do any street running in the vicinity of UNC Hospital, tracks would likely be embedded in the street. Standard practice for embedded track anticipates a concrete slab encapsulating the rail and this slab is 15 to 18 inches in depth.

There is typically no impact since the distributed axle load of a light rail vehicle is comparable to the axle load distribution of a HS-20 truck. This has been demonstrated on numerous other street running light rail projects.

Detailed information on the location and depth of utilities in the hospital area, above and below streets, and in-between buildings, would help staff determine what, if any impacts may occur on utilities during light rail construction and operations.

Discussion: Emergency Vehicles

Access for ambulances and other emergency vehicles is a critical issue for any hospital complex. Whereas many locations in a city need to plan for comparatively rare use by emergency vehicles, at UNC Hospital their presence is a constant and daily part of hospital operations.

The emergency room is located on Emergency Room Drive, which extends north from the Hibbard/Manning intersection. According to emergency room staff onsite, this is the road ALL ambulances use to bring patients to UNC Hospital.

Figure 4. UNC Emergency Room Access Rd



Movements of trains in and out of Manning Drive from a station adjacent to Hibbard Drive would need to be managed carefully to maximize the speed and safety of vehicles getting to the Emergency Room. Other transit properties such as Houston have installed light rail signal pre-emption for emergency vehicles using OPTICON technology, which recognizes the strobe lights on modern ambulances, fire and police vehicles and gives those vehicles priority over train movements. These technologies could be explored for local application, and should be examined in greater detail in an additional study.

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Discussion: Overall Traffic Congestion On Manning Drive

In a July 2010 meeting, University officials raised concerns that light rail trains running on Manning Drive would increase the level of traffic congestion in front of UNC Hospital and some of its key entrances. While adding trains to the mix of street traffic will certainly introduce a new mobility element for pedestrians, cyclists, bus operators and motorists to negotiate, it is not clear whether or not adding rail service to Manning Drive would increase traffic congestion or reduce it.

Prior estimates indicate that a light rail installation bringing 6 trains per hour to the hospital from the Friday Center could replace 24 to 30 peak period buses per hour currently operated by Chapel Hill Transit and Triangle Transit. The additional capacity of the trains may also divert more motorists who currently drive and park near the hospital to transit.

A detailed traffic impact study that includes assumptions and projections about mode shifts from bus and car to rail would be needed to address this concern at an appropriate level of analysis.

POSSIBLE PATHS FOR TRAINS FROM UNC HOSPITAL TO CARRBORO

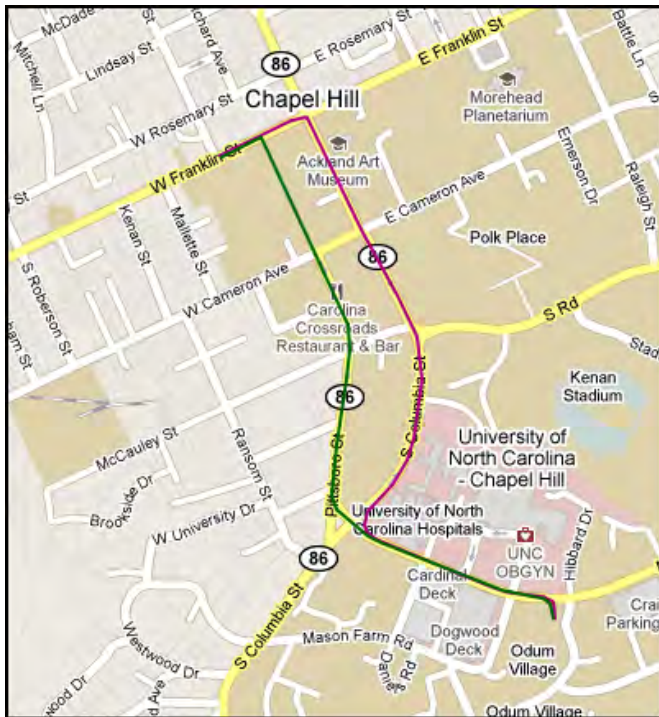
Assuming light rail trains can move forth from the hospital area, this analysis assumes that trains would travel north on S. Columbia Street, and south on Pittsboro St. The recently released downtown Chapel Hill development framework indicates a possible extension of Pittsboro St through to Franklin Street. If this came to happen, light rail could take advantage of this development.

Figure 4. Downtown Chapel Hill Framework Proposal to Extend Pittsboro Street



With the proposed street extensions envisioned above, light rail could get to downtown Chapel Hill using the purple line in Figure 5 for westbound travel, and the green line for eastbound travel.

Figure 5. UNC Hospital to Downtown Chapel Hill – Potential Concept



This alignment allows for “tail tracks” to store trains up to 2 cars in length in the center of the street in the block of West Franklin St between Church St and the extended Pittsboro St. If financial or other considerations only made it possible to get to downtown Chapel Hill in an interim phase before reaching downtown Carrboro, this would be one way to provide end-of-line capacity to have trains layover in the less-busy midday or be ready for early morning departures.

For downtown Chapel Hill, the north/westbound station could be placed in front of the Ackland Art Museum on the side of South Columbia Street, and the south/eastbound station could be placed on the eastern side of a redeveloped University Square parcel on the side of the Pittsboro street extension.

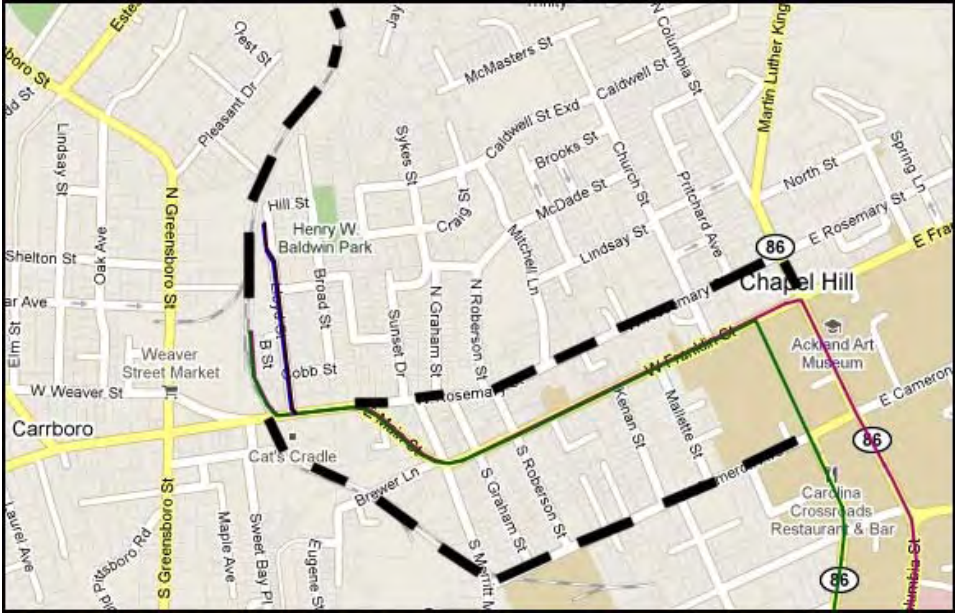
Once in downtown Chapel Hill, the environment is such that if you can get an automobile to downtown Carrboro and back, you can probably get a train to downtown Carrboro and back—though how to do that will take careful and thoughtful planning and detailed study.

Figure 6 on the next page demonstrates how this alignment could proceed west to downtown Carrboro via West Franklin Street, operating in a manner similar to the Minneapolis train shown in Figure 1. (Franklin St is wider than the street in MN) Once reaching Main St in Carrboro, the train would operate more like the Portland example in Figure 2 until it returned to the rail corridor behind Harris Teeter.

Other possible routings that could be explored in detail include the black dotted lines in Figure 6, which utilize Cameron Avenue and the University rail spur/Libba Cotton bikeway, or utilize Rosemary Street.

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Figure 6. Downtown Chapel Hill to Downtown Carrboro – Potential Concept



Within downtown Carrboro, a station location will need to be found. Figure 7 shows two possible ways to get from Main Street in Carrboro into the University Railroad corridor to then travel on to Carolina North. Three potential station sites, A, B, and C are identified. Each has benefits and drawbacks in terms of access for pedestrians, impact on adjacent buildings from station or track elements, and potential for ridership.

Figure 7. Downtown Carrboro Station Locations and Rail Corridor Access



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REVERSING TRAINS

If light rail is extended to Carrboro, and not on to Carolina North at the same time, then there will need to be infrastructure near the Carrboro station that allows for storage of a trainset or two, called “tail tracks.” In most end-of-line stations, these tail tracks are just after the end station. Since midday trains are stored on these tracks, the tail track cannot be located in a street if the light rail is operating as a streetcar through that street segment. Hence, tail tracks would need to be located off-street with a signalized transition in and out of the street.

Unlike the tail tracks described for Franklin Street earlier in this document, it is more difficult to find a location in downtown Carrboro for tail tracks that are not adjacent to the existing rail corridor. This means that the best location for tail tracks may be on the east side of the University railroad tracks and west of Lloyd St if an eventual extension to Carolina North is to be held open as a possibility.

On the other hand, if the rail segment to Carolina North opened at the same time as the segment to Carrboro, it would remove the need to place tail tracks in or near downtown Carrboro, and train switching and storage could be managed closer to Carolina North, simplifying some train management in and near downtown.

TRAINS AND TRAFFIC

In an ideal world, we would be able to deploy trains to Carrboro and avoid all interactions with motor vehicle traffic, but the urban geography of Carrboro and Chapel Hill makes this challenging, and elevated track and tunneling come at a cost likely to render the project financially infeasible. Therefore, an extension to Carrboro will probably involve some interactions between trains and cars.

However, light rail trains and cars coexist successfully in many other US cities, with millions of annual miles of safe operation, despite the likelihood of conflicts between trains and cars being higher than in a rail-only operating environment. The federal government’s *Transit Cooperative Research Program Report 17: Integration of Light Rail Transit Into City Streets* provides a detailed analysis of best practices in how trains, buses, pedestrians, cyclists and cars can coexist safely and successfully.

FUNDING

Currently, there is no rail extension specified to Carrboro in the fiscally constrained 2035 Long Range Transportation Plan for the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization. Rail to Carrboro and Carolina North was included in previous plans (2025,2030) but was removed in order to match planned investments to available revenue projected for the 2005-2035 timeframe.

The fixed guideway transit investment chosen by the MPO in the spring of 2011 will likely be funded by a mix of federal, state, and local funds, with the Orange County half-cent sales tax specified in House Bill 148 representing the primary revenue source to fund major transit capital projects.

DRAFT

While it would be speculative at best to try to specify ways to fund an extension to Carrboro, it is reasonable to suggest that the mix of funding opportunities available for rail transit to UNC Hospital would also be available in similar percentages to extend to Carrboro if a successful line were up and running by the early to mid-2020s.

ACTION STEPS

To consider extending light rail or other higher-order transit from UNC Hospital to Carrboro in the future, the next steps may include:

- Establishing that the design a first segment of rail to UNC Hospital will not preclude extensions to Downtown Chapel Hill, Downtown Carrboro, and Carolina North
- Identifying a schedule and resources for a more detailed study of the opportunities and constraints that exist in extending rail to Carrboro
- Conduct a corridor or feasibility study examining these or other potential rail extension alternatives that might best connect Downtown Chapel Hill, the UNC Main Campus, Carrboro, and Carolina North with the proposed first phase of light rail at UNC Hospital
- Consider inclusion of any rail extensions in Orange County in the fiscally constrained 2040 DCHC LRTP

Comparison of FY2009-2015 STIP and FY2011-2020 STIP

Highway, Bridge, Bicycle and Pedestrian Projects

New Projects

Division	Project #	Route	Description	Total Cost (thousands)			Year Begin Construction			\$ Funded			\$ Unfunded	
				2009-2015	2011-2020	Difference	2009-2015	2011-2020	Delay	2009-2015	2011-2020	Difference	2009-2015	2011-2020
7	I-3306	I-40	I-85 in Orange Co. to US 15-501	47,000	47,000	-	post year	2019	new	-	23,500	23,500	47,000	23,500
7	I-0305	I-85	I-40 at Hillsborough to Durham County Line.	210,782	210,782	-	post year	2020	new	-	58,497	58,497	210,782	152,285
5	U-4716	SR 1978 (Hopson Rd.)/SR 1980 (Church St.)	Construct a grade separation, extend Church St. and close Church St. crossing	6,500	31,016	24,516	post year	2011	new	-	20,441	20,441	6,500	7,020
7	U-5304	US 15-501 (Bypass)	S. Columbia St. to Ephesus Ch. Rd.; bicycle, pedestrian and transit accommodations	-	5,150	5,150	post year	2019	new	-	5,150	5,150	-	-
7	B-4962	Eno River	Replace Bridge No. 46	6,200	6,600	400	2015	2018	new	3,350	6,600	3,250	2,850	-
7	B-5348	Phil's Creek	Replace Bridge No. 85	-	1,063	1,063	post year	2019	new	-	1,063	1,063	-	-
5, 8	FS-1008B	NC 751 (Feasibility Study)	US 64 in Chatham to north of Fayetteville Rd in Durham; widen to multi-lanes	n/a	n/a	n/a	n/a	n/a	new	n/a	n/a	n/a	n/a	n/a
5	FS-1005C	NC 54 (Feasibility Study)	I-40 to NC 55; widen to multi-lanes	n/a	n/a	n/a	n/a	n/a	new	n/a	n/a	n/a	n/a	n/a
5	C-5175	DATA	Operating assistance for new fixed route	-	2,438	2,438	n/a	2013	new	-	2,438	2,438	-	-
7	C-5177	MLK Jr. (shared pathway)	Homestead Rd. to Piney Mtn. Rd.	-	906	906	n/a	2013	new	-	906	906	-	-
5	C-5178	Campus Walk (Morreene Rd. to Lasalle St.) and Lasalle St. (Kangaroo Dr. to Erwin Rd.)	Construct sidewalks	-	336	336	n/a	2014	new	-	336	336	-	-
7	C-5179	North Estes Dr.	Construct pathway, sidewalk & bike lanes	-	1,182	1,182	n/a	2015	new	-	1,182	1,182	-	-
5	C-5182	Hope Valley Rd.	MLK Pkway and US 15-501 Bus.; sidewalks and bike lanes	-	1,386	1,386	n/a	2016	new	-	1,386	1,386	-	-
5	C-5183	Cameron Blvd. (Erwin Rd. to Duke Univ. Rd.) and Alston Ave. (Carpenter Fletcher and Sedwick	Construct sidewalks	-	2,127	2,127	n/a	2016	new	-	2,127	2,127	-	-
7	C-5184	Riverwalk Trail	Construct paved trail along Eno River (Phase III)	-	621	621	n/a	2018	new	-	621	621	-	-
7	W-5318	NC 86	NC 57 to Caswell Co.; geometric and shoulder improvements	-	4,654	4,654	n/a	2015	new	-	4,654	4,654	-	-
7	C-5181	Jones Creek Greenway	Bridge and connector trail	-	300	300	n/a	2015	new	-	300	300	-	-
				45,079						125,851				

Notes:

1. The tables in this document do not include highway maintenance and repaving projects, and those projects funded by traditional transit funding sources.
2. The MPO designates which projects receive Congestion Mitigation and Air Quality (CMAQ) funding, which are identified in these tables with the "C" prefix in the project number. Therefore, an issue with the funding or schedule of a CMAQ projects needs to be addressed with the MPO, and not NCDOT.

Change in Cost and Schedule

Division	Project #	Route	Description	Total Cost (thousands)			Year Begin Construction			\$ Funded			\$ Unfunded	
				2009-2015	2011-2020	Difference	2009-2015	2011-2020	Delay	2009-2015	2011-2020	Difference	2009-2015	2011-2020
5, 7	EB-4707	SR 2220 (Old Chapel Hill Rd.)-SR 1838 (Old Durham Rd.)/US 15-501	Durham Co. to Orange Co. bicycle improvements	3,828	5,450	1,622	2009	2011	2	3,828	4,000	172	-	-
5	U-4763B	Triangle Parkway	I-540 to I-40	190,610	190,568	(42)	2009	2011	2	190,610	190,568	(42)	-	-
7	U-3306	SR 1733/Weaver Dairy Rd.	NC 86 to Erwin Rd.	15,995	17,125	1,130	2010	2011	1	15,995	17,125	1,130	-	-
7	U-2803	SR 1919/Smith Level	Rock Haven Road to Bridge NO. 88	5,400	7,450	2,050	2011	2013	2	5,400	7,450	2,050	-	-
7	U-0624	NC 86/S. Columbia St.	SR 1906 (Purefoy Rd.) to SR 1902 (Manning Drive)	6,660	7,310	650	2009	2012	3	6,660	7,310	650	-	-
5	U-0071	East End Connector	NC 147 to north of NC 98	155,401	172,733	17,332	2013	2014	1	122,151	172,733	50,582	33,250	-
5	U-3308	NC 55/Alston Ave.	NC 147 to US 70 Bus-NC 98	23,321	28,428	5,107	2011	2014	3	23,321	28,428	5,107	-	-
7	U-3808	Elizabeth Brady Road Extension	South of US 70 Bus to north of US 70 Bypass at St. Mary's Rd.	33,994	-	(33,994)	2012	Deleted	n/a	33,994	-	(33,994)	-	-
5	B-3638	US 70 Bus/Main St.	Campus Drive Replace Bridge	975	1,300	325	2010	2012	2	975	1,300	325	-	-
5	B-4943	SR 1616	Sandy Creek Replace Bridge	415	477	62	2013	2020	7	415	477	62	-	-
5	C-4928	Morreene Rd., Neal Rd./Erwin Rd.	Construct bike lanes and sidewalks	556	1,441	885	2009	2011	2	556	1,441	885	-	-
5	W-5110	NC 55 and Lawson St.	Construct left turn lanes on NC 55	975	975	-	2011	2012	1	975	975	-	0	0
7	EL-4994	Orange County	Bolin Creek Greenway	738	1476	738	2008	2011	3	738	1,476	738	0	0
5	U-4724	Cornwallis Rd., S. Roxboro Rd./University Dr.	Bike and pedestrian feature	2,270	1,970	(300)	2010	2011	1	2,270	1,970	(300)	-	-
				Project Cost Increase						Project Funding Increase				
				Net Cost Change						Net Funding Change				
				29,601						61,701				
				(4,435)						27,365				

Funded Projects Currently Under Construction or In Progress

Division	Project #	Route	Description	Total Cost (thousands)			Construction 2011-2020
				2009-2015	2011-2020	Difference	
5	U-3309	SR 2028/T.W. Alexander Dr.	Cornwallis Rd to Miami Blvd.	13,961	14,933	972	under const.
5	U-3804	SR 1321/Hillandale Rd.	I-85 to Carver Street	11,191	11,941	750	under const.
5	U-4009	SR 1126/Service Rd.	Parallel to US 15-501 at Garrett Rd.	5,683	5,683	-	under const.
5	U-4011	SR 1959/S. Miami Blvd.	South of SR 2112 (Methodist St.) to north of SR 1960 (Bethesda Avenue)	6,477	8,265	1,788	under const.
5	U-4012	US 15-501	N. of Mt. Moriah Rd. to S. of Garrett Rd.	15,609	15,609	-	under const.
5	U-4026	SR 1613/Davis Dr.	Morrisville-Carpenter Rd. to NC 54	38,706	39,063	357	under const.
7	U-4704	Chapel Hill	Chapel Hill-Carrboro Computerized Traffic Signal System	5,000	5,450	450	under const.
5,7,8	U-4726	Urban Area Bike/Ped Allocation	DCHC MPO planning area	7,419	11,941	4,522	in progress
7	B-4216	SR 1002 - Strouds Creek	Replace bridge No. 66	1,125	1,054	(71)	under const.
5	B-3450	SR 1116 (Garrett Rd.)	New Hope Creek, Replace Bridge; Sandy Creek, Replace Bridge	4,986	4,986	-	under const.
8	EB-2921F	American Tobacco Rail Trail	Durham Co. to Wake Co.	2,392	2,392	-	in progress
7	C-4932A	Orange County	125 Space Park and Ride Lot.	275	275	-	under const.
5	C-4702	Durham County	10 Replacement buses	3,000	3,000	-	in progress
7	EL-4828	Morgan Creek Greenway West	Smith Level Rd. to University Lake	600	535	(65)	in progress
7	EL-4601	Morgan Creek Greenway East	US 15-501 Culbeth Rd. to Smith Level Rd	872	1,290	418	in progress
5	EB-3606	Orange County	Bicycle route mapping and signing	50	50	-	in progress
5, 7	C-4924	TJCOG	Develop flexible work schedule for employees and organizations in Triangle ozone non-attainment area for 3 yrs.	300	5,626	5,326	in progress
5	C-4929	Bicycle Parking Program	Install bike racks at various locations	48	48	-	in progress
				Net funding change		14,447	

Note: Funding increase for some ongoing programs might be based on increase in plan years
(FY09-15 TIP = 7 years; FY11-20 TIP = 10 years)

UnFunded Projects (No change in unfunded status)

Division	Project #	Route	Description	Total Cost 2009-2015	Total Cost 2011-2020	Difference	Year begin
5	I-4743	I-85	US 70 to SR 1632 (Red Mill Rd.)	n/a	n/a	n/a	post year
7	R-3438	Hillsborough Western Bypass	US 70 to NC 57	7,450	7,450	-	post year
7	R-2825	SR 1009/S. Churton St.	I-40 to Eno River	19,300	22,750	3,450	post year
7	U-2805	SR 1777 (Homestead Rd.)/SR 1834 (High School Rd.)	Widen to multi-lanes	10,600	10,600	-	post year
7	U-2909	SR 1780 (Estes Dr.)/SR 1772 (Greensboro St.)	Widen to multi-lanes	7,600	6,855	(745)	post year
5	U-2405	MLK Jr. Parkway/NC 55	Construct interchange	25,800	29,850	4,050	post year
5,7	U-2807	US 15-501 SR 1010 (Franklin St.)/US 15-501 bypass in Durham	Major corridor upgrade	123,000	156,000	33,000	post year
5	U-4720	US 70	Lynn Rd. to the proposed Northern Durham Parkway	n/a	n/a	n/a	post year
5	U-4721	Proposed Northern Durham Parkway	I-540 to Roxboro Rd.	n/a	n/a	n/a	post year
5	U-4722	US 501 (Roxboro Rd.)	US 501 bypass (Duke St.) to SR 1640 (Goodwin Rd.)	n/a	n/a	n/a	post year
5	U-2831B	Riddle Rd./SR 1951 (So-Hi Dr.)	Briggs Ave extension	10,685	10,685	-	post year
7	U-3436	SR 1148 (Eno Mountain Rd.) and SR 1192 (Mayo St.) at SR 1006 (Orange	Realign intersection and make safety improvements	2,350	2,350	-	post year
7	EL-4995	Orange County	Dry Creek Greenway	700	700	-	post year
7, 8	EB-5110	Bolin Creek Greenway (Chapel Hill)	NC 86 to Umstead Park	-	-	-	Feasibility Study
7	EB-4710	Seawell School Rd.	Homestead to Estes. Bicycle improvements	2,000	-	(2,000)	Deleted

Division 5 One-on-One Meeting FY 2011-2020 Transportation Improvement Program

Agenda

- 1. 2011-2020 TIP Items for Discussion**
 - a. General Funding and Design Issues**
 - b. Major Project Schedules and Funding**
 - c. Project Study and Project Management Requests**
-

1. 2011-2020 TIP Items for Discussion

The DCHC MPO has reviewed the 2011-2020 Draft STIP and developed the following list of issues for discussion. The MPO is developing the 2011-2020 MTIP which will be approved in late spring 2011.

a. General Funding and Design Issues

1. SPOT and Loop Evaluation Processes

The DCHC MPO commends the NCDOT for developing the SPOT and Loop evaluation processes that incorporate a more objective and open methodology for equity formula and loop highway projects. The MPO appreciates NCDOT's solicitation of input to the development of those evaluation methodologies and the willingness of the NCDOT to address many of the MPO's concerns and incorporate its suggestions.

2. Prioritize funding for bicycle, pedestrian, and transit projects/SPOT Improvements

The DCHC MPO strongly supports multi-modal transportation. Many of the MPO's top priorities are bicycle, pedestrian, and transit projects (see Regional Priority List). In the past, the traditional funding sources for these projects have disproportionately been the target for rescissions. In addition to the funding sources that target these projects, the DCHC MPO would like these projects to receive funds traditionally used for highway projects such as STP funds. Bicycle/pedestrian projects are typically far less costly than highway projects. With so little revenue available for new projects, it would be a good opportunity to use limited resources on a greater number of these less expensive bicycle/pedestrian projects.

As discussed above, the SPOT process has been a substantial improvement over the previous prioritization process. However, the MPO believes that the SPOT does not allocate sufficient funding to bicycle, pedestrian and transit projects, and the MPO is eager to work with the NCDOT to improve this weakness.

3. Mobility Fund/Large Urban Projects Need Funding

The MPO commends the NCDOT for their part in getting the Mobility Fund enacted by the North Carolina General Assembly. As the NCDOT develops the evaluation process and criteria for this fund, the MPO encourages the NCDOT to prioritize large projects in urban areas. DCHC MPO has only one new highway project (i.e., Hopson Road project, which has only moderate regional impact) and three relatively minor bicycle, pedestrian and transit related projects in Division 5 funded in the draft FY 2011-2020 STIP. These are few projects given continued growth in population and employment in this region, and the fact that the draft FY 2011-2020 STIP assumes five additional planning years (from 2015 through 2020). The Mobility Fund can prioritize large urban projects and provide relief to areas such as the DCHC MPO.

4. Complete Streets/Project Descriptions

NCDOT has changed its approach to highway design from accommodating motor vehicles only to providing for a multi-modal transportation system. The Complete Streets program has initiated much of this needed change. However, on roadway projects that include widening and multi-modal facilities, the project descriptions in the TIP continue to say “widen to multi-lanes” with no mention of multi-modal facilities. The DCHC MPO continues to believe that the TIP would better communicate to the public and to NCDOT departments the actual project scope if the project descriptions said “widen to multi-lanes and include bicycle, pedestrian, and transit facilities” where appropriate.

b. Major Project Schedules and Funding

5. U-0071 (East End Connector)

The DCHC MPO strongly supports the change in funding for the East End Connector. In the FY2009-1015 STIP, part of this project (i.e., \$33.5 million) was funded using STP funds, which drew down from the region’s available equity formula funds. In the draft STIP, Highway Trust Funds appropriately fund the entire project.

The DCHC MPO requests that construction for this project not be delayed any further. The first year for construction was delayed from 2013 to 2014 between the FY2009-2015 STIP and draft FY2011-2020 STIP, which follows a two year delay between the previous set of STIPs. This project is Durham’s highest priority and would greatly improve safety, congestion, and access through Durham.

6. FS-1005C (NC 54, from I-40 to NC 55)

The schedule for this project, which includes additional lanes and accommodations for bicyclists, pedestrians and transit, should be accelerated. It has the #1 ranking for regional tier projects in NCDOT’s statewide SPOT report, and is the #5 highway priority for the DCHC MPO. The draft STIP only designates a feasibility study, and does not even include planning or

environmental work for the project, let alone construction funding, over the next ten years. The MPO wants to work with the NCDOT to accelerate the schedule for this project and identify construction funding.

7. New Project (Fayetteville Road, from Woodcroft Parkway to Riddle Rd.)

This project is at the top of the MPO's regional priority list and placed fairly high in the NCDOT's statewide SPOT rankings, i.e., #35. It is a critical element for reducing congestion in the north/south corridor of south-central Durham. The City of Durham has already completed some preliminary design and environmental work on this alignment, and plans to construct a realignment of the Fayetteville Rd./Riddle Rd./Buxton Rd. intersection. Thus, the widening of Fayetteville Rd. will help leverage the benefits of the City's investment in this corridor and the project might be ready for construction in a relatively short time frame. The MPO wants to work with the NCDOT to identify funding to construct this project.

8. New Project (Erwin Road, from US 15-501 to NC 751)

This project, which is #3 in the MPO's regional priority list, includes bicycle, pedestrian and safety improvements. It is a critical transportation link between Durham and Chapel Hill and as a consequence the levels of vehicle, bicycle and pedestrian traffic along segments of this route are increasing. The MPO wants to work with the NCDOT to complete a feasibility analysis of this project and identify construction funding.

9. U-3308 (NC 55/Alston Avenue, NC 147 to Holloway St.)

The construction of this project has been delayed three years in the draft STIP to the year 2014. The DCHC MPO appreciates the willingness of the NCDOT to continue working with local officials to find design and economic justice solutions for this project. The City of Durham still supports this project, and therefore wants the construction to begin as soon as possible after a community consensus is reached.

10. U-2405 (M. L. King Jr. Parkway and NC 55 Interchange)

With the completion of M. L. King Jr. Parkway from US 15-501 to NC 55, it is appropriate to complete the last link of this important thoroughfare from NC 55 to Cornwallis Road to serve the Research Triangle Park. The MPO wants to move forward by funding Alternative 2 from the 2008 feasibility study that considered two alternatives for this intersection. That alternative proposed a modified at-grade intersection with a cost of \$29,850,000.

11. FS-1008B (NC 751, Feasibility Study for adding lanes)

This feasibility study proposes to add lanes between US 64 in Chatham County and north of Fayetteville Road in Durham County. The study is at odds with the MPO's 2035 Long Range Transportation Plan (2035 LRTP), which does not have any capacity improvements to that segment of NC 751. Two major projects in the same travel corridor, the NC 55 widening and the new NC 540 alignment, appear

to already support the travel demand in that corridor. The MPO wants to use feasibility study resources for more worthy projects identified in the agenda.

c. Planning Study and Project Management Requests

12. Loop Projects: U-4720 (US 70), U-4721 (Northern Durham Parkway), U-4722 (US 501/Roxboro Rd.), and I-4743 (I-85)

With the East End Connector (U-71) included in the draft FY 2011-2020 STIP, it is important to initiate the planning process for the next priority Highway Trust Fund projects in Durham. The loop projects to be considered for study include: the US 70 conversion to a freeway; construction of the Northern Durham Parkway; the widening of Roxboro Road from Duke Street to Goodwin Road; and the widening of I-85 from US 70 to Redwood Road. In the statewide ranking of loop projects, the Roxboro Road project was ranked second and the I-85 project ranked higher than one-half of the funded loop projects. The high ranking of Roxboro Road is at odds with the DCHC MPO's stated priority, which has Roxboro Road as the last loop project to be constructed. The DCHC MPO and NCDOT need to discuss and identify the next loop project to be studied and reserve funding to move that study forward.

13. C-4402 (NC 54 Bicycle Improvements)

NCDOT previously agreed to manage EB-4707 (Old Durham-Chapel Hill Road Bicycle and Pedestrian Improvements) if the City of Durham would agree to manage C-4402. However, the DCHC MPO requests that NCDOT reconsider managing C-4402. NC 54 is a major State route. The MPO and the City of Durham do not have the resources to manage a project of this magnitude on the State system.

14. U-4724 (Cornwallis Rd., S. Roxboro Rd. to Chapel Hill Rd.)

This project is currently funded using the MPO's STP-DA funds. Additional funding may be needed depending on a revised cost estimate.

15. Additional DCHC MPO Priority Projects

There are three additional Division 5 highway projects in the DCHC MPO Regional Priority List that are not addressed in the draft STIP:

- a. NC 54 (from I-40 west to Barbee Chapel Rd.), widen to six lanes divided with sidewalks. This project is #21 on the priority list and a feasibility study should be considered.
- b. Old Oxford Highway (Roxboro Road to Hamlin Road), expand capacity, bike lanes and sidewalks. This project is #22 on the priority list and a feasibility study should be considered.
- c. NC 751 (S. Roxboro Road to NC 54), widen to four lanes, bike lanes and sidewalks. The City of Durham plans to construct this project but will need substantial cooperation from the NCDOT to avoid delays.

Division 7 One-on-One Meeting FY 2011-2020 Transportation Improvement Program

Agenda

FY 2011-2020 TIP Items for Discussion

- a. General Funding and Design Issues**
 - b. Project Schedules and Funding**
 - c. Other Items**
-

FY 2011-2020 TIP Items for Discussion

The DCHC MPO has reviewed the FY 2011-2020 Draft STIP and developed the following list of issues for discussion. The MPO is developing the FY 2011-2020 MTIP which will be approved in late spring/early summer 2008.

a. General Funding and Design Issues

1. SPOT and Loop Evaluation Processes

The DCHC MPO commends the NCDOT for developing the SPOT and Loop evaluation processes that incorporate a more objective and open methodology for equity formula and loop highway projects. The MPO appreciates NCDOT's solicitation of input to the development of those evaluation methodologies and the willingness of the NCDOT to address many of the MPO's concerns and incorporate its suggestions.

2. Prioritize funding for bicycle, pedestrian, and transit projects/SPOT Improvements

The DCHC MPO strongly supports multi-modal transportation. Many of the MPO's top priorities are bicycle, pedestrian, and transit projects in Orange County (see Regional Priority List). In the past, the traditional funding sources for these projects have disproportionately been the target for rescissions. In addition to the funding sources that target these projects, the DCHC MPO would like these projects to receive funds traditionally used for highway projects such as STP funds. Bicycle/pedestrian projects are typically far less costly than highway projects. With so little revenue available for new projects, it would be a good opportunity to use limited resources on a greater number of these less expensive bicycle/ pedestrian projects.

As discussed above, the SPOT process has been a substantial improvement over the previous prioritization process. However, the MPO believes that the SPOT does not allocate sufficient funding to bicycle, pedestrian and transit projects, and the MPO is eager to work with the NCDOT to improve this allocation weakness.

3. Need additional funding for transportation

The MPO commends the NCDOT for their part in getting the Mobility Fund enacted by the North Carolina General Assembly. As the NCDOT develops the evaluation process and criteria for this fund, the MPO encourages the NCDOT to prioritize large projects in urban areas. The DCHC MPO has two new major highway projects in Division 7 shown in the draft FY 2011-2020 STIP, including I-3306 (I-40 widening) and I-0305 (I-85 widening), which are scheduled for construction relatively far into the future (years 2019 and 2020, respectively). The high cost of these projects has left no funding for other roadway capacity projects in the second half of the draft STIP, i.e., years 2016 to 2020. The Mobility Fund needs finance projects like the I-40 widening and I-85 widening so funding is also available for other roadway, bicycle, pedestrian and transit projects.

Meanwhile, all Division 7 roadway projects in the first half of the draft STIP, i.e., years 2011 to 2015, have been delayed one to three years when compared to the FY2009-2015 STIP. These projects have been delayed even though the Elizabeth Brady Road Extension, budgeted at \$34 million and planned for a 2012 construction start, was deleted from the draft STIP. The Town of Hillsborough is concerned that none of the Town's priority projects are funded in the draft STIP.

4. Complete Streets/Project Descriptions

NCDOT has changed its approach to highway design from accommodating motor vehicles only to providing for a multi-modal transportation system. The Complete Streets program has initiated much of this needed change. However, on roadway projects that include widening and multi-modal facilities, the project descriptions in the TIP continue to say "widen to multi-lanes" with no mention of multi-modal facilities. The DCHC MPO continues to believe that the TIP would better communicate to the public and to NCDOT departments the actual project scope if the project descriptions said "widen to multi-lanes and include bicycle, pedestrian, and transit facilities" where appropriate.

b. Project Schedules and Funding

5. Churton Street Congestion in the Town of Hillsborough

The Elizabeth Brady Road Extension project (U-3808) was eliminated from the FY2011-2020 STIP. The principal purpose of that project was to relieve traffic congestion on Churton Street. The Town of Hillsborough and the DCHC-MPO are currently analyzing several projects from the draft STIP and 2035 LRTP to identify those whose cumulative effects will have the greatest positive impact on Churton Street congestion. It is requested that the NCDOT study this set of projects as an alternative to the Elizabeth Brady Extension. The projects include:

- a. R-2825 (South Churton Street): A Feasibility study was completed for this project in the mid-1990s but will need to be updated to recognize local

planning efforts such as the South Churton Corridor Study and the schedule for the I-85 widening project. It appears that this project, which includes congestion management, access limits, aesthetic and capacity improvements between US 70 Business and Interstate 40, cannot move forward until the I-85 widening is complete. One study concluded that the South Churton Street project alone will improve corridor travel time by 10%.

- b. U-3436 (Eno Mountain Road/Mayo Street alignment): This project is to realign the intersection and make additional safety improvements.
- c. NC 86 widening between US 70-A and Old NC 10: This project is in the 2035 LRTP but not the draft STIP. This project could be integrated with the I-85 widening.
- d. NC 86 widening from US 70 Bypass to Coleman Loop Road: This project is in the 2035 LRTP but not the draft STIP. The segment between the US 70 Bypass and NC 57 is the highest priority.
- e. Orange Grove Road Extension to US 70-Alternate: This project is in the 2035 LRTP but not the draft STIP. One study concluded that this project alone will improve corridor travel time by 10%.

**6. I-0305 (I-85 widening, from I-40 to Durham County line)
I-3306 (I-40 widening, from I-85 to Durham County line)**

These projects are not among the DCHC MPO priority highway projects and the I-40 widening project in particular is a low priority among the highway projects in the 2035 LRTP (in which it is scheduled for the 2025-2035 completion period). The MPO is concerned that the cost and scheduling of this large project precludes consideration of the set of projects submitted as an alternative to the former Elizabeth Brady Road Extension project (U-3808), which is discussed above, and consideration of higher priority sidewalk, bike lanes and safety improvement projects in Chapel Hill, Carrboro and Hillsborough.

In particular, the MPO wants to change the phase descriptions to prioritize the rebuilding of interchanges at NC 86, SR 1009 (Old NC 86) and US 70 before widening of the roadway.

7. U-5304 (US 15-501 bypass, bike/pedestrian/ transit accommodations from S. Columbia St. to Ephesus Church Road)

This project is #6 in the MPO's highway priority list. The construction year, 2019, should be moved to an earlier year given the high priority of the project and the lack of highway projects in the second half of the draft STIP.

8. CMAQ Projects (e.g., C-5184, Riverwalk in Hillsborough)

The DCHC MPO adopted an updated CMAQ project schedule in June 2010 that accelerated the construction of several CMAQ projects. The due date for that update was September 30, 2010. Apparently, these CMAQ updates have not been incorporated into the draft FY2011-2020 STIP. For example, the Riverwalk in Hillsborough has the following schedule in that CMAQ update: design in year 2013; right-of-way in 2014; and, construction in 2015. The draft STIP does not have construction until 2018. Please confirm that the updated CMAQ projects will be appropriately incorporated into the final STIP.

9. EB-4980 (Orange Grove Road Pedestrian Bridge)

This project is the number one priority for Orange County and was also listed on the Town of Hillsborough's priority list. The NCDOT Director of Division of Bicycle and Pedestrian Transportation recommends removing this project from the current five-year work plan and TIP schedule due to a lack of necessary supporting pedestrian facilities along Orange Grove Road. The DCHC MPO requests that this project remain on the TIP schedule. The County is developing a CTP, anticipated to be adopted in Spring 2012, and is also developing a Safe Routes to School Action Plan to address barriers to walking and bicycling at three Orange County schools including New Grady Brown Elementary. The pedestrian bridge is necessary for safe transport across I-40 for many of these school children, and a key part of the plan for that school.

10. Hillsborough Train Station and Multimodal Center

This project is the top transit priority for the Town of Hillsborough. The MPO wants to work with NCDOT to identify an appropriate funding source for this project.

c. Other Items

11. Roadway Signage in the Hillsborough Area

The Town of Hillsborough's Wayfinding Task Force recently made several recommendations to add, consolidate and relocate roadway signs in Hillsborough. NCDOT staff were involved during the Wayfinding Task Force planning process. The Town of Hillsborough wants to work with NCDOT to implement the Task Force recommendations, and therefore requests that the NCDOT identify a contact person for this effort.

Some of the key Task Force recommendations include:

- Consolidate and replace NCDOT highway signs (i.e., I-40, I-85, US 70 and US 70A), particularly along South Churton Street;
- Add directional signage for I-40, especially in downtown Hillsborough and exit #164 on I-85;
- Improved signage on I-40 and I-85 for Hillsborough destinations, including a separate Attractions sign that lists the local destinations.

12. B-4962 (Replace Bridge #46, Eno River and US 70 bypass)

Orange County sent a letter, dated October 27, 2009, to the NCDOT/PDEA/ Bridge Project Unit stating some concerns with design of this replacement bridge. Please identify to what extent the bridge design will accommodate each of the items specified in that letter.