APPENDIX B
USFWS COORDINATION

ORGANIZATION OF APPENDIX B

B-1. USFWS Concurrence Letter (12/16/14)

B-2. Final Biological Assessment (November 2013)

B-3. Final Technical Report on Direct, Indirect, and Cumulative Impacts to Federally Listed Species (November 2013)

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APPENDIX B-1
USFWS CONCURRENCE LETTER (Dec 16, 2013)

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Asheville Field Office
160 Zillicoa Street
Asheville, North Carolina 28801

December 16, 2013

Ms. Jennifer Harris, P.E.
North Carolina Department of Transportation
1538 Mail Service Center
Raleigh, North Carolina 27699-1538

Dear Ms. Harris:

Subject: Endangered Species Concurrence for the Proposed Monroe Connector/Bypass Project, Mecklenburg and Union Counties, North Carolina, TIP Nos. R-3329 and R-2559

We have reviewed the Biological Assessment (BA), the Technical Report on Direct, Indirect and Cumulative Effects to Listed Species (November 2013), and your concurrence request regarding potential impacts to: (1) the federally endangered Carolina heelsplitter (*Lasmigona decorata*), (2) designated critical habitat for the Carolina heelsplitter in Goose and Duck Creeks, and (3) the federally endangered Schweinitz's sunflower (*Helianthus schweinitzii*). We provide the following comments in accordance with the provisions of section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1543) (Act).

The North Carolina Department of Transportation (NCDOT)/North Carolina Turnpike Authority (NCTA) proposes to construct a new location, controlled access toll facility from I-485 in Mecklenburg County to US 74 between the towns of Wingate and Marshville in Union County, about 20 miles in length. The project is known as the Monroe Connector/Bypass and roughly parallels existing US 74 to the north, connecting to existing US 74 on both the eastern and western termini.

Carolina heelsplitter (*Lasmigona decorata*)

According to the information provided, the project, as proposed, has no direct effect to the Goose and Sixmile Creek watersheds. The analysis of indirect and cumulative impacts focused primarily on changes in the levels of impervious surface, water quality parameters, and traffic patterns as a result of construction of the project. Current levels of imperviousness in the Goose and Sixmile Creek watersheds are at 13 percent and 25 percent, respectively, and are expected to increase to 18 percent and 31 percent in the 2030 no-build scenario. These changes are independent of the project, which shows little change in the levels of imperviousness between the build and no-build scenarios. Given that aquatic habitat degradation begins at levels of

6-percent imperviousness, these watersheds are already experiencing negative changes affecting the long-term viability of the Carolina heelsplitter in both Goose and Sixmile Creeks. Water quality parameters modeled for these watersheds show similar trends for the build and no-build scenarios. The project will not significantly change either traffic patterns or volumes in the sensitive watersheds.

Although the analysis concluded that the effects to the Carolina heelsplitter from the proposed project are very similar to the no-build scenario, the analysis also acknowledged that there is a level of uncertainty associated with the conclusions because of the assumptions used in the analysis of effects. In order to address this uncertainty, the NCDOT/NCTA funded conservation in the Flat Creek watershed in South Carolina to help offset any potential but unpredictable impacts to the species. In addition, the NCDOT/NCTA funded the continued operation of the U.S. Geological Survey's stream gauge on Goose Creek for 5 years. Based on the analysis, the information provided and the proposed conservation, we concur that the proposed project is "not likely to adversely affect" the Carolina heelsplitter in the project area. However, the Carolina heelsplitter is one of the most critically endangered species in the southeastern United States and is rapidly declining throughout its range, primarily from the effects of increased impervious surface area as a result of urbanization. Without significant conservation efforts, this species is likely to become extinct in the near future. Given the degree of imperilment of the Carolina heelsplitter and in accordance with section 7(a)(1) of the Act, we encourage you to consider implementing additional measures to help further the purposes of the Act, such as conservation and restoration within the Goose and Duck Creek watershed and/or the purchase of additional land or credits in the Flat Creek watershed.

Schweinitz's sunflower (*Helianthus schweinitzii*)

There are two occurrences of the Schweinitz's sunflower--Elemental Occurrence (EO) #s 77 and 230--located along Secrest Shortcut Road, very close to the construction limits of the project (Figure 7 in the November 19, 2013, BA). The NCDOT/NCTA has committed to protecting these two plant occurrences with measures and commitments that will protect them from impacts during construction of the Monroe Connector/Bypass project and measures and commitments to preserve these populations in perpetuity (see letter from the NCDOT to the U.S. Fish and Wildlife Service [Service] dated December 6, 2013).

The project was designed to avoid impacting EO #s 77 and 230. The interchange at Unionville - Indian Trail Road was compressed so the construction limits do not encroach within the boundaries of either EO. The project ends at a sufficient distance from EO #230 so that there is no chance of encroachment due to clearing, staging, utilities, etc. The aerial utility lines over population EO #77 will need to be raised as part of the construction, but this will not impact the plants. Since the construction limits will end approximately 100 feet from EO #77, the contractor is required to demark the population boundaries with tree protection fencing. This requirement will be in any contract for construction.

On-site preservation of EO #s 230 and 77 will be the responsibility of the NCDOT. "Do Not Mow" signs have been installed at both populations. NCDOT Division 10 personnel are aware of the populations and will continue to follow vegetation management guidelines as noted in an

email from the Division Environmental Officer (Thompson 2013) and provided in Appendix E of the November 19, 2013, BA.

The NCTA notified Union Power of EO #77 in 2010. Union Power has since included this population as Site R in their Schweinitz's Sunflower Restricted Sites plan (November 19, 2013, BA – Appendix D), and this information is provided to all Union Power employees through the Dashboard System. The commitments from both the NCDOT and Union Power will be adhered to for as long as the respective conservation areas are under their ownership. While this can't necessarily be considered "in perpetuity," ownership of such areas is very rarely relinquished. As such, there is no reason to assume these sites will not continue to be managed for the Schweinitz's sunflower for the foreseeable future.

Summary of Protection

The actions and commitments of the NCTA to protect and preserve Schweinitz's sunflower EO #s 77 and 230 with regard to the Monroe Connector/Bypass project are summarized as follows:

- "No Mow" signs have been posted by the NCDOT at both EOs.
- The populations are being managed by the NCDOT in accordance with the "NCDOT Roadside Vegetation Management Guidelines in Marked Areas" plan.
- The populations have been incorporated into the Union Power Schweinitz's Sunflower Restricted Sites plan as Site R and will be managed accordingly.
- The Design-Build Team will clearly demark the two Schweinitz's sunflower populations with tree-protection fencing.
- Prior to commencing construction, the Design-Build Team and the NCTA/NCDOT will meet with the Service to discuss the protection and preservation of EO #s 77 and 230.

This bulleted list will be added to the "green sheet" of project commitments in the Supplemental Final Environmental Impact Statement. The NCTA will continue to coordinate with the Service throughout the National Environmental Policy Act process and project construction in order to ensure the protection and preservation of these populations.

The project was designed to avoid direct impacts to the Carolina heelsplitter by avoiding the sensitive watersheds and to the Schweinitz's sunflower by protecting known plant occurrences. However, the BA states that there is the possibility for contractors to propose and locate waste and borrow sites in the sensitive watersheds or other locations, some of which may have occurrences of the Schweinitz's sunflower. We strongly recommend that NCDOT/NCTA not agree to waste and borrow sites in sensitive locations. If the placement of waste and borrow in sensitive watersheds or in locations that could impact the Schweinitz's sunflower cannot be avoided, further consultation with the Service may be required. Therefore, this concurrence is specifically for the project as described and does not cover any other currently unknown sites impacted as part of the construction project.

Based on the information provided for the highway project and the conservation measures proposed for the Carolina heelsplitter and the Schweinitz's sunflower, we concur that the project

as proposed is not likely to adversely affect these species. Consultation under section 7 of the Act must be reinitiated if: (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered, (2) this action is subsequently modified in a manner that was not considered in this review, or (3) a new species is listed or critical habitat is determined that may be affected by the identified action.

Other Rare Species

Northern long-eared bat (NLEB) – The NLEB was proposed for listing on October 2, 2013, and a final listing determination is expected by October 2, 2014. Given the likelihood that the NLEB will be listed within the year, we recommend that the NCDOT/NCTA incorporate bat conservation measures into project plans. NLEB Conference guidance and survey protocols should be available in early 2014.

Savannah lilliput – This rare freshwater mussel has been petitioned for federal listing and is listed by the state as endangered. According to information provided in the BA, the Savannah lilliput occurs in South Fork Crooked and Richardson Creeks. The occupied reach of South Fork Crooked Creek is in the project alignment and will be directly impacted by project construction. The occupied reach of Richardson Creek is in the Future Land Use Study Area. Given the projected growth on the eastern end of the project and along US 601 South, the occurrence in Richardson Creek is likely to be impacted by development associated with the project.

We reiterate our recommendation that at the project crossing of South Fork Crooked Creek avoidance and minimization measures be designed, implemented, and documented to protect the Savannah lilliput. Additionally, measures to protect the occupied reach of Richardson Creek should be considered. Proactively avoiding impacts to this mussel and documenting those efforts will help to avoid the reinitiation of consultation should this species be listed during project construction.

We appreciate the opportunity to provide these comments and will continue to participate in the planning process for this project. If you have questions about these comments, please contact Ms. Marella Buncick of our staff at 828/258-3939, Ext. 237. In any future correspondence concerning this project, please reference our Log Number 4-2-07-132.

Sincerely,

Janet A. Mizzi
Field Supervisor

Electronic copies to:
Ms. Marla J. Chambers, North Carolina Wildlife Resources Commission
Mr. Alan Johnson, North Carolina Division of Water Resources
Mr. Chris Militscher, Environmental Protection Agency
Ms. Liz Hair, U.S. Army Corps of Engineers

APPENDIX B-2
FINAL BIOLOGICAL ASSESSMENT (Nov 2013)

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STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

PAT MCCRORY
GOVERNOR

ANTHONY J. TATA
SECRETARY

November 19, 2013

Ms. Marella Buncick
U. S. Fish and Wildlife Service
160 Zillicoa Street
Asheville, North Carolina 28801

SUBJECT: Section 7 Informal Consultation for Carolina heelsplitter (*Lasmigona decorata),* Schweinitz's sunflower (*Heliantus schweinitzii)*, Michaux's sumac (*Rhus michauxii),* smooth coneflower (*Echinacea laevigata*), and Northern long-eared bat (*Myotis septentrionalis*) relating to Monroe Connector/Bypass, Mecklenburg and Union Counties, North Carolina. Federal Aid Project Number STP-NHF-74(90), WBS Element 34533.1.TA1, STIP Project Number R-3329 and R-2559

Dear Ms. Buncick:

Please find attached a Biological Assessment (BA), Technical Report (TR) on Direct, Indirect and Cumulative Impacts to Federally Listed Species *Response to FWS Letter dated December 20, 2012* (TR), and Responses to the FWS letter dated November 1, 2013. The TR takes information provided in the Indirect and Cumulative Effect Quantitative Analysis Update and then performs a more detailed, scaled-down analysis on the potential for the project to impact federally listed species.

We have addressed your comments and incorporated them as appropriate into these documents. As you will note, we have chosen not to include a BA for the Savannah lilliput or Georgia aster in this document, but will prepare a separate Technical Memorandum as consistent with our past handling of petitioned species for this project. The Northern long-eared bat is noted in this BA as "Unresolved" and will be assessed in a separate document once USFWS provides management and conference guidance. This will afford us the advantage of seeking concurrence for the currently listed species immediately, and provide time to assimilate information for the petitioned and proposed species, particularly the Northern long-eared bat.

You will also note that this BA now includes references to NEPA documents that have been completed and were delivered to your office on November 18, namely the Draft

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TRANSPORTATION BUILDING
1 SOUTH WILMINGTON STREET
RALEIGH NC

Supplemental Final EIS and the Indirect and Cumulative Effect Quantitative Analysis Update (included as Appendix E of the Draft Supplemental Final EIS).

The BA has concluded the proposed action will have "No Effect" on the smooth coneflower and Michaux's sumac. A conclusion of "May Affect/Not Likely to Adversely Affect" was reached for the Carolina heelsplitter and Schweinitz's sunflower. In addition it was concluded that the proposed action "May Affect/Not Likely to Adversely Affect" designated Critical Habitat (Unit 1) for the Carolina heelsplitter.

We are requesting your written concurrence with these findings. We would appreciate a response by December 5, 2013, if possible. Once again, your timely attention to this matter is greatly appreciated. If you need further information, or have any questions concerning these materials, please contact me at 919-707-6025 or jhharris1@ncdot.gov.

Sincerely,

Jennifer Harris

Jennifer Harris, P.E.
Project Development Section Head – Western Region and Turnpike

cc: George Hoops, P.E., FHWA

BIOLOGICAL ASSESSMENT

AN ASSESSMENT OF POTENTIAL IMPACTS TO CAROLINA HEELSPLITTER (*Lasmigona decorata*) and DESIGNATED CRITICAL HABITAT, SCHWEINITZ'S SUNFLOWER (*Helianthus schweinitzii*), MICHAUX'S SUMAC (*Rhus michauxii*), SMOOTH CONEFLOWER (*Echinacea laevigata*), and Northern Long-Eared Bat (*Myotis septentrionalis*)

MONROE CONNECTOR/BYPASS

MECKLENBURG and UNION COUNTIES, NORTH CAROLINA

FEDERAL AID PROJECT NUMBER STP-NHF-74(90)
WBS ELEMENT 34533.1.TA1
STIP PROJECT NUMBER R-3329/R-2559

PREPARED FOR:

Federal Highway Administration
Raleigh, North Carolina

AND

North Carolina Turnpike Authority
A Division of North Carolina Department of Transportation
Raleigh, North Carolina

November 19, 2013

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1.0 INTRODUCTION

The North Carolina Turnpike Authority (NCTA), a division of the North Carolina Department of Transportation (NCDOT), in cooperation with the Federal Highway Administration (FHWA), proposes to construct a project known as the "Monroe Connector/Bypass" in Mecklenburg and Union Counties, North Carolina. The purpose of this Biological Assessment (BA) is to review the project and determine whether the proposed action may affect federally listed species that occur in the Action Area (Figure 1).

The proposed roadway is included in the NCDOT's *2013-2023 State Transportation Improvement Project* (STIP), project numbers R-3329 (Monroe Connector) and R-2559 (Monroe Bypass), as a controlled-access toll road extending from US 74 near I-485 in Mecklenburg County to US 74 between the towns of Wingate and Marshville in Union County, a distance of approximately 20 miles. NCDOT previously studied these as two separate projects; however, the two projects are now being advanced by NCTA as a single project at the request of the Mecklenburg-Union Metropolitan Planning Organization (MUMPO).

This Biological Assessment (BA) is based upon information provided in the Technical Report on Direct, Indirect and Cumulative Impacts to Federally Listed Species *Response to FWS Letter dated December 20, 2012* (TR) (Baker Engineering 2013a), the Indirect and Cumulative Effects Quantitative Analysis Update (ICE Report) (Baker Engineering 2013b), Draft Supplemental - Final Environmental Impact Statement (DS-FEIS) (Atkins 2013), and analyses detailed in this report.

This BA addresses potential effects to federally protected species associated with the proposed Monroe Connector/Bypass. This BA is prepared in accordance with legal requirements established under Section 7 of the Endangered Species Act (ESA) (16 U.S.C. 1536 (c)), and is consistent with the standards established in USFWS Region 4 guidance (USFWS 2005), FHWA guidelines (USDOT 2002), and NCDOT guidance (NCDOT 2002).

The species evaluated in this BA are:

- Carolina heelsplitter (*Lasmigona decorata*) and its designated Critical Habitat
- Schweinitz's sunflower (*Helianthus schweinitzii*)
- Michaux's sumac (*Rhus michauxii*)
- Smooth coneflower (*Echinacea laevigata*)
- Northern long-eared bat (*Myotis septentrionalis*)

1.1 Statutory Authority of Action

Section 7(a)(2) of the ESA (16 USC 1531-1544 and Section 1536) requires that each Federal agency shall, in consultation with USFWS, insure that any action authorized, funded, or carried out by such agency, is not likely to jeopardize the continued existence of an endangered or threatened species, or result in the destruction or adverse modification of critical habitat.

NCDOT derives their statutory authority via North Carolina General Statutes (NCGS) 143B-345 and 346 and FHWA derives their statutory authority via 49 US Code (USC) 104.

As defined in 50 Code of Federal Regulations (CFR) Part 402.02, "actions" include all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas. Since the proposed project includes both funding by FHWA and approval by the U.S. Army Corps of Engineers (USACE) pursuant to the Clean Water Act, it is subject to consultation under Section 7 of the ESA.

1.2 Summary of Consultation History

This section describes the consultation history of this project, beginning with the two separate projects and then as a single project as it is currently proposed. Much of the Section 7 coordination occurred during Turnpike Environmental Agency Coordination (TEAC) meetings and various other meetings and types of correspondence regarding the ESA and protected species.

Monroe Bypass (R-2559)

An Environmental Assessment (EA) was issued on March 14, 1996, and a Finding of No Significant Impact (FONSI) was completed on June 20, 1997 for the Monroe Bypass (a new location freeway facility from US 601 to US 74 near Marshville in Union County). As part of that FONSI, comments concerning the Monroe Bypass were solicited from various agencies, including the USFWS. In a letter dated April 18, 1997 the USFWS issued a concurrence that the project is "not likely to adversely affect" the federally endangered Carolina heelsplitter or Schweinitz's sunflower. However, the USFWS subsequently rescinded their "not likely to adversely affect" concurrence for the USACE's determination of effect. In a letter dated August 8, 2002, written in response to the public notice issued for the Section 404 Permit Application, the USFWS stated that based on "new information and a changed condition" their previous concurrence was no longer valid.

Monroe Connector (R-3329)

NCDOT began the planning process in 1999 for the Monroe Connector (from near I-485 in Mecklenburg County to US 601 in Union County). A Draft EIS was issued on October 17, 2003,

and released for review and comment by the public and environmental resource and regulatory agencies in November 2003. Based on comments received from the various federal and state agencies and the public, and due to concerns regarding logical termini of the Monroe Connector and Monroe Bypass projects, the 2003 Draft EIS was rescinded on January 30, 2006 by notice in the Federal Register (Vol. 71, No. 19, page 4958). The notice stated that FHWA, NCDOT and NCTA plan to prepare a new Draft EIS for the combined Monroe Connector/Bypass project.

2005 Draft BA

A Draft BA was originally prepared on October 28, 2005 which assessed effects from both the Monroe Bypass (R-2559) and the Monroe Connector (R-3329) on the Carolina heelsplitter and Schweinitz's sunflower. Consultation with USFWS was not initiated due to the rescission of the Monroe Connector Draft EIS.

- May 17, 2007, TEAC meeting: In identifying potential corridors/study alternatives, the study area was developed to avoid direct impacts to Goose Creek basin in an effort to minimize impacts to Carolina heelsplitter. It was suggested that impacts to Stewarts Creek be minimized as it feeds Lake Twitty and the Goose Creek watershed. Additionally, USFWS planned to provide information about the Schweinitz's sunflower population near Secrest Shortcut Road. USFWS suggested the team consider a new approach to indirect and cumulative impacts which may be useful. NCTA planned to follow up with USFWS.
- June 29, 2007, Meeting: FHWA and NCTA met with USFWS and WRC to discuss the scope of work, study area, and methodologies for the Quantitative ICE study, which was completed in 2010 (Baker Engineering 2010). USFWS stated that previous ICE studies had used a standard five to seven mile distance from interchanges as an assumed study area for induced growth. NCTA stated that the assumption would be revisited as part of the Quantitative ICE study. FHWA and NCTA asked USFWS to provide input on which indicators should be used for analyzing impacts to the mussels. USFWS noted that impact analysis would be influenced by NPDES permit decisions. USFWS also suggested NCTA determine the current status of land use controls and regulations in the project area. WRC requested analysis of impervious surface increase for the land use analysis. WRC also stated that stormwater and 303(d) streams may be issues. NCTA addressed these comments and incorporated these suggestions into the project documents.
- December 5, 2007, TEAC Meeting: USFWS suggested that NCTA consider eliminating the interchange at US 601 with new location alternatives to reduce potential indirect impacts on the Goose Creek watershed. NCTA addressed both the US 601 option and without the US 601 option in the quantitative ICE analyses (Baker Engineering 2010).
- September 23, 2008, TEAC Meeting: NCTA noted that two populations of Schweinitz's sunflower were identified near the proposed Unionville Indian Trail Road interchange. No direct impacts were anticipated; however, it was determined that the biological conclusion in the Draft Natural Resources Technical Report would be "unresolved" until NCTA/FHWA and USFWS coordinated on this issue.

- March 31, 2009, A Draft EIS, prepared by PBS&J (2009) was issued for the Monroe Connector/Bypass. It included discussion of federally-protected species in the project area, including biological conclusions for potential effects to these species as follows:
    - Carolina heelsplitter (*Lasmigona decorata*) and its designated Critical Habitat – Unresolved
    - Schweinitz's sunflower (*Helianthus schweinitzii*) – May Affect/Not Likely to Adversely Affect
    - Michaux's sumac (*Rhus michauxii*) – No Effect
    - Smooth coneflower (*Echinacea laevigata*) – No Effect

USFWS commented on the Draft EIS via letter dated June 12, 2009. USFWS comments relating to the ESA and NCTA responses to those comments follow:

Schweinitz's sunflower

- USFWS stated, "*…it is premature to determine that there will be no impacts to the Schweinitz's sunflower (Helianthus schweinitzii) from this project. Until more specifics about design and any changes that may result from public comment or other information are available we believe the appropriate conclusion for this species is 'unresolved.'*"
- NCTA responded that two populations of Schweinitz's sunflower were identified near Interchange 3 and per Draft EIS comments; a subsequent interchange redesign changed the configuration to a compressed urban diamond. FHWA and NCTA stated they would coordinate with USFWS in accordance with Section 7 of the ESA in the preparation of this BA.

Goose Creek

- USFWS stated, "*We remain concerned about the overall impacts to streams and wetlands and wildlife habitat…in particular, the potential for impacts to the Goose Creek watershed, which is occupied by and designated critical habitat for the federally endangered Carolina heelsplitter.*"
- NCTA responded with reference to Section 2.3.3 of the Final EIS (PBS&J 2010a-rescinded) which includes measures to avoid and minimize impacts to streams and wetlands as well as a special project commitment to implement BMPs based on NCDOT's *Design Standards in Sensitive Watersheds*. NCTA further stated that the detailed study alternatives (DSAs) would not be located within the Goose Creek watershed and that indirect and cumulative land use and impervious surface changes were analyzed in the Quantitative ICE (Baker Engineering 2010).

Forest / Habitat Fragmentation

- USFWS stated, "*Forest fragmentation is described as an indirect effect of highway projects, but we believe that the impacts of fragmentation are direct effects that should be quantified.*"
- NCTA responded that habitat fragmentation had been addressed in the Quantitative ICE (Baker Engineering 2010).

Indirect and Cumulative Impacts

- USFWS stated, "*Indirect and cumulative impacts continue to be a great concern for this project. ... This is a significant omission in determining environmental impacts from the project, especially regarding potential impacts to the Carolina heelsplitter and its critical habitat.*"
- NCTA responded, stating that the USFWS comment refers to the Qualitative ICE (HNTB 2009). Subsequently, a Quantitative ICE Analysis (Baker Engineering 2010) and a Quantitative Water Quality ICE Analysis (PBS&J 2010b) were prepared to quantify indirect and cumulative impacts. These reports were summarized in Section 2.5.5 of the Final EIS (PBS&J 2010a).

Habitat Protection

- USFWS stated, "*Any new development that occurs without measures adequate to protect the species and its habitat is likely to result in extirpation of the species and adverse impacts to its designated critical habitat.*"
- NCTA responded by referencing Section 7 coordination and the on-going development of the 2010 BA (FHWA 2010). They also referenced the Quantitative ICE (Baker Engineering 2010) which found no measurable differences in percent impervious surface between the Preferred Alternative and the No Build Alternative for the FLUSA as a whole, and no change in the Goose Creek Watershed.
- July 22, 2009, representatives of NCTA, FHWA, and USFWS met to discuss design revisions incorporated into the Preferred Alternative as a result of public comments on the Draft EIS. This included revising the proposed interchange configuration at Unionville-Indian Trail Road to reduce the footprint of the design. Two populations of Schweinitz's sunflower were identified along Secrest Shortcut Road in the vicinity of this proposed interchange. USFWS indicated that based on the design change, which would increase the potential for future development adjacent to the interchange, it would be highly likely that the populations would be lost due to indirect impacts of this project, either related to future road improvements along Secrest Shortcut Road or to future development. USFWS recommended formal Section 7 consultation for these impacts to Schweinitz's sunflower.
- August 12, 2009, TEAC Meeting: NCTA noted that formal Section 7 consultation for Carolina heelsplitter and its designated critical habitat and Schweinitz's sunflower was anticipated. USFWS clarified that a decision to enter formal consultation had not yet been made and a final decision would be based on results of the quantitative land use studies / ICE analyses. It was noted that the FLUSA would be expanded to include the entire Goose Creek watershed. USFWS suggested that localities should be asked specifically about how the *Site Specific Water Quality Management Plan for the Goose Creek Watershed* will be implemented. NCDWQ responded that their agency would be implementing the plan initially and that training would be provided to the local governments. USFWS also stressed the importance of documentation of assumptions and rationale regarding future land use. USFWS suggested that the water quality component of the ICE would be useful for Section 7 consultation. It was determined that the agencies would identify which parameters they would require in the final water quality analysis.

- September 8, 2009, TEAC Meeting: Per USFWS request, NCTA agreed to evaluate ICE with and without the US 601 interchange, which is the closest major interchange to the Goose Creek watershed in the Baker Engineering (2010) Quantitative ICE study. USFWS requested more information about the water quality ICE model (i.e. input parameters, adaption to suburban landscapes, groundwater, etc.). Sixmile Creek watershed was suggested to be included in the modeling efforts.
- October 31, 2009, TEAC Meeting: The Generalized Water Loading Function (GWLF) model was presented to describe water quality modeling and analysis. Agencies were requested to identify and provide stressors in addition to those presented. USFWS suggested NCTA review the Goose Creek watershed management plan for other sources of impairment. NCTA stated they would proceed with the study area as identified for water quality modeling. However, if the Quantitative ICE indicated indirect impacts in Sixmile Creek watershed, NCTA committed to reevaluate whether to include more of the watershed in the analysis and/or perform additional analysis.
- November 11, 2009, TEAC Meeting: Preliminary results of the Baker Engineering Quantitative ICE were presented at this meeting. Several agency representatives expressed uncertainty as to the accuracy of the projections and NCTA asked if there were any suggestions for another method to determine future growth that would be defensible. None were offered. Agencies were requested to provide opinions / recommendations regarding methodologies throughout the planning process (see June 29, 2007 meeting, above). USFWS requested a discussion on how the Hartgen method was used to perform validation. NCTA hosted additional meetings to discuss and explain methodologies and associated reports also included detailed discussions regarding chosen methodologies.
- February 2, 18, 22, 2010, Telephone Correspondence: USFWS provided updated data from the Draft 5-year Status Reviews for Smooth coneflower and Michaux's sumac (Suiter 2010a and 2010b, USFWS, pers. comm.).
- February 10, 2010, Email Correspondence: USFWS provided updated data (narrative from a recent Biological Opinion) for Schweinitz's sunflower (Wells 2010, USFWS, pers. comm.).
- February 10-11, 2010, Email Correspondence: USFWS stated that a previous relocation of Schweinitz's sunflower from Secrest Shortcut Road (Natural Heritage Program Element Occurrence #77) to Cane Creek Preserve was associated with a NCDOT Division level project with no federal nexus to trigger Section 7 consultation (Buncick 2010a, USFWS, pers. comm.).
- March 30-April 1, 2010, Email Correspondence: USFWS provided details about other Section 7 consultations in the Action Area (Buncick, 2010b, pers. comm.) (Section 1.3).
- May 25, 2010, Draft Biological Assessment completed by Catena and submitted to NCTA
- July 26, 2010, completed BA package prepared by FHWA and NCDOT received by USFWS.
- July 29, 2010 USFWS concurred with FHWA's determination of "Not Likely to Adversely Affect" regarding construction of the subject project and associated impacts to federally listed Carolina heelsplitter and its designated critical habitat and the Schweinitz's sunflower, and "no effect" to Michaux's sumac and Smooth coneflower.

- September 1, 2010 the Record of Decision (ROD) issued.
- In November, 2010, the Southern Environmental Law Center (SELC) on behalf of the North Carolina Wildlife Federation, Clean Air Carolina and Yadkin Riverkeeper, filed suit against NCTA and FHWA, alleging failures to correctly follow procedures for studying the environmental effects of the proposed project.
- April 2011 USACE issued 404 permit.
- August 18, 2011, USFWS sent a letter to FHWA asking for clarification regarding potential impacts to federally listed species for the proposed project. USFWS stated that their concurrence that the project was "Not Likely to Adversely Affect" the Carolina heelsplitter was based on assurances that the No-Build scenario in the Quantitative ICE (Baker Engineering 2010) did not include the proposed project. The letter asks for further information on this topic.
- August 23, 2011, USFWS sent a letter to FHWA seeking to clarify the August 18, 2011 letter. In order to avoid miscommunication, a meeting between the agencies was requested to discuss the project.
- In October 2011, a US District Court Judge ruled in favor of NCTA and FHWA regarding the environmental study.
- On October 31, 2012, SELC filed an appeal of the U.S. District judge's decision.
- On May 3, 2012, the Fourth Circuit Court of Appeals overturned the ruling of the lower court and found that the agencies failed to disclose the underlying assumptions of their analysis and falsely responded to public concerns. The Court remanded the matter so the agencies could publically and fully evaluate the "no-build" data.
- Design on the project was halted in May 2012.
- On June 15, 2012, NCDOT filed a petition to the Fourth Circuit Court of Appeals for rehearing of the case to address technical data and other facts that the state believes the higher court misunderstood.
- On June 29, 2012, the Fourth Circuit denied the petition for rehearing.
- Subsequent to the Fourth Circuit Court's decision, the FHWA rescinded the ROD on July 3, 2012.
- NCTA and FHWA commenced work to address the issues raised by the Fourth Circuit Court of Appeals.
- July 18, 2012, TEAC Meeting: USFWS asked if a merger type process to review the new data and provide comments had been considered. NCTA and FHWA agreed to discuss this and determine some key points for agency involvement and input in this process. Agencies will be asked to provide input and comments on all documents. USFWS noted that depending on the outcome of NCTA's current studies, they may need to revisit consultations under Section 7 of the Endangered Species Act. At that time, no modifications appeared to be needed. NCTA and FHWA agreed to continue to coordinate with USFWS to determine an appropriate course of action.

- November 7, 2012, NCDOT and USFWS met in preparation of the TEAC meeting taking place the following day (see below).
- November 8, 2012, TEAC Meeting: USFWS requested verification that since there were no changes in the land use, the water quality impacts would not be remodeled. Ms. Harris explained that pursuant to the meeting that took place between NCDOT and USFWS on 11/7, this issue needed further discussion in regards to if and where additional water quality modeling needed to be completed. FHWA stated that additional modeling was not necessary and once a thorough explanation of the differences found in the most recent study was provided to the agencies, stakeholders, and the public, then sufficient information would have been provided to show that no additional water quality analysis would be necessary.
- On December 20, 2012, the USFWS sent NCTA a letter that among other items, recommended a re-initiation of Section 7.
- July 10, 2013, FHWA met with USFWS in Atlanta, GA to discuss the project's status and findings from new ICE Analysis, which was finalized in November 2013 (Baker Engineering 2013b)
- August 28, 2013, FHWA submitted the following draft Endangered Species Act (ESA) information to USFWS:
    - Report on Effect to Species for FWS_DRAFT_082613 MW_toFHWA_rev.docx (Draft Technical Report – DTR)
    - Copy of FWS_Monroe_Maps 081913.pdf
    - Appendix A Interview Summaries.pdf
    - Appendix B Union_County_Growth_Memo_091112_Final.pdf
    - Appendix C Reports of Independent Economist.pdf
- September 30, 2013, the USFWS provided a letter with comments to the FHWA August 28, 2013 draft ESA information submittal.
- October 23, 2013, conference call with USFWS, FHWA/ NCDOT NEPA document team to discuss documents that were to be delivered October 24, 2013
- October 24, 2013, FHWA delivered the following draft documents to USFWS with accompanying cover letter:
    - Revised DTR
    - Response to USFWS Comments on Technical Report (DTR) 10-23-13
    - Draft BA
    - Biological Assessment Cover Letter
    - Draft ICE Report
- October 29, 2013, USFWS email with interim comments on Draft BA
- October 30, 2013, phone conversation with Marella Buncick (USFWS) and Michael Wood (Catena) discussing Draft BA
- November 1, 2013, USFWS via email with attachment final comments on Draft BA and DTR

Other Consultations in Action Area

There have been several previous consultations within the Action Area (as defined in Section 3.0) of the project:

- B-2647 (Carolina heelsplitter): Bridge No. 3 on SR 1547 over Goose Creek in Union County (TIP B-2647) was replaced during 1998. The findings of an informal consultation were transmitted to the USFWS in a letter dated May 14, 1998.
- R-2123 (Carolina heelsplitter): During the 1990s and early part of the 2000's, the Charlotte Outer Loop (TIP R-2123) was designed and constructed within the Goose Creek Subbasin. There were several consultations and re-initiations throughout the development and construction of the project.
- (Carolina heelsplitter): Wal-Mart Real Estate Business Trust development of a commercial center (Wal-Mart Supercenter) on an approximately 50-acre site near the intersection of US Hwy 521 and SC 160, within the Sixmile Creek watershed in Lancaster County, South Carolina. The project site drains into the North Carolina portion of Sixmile Creek, and the entire Sixmile Creek watershed was evaluated in the Biological Assessment (Catena 2007b) that concluded that the project was "Not Likely to Adversely Affect" the Carolina heelsplitter.
- U-2506 (Carolina heelsplitter): Involved the extension of Rea Road (SR 3624) on new alignment from its former terminus at the then proposed Charlotte Outer Loop (I-485) in Mecklenburg County, NC to NC 16 in Union County, NC. The roadway extension involved a new crossing of Sixmile Creek in between the NC 16 and SR 3635 (Marvin Road) crossings. Although the project itself is located outside of the Action Area, the Sixmile Creek watershed as a whole was evaluated in the consultation. Freshwater mussel surveys were conducted in 1999 prior to the authorization of the USACE 404 permit, for a standard distance of 1,312 feet below and 328 feet above the proposed crossing. A large number of mussels, primarily the Eastern elliptio, were found during this survey effort; however, typical Carolina heelsplitter habitat is not present in this reach of the stream. Based on the survey results, and the lack of typical habitat, it was concluded that the project was "Not Likely to Adversely Affect" the Carolina heelsplitter. The USFWS concurred with these findings, and the project was let for construction later that year and completed the following year. NOTE: Schweinitz's sunflower was also addressed as part of this project, but its occurrence was outside of the Action Area.
- U-2510 (Carolina heelsplitter): Involved the widening of NC 16 from the intersection with the Rea Road Extension in Union County, NC north to I-485. The widening of the roadway involved replacing the existing culvert over Sixmile Creek with a bridge. As with the Rea Road Extension project, mussel surveys were completed for this project in August 2004, with similar results and a concurrence of "Not Likely to Adversely Affect" was issued by USFWS. As a result of the discovery of Carolina heelsplitter in Sixmile

Creek, the USFWS asked NCDOT to reinitiate consultation in April 2006, and perform additional surveys. These surveys were conducted later that month, with similar results to the previous surveys. Again a "Not Likely to Adversely Affect" conclusion was reached and concurred with by USFWS.

- R-5114 (Carolina heelsplitter): Involved the rehabilitation of NC 218 in Mecklenburg, Union, and Anson Counties. This was an American Recovery and Reinvestment Act (ARRA) project which involved repairing deteriorated sections of the existing roadway, overlaying with asphalt and several culvert replacements (Duck Creek).
- (Carolina heelsplitter): USFWS consulted on a natural gas pipeline project that involved crossings of Goose and Duck Creeks. Based on results of surveys for listed plants and measures incorporated into the project to avoid impacts to the Carolina heelsplitter, USFWS concurred with the determination of a "Not Likely to Adversely Affect" conclusion.
- (Carolina heelsplitter): USFWS consulted with NCWRC in the past on several restoration projects in the Goose Creek watershed. A "Not Likely to Adversely Affect" conclusion was reached and concurred with by USFWS.
- B-5109 (Carolina heelsplitter): Bridge No. 29 on NC 218 over Goose Creek. A BA was submitted on April 5, 2013 with the determination of a "May Affect, Likely to Adversely Affect" conclusion. A BO was issued on May 20, 2013 which concurred that "implementing this project is not likely to jeopardize the continued existence of the Carolina heelsplitter or adversely modify its critical habitat" (USFWS 2013).
- Carolina heelsplitter: Bridge No. 6 on SR 1600 over Duck Creek in Union County. Biological Assessment concluded the project "May Affect, Likely to Adversely Affect" the Carolina heelsplitter. The BA was submitted in May 2012. A concurrence has not been issued as of the writing of this document.

1.3 Habitat Conservation Plans In Action Area

There have been no Habitat Conservation Plans developed for any listed species within the Action Area.

1.4 Northern Long-eared Bat

The northern long-eared Bat (*Myotis septentrionalis*) was proposed for listing as Endangered on October 02, 2013 (Federal Register DOC #: 2013-23753), under provisions of the Endangered Species Act of 1973 (as amended) (58 FR 34926-34932). Section 7(a)(4) of the Endangered Species Act of 1973 states that "Each Federal agency shall confer with the Secretary on any agency action which is likely to jeopardize the continued existence of any species proposed to be listed, or result in the destruction or adverse modification of critical habitat proposed to be designated for such species." As of the date of this document, no designated critical habitat has been proposed for the northern long-eared bat (Federal Register DOC #: 2013-23753).

The northern long-eared bat ranges across much of the eastern and north central United States, and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia. This range includes portions of 39 states, including North Carolina (Federal Register DOC #: 2013-23753). In North Carolina it occurs scattered over most of the state except for the southern Coastal Plain and the southeastern Piedmont. Prior to the 1980's, the species was thought to be limited in NC almost exclusively to the mountains, with an outlier record from Wake County. However, since then, many records from across the Piedmont, and even from the northern Coastal Plain, have been made (http://www.dpr.ncparks.gov/mammals/view.php?species_id=28). Potential habitat for this species may occur within the project action area. The USFWS is developing a management plan and guidance on how to address assessing potential impacts to this species, which is expected to be completed by January 2014 (Marella Buncick, USFWS, pers. comm., October 2013). Until this information is available, potential impacts to this species cannot be assessed.

As such, FHWA and NCDOT will coordinate with USFWS when the management plan and guidance becomes available. Any assessment of the project impact will be contained in a separate document. Therefore, the impact of the Monroe Bypass/Connector on the Northern long-eared bat is **"Unresolved"**.

2.0 PROJECT DESCRIPTION

The Monroe Connector/Bypass is proposed to be a controlled-access toll road extending from US 74 near I-485 in Mecklenburg County to US 74 between the towns of Wingate and Marshville in Union County, a distance of approximately 20 miles. The project will occupy approximately 1,240 acres within the proposed right of way (ROW). The proposed action will improve mobility and capacity within the project study area by providing a facility for the US 74 corridor that allows for high-speed regional travel consistent with the designations of the North Carolina Strategic Highway Corridor (SHC) program and the North Carolina Intrastate System, while maintaining access to properties along existing US 74.

2.1 Avoidance and Minimization

Consideration was given to the location of endangered species throughout the alternatives development and design process, based on the best available information regarding the known locations of the protected species populations. As stated in Section 2.2.2 in the DS-FEIS "all alternatives were purposely kept from encroaching on the Goose Creek watershed in an effort to avoid direct effects to the Carolina heelsplitter and its designated critical habitat" (Atkins 2013).

To the north, the boundary does not encroach on either the Goose Creek watershed or on Lake Twitty (a water supply). Previous studies included these areas, but because of concerns surrounding the presence of the federally-endangered Carolina heelsplitter mussel in Goose Creek and because Lake Twitty is a critical watershed, these areas were eliminated from the current project study area. Previously identified corridors for the Monroe Connector and Monroe Bypass that would result in direct impacts to the Goose Creek watershed or Lake Twitty are not included in this analysis.

Additionally, alternatives were kept outside of the Waxhaw Creek watershed, known Carolina heelsplitter habitat, as stated in Section 2.2.2 in the DS-FEIS:

A corridor south of the Lake Lee critical watershed would not be reasonable or practical due to substantially greater length and potential impacts to the Waxhaw Creek watershed, which is also a known Carolina heelsplitter habitat.

3.0 DESCRIPTION OF ACTION AREA

The action area, as defined in 50 CFR 402.02, means areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action. The defined Action Area for the proposed project includes several area types: those directly impacted by construction activities; those potentially impacted by indirect effects or cumulative effects; and those in which conservation measures are utilized to offset any impacts are proposed outside of the construction areas and the identified zone of indirect impacts. The Action Area for this BA is also referred to as the Future Land Use Study Area (FLUSA) in this and other associated NEPA documents.

The defining of the Action Area / FLUSA was coordinated with the environmental regulatory agencies at the January 25, 2007 TEAC meeting. The limits of the FLUSA was also discussed at the February 14, 2007 TEAC meeting, with discussions concluding at the March 22, 2007 TEAC meeting. The FLUSA was expanded to include the entire Goose Creek Watershed to allow for evaluation of potential indirect and cumulative effects on the Carolina heelsplitter and its designated critical habitat.

3.1 Areas of Direct Effects

Direct effects are caused by the proposed action and generally occur at the same time and place as the project. Areas of direct effects include, but are not limited to: the footprint or ROW of the facility, construction areas, or any other activity that causes ground disturbing activities that can be directly associated with the project.

Direct effects also refer to other activities that are interrelated or interdependent with the proposed action. Interrelated actions are defined as federal actions that are part of a larger action and depend on the larger action for their justification [50 CFR 402.02]. Interrelated action areas include project-associated utility relocations, as well as construction borrow pits, haul roads, and staging areas. Interrelated actions are assessed in this document. Interdependent actions, defined as federal actions having no independent utility apart from the proposed action [50 CFR 402.02], were evaluated with regard to direct effects to endangered species and critical habitat. No direct interdependent actions are anticipated.

3.2 Areas of Indirect Effects

Areas of indirect effects include, but are not limited to, those areas that are impacted by, or will result from, the proposed action and are later in time, but are still reasonably certain to occur [50 CFR 402.02]. These types of impacts can include natural responses to the proposed action's direct impacts, or can include human induced impacts associated with the proposed action. Indirect effects also refer to activities that are interrelated or interdependent with the proposed action. These actions were evaluated with regard to indirect effects to endangered species and critical habitat.

3.3 Conservation Measures

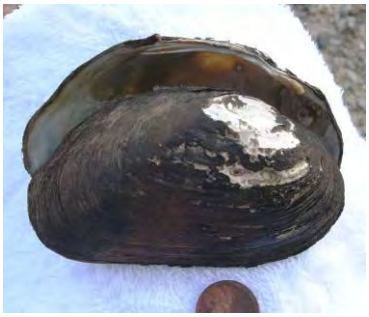
Conservation measures are those measures that facilitate conservation of the species and offer some level of protection to the population. These measures are discussed in Sections 8.6 and 9.5 of this report.

4.0 ENVIRONMENTAL BASELINE – CAROLINA HEELSPLITTER

4.1 Species Description: Carolina Heelsplitter

4.1.1 Designation (Legal Status)

The Carolina heelsplitter, of the family Unionidae, was listed as Endangered on June 30, 1993, under provisions of the Endangered Species Act of 1973 (as amended) (58 FR 34926-34932) (USFWS 1993a). Critical habitat was designated for Carolina heelsplitter on September 2, 2002, (67 FR 44501-44522), described in detail in Section 4.2.



4.1.2 Characteristics

The Carolina heelsplitter (*Lasmigona decorata*), originally described as *Unio decoratus* by (Lea 1852), synonymized with *Lasmigona subviridis* (Conrad 1835) by Johnson 1970), and later separated as a distinct species (Clarke 1985), is a federally Endangered freshwater mussel, historically known from several

locations within the Catawba and Pee Dee River systems in North Carolina and the Pee Dee, Savannah, and possibly the Saluda River systems in South Carolina.

The Carolina heelsplitter is characterized as having an ovate, trapezoid-shaped, unsculptured shell. The outer surface of the shell ranges from greenish brown to dark brown in color, with younger specimens often having faint greenish brown or black rays. The shell's nacre is often pearly white to bluish white, grading to orange in the area of the umbo (Keferl 1991). The hinge teeth are well developed and heavy and the beak sculpture is double looped (Keferl and Shelly 1988). Morphologically, the shell of the Carolina heelsplitter is very similar to the shell of the green floater (Clarke 1985), with the exception of a much larger size and thickness in the Carolina heelsplitter (Keferl and Shelly 1988).

Prior to collections in 1987 and 1990 by Keferl (1991), the Carolina heelsplitter had not been collected in the 20th century and was known only from shell characteristics. Because of its rarity, very little information of this species' biology, life history, and habitat requirements was known until very recently. Feeding strategy and reproductive cycle of the Carolina heelsplitter have not been documented, but are likely similar to other native freshwater mussels (USFWS 1996).

The feeding processes of freshwater mussels are specialized for the removal (filtering) of suspended microscopic food particles from the water column (Pennak 1989). Documented food sources for freshwater mussels include detritus, diatoms, phytoplankton, and zooplankton (USFWS 1996).

McMahon and Bogan (2001) and Pennak (1989) should be consulted for a general overview of freshwater mussel reproductive biology. Freshwater mussels have complex reproductive cycles, which usually include a larval stage (glochidium) that is an obligatory parasite on a fish. The glochidia develop into juvenile mussels and detach from the "fish host" and sink to the stream bottom where they continue to develop, provided suitable substrate and water conditions are available (USFWS 1996). Often, this relationship is quite species-specific with a mussel being able to infect only one species of fish or a small group of closely related species. Many of the fish host associations have been documented by direct evidence on wild-caught fishes or implicated in laboratory infestation experiments (Watters 1994).

Until recently, nothing was known about the host species(s) for the Carolina heelsplitter (USFWS 1996, Bogan 2002). Starnes and Hogue (2005) identified the most likely fish host candidates (15 species) based on fish community surveys in occupied streams throughout the range of the Carolina heelsplitter.

Captive propagation efforts for this species had not been attempted in the past; however, due to the critical level of imperilment of the North Carolina populations, acting on recommendations from the NC Scientific Council on Mollusks, the NC Wildlife Resources Commission (NCWRC)

funded a life history/captive propagation study, which allowed for salvage of individuals from the Goose/Duck and Sixmile Creek populations to be used in the study. A total of nine minnow species (Cyprinidae) were identified as suitable, and two sunfish species (*Lepomis* spp.) were identified as marginally suitable host species (Eads et al. 2010). All of these species may occur in habitat types known to be occupied by the Carolina heelsplitter; however, "it is always possible that it may use a combination of fish host species and some may not be native to all streams inhabited by this mussel" (Starnes and Hogue 2005).

Another member of the genus *Lasmigona*, the green floater (*Lasmigona subviridis*), perhaps a close relative to the Carolina heelsplitter, has been documented to be capable of in situ early development with glochidia developing within the marsupium of the female (Barfield and Watters 1998), thus it is possible that the Carolina heelsplitter may also be able to propagate by direct transformation.

4.1.3 Distribution and Habitat Requirements

Currently the Carolina heelsplitter has a very fragmented, relict distribution. At the time of listing, it was known to be surviving in only six streams and one small river (USFWS 1996); however, subsequent discoveries have increased the number of known populations to eleven.

Pee Dee River Basin:

1. Duck Creek/Goose Creek – Mecklenburg/Union Counties, NC
2. Flat Creek/Lynches River – Lancaster/Chesterfield/Kershaw Counties, SC

Catawba River Basin:

3. Sixmile Creek (Twelvemile Creek Subbasin) – Union/Mecklenburg Counties, NC and Lancaster County, SC
4. Waxhaw Creek – Union County, NC and Lancaster County, SC
5. Cane Creek/Gills Creek – Lancaster County, SC
6. Fishing Creek Subbasin – Chester County, SC
7. Rocky Creek Subbasin (Bull Run Creek/UT Bull Run Creek/Beaverdam Creek – Chester County, SC

Saluda River Basin:

8. Redbank Creek – Saluda County, SC
9. Halfway Swamp Creek – Greenwood/Saluda Counties, SC

Savannah River Basin:

10. Little Stevens Creek/Mountain Creek/Sleepy Creek /Turkey Creek (Stevens Creek Subbasin) – Edgefield/McCormick Counties, SC.
11. Cuffytown Creek (Stevens Creek Subbasin) – Greenwood/McCormick Counties, SC

All of these populations occur in stream reaches within the Piedmont Physiographic Province, particularly within two northeast trending lithostratigraphic belts of the Carolina Terrane, the Carolina Slate Belt and the Charlotte Belt. The Carolina Slate Belt is a band of greenschist facies metavolcanic and metasedimentary rock formations positioned in the central and lower Piedmont province extending from south-central Virginia to extreme eastern Georgia (Howell 2005, Butler and Secor 1991). The Charlotte Belt extends from north central North Carolina to eastern Georgia and is comprised of amphibolite facies metavolcanic and metaplutonic rock (Howell 2005, Butler and Secor 1991). These formations strongly dictate the channel morphology and character of stream substrates where they intersect. Starnes and Hogue (2005) describe such reaches as "generally characterized by dark, often tilted, bedrock stream bottom with associated large and small rock rubble interspersed with pockets of sand, silt, and gravel."

Habitat for this species has been reported from small to large streams and rivers as well as ponds. The ponds are believed to be millponds on some of the smaller streams within the species' historic range (Keferl 1991). Keferl and Shelly (1988) and Keferl (1991) reported that most individuals have been found along well-shaded streambanks with mud, muddy sand, or muddy gravel substrates; however, numerous individuals in several of the populations have been found in cobble and gravel dominated substrate in stream reaches intersecting the more resistant rock formations described above (Catena personal observations). The stability of stream banks appears to be very important to this species (Keferl 1991).

4.1.4 Threats to Species (Particularly Goose/Duck Creek and Sixmile Creek Populations)

Habitat degradation, water quality degradation, and changes in stream flow (water quantity) are the primary identified threats to the Carolina heelsplitter. Specific types of activities that lead to these threats have been documented by the USFWS in the Recovery Plan, Federal Register and other publications (USFWS 1996, 2002, 2003). These specific threats include the following:

- Siltation resulting from poorly implemented agricultural, forestry and developmental activities;
- Golf course construction;
- Road construction and maintenance;
- Runoff and discharge of municipal, industrial and agricultural pollutants;
- Habitat alterations associated with impoundments, channelization, dredging, and sand mining operations; and
- Other natural and human-related factors that adversely modify the aquatic environment.

These threats, alone and collectively, have contributed to the loss of the Carolina heelsplitter in streams previously known to support the species (USFWS 2002). In addition, many of the remaining populations occur in areas experiencing high rates of urbanization, such as the Charlotte, NC and Augusta, GA greater metropolitan areas. The low numbers of individuals and the restricted range of each of the surviving populations make them extremely vulnerable to

extirpation from a single catastrophic event or activity (USFWS 1996). The cumulative effects of several factors, including sedimentation, water quality degradation, habitat modification (impoundments, channelization, etc.), urbanization and associated alteration of natural stream discharge, invasive species, and other causes of habitat degradation have contributed to the decline of this species throughout its range (USFWS 1996).

Extensive threats to the species, including sedimentation, toxic contaminants, habitat alterations, urbanization/impervious surface area, thermal pollution, invasive species, and other causes of habitat degradation, are discussed in further detail below.

4.1.4.1 Sedimentation

Sedimentation resulting from improper erosion control of various land usage practices, including agriculture, forestry, and development activities, has been recognized as a major contributing factor to the degradation of mussel populations (USFWS 1996, Brim Box and Mossa 1999, Chapman and Smith 2008). Siltation has been documented to be extremely detrimental to mussel populations by degrading substrate and water quality, increasing potential exposure to other pollutants, and by direct smothering of mussels (Ellis 1936, Marking and Bills 1979). Sediment accumulations of less than one inch have been shown to cause high mortality in most mussel species (Ellis 1936). Accelerated sedimentation and erosion resulting from a bridge construction project in Massachusetts lead to the extirpation of a population of the dwarf wedgemussel (*Alasmidonta heterodon*), a federally endangered freshwater mussel (Smith 1981).

4.1.4.2 Toxic Contaminants

The presence of toxic contaminants has been attributed as a contributor to widespread declines of freshwater mussel populations (Havlik and Marking 1987; Bogan 1993; Neves et al. 1997). Toxic contaminants can produce lethal or sub-lethal responses to freshwater mussels. The sensitivities of freshwater mussels to toxic contaminants is variable based on species, life stage (glochidium, juvenile, or adult), and environmental conditions, as well as concentration and exposure route (water column, sediments, etc.), frequency, and duration. Several studies have indicated that freshwater mussels are among the most sensitive aquatic organisms to various toxicants, particularly cadmium, copper and ammonia (Grabarkiewicz and Davis 2008).

Freshwater mussels are extremely sensitive to ammonia, a form of nitrogen (Goudreau et al. 1993; Augspurger et al. 2003, Bartsch et al. 2003, Newton et al. 2003; Wang et al. 2007a; 2007b). Anthropogenic sources of ammonia in surface waters include sewage treatment effluent, industrial wastewater effluent, and runoff and ground water contamination from lawn/turf management, livestock operations, and faulty septic systems. Sewage treatment effluent has been documented to significantly affect the diversity and abundance of mussel fauna (Goudreau et al. 1988). Goudreau et al. (1988) found that recovery of mussel populations might not occur

for up to two miles below discharges of chlorinated sewage effluent. Similarly, surveys in the Goose Creek watershed show a dramatic absence of mussel fauna below the Oxford Glen WWTP on Stevens Creek for a considerable distance (approximately 1.6 km/1mi) below the discharge point (NCWRC 2010). A study conducted in the Goose Creek watershed documented that baseflow concentrations of chlorine nearly double directly downstream of the Hunley Creek WWTP located on Goose Creek (Allan 2004).

Recent studies indicate that current federal and state water quality standards for many pollutants commonly found in wastewater discharges and stormwater runoff are likely not protective of freshwater mussels and current regulations controlling the discharge or runoff of these pollutants are not protective (Augspurger et al. 2003). The U.S. Environmental Protection Agency (EPA) has been evaluating potential revision of the current federal standards (acute and chronic standards) for ammonia, but has yet to revise them to a protective level (USFWS 2007). Water quality monitoring by the North Carolina Division of Water Quality [Note: North Carolina Division of Water Quality changed its name to North Carolina Division of Water Resources in 2013] (NCDWQ 2002) identified average and maximum concentrations of ammonia in Goose Creek as being among the highest of any monitored sites in the Yadkin/Pee Dee River Basin.

In addition to ammonia, several other pollutants have been identified as exceeding levels of concern in Goose Creek, including, but not limited to, sediment/suspended solids (NCDWQ 2000; Chen et al. 2001; Allan 2005), copper (NCDWQ 2002), chlorine (NCDWQ 1998), and phosphate, a form of phosphorus (Chen et al. 2001; NCDWQ 2002, 2003; Allan 2005). While phosphate itself is not toxic, concerns with extremely high concentrations of phosphate pertain to increased biological production, such as algal blooms, which can result in lowering of dissolved oxygen (Binkley et al. 1999).

Concentrations of several of these pollutants in Goose Creek, including ammonia, appear to be on an increasing trend (Chen et al. 2001; USFWS et al. 2005). Currently there are no water quality standards, or monitoring requirements for ammonia, copper and phosphorus in North Carolina (USFWS 2007); however, the Goose Creek Site Specific Management Plan (NCDENR 2009) requires that any direct or indirect discharge that may cause ammonia toxicity to the Carolina heelsplitter, action shall be taken to reduce ammonia (NH3-N) inputs to achieve 0.5 milligrams per liter or less of total ammonia based on chronic toxicity defined in 15A NCAC 02B .0202. This level of total ammonia is based on ambient water temperature equal to or greater than 25 degrees Celsius (NCDENR 2009).

In addition, recent studies indicate other toxicants present in wastewater effluent such as pharmaceuticals and personal care products (fluoxitine, estrogenic compounds, opiate derivatives etc.) cause a wide array of neurotoxicological (Gagné et al 2007a), reproductive (Bringolf et al. 2007, Gagné et al 2007b) and behavioral (Heltsley et al. 2006) impacts to freshwater mussels.

Other sources of toxic contaminants in surface waters arise from highway and urban runoff. Numerous pollutants have been identified in highway runoff, including various metals (lead, zinc, iron, etc.), sediment, pesticides, deicing salts, nutrients (nitrogen, phosphorus), and petroleum hydrocarbons (Yousef et al. 1985, Gupta et al. 1981). The sources of these runoff constituents range from construction and maintenance activities to daily vehicular use. Hoffman et al. (1984) concluded that highway runoff can contribute up to 80 percent of the total pollutant loadings to receiving water bodies. Petroleum hydrocarbons, polycyclic aromatic hydrocarbons, lead, and zinc were some of the pollutants identified in this study.

The toxicity of highway runoff to aquatic ecosystems is poorly understood. A major reason for this poor understanding is a lack of studies focusing solely on highway runoff. Potential impacts of highway runoff have often been inferred from studies conducted on urban runoff; however, the relative loadings of pollutants are often much greater in urban runoff, because of a larger drainage area and lower receiving water dilution ratios (Dupuis et al. 1985). The negative effects of urban runoff inputs on benthic macroinvertebrate communities have been well documented (Garie and McIntosh 1986; Jones and Clark 1987; Field and Pitt 1990). Lieb (1998) found the macroinvertebrate community of a headwater stream in Pennsylvania to be highly degraded by urban runoff via a detention pond. Improvements were observed at continual distances downstream from the discharge point, however all sites examined were still impaired compared to a reference community.

The few studies that examined actual highway runoff show that some species demonstrate little sensitivity to highway runoff exposure, while others are much more sensitive (Dupuis et al. 1985). Maltby et al. (1995) found elevated levels of hydrocarbons and metals in both stream sediments and the water column below a heavily traveled British motorway. They demonstrated that the benthic amphipod (*Gammarus pulex*) experienced a decrease in survival when exposed to sediments contaminated with roadway runoff. However, this species showed no increase in mortality when exposed to water contaminated with roadway runoff. Unfortunately, most of these studies only measured acute toxicity to runoff and did not examine long-term effects.

The effects of highway runoff on freshwater bivalves have not been studied extensively. Augspurger (1992) compared sediment samples and soft tissues of three Eastern elliptio (*Elliptio complanata*), a relatively common species upstream and downstream of the I-95 crossing of Swift Creek in Nash County, North Carolina. The sediment samples as well as the mussels exhibited higher levels of aliphatic hydrocarbons, arsenic, lead, zinc, and other heavy metal contaminants in the downstream samples. Because of the small sample size, the effect on the health of these mussels was not studied. In another study, contaminant analysis of stream sediments showed an increase of polycyclic aromatic hydrocarbons and some metals downstream of road crossings, although there was no direct correlation found between increasing contaminant levels and decreasing mussel abundance at these crossings (Levine et al. 2005). The Eastern elliptio was the only mussel species that was found in large enough numbers for

statistically valid comparisons. The Eastern elliptio is generally considered more tolerant of water quality degradation than many other mussel species. Further research is needed before the effects of highway runoff on sensitive mussel species such as the Carolina heelsplitter can be determined.

In addition, contamination of surface water from toxic spills along roadways is known to have significant impacts to aquatic communities. A toxic spill resulting from a tanker truck accident that was carrying Octocure 554 (a chemical liquid used in the rubber making process), killed several miles of mussel populations in the Clinch River near Cedar Bluff, Virginia. The spill killed thousands of fish and mussels, including three federally protected species. The Clinch River contains one of the most diverse mussel faunas in the United States. The stretch of the river affected by the spill was one of the few remaining areas that contained a reproducing population of the Endangered tan riffleshell (*Epioblasma florentina walkeri*). The toxic spill is believed to have eliminated this population (Richmond Times Dispatch 1998).

4.1.5 Habitat Alterations

The impact of impoundments on freshwater mussels has been well-documented (USFWS 1992a, Neves 1993). Dam construction transforms lotic habitats into lentic habitats, which results in changes within aquatic community composition. Muscle Shoals on the Tennessee River in northern Alabama, once the richest site for mussels in the world, is now at the bottom of Wilson Reservoir, covered with 19 feet of muck (USFWS 1992b). Large portions of all of the river basins within the Carolina heelsplitter's range have been impounded; this is believed to be a major factor contributing to the species decline (USFWS 1996). This is especially true in the larger river habitats within the species historic range, such as the Catawba and Savannah Rivers, where impoundments have significantly altered habitat. The two extant populations in the Savannah River Basin are functionally isolated from each other by an impoundment on Stevens Creek, as such, there are considered two separate units for management (USFWS 1996).

4.1.5.1 Urbanization/Impervious Surface Area

The correlation of increasing development within a watershed and decreasing water quality is well documented (Lieb 1998, Crawford and Lenat 1989, Garie and McIntosh 1986, Lenat et al. 1979), and is largely associated with increases in impervious surface area. These increases in impervious surface area can affect water quality in a variety of ways, particularly with regard to changes to stream flow, water temperature, total suspended sediment, and pollutant loadings.

Multiple studies have demonstrated that water quality and stream ecosystem degradation begins to occur in watersheds that have approximately 10percent coverage by impervious surfaces (Stewart et al. 2000, Schueler 1994, Arnold and Gibbons 1996). The NCWRC recommendations

for management of protected aquatic species watersheds are to limit imperviousness to 6 percent of the watershed (NCWRC 2002).

The percentage of impervious surface has increased dramatically in the Goose Creek watershed in recent years. The current baseline of 13 percent imperviousness in Goose Creek (Baker Engineering 2013b) has increased by 6.1 percent since 2003 when the impervious surface area in the Goose Creek watershed was calculated to be 6.9 percent (HNTB 2003), far exceeding the threshold proposed by NCWRC. This trend is expected to increase, and an 18 percent level of imperviousness is predicted for the year 2030 (Baker Engineering 2013b). Similarly, Sixmile Creek far exceeds the 6 percent threshold, as the current baseline is 26 percent imperviousness, which is expected to increase to 31 percent by2030 (Baker Engineering 2013b).

Increases in impervious surface area within a watershed can result in extremes in peak discharge, runoff volume and base flow conditions. The Carolina heelsplitter may inherently be more susceptible to the consequences of these extremes than other mussels. While most mussels will usually dig into the substrate such that only the siphons are exposed or the very top of the shell, the Carolina heelsplitter is usually found with about 1/3 of its shell lodged in the substrate (Catena personal observations). As a result, it is much more prone to dislodgement during high base flows and less able to bury itself in the substrate during low flow conditions. This factor likely makes the Carolina heelsplitter more prone to predation and desiccation, even during periods of normal precipitation, than other freshwater mussels.

- *Peak Discharge*

Peak discharge is the maximum rate of stormwater flow expected from a storm event, measured in cubic feet per second (cfs). Peak discharge is often one metric used in analyzing impacts from development. Peak discharge affects channel stability (or instability), which is one of the identified constituent elements. Increases in peak discharge equates to higher velocity, which in turn increases the scouring effect (surface erodibility) of the runoff. Accordingly, sedimentation will increase as erosion rates increase. Allan (2005) documented dramatic increases in sediment and nutrient concentrations during high flow events in the Goose Creek subbasin.

Increases of peak discharge rates, coupled with deforestation, have been shown to result in stream narrowing and incision and subsequent loss of ecosystem function (Sweeney et al. 2004). Increased runoff volume and peak discharge (from typical and atypical storm events) destabilize the stream channel.

- *Runoff Volume*

Runoff volume is the amount of stormwater expected from a storm event, measured in acre-feet. Like peak discharge, runoff volume is another metric often used in determining impacts of

development, especially on the aquatic environment. For example, increases in the amount of runoff normally equates to increased sediment. While the two indicators are related, when analyzed separately, both are useful in assessing impacts to aquatic systems.

In a stable system, an increase in the velocity may have little impact if volume does not change, provided that measures to slow the increased velocity have been implemented. However, the increased runoff volume may have enough sediment to cause detrimental impacts. Regardless, it is important to consider both the rate (peak discharge) and the amount (runoff volume) when assessing impacts to aquatic systems. Again, sufficient stormwater controls accompanying future development activities in any given watershed is essential for conservation of sensitive aquatic species such as the Carolina heelsplitter.

- *Decreased Base Flow*

Increases of impervious surface lead to decreases in infiltration and base flow (groundwater flow) within adjacent streams. This can result in the following:

- During periods of reduced base flow, there is less water to cover the stream bottom.
- Widened streams have less overhanging tree cover and are exposed to more sunlight, resulting in increased water evaporation and temperature, especially in areas with shallower water.
- If base flow is reduced, yet WWTP discharge remains constant or increases, it takes longer for the stream to dilute the nutrients and other toxins in the effluent, thereby extending the WWTP effluent "plume" further downstream.
- Permitted and un-permitted water withdrawals for crop and turf/lawn irrigation further exacerbate this effect. Currently, there is an irrigation withdrawal from Goose Creek at approximately mid-length of its course. During summer months withdrawals of up to 188 gallons per minute (gpm), or 0.42 cfs can significantly affect the available dilution for downstream dischargers (Belnick, 2001).

4.1.5.2 Thermal Pollution

Concerns over effects of thermal pollution from urban runoff on aquatic systems have increased in recent years. Elevation of stream temperature can raise Biochemical Oxygen Demand (BOD), lower dissolved oxygen (DO), and alter faunal composition (Roa-Espinosa et al. 2003, Poole et al. 2001). Typically, runoff from a developed impervious area will have a temperature similar to the temperature of the impervious area. During the hot summer months, this could potentially make the stormwater runoff reach temperatures up to and above 90°F, which could be detrimental to the aquatic life. Traditional structural stormwater controls, such as open storm-water detention ponds/basins that do not allow for infiltration, do not protect receiving water bodies against adverse temperature effects. For these and other reasons, the USFWS feels that the Goose Creek Site Specific Management Plan (NCDENR 2009), will not provide adequate

protection to the Carolina heelsplitter, because the plan states that although measures to promote infiltration and groundwater recharge are to be "considered," such measures will not be required (USFWS 2008). Various stormwater BMPs have been shown to be effective in ameliorating temperature effects (NC State Cooperative Extension 2006a). Bioretention devices were shown to reduce runoff temperature by 5-10°F in Greensboro, NC (NC State Cooperative Extension 2006b).

The loss of riparian buffers as well as peak discharge-related channel widening can also contribute to stream temperature increases, by increasing sunlight exposure and decreasing water depth.

4.1.5.3 Invasive Species

The introduction of exotic species such as the Asian clam (*Corbicula fluminea*) and zebra mussel (*Dreissena polymorpha*) has also been shown to pose significant threats to native freshwater mussels. The zebra mussel is not known from any waterbodies supporting the Carolina heelsplitter (USFWS 1996); however, the Asian clam is established in most of the major river systems in the United States (Fuller and Powell 1973), including those streams still supporting surviving populations of the Carolina heelsplitter (USFWS 1996).

Concern has been raised over competitive interactions for space, food, and oxygen with the Asian clam and native mussels, possibly at the juvenile stages (Neves and Widlack 1987, Alderman 1997). In addition, under high densities, Asian clam beds are subject to large die-offs, which have been shown to dramatically increase pore water ammonia, and reduce DO during low-flow summer months (Cooper et al. 2005).

4.1.5.4 Other Causes of Habitat Degradation

Loss of riparian buffers can lead to degradation of adjacent aquatic habitats. The role of forested riparian buffers in protecting aquatic habitats is well documented (NCWRC 2002). The Recovery Plan for the Carolina heelsplitter (USFWS 1996) identifies the establishment of stream buffer zones as a major Recovery Objective (Task 1.4). Riparian buffers provide many functions including pollutant reduction and filtration, a primary source of carbon for aquatic food web, stream channel stability, and maintenance of water and air temperatures. Numerous studies have recommended a range of buffer widths needed to maintain these functions. Recommended widths vary greatly depending on the parameter or function evaluated. Wide contiguous buffers of 100-300 feet are recommended to adequately perform all functions (NCWRC 2002). The NCWRC recommends a minimum of 200 foot native, forested buffer on perennial streams and a 100 foot forested buffer on intermittent streams in watersheds that support federally endangered and threatened aquatic species (NCWRC 2002). Although not officially adopted, the USFWS uses the NCWRC recommendations as guidance when addressing federally protected aquatic

species in North Carolina. The Site Specific Water Quality Management Plan for the Goose Creek Watershed (NCDENR 2009) requires undisturbed riparian buffers within 200 feet of waterbodies within the 100-year floodplain and within 100 feet of waterbodies not within the 100-year floodplain. The USFWS feels that this level of protection is not sufficient to protect the Carolina heelsplitter, as Rule 15A NCAC 02B.0607 exempts or potentially allows (with NCDWQ approval) numerous activities within the "undisturbed" buffers, with no requirement for mitigation (USFWS 2008).

Another human-related factor adversely impacting habitat of the Carolina heelsplitter is recreational all-terrain vehicle (ATV) use. ATV tracks have been noted crossing streams as well as traveling stream channels within Carolina heelsplitter habitat, in particular in several segments of Goose Creek. In addition to directly running over mussels, ATVs destabilize stream banks and floodplains, causing sedimentation and buffer degradation. While there is no quantitative data available on ATV use, locally, this can have significant impacts.

4.1.5.5 Identified Action Area Threats

The Goose Creek and Sixmile Creek populations of the Carolina heelsplitter are threatened by numerous sources of degradation. Both of these watersheds have experienced rapid urbanization in recent years (Catena 2007a, 2007b, HNTB 2009, Baker Engineering 2013a, 2013b), which have contributed to, or exacerbated these threats. Specific threats to Carolina heelsplitter populations in these two watersheds are listed in Table 1.

4.2 Designated Critical Habitat

In accordance with Section 4 of the ESA, Critical Habitat for listed species consists of:

(1) The specific areas within the geographical area occupied by the species at the time it is listed in which are found those physical or biological features (constituent elements) that are:
    a. essential to the conservation of the species, and
    b. which may require special management considerations or protection
(2) Specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of Section 4 of the Act, upon a determination by the Secretary that such areas are "essential for the conservation of the species."

Table 1. Threats to Carolina heelsplitter in the Goose Creek Basin and Action Area

Threat/Concern	Specific Problems	Potential Sources
Water Quality Degradation	Fecal coliform Ammonia Nitrate/Nitrite Chlorine Phosphorus Dissolved oxygen Copper Pesticides Other toxicants	Wastewater treatment facilities Agricultural runoff Golf course runoff Lawn care chemicals Urban runoff Fertilizer applications Isolated spills
Habitat Degradation	Sediment Total suspended solids Riparian buffer loss Stream scour Stream/bank instability	Changes in stream flow Increased stormwater runoff Construction Land development Recreational use (ATV) Poor land management practices
Water Quantity Degradation	Mussel dislodgement Drought mortality (desiccation and increased predation)	Increased stormwater volume/velocity Reduced infiltration and ground water recharge Increased impervious cover
Invasive Species	Competitive interactions, water quality effects	Asian clam

When designating Critical Habitat, the USFWS identifies physical and biological features (primary constituent elements) that are essential to the conservation of the species and that may require special management considerations or protection. The primary constituent elements essential for the conservation of the Carolina heelsplitter (USFWS 2002) include:

1. permanent flowing, cool, clean water
2. geomorphically stable stream and river channels and banks
3. pool, riffle, and run sequences within the channel
4. stable substrates with no more than low amounts of fine sediment
5. moderate stream gradient
6. periodic natural flooding
7. fish hosts, with adequate living, foraging, and spawning areas for them.

Critical Habitat for the Carolina heelsplitter was designated in 2002 (USFWS 2002). The designated area totals approximately 148 kilometers (92 miles) of nine creeks and one river in North and South Carolina (Figures 2 and 3). Six areas (Units) have been designated as critical habitat and a description of each follows.

Unit 1. Goose Creek and Duck Creek (Pee Dee River system), Union County, NC

Unit 1 encompasses approximately 7.2 km (4.5 mi) of the main stem of Goose Creek, Union County, NC, from the N.C. Highway 218 Bridge, downstream to its confluence with the Rocky River, and approximately 8.8 km (5.5 mi) of the main stem of Duck Creek, Union County, NC, from the Mecklenburg/Union County line downstream to its confluence with Goose Creek. Details regarding recent surveys in Goose/Duck Creeks, and conditions within the Critical Habitat Unit are discussed in Section 4.4.

Unit 2. Waxhaw Creek (Catawba River system), Union County, NC

Unit 2 encompasses approximately 19.6 km (12.2 mi) of the main stem of Waxhaw Creek, Union County, NC, from the N.C. Highway 200 Bridge, downstream to the North Carolina/South Carolina state line. Very few Carolina heelsplitter individuals have been found in Waxhaw Creek since they were first discovered in 1987. Keferl (1991) found one live individual in 1987 and two in 1990. Subsequent surveys failed to find any individuals until one weathered shell was found in 1996, followed by one live individual in 1998, one weathered shell in 2005, three live individuals at three separate sites in 2006 (NCWRC Database) and no live individuals in 2011 (USFWS 2012a). Surveys of Waxhaw Creek in South Carolina, conducted in 2004, documented only two live individuals at a single site – one of only a couple of sites in the stream below the North Carolina/South Carolina state line that appeared to provide suitable substrate for the heelsplitter (USFWS 2012a). The population level in Waxhaw Creek is therefore very low, making it extremely vulnerable to extirpation.

Unit 3. Gills Creek (Catawba River system), Lancaster County, SC

Unit 3 encompasses approximately 9.6 km (6.0 mi) of the main stem of Gills Creek, Lancaster County, SC, from the County Route S-29-875, downstream to the SC Route 51 Bridge, east of the City of Lancaster. One 88.0 mm fresh shell and one 67.0 mm live individual discovered in 1998 represent this population (Alderman 1998). No additional surveys have been completed in this section of Gills Creek since 1998. In 2006 Catena discovered the species (two live and one shell) at three sites in Cane Creek, a tributary to Gills Creek (USFWS 2012a). While Cane Creek is not within the boundaries of Unit 3, Gills Creek and Cane Creek are considered a single population from a management perspective, as there are no physical barriers that would isolate the two areas. The discovery of the Carolina heelsplitter in Cane Creek demonstrates that this population has been reduced to small pockets of habitat in the watershed. Additional surveys in 2011 in Gills Creek from the South Carolina Highway 9 Bridge upstream to the Langley Road crossing resulted in the discovery of one live individual (USFWS 2012a). This population is very small, consisting of a few individuals, and increasingly at risk of being extirpated.

Unit 4. Flat Creek (Pee Dee River system), Lancaster County, SC, and the Lynches River (Pee Dee River system), Lancaster, Chesterfield, and Kershaw Counties, SC

Unit 4 encompasses approximately 18.4 km (11.4 mi) of the main stem of Flat Creek, Lancaster County, SC, from the SC Route 204 Bridge, downstream to its confluence with the Lynches River. Additionally, Unit 4 encompasses approximately 23.6 km (14.6 mi) of the main stem of the Lynches River, in Lancaster and Chesterfield Counties, SC, from the confluence of Belk Branch, Lancaster County, northeast (upstream) of the U.S. Highway 601 Bridge, downstream to the SC Highway 903 Bridge in Kershaw County, SC.

Within this unit in 2005 to 2007, the Lynches River local population was represented by 14 live and two fresh dead shells (54-87mm) found above SC 265 in Chesterfield/Lancaster Counties, SC (USFWS 2012a). In 2011, 13 live and one shell were found in this area (Catena 2011). Between 1994 and 1997, the Flat Creek local population was represented by 28 live individuals ranging in length from 54.15 to 94.1 mm and by four shells ranging in length from 41.0 to 86.1 mm (Alderman 1998). In 2007, Alderman conducted surveys of two reaches of Flat Creek, one in upper Flat Creek and one in middle-lower Flat Creek, and documented 15 live Carolina heelsplitters, including several age classes, some likely less than five years of age based on shell measurements (USFWS 2012a). In 2010, Alderman and USFWS found 50 live and one weathered shell in Flat Creek, with a large number of size classes represented (USFWS 2012a). The population in Flat/Lynches Creek exists in relatively low numbers, and in Lynches Creek has a highly fragmented distribution (USFWS 2012a).

Unit 5. Mountain and Beaverdam Creeks (Savannah River system), Edgefield County, South Carolina, and Turkey Creek (Savannah River system), Edgefield and McCormick Counties, SC

Unit 5 encompasses approximately 11.2 km (7.0 mi) of the main stem of Mountain Creek, Edgefield County, SC, from the SC Route 36 Bridge, downstream to its confluence with Turkey Creek; approximately 10.8 km (6.7 mi) of Beaverdam Creek, Edgefield County, from the SC Route 51 Bridge, downstream to its confluence with Turkey Creek; and approximately 18.4 km (11.4 mi) of Turkey Creek, from the SC Route 36 Bridge, Edgefield County, downstream to the SC Route 68 Bridge, Edgefield and McCormick Counties, SC. Within this unit, only a single shell of the Carolina heelsplitter had been found in Beaverdam Creek since its discovery there (Alderman 1995). Additional surveys of the Beaverdam Creek between 1995 and 2007 failed to locate any individuals (USFWS 2012a). Extensive surveys of the creek in 2010, however, resulted in the discovery of one live heelsplitter and one shell (USFWS 2012a).

Until recently, the Turkey Creek local population was represented by a few shells discovered in 1995 and by one live individual discovered in 1997 (Mcdougal 1997). Subsequent surveys have yielded several more live individuals: two in 2006, two in 2007, one in 2010 (USFWS 2012a),

and 10 individuals in 2012 (1) and 2013 (9) (Catena 2013). The Mountain Creek local population is represented by 15 live individuals ranging in length from 38.7 to 84.9 mm and by 15 shells ranging in length from 53.0 to 98.0 mm (Alderman 1998, 2002). During surveys conducted in 2009 and 2010, USFWS biologists recorded nine live heelsplitters at sites scattered throughout the stream (USFWS 2012a). During 2002, two additional local populations of Carolina heelsplitter were discovered within the Turkey Creek Subbasin, one in Little Stevens Creek represented by a shell fragment, and one in Sleepy Creek represented by seven live individuals ranging in length from 51.1 to 73.0 mm and by three shells ranging in length from 61.4 to 71.0 mm (Alderman 2002). Most recently, seven live and one moribund individuals were documented in Little Stevens Creek in 2006 (USFWS 2012a). A survey in 2011 of Little Stevens Creek yielded just one live individual. Additionally, during surveys conducted in Sleepy Creek in 2011, USFWS biologists recorded a total of 18 live individuals in an approximately 6.6 km (4.10 mi) reach of the stream (USFWS 2012a). Overall, this population of Carolina heelsplitter consists of several small populations that are fragmented throughout the watershed. This distribution of individuals makes the population highly vulnerable to extirpation, though it appears that a few of these pockets may be rebounding.

Unit 6. Cuffytown Creek (Savannah River system), Greenwood and McCormick Counties, SC

Unit 6 encompasses approximately 20.8 km (12.9 mi) of the main stem of Cuffytown Creek, from the confluence of Horsepen Creek, northeast (upstream) of the SC Route 62 Bridge in Greenwood County, SC, downstream to the U.S. Highway 378 Bridge in McCormick County. Within this unit, three live individuals were discovered in 1998 and two live individuals were discovered in 2001, with lengths ranging from 53.5 to 71.5 mm. One shell was discovered in 1998 with a length of 63.0 mm (Alderman 1998, 2002). Biologists conducting surveys in 2010 found two live individuals at two separate sites. This appears to be a very small population and highly vulnerable to extirpation (USFWS 2012a).

Five of the eleven Carolina heelsplitter populations listed in Section 4.1.3: Sixmile Creek, Fishing Creek, Rocky Creek, Redbank Creek, and Halfway Swamp Creek, were discovered after Critical Habitat was designated. These populations are all limited in size and distribution.

4.3 Potential Effects of Roadway Projects on Freshwater Mussels and Habitat

A number of potential direct and indirect effects to the freshwater mussels and their habitat, which could result from roadway projects, are identified below. Potential cumulative effects are also discussed in this section. While several threats to the Carolina heelsplitter are recognized (Section 4.1.4), potential roadway-related threats fall into three main categories:

1) physical effects (habitat degradation, direct mortality of individuals),
2) water quality effects (chemical, temperature, and biological pollutants),

3) water quantity effects (changes in peak and base flows).

4.3.1 Potential Direct Effects

Direct effects refer to consequences that can be directly attributed to the project. Direct impacts associated with road construction include, but are not limited to, land-clearing, loss of habitat, stream re-channelization, hydrologic modification, and erosion associated with construction in the project corridor as well as within fill/borrow areas, and construction staging/access areas outside of the project corridor. The potential effects of these activities on aquatic species, especially freshwater mussels, include degradation of habitat due to siltation, substrate disturbance (resulting in physical injury to individual mussels, and reduced habitat suitability), temporary, and permanent alteration of flows (temporary dewatering, causeway construction, channel restriction etc.), and runoff of pollutants, that originate from the project corridor during construction, and once in operation, that result in mortality, or harm (stress, adverse behavioral responses, or limited viability etc.) to individual mussels. Potential impacts to mussel habitat include channel and stream bank scouring, erosion, and runoff of pollutants that originate from the project corridor during construction, and once in operation.

4.3.2 Potential Indirect Effects

Indirect effects are those effects that are caused by, or will result from, the proposed action and are later in time, but are still reasonably certain to occur [50 CFR 402.02]. These types of impacts can include natural responses to the proposed action's direct impacts, or can include human induced impacts associated with the proposed action.

4.3.2.1 Indirect Effects on Land Use

Project-induced changes in land use are also considered part of the indirect impacts of a proposed action. These types of land use changes are not direct consequences of the road construction, but result from modifications in access to parcels of land and from modifications in travel time between various areas (Mulligan and Horowitz 1986). Indirect land use impacts of highway projects include residential, commercial, and industrial developments and linear urban sprawl along a highway corridor or in the vicinity of interchanges.

Economic development is often used as a criterion in highway funding (Eagle and Stephanedes 1987). Historically, transportation has been viewed as a necessary precursor to economic development (Anderson et al. 1992), and transportation infrastructure is "one of the principle policy levers that state and local governments can use to increase their attractiveness to business investors" (Forkenbrock 1990).

Depending upon local land development regulations, development demand, water/sewer availability, and other factors, roadway improvements can also result in encouragement of

additional unintended development and sprawl. Improvements to levels of service, better accommodation of merging and exiting traffic, and reductions in travel times can have land development impacts outside of the direct project area. Any induced growth and development within this area has the potential to degrade water quality, scenic values, and recreational opportunities unless proper planning and development regulations are utilized. This potential increases in areas with minimal or no planning programs and virtually non-existent development controls

4.3.2.2 Indirect Changes in Traffic Patterns

Project-induced development has the potential to affect traffic patterns on the existing road network within the action area of roadway construction projects. Increased traffic volumes on the road networks traversing the watersheds could potentially affect the associated aquatic communities, including freshwater mussels, by causing water quality degradation, while decreases in traffic volume could have a potential beneficial effect, by decreasing concentrations of toxicants originating from roadway runoff, and/or toxic spills along roadways.

4.3.3 Potential Cumulative Effects

Cumulative effects are those effects of future state or private activities, not involving federal actions, which are reasonably certain to occur within the action area of the proposed federal action. Cumulative effects to mussels and their habitat include continued non-federal development pressures, and their subsequent environmental consequences in the watersheds that are independent of the federal action.

4.4 Presence within Action Area

The Action Area / FLUSA encompasses streams within two major River Basins, the Catawba and Yadkin-Pee Dee. This includes portions of the subbasins within the project alignment, as well as others that are not, including McAlpine Creek (Irvins Creek, Campbell Creek, and Fourmile Creek), Goose Creek (Stevens Creek, Duck Creek, and Paddle Branch), Sixmile Creek, Twelvemile Creek (West Fork, Davis Mine Creek and East Fork), Bearskin Creek, (Horsepen Creek, Camp Branch and Lick Fork), and Lanes Creek (Henry Branch and Barkers Branch). These watersheds are depicted in Figure 4. As the Carolina heelsplitter is known to occur in water bodies ranging in size from large rivers to headwater streams, all perennial streams within the action area were evaluated for presence of this species

4.4.1 Project Alignment

The 31 perennial streams within the project alignment were evaluated for the presence of this species (Catena 2009). The streams are within the following subbasins: Crooked Creek (North and South Forks), Stewarts Creek, and Richardson Creek (includes Ray Fork, Salem Branch and

Meadow Branch). The Carolina heelsplitter was not found in any of these water bodies (Catena 2009). Surveys conducted in 2009 were updated in 2012 (Catena 2012b). In order to determine the location for the 2012 mussel surveys, the location of potential effects and/or impacts within the FLUSA (note: referred to as Project Study Area (PSA) in survey report) were overlaid with streams identified during the 2009 surveys that contain a robust freshwater mussel population that could potentially support the Carolina heelsplitter. Accordingly, South Fork Crooked Creek and Stewarts Creek in the vicinity of the project alignment, and portions of Crooked Creek and Richardson Creek were surveyed.

Overall the results of the 2012 survey efforts are very similar to the 2009 surveys, and as was the case in 2009, the Carolina heelsplitter was not found in any of the surveyed streams. In addition, the Savannah Lilliput remains extant in South Fork Crooked Creek, and as in 2009, a concentration of individuals was found within the proposed roadway crossing. The 2012 survey report is included as Appendix A.

The difference in results between the two surveys are likely a result of differences in time of year, survey conditions, and level of effort, rather than an indication of changes in mussel abundances. For example, while the Savannah Lilliput was found in low numbers (3 individuals) in Richardson Creek in 2009, it was not located in 2012, but is likely still present. There was a large amount of leaf pack covering the substrate in 2012 generally making surveying difficult. This coupled with the very small size of the Savannah Lilliput (< 2 inches) is likely the reason it was not detected. The fact that most of the other species occurring in Richardson Creek were found in similar numbers further supports this assumption. Furthermore, the difficulty of detecting a species that is present in low numbers during a one-time survey is highlighted by the fact that the Paper pondshell was found (one individual) in Richardson Creek in 2012, but not in 2009, although it was known from the stream prior to 2009 (NCWRC Unpublished Aquatic Species Database).

4.4.2 Mussel Fauna in Project Footprint

Existing mussel survey data within the project footprint were reviewed. Data sources consulted included the NCWRC Unpublished Aquatic Species Database, which was reviewed in October 2013, the NC Natural Heritage Program (NCNHP) database (NCNHP 2013), reviewed in July 2013, and Johnson (1970), and surveys conducted by Catena. Habitat evaluations/mussel surveys were conducted in the perennial streams within the project alignment in 2009 (Catena 2009). Catena also conducted surveys in the streams that were outside of the project alignment but needed updated survey information to determine the presence/absence of the Carolina heelsplitter: Lanes Creek, Richardson Creek upstream of the project alignment, and Crooked Creek downstream of the project alignment (Catena 2009, 2010b).

A total of 15 freshwater mussel species have been recorded in the action area watersheds (Table 2). In addition to the Carolina heelsplitter, other rare freshwater mussel species known from the FLUSA include the State Endangered (E) Atlantic pigtoe (*Fusconaia masoni*), Brook floater (*Alasmidonta varicosa*), Carolina creekshell (*Villosa vaughnaniana*), and Savannah lilliput (*Toxolasma pullus*); the state Threatened (T) Creeper (*Strophitus undulatus*); the State Special Concern (SC) Notched rainbow (*Villosa constricta*); the State Significantly Rare (SR) Eastern Creekshell (*Villosa delumbis*); and the Watch List (W3, W5) Carolina spike (*Elliptio producta*).

Based on location, geology, life history and distribution, it is likely that the Carolina heelsplitter occurred in portions of most, if not all, of the subbasins in the surveyed area at one point in time. However, it is currently limited to the Goose Creek and Sixmile Creek subbasins.

4.4.2.1 Distribution in Goose/Duck Creek

The Carolina heelsplitter was first discovered in Goose Creek in 1987 (Keferl 1991) and in Duck Creek in 2000 (NCWRC Database). Between 1993 and 1999 a total of 15 live individuals had been recorded in Goose Creek.

Table 2. Freshwater Mussel Species in Action Area Streams

Scientific Name	Common Name	Federal Status	State Status	Action Area Streams*
Alasmidonta varicosa	brook floater	~	E	RC
Elliptio angustata	Carolina lance	~	~	CC,GC
Elliptio complanata	Eastern elliptio	~	~	All
Elliptio icterina	variable spike	~	~	BC,GC,LC,RC,XC,TC
Elliptio producta	Carolina spike	~	W3, W5	GC,XC,TC
Fusconaia masoni	Atlantic pigtoe	~	E	GC,LC
Lasmigona decorata	Carolina heelsplitter	E	E	GC,XC,TC**
Pyganodon cataracta	Eastern floater	~	~	BC,CC,LC,RC,SC,XC,TC
Strophitus undulatus	creeper	~	T	GC,BC,LC
Toxolasma pullus	Savannah lilliput	~	E	CC, LC, RC
Uniomerus carolinianus	Florida pondhorn	~	~	BC,CC,LC,RC,TC
Utterbackia imbecillis	paper pondshell	~	~	CC,RC,SC
Villosa constricta	notched rainbow	~	SC	GC,TC
Villosa delumbis	Eastern creekshell	~	SR	All
Villosa vaughaniana	Carolina creekshell	~	E	CC,GC,LC,RC,XC,TC

*BC, CC, GC, LC, MC, RC, SC, XC, and TC denote Bearskin Creek, Crooked Creek, Goose Creek, Lanes Creek, McAlpine Creek, Richardson Creek, Stewarts Creek, Sixmile Creek and Twelvemile Creek subbasins, respectively.
**Historic Record

NCWRC surveys in early 2002 found 16 live individuals in Duck Creek (NCWRC Database); however, following extreme drought conditions in late 2002, where much of the streambed in both creeks was dry, status surveys in Duck Creek yielded only four live and more than 40 fresh

dead. One fresh-dead shell was also found in Goose Creek during the 2002 drought surveys just below US 601. Pools and wet streambeds were much more common in lower Goose Creek, apparently providing refuge from desiccation during the drought.

Between 2004 and 2005, four live individuals were found at two locations within Goose Creek, and 12 live individuals were found at six locations within Duck Creek. Prolonged severe drought conditions persisted in the Goose Creek watershed in 2006 through 2007. A total of nine individuals have been found in Duck Creek between 2006 and 2009. Three of the individuals were found on more than one occasion. Four of these individuals were taken into captivity, as much of the stream channel was dry when they were found. A survey conducted in 2011 of the critical habitat portion of Goose Creek, from the Rocky River confluence to the NC 218 crossing, located a total of 12 live individuals, and one fresh dead shell (Catena 2012a). All of the live individuals were taken into captivity for a joint propagation effort between North Carolina State University and the North Carolina Wildlife Resources Commission. The majority of the individuals were estimated to be <5 years of age based on shell condition and growth rests, indicating relatively recent reproduction. Repeated survey efforts in Duck Creek in 2011 and 2012 have not located any live individuals post drought.

Distribution and relative abundances (based on Catch Per Unit Effort) of freshwater mussel species known to occur in the Goose Creek watershed have generally declined since 2003, to the extent that mussels are increasingly rare in the subbasin. Species like the Atlantic pigtoe and notched rainbow may be extirpated (NCWRC Database).

4.4.2.2 Distribution in Sixmile Creek

The Carolina heelsplitter was first discovered in Sixmile Creek in 2006 (Catena 2007b). A total of 16 live individuals and 3 dead shells were found in the creek extending from near the confluence with Twelvemile Creek in Lancaster County, SC, upstream to the vicinity of the Marvin Road (SR 1312) crossing on the Mecklenburg/Union County line. In 2009, two live individuals were found between the SC/NC state line and the Marvin Road crossing (NCWRC Database), and in 2011 one live individual was found in the same area (USFWS 2012a).

4.5 Watershed Conditions

Characteristics and conditions of the two watersheds within the Action Area supporting the Carolina heelsplitter, Goose Creek and Sixmile Creek are discussed below.

4.5.1 Goose Creek Subbasin (03040105)

The Goose Creek subbasin occupies an area of 29 square miles in Union and Mecklenburg Counties. There are 163 miles of identified perennial streams within the subbasin. From the

headwaters in Mecklenburg County approximately 4.7 mi east of the town of Matthews to the confluence with the Rocky River 3.2 mi south of Midland on the Union/Stanly County line, Goose Creek is approximately 15.5 mi in length. Major tributaries include Stevens Creek, Paddle Branch and Duck Creek.

4.5.2 Water Quality

4.5.2.1 Best Usage Classification

The NCDENR assigns a best usage classification to all waters of North Carolina. These classifications, which are the responsibility of the NCDWR, provide a level of water quality protection to ensure that the designated usage of that water body is maintained. Table 3 lists the streams in the Action Area within the Goose Creek Subbasin and their Usage Classification and NCDWR Index number (#).

Table 3. Streams Within Goose Creek Subbasin

Steam Name	Usage Classification	DWR Index #
Stevens Creek	C	13-17-18-1
Paddle Branch*	C	13-17-18-2
Duck Creek	C	13-17-18-3
Goose Creek	C	13-17-18

* Paddle Branch is a tributary to Duck Creek

Class C waters are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture, and other uses suitable for Class C. There are no restrictions on watershed development or types of discharges.

4.5.2.2 Impaired 303(d) Listing

As mandated in Section 303(d) of the Clean Water Act., states, territories, and authorized tribes are required to develop lists of impaired waters, which are defined as water bodies that do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. These water quality standards include designated uses, numeric and narrative criteria, and anti-degradation requirements as defined in 40 CFR 131. Failures to meet standards may be due to an individual pollutant, multiple pollutants, or unknown causes of impairment, originating from point and non-point sources and/or atmospheric deposition. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop Total Maximum Daily Load limits (TMDLs) of identified pollutants for these waters.

In recent years, both Goose (from SR 1524 to the Rocky River) and Duck Creek (from its source to Goose Creek) in Union County had been on the NCDWQ's Section 303(d) Category 5 list of

impaired streams. However, the 2012 303(d) List, which only includes Category 5 waters, does not list Goose or Duck Creek. Category 5 waters are those impaired for one or more designated uses by a pollutant(s), and require a TMDL for the pollutant(s).

Since 1998, Goose Creek had been on the 303(d) for various impairments, such as fecal coliform. Currently, it is listed as a Category 4b for turbidity and ecological/biological integrity benthos, indicating that, while the stream is still impaired, a management strategy is in place to address exceedances (NCDWR 2012). Goose Creek from SR 1524 to Rocky River is categorized as 4t for fecal coliform, indicating that the stream is impaired, but that a TMDL has been approved (NCDWR 2012). Duck Creek, which was included on the 2008 draft list for the first time, has also been downgraded to a Category 4b for ecological/biological integrity benthos.

The 303(d) Category 5 streams in the FLUSA are listed in Tables 4 and 5 along with details of the impairments, and shown in Figure 4.

4.5.2.3 Nonpoint Source Pollution

Nonpoint source (NPS) pollution refers to runoff that enters surface waters through stormwater or snowmelt. There are many types of land use activities that are sources of NPS pollution including land development, construction activity, animal waste disposal, mining, agriculture and forestry operations, and impervious surfaces such as roadways and parking lots. Various nonpoint source management programs have been developed by a number of agencies to control specific types of nonpoint source pollution (e.g. forestry, pesticide, urban, and construction-related pollution etc.). Each of these management programs develops Best Management Practices (BMPs) to control the specific type of NPS pollution.

Table 4. Catawba River Basin Impaired (Category 5) Streams 2012. Use of listed streams for "Aquatic Life".

Stream	AU Number	Length/Area	Reason for Rating	Parameter (Year)
Sixmile Creek (030501030203)	11-138-3	8.8 FW Miles	Fair Bioclassification	Ecological/Bio Int, Fish Comm (2006)
McAlpine Creek (030501030107)	11-137-9b	6.3 FW Miles	Fair Bioclassification	Ecological/Bio Int. Benthos (1998)
McAlpine Creek (030501030107)	11-137-9a	8.2 FW Miles	Fair Bioclassification	Ecological/Bio Int. Benthos (1998)

FW – Freshwater Miles

The Nonpoint Discharge Elimination System (NPDES) Stormwater Permitting program institutes permitting requirements for municipal separate storm sewer systems (MS4) and also established post-construction stormwater management requirements in both incorporated and unincorporated areas for development activities outside of the permitted MS4s (NPDES Phase II). Development activities in these areas must meet post-construction requirements. Within the Action Area, Mecklenburg County enforces the Phase II and post-construction requirements

within the county while NCDWR currently enforces the same regulations within Union County and any communities which do not have Phase II permits. The post-construction ordinance allows NCDWR to implement undisturbed riparian buffer rules within the Goose Creek, Sixmile Creek, and Waxhaw Creek watersheds, which are habitat to the Carolina heelsplitter. These buffer requirements are only implemented when NCDWR receives a permit application, whether stormwater or Section 401 (Randall 2010, pers. comm.). The NCDWR requires that permits in the Goose Creek watershed include post-construction requirements of 200 foot undisturbed riparian buffers on perennial streams, 100 foot riparian buffers on intermittent streams, and a ten percent impervious surface threshold for engineered stormwater controls (NCDWQ 2009).

NCDWR also implements the buffer requirements from the Goose Creek Site Specific Management Plan (NCDENR 2009b), which requires all projects disturbing more than one acre of land to control stormwater as described in Rule .0602 of the plan (see Section 4.5.2.7 of this report).

4.5.2.4 Point Source Pollution

Point source discharges of pollution are defined as pollutants that enter surface waters through a pipe, ditch, or other well-defined point of discharge. These include municipal and industrial wastewater treatment facilities, small domestic discharging treatment systems (schools, commercial offices, subdivisions and individual residents), and stormwater systems from large urban areas and industrial sites. The primary pollutants associated with point source discharges include nutrients, solids/sediments, oxygen demanding wastes, and toxic substances such as chlorine, ammonia and metals.

There are five permitted wastewater discharges in the Goose Creek subbasin (**Error! Reference source not found.**6), two of which have been decommissioned (Figure 5). These facilities currently fall under the Goose Creek Site Specific Management Plan (NCDENR 2009) NPDES Permitting Policy, which was implemented by NCDWR (formerly NCDWQ) in conjunction with other resource agencies.

The NPDES Permitting Policy includes limits on various parameters, including, but not limited to chlorine (since October 2002), ammonia, fecal coliform, BOD, DO, flow, and temperature, for the existing facilities. Compliance reports from the 2005-2010 review period show routine problems with several parameter limits exceeded at the Fairfield Plantation and Hunley Creek WWTPs, which have since been decommissioned. A summary of violations obtained from NCDENR Central Files on April 6, 2010, October 17, 2012 and November 2, 2012 is provided below.

Table 5. Yadkin-Pee Dee River Basin Impaired (Category 5) Streams 2012. Use of listed streams for "Aquatic Life".

Stream	AU Number	Length/Area	Reason for Rating	Parameter (Year)
Little Richardson Creek (030401050504)	13-17-36-4-(0.5)	77.1 FW Acres	Standard Violation	Chlorophyll a (2008)
Little Richardson Creek (030401050504)	13-17-36-4-(2)	38.7 FW Acres	Standard Violation	Chlorophyll a (2008)
Richardson Creek (030401050504)	13-17-36-(3.5)b	106.4 FW Acres	Standard Violation	Chlr a (2008), pH (2008)
Richardson Creek (030401050506)	13-17-36-(5)a1a	8.2 FW Miles	Fair Bioclassification	Eco/Bio Int. Benthos (1998)
Stewarts Creek (030401050503)	13-17-36-9-(1)	8.3 FW Miles	Fair Bioclassification	Eco/Bio Int. Benthos (2008)
Stewarts Creek (030401050503)	13-17-36-9-(4.5)	131.1 FW Acres	Standard Violation	DO (2012), Copper (2008), Chlr. a (2008)
Richardson Creek (030401050501)	13-17-36-(5)a1b	3.9 FW Miles	Standard Violation	Copper (2008)
Richardson Creek (030401050501)	13-17-36-(5)a2	4.7 FW Miles	Standard Violation	Copper (2008)
Beaverdam Creek (030401050602)	13-17-40-11	12.1 FW Miles	Standard Violation	Copper (2008), DO (2008)
Crooked Creek (030401050702)	13-17-20-2a	5.6 FW Miles	Fair/Poor Bioclassification	Eco/Bio Int. Fish Comm/Benthos (1998)
Crooked Creek (030401050702)	13-17-20-2b	8.8 FW Miles	Fair Bioclassification	Eco/Bio Int. Benthos (1998)
Crooked Creek (030401050702)	13-17-20-1	12.0 FW Miles	Standard Violation	Turbidity (2004)
Crooked Creek (030401050702)	13-17-20	12.9 FW Miles	Standard Violation/Fair Bioclassification	Turbidity (2010), Eco/Bio Int. Benthos (2012)

FW - Freshwater Miles

Table 6. Permitted Wastewater Treatment Plants (WWTP) in the Goose Creek Watershed

Permit	Facility	Receiving Stream	Flow (GPD)	Owner
NC0063584	Oxford Glen	Stevens Creek	75,000	Aqua NC
NC0065749	Ashe Plantation	Duck Creek	100,000	Aqua NC
NC0072508	Hunley Creek	Goose Creek	Decommissioned (2006)	Union County
NC0034762	Fairfield Plantation	Goose Creek	Decommissioned (2011)	Goose Creek Utility Co
NC0065684	Country Wood	Goose Creek	670,000	Aqua NC

Oxford Glen (Aqua North Carolina)

- No records available for 2005
- No violations recorded for 2006-2009
- A notice of violation (NOV) was documented on September 22, 2010 due to failing to report dissolved oxygen, temperature and pH during the May 2010 self-monitoring period. No civil penalties were issued.

Ashe Plantation (Aqua North Carolina)

- A NOV from DWQ was documented on March 1, 2010 due to exceeding the daily maximum of total suspended solids (TSS) in the November 2009 self-monitoring report. No civil penalties were assessed.

Hunley Creek (Union County)

- Numerous NOVs and civil penalties were documented throughout 2005-2006 monitoring period due primarily to exceedences of BOD, with occasional exceedences of flow, fecal coliform, TSS, and total suspended residue (TSR). Civil penalties assessed included approximately $30,510.11 while receipts of payment received included $24,436.08.
- In May 2006, this facility was decommissioned. Wastewater previously directed to the Hunley Creek WWTP was redirected to the Crooked Creek watershed for treatment. No NOVs were identified for this WWTP throughout 2007-2010 due to decommission (Union County 2006).

Fairfield Plantation (Goose Creek Utility Company)

- DWQ sent a memorandum to the Attorney General's Office on January 13, 2010, requesting Injunctive Relief with regard to the Fairfield Plantation WWTP. DWQ described how the WWTP is in a "state of disrepair" with questionable structural integrity and a history of deteriorating conditions. Improvements to the structure were not made due to the fact that connection to the Union County Public Works sewer system was imminent. In February 2011, NCDWQ terminated the NPDES permit for this facility, and Union County Public Works commenced treating the wastewater previously treated by the Goose Creek Utility Company (Black & Veatch Holding Co 2011).
- DWQ sent a letter to NC Utilities Commission dated February 4, 2010, requesting its advice, counsel and assistance in addressing the situation with this WWTP:

  "This WWTP currently operates under the terms of a NPDES permit issued in 1994. As such, effluent limitations and monitoring requirements are not as stringent as those found in contemporary permits for facilities discharging to Goose Creek. This WWTP

has deteriorated to the point that its structural integrity is questionable and its owners attest that it cannot consistently meet currently applicable (1994) permit limits."

- Numerous NOVs and civil penalties were documented throughout 2009-2010 monitoring period due primarily to exceedences of flow, with occasional exceedences of fecal coliform, DO, and ammonia. Civil penalties assessed included $12,899.37 for this period. No receipts of payment were documented for these penalties.

Country Wood (Aqua North Carolina)

- There are no documented violations at this facility between 2006 and September 2011; though there were no records for 2005.
- Ammonia violations were recorded in September and November 2011, for which civil penalties totaling $1,289.34 were issued and $894.67 in payment was received.

In addition to chlorine limits, a moratorium on new facilities or expansion of existing facilities within the Goose Creek watershed was instituted under the Goose Creek Site Specific Management Plan (NCDENR 2009b).

4.5.2.5 Ecological Significance

The NCNHP maintains a database of rare plant and animal species, as well as significant natural areas, for the state of North Carolina. The NCNHP compiles the NCDENR priority list of "Natural Heritage Areas" as required by the Nature Preserves Act (NCGS 113A-164 of Article 9). Natural areas (sites) are inventoried and evaluated on the basis of rare plant and animal species, rare or high quality natural communities, and geologic features occurring in the particular site. NCNHP has revised its process for establishing conservation priorities (NCDENR 2013) for the more than 2,400 Significant Natural Heritage Areas (SNHA) that have been identified through field investigations. Each SNHA receives two significance ratings, which measure different values

1. Element Collective Value rates each SNHA on the basis of the number and rarity of all the elements it contains.

2. Element Representational Value rates each SNHA on its importance in protecting the best occurrences of individual elements.

This paired rating system provides two distinct values for each site, one which reflects the biodiversity of the state and one which reflects the overall biodiversity of each SNHA. Each site is assigned two values, a Representational Rating (R1-R5) and a Collective Value Rating (C1-C5). The two ratings measure different and complementary qualities of each site. The Goose

Creek Subbasin Aquatic Habitat has a Representational Value R1 (Outstanding), and a Collective Value of C3 (High) (NCDENR 2013).

The Goose Creek Subbasin supports several other rare aquatic species besides the Carolina heelsplitter. They are listed Table 7 along with their state and federal status.

Table 7. Rare Aquatic Species in Goose Creek Subbasin

Scientific Name	Common Name	NC Status	Federal Status	Species Type
Etheostoma collis collis	Carolina darter	SC	~	Fish
Fusconaia masoni	Atlantic pigtoe	E	~	Mussel
Lasmigona decorata	Carolina heelsplitter	E	E	Mussel
Strophitus undulatus	creeper	T	~	Mussel
Villosa constricta	notched rainbow	SC	~	Mussel
Villosa delumbus	Eastern creekshell	SR	~	Mussel
Villosa vaughaniana	Carolina creekshell	E	~	Mussel

E = Endangered, T = Threatened, SC = Special Concern, SR = Significantly Rare, ~ = no rating (NCNHP 2013)

The Goose Creek watershed is considered to be a globally significant ecosystem; as such several efforts have been undertaken by USFWS, NCDOT and NCWRC to preserve this ecosystem. NCWRC has acquired 23 conservation easements on 156 acres along Goose Creek and Duck Creek, using a $1.8 million NC Clean Water Management Trust Fund grant specifically awarded to address Goose Creek's water pollution problems. In addition to buying conservation easements, NCWRC has used grants to fund other projects, including the stream restoration and stabilization of five streams and ditches in the watershed (PBS&J 2010b). NCDOT has acquired, or funded stream mitigation projects in the Goose Creek watershed; however, those projects were utilized towards mitigation requirements associated with other NCDOT projects.

4.5.2.6 Conditions within Critical Habitat Unit 1

Water quality and stream habitat conditions within the Goose Creek have deteriorated significantly in recent years, to the level that several of the Constituent Elements have been significantly altered to the extent that they may no longer be present. The habitat degradation has coincided with the rapid urbanization of the watershed, which was discussed in Section 4.1.5.1. Each of the Constituent Elements of Unit 1 and the way they have been compromised are discussed below:

1) Permanent flowing, cool, clean water: The mainstems of both Goose and Duck Creeks have experienced several prolonged periods of interrupted flow (Catena personal observations, John Fridell, pers. comm.). This has resulted in mortality of several individuals (John Fridell, pers. comm.). In addition, various toxic contaminants have been reported in the watershed (Section 4.1.4.2), and both Goose and Duck Creeks are listed as impaired (Section 4.5.2.2).

2) Geomorphically stable stream and river channels and banks: The effects of urbanization on peak discharge and channel stability were discussed in Section 4.1.5.1. Channel incision, headcutting, and numerous streambank failures leading to new channel cuts have occurred in the Goose Creek watershed in recent years, especially in the mainstem of Goose Creek (Catena personal observations, John Alderman and John Fridell, pers. comm., Allan 2005).

3) Pool, riffle, and run sequences within the channel: While these habitat sequences are still present within the Critical Habitat Unit, large accumulations of fine sediments occur in many of these areas (see below).

4) Stable substrates with no more than low amounts of fine sediment: As a result of channel instability, and erosion from the landscape, large accumulations of fine sediment occur throughout the channel of Goose Creek, and to a lesser extent Duck Creek (Catena personal observations, John Alderman and John Fridell, pers. comm., Allan 2005). As stated above, Allan (2005) documented dramatic increases in sediment concentrations during high flow events in the Goose Creek subbasin.

5) Moderate stream gradient: This constituent element is generally still present; however significant channel incision has occurred throughout much of the Goose Creek channel (see below).

6) Periodic natural flooding: The effects of urbanization on stream channel scour, and the subsequent effects on freshwater mussels and mussel habitat are discussed in Section 4.1.5.1. The mainstem of Goose Creek has incised significantly in recent years to the level that in many areas the floodplain is inaccessible from the channel except during extremely high flows (Catena personal observations, John Alderman and John Fridell, pers. comm.), which increases velocities for lower level events that further contributes to channel instability and habitat degradation.

7) Fish hosts, with adequate living, foraging, and spawning areas for them: There have been no documented extirpations of any fish species within the Goose Creek watershed, and Starnes and Hogue (2005), found several of the species of cyprinids (minnows) in the watershed, which have been identified as fish hosts for the Carolina heelsplitter (Eads et al. 2010). However, the habitat degradation (high levels of silt, channel scour etc.) discussed above may be compromising spawning habitat for the host species.

4.5.2.7 Goose Creek Watershed Site Specific Water Quality Management Plan

In 2009, a Site Specific Management Plan for the Goose Creek Watershed was adopted to protect the Carolina heelsplitter (NCDENR 2009). The purpose of the actions required by this site-specific management strategy that comprises the site-specific water quality management plan

(Plan) is for the maintenance and recovery of the water quality conditions required to sustain and recover the Carolina heelsplitter population in the Goose Creek Watershed. The site-specific management strategies shall be implemented to:

(1) Control stormwater for projects disturbing one acre or more of land
(2) Control wastewater discharges
(3) Control toxicity to streams supporting the Carolina heelsplitter
(4) Maintain riparian buffers

Charlotte-Mecklenburg Storm Water Services began administering the Plan in October 2009. This Plan stemmed from the Water Quality Recovery Plan (WQRP) for the Goose Creek Watershed, required as part of Charlotte-Mecklenburg's Phase II Storm Water Permit application. The required WQRP was implemented to comply with the pollutant load limitations set forth in the 2007 Goose Creek total maximum daily load (TMDL) for Fecal Coliform. In the NC 2010 Integrated Report, 303(d) List, the Mecklenburg County reach of Goose Creek was changed from a 4a to a 1t designation because that part of the water body was compliant with the TMDL. In 2011, the County was informed that it was no longer required to implement the WQRP, but it must continue to implement six expanded and/or tailored BMP's, that were identified in the WQRP. These have been included in the Charlotte-Mecklenburg Storm Water Management Plan and implementation is ongoing.

As part of the Goose Creek TMDL (Section 4.5.3.), Mecklenburg County collects water quality samples, including fecal coliform, from Goose Creek at Steven's Mill Road, in Union County. In the most recent sample year, FY2013, sixteen samples were collected and analyzed for fecal coliform. Based on the results of these analyses, when compared with data collected during the last five years, fecal coliform concentrations for this reach of Goose Creek have remained essentially unchanged. As such, this reach of Goose Creek remains as a Category 4t stream as noted in the 2012 Integrated Report and 303(d) List.

Additionally, during FY2013, Mecklenburg County completed a specialized sampling effort in order to characterize fecal coliform distribution in five catchment areas of the Goose Creek watershed, for a variety of land covers, as well as during regular base flow and storm impacted events. Sampling results indicated that sediment is a primary source of elevated fecal coliform levels in Goose Creek. It was concluded that while enhanced erosion control measures required in Goose Creek were proving effective at controlling development related sediment run off, stream bed and bank stability were also a contributor elevated fecal coliform levels and that stream restoration projects are an effective tool for reducing this sediment source.

The specifics of the Plan are contained in North Carolina Administration Codes: 15A NCAC 2B .0600-.0609.

During the drafting of the Management Plan, the USFWS noted that they believed the management plan was insufficient to protect the Carolina heelsplitter, and does not allow for recovery of the species in the creek, as was stated as the purpose of the plan (USFWS 2008). Specifically, the USFWS stated that "the subject rules: (1) affect primarily only certain future development activities within the Goose Creek watershed, and, it is the Service's belief, are inadequate to prevent further decline of water quality and the Carolina heelsplitter from the effects of the future development activities subject to the rules; (2) fail to address the likely detrimental effects to water quality associated with numerous other potential future land use activities within the watershed; and, (3) do practically nothing to address the effects of existing landuse activities affecting water quality within the watershed which have contributed the decline of the Carolina heelsplitter within the Goose Creek watershed" (USFWS 2008).

4.5.3 Goose Creek TMDL

TMDLs were established for fecal coliforms in Goose Creek (MCWQP 2005). Fecal coliform load reductions of 92.5 percent would be required for water quality in Goose Creek to be considered no longer impaired and removed from the 303(d) list.

4.5.4 Summary of regulatory effects

4.5.4.1 Responsible entities for enforcement of Site Specific Water Quality Management Plan

In Union County, the NCDWR maintains enforcement of the Plan. Requests for variances to allow an activity not allowed by the Plan must be submitted to the NCDWR and eventually proposed to the Environmental Management Commission for approval.

Enforcement of the Plan in Mecklenburg County has been designated by the NCDWR to the Charlotte-Mecklenburg Stormwater Services. Requests for variances must proceed through Charlotte-Mecklenburg Stormwater Services to the Charlotte-Mecklenburg Storm Water Advisory Committee. If approved, it goes to NCDWR and the EMC for final approval.

4.5.4.2 Issuance of Variances to the Plan

According to Rusty Rozzelle with Charlotte-Mecklenburg Stormwater Services (personal communication August 1, 2013), since the implementation of the rule, no variances have been requested to use or develop riparian buffer areas within Goose Creek in Mecklenburg County. Likewise, according to Jennifer Burdette with the NCDWR (personal communication August 1, 2013), no variances have been requested to use or develop riparian buffer areas within Union County.

4.5.4.3 Removal of the Inter-basin Transfer Restrictions

On May 9, 2013, the March 14, 2002 ban on transferring water from the Catawba River Basin to the Goose Creek River Basin was eliminated, the effects of which are considered in the Environmental Assessment (EA) for the Addition of the Goose Creek Watershed to the IBT Certificate under the Provisions of G.S 143-215.22I (CH2M Hill 2013). The EA concludes that the direct, indirect, and secondary and cumulative impacts of removing the ban from the IBT Certificate on Goose Creek Watershed would be insignificant given the watershed mitigation measures that have been implemented by the Town of Mint Hill through its post construction ordinance.

To date, no transfers have taken place since the ban on inter-basin transfers was eliminated. Infrastructure is typically installed either via citizen requests for service through the City of Charlotte's Street Main policy or extensions by developers that are donated. The City of Charlotte did have one water line on Thompson Road that was incomplete, and there are plans to finish it, though no construction date has been set. There are no other plans for extensions by Charlotte-Mecklenburg Utility Department (Barry Shearin, City of Charlotte, personal communication, July 22, 2013 and July 24, 2013).

4.5.5 Sixmile Creek Subbasin (03050103)

Sixmile Creek arises in Mecklenburg County, approximately three miles west of Stallings, and flows in a general southwest direction for approximately 8.8 miles before entering Lancaster County, SC. The stream then flows approximately 10 miles before entering Twelvemile Creek near Hancock, SC, which in turn flows approximately six more miles before entering the Catawba River near Van Wyck, SC. Sixmile Creek and Twelvemile Creek are included in North Carolina Catawba River Subbasin 03-08-38 (NCDWQ 2010) and are located within Union and Mecklenburg Counties, NC. Sixmile Creek forms the boundary between these two counties for much of its course. The Sixmile Creek watershed drains the southeastern and southwestern portions of Mecklenburg and Union Counties, respectively, while Twelvemile Creek drains southwestern Union County (NCDWQ 2010). Both streams have very low flows during the summer months and may stop flowing during periods of drought (NCDWQ 2010).

The Sixmile Creek watershed has undergone a significant amount of economic development, including residential, commercial and office space has occurred along the US 521 corridor between I-485 in Mecklenburg County, NC and US 160 in Lancaster County, SC. Over the eight-year period between 1998 and 2006, developed land use increased by approximately 18 percent. Agricultural lands decreased by a total of 1,996 acres and forested lands decreased by 2,579 acres between 1998 and 2006 (Catena 2007b). The agricultural and forested lands were replaced with residential properties, industrial / commercial properties, and paved roads. The residential land use category increased by 4,017 acres and the industrial / commercial and paved

roads categories increased by 400 acres and 200 acres, respectively (Catena 2007b). High density residential areas increased by approximately 6.6 percent whereas moderate and low density residential areas increased by almost 5 and 3 percent, respectively from 1998 to 2006 (Catena 2007b). The TR (Baker 2013a) estimates that of the 1,600 acres of Sixmile Creek within the FLUSA, 66 percent was developed in 2010 and 83 percent will be developed in 2030.

4.5.6 Water Quality

4.5.6.1 Best Usage Classification

In North Carolina, Sixmile Creek is assigned a Best Usage Classification of C from its source to the NC/SC state line. The South Carolina portion of Sixmile Creek is contained within the Twelvemile Creek subbasin (classification 03050103-030). Water quality standards are assigned and assessed using basically similar methods to those described in North Carolina (SCDHEC 2005).

4.5.6.2 Impaired 303(d) Listing

Currently the 8.8-mile segment of Sixmile Creek from its headwaters to the South Carolina border is classified as "Impaired for Aquatic Life" due to Fair bioclassification (NCDWR 2012) (Figure 4). In the mid 1990's, the South Carolina portion of Sixmile Creek was place on the 303(d) list for several years. In the mid 1990's, zinc levels exceeded impairment thresholds and the creek was placed on the 303(d) list of impaired waters. By 2002, the zinc level was sufficiently reduced and the stream was fully supporting of aquatic life; however, the recreational use was not supported due to fecal coliform levels. Additionally, trends of decreasing DO, decreasing pH, increasing BOD, increasing turbidity, and increasing total phosphorus and total nitrogen were identified (SCDHEC 2005).

4.5.6.3 Nonpoint Source Pollution

Nonpoint source pollution, runoff that enters surface waters through stormwater or snowmelt, is identified as a major source of water quality degradation in this subbasin (NCDENR 2004, NCDENR 2008). Land development, construction activities, animal waste disposal, mining, forestry operations, agriculture, and impervious surfaces (urban runoff) are examples of land uses that contribute to NPS pollution. Many NPS management programs have been developed to control runoff with BMPs for stormwater management.

The naturally low flow of Sixmile Creek increases stream sensitivity to nonpoint source runoff (NCDENR 2004).

4.5.6.4 Point Source Pollution

Point source pollution includes discharges of pollutants directly to surface waters through a pipe, ditch, or other well-defined point of discharge. Point sources include municipal and industrial WWTPs, small domestic discharging treatment systems, and stormwater systems from municipal areas and industrial sites.

One major municipal NPDES facility was located on Sixmile Creek (NPDES Permit NC0066559/001). Between 1997 and 2003 in Union County, this site failed two effluent toxicity tests. Since that time, the NPDES point source has been removed from Sixmile Creek (NCDENR 2004). However, despite the removal of the NDPES point source, Sixmile Creek received the highest conductivity rating (185 µmhos/cm) of any stream in the basin during the 2004 sampling effort (NCDENR 2004), indicating the likely presence of pollutants such as chloride, phosphate, or nitrate.

4.5.6.5 Point Source and NPS Pollution Control

Stormwater management to control point and nonpoint source pollution is implemented by NCDWR under the NPDES stormwater permitting Phase II requirements [Session Law 2006-246]. These requirements are implemented in the Sixmile Creek watershed through the City of Charlotte's NPDES municipal separate storm sewer system (MS4) permit in Mecklenburg County and through the NCDWR's post-construction stormwater permitting in Union County and the Village of Marvin (NCDWQ 2009).

Projects that disturb an acre or more of land within Union County and the Village of Marvin are subject to NCDWR stormwater review under the post-construction stormwater permitting program (NCDWQ 2009). NCDWR requires that projects meet not only the post-construction requirements but also the more stringent buffer and stormwater requirements for the protection of the Carolina heelsplitter within the Sixmile Creek watershed, similar to the Goose Creek Site Specific Management Plan (Randall 2010, NCDWQ Stormwater, pers. comm.). These buffer requirements are only implemented when NCDWR receives a permit application, whether stormwater or Section 401 (Randall 2010, pers. comm.). The NCDWQ requires that permits in the Sixmile Creek watershed include post-construction requirements of 200 foot undisturbed riparian buffers on perennial streams, 100 foot riparian buffers on intermittent streams, and a ten percent impervious surface threshold for engineered stormwater controls (NCDWQ 2009).

4.5.6.6 Ecological Significance

The Sixmile Creek Subbasin supports several other rare aquatic species besides the Carolina heelsplitter. They are listed Table 8 along with their state and federal status.

Table 8. Rare Aquatic Species in Sixmile Creek Subbasin

Scientific Name	Common Name	NC Status	Federal Status	Species Type
Etheostoma collis collis	Carolina darter	SC	~	Fish
Lasmigona decorata	Carolina heelsplitter	E	E	Mussel
Strophitus undulatus	Creeper	T	~	Mussel
Villosa vaughaniana	Carolina creekshell	E	~	Mussel
Villosa delumbus	Eastern creekshell	SR	~	Mussel

E = Endangered, T = Threatened, SC = Special Concern, SR = Significantly Rare, ~ = no rating (NCNHP 2013)

5.0 ENVIRONMENTAL BASELINE – SCHWEINITZ'S SUNFLOWER

This section discusses the characteristics and current status of the Schweinitz's sunflower throughout its range and within the proposed action area. The USFWS issued a 5-Year Review of the Schweinitz's sunflower in 2010 (USFWS 2010a).

5.1 Species Description

A detailed description of characteristics, habitat requirements, legal status, and primary threats to the species are summarized below.

5.1.1 Designation (Legal Status)

Schweinitz's sunflower was listed as Endangered on May 7, 1991, under provisions of the Endangered Species Act of 1973 (as amended) (FR 56(88): 21087-21091) (USFWS 1991). Currently there is no critical habitat designated for Schweinitz's sunflower.

5.1.2 Characteristics

Schweinitz's sunflower is a rhizomatous perennial herb described from North Carolina by Torrey and Gray (1841) that grows 1 to 2 meters tall from a cluster of carrot-like tuberous roots (USFWS 1994, Radford et al. 1968). Stems are usually solitary, branching only at or above mid-stem, with the branches departing from the stem at about a 45-degree angle. The stem is usually pubescent but can be nearly glabrous and is often purple in color.

The leaves are opposite on the lower portion of the stem, changing to alternate above. In shape, the leaves are lanceolate, wider near their bases, but variable in size, being generally larger on the lower portion of the stem, and gradually reduced upwards. Lower stem leaves average 10 to

20 centimeters long and 1.5 to 2.5 centimeters wide (about 5 to 10 times as long as wide). Upper stem leaves (subtending branches of the inflorescence) average about 5 centimeters long and 1 centimeter wide. Leaf margins are entire with a few obscure serrations and are generally also somewhat revolute.

Texture of the leaves is rather thick and stiff and the pubescence of the leaves is distinctive. The upper surface of the leaves is rough, with the broad-based spinose hairs directed toward the tip of the leaf. The lower surface is more or less densely pubescent, with soft white hairs obscuring the leaf surface. From September to frost, Schweinitz's sunflower blooms with comparatively small heads of yellow flowers. The nutlets are 3.3 to 3.5 millimeters long and are glabrous with rounded tips. (NC-ES 2010, USFWS 1994)

The pubescence of the leaves is distinctive and is one of the best characteristics to distinguish Schweinitz's sunflower from its relatives. Additionally, the following characteristics separates Schweinitz's sunflower from all other eastern North American species in the genus: the heads are generally small (the involucre is less than 1 centimeter across), stems are generally sparsely strigose or hirsute below the inflorescence, the leaves are typically sessile to short-petiolate (petiole less than 1.5 centimeter long, very rarely to 3 cm long), scabrous above with dense soft white hairs below, lanceolate, and broadest near the base (USFWS 1994).

5.1.3 Distribution and Habitat Requirements

Schweinitz's sunflower is endemic to the Piedmont physiographic region of North and South Carolina. At the time of its listing in 1991, Schweinitz's sunflower was distributed across five counties in NC and one county in SC. As of 2006, the global range of Schweinitz's sunflower included more than 86 populations distributed across Anson, Cabarrus, Davidson, Gaston, Mecklenburg, Montgomery, Randolph, Richmond, Rowan, Stanly, Stokes, Surry, and Union Counties, NC, and Lancaster and York Counties, SC (Wells 2010, pers. comm.). There are currently 78 extant populations in NC and 8 extant populations in SC (USFWS 2010a), all known from the aforementioned counties.

Historically, it is believed that Schweinitz's sunflower occupied open prairie and Post Oak-Blackjack Oak Savannas that were maintained by relatively frequent fire (USFWS 1994). Current habitats include roadsides, periodically disturbed or maintained utility rights of way, old pastures, and sunny or semi-sunny woodland openings. While the plant occurs on a variety of soils, it is generally found on shallow, poor, clayey or rocky soils, especially those derived from mafic rock. Where Schweinitz's sunflower occurs in relatively natural areas, the natural community is considered a Xeric Hardpan Forest (Schafale and Weakley 1990).

NatureServe (2010) characterizes Schweinitz's sunflower habitat as "clearings in, and edges of, upland oak-pine-hickory woods and piedmont longleaf pine forests in moist to dryish sandy

loams." In addition, Schweinitz's sunflower requires the "full to partial sun of an open habitat, which was formerly maintained over the species' range by wildfires and grazing by herds of American bison (*Bison bison*) and elk (*Cervus canadensis*)" (NatureServe 2010). Now most occurrences are confined to roadsides and utility rights of way that are periodically maintained or disturbed and/or managed for the species.

5.1.4 General Threats to Species

Schweinitz's sunflower is endangered by the loss of historic levels of natural disturbance (i.e. fire, grazing by herbivores), development, mining and encroachment by exotic species (USFWS 1994). The species requires fire or other vegetation management to maintain an open canopy (NatureServe 2010). Primary threats to this species occur from direct habitat loss, degradation, and fragmentation due to residential, commercial, and industrial development, highway construction and improvement, and intensive maintenance of roadsides and utility rights of way (USFWS 1994).

5.1.5 Roadway-Related Threats to Species

Potential direct and indirect effects to plant species resulting from road construction projects were evaluated for this BA. These potential effects are discussed within their respective sections below.

5.1.5.1 Potential Direct Effects

Direct effects refer to consequences that can be directly attributed to a project. Direct effects associated with roadway projects include, but are not limited to, land clearing and loss, degradation, and/or modification of habitat in the project corridor, in fill/borrow/spoil areas, and in construction staging/access areas outside of the project corridor. Potential direct effects to plant species associated with transportation projects include habitat modification and/or destruction resulting from highway construction and improvement, utility relocation, and intensive maintenance of roadside and utility ROWs. Intensive maintenance includes herbicidal treatments, mowing, and ground disturbing activities, particularly during critical growth periods of the species.

5.1.5.2 Potential Indirect Effects

Indirect effects, together with the effects of other activities that are interrelated or interdependent with the action, have been evaluated in this assessment and TR. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur [50 CFR 402.02]. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification while interdependent actions are those that have no independent utility apart from the action under consideration [50 CFR 402.02]. These types of

indirect effects can include natural responses to the direct effects of the proposed action, or can include human-induced effects associated with the proposed action.

Potential indirect effects to plant species associated with transportation projects include the loss, degradation, destruction, fragmentation, or modification of habitat resulting from land conversion induced by roadway construction. Land conversion (changes in land use) includes residential, commercial, and industrial development as well as linear urban sprawl along the highway corridor or in the vicinity of interchanges. Also included as indirect effects are reasonably foreseeable local roadway improvements (e.g. widening) necessitated by increased traffic associated with the proposed action. These types of land use changes are not direct consequences of road construction, but rather a result of modifications in access to parcels of land and modifications in travel time between different areas (Mulligan and Horowitz 1986).

Economic development is often used as a criterion in highway funding (Eagle and Stephanedes 1987). Historically, transportation has been viewed as a necessary precursor to economic development (Anderson et al. 1992), and transportation infrastructure is "one of the principle policy levers that state and local governments can use to increase their attractiveness to business investors" (Forkenbrock 1990). Thus, planned or forecasted project-induced changes in land use are considered to be indirect effects of a proposed action.

Alternatively, depending on the extent of local land development regulations, development demand, and water/sewer availability, among other factors, roadway improvements may result in unintentional development and sprawl. These unintended land use changes are also project-induced and therefore are considered to be indirect effects of the proposed action. Improvements to levels of service, better accommodation of traffic, and reductions in travel times may encourage changes in land development outside of the direct project area. This induced growth and development with limited or no proper planning programs along with unchecked development controls, has the potential to degrade suitable habitat for endangered plant species as a result of a proposed action.

5.1.5.3 Potential Cumulative Effects

Cumulative effects are those effects of future state or private activities, not involving federal activities, which are reasonably certain to occur within the action area of the proposed federal action [50 CFR 402.02]. Cumulative effects within an action area may include foreseeable infrastructure projects independent of the federal action, such as water and sewer service expansion, which have the potential to stimulate land development and associated roadway improvements. Other small-scale adverse effects to plant species may also occur within the project action area. Though difficult to predict or quantify, other potential cumulative effects may also include mismanagement of the species or its habitat by private landowners (i.e. poor conservation maintenance or herbicide use), habitat degradation caused by traffic accidents

occurring within roadside populations, private harvesting of the species for medicinal or otherwise personal use, or habitat impairment caused by emergency repair efforts within utility ROW.

5.2 Presence in Action Area

In order to determine presence of the species within the Action Area, the NCNHP natural heritage database was searched for known populations, or Element Occurrences (EO), suitable habitat was evaluated, and presence/absence surveys were conducted. Species surveys were conducted within the project alignment and vicinity (ESI 2007, Atkins 2012).

The NCNHP identified six EO of Schweinitz's sunflower within the FLUSA (Figure 2) in July 2013 (NCNHP 2013). Table 9 summarizes the location within the project alignment, FLUSA, or Conservation Area.

Table 9. NCNHP Schweinitz's sunflower EO populations within Action Area (NCNHP 2013)

EO #	EO Rank*	Population	Status	Last Observed	Details/Comments
5	X	0 stems	Destroyed	Sep, 1957	No suitable habitat identified in 1982 and 1990. Presumed extirpated.
18	C	183 stems	Extant	Oct 21, 2008	North Fork Crooked Creek Site: Located within utility and roadway ROWs along south side Indian Trail-Fairview Road. Union Electric mows the utility ROW on a 5-yr rotation. NCDOT mows roadside ROW.
31	X	0 stems	Destroyed	July 31, 1995	In 1998, 210 stems transplanted to McDowell Prairie Site.
77	CD	192 stems	Extant	Oct 11, 2003	South Fork Crooked Creek Site: Located along roadside, southwest bank of Secrest Shortcut Road. "Do Not Mow" sign marks population.
78	D	62 stems	Extant	Nov 4, 2003	Bearskin Creek Site: Located along south side of Gold Mine Road within utility and NCDOT ROWs.
230	D	12 stems	Current	Sep, 2009	South Fork Crooked Creek, Secrest Shortcut Road West of Unionville-Indian Trail Road

* EO Rank description: X = extirpated; C = Fair estimated viability/ecological integrity; CD = Fair or poor estimated viability/ecological integrity; D = Poor estimated viability/ecological integrity

Atkins performed field survey within the footprint of the Monroe Bypass / Connector in 2012. The footprint was based upon the final design, including utility relocations, from the Design-Build team. Prior to performing the surveys, Atkins reviewed aerial photos of the affected area to identify suitable habitat, which consists of roadsides, utility right-of-ways, field edges, and other areas that receive abundant sunlight and are infrequently but regularly maintained. A total

of approximately 35 acres, or 13.5 miles of linear transects, were targeted for field surveys. Surveys were performed visually using systematic overlapping transects to cover suitable habitat areas. Atkins scientists visited the known locations of Schweinitz's sunflower along Secrest Shortcut Road to determine the local phenology of the species and to establish a search image. The Atkins surveys did not discover any previously unknown populations. The findings of the EO#77 and EO#230 are noted below. Atkins scientists visited a known location along Highway 601 just north of the project corridor, but did not find any plants (Atkins 2012). The report is appended (Appendix B).

EO# 77

EO# 77 is located on Secrest Shortcut Road (SR 1501) between Unionville-Indian Trail Road (SR 1367) and the crossing of the South Fork Crooked Creek near GPS location 35.0721ºN, -80.6097ºW (Figure 7). This roadside population was located in 2003 by Larry Thompson (NCDOT Div. 10) with a total count of 192 stems and a NCNHP element occurrence rank of CD (NCNHP 2013), all within either NCDOT ROW or Union Power ROW. This 2003 survey is the only survey event NCNHP currently has on record in their database (see Table 6 in Section 5.2).

NCDOT Division-level road improvements on Secrest Shortcut Road associated with a NCDOT "Moving Ahead" project led to subsequent monitoring of EO# 77. A total of 314 stems were counted by NCDOT, all of which were on the southwestern side of the road in 2004 (Frazer 2010, NCDOT-NEU, pers. comm.), earning it an NCNHP EO rank of B. Due to the proximity of the population to the roadway, NCDOT consulted USFWS regarding efforts to protect this population from a combination of impacts during the planned roadway resurfacing and shoulder widening (Buncick 2010a, pers. comm.; Thompson 2010a, NCDOT Div. 10, pers. comm.). As a result of the discussions with USFWS, in October 2006, NCDOT relocated a total of 418 plants from EO# 77 to the newly developed Cane Creek Park Piedmont Prairie Restoration Area (Cane Creek Park), a five acre conservation easement which serves as a permanent refuge for protected plant species (NCDOT et al. 2006, HARP 2009). NCDOT arranged the creation of the Cane Creek Park conservation/management area with Union County and provided the funds for initial site preparation, maintenance, and monitoring.

Although the EO# 77 population was transplanted from the southwestern bank of Secrest Shortcut Road to Cane Creek Park in October 2006 (HARP 2009), the species was able to re-colonize this area from either germination of remaining seeds, or by vegetative propagation from remaining underground rhizomes as was noted by ESI in the 2009 surveys, where they recorded 103 stems on the northern side and 31 stems on the southwestern side of Secrest Shortcut Road (Petitgout 2010b, pers. comm.). The 2012 Atkins surveys found three plants with six stems on the southwestern side of Secrest Shortcut Road and an estimated 17 plants with 60 stems on the northern side. The Atkins report notes that maintenance in the Union

Power ROW appears to be more regular and timed to ensure survival and increase of this population. The population is located entirely within existing NCDOT ROW and Union Power ROW.

EO# 230

EO# 230 is located on Secrest Shortcut Road (SR 1501), approximately 600 feet west of the intersection with Unionville-Indian Trail Road along the southern side of the road near GPS location 35.0759º N, -80.6136º W (Figure 7), and is located within existing NCDOT ROW. It was located by ESI in 2007, during surveys conducted for this project (ESI 2007) and was noted as a very small population (12 stems) that occurs primarily between the roadside swale and the power line adjacent to Secrest Shortcut Road (Petitgout 2010b, pers. comm.). This population was referred to as ESI 1 in previous NEPA documents for this project. The 2012 Atkins surveys found four plants with eight stems.

5.2.1 FLUSA

In addition to the two aforementioned occurrences of Schweinitz's sunflower in the Project Alignment, a review of NCNHP (2013) database records indicated an additional four EOs in the FLUSA. Two of the four EOs are extant populations (EO# 18, EO# 78), one population has been relocated and is now considered destroyed (EO #31), and one was last noted in 1957 and no longer has suitable habitat, so is also considered destroyed (EO# 5).

EO# 18

EO# 18 is the most northern population in the FLUSA and is referred to as the "North Fork Crooked Creek Sunflower Site" by NCNHP. It is located mostly along the southern side of Indian Trail-Fairview Road (SR 1520) approximately halfway between Rocky River Road (SR 1514) and Cunningham Lane (SR 1526) near GPS location 35.1014º N, -80.5985º W. A total of 183 plants were last observed within the utility easement on October 21, 2008 during a survey conducted by J. R. Siler, of Environmental Resources of the Carolinas (NCNHP 2013). This population has a current element occurrence rating of C. Union Power (2010) mows and/or hand clears the utility line ROW as needed, per their agreement with USFWS regarding access to Schweinitz's sunflower restricted sites.

EO# 78

EO#78 is the most southern population within the FLUSA and is referred to as the "Bearskin Creek Sunflower Site" by NCNHP. It is located along the south side of Gold Mine Road (SR 1162) near GPS location 35.1184º N, -80.7790º W (NCNHP 2013). According to NCNHP (2013), the most recent survey was conducted by Larry Thompson (NCDOT Div. 10) on

November 4, 2003. A total of 62 stems were observed mostly on the back side of a ditch maintained by the NCDOT; however, some plants are also within Union Power's right-of-way. This population has an element occurrence rating of D. As a management commitment, NCDOT installed "Do Not Mow" signs marking the boundaries of the population and Union Power was notified of the population within their right-of-way (NCNHP 2013, Union Power 2010).

EO# 31

EO# 31 is located along the western end of the FLUSA and is referred to as the "Rea Road Sunflower Site" by NCNHP. This EO is located along NC 16, approximately 0.05 mile north of the intersection with Rea Road (SR 3624). According to NCNHP (2013), this population was reported by NCDOT as having been sprayed with herbicide in September 1993. NCNHP's (2010) current status for this population is "destroyed" since the population (210 stems) was transplanted to McDowell Prairie in 1998. This population was recognized as extirpated in 2005 (NCNHP 2013), and as such, will not be further discussed in the effects section of this report.

EO# 5

EO#5 is located in the central portion of the FLUSA, just west of US 601, south of its intersection with Sikes Mill Road (SR 1001) and north of the US 601 crossing of Stumplick Branch. It was originally located in 1957 by H. E. Ahles; however, additional surveys by Matthews and Creel in 1982 and Weakley in 1990 failed to confirm an extant population. NCNHP (2013) considers this an extirpated population and as such, this population will not be further discussed in the effects section of this report.

5.2.2 Conservation Areas

Proposed conservation areas do not occur outside of the alignment or the FLUSA. Conservation measures for Schweinitz's sunflower are discussed in Section 9.5.

6.0 ENVIRONMENTAL BASELINE – MICHAUX'S SUMAC

This section discusses the characteristics and current status of the Michaux's sumac throughout its range and within the proposed action area. Most of the following text references data from the draft 5-year status review, obtained through personal communication with Mr. Dale Suiter, USFWS, in addition to the 1993 USFWS Recovery Plan for Michaux's sumac.

6.1 Species Description

A detailed description of characteristics and habitat requirements, as well as the legal status for Michaux's sumac is provided below. In addition, primary threats to the species are also summarized below.

6.1.1 Designation (Legal Status)

Michaux's sumac was listed as Endangered on September 28, 1989, under provisions of the Endangered Species Act of 1973 (as amended) (FR 54(187): 39853-39857) (USFWS 1989). Currently there is no critical habitat designated for Michaux's sumac.

6.1.2 Characteristics

Michaux's sumac is a rhizomatous shrub that grows 0.2 to 1.0 meter in height. Although it is usually dioecious, monoecious individuals have been reported in some populations (USFWS 1993b). The entire plant is densely pubescent. The narrowly winged or wingless rachis supports 9 to 13 sessile, oblong to oblong-lanceolate leaflets that are each four to nine centimeters long, two to five centimeters wide, and acute to acuminate (USFWS 1993b, NatureServe 2010). The bases of the leaflets are rounded, and their edges are simply or doubly serrate. Flowering occurs in June and the small flowers are borne in a terminal, erect, dense cluster, with each one being four- to five-parted and greenish-yellow to white (USFWS 1993b). The fruit is a red, densely short-pubescent drupe, five to six millimeters broad, and is visible on female plants from August to October (USFWS 1993b). Michaux's sumac can generally be distinguished from other species in the genus due to its small stature, dense pubescence, and evenly serrate leaflets. Michaux's sumac, also called false poison sumac, is quite harmless compared to poison sumacs of superficial resemblance.

Little information is available on the population biology and reproductive requirements of Michaux's sumac. Most of the surviving populations appear to contain plants of only one sex and therefore reproduce only vegetatively, if at all (USFWS 1993b). Due to the rhizomatous nature of the species, this may mean that the single-sex populations may be clones of one or a few individuals. Limited genetic variation within populations may also contribute to the observed low rates of seed production and seed viability has been shown to be extremely low (Suiter 2010a, pers. comm.).

6.1.3 Distribution and Habitat Requirements

Michaux's sumac was originally described from "Mecklenburg County, North Carolina" as *Rhus pumula* by André Michaux in 1803, but later changed to *R. michauxii* by Sargent in 1895, to correct Michaux's use of a homonym (pullus) and to honor its discoverer (Barden and Matthews 2004). Historically, Michaux's sumac has been documented in Davie, Durham, Franklin, Hoke, Johnston, Lincoln, Mecklenburg, Moore, Orange, Richmond, Robeson, Scotland, Wake, and Wilson Counties in North Carolina; Florence, Kershaw, and Oconee Counties in South Carolina; Columbia, Elbert, Gwinnett, Muscogee, Newton, and Rabun Counties in Georgia; and Alachua County, Florida (USFWS 1993b). Many of these populations have been extirpated. As of 2009, there are 40 populations range-wide (Suiter 2010a, pers. comm.). The NCNHP currently lists 32 extant populations in NC known from Cumberland, Davie, Durham, Franklin, Hoke, Moore, Nash, Richmond, Robeson, Scotland, Union, and Wake Counties (NCNHP 2013). Four extant occurrences are known in Georgia and four extant occurrences are known in Virginia (Suiter 2010a, pers. comm.). All previously known populations in South Carolina and Florida are currently considered extinct (Suiter 2010a, pers. comm.; Holling 2012, pers. comm.).

Michaux's sumac grows in sandy or rocky open woods on sandy or sandy loam soils with low cation exchange capacities and appears to depend upon some form of disturbance to maintain the open quality of its habitat (USFWS 1993b, Suiter 2010a, pers. comm.). Michaux's sumac can occur on circumneutral soils, loamy swales, or on clayey soils derived from mafic rocks, depending on the physiographic province where it occurs (NatureServe 2010). Most extant populations can be found on open disturbed areas, such as railroad, road, and utility rights-of-way that are periodically maintained and/or managed for the species.

Not much is known about the population dynamics of Michaux's sumac. Fire or some other forms of disturbance, such as mowing or hand clearing (outside the normal flowering and fruiting time), appears to be essential for maintaining the open habitat preferred by Michaux's sumac (USFWS 1993b). Without periodic disturbance, this type of habitat is overgrown by woody vegetation. As this overgrowth occurs, Michaux's sumac begins to decline due to its intolerance of shade. The current distribution of Michaux's sumac demonstrates its dependence on disturbance. Of the remaining populations, most are located in areas that receive significant disturbance through periodic clearing or maintenance by fire.

6.1.4 General Threats to Species

Michaux's sumac is threatened by fire suppression and ecological succession (competition/shading by woody species) that occurs in areas not burned on a regular basis (Suiter 2010a, pers. comm.). Additionally, forested populations are threatened by timber and utility rights of way populations are threatened by herbicide use, ground disturbing activities, and mowing during critical growth periods (Suiter 2010a, pers. comm.). Multiple observations also

suggest that limited seed production continues to be a problem at most populations (Suiter 2010a, pers. comm.).

The greatest threat to Michaux's sumac comes from the loss/degradation or modification of habitat from activities such as development (residential, commercial, or industrial), highway construction and improvement, and intensive and/or untimely maintenance of existing utility and roadside rights of way (USFWS 1993b). Other threats include low genetic diversity within the existing populations and hybridization with other species of Rhus.

6.1.5 Roadway-Related Threats to Species

A number of potential direct and indirect effects to plant species resulting from road construction projects were evaluated for this BA. These potential effects are discussed in Section 5.1.5 for Schweinitz's sunflower, and are applicable to Michaux's sumac as well.

6.2 Presence in Action Area

A review of NCNHP (2013) database records indicated one known occurrence (EO# 40) of Michaux's sumac within the FLUSA and none in the Conservation Areas (Figure 6)

EO# 40

EO# 40 is actually the type locality of Michaux's sumac, as André Michaux discovered it here on July 21, 1794 (Barden and Matthews 2004). This site is located along the southwestern portion of the FLUSA, "probably…no more than a mile or two north of New Town Road (SR 1315), probably along Providence Road (NC 16) or Antioch Church Road (SR 1338)" (Barden and Matthews 2004). Although Michaux described the type locality as Mecklenburg County, this location is now in Union County, which was formed in 1842 from portions of Mecklenburg County and Anson County. As such, the type locality for this species occurs in Union County (Barden and Matthews 2004). The EO is mapped by NCNHP as an area rather than an exact location due to difficulty in determining the exact location of the population based on the original survey (Buchanan 2010a, pers. comm.). Barden and Matthews (2004) spent two days searching along Michaux's route for the population, but did not find the species as little suitable habitat remains. NCNHP (2013) currently ranks this population as "historical", which indicates a lack of recent field information verifying the existence of the EO; this EO is based only on historical collections data.

Surveys for federally threatened and endangered plant species were conducted by ESI within the project study area (PSA). At the time of the surveys in 2007, the PSA included several detailed study alternatives and was therefore much larger than the final selected alternative, but much

smaller than the FLUSA (Figure 8). Survey methodologies and results are included in a Nov. 15, 2007 Endangered Plant Survey Update letter (ESI 2007).

Atkins (2012) performed updated field survey within the final footprint of the Monroe Bypass / Connector in 2012. Prior to performing the surveys, Atkins reviewed aerial photos of the affected area to identify suitable habitat, which consists of roadsides, utility right-of-ways, field edges, and other areas that receive abundant sunlight and are infrequently but regularly maintained. A total of approximately 35 acres, or 13.5 miles of linear transects, were targeted for field surveys. Surveys were performed visually using systematic overlapping transects to cover suitable habitat areas. No Michaux's sumac populations were identified during the 2012 field surveys.

Based on the results of these surveys and the NCNHP natural heritage database search, there are no known documented occurrences of Michaux's sumac within the proposed project alignment.

7.0 ENVIRONMENTAL BASELINE – SMOOTH CONEFLOWER

This section discusses the characteristics and current status of the smooth coneflower throughout its range and within the proposed action area. Most of the following text references data from the 5-year status review (USFWS 2010b), in addition to the 1995 USFWS Recovery Plan for smooth coneflower.

7.1 Species Description

A detailed description of characteristics, habitat requirements, legal status, and primary threats to the species are summarized below.

7.1.1 Designation (Legal Status)

Smooth coneflower was federally listed as endangered on October 8, 1992, under provisions of the Endangered Species Act of 1973 (as amended) (FR 57(196):46340-46344) (USFWS 1992c). Currently there is no critical habitat designated for smooth coneflower.

7.1.2 Characteristics

Smooth coneflower was described from material collected in South Carolina by Boynton and Beadle (1903). It is a rhizomatus perennial herb that grows up to 1.5 meters tall from a vertical root stock, and the stems are typically smooth, with few leaves (USFWS 1995). The largest leaves are the basal leaves, reaching 20 cm long and 7.5 cm wide, with long petioles, an elliptical to broadly lanceolate shape, tapering to the base. Texture of the basal leaves is smooth to slightly rough. The midstem leaves, if present, have shorter petioles and are smaller than the basal leaves. Flower heads are usually solitary, consisting of light pink to purplish ray flowers,

usually drooping at a length of 5 to 8 cm (USFWS 1995). Disk flowers are approximately 5 mm long and have tubular purple corollas and with generally erect, short, triangular teeth (USFWS 1995, NatureServe 2010).

Information is limited on the life history and species biology of smooth coneflower. Flowering occurs from May through July, and fruits develop from late June to September (USFWS 1995). The fruit is a gray-brown, oblong-prismatic achene, usually four-angled, and 4 to 4.5 mm long (USFWS 1995). Seeds are 0.5 cm long. Reproduction is generally only by sexual means; however, vegetative reproduction has been reported from some of the southern National Forest populations (USFWS 1995).

The smooth coneflower can be distinguished from its most similar relative, the purple coneflower (*Echinacea purpurea*), by its leaves (USFWS 1995). Smooth coneflower leaves are never cordate (heart-shaped) like those of the purple coneflower. In addition, the chaffy scales at the base of the fruit in the smooth coneflower are incurved, while those of the purple coneflower are straight. The vertical rootstock of smooth coneflower also distinguishes itself from purple coneflower, which typically has a horizontal rootstock (USFWS 1995).

7.1.3 Distribution and Habitat Requirements

Smooth coneflower is endemic to the Piedmont or Mountain physiographic provinces. At the time of its listing in 1995, 24 known populations of smooth coneflower was distributed across Virginia, North Carolina, South Carolina, and Georgia (USFWS 1995). Currently there are 11 extant populations in Georgia, eight in North Carolina, 16 in Virginia (USFWS 2010b), and 34 in South Carolina (Holling 2012). Extant populations of Smooth Coneflower in the Carolinas are located in Durham, Granville, and Mecklenburg Counties, North Carolina (Buchanan 2010b, pers. comm.) and Allendale, Anderson, Barnwell, Oconee, Pickens, and Richland Counties, South Carolina (Holling 2012, pers. comm.).

Smooth coneflower populations naturally occur in xeric hardpan forests and diabase glades natural communities in North Carolina (as described by Schafale and Weakley 1990), in dolomite woodlands or glades natural communities in Virginia (as described by Rawinski 1994) (USFWS 1995) and in distinct physiographic provinces / habitats in open woodlands over marble, sandy loams, chert, and amphibolites in South Carolina (USFWS 2010b). Smooth coneflower is typically found in open woods, cedar barrens, roadsides, clear cuts, dry limestone bluffs, and periodically maintained utility ROWs (USFWS 1995, 2010b). The species is usually found on soils rich in magnesium and/or calcium, associated with amphibolite, dolomite, or limestone, gabbro, diabase, and marble (USFWS 1995).

Optimal sites for smooth coneflower include areas with abundant sunlight and little competition in the herbaceous layer, with periodic disturbance (historically by natural fires and large herbivores) to reduce the shade and competition of woody plants (USFWS 1995).

7.1.4 General Threats to Species

Smooth coneflower is threatened range-wide by the suppression of fire and ecological succession (competition/shading by woody species) that occurs in areas not burned on a regular basis (USFWS 1995, 2010b). Additional threats include timber operations as well as intensive maintenance of utility ROW populations (herbicide use and/or mowing during critical growth periods). Also a threat to this species, but to a lesser degree, is habitat modification and/or destruction resulting from land conversion or highway construction and residential, commercial, and industrial development (USFWS 2010b).

7.1.5 Roadway-Related Threats to Species

A number of potential direct and indirect effects to plant species resulting from road construction projects were evaluated for this BA. These potential effects are discussed in Section 5.1.5 for Schweinitz's sunflower, and are applicable to smooth coneflower as well.

7.2 Presence in Action Area

A review of NCNHP (2013) natural heritage database indicated no documented occurrences of Smooth coneflower within the FLUSA or Conservation Areas. Plant surveys conducted by Environmental Services, Inc. (ESI) within what was termed the PSA or "project study area" in 2007 did not find locate any species. Survey methodologies and results are included in a Nov. 15, 2007 Endangered Plant Survey Update letter (ESI 2007). The footprint of the Monroe Bypass / Connector is entirely within Union County. Since smooth coneflower is only listed for Mecklenburg County, it was not included in the Atkins 2012 field surveys (Atkins 2012). Based on the results of this survey and the NCNHP natural heritage database search, there are no known documented occurrences of smooth coneflower within the proposed project alignment.

8.0 EFFECTS OF PROPOSED ACTION– CAROLINA HEELSPLITTER AND CRITICAL HABITAT

Potential effects to the freshwater mussels (i.e. Carolina heelsplitter) and mussel habitat discussed in Sections 4.1 and 4.3 were thoroughly evaluated with regard to this project. In order to determine the project effects on the Carolina heelsplitter and its designated Critical Habitat, effects with and without the proposed project (Build vs. No-Build scenarios) were evaluated.

8.1 Direct Effects

Based on mussel survey data and habitat evaluations, the Carolina heelsplitter does not occur in any of the waterbodies within the project corridor of the proposed action. However, because of the proximity to the project corridor, the contractor may use areas within the Goose Creek and Sixmile Creek watersheds for staging, storage, refueling, borrow pit or spoil areas. Although buffer areas of intermittent or perennial streams within these watersheds would be excluded from being used for borrow/spoil per the Goose Creek Watershed Site Specific Management Plan and the similar post construction ordinance requirements for the Sixmile Creek watershed, borrow/spoil areas outside of the buffers still have the potential to affect water quality and in turn the Carolina heelsplitter through sedimentation, erosion, and introduction of toxic compounds into streams via storm-water channels, ditches, and overland runoff or through losses during the hauling process. The potential for these effects to occur can be eliminated, or minimized by developing measures to control sedimentation, erosion and introduction of toxic compounds from entering streams in these areas.

The NCDOT will strongly discourage the contractor from choosing location of borrow sites, staging areas, equipment storage areas, and refueling areas within Goose Creek or Sixmile Creek watersheds in association with this project. Such a decision will have to be substantiated with documentation as to why there aren't other reasonable options. As such, the likelihood of the contractor choosing such a site is remote. However, if it is decided that such a site is ultimately the best way to move the project forward, the NCDOT Division Environmental Officer will coordinate with the NCTA, USFWS, and the contractor to develop BMPs for each site to avoid/minimize the potential for adverse effects.

8.2 Indirect Effects

Potential project related indirect effects to the Carolina heelsplitter and Critical Habitat, which are assessed at a detailed, Goose and Sixmile Creek watersheds scale in Section 6.0 of the TR, are induced land development and changes in traffic patterns.

8.2.1 Induced Land Development

As discussed in Section 4.3, roadway construction can influence land use and result in development that would not occur without the road (induced development). While land development itself does not affect freshwater mussels and their habitat, increases in sediment loads and certain pollutants, alterations in flow regime (base flow and peak discharge) and loss of riparian buffers are consequences of development that lead to water quality degradation. How these consequences of land development affect water quality and ultimately freshwater mussels is discussed in Sections 4.1.4 and 4.1.5 of this report.

The indirect induced land use development effects of project construction on the Carolina heelsplitter and its Critical Habitat was evaluated in Section 6.0 of the TR. Three land use scenarios were considered, Updated Baseline 2010, Updated 2030 No-Build, and Updated 2030 Build. The results are provided in Tables 10 and 11.

Table 10: Updated Land Use Scenario Results, Sixmile Creek Watershed

Land Use	Updated Baseline (2010)		Updated 2030 No-Build			Updated 2030 Build		
	Total Area (acres)	% of Total Area	Total Area (acres)	% of Total Area	Change in % from Baseline	Total Area (acres)	% of Total Area	Change in % from No-Build
Total Residential	900	52%	1,100	69%	17%	1,100	69%	0%
Low Density	*200*	*13%*	*300*	*16%*	*3%*	*300*	*16%*	*0%*
Medium Density	*600*	*37%*	*700*	*44%*	*8%*	*700*	*44%*	*0%*
High Density	*0*	*3%*	*100*	*9%*	*6%*	*100*	*9%*	*0%*
Commercial	0	0%	0	1%	1%	0	1%	0%
Industrial/Office/Institutional	0	2%	0	2%	0%	0	2%	0%
Transportation	200	12%	200	12%	0%	200	12%	0%
Total Developed	**1,100**	**66%**	**1,400**	**83%**	**17%**	**1,400**	**83%**	**0%**
Total Agricultural	**100**	**7%**	**100**	**4%**	**-3%**	**100**	**4%**	**0%**
Total Forested	**400**	**27%**	**200**	**13%**	**-14%**	**200**	**13%**	**0%**
Total Other	**0**	**0%**	**0**	**0%**	**0%**	**0**	**0%**	**0%**
TOTAL	**1,600**	**100%**	**1,600**	**100%**	**0%**	**1,600**	**100%**	**0%**

Notes: Results have been rounded to the nearest 100 acres and whole percent. Differences were calculated prior to rounding. Totals may appear not to equal the sum of the parts because of rounding.

Table 11: Updated Land Use Scenario Results, Goose Creek Watershed

Land Use	Updated Baseline (2010)		Updated 2030 No-Build			Updated 2030 Build		
	Total Area (acres)	% of Total Area	Total Area (acres)	% of Total Area	Change in % from Baseline	Total Area (acres)	% of Total Area	Change in % from No-Build
Total Residential	10,600	39%	13,900	51%	12%	13,900	51%	0%
Low Density	*10,400*	*39%*	*13,100*	*48%*	*10%*	*13,100*	*48%*	*0%*
Medium Density	*100*	*1%*	*800*	*3%*	*2%*	*800*	*3%*	*0%*
High Density	*0*	*0%*	*0*	*0%*	*0%*	*0*	*0%*	*0%*
Commercial	0	0%	600	2%	2%	600	2%	0%
Industrial/Office/Institutional	100	0%	100	1%	0%	100	1%	0%
Transportation	1,400	5%	1,400	5%	0%	1,400	5%	0%
Total Developed	**12,100**	**45%**	**16,100**	**59%**	**15%**	**16,100**	**59%**	**0%**
Total Agricultural	**5,800**	**21%**	**4,400**	**16%**	**-5%**	**4,400**	**16%**	**0%**
Total Forested	**9,100**	**34%**	**6,500**	**24%**	**-9%**	**6,500**	**24%**	**0%**
Total Other	**100**	**0%**	**100**	**0%**	**0%**	**100**	**0%**	**0%**
TOTAL	**27,000**	**100%**	**27,000**	**100%**	**0%**	**27,000**	**100%**	**0%**

Notes: Results have been rounded to the nearest 100 acres and whole percent. Differences were calculated prior to rounding. Totals may appear not to equal the sum of the parts because of rounding.

Figure 9A depicts changes in land use projected to occur under the No-Build scenario as compared to the current Baseline condition in both watersheds which Figure 10A illustrates changes in land use from the No-Build to Build scenario. As noted, there are no projected changes in land use in either the Sixmile or Goose Creek Watersheds.

Methodology and results of the land use and impervious surface estimation are detailed in the ICE Report (Baker Engineering 2013b). The land use forecasts were developed using recommended methods as described in NCDOT and FHWA ICE Guidance, and are based on the Socioeconomic Forecasts developed by MUMPO. The quantities of projected development and associated levels of imperviousness rely on assumptions about development density and associated assumptions noted in Section 5.0 of the ICE Report. The accuracy and certainty of the results of the analyses are also noted throughout the ICE Report. Throughout the report, Baker Engineering (2013b) notes where choices in methodology were necessary, the path chosen led to results that would be conservatively high, rather than potentially underestimating effects.

8.2.1.1 Impervious Surface Area

The TR (Section 6.4) indicates continued development will occur throughout the FLUSA, which is expected to result in subsequent increases in percentage of impervious surface area in both Goose Creek and Sixmile Creek watersheds. Current levels of imperviousness in the Goose Creek and Sixmile Creek watersheds are 13 percent and 25 percent, respectively (Table 18 in TR), which far exceed the NCWRC recommendations (NCWRC 2003) of 6 percent for management of sensitive aquatic species. The amount of imperviousness is expected to continue increasing, with levels of 18 percent and 31 percent for Goose Creek and Sixmile Creek, respectively, projected for year 2030 No-Build (Table 18 in TR), which will significantly affect the continued viability of these populations. However, these changes are independent of the project as there are no measurable changes in the level of imperviousness between Build and No-Build scenarios (Table 21 in TR).

8.2.1.2 Water Quality Parameters

A Water Quality Assessment was completed for this project by PBS&J in 2010 (2010b). The Water Quality Assessment was based on the results of predicted change in land use documented in the Quantitative ICE completed in 2010. The 2013 TR predicted impervious surface results that are essentially the same as the 2010 Quantitative ICE (Baker Engineering 2010) results. The model calibration completed for the 2010 Water Quality Assessment (PBS&J 2010b) used the Nash-Sutcliffe coefficient, as recommended by the American Society of Civil Engineers, to evaluate the correlation between modeled and observed stream flows. The analysis at both the calibration stage and at the validation stage both returned a 0.78, which indicated a very good fit. Therefore, since the predicted land use results have changed very little, and are well within the typical variability of hydrological modeling, any new water quality modeling would be highly

unlikely to show any differences from the prior results. As such, no additional water quality was performed for this project.

The 2010 Water Quality Assessment incorporated two models (GWLF-E and RUNQUAL-E) to appropriately reflect the conditions of the watersheds (rural and urban). Both GWLF-E and RUNQUAL-E were used to model streamflow, runoff, and pollutant loading (N, P, TSS, and fecal coliform) in the Study Area. GWLF-E was employed in rural sub-catchments of the Study Area, while RUNQUAL-E was used in urban subcatchments (PBS&J 2010b).

The Water Quality Assessment analysis was performed by constructing watershed models for portions of eighteen 14-digit hydrologic units composing the FLUSA using the ArcView Generalized Watershed Loading Functions (AVGWLF) modeling suite (PBS&J 2010b). Model estimates of annual streamflow, runoff, and annual overland pollutant loadings of total nitrogen, total phosphorus, total suspended sediment, and fecal coliform loads produced from three land use scenarios – Baseline Condition, 2030 No Build, and 2030 Build – were analyzed to assess the project effects (PBS&J 2010b). Specifically, model results of the No Build and the Build scenarios compared differences in streamflow and pollutant loadings attributable to the project.

While the results of the Water Quality Assessment indicate an overall continued degradation of water quality in the Goose Creek and Sixmile Creek watersheds, there are no projected differences between Build vs. No-Build scenarios in year 2030 for annual streamflow (water quantity), runoff, total phosphorus, total nitrogen, total suspended sediment, annual total fecal coliform, and mean fecal coliform (Tables 15-21 in PBS&J 2010b). While the pollutant loadings modeled in this analysis do not include all of the pollutants that were discussed in Section 4.1.4.2, such as copper, chlorine, etc., the sources of these contaminants, like the ones that were modeled, are largely anthropogenic and are reflective of land use. Parameters and indicators used in the models were discussed with the regulatory agencies at various TEAC meetings (see Section 1.2 of this report). Furthermore, sedimentation and runoff as well as point source discharges are the most common pathways for these other pollutants to enter surface waters; therefore, as discussed above, since there are no projected differences with regard to runoff and sediment load (Tables 16 and 19 in PBS&J 2010b), or development patterns (Tables 10 and 11) within the Goose Creek and Sixmile Creek watersheds, there would be no projected differences of loadings of these other pollutants Build vs. No-Build.

The results of the Water Quality Assessment (PBS&J 2010b) reflect those of the TR, which also concluded no differences in Build vs. No-Build scenarios with regard to development patterns and impervious surface area in the Goose Creek and Sixmile Creek watersheds. Similarly, the watersheds that have projected increases in streamflow, runoff, and pollutant loadings (Crooked, Richardson-Middle, Rays Fork, Stewarts, Richardson-Lower, and Salem Creeks) (Section 5.0 in PBS&J 2010b), are those where project-induced development and increases in impervious surface area are also projected (Table 21 in Baker Engineering 2013b).

It is important to note that in the construction of the water quality model, the only stormwater BMP considered was riparian buffers. Site specific BMPs (e.g. stormwater ponds, bioretention basins, etc.) were not accounted for in the modeling. Therefore, in reality reductions in pollutant loadings and runoff discharges will be realized in areas with treated stormwater.

8.2.2 Changes in Traffic Patterns

The forecasted traffic levels indicate that the induced growth impacts of the proposed project will add to the total volume of traffic in Union County and to the total vehicle miles traveled and vehicle hours traveled. Roads that connect to the Monroe Connector/Bypass (referred to as Y-lines in design plans) will likely see some increases in traffic, mostly in the immediate vicinity of interchanges. Since most of the additional development in a Build Scenario is expected in the eastern portions of the study area, the additional volumes mostly fall on roadways east of US 601 and outside the Goose Creek and Sixmile Creek watersheds. As detailed below, there are no project increases in traffic volumes on US 601 in the Goose and Sixmile creek watersheds. Therefore, there are no projected increases in traffic volumes associated with induced development in the Goose Creek and Sixmile Creek watersheds.

8.2.2.1 Changes in Traffic Patterns to US 601

There are plans to widen US-601 south of the Monroe Connector/Bypass. While traffic throughout Union County is projected to increase through the design year of the project, widening of the sections of US 601 north of Ridge Road are not included in the constrained long-range transportation plan for MUMPO. The proposal to widen the section between Ridge Road and Lawyers Road was considered in the 2035 MUMPO Long Range Transportation Plan, but the project is ranked 261 out of 307 projects considered and was left unfunded. The widening south of the bypass has been incorporated into the ICE Report. US 601 north of the Monroe Bypass to the Union/Cabarrus Line includes the areas that cross Stewarts Creek, Crooked Creek and Goose Creek watersheds. Since the indirect and cumulative land use results show no increase in development along US 601 north of Stewarts Creek, one would not expect to see any substantial increase in traffic volume along the US 601 corridor north of Stewarts Creek. It is more likely that for the segments of US 601 north of Stewarts Creek, traffic volumes would decrease in a Build Scenario relative to a No-Build Scenario due to through trips diverting off of NC 218 and US 601 to the Monroe Connector/Bypass for longer distance travel between counties or across the region.

In an effort to further evaluate any potential traffic effects to US 601, raw traffic model data was analyzed under No-Build and Build Scenarios to determine whether the proposed project might affect the likelihood that US 601 will require widening in the future in Section 6.7 of the TR

(Baker Engineering 2010a). In the Build Scenario with the induced development included, traffic volumes are expected to mostly decrease to between 5,300 and 13,000 vehicles per day (VPD). The only segment that increases compared to the No-Build Scenario north of Ridge Road is the segment between Ridge Road and Sykes Mill road, where volumes would increase by approximately 2 percent or 300 VPD. All other segments decrease in volume between 3 to 13 percent (300 to 1,200 VPD) (Map 23 in the TR). Since the Build Scenario is likely to see a reduction, overall, in volumes north or Ridge Road, the proposed project would be unlikely to increase the need to widen US 601 north of Ridge Road. Furthermore, for a rural two-lane road, the projected traffic volumes are below the Annual Average Daily Traffic (AADT) threshold of 15,000 (+/- 5,000) at which widening might be recommended. Therefore, there is no expectation that the traffic impacts associated with induced development from the Monroe Connector/Bypass would necessitate any improvements to US-601 north of Ridge Road.

8.2.3 Summary of Indirect Effects

As discussed above, both the TR and Water Quality Assessment analyses forecast continued degradation in the Goose Creek and Sixmile Creek watersheds. However, both of these studies also indicate that this degradation will occur with or without the project, and are thus not indirect effects of the project action. While the anticipated decrease in truck traffic through the Goose Creek watershed as a result of the project could be considered a beneficial effect as it will likely reduce the amount of roadway pollutants entering the stream, and lessen the likelihood of toxic spills, given the level of non-project related future development and water quality degradation that is forecast in the watershed, any indirect benefits will be minor to insignificant.

8.3 Cumulative Effects

Although the cumulative effects definition under ESA differs from that under NEPA, the cumulative analysis was performed using the NEPA definition. Therefore, the potential cumulative effects discussed in this BA, as defined per ESA, may be somewhat overestimated since the TR included the effects of future federal actions *as well as* non-federal actions.

Future state and private activities, including federal actions, are reasonably certain to occur within the Goose Creek and Sixmile Creek watersheds (Baker Engineering 2013b) that will continue to impact the Carolina heelsplitter. However, as indicated above, these effects are expected to occur with or without (Build vs. No-Build) the proposed action.

It should be noted that communities in the Goose and Sixmile Creek watersheds have developed regulations to reduce the cumulative effect of development on water quality in these sensitive watersheds. These regulations include the Site Specific Water Quality Management Plan for the Goose Creek Watershed, the Goose Creek Water Quality Recovery Program Plan for the Fecal Coliform TMDL, and Charlotte-Mecklenburg Water Quality Buffer Implementation Guidelines.

While the effectiveness of these plans has been questioned by USFWS (Section 4.5.2.7), it nonetheless provides more stringent restrictions to development than what would otherwise be enforced.

8.4 Conclusions of Effects – Carolina Heelsplitter

While it is documented that both the Goose Creek and Sixmile Creek populations of the Carolina heelsplitter are imperiled and continue to be threatened by future adverse impacts, direct and indirect effects to these populations are very unlikely to occur as a result of the proposed project.

Direct Effects

As discussed in Section 8.1, the project alignment does not occur within either the Goose Creek or Sixmile Creek watersheds; thus, the only potential direct effects associated with project construction would be sedimentation/erosion and introduction of toxic compounds originating from borrow/spoil areas, staging areas, equipment storage areas, and refueling areas and entering Goose Creek or Sixmile Creek via unregulated stormwater channels, ditches, and overland runoff. At this time, the locations of potential borrow/spoil sites staging areas, equipment storage areas, and refueling areas have not been chosen. In the event that any of these sites are selected within either the Goose Creek or Sixmile Creek watersheds, existing regulations excluding stream buffer areas from being used for these purposes, and the commitment of NCDOT to adopt measures to avoid/minimize the potential for adverse effects in non-regulated areas within the respective watersheds, make it extremely unlikely (discountable) that project-related direct effects could occur.

Indirect Effects

As summarized in Section 8.2, based on the TR and the Water Quality Assessment (Section 5.0 in PBS&J 2010b) analyses, project-related indirect effects in the form of increased impervious surface and increased water quality degradation in the Goose Creek and Sixmile Creek watersheds are not projected to occur. In addition, adverse effects to water quality in the Goose Creek and Sixmile Creek watersheds associated with changes in traffic volumes are also not anticipated as traffic forecasts do not predict project-induced increased traffic volumes on the road networks traversing these watersheds. The projected reduction in volume of truck traffic through the Goose Creek watershed may reduce the amount of roadway pollutants entering the stream and lessen the likelihood of toxic spills, which could be considered a slight beneficial effect, but is considered unquantifiable. As such, no indirect effects to the Carolina heelsplitter populations in Goose Creek and Sixmile Creek are anticipated.

Cumulative Effects

Direct effects are extremely unlikely, though cannot be unquestionably discounted. The TR analysis and analysis in this document found that there are no anticipated indirect effects. Accordingly, cumulative effects to the Carolina heelsplitter are extremely unlikely, though cannot be unquestionably discounted.

Biological Conclusion

Construction of the Monroe Bypass/ Connector is not anticipated to have any direct, indirect, or cumulative effect on the Carolina heelsplitter populations in Goose Creek and Sixmile Creek. However, as noted in Section 6.9 of the TR and noted above, there are limitations to the accuracy and certainty of the results of any analysis that attempts to project future growth or development. As such, given the inherent level of uncertainty in the forecasting models for this project, the proximity of these two watersheds to the project corridor, and as discussed above, a "No Effect" determination cannot be concluded. Therefore, it is concluded that the proposed action **"May Affect, Not Likely to Adversely Affect"** the Carolina heelsplitter.

8.5 Conclusions of Effects-Critical Habitat

As discussed in Section 4.5.2.6, water quality and physical habitat conditions in the Goose Creek watershed have deteriorated in recent years to the extent that the constituent elements may no longer be present. As projected in the Section 6.0 of the TR and the Water Quality Assessment (Section 5.0 in PBS&J 2010b), the amount of impervious surface area and water quality degradation is expected to continue to increase in the Goose Creek watershed. However, these increases are anticipated to occur independently of the proposed action. As concluded in Section 8.4, project-related direct effects to Goose Creek and the Carolina heelsplitter are very unlikely to occur, and potential indirect effects are also very unlikely to occur, or are discountable. Therefore, as adverse effects to Goose Creek are very unlikely to occur, it can be concluded that the proposed action **"May Affect, Not Likely to Adversely Affect"** Critical Habitat Unit 1.

8.6 Conservation Measures –Carolina Heelsplitter & Critical Habitat

In an effort to off-set potential impacts from some unanticipated event associated with construction of the Monroe Bypass/ Connector, NCDOT has either completed, or proposes, the following:

- If any construction staging, storage, refueling, borrow pit or spoil areas are to occur in the Goose Creek and Sixmile Creek watersheds, the NCTA will coordinate with the NCDOT DEO, USFWS, and the contractor to develop BMPs for each site to avoid and minimize the potential for adverse effects (Section PC of Atkins 2013). Additionally, NCTA will follow NCDOT's *Design Standards in Sensitive Watersheds* for implementing erosion and sediment control BMPs along the entire project (Section PC of Atkins 2013).

- In collaboration with, and at the request of, the USFWS, a payment in the amount of $150,000 was provided to the Carolina heelsplitter Conservation Bank in the Flat Creek watershed in Lancaster County on August 4, 2010. The details of the transaction are in Appendix C.
- In collaboration with, and at the request of, the USFWS, NCDOT continued its funding of the USGS stream gauges on the US 601 crossing of Goose Creek and the SR 1103 crossing of Waxhaw Creek. A payment of $150,200 was provided on September 14, 2010 to fund operation through June 2015 (Appendix C).

9.0 EFFECTS OF PROPOSED ACTION – SCHWEINITZ'S SUNFLOWER

9.1 Direct Effects

There is suitable habitat for Schweinitz's sunflower in the project alignment; however, there are no known populations within the proposed project alignment, right-of-way (ROW), or clearing limits. Based on NCNHP (2013) EO data as well as project study area surveys (Atkins 2012), there are two populations of this species (EO# 230 and EO# 77) within approximately 500 feet of the proposed project alignment in the vicinity of the proposed interchange at Indian Trail-Fairview Road. These populations are currently within either the NCDOT ROW (both E0# 230 and #77) or the Union Power ROW (EO# 77 only), which contains aerial utility lines. The interchange has been specifically designed to avoid encroachment on these two populations. NCDOT has further committed to preserving and managing these populations during construction as noted in Section PC (Special Project Commitments) of the DS-FEIS (Atkins 2013). Union Power is managing EO #77, noted as Site R in Union Power Dashboard System, in accordance with their agreement with USFWS: Union Power's Schweinitz's Sunflower Restricted Sites Plan (Union Power 2010) (Appendix D). NCDOT is managing both populations in accordance with the NCDOT Roadside Vegetation Management Guidelines in Marked Areas (Appendix E).

As part of the proposed roadway construction, the power lines above EO #77 will be raised, but kept in the same location (Shumate 2010, NCTA, pers. comm.), which will not result in impacts to the plants. The project will not require utility coordination near EO #230.

Therefore, direct effects to Schweinitz's sunflower are not anticipated to occur as a result of the proposed project.

9.2 Indirect Effects

Based on the TR, there is an estimated 30 percent decrease in land cover types presumed to provide potential suitable habitat for the Schweinitz's sunflower with the No-Build scenario. The incremental effect with the 2030 Build scenario is approximately a four percent decrease in potential suitable habitat (34 percent versus 30 percent). This decrease in habitat, combined with

changes in land use resulting from reasonably foreseeable infrastructure projects, may potentially result in indirect effects to Schweinitz's sunflower.

The land use analysis indicates a significant increase in development and residential growth throughout the FLUSA regardless of construction of the proposed project. Figure 9B depicts changes in land use projected to occur under the No-Build scenario as compared to the current Baseline condition in relationship to known sunflower populations. Figure 10B illustrates changes in land use from the No-Build to Build scenarios, such as from Residential to Non-Residential (commercial, industrial, etc.) relative to known populations of the sunflower. Land use around EO# 31, EO# 78, and EO# 18 is not anticipated to change as a result of the project. Land use near EO# 5 is expected to change generally from Undeveloped and Residential to Non-Residential, but since this population is believed to be extirpated, no indirect impacts are anticipated.

There are also several categories of land use change near EO# 77 and EO# 230. While the specific locations of these EO are not anticipated to incur changes in land use, due to their proximity to areas that are projected to experience induced changes in land use, EO# 230 and EO# 77 could potentially be indirectly affected, as they have an increased risk of degradation due to the projected increase in density of nearby development.

However, water and sewer service is currently available throughout this area (Cockerhan 2010, Union County Engineering, pers. comm.); therefore, installation of potential additional infrastructure for these services is not expected. In addition, Union Power does not plan to relocate their utility lines near these populations for the Monroe Connector/Bypass. Power line relocation is not typically necessary in response to residential, commercial, or light industrial / office development. NCDOT Division 10 also recently resurfaced and widened the shoulders of Secrest Shortcut Road and does not foresee a need for further road widening to accommodate future development (Thompson 2010a, pers. comm.). Furthermore, these populations are within NCDOT and Union Power ROW and both agencies have agreed to preserve these populations in place. As such, no indirect effects are anticipated to the known populations.

A large portion of the four percent loss of potential habitat includes fringe ecotones, primarily along the edges of agricultural fields that are generally maintained. Such areas are typically not where Schweinitz's sunflower is found in the FLUSA; they are typically found within NCDOT ROW and utility easements. As such, the four percent loss of habitat is not "high-quality" habitat. Further, overall there is, and will continue to be, sufficient suitable habitat in the form of NCDOT ROW and utility easements throughout the FLUSA for Schweinitz's sunflower to colonize. Therefore, it is not anticipated that the project will have indirect effects on the species.

9.3 Cumulative Effects

Although the cumulative definition under ESA differs from that under NEPA, the cumulative analysis was performed using the NEPA definition. Therefore, the cumulative effects discussed in this BA, as defined per ESA, may be somewhat overestimated since the Quantitative ICE analysis included the effects of future federal actions *as well as* non-federal actions.

Future state and private activities, not involving federal actions, are reasonably certain to occur throughout the FLUSA, specifically in the vicinity of EO# 18 and EO# 78, which could affect these populations (Figure 21 in TR). The area around EO# 18 is expected to incur a change in land use from Undeveloped to Residential and the area around EO# 78 is expected to incur a change in land use from undeveloped to Non-Residential, independent of the proposed Monroe Connector/Bypass. The anticipated growth will likely affect these populations by degrading potentially suitable habitat through the expansion of residential and industrial development in areas currently undeveloped. Additional development in the vicinity of EO# 78 may include future infrastructure projects (i.e. sewer and water expansion) associated with the anticipated land use changes since this area is currently slated for future County sewer service. This future growth is expected to occur through future state, local, and private actions, not requiring federal permits or funds to complete.

Reasonably foreseeable small-scale adverse effects to Schweinitz's sunflower may also occur within the Action Area; however, they are difficult to predict or quantify. Poor conservation management of the species at EO# 77 by the landowner has occurred in the past, namely excessive mowing (Thompson 2010b, pers. comm.). In addition, a past traffic accident caused habitat degradation in the vicinity of EO# 77 (Thompson 2010b, pers. comm.). The NCDOT has since widened Secrest Shortcut Road, which will likely aid in minimizing minor traffic accidents.

9.4 Conclusion of Effects

Direct and indirect effects to these populations of Schweinitz's sunflower are unlikely to occur as a result of the proposed project.

9.4.1 Direct Effects

The project alignment does not occur within the bounds of any known Schweinitz's sunflower populations; therefore, the only potential direct effects associated with the proposed project include the raising of the utility lines above EO# 77, which is not anticipated to adversely affect this population. Given the proximity of these two populations to the project corridor, NCDOT has committed to taking extra precautions, such as installing construction fencing around these populations, to ensure construction activities (e.g. worker parking, etc.) do not affect these

populations. This commitment is noted in the Special Project Commitments of the DS-FEIS (Atkins 2013). As such, the project is not expected to have direct effects to Schweinitz's sunflower.

9.4.2 Indirect Effects

As summarized in Section 9.2 of this report and Section 6.6 of the TR, indirect effects to Schweinitz's sunflower in the form of project-related changes in land use may potentially occur. Two populations (EO# 230 and EO# 77) are situated close to Interchange 3 (Indian Trail-Fairview Road), where variations in future land use are expected. However, the specific locations of these populations are not anticipated to incur changes in land use (Map 22 TR). The proximity of these populations to the interchange could potentially result in EO# 230 and EO# 77 being indirectly affected, as they have an increased risk of degradation due to the projected increase in density of nearby development.

In an effort to minimize the potential for adverse effects to these populations, FHWA and NCTA propose on-site preservation of these two populations as a conservation measure (Section 9.5.1). Reasonably foreseeable unavoidable impacts to these populations are not anticipated with on-site preservation and management.

9.4.3 Cumulative Effects

Neither direct nor indirect project induced effects are anticipated, but as detailed above cannot be unquestionably discounted for various reasons. Further, cumulative effects, independent of the proposed action, in the form of loss of potential habitat are expected, though not anticipated to affect the viability of the species.

9.4.4 Biological Conclusion

Project-related direct and indirect effects to Schweinitz's sunflower are extremely unlikely to occur (or are discountable). Potential direct and indirect effects are anticipated to be avoided by on-site preservation and management, the details of which are provided in Section 9.5. Cumulative effects independent of the proposed action are expected, though not anticipated to affect the viability of the species. Therefore, it can be concluded that the proposed action "**May Affect, Not Likely To Adversely Affect"** Schweinitz's sunflower.

9.5 Schweinitz's Sunflower Conservation Measures

The Recovery Plan for Schweinitz's sunflower lists several actions needed for the conservation of the species. This includes surveying suitable habitat for additional populations and potential reintroduction sites, protecting known remnant populations and viable populations through various protective management tools (i.e. management and cooperative agreements, acquisition

of parcels containing preferred habitat, etc.), monitoring existing populations, conducting research, and implementing management plans on protected populations (USFWS 1994).

Conservation measures are those measures that can be taken to offset potential adverse effects to a protected species. Conservation measures for plant species typically fall into two categories: (1) Protection of extant populations through the use of management / cooperative agreements, and (2) relocation of extant populations to areas where they can be preserved and maintained. Conservation, relocation, or preservation of known populations may help alleviate potential direct, indirect, and cumulative effects to plant species within the Action Area.

The conservation measure of preference is most always to preserve the species in place, with relocation / transplanting being a viable alternate option if on-site preservation is not feasible. After evaluating the potential effects, NCTA and FHWA determined on-site preservation of EO# 230 and EO# 77 to be a feasible, preferable option, which conserves the species in its present habitat within the Action Area. This population has flourished at its current location, despite the past instances of excessive maintenance by the local landowner, a traffic accident, and even removal and relocation of the original population. The impressive re-growth of EO# 77 leads to the determination of on-site preservation as the preferred conservation measure for this population.

9.5.1 On Site Preservation

NCDOT has been protecting roadside populations of rare plants since 1989, marking these populations in order to prevent them from being mowed (AASHTO 2009). NCDOT signed a Memorandum of Understanding (MOU) with NCDENR in 1990 that committed NCDOT to protect populations of threatened and endangered species that occur within NCDOT ROW. Working to protect roadside populations of federal and state-listed endangered and threatened species, NCDOT established general statewide management guidelines for areas marked for rare species; "NCDOT Roadside Vegetation Management Guidelines in Marked Areas" (Appendix E).

On site preservation of EO# 230 and EO# 77 will be the responsibility of NCDOT. Funds will be designated for the resources and labor to mark the extent of both populations with "Do Not Mow" signs. Additionally, NCDOT Division personnel and field maintenance crews will conduct vegetation management and maintenance activities per "NCDOT Roadside Vegetation Management Guidelines in Marked Areas". NCDOT did not immediately install signage since it was anticipated that they could conflict with construction of the Monroe Bypass/ Connector Project and other protective measures (fencing, other signs) would be used during construction, but have since installed the signs. NCDOT Division 10 personnel are aware of the populations and will continue to follow aforementioned vegetation management guidelines as noted in an email from the DEO (Thompson 2013) provided in Appendix E.

NCTA notified Union Power of EO #77 in 2010. Union Power has since included this population as Site R in their Schweinitz's Sunflower Restricted Sites plan (Appendix D), and this information is provided to all Union Power employees through the Dashboard System (Ortiz 2013). Letters from NCTA to Division 10 and Union Power requesting onsite preservation are included in Appendix F. The commitments from both NCDOT and Union Power will be adhered to for as long as the respective conservation areas are under their ownership. While this can't necessarily be considered "in perpetuity", ownership of such areas are very rarely relinquished. As such, there is no reason to assume these sites will not continue to be managed for Schweinitz's sunflowers for the foreseeable future.

In addition, continued NCDOT management of EO# 78 and EO# 18 within the ROW, per "NCDOT Roadside Vegetation Management Guidelines in Marked Areas" as well as continued Union Power management of these populations, would lessen the likelihood of the anticipated impacts to these populations.

10.0EFFECTS OF PROPOSED ACTION – MICHAUX'S SUMAC

10.1 Direct Effects

Based on NCNHP (2013) Natural Heritage EO data as well as project study area surveys (ATKINS 2012), Michaux's sumac is not currently known within the proposed project alignment, ROW, or clearing limits. As such, direct effects to Michaux's sumac are not anticipated.

10.2 Indirect Effects

Based on NCNHP (2013) Natural Heritage EO data as well as project study area surveys (ATKINS 2012), Michaux's sumac is not currently known within the FLUSA. Therefore, indirect effects to Michaux's sumac are not anticipated.

10.3 Cumulative Effects

Cumulative effects to Michaux's sumac are not anticipated as neither direct nor indirect effects are anticipated to occur to this species as a result of the proposed action.

10.4 Conclusion of Effects

Based on NCNHP (2013) Natural Heritage EO data as well as project study area surveys (ESI 2007), Michaux's sumac is not known within the Action Area, and therefore the project will have **"No Effect"** on this species.

11.0EFFECTS OF PROPOSED ACTION – SMOOTH CONEFLOWER

11.1 Direct Effects

Smooth coneflower is not listed by the USFWS as occurring in Union County nor are there NCNHP (2013) Natural Heritage EO records near the proposed project alignment, ROW, or clearing limits. As such, direct effects to Smooth coneflower are not anticipated.

11.2 Indirect Effects

Based on the TR, there are no indirect effects anticipated in Mecklenburg County. Further, there are no known NCNHP (2013) Natural Heritage EOs of this species within the FLUSA. Therefore, indirect effects to Smooth coneflower are not anticipated.

11.3 Cumulative Effects

Cumulative effects to Smooth coneflower are not anticipated as neither direct nor indirect effects are anticipated to occur to this species as a result of the proposed action.

11.4 Conclusion of Effects

Since there will be no direct or indirect effects within Mecklenburg County and the lack of EO records within or near the FLUSA, the project will have **"No Effect"** on this species.

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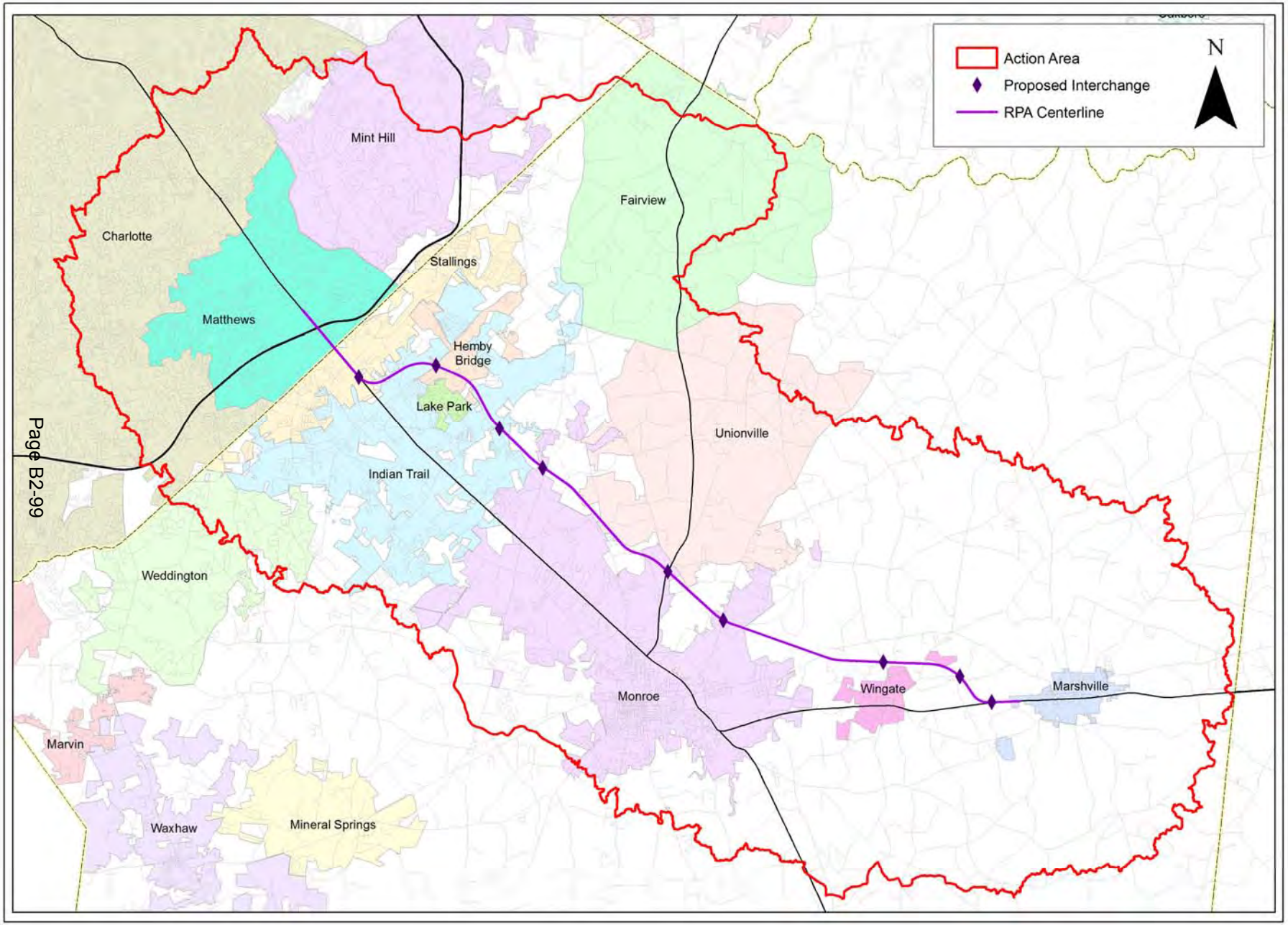


Prepared By:
The Catena Group

Prepared For:
North Carolina Turnpike Authority

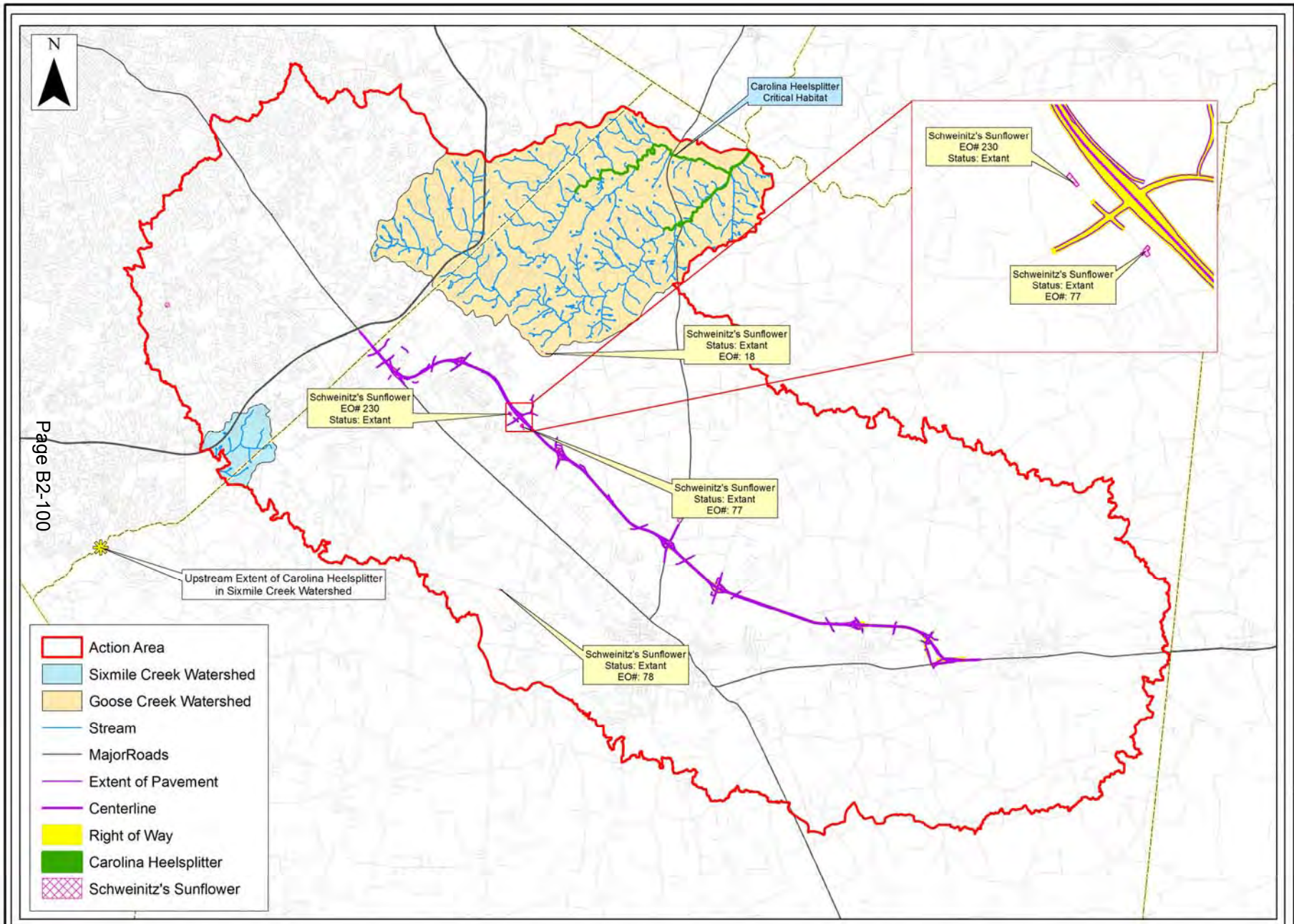
Title:
Monroe Connector/Bypass (R-3329/R-2559)

Action Area

Mecklenburg and Union Counties, North Carolina

Date: November 2013	
Scale: 0 1 2 Miles	
Job No.: 1161	
Drawn By: KEM	Checked By: NMS

Figure
1



Prepared By:
The Catena Group

Prepared For:
North Carolina Turnpike Authority

Title:
Monroe Connector/Bypass (R-3329/R-2559)

Project Proximity to Endangered Species and Critical Habitat

Mecklenburg and Union Counties, North Carolina

Date:	November 2013
Scale:	0 1 2 Miles
Job No.:	1161
Drawn By:	KEM
Checked By:	NMS

Figure
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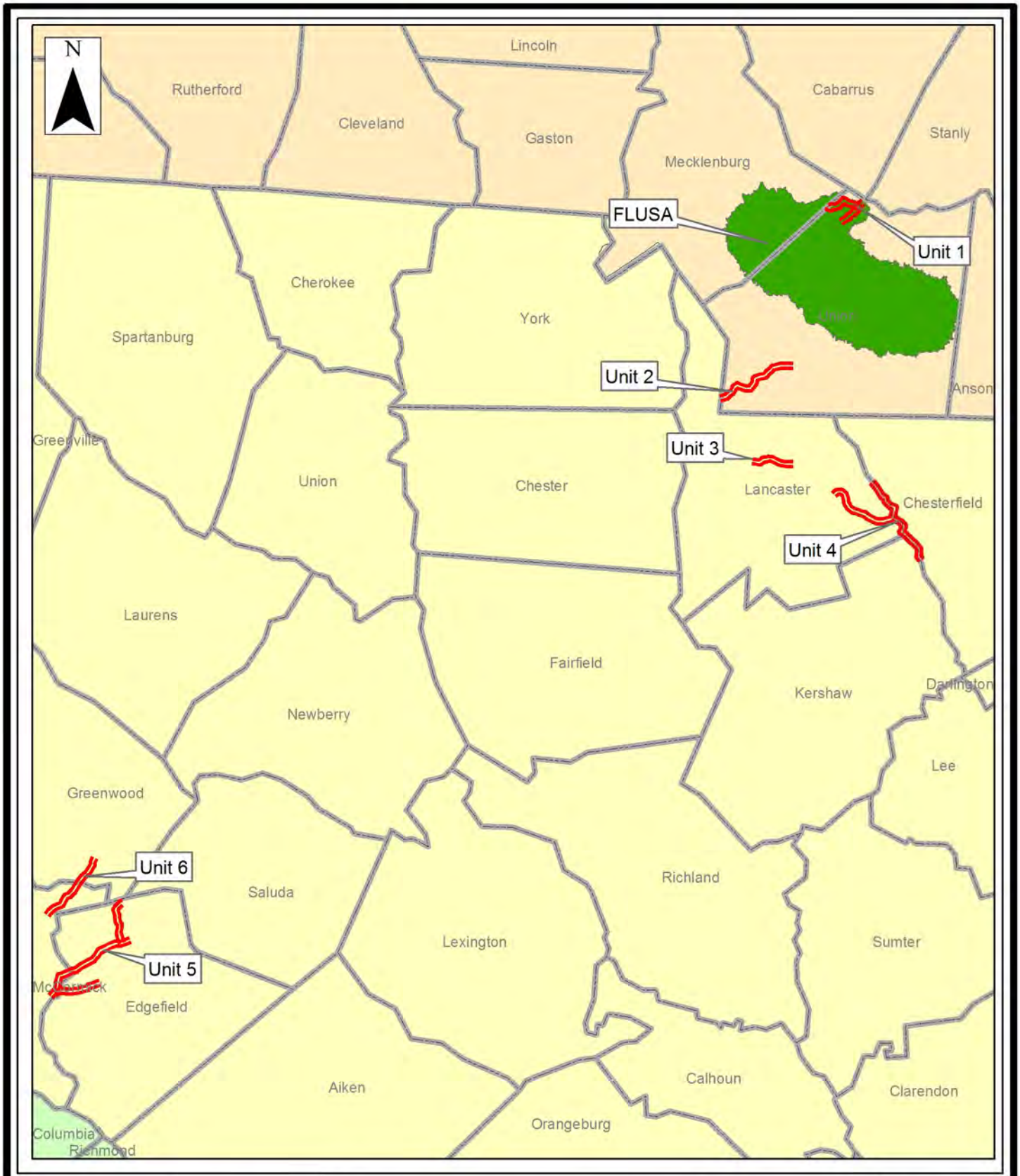


Prepared By: The Catena Group

Prepared For: State of North Carolina Department of Transportation

Monroe Connector/Bypass (R-2239-/R-2559)

Carolina Heelsplitter: USFWS Critical Habitat Units

North and South Carolina

Date: November 2013

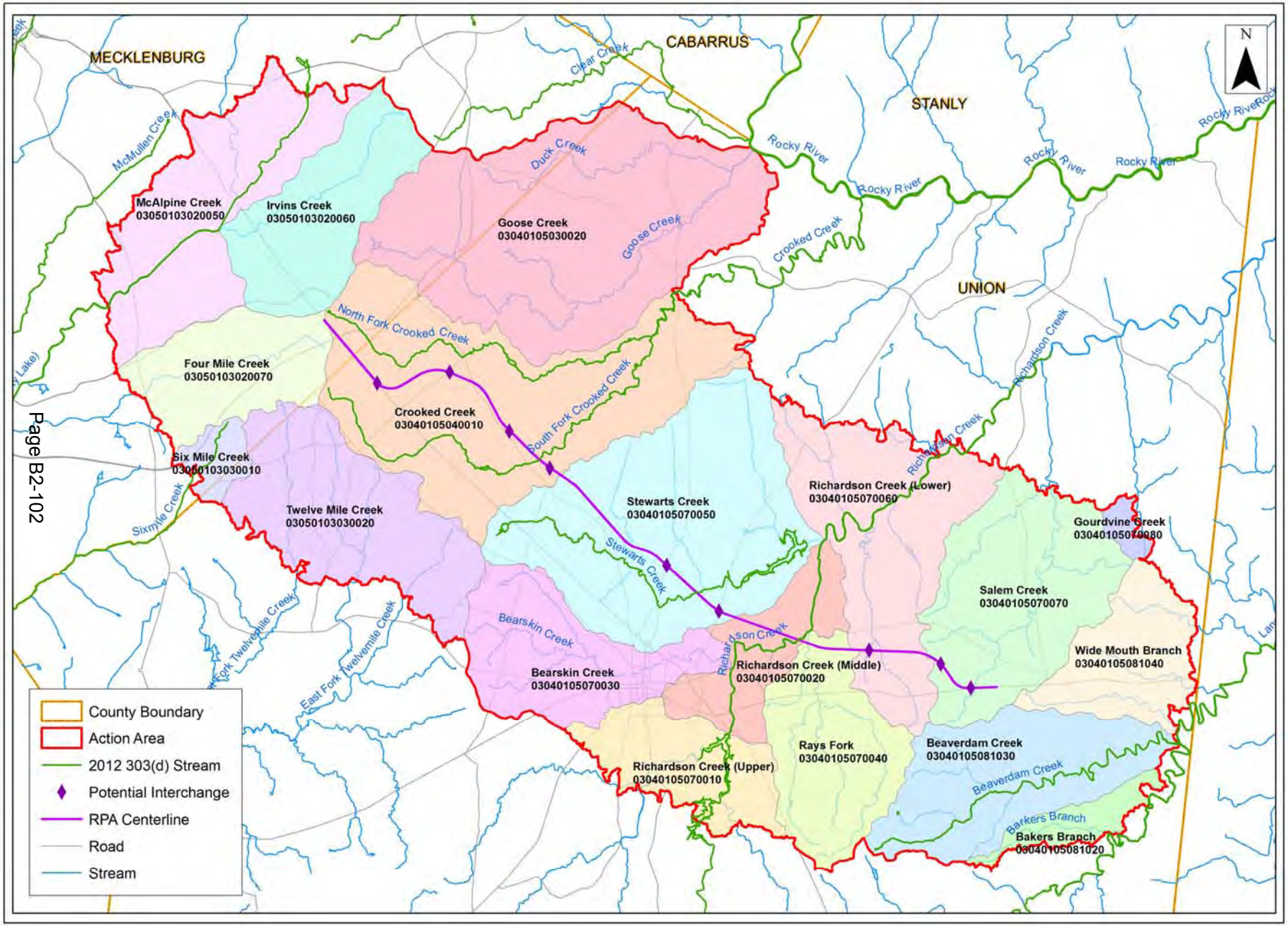
Scale 0 2 4 8 Miles

Job No.: 1161

Drawn By: KEM

Checked By: NMS

Figure 3



Page B2-102

Prepared By:
The Catena Group

Prepared For:
North Carolina Turnpike Authority

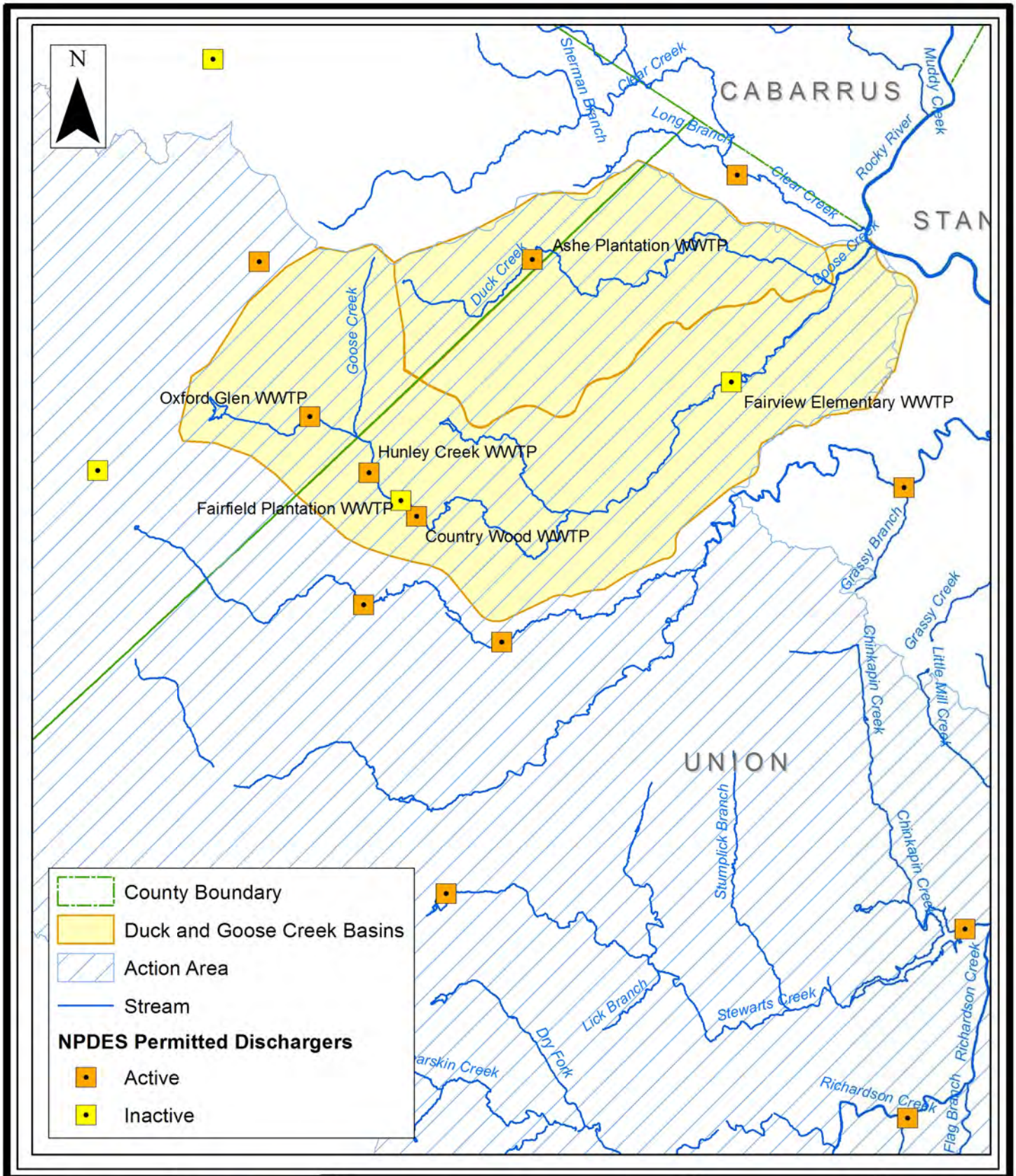
Title:
Monroe Connector/Bypass (R-3329/R-2559)

Watersheds and 303(d) Streams

Mecklenburg and Union Counties, North Carolina

Date: November 2013
Scale: 0 1 2 Miles
Job No.: 1161
Drawn By: KEM
Checked By: NMS

Figure 4



Prepared By: The Catena Group

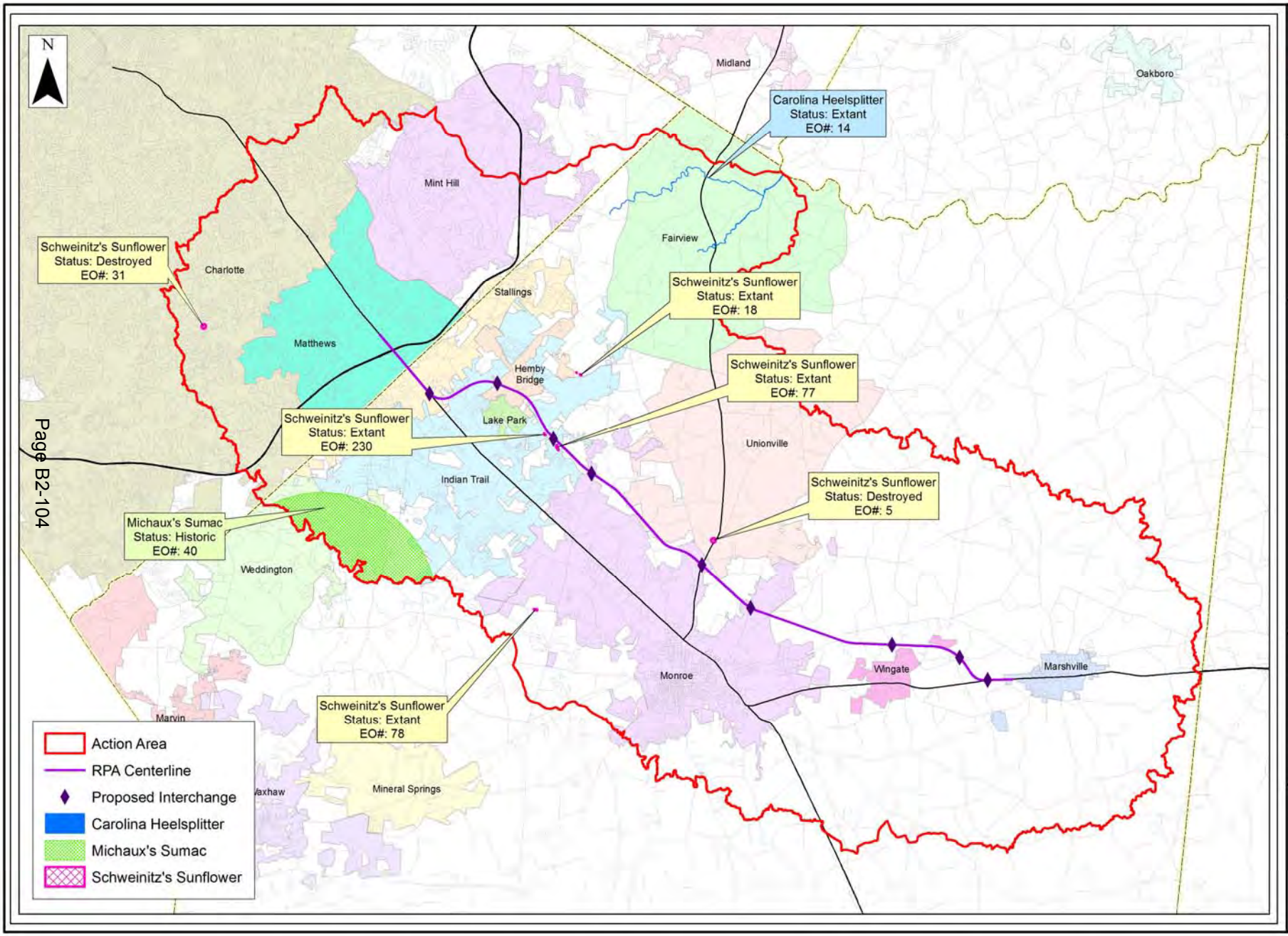
Prepared For: State of North Carolina Department of Transportation

Monroe Connector/Bypass (R-3329/R-2559)

WWTP Locations
Goose and Duck CreekBasins
Union and Mecklenburg Counties,North Carolina

Date: November 2013
Scale 0 0.5 1 Miles
Job No.: 1161
Drawn By: KEM
Checked By: NMS

Figure 5



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The Catena Group

Prepared For:
North Carolina Turnpike Authority

Title:
Monroe Connector/Bypass (R-3329/R-2559)

NCNHP Element Occurrences

Mecklenburg and Union Counties, North Carolina

Date:	November 2013
Scale:	0 1 2 Miles
Job No.:	1161
Drawn By: KEM	Checked By: NMS

Figure 6

Prepared By:
The Catena Group

Prepared For:
North Carolina Turnpike Authority

Title:

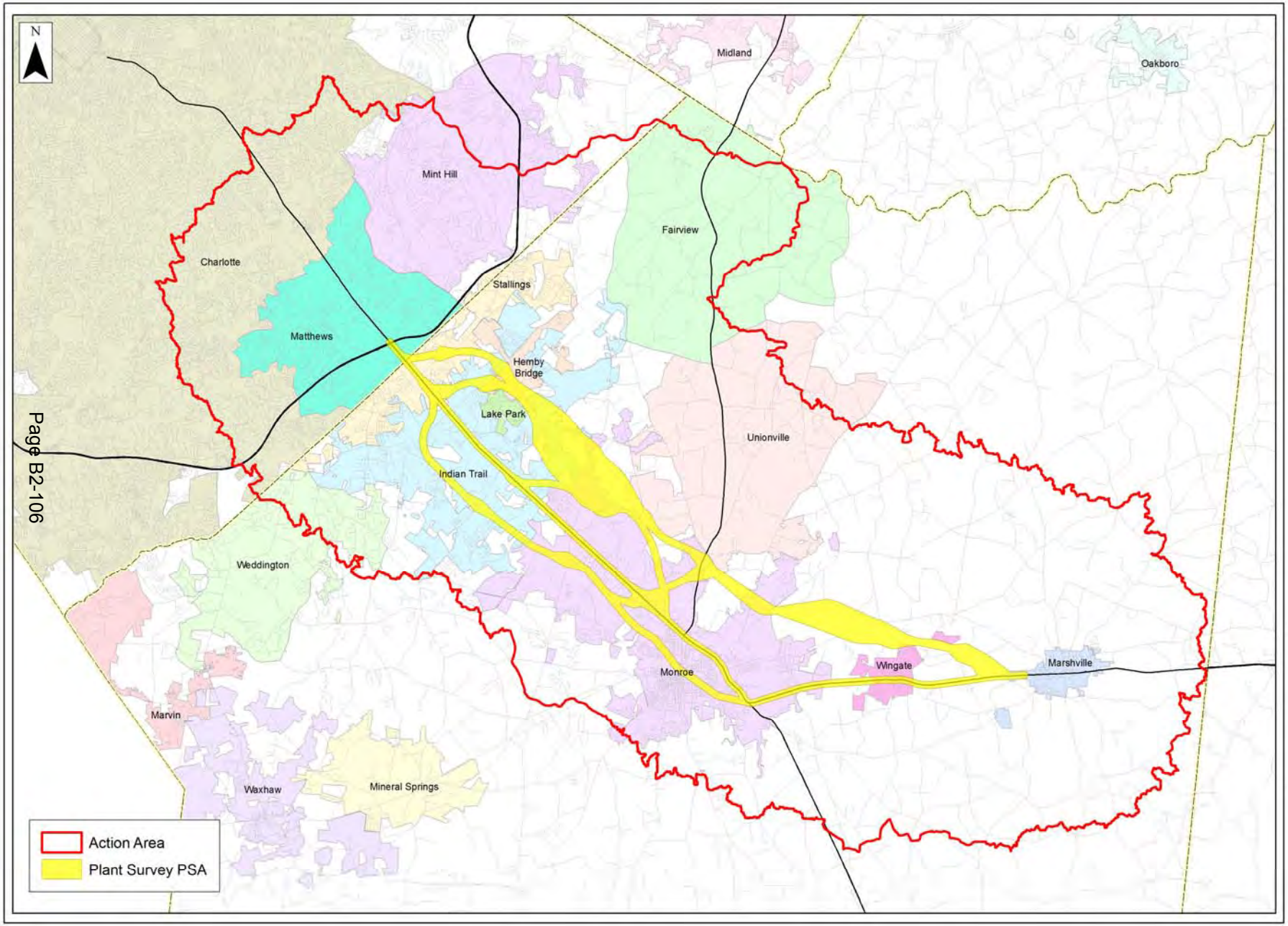
Monroe Connector/Bypass (R-3329/R-2559)

Potential Impact Schweinitz's Sunflower Populations

Mecklenburg and Union Counties, North Carolina

Date:	November 2013
Scale:	0 250 500 Feet
Job No.:	1161
Drawn By: KEM	Checked By: NMS

Figure 7



Prepared By:
The Catena Group

Prepared For:
North Carolina Turnpike Authority

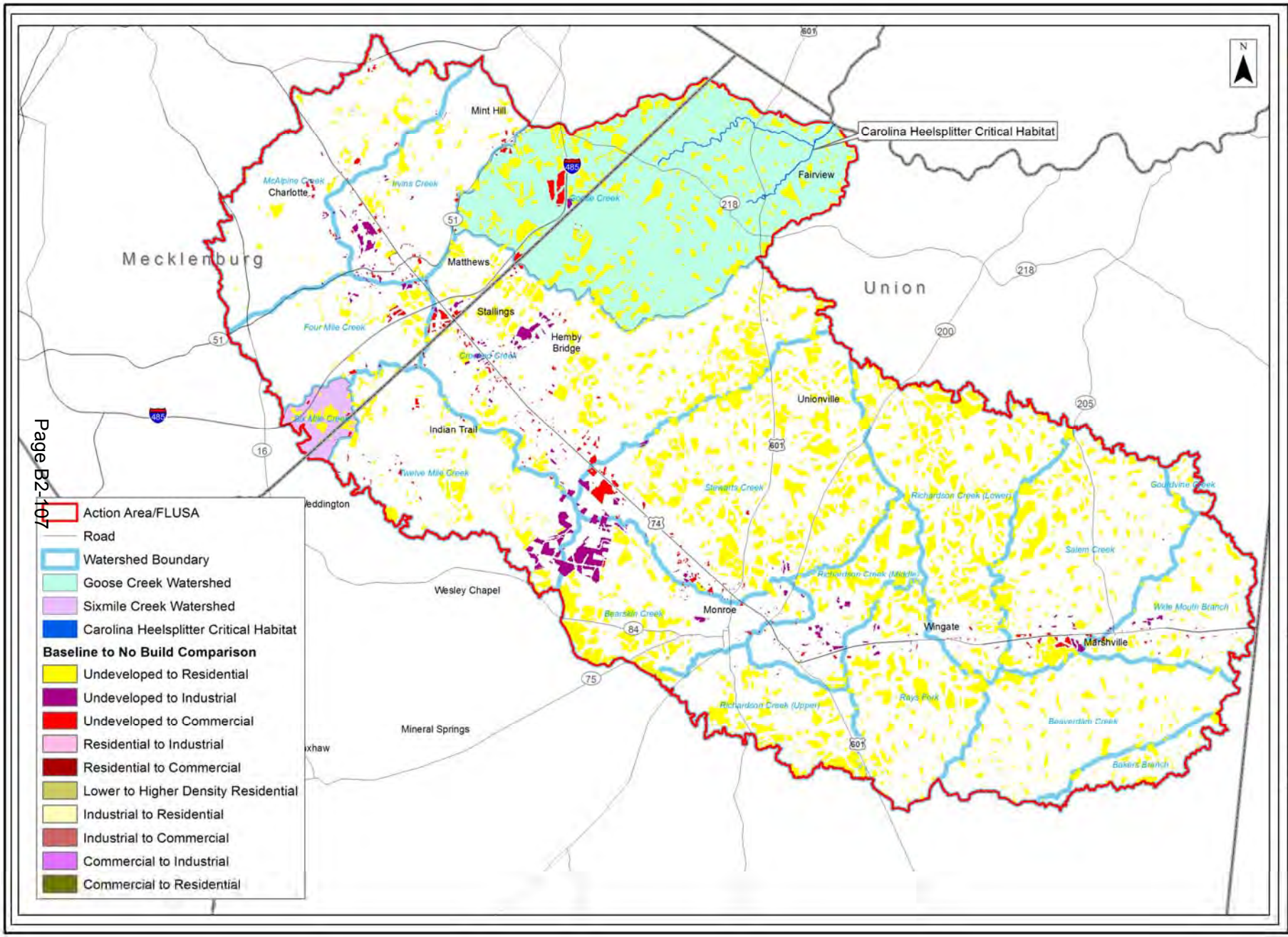
Title:
Monroe Connector/Bypass (R-3329/R-2559)

Plant Survey Project Study Area

Mecklenburg and Union Counties, North Carolina

Date:	November 2013
Scale:	0 1 2 Miles
Job No.:	1161
Drawn By: KEM	Checked By: NMS

Figure
8



Prepared By:
The Catena Group

Prepared For:
North Carolina Turnpike Authority

Title:
Monroe Connector/Bypass (R-3329/R-2559)

Projected Land Use Changes 2030 No-Build (as Compared to Baseline) Effects to Carolina Heelsplitter Critical Habitat

Mecklenburg and Union Counties, North Carolina

Date: November 2013

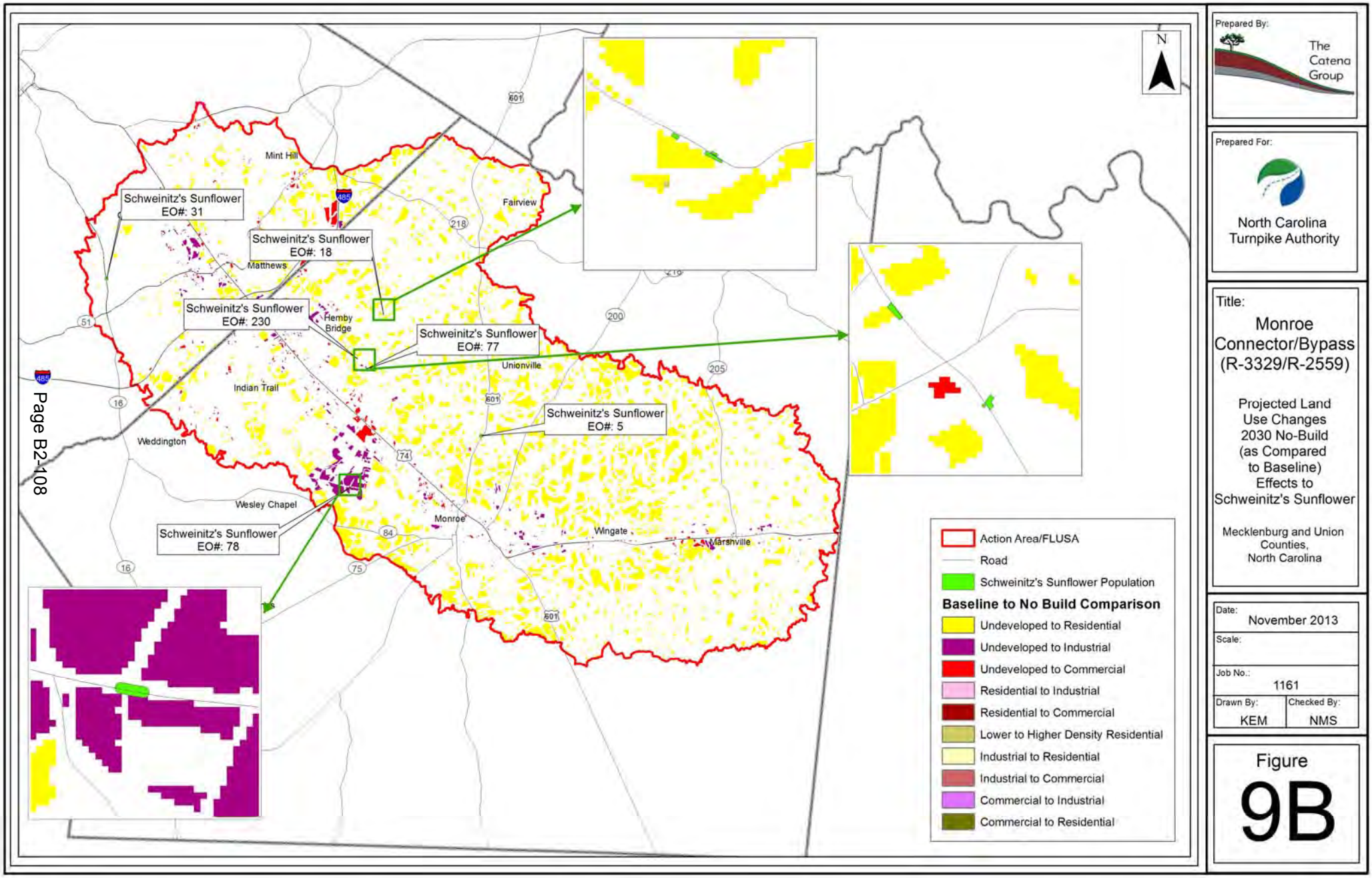
Scale: 0 1 2 Miles

Job No.: 1161

Drawn By: KEM

Checked By: NMS

Figure 9A



Prepared By:
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Prepared For:
North Carolina Turnpike Authority

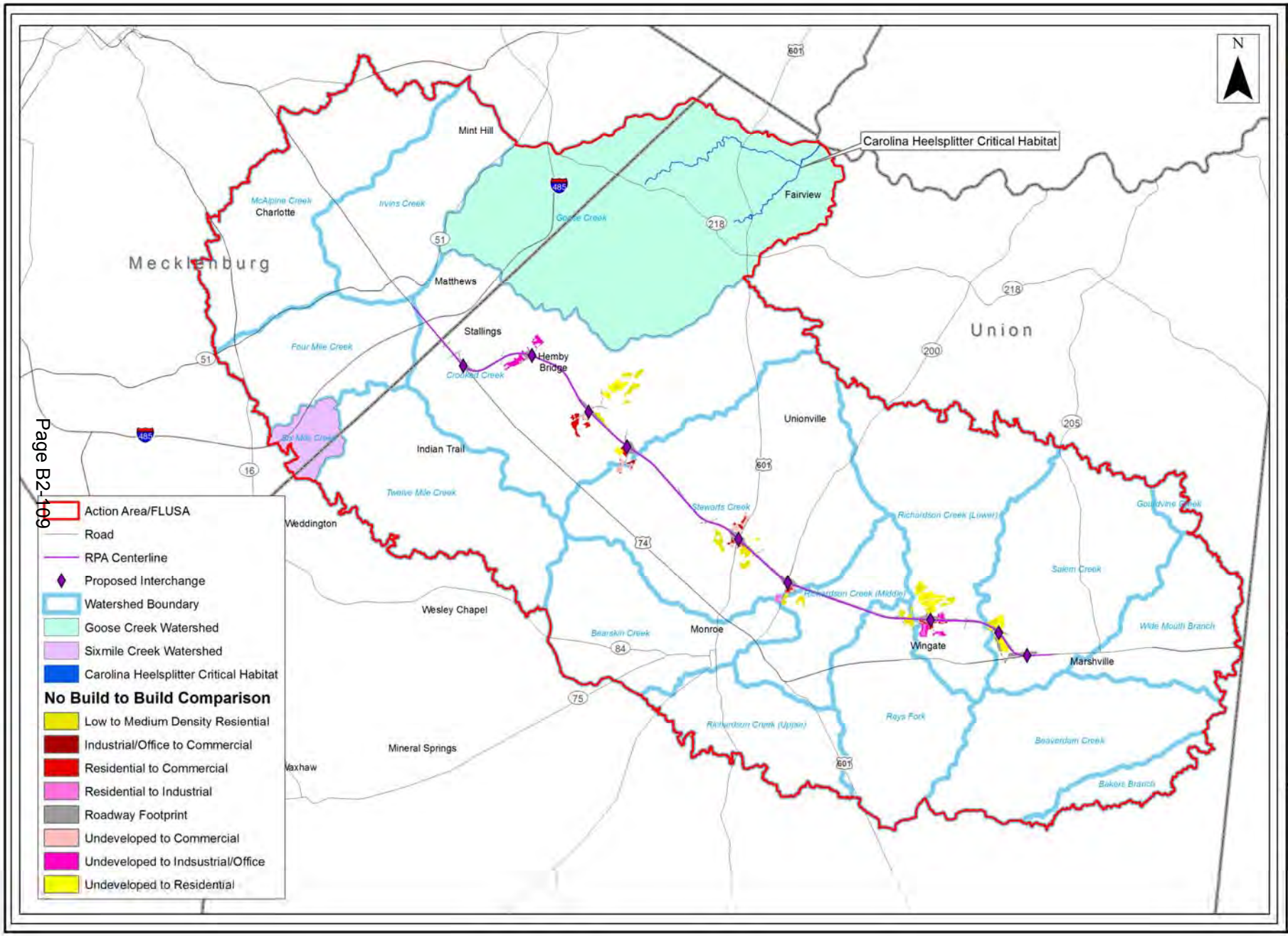
Title:
Monroe Connector/Bypass (R-3329/R-2559)

Projected Land Use Changes 2030 No-Build (as Compared to Baseline) Effects to Schweinitz's Sunflower

Mecklenburg and Union Counties, North Carolina

Date:	November 2013
Scale:	
Job No.:	1161
Drawn By: KEM	Checked By: NMS

Figure
9B



Prepared By:
The Catena Group

Prepared For:
North Carolina Turnpike Authority

Title:
Monroe Connector/Bypass (R-3329/R-2559)

Projected Land Use Changes 2030 Build (as Compared to No Build) Effects to Carolina Heelsplitter Critical Habitat

Mecklenburg and Union Counties, North Carolina

Date: November 2013

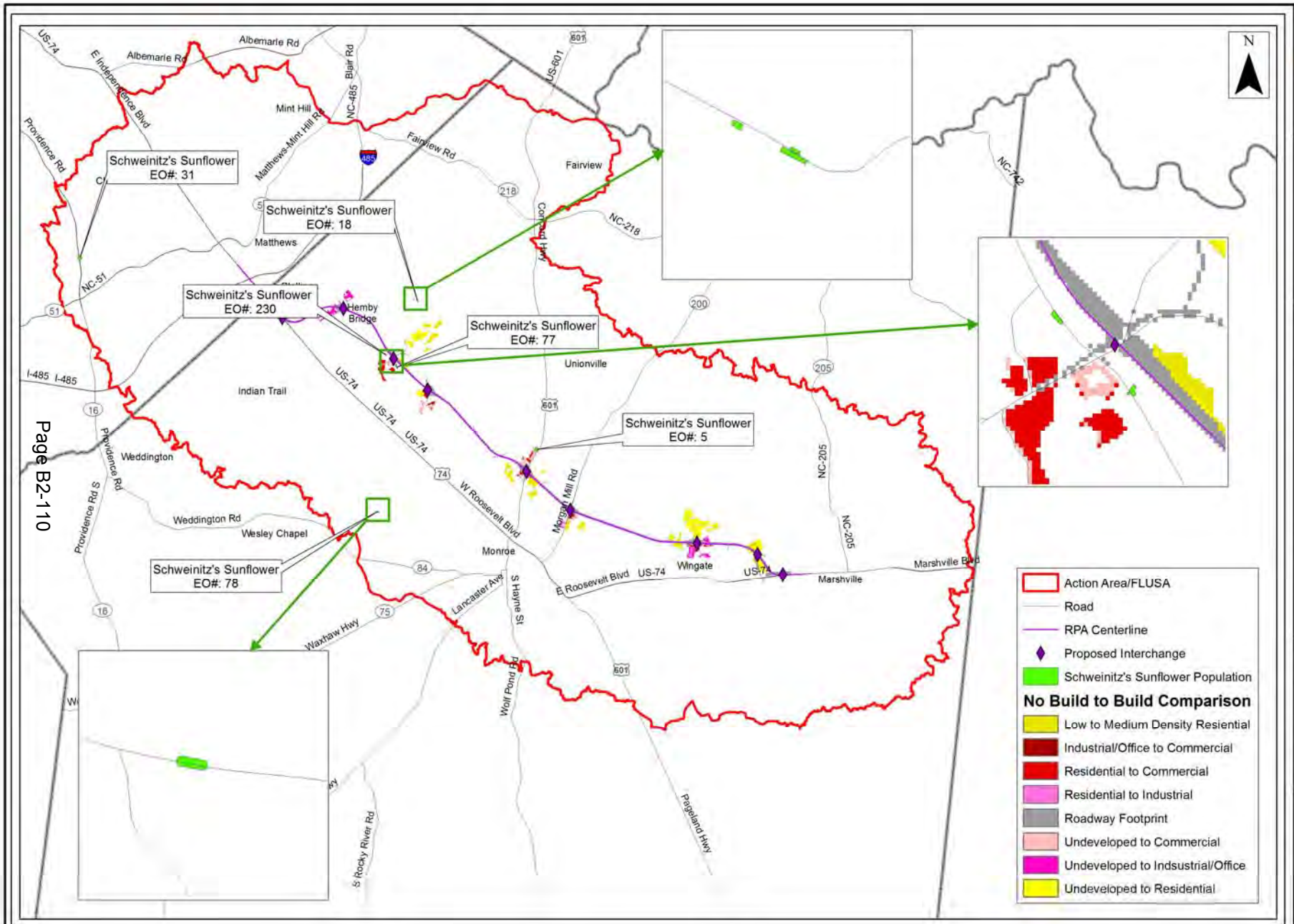
Scale: 0 1 2 Miles

Job No.: 1161

Drawn By: KEM

Checked By: NMS

Figure 10A



Prepared By:
The Catena Group

Prepared For:
North Carolina Turnpike Authority

Title:
Monroe Connector/Bypass (R-3329/R-2559)

Projected Land Use Changes 2030 Build (as Compared to No Build) Effects to Schweinitz's Sunflower

Mecklenburg and Union Counties, North Carolina

Date:	November 2013
Scale:	0 1 2 Miles
Job No.:	1161
Drawn By:	KEM
Checked By:	NMS

Figure
10B

APPENDIX A

The Catena Group 2012 Updated Mussel Survey Report

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Freshwater Mussel Survey Report Update

Monroe Bypass

(STIP No. R-3329/R-2559)

Mecklenburg and Union Counties, NC

Prepared for:

Atkins
5200 77 Center Dr., STE 500
Charlotte, NC 28217

PREPARED BY:

The Catena Group, Inc.
410-B Millstone Drive
Hillsborough, NC 27278

October 26, 2012

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1.0 INTRODUCTION **& BACKGROUND**

The North Carolina Turnpike Authority (NCTA) proposes construction of the Monroe Bypass on new location from I-485 near Indian Trail, NC, to US 74 just west of Marshville, NC (Figure 1). Project construction will impact streams within the Rocky River Subbasin of the Greater Yadkin-Pee Dee River Basin, and potentially the headwaters of Four Mile Creek within the Sugar Creek Subbasin of the greater Catawba River Basin. The Federally Endangered Carolina Heelsplitter (*Lasmigona decorata*) and the state Endangered/Federal Species of Concern (FSC) Atlantic Pigtoe (*Fusconaia masoni*), Carolina Creekshell (*Villosa vaughaniana*), and Savannah Lilliput (*Toxolasma pullus*), are known to occur in the Rocky River Subbasin. In addition to these species, there are several other rare freshwater mussel species that are known to occur in this portion of the Rocky River Subbasin: Eastern Creekshell (*Villosa delumbis*), Creeper (*Strophitus undulatus*), and Notched Rainbow (*Villosa constricta*). The Creeper is considered Threatened and the Notched Rainbow and Eastern Creekshell are considered Special Concern and Significantly Rare by North Carolina.

In 2009 the Catena Group, Inc. (Catena) conducted freshwater mussel surveys in all water bodies within the proposed alignment, as well as within select stream reaches that were lacking recent survey data within the proposed alignment and within the Future Land Use Study Area (FLUSA) identified by NCTA. The Carolina Heelsplitter was not found within any of the streams surveyed; however, it is known to occur within Goose/Duck Creek, which is within the FLUSA. The survey results, which are detailed in the July 21, 2009 Freshwater Mussel Survey Report indicated fairly diverse and robust freshwater mussel populations within South Fork Crooked Creek and Stewarts Creek in the vicinity of the project alignment, as well as in portions of Crooked Creek and Richardson Creek within the FLUSA. The Savannah Lilliput was found within the project crossing in the FLUSA. The U.S. Fish and Wildlife Service (USFWS) is in the process of developing an "Elevation to Candidate Species Status" package for this species to determine if it warrants formal listing as Threatened or Endangered in the future (John Fridell, USFWS Recovery Biologist, personal communication). In addition, the Center for Biological Diversity (CBD) recently petitioned the USFWS to list 404 aquatic species in the southeastern United States, including the Savannah Lilliput as either Threatened or Endangered under the Endangered Species Act (CBD 2010).

Since more than two years have passed since these surveys were completed, Catena was retained by Atkins to update mussel surveys for the Monroe Bypass.

2.0 MUSSEL SURVEY EFFORTS

In order to determine the location for the 2012 mussel surveys, the location of potential effects and/or impacts within the FLUSA were overlaid with streams identified during the 2009 surveys that contain a robust freshwater mussel that could potentially support the Carolina Heelsplitter.

Accordingly, South Fork Crooked Creek and Stewarts Creek in the vicinity of the project alignment, and portions of Crooked Creek and Richardson Creek were surveyed.

2.1. Mussel Survey Methodology

Survey locations were chosen based on mapping and pre-survey investigations as provided by NCTA, accessibility, and appropriate habitat for the target species as determined in the field.

Surveys were conducted by Catena personnel on the following dates; September 26, 2012 (Tim Savidge, Tom Dickinson, Chris Sheats, and Ivy Kimbrough), October 3-5, 2012 (Tim Savidge and Ivy Kimbrough), and October 18, 2012 (Tim Savidge and Nancy Scott).

Within the surveyed reaches, all habitat types (riffle, run, pool, slack-water, etc.) were sampled by a minimum of a two-person team. The survey team began at the downstream end of the survey reach and proceeded upstream with the team spread across the stream into survey lanes. A combination of visual, bathyscope (glass-bottom view buckets), and tactile methodologies were employed as appropriate. Upstream and downstream survey limits were recorded using a hand-help Garmin 12 or e-trex Vista GPS unit. Times searches were employed in each reach to provide a catch per unit effort (CPUE). Searches were also conducted for relict shells.

3.0 RESULTS

3.1. Within Alignment

3.1.1. South Fork Crooked Creek

South Fork Crooked Creek was evaluated in two sections; 1) from Unionville-Indian Trail Road (SR 1367) upstream approximately 580 feet and 2) from Rocky River Road (SR 1007) to 35.0652°N, -80.60031°W, approximately 1,000 feet below Secrest Shortcut Road (Figure 2).

1) Only approximately 580 feet of this section of South Fork Crooked Creek was surveyed in 2012 due to poor survey conditions. The stream channel ranged from 4 – 5 meters (13 – 16.5 ft) wide with approximately 2 meter (6 ft) high clay stream banks. Banks were unstable and significantly eroded. The surveyed reach consisted of mostly long pool and slow moving run habitat. Substrate was dominated by sand and hard-packed clay. The surrounding area consisted of a pasture and residences. There was a large amount of woody debris. Heavy accumulations of leaf pack and other organic material covered much of the substrate, making surveying difficult. A total of 8 Eastern Elliptio, 2 Variable Spike, and 1 Eastern Creekshell was found in 1.17 person hours of survey time (Table 1). In addition, the Asian Clam (*Corbicula fluminea*) was common and the aquatic snails *Physella* sp. and Two-ridged Rams Horn (*Helisoma anceps*) were also present.

Table 1. CPUE for Freshwater Mussels: South Fork Crooked Creek Section 1

Scientific Name	Common Name	Number	CPUE #/person hr
Elliptio complanata	Eastern Elliptio	8	6.84/hr
Elliptio icterina	Variable Spike	2	1.71/hr
Villosa delumbis	Eastern Creekshell	1	0.85/hr

2) The stream channel ranged from 4 – 8 meters (13 – 26 ft) wide with approximately 2 meter (6 ft) high clay banks. Banks ranged from unstable and scoured to more stable areas exhibiting only minor erosion and undercutting. The survey reach consisted of mostly long pool and slow moving run habitat with the occasional riffle areas where significant bedrock outcroppings were present. Substrate was dominated by sand, hard-packed clay, gravel, cobble, and silt with occasional slate bedrock outcropping. The surrounding landuse was predominately cropland, with riparian buffers of varying width. A total of 1,125 Eastern Elliptio, 398 Variable Spike, 3 lanceolate Elliptio sp., 2 Eastern Floater, 4 Eastern Creekshell, 3 Carolina Creekshell, 15 Florida Pondhorn (*Uniomerus carolinianus*) and 12 Savannah Lilliput were found in 11.4 person hours of survey time (Table 2). Eleven of the 12 Savannah Liliput were found in an approximately 10 meter (33 ft) section of the creek at 35.06540°N, -80.59915°W. The Asian Clam was common and the aquatic snails Physella sp. and Two-ridged Rams Horn were also present.

Table 2. CPUE for Freshwater Mussels: South Fork Crooked Creek Section 2

Scientific Name	Common Name	Number	CPUE #/person hr
Elliptio complanata	Eastern Elliptio	1,125	98.68/hr
Elliptio icterina	Variable Spike	398	34.91/hr
Elliptio sp	lanceolate elliptio species	3	0.26/hr
Pyganadon cataracta	Eastern Floater	2	0.18/hr
Uniomerus carolinianus	Florida Pondhorn	15	1.58/hr
Villosa delumbis	Eastern Creekshell	4	0.35/hr
Villosa vaughaniana	Carolina Creekshell	3	0.26/hr
Toxolasma pullus	Savannah Lilliput	12	1.05/hr

3.1.2. Stewarts Creek

In this downstream project crossing of Stewarts Creek (Figure 2), the stream channel ranged from 5 - 10 meters (16 – 33 ft) wide and stream banks ranged from 1 – 2 meters (3 – 6.5 ft) high. Banks ranged from stable to exhibiting some areas of erosion and undercutting. The surveyed reach sequenced from a rock fall riffle/run to a pool and slack water habitat often lined with bedrock outcroppings. Substrate was dominated by unconsolidated sand, angular cobble, and boulder, with areas of clay banks, silt, gravel, and bedrock. The surrounding area consisted of a moderate to wide forested buffer to poultry houses, and a utility corridor. A total of 17 Eastern

Elliptio, 6 Variable Spike and 7 Eastern Floater were located during 2.63 person-hours of survey time (Table 3). The Asian Clam was present.

Table 3. CPUE for Freshwater Mussels: Stewarts Creek

Scientific Name	Common Name	Number	CPUE #/person hr
Elliptio complanata	Eastern Elliptio	17	6.46/hr
Elliptio icterina	Variable Spike	6	2.28/hr
Pyganadon cataracta	Eastern Floater	7	2.66/hr

3.2. Additional Area Mussel Survey Results

Additional mussel surveys were conducted outside of the project study corridor in the best potential mussel habitats in the watersheds proposed to be impacted by the Monroe Bypass. The areas chosen for this effort were Richardson Creek upstream of the WWTP discharge facility and lower Crooked Creek, near its confluence with the Rocky River.

3.2.1. Richardson Creek

The additional mussel survey efforts in Richardson Creek were focused upstream of the Monroe WWTP discharge in the vicinity of the Walkup Road (SR 1106) crossing (Figure 2). In this section, Richardson Creek ranged from 12-15 meters (39 – 50 ft) wide with approximately 2 meter (6 ft) high stream banks. Banks generally exhibited some areas of erosion and undercutting, but were stabilized in areas with bedrock outcroppings. The surveyed reach mostly consisted of long shallow pool and slow moving run habitat punctuated with shallow gravel riffle areas. In order of dominance, substrate consisted of cobble, gravel, clay banks, silt, boulder, and bedrock. The surrounding area consisted of a narrow to moderate natural buffer to residential/ commercial areas and road. Large accumulations of leaf pack were present in some areas making surveying difficult, and a Beaver dam has been constructed in the upper limits of this survey reach. A total of 216 Eastern Elliptio, 15 Variable Spike, 2 lanceolate *Elliptio* sp., 12 Eastern Floater, 10 Florida Pondhorn, 10 Eastern Creekshell, 3 Carolina Creekshell, and 1 Paper Pondshell (*Utterbackia imbecellis*) were found in 7.00 person hours of survey time (Table 4). In addition, the Asian Clam the aquatic snails Two-ridged Rams Horn, Marsh Rams-horn (*Planorbella trivolvis*), a Physid (*Physella* sp.) and Pointed Campeloma (*Campeloma decisum*) were present.

Table 4. CPUE for Freshwater Mussels: Richardson Creek Additional Area

Scientific Name	Common Name	Number	CPUE #/person hr
Elliptio complanata	Eastern Elliptio	216	30.86/hr
Elliptio icterina	Variable Spike	15	2.14/hr
Elliptio sp.	lanceolate elliptio species	2	0.29/hr
Pyganadon cataracta	Eastern Floater	12	1.71/hr
Uniomerus carolinianus	Florida Pondhorn	10	1.43/hr
Villosa delumbis	Eastern Creekshell	10	1.43/hr

Villosa vaughaniana	Carolina Creekshell	3	0.43/hr
Utterbackia imbecellis	Paper Pondshell	1	0.14/hr

3.2.2. Crooked Creek

The additional mussel survey efforts in Crooked Creek watershed were focused on the last several miles of the main stem of Crooked Creek from its confluence with Rocky River to the vicinity of Brief Road (SR 1547) (Figure 2). In this section, Crooked Creek ranged from 12 – 20 meters (39 – 65.5 ft) wide with approximately 0.5 – 2 meter (1.5 – 6.5 ft) high and mostly stable clay stream banks. The entire reach consisted of a relatively high gradient sequence of riffle/run to pool habitats marked by a dominance of slate bedrock that provided grade control and stability throughout. In order of dominance, substrate consisted of angular cobble, bedrock, gravel, boulder, sand, clay, and silt. The stream reach was surrounded by an extensive hardwood forest that buffers the area's mostly agricultural land use.

Crooked Creek was evaluated in three sections 1) from its confluence with Rocky River to 35.16088°N, -80.45517°W, 2) from 35.14651°N, -80.47060°W to 35.14168°N, -80.47370°W, and 3) from NC 218 up to 35.13177°N, -80.49202°W.

1) Heavy accumulations of leaf pack covered much of the substrate, making surveying difficult. A total of 7 Eastern Elliptio were found in 1.40 person hours of survey time (Table 5).

Table 5. CPUE for Freshwater Mussels: Crooked Creek Additional Area 1

Scientific Name	Common Name	Number	CPUE #/person hr
Elliptio complanata	Eastern Elliptio	7	5/hr

2) A total of 85 Eastern Elliptio, 16 Variable Spike, 23 Florida Pondhorn, 15 Eastern Creekshell, and 13 Carolina Creekshell were found in 12.00 person hours of survey time (Table 6). In addition, the Asian Clam and the aquatic snails Two-ridged Rams Horn and Pointed Campeloma were present.

Table 6. CPUE for Freshwater Mussels: Crooked Creek Additional Area 2

Scientific Name	Common Name	Number	CPUE #/person hr
Elliptio complanata	Eastern Elliptio	85	7.08/hr
Elliptio icterina	Variable Spike	16	1.33/hr
Uniomerus carolinianus	Florida Pondhorn	23	1.92/hr
Villosa delumbis	Eastern Creekshell	15	1.25/hr
Villosa vaughaniana	Carolina Creekshell	13	1.08/hr

3) A total of 20 Eastern Elliptio, 4 Variable Spike, and 2 Florida Pondhorn were found in 1.50 person hours of survey time (Table 7). In addition, the Asian Clam and the aquatic snails Two-ridged Rams Horn and Pointed Campeloma were present.

Table 7. CPUE for Freshwater Mussels: Crooked Creek Additional Area 3

Scientific Name	Common Name	Number	CPUE #/person hr
Elliptio complanata	Eastern Elliptio	20	13.33/hr
Elliptio icterina	Variable Spike	4	2.67/hr
Uniomerus carolinianus	Florida Pondhorn	2	1.33/hr

3.3. Mussel Survey Discussion

Catena conducted mussel surveys within the FLUSA for the proposed Monroe Bypass project in both 2009 and 2012. The streams identified during the 2009 surveys that contain a robust freshwater mussel fauna were revaluated in 2012, because these streams could potentially support the Carolina Heelsplitter. Overall the results of the two survey efforts are very similar, and as was the case in 2009, the Carolina Heelsplitter was not found in any of the surveyed streams. In addition, the Savannah Lilliput remains extant in South Fork Crooked Creek, and like in 2009, a concentration of individuals was found within the proposed roadway crossing.

Differences between the two survey efforts are more likely a result of differences in time of year, survey conditions, and level of effort, rather than an indication of changes in mussel abundances. For example, while the Savannah Lilliput was found in low numbers (3 individuals) in Richardson Creek in 2009, it was not located in 2012, but is likely still present. As mentioned above, there was a large amount of leaf pack covering the substrate in 2012 generally making surveying difficult. This coupled with the very small size of the Savannah Lilliput (< 2 inches) is likely the reason it was not detected. The fact that most of the other species occurring in Richardson Creek were found in similar numbers further supports this assumption. Furthermore, the difficulty of detecting a species that is present in low numbers during in a one-time survey is highlighted by the fact that the Paper Pondshell was found (one individual) in Richardson Creek in 2012, but not in 2009, although it was known from the stream prior to 2009 (NCWRC Unpublished Aquatic Species Database).

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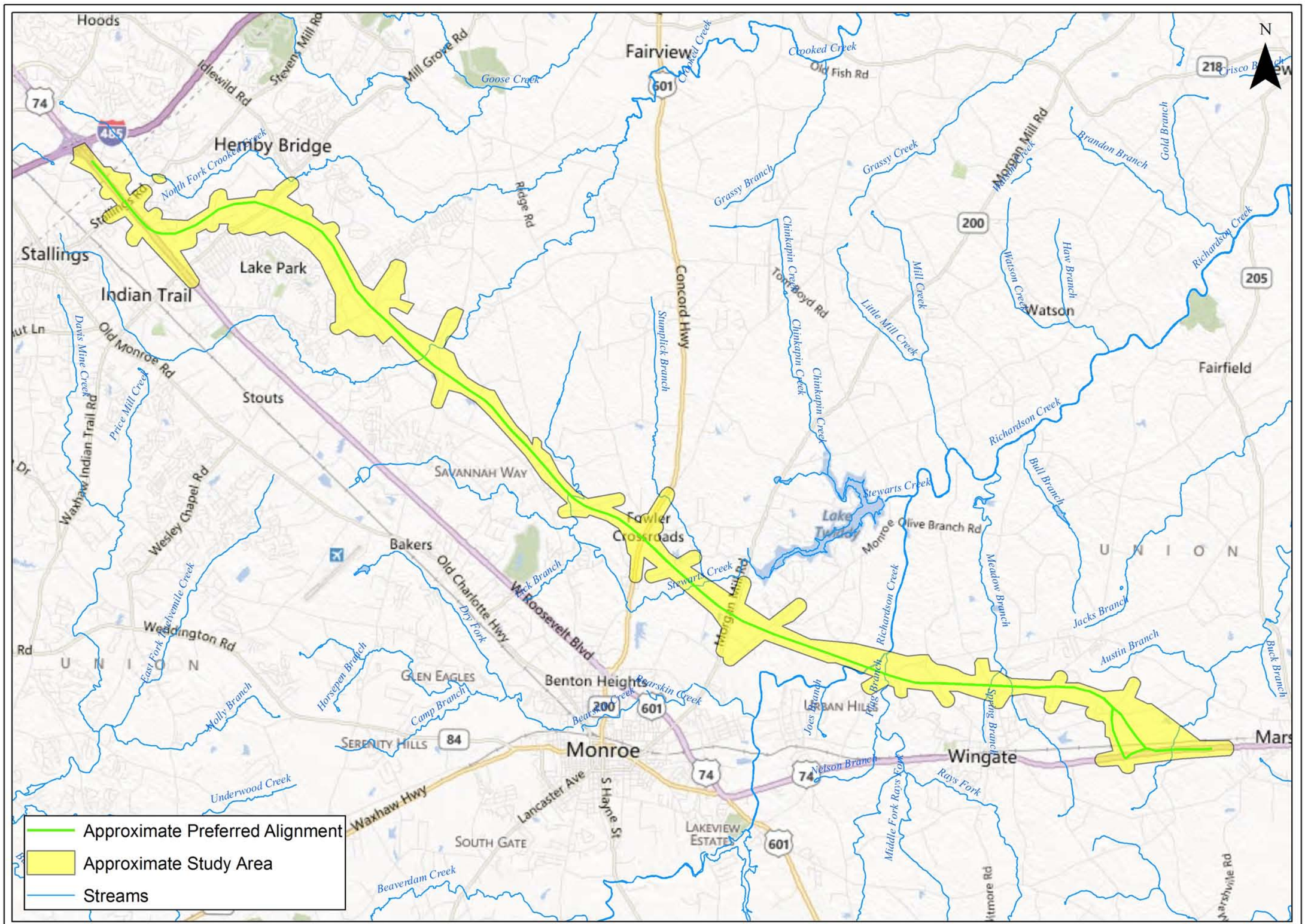


The Catena Group

Date: October 2012

Scale: 0 0.25 0.5 1 Miles

Job No.: 1161

Title:

Freshwater Mussel Surveys

Monroe Bypass (STIP R-3329 / R-2559)

Study Area

Mecklenburg and Union Counties, North Carolina

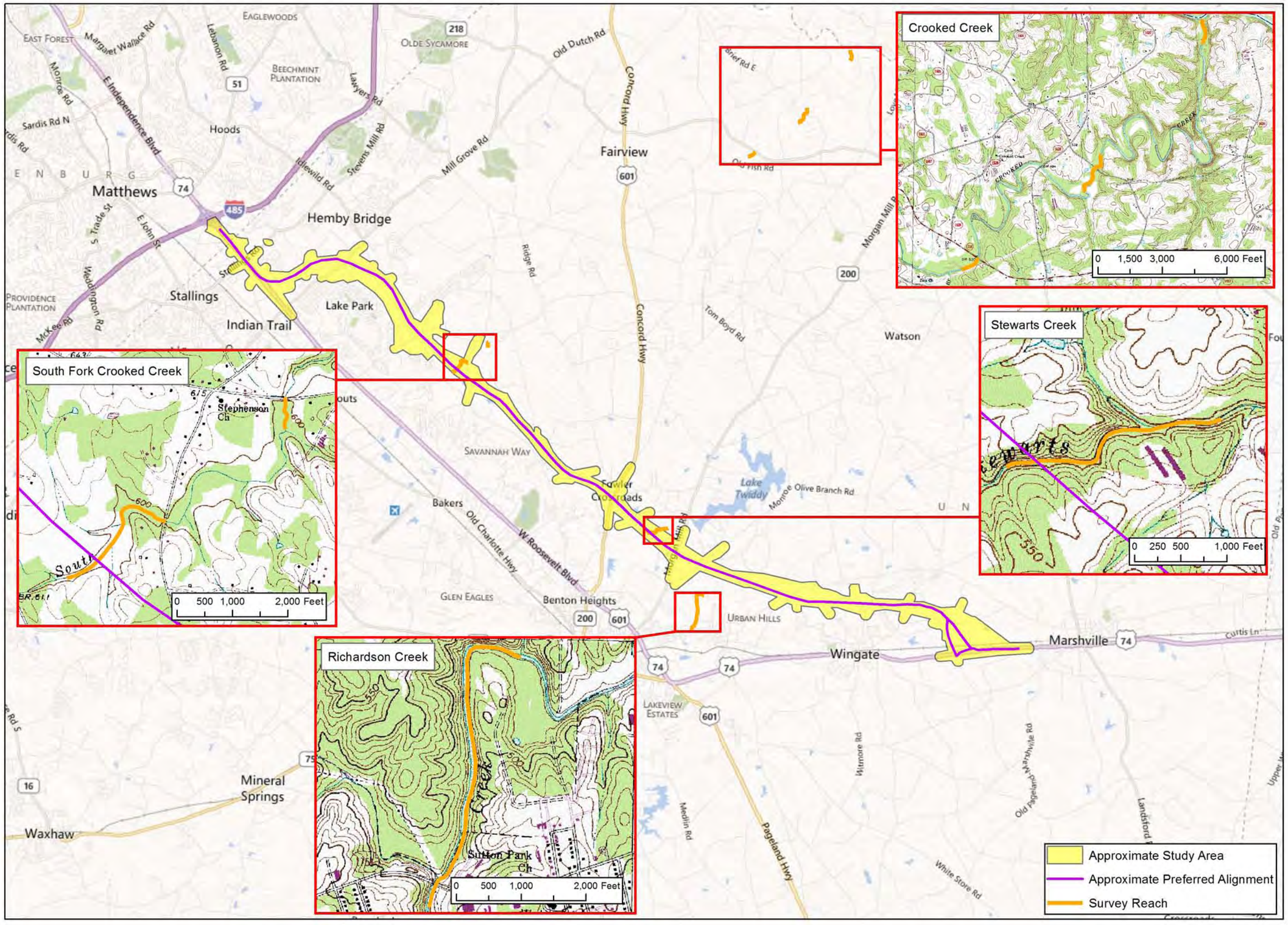
Client:

ATKINS

Atkins

Figure

1



The Catena Group

Date: October 2012

Scale: 0 0.5 1 2 Miles

Job No.: 1161

Title:

Freshwater Mussel Surveys

Monroe Bypass (STIP R-3329 / R-2559)

Study Area

Mecklenburg and Union Counties, North Carolina

Client:

ATKINS

Figure

2

APPENDIX B

ATKINS 2012 Plant Survey Report

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ATKINS

MEMORANDUM

To: file

From: Elizabeth Scherrer

CC: Christy Shumate

Date: October 1, 2012 (Revised 10/9/12)

Re: Surveys for Schweinitz's sunflower, Michaux's sumac, and Georgia aster at Monroe Bypass (STIP No. R-3329/R-2559) Revised Task Order 13F(E)

On September 17 through 21, Atkins scientists Elizabeth Scherrer and Jonathan Carr performed surveys for Schweinitz's sunflower (*Helianthus schweinitzii*), Michaux's sumac (*Rhus michauxii*), and Georgia aster (*Symphyotrichum georgianum* or *Aster georgianus*) at the Monroe Bypass project site. The survey area consisted of all areas affected by the project, including ROW, utility relocations, borrow/fill site, staging areas, etc., to update the survey conducted in September and October 2007. Also included in the survey area were the three known locations of Schweinitz's sunflower near the project area with a 500-foot buffer. Since all sites for utility relocations were not known at the time of the surveys, extensions of the plant survey area were drawn along all intersections with existing roads for a distance of 1,000 to 1,500 feet and a width of 200 feet.

Previous to the field surveys, Atkins reviewed aerial photos of the affected area to identify possible habitat areas for the three species. Suitable habitat consists of roadsides, utility right-of-ways, field edges, and other areas that receive abundant sunlight and are infrequently but regularly maintained. A total of approximately 35 acres, or 13.5 miles of linear transects, were targeted for field surveys. Surveys were performed visually using systematic overlapping transects to cover all suitable habitat areas. No plants of any of the three species were found. The Biological Conclusion is No Effect.

Previous to the field surveys, Atkins scientists visited the known locations of Schweinitz's sunflower along Secrest Shortcut Road to determine the local phenology of the species and to establish a search image. The two populations on the east side of the road appeared to be declining due to encroachment of shrubs and saplings. Four plants with 8 stems were found at the more northerly location, while 3 plants with 6 stems were seen at the more southerly location. In the powerline population east of Secrest Shortcut Road, an estimated 17 plants with 60 stems were found. Maintenance in this right-of-way area appears to be more regular and timed to ensure survival and increase of Schweinitz's sunflower. Atkins scientists visited the site of a known location along Highway 601 just north of the project corridor, but did not find any plants. A known population of Georgia aster on Cunningham Lane in Union County was also visited where approximately 12 stems were found that were in the first stages of blooming.

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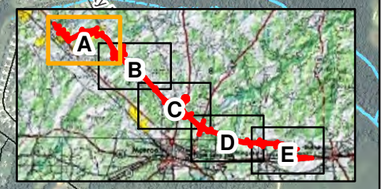
Schweinitz's Sunflower
Georgia Aster
Michaux's Sumac
Survey Area

Monroe Connector/Bypass
(Garden Parkway)
R-3329 and R-2559
100030367



MECKLENBURG COUNTY
UNION COUNTY

North Fork Crooked Creek
South Fork Crooked Creek
South Fork Crooked Creek

Survey Area
Sunflower Habitat Transects
NHP Sunflower Occurrences

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W
E
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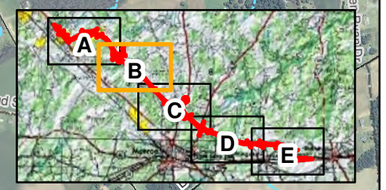
1,500 750 0 1,500
Feet

Figure
A

Schweinitz's Sunflower
Georgia Aster
Michaux's Sumac
Survey Area

Monroe Connector/Bypass
(Garden Parkway)
R-3329 and R-2559
100030367



Survey Area
Sunflower Habitat Transects
NHP Sunflower Occurrences

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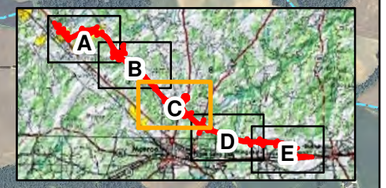
Feet

Figure
B

Schweinitz's Sunflower
Georgia Aster
Michaux's Sumac
Survey Area

Monroe Connector/Bypass
(Garden Parkway)
R-3329 and R-2559
100030367



Survey Area
Sunflower Habitat Transects
NHP Sunflower Occurrences

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Feet

Figure
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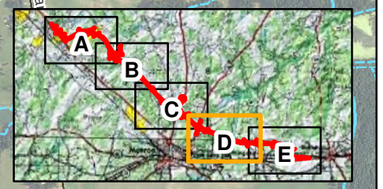
Schweinitz's Sunflower
Georgia Aster
Michaux's Sumac
Survey Area

Monroe Connector/Bypass
(Garden Parkway)
R-3329 and R-2559
100030367



Survey Area
Sunflower Habitat Transects
NHP Sunflower Occurrences

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1,500 750 0 1,500
Feet

Figure
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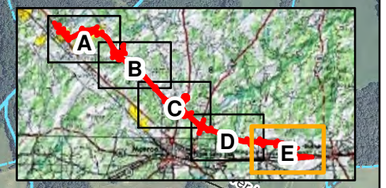
Schweinitz's Sunflower
Georgia Aster
Michaux's Sumac
Survey Area

Monroe Connector/Bypass
(Garden Parkway)
R-3329 and R-2559
100030367



Survey Area
Sunflower Habitat Transects
NHP Sunflower Occurrences

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1,500 750 0 1,500
Feet

Figure
E

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APPENDIX C

Conservation Measure Funding

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NC Department of Transportation
1514 Mail Service Center
Raleigh, NC 27699-1514

Phone: *919-733-3624 x354*
Fax: *919-733-9247*
Internet: *www.ncdot.org*

Warrant: 2967460

ENVIRONMENTAL BANC & EXCHANGE
10055 RED RUN BLVD, STE 130
OWINGS MILL MD 21117

Payment No.: **2001675228**
Warrant Date: **10/05/2010**
Vendor No.: **17096**

Page: **1 of 1**

Invoice Number	Invoice Date	DOT Tracking # / Remarks	PO/Contract #	Gross Invoice Amount*	Discount	Net Amount*
HS-PH1-1	08/04/2010	5200916126	6300025121	150,000.00	0.00	150,000.00
		Check Total				**$150,000.00**

Cashed 10/13/10

DETACH FROM CHECK AND KEEP FOR YOUR RECORDS

* Includes unplanned freight, if applicable

NC Department of Transportation
1514 Mail Service Center
Raleigh, NC 27699-1514

66-1059
531

Warrant 2967460
Date 10/05/2010
Void after One Year

PAY TO THE ORDER OF

$ 150,000.00

($> > > > 150,000.00)

ENVIRONMENTAL BANC & EXCHANGE
10055 RED RUN BLVD, STE 130
OWINGS MILL MD 21117

&%1B$(10100XA

State Treasurer, Raleigh, North Carolina
Payable at Par Through Federal Reserve System

Mark L. Foster
Chief Financial Officer

O2967460O T053110594T 5V000V601O

INVOICE

5200916126

North Carolina Turnpike Authority
Attn: Leslie Schuck
5400 Glenwood Avenue, Suite 400
Raleigh, NC 27612

August 4, 2010
Invoice - HS-PH1-1
Job - 711-SC02-065
GL - 02-902-711-430065

#63-251211 V-17096

Carolina Heelsplitter Conservation Bank:

	Units	Cost Per Unit	Invoice Amount
Item 1 - Carolina Heelsplitter Mussel Credits	25 0000	$ 6,000 00	$ 150,000 00
TOTALS			$ 150,000 00

Kindly submit a check in the amount of **$150,000.00** for **25 0000 Carolina Heelsplitter Mussel Credits**

Please make check payable to

Environmental Banc & Exchange, LLC
10055 Red Run Blvd., Ste. 130
Owings Mills, MD 21117

ok dwj

559100003.

Gaston 34922 1.TA1 0
Monroe 34533 1 TA1 150,000.00
Triangle Pkwy 39942 1.TA1 0
Cape Fear 40114 1 TA1 0
Mid Currituck 34470 1.TA1 0
Western Wake 35520.1 TA1 0

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

BEVERLY EAVES PERDUE
GOVERNOR

EUGENE A. CONTI, JR.
SECRETARY

REQUEST FOR COMMODITY/SERVICE PROCUREMENT

V-170960.

DATE: August 12, 2010

TO: State Purchase & Contract Office (Choose One) ☒
Statewide IT Procurement Office ☐

FROM: Eugene A. Conti, Jr.
NCDOT Secretary EC [signature]

THRU: NCDOT Using Agency: North Carolina Turnpike Authority

Requestor: Steve DeWitt [signature]

Requested Commodity/Service: Carolina Heelsplitter Mussel Credits – 25 credits @ $6,000 each

Justification of Procurement: We have received the approval the US Department of the Interior Fish and Wildlife Service for our proposed conservation measures with regards to the Monroe connector/Bypass project – please see attached letter.

Source of Funding: Monroe Connector/Bypass – 34533.1 TA1

Requested Amount: $ 150,000.00

Comments: _____

OK
GV
8 Sept 10

MAILING ADDRESS:
NC DEPARTMENT OF TRANSPORTATION
PURCHASING SECTION
1510 MAIL SERVICE CENTER
RALEIGH, NC 27699-1510

TELEPHONE: 919 733-7101
FAX 919-733-8743
WEBSITE: WWW.NCDOT.GOV

LOCATION:
401 OBERLIN ROAD
SUITE 250
RALEIGH, NC 27605

STATE OF NORTH CAROLINA
TURNPIKE AUTHORITY

BEVERLY E PERDUE
GOVERNOR

1578 MAIL SERVICE CENTER, RALEIGH, N C 27699-1578

DAVID W. JOYNER
EXECUTIVE DIRECTOR

Memorandum

To: File

From: Christy Shumate, AICP – NCTA-GEC

Subject: Conservation Measures for Carolina Heelsplitter Related to the Monroe Connector/Bypass Project

Date: May 25, 2010

The purpose of this memo is to document NCTA's decision process with regards to proposed conservation measures for the federally-endangered Carolina heelsplitter related to the Monroe Connector/Bypass project.

During preparation of the Biological Assessment, NCTA, FHWA, and consultants discussed proposing conservation measures to support the "May Affect, Not Likely to Adversely Affect" conclusion for the Carolina heelsplitter. Conservation measures considered included:

- Limitations on construction-related activities within the Goose Creek and Sixmile Creek watersheds.
- Stormwater improvement projects in the Goose Creek watershed.

A draft Biological Assessment was submitted to USFWS for informal review and discussion on April 19, 2010. No conservation measures were proposed in the draft document. NCTA opted not to propose anything, but instead discuss with USFWS following their review of the draft document. USFWS provided comments on the draft Biological Assessment via email on May 11, 2010. These included the following comment:

> *"Based on the conclusion on page 62, specifically, "... levels of uncertainty inherent in ICE analyses, a "No Effect" determination cannot be concluded". Given the current status of the Carolina heelsplitter and its habitat within the Goose, Duck and Sixmile Creek watersheds, any effects resulting from these uncertainties could be significant to the Carolina heelsplitter. Also, Section 7(a)(1) of the Endangered Species Act requires federal agencies to go beyond just avoiding or minimizing adverse effects to federally-listed species by utilizing their authorities to further the purposes of the Act by carrying programs for the conservation of listed species. Accordingly, we believe that some form of conservation for heelsplitter should be considered to address this uncertainty. We would be happy to meet to discuss conservation banking opportunities or other possibilities for conservation."*

In a phone conversation with USFWS representatives (Marella Buncick, Alan Ratzclaff, John Fridell) on May 14, 2010 at 1:00 PM, USFWS indicated their preferred conservation measure would be a monetary contribution to the Carolina Heelsplitter Conservation Bank. The mitigation bank is located in the Flat Creek watershed in Lancaster County, South Carolina and is managed by EBX. This watershed contains the most viable population of heelsplitter mussels. A monetary contribution could be used to

acquire additional easements within the watershed or for restoration or research within the existing bank. USFWS did not indicate an appropriate amount for this contribution.

Bruce Ellis, NCDOT-NEU, in a phone conversation on May 17, 2010, noted that NCDOT would support a monetary contribution to the Conservation Bank. Although the bank is out of state, it offers the best protection for the species as a whole. Mr. Ellis also stated that NCDOT has been funding water quality monitoring gauges in Goose and Waxhaw Creeks through a contract with USGS. The contract expires in June 2010, and Mr. Ellis suggested that the NCTA renew this contract as part of the Monroe Connector/Bypass project. He estimated the cost to be approximately $10,000-12,000 per year for 5 years for a total of $50,000-60,000.

In determining an appropriate amount for a monetary contribution to the Conservation Bank, NCTA considered direct and indirect impacts in Goose and Sixmile Creek watersheds from the project, direct impacts in other watersheds, average land value in Lancaster County, South Carolina, and the Bank's credit pricing schedule, as follows:

- The project does not have direct impacts in Goose Creek or Sixmile Creek watersheds. Based on Baker's Indirect and Cumulative Effects Quantitative Analysis (April 2010), the project does not contribute indirect effects to these watersheds.
- The project would result in approximately 23,083 linear feet of stream impacts (10,353 linear feet perennial and 12,729 linear feet intermittent) and 8.1 acres of wetlands.
- Average cost of undeveloped land in Lancaster County, South Carolina was estimated based on a web search of acreage for sale (see summary in Attachment). This cost is estimated to be $4,530 per acre.
- The Conservation Bank offers credits for impacts to riparian buffers and impervious surface creation. The price per credit is $6,000 (see Attachment).

The following assumptions were used to determine a reasonable number of credits that the project might require (if in a protected watershed). These assumptions were used to provide an estimate of an appropriate monetary contribution only – the project does not require purchase of any credits. Based on the anticipated direct impacts of the project (see assumptions in Attachment), approximately 25 credits would be appropriate. At a cost of $6,000, this would result in a total contribution of $150,000 to the Bank.

The Biological Assessment with request for concurrence on its biological conclusions was submitted to USFWS on May 25, 2010 for informal consultation under Section 7 of the Endangered Species Act. A response is expected from USFWS by June 30, 2010. The Biological Assessment included the following conservation measures to further ensure a conservative approach to the analysis of the project's impacts on this species and its habitat. (Section 8.6):

- if any construction staging, storage, refueling, borrow pit or spoil areas are to occur in the Goose Creek and Sixmile Creek watersheds, the NCTA will coordinate with the NCDOT DEO, USFWS, and the contractor to develop BMPs for each site to avoid and minimize the potential for adverse effects. Additionally, NCTA will follow NCDOT's Design Standards in Sensitive Watersheds for implementing erosion and sediment control BMPs along the entire project.
- NCTA is proposing to renew the funding of the USGS monitoring station at the US 601 crossing of Goose Creek in Union County.
- NCTA is proposing to provide funding to the Carolina Heelsplitter Conservation Bank in the Flat Creek watershed in Lancaster County, South Carolina in the amount of $150,000 to support ongoing research and surveying efforts, as well as protect, manage, and monitor land in the conservation bank.

ATTACHMENT

Current land prices in Lancaster County, South Carolina (May 2010) based on real estate listings (http://www.landwatch.com/South_Carolina_land_for_sale/Lancaster_County)

Acres	Asking Price	Avg Cost/Acre
140 @	399000 =	$2850
2.1 @	19,500 =	$9285
23.7 @	105000 =	$4430
76 @	201400 =	$2650
107 @	262150 =	$2450
1 @	8000 =	$8000
99 @	262350 =	$2650
3 @	4000 =	$1333
19 @	79000 =	$4158
5.2 @	39000 =	$7500

AVERAGE = $4,530/ac

Conservation Bank Credits

FWS Mitigation Credit Requirements per Acre	Credit:Impact Ratios Perennial	Intermittent
0-50' buffer encroachment	10 1	5 1
50'-100' buffer encroachment	5.1	2 1
100'-200' buffer encroachment	2.1	N/A
impervious surface creation	1 75·1	N/A

Using 5:1 ratio for perennial streams and assuming an average width of 10 feet:
10,353 feet x 10 feet / 43560 sf/ac x 5 = 11.5 credits

Using 2:1 ratio for intermittent streams and assuming an average width of 10 feet:
12,729 feet x 10 feet / 43560 sf/ac x 2 = 5.5 credits

Using 1:1 ratio for wetlands
8 ac = 8 credits

TOTAL = 25 credits

Environmental Banc & Exchange

OUR WORK

The Carolina Heelsplitter Conservation Bank

The Carolina Heelsplitter Conservation Bank is dedicated to preserving, enhancing, and restoring key parcels of land in target watersheds with viable populations of the Federally Endangered Carolina heelsplitter mussel. The Bank offers a creative, landscape scale solution to the preservation and recovery of this rare and endangered mussel species.

The service area of the Bank includes watersheds with known populations of the Carolina heelsplitter mussel in North and South Carolina. Credits may be purchased from the Bank and used to offset mitigation requirements associated with the Carolina heelsplitter mussel with the approval of federal, state and/or local agencies.

Regulatory considerations

A landowner or developer may need to mitigate for direct or indirect impacts to the Carolina heelsplitter mussel, or associated habitat, if one of the following applies to the project:

- Section 7 and Section 10 of the Endangered Species Act provides the U.S. Fish & Wildlife Service jurisdiction on projects which involve Federal monies, projects requiring a Federal permit, (such as a 404 permit from the U.S. Army Corp of Engineers), or projects covered by a Habitat Conservation Plan
- For projects in South Carolina within the Six Mile Creek watershed, Lancaster County Ordinance #963 (amended version of Ordinance #901) specifies mitigation requirements for the creation of impervious surface and/or impacts to riparian buffers.
- Situations where a project sponsor desires to eliminate the potential for liability from future impacts through a consultation with the U.S. Fish & Wildlife Service.
- State, county or local regulations and/or ordinances which may require mitigation for projects located in watersheds with known Carolina heelsplitter populations.

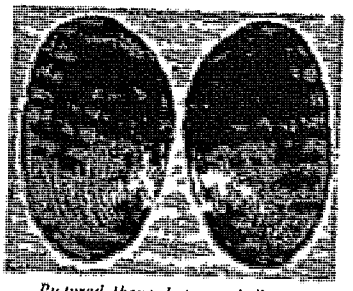
To discuss how the Bank can assist you in meeting your compensatory requirements, please contact Randy Wilgis, **randy@ebxusa.com**
803-432-4890 (ofc)
410-236-5123 (cell)

We are glad to share our experiences in working out collaborative Heelsplitter mitigation solutions between local governments, regulatory agencies, and developers. Contact Randy Wilgis, **randy@ebxusa.com**

The Carolina Heelsplitter Mussel is Unique and Rare

- Historically, the Carolina heelsplitter was estimated to have a distribution covering much of the Piedmont sections of the Savannah, Santee-Cooper, and Pee Dee river basins.
- Today the endemic Carolina heelsplitter mussel species is limited to a small area of the Piedmont within North and South Carolina,

with small populations remaining in only 10 creek or headwater river watersheds.
- Habitat destruction due to silviculture, development, and agriculture has reduced and fragmented habitat.
- The Carolina heelsplitter historically served an important function in maintaining water quality in North and South Carolina It was also an important component within aquatic food webs.



Pictured above: Exterior shell of the Carolina Heelsplitter

Conservation Bank Property is High-Quality Habitat

The initial phase of the Carolina Heelsplitter Conservation Bank encompasses approximately 810 acres of land and is situated adjacent to the Forty Acre Rock Heritage Preserve in Lancaster County. This property is located within the Flat Creek watershed, which has one of the most viable populations of the Carolina heelsplitter in the Carolinas. The Bank includes approximately 400 acres of riparian buffers which protect three major tributaries feeding into Flat Creek, and 25 acres of high quality wetlands The Bank will incorporate a trust fund to support the ongoing research and surveying efforts to provide long term protection and re-establishment of the endangered Carolina heelsplitter, along with an endowment fund to protect, manage and monitor the land in perpetuity.

Carolina Heelsplitter Credit Purchasing Process

Credit calculation ratios for projects in the Six Mile Creek watershed in Lancaster County, SC can be found in County Ordinance #963. Per the ordinance, credits need to be acquired prior to release of the grading permit.

If your project is in North Carolina or in South Carolina outside of the Six Mile Creek watershed, the Bank will have a service area approved by U.S. Fish & Wildlife Service encompassing all of North and South Carolina but the use of credits from the Bank is subject to approval by state and local regulatory agencies.

To discuss how the Carolina Heelsplitter Conservation Bank can assist you in meeting your Carolina heelsplitter compensatory requirements, please contact Randy Wilgis with the Environmental Banc & Exchange. Randy can be reached at:

803-432-4890 (ofc)
410-236-5123 (cell)
randy@ebxusa.com

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hswyers @usgs.gov

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

BEVERLY EAVES PERDUE
GOVERNOR

EUGENE A. CONTI, JR.
SECRETARY

6300026417

REQUEST FOR COMMODITY/SERVICE PROCUREMENT

#V-1873

DATE: September 14, 2010

(Choose One)

TO: State Purchase & Contract Office ☒
Statewide IT Procurement Office ☐

FROM: Eugene A. Conti, Jr.
NCDOT Secretary

THRU: NCDOT Using Agency: North Carolina Turnpike Authority

Requestor: David Joyner

Requested Commodity/Service: US Geological Survey data program for Waxhaw Creek (period of July 2010 thru June 2015) and Goose Creek (period of October 2010 thru September 2015) – $75,100 each = $150,200.00

Justification of Procurement: WUSGS program with the NCDOT for the operation and maintenance of the streamgaging station at: Goose Creek at Highway 601 near Fairview, NC (USGS station number 02124692) and Waxhaw Creek at SR 1103 near Jackson, NC (USGS station number 02147126) - Monroe Connector/Bypass project.

Source of Funding: Monroe Connector/Bypass – 34533.1.TA1

Requested Amount: $ 150,200.00

Comments: _____

MAILING ADDRESS:
NC DEPARTMENT OF TRANSPORTATION
PURCHASING SECTION
1510 MAIL SERVICE CENTER
RALEIGH, NC 27699-1510

TELEPHONE: 919-733-7101
FAX: 919-733-8743

WEBSITE: WWW.NCDOT.GOV

LOCATION:
401 OBERLIN ROAD
SUITE 250
RALEIGH, NC 27605

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
North Carolina Water Science Center
3916 Sunset Ridge Road
Raleigh, North Carolina 27607

RECEIVED
SEP 1 2010
DIVISION OF HIGHWAYS
PDEA-OFFICE OF NATURAL ENVIRONMENT

August 30, 2010

Mr. Bruce Ellis
NCDOT
Natural Environment Unit
1598 Mail Service Center
Raleigh, NC 27699-1598

Dear Bruce:

Thank you for your continuing support of U.S. Geological Survey data programs, which we conduct across North Carolina in cooperation with more than 30 local, State and Federal agencies.

Our program with the NCDOT for the operation and maintenance of the streamgaging station on Goose Creek at Highway 601 near Fairview, NC (USGS Station Number 02124692) for the period October 1, 2010 through September 30, 2015 is summarized in the table below.

Annual Operation Period	Annual Operation and Maintenance Costs
October 1, 2010 – September 30, 2011	$ 14,300
October 1, 2011 - September 30, 2012	$ 14,600
October 1, 2012 - September 30, 2013	$ 15,000
October 1, 2013 - September 30, 2014	$ 15,400
October 1, 2014 – September 30, 2015	$ 15,800
TOTAL	$ 75,100

Attached are are four copies of the Joint Funding Agreement (JFA). Please have the enclosed JFA signed and return two copies to us before September 30, 2010. Regulations state that we cannot continue to work or start new work until we receive the signed agreement. Work performed with funds from this agreement will be conducted on a fixed-price basis. The results of all work under this agreement will be available for publication by the USGS.

(919) 571-4000 • FAX (919) 571-4041

Let us know if you have any questions about our program or if we can assist you in any other way. If you have any questions, please call me at (919) 571-4000 or Jerald "Boo" Robinson at (704) 3344,6272 etx. 11.

Sincerely,

Holly S. Weyers, Director
USGS North Carolina Water Science Center

cc: Jerald "Boo" Robinson, USGS, Charlotte Field Office

Form 9-1366
(Oct. 2005)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	NC002
Agreement #:	11E4NC2510GOOSE
Project #:	2510-
TIN #:	53-0196958
Fixed Cost Agreement	☑ Yes ☐ No

FOR
WATER RESOURCES INVESTIGATION

THIS AGREEMENT is entered into as of the 30th day of August, 2010, by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, NATURAL ENVIRONMENTAL UNIT, party of the second part.

1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation the operation and maintenance of the streamgaging station on Goose Creek at Highway 601 near Fairview , NC (USGS Station Number 02124692), herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.

2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of $0.00.

(a) $0.00 by the party of the first part during the period October 1, 2010 **to** September 30, 2015

(b) $75,100.00 by the party of the second part during the period October 1, 2010 **to** September 30, 2015

(All are unmatched funds)

(c) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.

(d) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.
7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

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Form 9-1366
continued

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	NC002
Agreement #:	11E4NC2510GOOSE
Project #:	2510-
TIN #:	53-0196958

8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at costs, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.
9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered **quarterly**. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983).

U.S. Geological Survey
United States
Department of the Interior

USGS Point of Contact

Name: Jerald "Boo" Robinson
Address: 810 Tyvola Road
Suite 108
Charlotte, NC 28217
Telephone: 704-3344-6272, ext. 11
Email: jbrobins@usgs.gov

Signatures

By _____ Date 8/30/10
Name: Holly S. Weyers
Title: Director, NC Water Science Center

By _____ Date _____
Name:
Title:

By _____ Date _____
Name:
Title:

NC Department of Transportation
Natural Environmental Unit

Customer Point of Contact

Name: Bruce Ellis
Address: 1598 Mail Service Center
Raleigh, NC 27699-1598

Telephone: 919-715-1418
Email: bellis@dot.state.nc.us

Signatures

By _____ Date 9-19-10
Name:
Title:

By _____ Date _____
Name:
Title:

By _____ Date _____
Name:
Title:

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
North Carolina Water Science Center
3916 Sunset Ridge Road
Raleigh, North Carolina 27607

June 22, 2010

RECEIVED
JUN 24 2010
DIVISION OF HIGHWAYS
PDEA-OFFICE OF NATURAL ENVIRONMENT

Mr. Bruce Ellis
NCDOT
Natural Environment Unit
1598 Mail Service Center
Raleigh, NC 27699-1598

Dear Bruce:

Thank you for your continuing support of U.S. Geological Survey data programs, which we conduct across North Carolina in cooperation with more than 30 local, State and Federal agencies.

Our program with the NCDOT for the operation and maintenance of the streamgaging station on Waxhaw Creek at SR 1103 near Jackson, NC (USGS Station Number 02147126) for the period July 1, 2010 through June 30, 2015 is summarized in the table below.

Annual Operation Period	Annual Operation and Maintenance Costs
July 1, 2010 - June 30, 2011	$ 14,300
July 1, 2011 - June 30, 2012	$ 14,600
July 1, 2012 - June 30, 2013	$ 15,000
July 1, 2013 - June 30, 2014	$ 15,400
July 1, 2014 - June 30, 2015	$ 15,800
TOTAL	$ 75,100

Attached are are four copies of the Joint Funding Agreement (JFA). Please have the enclosed JFA signed and return two copies to us before June 30, 2010. Regulations state that we cannot continue to work or start new work until we receive the signed agreement. Our current JFA expires June 30, 2010. Work performed with funds from this agreement will be conducted on a fixed-price basis. The results of all work under this agreement will be available for publication by the USGS.

Let us know if you have any questions about our program or if we can assist you in any other way. If you have any questions, please call me or Jeanne Robbins at (919) 571-4001.

Sincerely,

Douglas A. Harned

Douglas A. Harned, Acting Director
USGS North Carolina Water Science Center

cc: Jerald "Boo" Robinson, USGS, Charlotte Field Office.

(919) 571-4000 • FAX (919) 571-4041

Form 9-1366
(Oct. 2005)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	NC002
Agreement #:	10E4NC2510
Project #:	2510-
TIN #:	53-0196958
Fixed Cost Agreement	☑ Yes ☐ No

Page 1 of 2

FOR
WATER RESOURCES INVESTIGATIONS

THIS AGREEMENT is entered into as of the 22nd day of June, 2010, by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the NC DEPARTMENT OF TRANSPORTATION, NATURAL ENVIRONMENT UNIT, party of the second part.

1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation for the operation and maintenance of the streamgaging station on Waxhaw Creek at SR 1103 near Jackson, NC (USGS Station Number 02147126), herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of $0.00.

(a) $0.00 by the party of the first part during the period July 1, 2010 **to** June 30, 2015

(b) $75,100.00 by the party of the second part during the period July 1, 2010 **to** June 30, 2015

(All unmatched funding)

(c) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.

(d) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.
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Form 9-1366 continued

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	NC002
Agreement #:	10E4NC2510
Project #:	2510-
TIN #:	53-0196958

8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at costs, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.
9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered **quarterly**. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983).

U.S. Geological Survey
United States
Department of the Interior

USGS Point of Contact

Name: Jeanne C. Robbins
Address: 3916 Sunset Ridge Road
Raleigh, NC 27607
Telephone: 919-571-4017
Email: jrobbins@usgs.gov

Signatures

By Douglas A. Harned Date 6-22-2010
Name: Douglas A. Harned
Title: Acting Director, USGS NC Water Science Center

By_____ Date_____
Name:
Title:

By_____ Date_____
Name:
Title:

NC Department of Transportoration
Natural Environment Unit

Customer Point of Contact

Name: Mr. Bruce Ellis
Address: 1598 Mail Service Center
Raleigh, NC 27699-1598
Telephone: 919-715-1418
Email: bellis@dot.state.nc.us

Signatures

By [signature] Date 9-19-10
Name:
Title:

By_____ Date_____
Name:
Title:

By_____ Date_____
Name:
Title:

Form 9-1366
(Oct. 2005)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	NC002
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Fixed Cost Agreement	☑ Yes ☐ No

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Form 9-1366
continued

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

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Project #:	2510-
TIN #:	53-0196958

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U.S. Geological Survey
United States
Department of the Interior

USGS Point of Contact

Name: Jeanne C. Robbins
Address: 3916 Sunset Ridge Road
Raleigh, NC 27607
Telephone: 919-571-4017
Email: jrobbins@usgs.gov

Signatures

By Douglas A. Harned Date 6-22-2010
Name: Douglas A. Harned
Title: Acting Director, USGS NC Water Science Center

By _____ Date _____
Name:
Title:

By _____ Date _____
Name:
Title:

NC Department of Transportoration
Natural Environment Unit

Customer Point of Contact

Name: Mr. Bruce Ellis
Address: 1598 Mail Service Center
Raleigh, NC 27699-1598
Telephone: 919-715-1418
Email: bellis@dot.state.nc.us

Signatures

By _____ Date 9-19-10
Name:
Title:

By _____ Date _____
Name:
Title:

By _____ Date _____
Name:
Title:

Form 9-1366
(Oct. 2005)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	NC002
Agreement #:	11E4NC2510GOOSE
Project #:	2510-
TIN #:	53-0196958
Fixed Cost Agreement	☑ Yes ☐ No

FOR
WATER RESOURCES INVESTIGATION

THIS AGREEMENT is entered into as of the 30th day of August, 2010, by the U.S. GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the NORTH CAROLINA DEPARTMENT OF TRANSPORTATION, NATURAL ENVIRONMENTAL UNIT, party of the second part.

1. The parties hereto agree that subject to availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation the operation and maintenance of the streamgaging station on Goose Creek at Highway 601 near Fairview , NC (USGS Station Number 02124692), herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50; and 43 USC 50b.
2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) includes In-Kind Services in the amount of $0.00.

by the party of the first part during the period

(a) $0.00 October 1, 2010 **to** September 30, 2015

by the party of the second part during the period

(b) $75,100.00 October 1, 2010 **to** September 30, 2015

(All are unmatched funds)

(c) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.

(d) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.
4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.
5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.
6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.
7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

Page 2 of 2

Form 9-1366
continued

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement

Customer #:	NC002
Agreement #:	11E4NC2510GOOSE
Project #:	2510-
TIN #:	53-0196958

8. The maps, records, or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records, or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program and, if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at costs, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records, or reports published by either party shall contain a statement of the cooperative relations between the parties.
9. USGS will issue billings utilizing Department of the Interior Bill for Collection (form DI-1040). Billing documents are to be rendered **quarterly**. Payments of bills are due within 60 days after the billing date. If not paid by the due date, interest will be charged at the current Treasury rate for each 30 day period, or portion thereof, that the payment is delayed beyond the due date. (31 USC 3717; Comptroller General File B-212222, August 23, 1983).

U.S. Geological Survey
United States
Department of the Interior

USGS Point of Contact

Name: Jerald "Boo" Robinson
Address: 810 Tyvola Road
Suite 108
Charlotte, NC 28217
Telephone: 704-3344-6272, ext. 11
Email: jbrobins@usgs.gov

Signatures

By_____ Date 8/30/10
Name: Holly S. Weyers
Title: Director, NC Water Science Center

By_____ Date_____
Name:
Title:

By_____ Date_____
Name:
Title:

NC Department of Transportation
Natural Environmental Unit

Customer Point of Contact

Name: Bruce Ellis
Address: 1598 Mail Service Center
Raleigh, NC 27699-1598

Telephone: 919-715-1418
Email: bellis@dot.state.nc.us

Signatures

By_____ Date 9-19-10
Name:
Title:

By_____ Date_____
Name:
Title:

By_____ Date_____
Name:
Title:

APPENDIX D

Union Power Cooperative
Schweinitz's Sunflower Restricted Sites Guidelines

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Understanding Reached With U.S. Fish and Wildlife Service Regarding Access Into Schweinitz Sunflower Restricted Sites Because of Union Power Cooperative Operations

Carrie Lorenz and Wil Ortiz will serve as the point of contact with the USFW to minimize misunderstandings and streamline the follow-up required.

- For Pre-Planned Activities- During the restricted access season of April 1st through November 15th, Union Power must make contact with Carolyn Wells at (828) 258-3939 ext 231 (Monday through Friday) between 8am and 5pm prior to work commencement. Zero can be pressed at any time to get to an operator or other co-worker. This applies if you need to cut a path to get to the equipment or require to introduce equipment into the sites. If you simply need to walk into the sites and no visual impact will be left then no contact is required. They want the opportunity to be able to move plants, if at all possible and necessary, to avoid being destroyed by Union Power activities.

- For Emergency Situations- Simply provide us with a map of the location highlighted. If warranted, we will submit report to the USFW regarding the access.

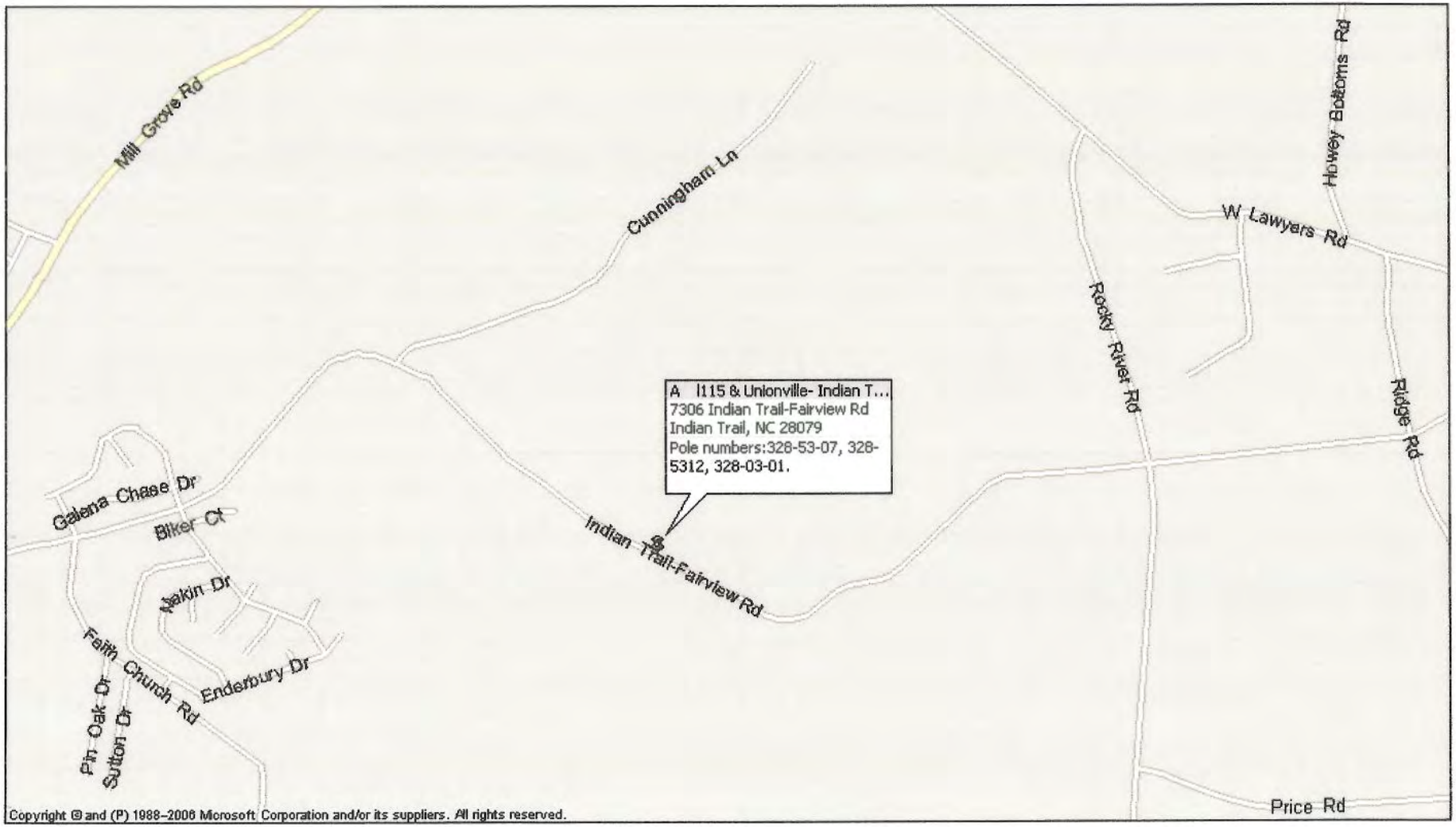
- Access During the Off-Season (November 16th through March 31st- no mowing or driving of vehicles that will compact the ground, create ruts, make holes, or in any way disturb the topsoil. Foot traffic is perfectly fine. Cutting of brush to access equipment is also permitted provided it's removed from the area.

NCDOT Management
Schweinitz's Sunflower Areas
Exact Locations of Sites NOT to MOW or Disturb within Utility ROWs

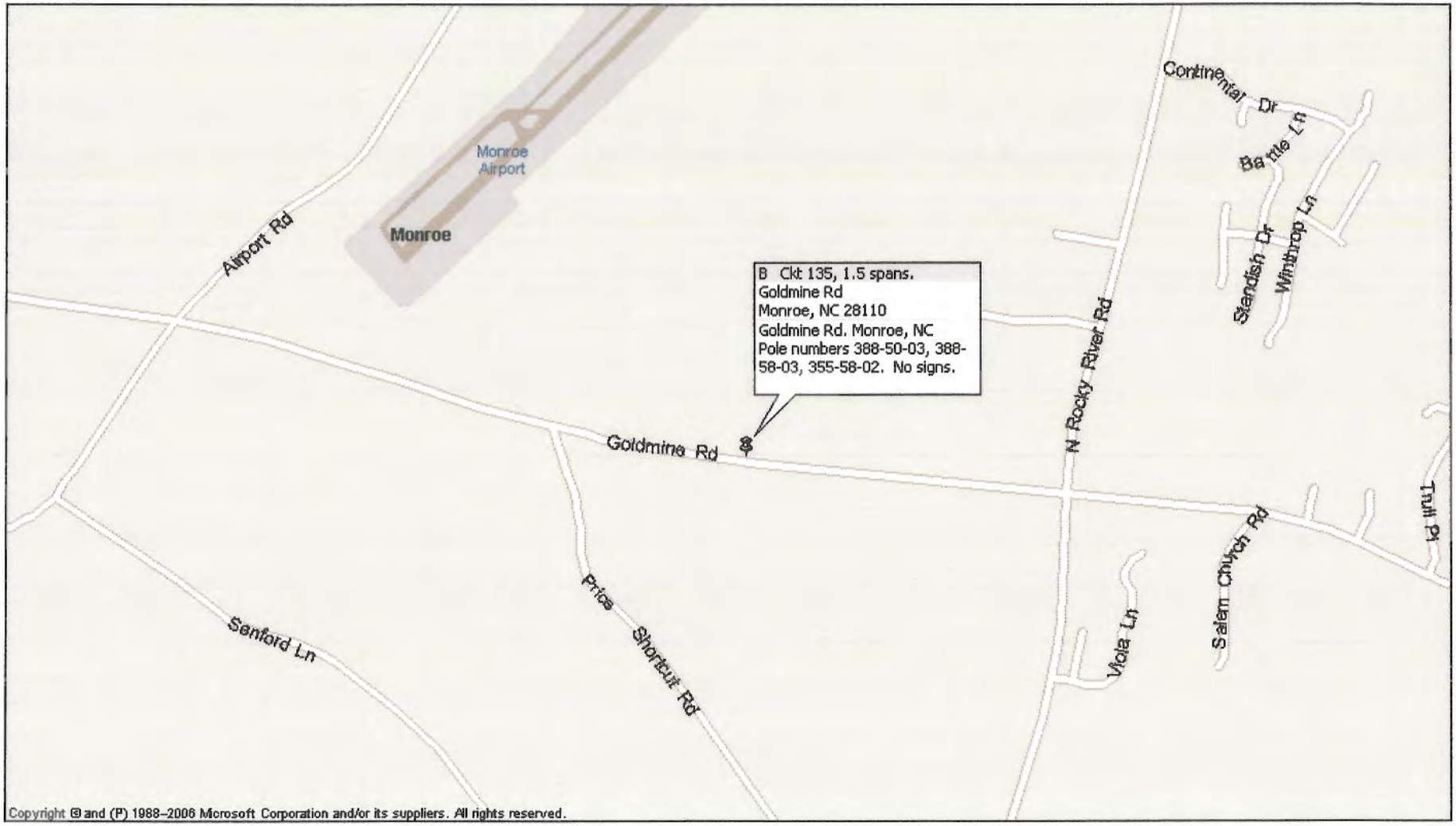
Location on Map	Address/Street	Circuit	Number of Spans	Pole Numbers	Notes
A	7306 Indian Trail-Fairview Rd	115 & Unionville-Indian Trail Transmission	4.5	328-53-07, 328-53-12, 328-03-01	
B	Goldmine Rd.	135	1.5	388-50-03, 388-58-03, 355-58-02	no signs
C	6616 Waxhaw Highway	152	1	446-29-03, 446-29-05	
D	6719 Waxhaw Highway	152	2	446-28-07, 446-28-06, 446-2804	
E	Waxhaw Highway & Western Union School Rd	152	3.5	446-27-02, 446-27-01, 446-28-08, 446-28-05,	
F	7623 Waxhaw Highway	152	6	445-40-08, 445-40-09, 445-40-01, 445-40-07, 446-33-05, 446-33-12, 446-33-03	There are 6 spans for sure, but there could be as many as 20 spans if some of the signs are missing.
G	3504 Waxhaw Marvin Rd	187	3	424-28-12, 424-27-11, 424-27-01, 424-19-02	Unsure if ROW is shared with DOT or not. Our lines don't follow the road exactly and there is a thin line of trees between road and lines.
H	9509 Marvin School Rd	188	0.25	403-07-02	no signs
I	9206 Joe Kerr Rd	188	1	383-63-03, 383-63-04	no signs
J	Miami Church Rd	71	2	171-64-04, 171-64-03, 171-64-02	
K	5485 Miami Church Rd	71	1.5	171-43-02, 171-43-08, 171-43-06	Lines shift away from DOT ROW and then merge back into same ROW again.
L	16301 Hwy 52 N	21	1.5	095-13-07, 095-13-08, 095-05-01	no signs
M	intersection of Wagoner Rd. & Hwy 52 N	21	2.5	095-05-01, 095-04-09, 095-04-03, 095-04-04	no signs, unsure if this is one of the spray areas or not
N	16093 Hwy 52 N	21	1	095-04-04, 095-04-05	no signs
O	15901 Hwy 52 N	21	1	075-59-02, 075-59-03	no signs
P	15585 Hwy 52 N	21	2	075-51-03, 075-51-02, 075-51-01	
Q	Old Beatty Ford Rd	21	1.5	075-42-03, 075-42-02, 075-42-01	

* note other sunflower areas are under Duke lines, if DOT would like to contact them as well, they are marked on the map.

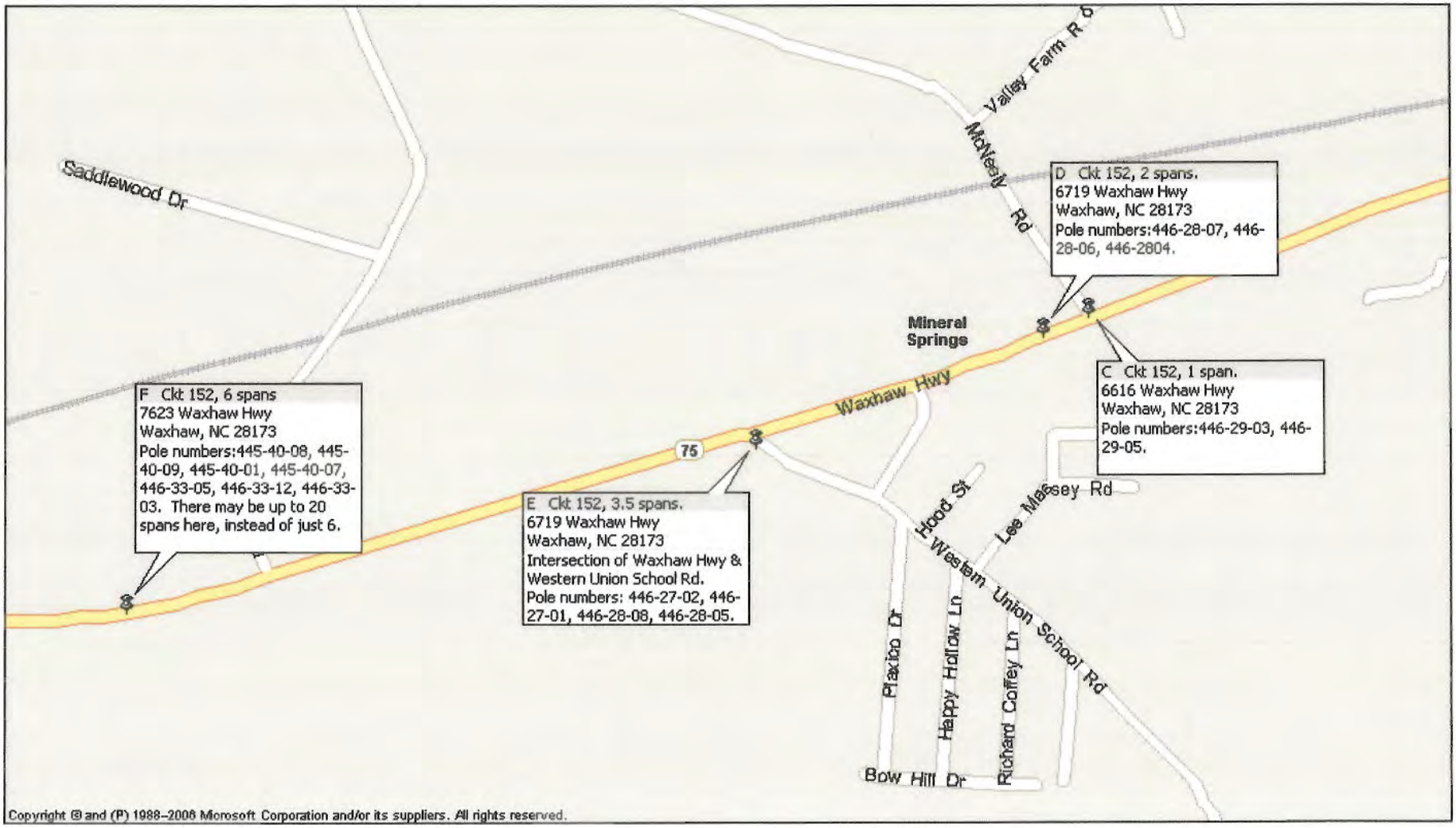
Schweinitz Sunflower
Site A



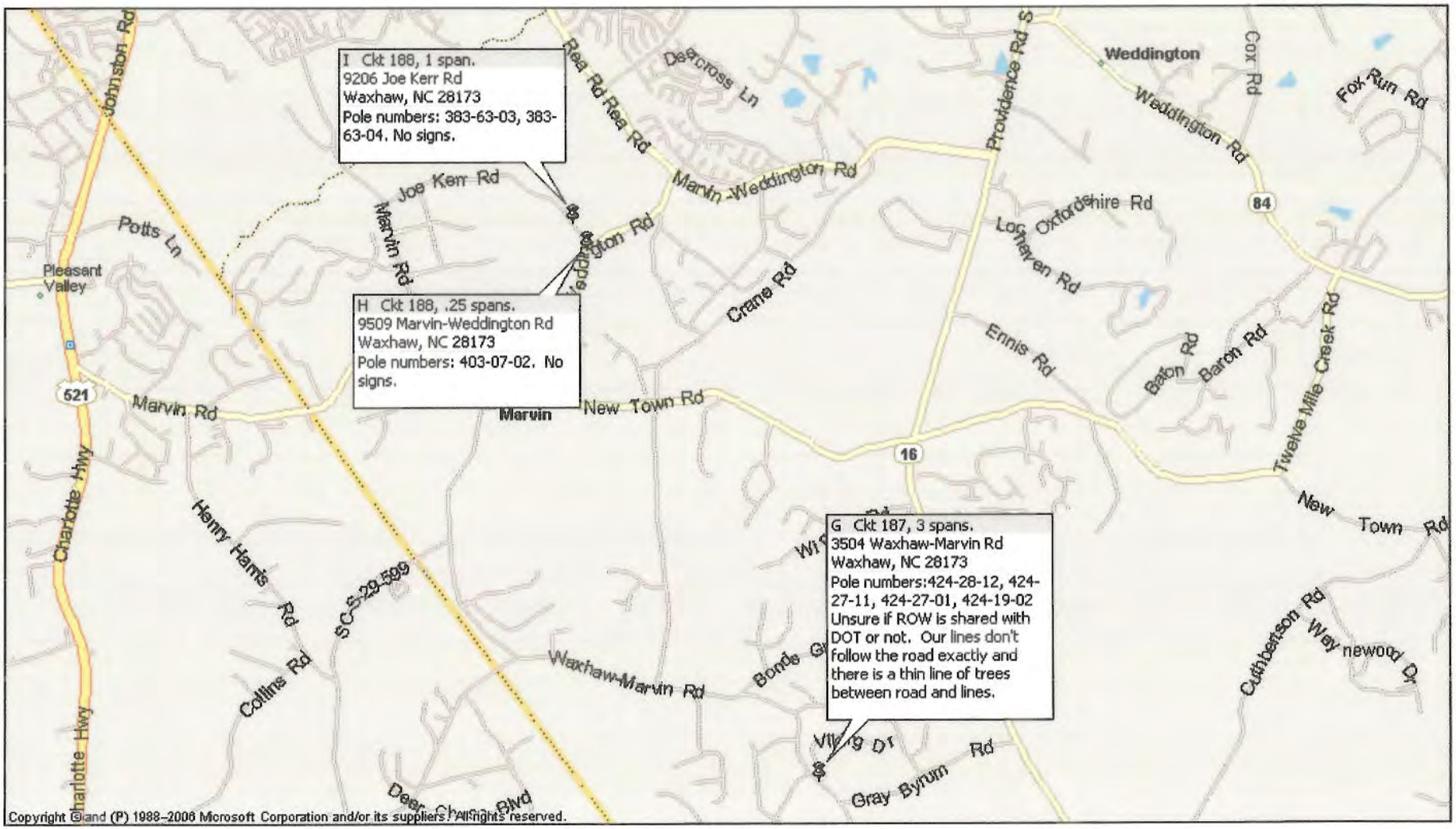
Schweinitz Sunflower
Site B



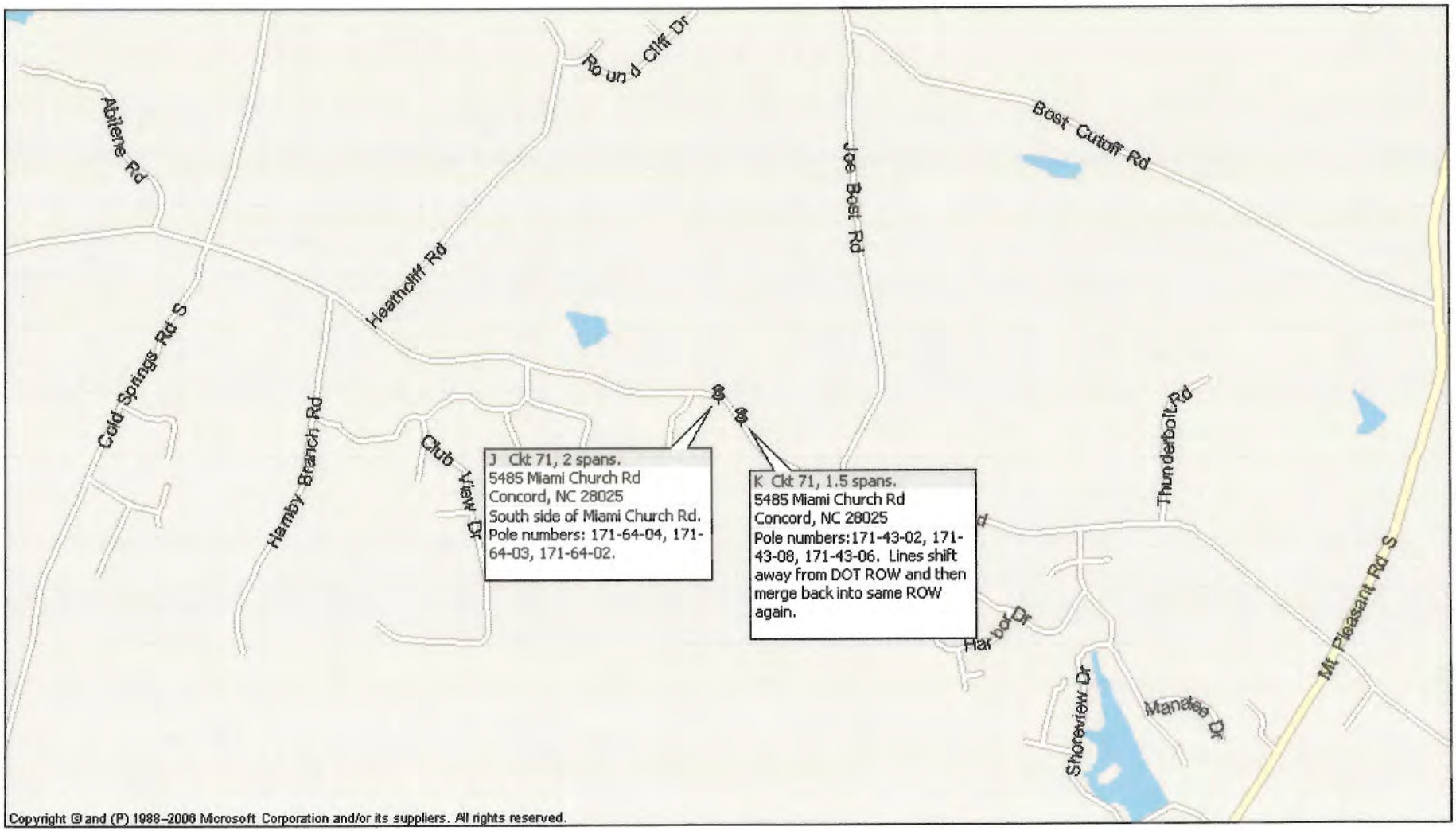
Schweinitz Sunflower
Site C-F



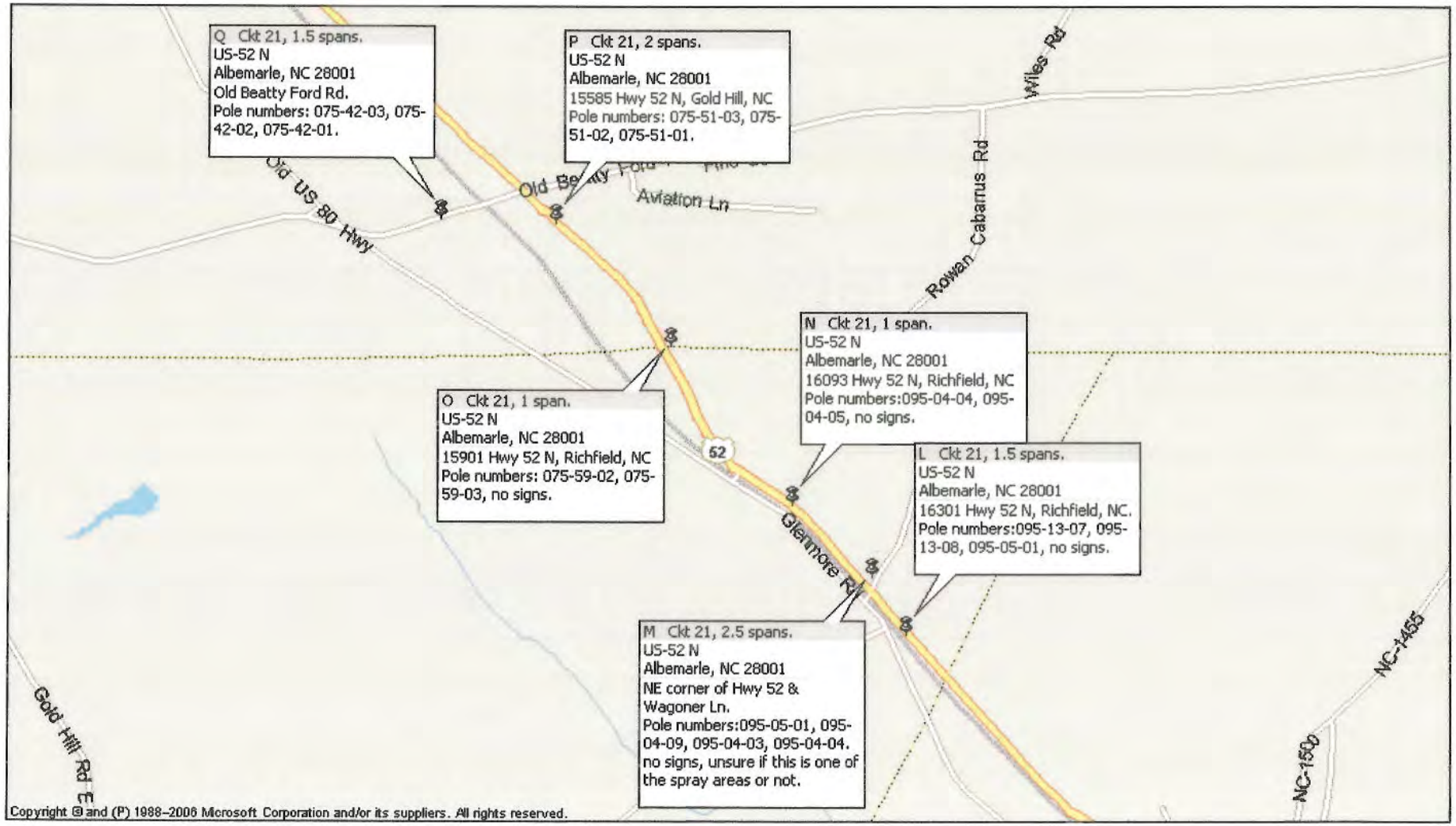
Schweinitz Sunflower
Site G-I



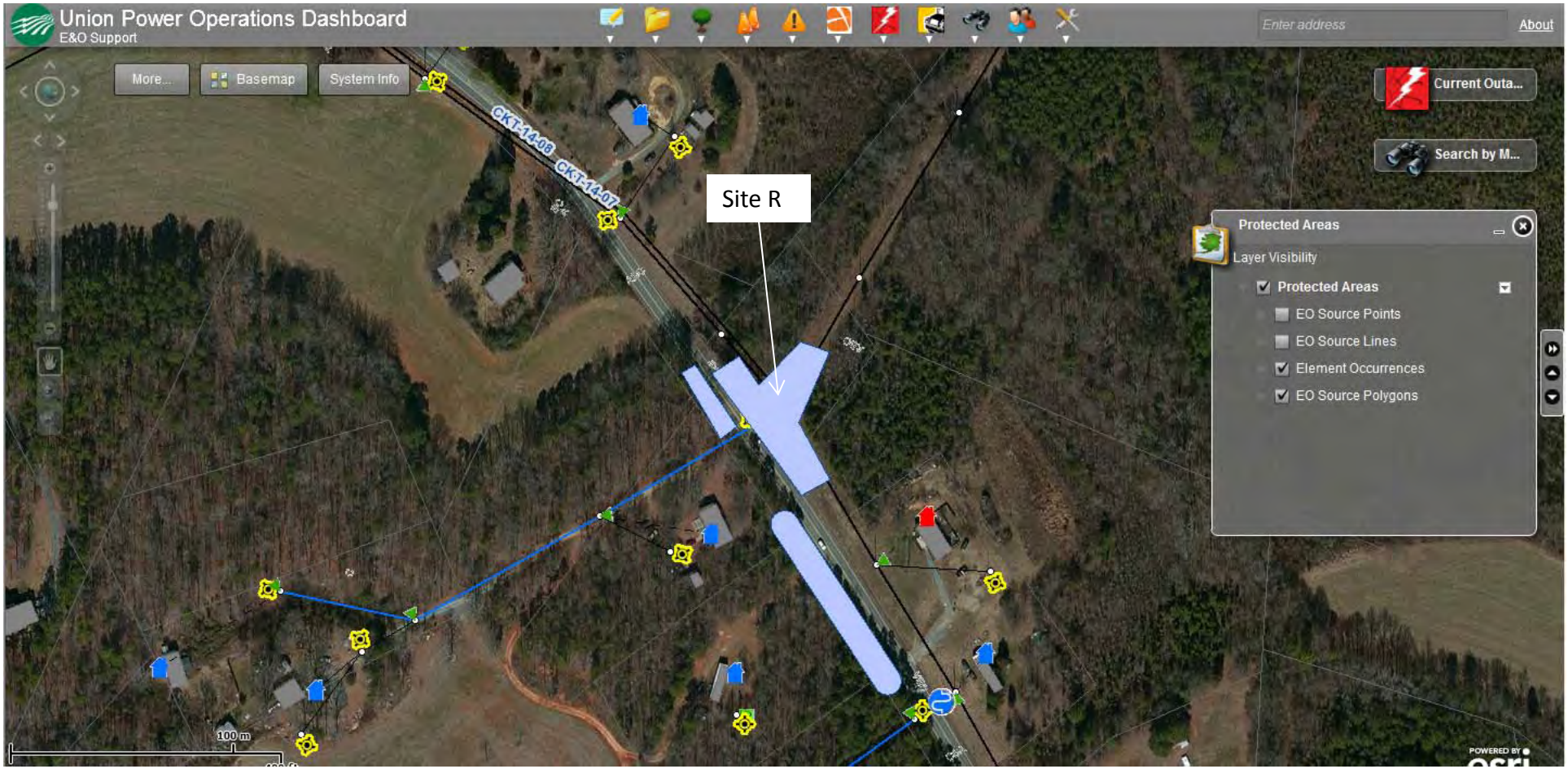
Schweinitz Sunflower
Site J & K



Schweinitz Sunflower
Site L-Q



Site R as it appears on our Dashboard System. All Field Personnel have access to this information.



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APPENDIX E

NCDOT Roadside Vegetation Management Guidelines in Marked Areas

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Center for Environmental Excellence by AASHTO
One Stop Source of Environmental Information for Transportation Professionals

Chapter 11
Appendix

11.33. NCDOT Roadside Vegetation Management Guidelines in Marked Areas

Example 35 : NCDOT Roadside Vegetation Management Guidelines in Marked Areas

- No mowing April 1-November 15.
- No herbicides, no fertilizers. (Exceptions can be made for herbicides under special circumstances, discussed below.)
- Mowing from November 16-March 31 is allowed and, in most cases (*see exception below) , should be done at least *every other year*. Winter mowing every year is acceptable. If regular contract mowers are unable to mow the sites under this time frame, NCDOT mowers may be used during the winter.
- Mowing should not be conducted when the soil is wet, as compaction and rutting will occur.
- In some instances, rare plants may be growing right along the edge of the road. Ideally, the plants should be protected if at all possible in this situation, but if NCDOT division staff determine that the road shoulder should be mowed during the growing season for safety or visibility, then the shoulder may be mowed accordingly. If possible, an NCDOT biologist can visit the site and mark where individual plants are, so they can be avoided.
- NCDOT mowing contracts are under modification to ensure that contractors are responsible for finding out if any endangered plants are within the areas they will be working, and for avoiding injury to the plants. The County Mowing Inspector or the Division Roadside Environmental Engineer should review the No Mow policy with each county maintenance office and mowing contractor prior to any mowing activities on roads with rare plant populations.
- The standard mowing height is usually four inches; ideally, the mower should be set at a level to avoid scalping the ground and damaging rare plants.
- Clippings from winter mowing should be left on site so any rare plant seeds produced will have the opportunity to germinate within the population. An exception can be made if only weeds are reproducing.
- Prior to entering the site, mowers and equipment should be cleaned off, removing any accumulated vegetative debris that contains weed seeds.
- Rare plants along roadsides often extend into utility line ROWs. Utilities managing plant growth in DOT ROWs must be told that herbicide use on DOT ROW is unlawful without a permit. Utilities conducting plant management *adjacent* to DOT ROWs should be notified when rare plants are present.

* Mowing Exception

There is an exception to winter mowing for Virginia spiraea. This shrub is found along streams, rivers and roadsides in the mountains. Because it is a woody shrub it should **never** be mowed, regardless of the time of year. Trimming or selective thinning of other woody vegetation that compete with this species may be recommended for management.

Signs/Stakes

When rare plants are discovered on NCDOT's ROW, the population should be marked with 'Do Not Mow' signs. These signs should be large enough to be easily noticed by roadside mowers. A variety of signs have already been placed along roadside populations; most simply state, 'Do Not Mow' while others include dates for the no mow period (April 1 - November 15) , or add 'Do Not Spray.' To ensure that signs are readily understood by a variety of workers, signs with universal symbols for 'Do Not Mow' and 'Do Not Spray' are under review for future use.

Do Not Mow signs should be positioned at both ends of a population, facing so mowers will see the signs as they approach the No Mow area. Where rare plants occur along a significant stretch of roadway it is suggested that double sided Do Not Mow signs be placed periodically along the population - two Do Not Mow signs placed back to back on a single post. The reasoning for this is that if a sign at one end of the population disappears, the mower will encounter another Do Not Mow sign before the entire population is mowed. Maintaining the signs and seeing that they are visible and in good condition is critical in order to protect these populations. Damaged or missing signs should be replaced as soon as possible, especially during the growing season. If possible, signs should be placed at a low enough level for the mower operator to see.

White-topped wooden stakes can also be useful in alerting mower operators that the site is designated as a No Mow area. These should be used in addition to (not instead of) Do Not Mow signs. The wooden stakes are approximately 40 inches long with the top six inches painted white, the same stakes used to delineate mowing patterns and areas that are off limits to mowers. Stakes should be placed at regular intervals along the entire edge of the roadway side of the population.

Encroachments/Maintenance

Division environmental officers, district offices and maintenance units should make sure rare plant sites are taken into consideration for proposed ROW encroachments and maintenance work. ROW encroachments such as driveways, utility work, minor widenings, installation of utility lines and pipes for driveways have the potential to damage rare plant populations. All ROW access requests and driveway access applications in areas where rare species are known to occur should be reviewed to ensure there will be no impacts. If impacts to rare plants are likely to occur, efforts should be made to avoid or minimize damage. District offices should maintain secondary road files with a notation to remind them that the road has a protected species.

Roadside maintenance activities, such as grading and ditch maintenance can also harm rare plants. As above, if impacts to rare plants are likely to occur, efforts should be made to avoid or minimize damage. Heavy equipment should be kept out of rare plant areas during the No Mow period. Employees working in the area should be shown the rare plant so they can avoid damaging them.

Herbicide Use

To reduce competition from invasive weeds, herbicides should only be used when mechanical removal is not an option. Herbicides can be used near rare plant populations when specifically prescribed by someone familiar with the biology of the rare plant. Two main herbicides have been recommended for use on roadside rare plant populations. These herbicides have been tried in a variety of situations by NCDOT and are believed to be most suitable for managing these sites, glyphosate triclopyr for woody vegetation. All herbicide applications for roadside rare plant sites should be conducted by a Licensed Pesticide Applicator.

< back to top >

Return to Section 1.1 »

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Michael Wood

From: Thompson, Larry B <lthompson@ncdot.gov>
Sent: Wednesday, November 13, 2013 11:15 AM
To: Michael Wood
Subject: Re: Schweinitz's Sunflowers Along Secrest Shortcut Road

Mike,

Yes, both of these populations are signed, in our GIS database and included in our roadside management plan.

If you need anything else from the Division, please let me know.

Regards,

Larry Thompson
Division Environmental Officer
NCDOT - 10th Highway Division

Michael Wood <mwood@thecatenagroup.com> wrote:

Larry – Per our discussion, please confirm that NCDOT has the two populations of Schweintiz's sunflowers, EO #77 and #230, noted in the NCDOT Roadside Vegetation Management Guidelines in Marked Areas plan.

Thanks.

Michael Wood, LSS
The Catena Group
410B Millstone Drive
Hillsborough, NC 27278
919-732-1300

www.thecatenagroup.com

Email correspondence to and from this sender is subject to the N.C. Public Records Law and may be disclosed to third parties.

APPENDIX F

NCTA Schweinitz's Sunflower Preservation Request Letters

NCDOT Division 10
Union Power

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STATE OF NORTH CAROLINA
TURNPIKE AUTHORITY

BEVERLY E. PERDUE
GOVERNOR

1578 MAIL SERVICE CENTER, RALEIGH, N.C. 27699-1578

DAVID W. JOYNER
EXECUTIVE DIRECTOR

March 23, 2010

Mr. Larry Thompson, Division Environmental Officer
North Carolina Department of Transportation
Division 10
716 West Main Street
Albemarle, NC 28001

RE: STIP R-3329/R-2559 (Monroe Connector/Bypass)
Preservation-in-Place of federally endangered Schweinitz's sunflower populations within NCDOT and Union Power rights of way on Secrest Shortcut Road

Dear Mr. Thompson:

The North Carolina Turnpike Authority (NCTA) has conducted threatened and endangered species surveys for the proposed Monroe Connector/Bypass (STIP R-3329/R-2559) in Union County and Mecklenburg counties. During these surveys, two populations of the federally endangered Schweinitz's sunflower (*Helianthus schweinitzii*) were identified within NCDOT right of way and Union Power right of way. These populations have the potential to be indirectly affected by the proposed project. The populations are described below and shown in the enclosed figure.

Population #1
This population is located on Secrest Shortcut Road (SR 1501), approximately 600 feet west of the intersection with Unionville-Indian Trail Road along the southern side of the road near GPS location 35.0759° N, -80.6136° W. It is a very small population (12 stems) that occurs primarily between the roadside swale and the power line adjacent to Secrest Shortcut Road.

Population #2
This population is located on Secrest Shortcut Road (SR 1501) between Unionville-Indian Trail Road (SR 1367) and the crossing of the South Fork Crooked Creek near GPS location 35.0721°N, -80.6097°W. It includes 103 stems on the northern side and 31 stems on the southwestern side of Secrest Shortcut Road. This population is currently mapped by the NC Natural Heritage Program (NHP) as element occurrence (EO) # 77.

NCTA is proposing specific management actions to preserve these two populations in place as a conservation measure to offset potential indirect effects of the proposed Monroe Connector/Bypass. We are requesting that the Division install "Do Not Mow" signs at these locations by June 1, 2010. We also request that the Division manage these populations per the "NCDOT Roadside Vegetation Management Guidelines in Marked Areas" guidance.

We have notified Union Power of the presence of these populations and have requested they add these two populations to their vegetation management plan. A copy of this letter is attached.

Additionally, it is our understanding that the Schweinitz's sunflower population on Goldmine Road (EO# 78) may not be marked with "Do Not Mow" signs. Please ensure that signs are installed at this location.

Please consider our request to preserve these two populations in place and verify in writing to the address above your commitment to manage the aforementioned sites in accordance with your vegetation management guidelines. We would appreciate your response by May 7, 2010.

If you have any questions or concerns regarding our request, please feel free to contact me or Christy Shumate at (919) 571-3000.

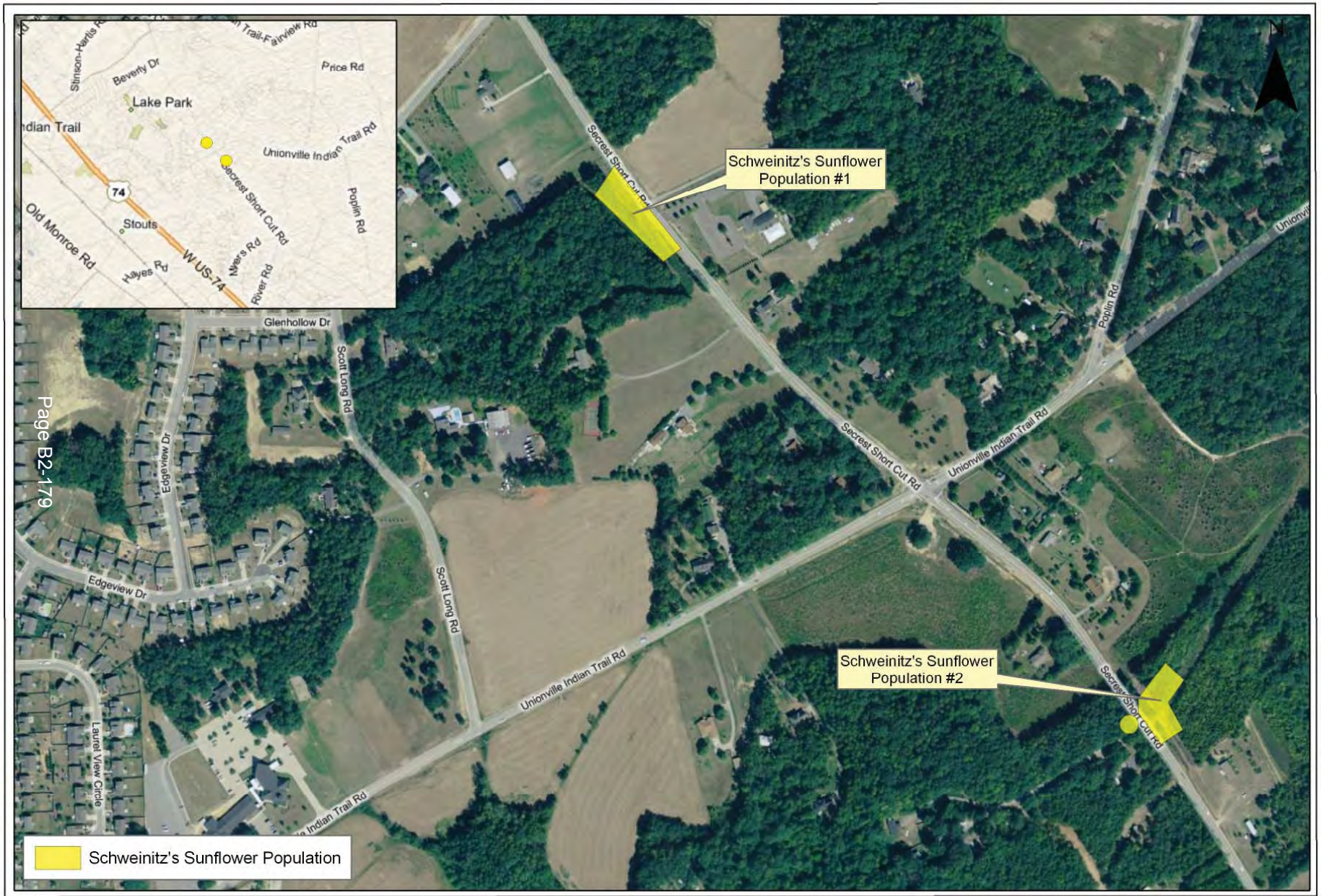
Sincerely,

Jennifer Harris

Jennifer Harris, P.E.
Director of Planning and Environmental Studies

Enclosures:
Figure 1 – Schweinitz's Sunflower Populations: Preservation Sites
Copy of letter to Mr. Wil Ortiz, Union Power

cc: George Hoops, FHWA
Bruce Ellis, NCDOT
Barry Moose, NCDOT Division 10
Jennifer Callahan, The Catena Group



The Catena Group

Date: February 2010

Scale: 0 190 380 Feet

Job No.: 1125

Title:

Monroe Connector/Bypass (R-3329/R-2559)

Schweinitz's Sunflower Populations: Preservation Sites

Union County, North Carolina

Aerial Photography www.bingmaps.com

Client:

North Carolina Turnpike Authority

Figure

1

STATE OF NORTH CAROLINA
TURNPIKE AUTHORITY

BEVERLY E. PERDUE
GOVERNOR

1578 MAIL SERVICE CENTER, RALEIGH, N.C. 27699-1578

DAVID W. JOYNER
EXECUTIVE DIRECTOR

March 23, 2010

Mr. Wil Ortiz
Regional Managing Arborist
Union Power Cooperative
Union Services Building
1543 Rocky River Road
Monroe, NC 28110

RE: STIP R-3329/R-2559 (Monroe Connector/Bypass)
Request for Preservation of federally endangered Schweinitz's sunflower populations within NCDOT and Union Power rights of way

Dear Mr. Ortiz:

The North Carolina Turnpike Authority (NCTA) has conducted threatened and endangered species surveys for the proposed Monroe Connector/Bypass (STIP R-3329/R-2559) in Mecklenburg and Union counties, NC. During these surveys, two previously unidentified populations of the federally endangered Schweinitz's sunflower (*Helianthus schweinitzii*) were identified within Union Power right of way and NCDOT right of way. The populations are described below and shown in the enclosed figure.

Population #1
This population is located on Secrest Shortcut Road (SR 1501), approximately 600 feet west of the intersection with Unionville-Indian Trail Road along the southern side of the road near GPS location 35.0759° N, -80.6136° W. It is a very small population (12 stems) that occurs primarily between the roadside swale and the power line adjacent to Secrest Shortcut Road.

Population #2
This population is located on Secrest Shortcut Road (SR 1501) between Unionville-Indian Trail Road (SR 1367) and the crossing of the South Fork Crooked Creek near GPS location 35.0721°N, -80.6097°W. It includes 103 stems on the northern side and 31 stems on the southwestern side of Secrest Shortcut Road. This population is currently mapped by the NC Natural Heritage Program (NHP) as element occurrence (EO) # 77.

NCTA is proposing specific management actions to preserve these two populations in place as a conservation measure to offset potential indirect effects of the proposed Monroe Connector/Bypass. "Do Not Mow" signs will be installed at these locations by June 1, 2010. We are requesting that Union Power add these two populations to the "Understanding Reached with US Fish and Wildlife Service Regarding Access Into Schweinitz's Sunflower Restricted Sites Because of Union Power Cooperative Operations" vegetation management plan.

Additionally, it is our understanding that population B (on Goldmine Road) in your vegetation management plan is shown as lacking "Do Not Mow" signs. We have contacted NCDOT Division 10 to install signs at this location.

Please consider our request to preserve these two populations and verify in writing to the address above your commitment to include the aforementioned sites in your vegetation management plan. We appreciate your response by May 7, 2010. We look forward to continuing to manage protected species sites within our shared rights of way with Union Power.

If you have any questions or concerns regarding our request, please feel free to contact me or Christy Shumate at (919) 571-3000.

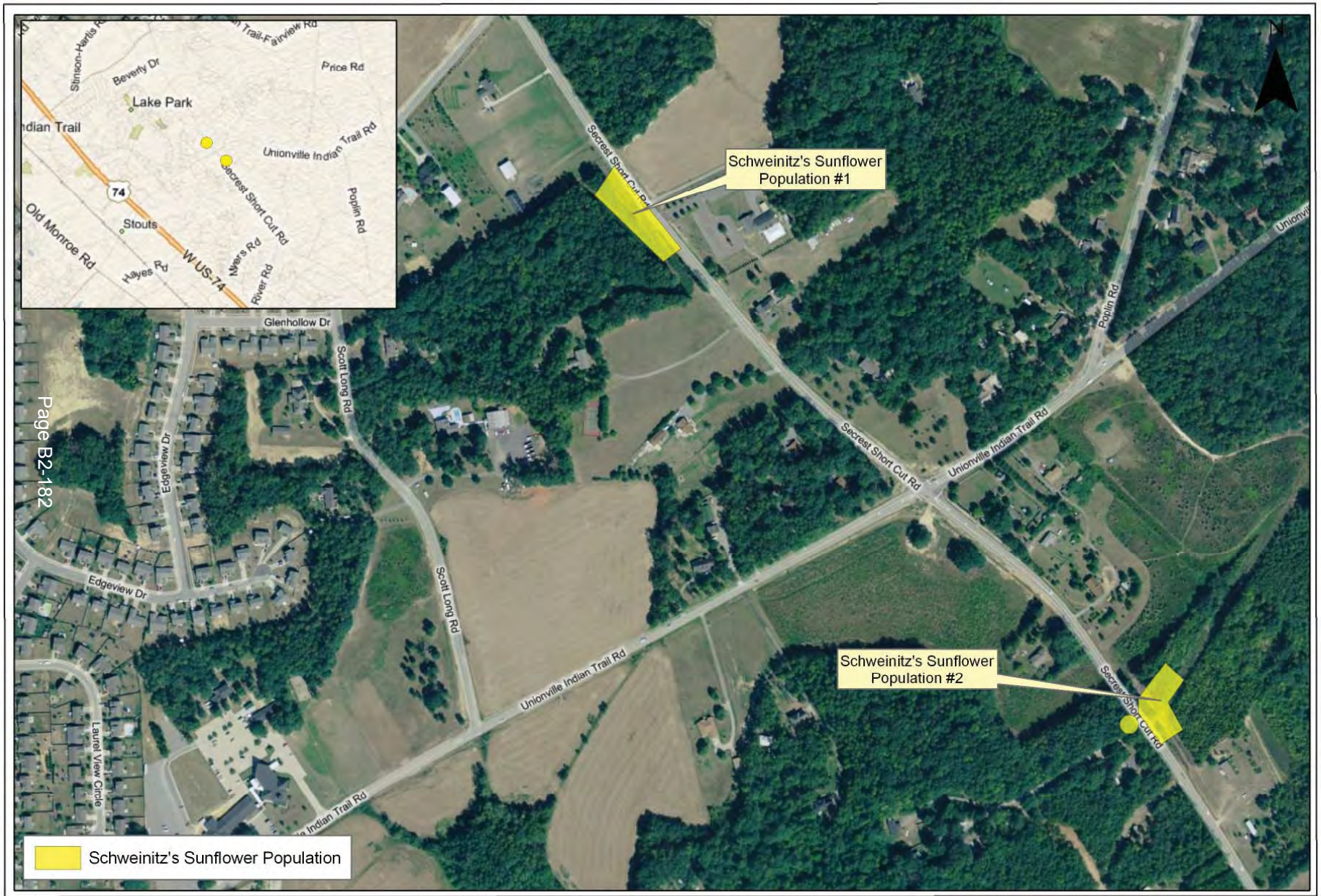
Sincerely,

Jennifer Harris

Jennifer Harris, P.E.
Director of Planning and Environmental Studies

Enclosures:
Figure 1 – Schweinitz's Sunflower Populations: Preservation Sites

cc: George Hoops, FHWA
Bruce Ellis, NCDOT
Barry Moose, NCDOT Division 10
Larry Thompson, NCDOT Division 10
Jennifer Callahan, The Catena Group



The Catena Group

Date: February 2010

Scale: 0 190 380 Feet

Job No.: 1125

Title: Monroe Connector/Bypass (R-3329/R-2559)

Schweinitz's Sunflower Populations: Preservation Sites

Union County, North Carolina

Aerial Photography www.bingmaps.com

Client: North Carolina Turnpike Authority

Figure 1

Document: USFWS email dated October 29, 2013
USFWS email w/ attachments dated November 1, 2013

Response To Comments

ORIGINAL COMMENT NO.	PRIMARY TOPIC	COMMENT	RESPONSE
2	Access to ICE Report	September 30, 2013 The document reportedly summarizes the conclusions reached in the evaluation of indirect and cumulative impacts (ICI). Can the larger ICI report be made available for review as well? It is helpful to have all the original data when reviewing a document of this nature.	September 30, 2013 The DTR includes nearly all the same methodology and results information as is included in the updated Quantitative ICE report, but then performs a more detailed and focused assessment of potential impacts to species. The draft Quantitative ICE report was provided via email on October 2, 2013.
		November 1, 2013 For the record, the USFWS was furloughed on October 1st, not returning to work until October 17th. Thus we did not receive this document until October 17th, 2013.	November 1, 2013 Noted.
3	Re-initiation of Section 7 Consultation	September 30, 2013 The updated information regarding these impacts represents a changed condition, and therefore, requires re-initiation of the section 7 consultation.	September 30, 2013 Re-initiation will be requested along with a stand-alone BA.
		November 1, 2013 Re-initiation has been requested. However, we do not consider the new current BA to be a stand alone document. For example, there are numerous references to information contained in the 2010 FEIS within the Schweinitz's sunflower section on pages 64 and 65. The information referenced should be placed into the BA itself to avoid requiring the reviewer to dig up a 3-year old legally insufficient document and search through 100+ pages for the information referenced. It could place the sufficiency of the BA into question.	November 1, 2013 The November BA has incorporated much of the referenced information into the text and referenced the supporting NEPA documents for details.
4	Sewer and Water Utility Availability	September 30, 2013 On page 9, the Technical Report notes that water and sewer moratoria were rescinded in Union County in 2012; however, there is no further discussion of this. What is the impact or potential impact of Union county rescinding the water and sewer moratorium? We recommend adding a discussion of the potential impacts of this rescission.	September 30, 2013 We have revised the DTR to include a footnote indicating the impacts of the change in sewer and water utility connection policies in Union County.

Document: USFWS email dated October 29, 2013
USFWS email w/ attachments dated November 1, 2013

Response To Comments

ORIGINAL COMMENT NO.	PRIMARY TOPIC	COMMENT	RESPONSE
		November 1, 2013 The footnote that has been added to the document is confusing. How is it possible that short term development that wasn't allowed in 2010 because of the moratorium, was already analyzed and considered in the ICE analysis? If there are short term increases in development activity these may result in impacts that are not assessed in the long-planned capital facilities expansions.	November 1, 2013 Update to footnote 5: Rescinding the moratorium may increase the short-term development activity within the study area, NCDOT spoke with area planners to address short-term development within the Goose Creek watershed and those changes are included in the 2013 ICE analysis within the updated baseline development assessment. However, long-term growth is more dependent on long planned capital facilities expansions for water and sewer capacity, which have already been analyzed and considered in the ICE Analysis. Furthermore, the short-term moratoria on water and sewer connections and the recently rescinded moratorium on inter-basin transfers were always considered short-term policies that would eventually be rescinded. Therefore, they were not considered a deterrent to growth in the long term in either the 2010 ICE or the 2013 ICE. Therefore, these policy changes do not affect long-term growth trends nor do they necessitate changes in long term growth projections for the study area.
6	Land Use Changes in Goose Creek Watershed	September 30, 2013 The Technical Report notes that both Unionville and Fairview are concentrating plans for development along the US 601corridor. In particular, Unionville expects to grow because of the new interchange with the project and US 601. We recommend including a cumulative impact analysis of the towns of Fairview and Unionville plans for development in the Goose Creek watershed?	September 30, 2013 The discussion of Unionville should not have been included in the Technical Report as it is not within the Goose Creek Watershed. The commercial and industrial nodes anticipated to develop in Fairview are expected to develop with or without the construction of the proposed project, as noted in Section 3.4. Since there is no indirect impact anticipated, these nodes would not constitute a cumulative impact to the watershed.
		November 1, 2013 But the question still remains---Unionville is the link between the project and the Goose Creek basin and if they plan to grow along that corridor BECAUSE of the project, it is important, even if it's not in the Goose creek basin proper.	November 1, 2013 Projected land use changes from the Build to No-Build alternatives for the Monroe Connector/Bypass are shown in Map 20. As discussed in the methodology section, they are intended to be conservative estimates (tend to overestimate growth). As the figure shows, there is no change in land use anticipated to be associated with the construction of the Monroe Connector/Bypass under the build alternative in the vicinity of the Goose Creek watershed. Land use changes near Unionville are limited to the immediate vicinity of the intersection of the new facility with US 601. For this reason, no ICEs are expected in the Goose Creek watershed, as summarized in Section 5.5 of the Quantitative ICE and the BA.

Document: USFWS email dated October 29, 2013
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Response To Comments

ORIGINAL COMMENT NO.	PRIMARY TOPIC	COMMENT	RESPONSE
8	Land Use Change in Goose Creek	September 30, 2013 On pages 62-63, the Technical Report notes that there is travel time savings and new water and sewer potential in the southeastern section of the Goose Creek basin, yet concludes that additional development is unlikely to be spurred by the addition of a freeway. Please provide further justification for this conclusion given that it would be logical to conclude that proximity plus time savings plus water and sewer expansion would result in a greater potential for development?	September 30, 2013 Map 15 indicates that some portions of Goose Creek watershed appear to see travel time savings from the Monroe Connector/Bypass. However, as documented in Section 5.2, the travel time analysis methodology "may overestimate the benefits to these portions of the study area. The analysis estimated travel time benefits to the I-485/US 74 Interchange since access to I-485 was regularly noted as a key benefit of the proposed project. These portions of the Goose Creek watershed have more direct access to I-485 via Idlewild Road, Lawyers Road and NC 218 and drivers originating from the southern portions of the Goose Creek watershed would likely find shorter travel times to I-485 via these roads than via the proposed project."
		November 1, 2013 in this response you only address travel time savings---what about the other factors of water and sewer	November 1, 2013 Our prior response addressed the travel time benefits of the project in southern Goose Creek watershed because, as documented in Section 5.2 of the DTR, increases in accessibility are the main drivers of induced growth. Water and sewer availability may provide the capacity for new development, but the provision of those utilities is expected to occur in that portion of the study area whether or not the proposed project is constructed. Since the proposed project is expected to provide little to no accessibility benefit to this part of the study area, no induced growth would be expected. Substantial development in western Union County is expected under both scenarios, but this growth is expected with or without the proposed project.
10	Schweinitz's sunflower protection	September 30, 2013 Section 6.2 At the bottom of page 69, the Technical Report notes that according to the Biological Assessment the NCTA will commit to on-site conservation of two extant populations of Schweinitz's sunflower. Please provide additional information as to what type of protection will be provided. Will it be in perpetuity?	September 30, 2013 The on site conservation measures are detailed in the BA. The commitments from both NCDOT and Union Power will be adhered to for as long as the respective conservation areas are under their ownership. While this can't necessarily be considered "in perpetuity", ownership of such areas are very rarely relinquished. As such, there is no reason to assume these sites will not continue to be managed for Schweinitz's sunflowers for the foreseeable future.
		November 1, 2013 The BA attaches the 2 letters, one to NCDOT and one to Union County, requesting the preservations in the ROW, however, there is no documentation provided of a response from either agency committing to the preservation. And while page 67 of the BA states that NCDOT has committed to preserving the species in place, the NCTA 2012a citation in the text is not identified in the Literature Cited section of the BA.	November 1, 2013 Union Power has provided confirmation and a figure from their Dashboard System showing EO#77, noted as Site R in figure, in their Schweinitz's sunflower Restricted Sites plan (Appendix D of BA). NCDOT has provided an email confirming that EO#77 and EO#230 are noted and in their NCDOT Roadside Vegetation Management Guidelines in Marked Areas plan (Appendix E of BA).

Document: USFWS email dated October 29, 2013
USFWS email w/ attachments dated November 1, 2013

Response To Comments

ORIGINAL COMMENT NO.	PRIMARY TOPIC	COMMENT	RESPONSE
14	Internal Document Reference	September 30, 2013 On page 73, there is reference to Section 5.3 but the Technical Report does not contain a Section 5.3. Please correct this reference.	September 30, 2013 This reference has been corrected.
		November 1, 2013 the reference has been corrected to sec 6.6 which discusses impacts to plant species but not impervious surface results	November 1, 2013 ICEs to plant species were based on an overall assessment of habitat, which was not dependent on changes to percent impervious within the FLUSA
15	Changes in Impervious Surface	September 30, 2013 On page 73, it appears that there is a 1% increase in imperviousness from the previous data presented. Please provide a more detailed explanation of the reason for this increase. For example, has the baseline changed and if so, how and where was it changed relative to the location of the listed species?	September 30, 2013 As noted in Section 6.5, the level of impervious surface for Sixmile Creek increased approximately 1% for all scenarios when compared to the 2010 Quantitative ICE. This change, as noted in Sections 1.7 and 6.5, is related to the update of the Baseline Land Use which was updated from a base year of 2007 to 2010. As noted in Section 6.5, the level of impervious surface for Goose Creek increased approximately 1% for all future year scenarios when compared to the 2010 Quantitative ICE. As noted in Sections 1.7 and 6.5, these changes are a result of changes in planned land use, particularly at the Lawyers Road interchange with I-485.
		November 1, 2013 which is the headwaters of Goose Creek thus the question more detail regarding where the 1% comes from.	November 1, 2013 Changes in land use within the Goose Creek watershed from the 2007 to 2010 baseline assessments are mainly the result of changes to the proposed Lawyers Road development. These changes were made based on the Lawyer's Road & I-485 Small Area Plan Future Land Use Map, as shown in Figure 2 of the Technical Report. This plan was adopted by Mint Hill in 2011, and was thus not a part of the previous analysis. As explained on page 13 of the technical report, during development of the 2010 Quantitative ICE analysis, most of this area was already designated as developed, as either Commercial or Low Density Residential. With the new information, some of the land previously identified as Low Density Residential is now identified as Medium Density Residential, Commercial, Institutional or Undeveloped (in the case of those areas identified as Open Space in the Small Area Plan). This development is scheduled to take place with or without the construction of the Monroe Connector/Bypass.

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Response To Comments

ORIGINAL COMMENT NO.	PRIMARY TOPIC	COMMENT	RESPONSE
17	Traffic Impacts Analysis	September 30, 2013 On page 76 there is a discussion of the changes to US 601 north of the project. The Technical Report notes that there is not a project to improve US 601 north of the project in the long range plan for MUMPO. Given the discussion of the planned development in Unionville and Fairview on US 601 north of the Monroe Connector Bypass, it would seem that such improvements would be being considered at least at the comprehensive transportation plan level.	September 30, 2013 This section has been revised to add more detail to the discussion of US 601 traffic impacts. As noted in that analysis, the induced growth impacts of the proposed project do not substantially affect traffic volumes on US 601. Furthermore, the predicted 2030 traffic levels on US 601 through the Goose Creek watershed are well below typical thresholds for widening and the modest development proposals for Unionville and Fairview would be unlikely to substantially change those predicted traffic volumes.
		November 1, 2013 these data should be summarized in the BA	November 1, 2013 This information has been incorporated into the November BA.

Document: USFWS email dated October 29, 2013
USFWS email w/ attachments dated November 1, 2013

Response To Comments

NEW COMMENT NO.	PRIMARY TOPIC	COMMENT	RESPONSE
20		October 29, 2013 On pages 64 and 65 there are references to commitments made to protect the 2 Sunflower populations that are in close proximity to the project. These commitments (and mapped locations??) should be reviewed to make sure they are still relevant and stated in the BA-- rather than referencing the EIS---- so that I can put them in the BO. Part of the rationale for "may affect not likely to adversely affect" is the commitment to avoid impacts to these populations and the details of your avoidance measures are important	October 29, 2013 These commitments are included in the BA and supported with recent documentation from Union Power and NCDOT. Map 7 of the BA shows their locations.
21	BA	November 1, 2013 The BA should be a stand alone document. The information presented needs to be complete and should provide clear, logical steps to the biological conclusions in the document. The current draft lacks the data needed to achieve this.	November 1, 2013 The BA has incorporated previously referenced material into the text and cited other NEPA documents for support and details.
22	Savannah Lilliput	November 1, 2013 Mussel surveys indicate that within the project impact area, the Savannah Lilliput occurs in both South Fork Crooked Creek and Richardson Creek. The mussels in South Fork Crooked Creek will be directly impacted by the project. This species is currently petitioned for listing as a federally protected species. We expect a listing decision to be made in the next couple of years. In conversations with other Service biologists there is strong evidence to indicate that listing is likely. We suggest that extra protective measures be provided at this crossing ahead of a potential listing decision. If the species is listed before the project is completed, project activities that could impact this species will likely have to be interrupted while consultation occurs.	November 1, 2013 As consistent with our past handling of petitioned species for this project, the association of the Savannah Lilliput and this project will be addressed in a separate Technical Memorandum.
23	Northern long-eared bat	November 1, 2013 The northern long-eared bat (*Myotis septentrionalis*) has been proposed for listing as an endangered species (published in the Federal Register October 2, 2013: Proposed Rules). The species is known to occur in Gaston County and the range includes Union County, North Carolina. During the summer, northern long-eared bats typically roost singly or in colonies in a variety of forested habitats, underneath bark or in cavities/crevices of both live trees and snags. Northern long-eared bats have also been documented roosting in structures (i.e., buildings, barns, etc.) during the summer. Northern long-eared bats predominately winter in hibernacula that include caves and abandoned mine portals. It should be noted that the general habitat types described above may not be all-inclusive, and additional habitat types may be identified as new information is obtained.	November 1, 2013 The northern long-eared bat has been noted in the BA and left as Unresolved. FHWA and NCDOT anticipate addressing the impacts of the project to the bat in a separate document once management and conference guidance is provided by USFWS.

APPENDIX B-3

FINAL TECHNICAL REPORT ON DIRECT, INDIRECT, AND CUMULATIVE IMPACTS TO FEDERALLY LISTED SPECIES (Nov 2013)

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Monroe Connector/Bypass (R-3329/R-2559)

Technical Report on Direct, Indirect and Cumulative Impacts to Federally Listed Species

Response to FWS Letter dated December 20, 2012

Prepared for the North Carolina Turnpike Authority

NORTH CAROLINA Turnpike Authority

A Division of North Carolina Department of Transportation

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November 19, 2013

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1.0 INTRODUCTION

1.1 What Is the Proposed Project?

The North Carolina Turnpike Authority (NCTA), a division of the North Carolina Department of Transportation (NCDOT), in cooperation with the Federal Highway Administration (FHWA), proposes to construct a project known as the Monroe Connector/Bypass. A project which would be a controlled-access toll road extending from US 74 near I-485 in Mecklenburg County to US 74 between the towns of Wingate and Marshville in Union County, a distance of approximately 20 miles. Map 1 shows the proposed project and surrounding area. The proposed action is included in the NCDOT 2009–2015 State Transportation Improvement Program (STIP) as Project R-3329 (Monroe Connector) and Project R-2559 (Monroe Bypass) as a toll facility.

1.2 What is the Purpose of this Document?

NCTA, through this document, is responding to the USFWS December 20, 2012 Letter sent to NCTA which among other items, recommended a re-initiation of consultation under Section 7 of the Endangered Species Act (ESA). Previous coordination on this issue is summarized in the May 25, 2010 Biological Assessment (BA).

This document evaluates previous conclusions regarding direct as well as indirect and cumulative effects (ICE) to federally listed species (threatened and endangered species) associated with the Monroe Bypass/Connector. The following species are listed for Union and/or Mecklenburg Counties: Carolina heelsplitter, Schweinitz's sunflower, Michaux's sumac, and smooth coneflower. The report summarizes updated surveys for these species within the project area as well as the conclusions reached in the evaluation of ICE and describes the data collected, methodologies used and analyses conducted for the ICE for the project. The document also re-evaluates and considers data, analytical research relevant to the project area, and new information relevant to the analysis of the indirect and cumulative effect on land use, water quality, and federally designated threatened and endangered species and their critical habitat. Since the Carolina heelsplitter lives in two watersheds in the study area, water quality is a major focus area of this analysis. Thus, results for the watershed level are provided in this update. As the listed plant species are generally found in opened habitats, ICE analysis for these species focuses on potential land use changes associated with the project.

1.3 Why Is this Update Needed?

As stated previously, Section 7 consultation for the Monroe Connector/Bypass was summarized in the May 2010 Biological Assessment. NCTA previously analyzed indirect and cumulative effects of the Detailed Study Alternatives for the proposed action through a Qualitative Indirect and Cumulative Effects Assessment (Qualitative ICE) completed for the Draft Environmental Impact Statement (DEIS Chapter 7) and incorporated into the Final Environmental Impact Statement (FEIS Appendix G). This analysis was expanded and extended for the Preferred Alternative through a Quantitative Indirect and Cumulative Effects Analysis for Land Use (Quantitative ICE) and Quantitative Indirect and Cumulative Effects Water Quality Analysis (WQA) completed for the Final Environmental Impact Statement (FEIS Appendices H & I). These reports were summarized in Section 2.5.5 of the FEIS and together these reports comprise the FEIS ICE analysis and conclusions. In August 2010, FHWA issued a Record of Decision (ROD) selecting Detailed Study Alternative D (DSA D) as the Selected Alternative for the proposed action based on the

analysis of the DEIS and FEIS showing that this alternative had lower overall impacts to the natural environment and residential areas compared to other alternatives.

In November 2010, The North Carolina Wildlife Federation, Clean Air Carolina and Yadkin Riverkeepers (Plaintiffs) filed suit to overturn the ROD. The U.S. District Court for the Eastern District of North Carolina decided the case in October 2011, finding for FHWA and NCTA that the FEIS was sufficient. Plaintiffs appealed the decision to the U.S. Court of Appeals for the Fourth Circuit and the appellate court vacated the District Court decision on May 3, 2012. The FHWA rescinded its ROD for the project on July 3, 2012 in response to the appeals court decision.

The primary purpose of this report is to provide an update to the US Fish and Wildlife Service (USFWS) on the direct, indirect and cumulative impacts to federally listed species. This includes a substantial update to the FEIS summary of the quantitative ICE effects documented in the FEIS Appendix H. This document will:

1. Review the direct impacts to species and updates surveys of the corridor (Section 2.0)
2. Review the scope of the ICE analysis and conditions and trends in the study area, including the existing land use scenario (Section 3.0)
3. Review the Metrolina Regional Model socioeconomic projections, including how other studies have used the projections, and evaluate the most appropriate use of those projections within the framework of the ICE analysis (Section 4.0)
4. Explain the methods used to estimate induced growth and develop the future land use scenarios (Section 5.0)
5. Report revised induced growth results and conclusions based on the updated land use scenarios (Section 6.0)
6. Review measures that localities and others could adopt to minimize any impacts of future development, whether induced or not, on sensitive environmental resources (Section 7.0).

This report summarizes the conclusions reached in the evaluation of direct, indirect and cumulative effects to species and describes the data collected, methodologies used and analysis. This document also re-evaluates and considers data, analytical research relevant to the project area, and new information relevant to the analysis of the indirect and cumulative effect on land use, water quality, and federally designated threatened and endangered species and their critical habitat in the surrounding area.

2.0 UPDATES TO DIRECT IMPACTS TO PROTECTED SPECIES

2.1 Updated Carolina Heelsplitter (Lasmigona decorata) Surveys

Carolina heelsplitter surveys were conducted in 2012.[1] The locations for the 2012 mussel surveys were determined by overlaying the location of potential effects and/or impacts within the Future Land Use Study Area (FLUSA) with streams identified during the 2009 surveys that contain a robust freshwater mussel population that could potentially support the Carolina heelsplitter. Accordingly, South Fork Crooked Creek and Stewarts Creek in the vicinity of the project alignment, and portions of Crooked Creek and Richardson Creek within the FLUSA were surveyed.

[1] *Freshwater Mussel Survey Report Update* (October 26, 2012), prepared by The Catena Group.

Overall the results of the 2012 survey efforts are very similar to the 2009 surveys, and as was the case in 2009, the Carolina heelsplitter was not found in any of the surveyed streams. Differences between the two survey efforts are more likely a result of differences in time of year and survey conditions, rather than an indication of changes in mussel abundances. For example, while the Savannah lilliput was found in low numbers (3 individuals) in Richardson Creek in 2009, it was not located in 2012, but is likely still present. There was a large amount of leaf pack covering the substrate of Richardson Creek in 2012 generally making surveying difficult. This coupled with the very small size of the Savannah lilliput (< 2 inches) is likely the reason it was not detected. The fact that most of the other species occurring in Richardson Creek were found in similar numbers further supports this assumption. Furthermore, the difficulty of detecting a species that is present in low numbers during a one-time survey is highlighted by the fact that the Paper pondshell was found (one individual) in Richardson Creek in 2012, but not in 2009, although it was known from the stream prior to 2009 (North Carolina Wildlife Resources Commission [NCWRC] Unpublished Aquatic Species Database).

2.2 Updated Endangered Plant Surveys

Surveys were performed 2012 for Schweinitz's sunflower (*Helianthus schweinitzii*) and Michaux sumac (*Rhus michauxii*).[2] The survey area was the final proposed design footprint for the Monroe Connector/Bypass, including all utility relocations. No previously unknown populations of any of the species were found.

[2] *Updated T&E Plant Species Field Review* (October 9, 2012), prepared by Atkins

3.0 UPDATE TO INDIRECT IMPACTS

3.1 Why Is an Updated Quantitative Indirect and Cumulative Effects Analysis Needed?

This report summarizes the conclusions reached in the evaluation of ICE and describes the data collected, methodologies used and analysis conducted for the ICE for the project. This document also re-evaluates and considers data, analytical research relevant to the project area, and new information relevant to the analysis of the indirect and cumulative effect on land use, water quality, and federally designated threatened and endangered species and their critical habitat in the surrounding area.

3.2 How Is an ICE Analysis Done?

The National Environmental Policy Act of 1969, as amended (NEPA), the North Carolina State Environmental Policy Act (SEPA), and the United States Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508) identify assessment of indirect and cumulative effects as a necessary component of environmental impact assessment for major Federal actions. The ICE analysis to evaluate potential land use changes and environmental effects associated with the Monroe Connector/Bypass project followed a process contained in guidance released in 2001 by the North Carolina Department of Transportation (NCDOT), in consultation with the North Carolina Department of the Environment and Natural Resources (NCDENR), the North Carolina State Attorney General's Office and the Association of Municipalities entitled *Guidance for Assessing Indirect and Cumulative Impacts for Transportation Projects in North Carolina, Volume I: Guidance Policy Report and Volume II: Practitioners' Handbook*.[3] In this guidance document, the agencies agreed to the following steps that should be taken to thoroughly assess indirect and cumulative impacts.

Step 1: Definition of the Future Land Use Study Area
Step 2: Identification of the FLUSA's Direction and Goals
Step 3: Inventory of Notable Features
Step 4: Identification of Important Impact Causing Activities
Step 5: Identification and Analysis of Potential Indirect/Cumulative Effects
Step 6: Analyze Indirect/Cumulative Effects
Step 7: Evaluate Analysis Results
Step 8: Assess the Consequences and Develop Appropriate Mitigation and Enhancement Strategies.

The first five steps are undertaken for a qualitative ICE study. The last three steps are undertaken if a quantitative study is required. The ICE analysis previously conducted for the Monroe Connector/Bypass project included a qualitative analysis for inclusion and publication in the DEIS and a quantitative analysis for inclusion and publication in the FEIS.

FHWA and NCTA presented the results of the analysis of the first five steps in a Qualitative ICE, which was included in the DEIS and the FEIS as Appendix G. Based on a review of data and information available since that report was completed, the results and conclusions in the FEIS Appendix G would not

[3] NCDOT and NCDENR. *Guidance for Assessing Indirect and Cumulative Impacts for Transportation Projects in North Carolina, Volume I: Guidance Policy Report and Volume II: Practitioners' Handbook.* November 2001.

be significantly different or introduce new significant impacts or information, which were not previously considered.

Subsequently, a Quantitative ICE was developed following steps six through eight and was presented in FEIS Appendix H. Because of new data, information and the results of the Fourth Circuit of the United States Court of Appeals, FHWA and NCTA have reanalyzed steps six through eight in this updated Quantitative ICE. The scope of this Quantitative ICE includes analysis of the potential of increased indirect and cumulative effects on water resources, threatened and endangered species, and in response to agency and public comment on the DEIS. The decision to use watersheds as boundaries to quantitatively analyze effects, instead of the zones presented in the Qualitative ICE, was made due to the water quality concerns expressed by resource agencies. Watershed boundaries were also used for analysis for compliance with Section 7 of the ESA. Land use changes within watersheds were analyzed first and those results were used to estimate changes in water quality and impacts on the federally protected species. Because the Carolina heelsplitter mussel is an aquatic species, this report includes an evaluation of potential ICEs to water quality in Goose Creek and Sixmile Creek. Map 2 shows each watershed within the project study area.

The Quantitative ICE analysis addresses the potential land use changes associated with the proposed project by developing three land use scenarios associated with the following conditions:

- **Existing (or Baseline) Land Use Scenario**: A scenario that reflects the land use conditions as they existed in 2010 to provide a basis for comparison for cumulative impacts assessment.
- **No-Build Land Use Scenario**: A scenario that reflects the best estimate of land use development conditions in 2030 if the proposed project is not built based on the assumptions and methods used in this report.
- **Build Land Use Scenario**: A scenario that reflects the best estimate of land use development conditions in 2030 if the proposed project is built based on the assumptions and methods used in this report.

3.3 What Is the Study Area for the ICE Analysis?

The NCDOT ICE Guidance indicates that the development effects of a new or improved roadway facility are most often found within one mile of an interchange, and approximately two to five miles along major intersecting roadways to the interchange. Using the ICE Guidance, it was determined for the purposes of the Draft EIS that the potential for ICE exists within about five miles of the various project alignments, which for the purpose of the study were evaluated as a single Build Alternative. This approximate five-mile radius is depicted in the Draft EIS, Figure 7-1, and is referred to in the Draft EIS and the Qualitative ICE Assessment as the FLUSA.

Based on coordination with USFWS and other agencies, the DEIS FLUSA was expanded to include all of the Goose Creek watershed (14-digit Hydrologic Unit 03040105030020) as well as the headwaters of some of the area streams in the FLUSA. The Goose Creek watershed is located at its closest point approximately one mile north of the proposed project in northwestern Union County. Although some of the FLUSA watersheds overlap Anson County, the FLUSA was not expanded into Anson County because it lies outside the five-mile radius and does not contain special resources noted in comments on the Draft EIS. This expanded FLUSA is the area within which the Build Alternatives have the potential to affect the

resources that are the subject of this report (water quality, threatened and endangered species, and land use). The expanded FLUSA is depicted in Map 1. The watersheds within the Study Area that are the subjects of this report are shown in Map 2 and area of each watershed within the study area is listed in Table 1; the Goose Creek watershed is the relatively large watershed along the northern border.

Table 1: Study Area Watersheds

Watershed Name	Area (Square Miles)
Sixmile Creek	2.6
Goose Creek	42.3

3.4 What Are the Land Use Conditions and Trends in the Study Area?

To understand existing land use conditions and estimate future land use conditions, a review and assessment of land use conditions, land use regulations, growth trends, growth factors and other factors was completed. Much of this analysis was already completed in the original Quantitative ICE analysis. Additional background research for this Quantitative ICE updated included:

- Updated interviews with local planners
- The 2010 Census and growth trends and conditions in the study area
- Additional development activity
- New planning documents (such as new land use plans and new capital improvement plans).

Interviews

In 2008, the study team interviewed planners with local jurisdictions within the FLUSA, such as the Council of Governments (COG) and city, county and town planning department representatives, as part of the Qualitative ICE Assessment. In August 2009, the study team interviewed with the same organizations as part of the FEIS Quantitative ICE, with follow-up questions as necessary. In September 2012, the study team interviewed representatives of the same organizations again to determine if any new information was available to inform the update of the ICE analysis. Table 2 lists the organization that was the focus of these recent interviews, the individual respondents, and the dates of contact. Those contacts whose jurisdictions include portions of Goose Creek or Sixmile Creek are italicized. The study team was unable to schedule an interview with the mayor of Hemby Bridge. Additionally, the project team was unable to meet with staff from Lake Park, but their most recent Unified Development Ordinance for the Village of Lake Park was obtained.

Each interview began with an introduction of the study and its purpose. A map of the study area was provided to facilitate communication, as were past interview summaries as applicable. The purpose of the interviews was to identify changes to future land use scenarios since the 2009 interviews for the Quantitative ICE and gather any new or updated databases or GIS data that would be useful to the analysis. The following data was requested:

- Approved developments
- Updated zoning
- Information on current stream buffer or other environmental protection areas
- Water and sewer utility information
- Water and sewer priority areas
- Future land use projections

- Existing land use
- Approved population and employment projections and anticipated variations from projections with each land use scenario.

Table 2: List of Interviews Completed in 2012[a]

Organization	Respondent	Date of Interview
Town of Wingate	Patrick Niland – Town Manager	September 6, 2012
Centralina COG	*Diane Dil – Centralina Planner I*	*September 12, 2012*
Town of Matthews	*Kathi Ingrish – Planning Director*	*September 10, 2012*
Town of Unionville	*Sonya Gaddy – Land Use Administrator*	*September 11, 2012*
Union County Planning	*Amy Helms – Water and Land Resources Division Manager* *Scott Huneycutt – Engineering Division Manager* *Richard "Dick" Black – Planning Director*	*September 12 & 19, 2012*
Town of Marshville	Amanda Reid – Town Manager	September 12, 2012
Town of Indian Trail	*Shelley DeHart – Director of Planning and Neighborhood Services* *Adam McLamb, Civil Engineer*	*September 14, 2012*
Town of Mint Hill	*John Hoard - Planner*	*September 14, 2012*
Town of Weddington	*Jordan Cook - Town Planner and Zoning Administrator*	*September 25, 2012*
Town of Wesley Chapel	Josh Langen – Planning and Zoning Administrator	September 12, 2012
Charlotte – Mecklenburg Planning	*Debra Campbell – Director, Charlotte-Mecklenburg Planning Department*	*September 14, 2012*
City of Monroe	Doug Britt – Senior Planner	September 11, 2012
Town of Fairview	*Ed Humphries – Land Use Administrator*	*September 11, 2012*
Town of Stallings	*Brian Matthews – Town Manager* *Lynne Hair – Town Planner*	*September 14, 2012*
Union County Partnership for Progress*	Gretchen Carson – Planner Melanie O'Connell Underwood – Interim Director	September 27, 2012
Union County Planning*	Richard "Dick" Black – Planning Director	January 21, 2013
CSX Corporation*	Vance E. Bennett Jim Van Derzee	November 29-30, 2012

[a] - Italics indicates contacts representing portions of the Goose Creek or Sixmile Creek watersheds

* Contacted after the initial round of interviews to obtain information on the Proposed Legacy Park Development

Prior to the discussion, staff provided a list of the questions to the respondents. Appendix A contains complete minutes from all of the interviews. The following 11 questions were asked during interviews with local planners:

1. *The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview?*

2. *Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census?*
3. *Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.*
4. *Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how?*
5. *What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects?*
6. *Have long-term growth expectations changed since the previous interview and if so how?*
7. *Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?*
    - *If so, does this updated plan reflect conditions in the future with or without the Monroe Connector/Bypass?*
8. *We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community?*
    - *Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis?*
9. *Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations?*
10. *Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)*
    - *Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox?*
    - *Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances?*
    - *How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans?*

Supplemental questions were asked pertaining to the specific interviewee's location or expertise. Face-to-face interviews were conducted to the extent practical. The interviews generally took between 30 and 60 minutes to complete. Notable information included:

- Often, zoning maps provided the best representation of current land use, while land use plans provided the best representation of future land use. Much of this information was available as geographic information systems (GIS) data.
- Some land use plans were in the process of being updated and were not yet available for this study. For example, Indian Trail was in the process of updating their Comprehensive Land Use Plan. Marshville indicated that the next update of their land use plan would include the Monroe Bypass/Connector. The City of Monroe was developing the US 74 Corridor revitalization Plan, which included the Monroe Bypass/Connector in its assumptions. Older land use plans tended not to include the Monroe Connector/Bypass, while the updated plans usually included the project.

- Based on the 2010 Census, the Mecklenburg-Union Metropolitan Planning Organization (MUMPO) Urbanized Area is expanding to include Marshville.
- Mecklenburg County now administers the Goose Creek Management Plan[4]
- Goose Creek Water Quality Recovery Program Plan for the Fecal Coliform Total Maximum Daily Load TMDL was revised in 2010. This is a plan to reduce fecal coliform impairments based on the TMDL report completed in 2005.
- Areas in the eastern portion of the study area were more likely to indicate that their future plans included the Monroe Connector/Bypass and that the implementation of certain aspects of their plans was contingent on the development of the facility.
- Water and Sewer moratoria were rescinded in Union County in 2012.[5]

Plans and Ordinances

Specific documents or information obtained during the interview process are summarized in Table 3.

In addition, Charlotte Department of Transportation (CDOT) staff were interviewed on June 19, 2012 to discuss the Traffic Analysis Zone (TAZ) projections and any updates to their data since they were developed in 2008. Further communications were conducted with CDOT staff as this report was prepared. Summaries of that interview and follow up communications are provided in Appendix A along with the interviews listed in Table 3.

Table 3: Zoning or Other Local Data Collected During Interviews*

Jurisdiction/Area	Document	Year
Goose Creek Watershed	*Goose Creek Water Quality Recovery Program Plan for the Fecal Coliform TMDL*	*2010*
City of Monroe	Zoning Ordinance	Modified 2010
	List of Current Developments	Modified 2009
Village of Lake Park	Unified Development Ordinance	Draft 2012
Town of Unionville	*Zoning Map*	*Updated 2011*
	Future Land Use Map	*2005*
	Zoning Amendments	*Modified 2012*
Town of Fairview	*Future Land Use Map*	*Modified 2010*
	Land Use Ordinance	*Updated 2009*

[4] This is a plan to guide restoration, retrofit and preservation efforts aimed at achieving specific goals for improving water quality conditions in the Goose Creek Watershed in Mecklenburg County such that these waters meet or exceed their State designated uses and are no longer rated as impaired on 303(d) lists. *Goose Creek Watershed Management Plan*. Charlotte-Mecklenburg Storm Water Services. October 31, 2009. http://charmeck.org/stormwater/Projects/Documents/GooseCreekWatershedManagementPlan.pdf

[5] Rescinding the moratorium may increase the short-term development activity within the study area, NCDOT spoke with area planners to address short-term development within the Goose Creek watershed and those changes are included in the 2013 ICE analysis within the updated baseline development assessment. However, long-term growth is more dependent on long planned capital facilities expansions for water and sewer capacity, which have already been analyzed and considered in the Indirect and Cumulative Effects Analysis. Therefore, this change in policy does not affect long-term growth trends in the study area.

Jurisdiction/Area	Document	Year
Town of Stallings	***Unified Development Ordinance***	*Adopted 2012*
	Post Construction Ordinance	*Adopted 2010*
Town of Mint Hill	*Unified Development Ordinance*	*Adopted 2011*
	Lawyers Road & I-485 Small Area Plan	*Adopted 2011*
	Pedestrian Master Plan	*Adopted 2011*
Town of Marshville	Urbanized Area Expansion	Updated 2010
	Comprehensive Pedestrian Plan	Adopted 2010
	Comprehensive Transportation Plan	Updated 2010
Town of Wingate	Land Use Ordinance	Updated 2010
	Wingate 2020 Plan (Comprehensive Plan and Concept Plan)	Adopted 2010
	Wingate Mixed Use Center Plan	Draft 2012
Town of Weddington	*Local Area Regional Transportation Plan*	*Updated 2009*
	Land Use Map	*Modified 2012*
	Zoning Map	*Modified 2011*
	Land Use Plan	*Modified 2011*
Village of Wesley Chapel	Flood Damage Prevention Ordinance	Updated 2009
	Subdivision Ordinance	Updated 2011
	Western Union County Local Area Regional Transportation Plan	Prepared 2009
	Zoning Ordinance	Updated 2012
Town of Matthews	*Zoning Code*	*Modified 2010*
	Unified Development Ordinance	*Draft 2012*
	Downtown Master Plan	*Draft 2012*
	Town of Matthews Land Use Plan	*Draft 2012*
	Demographic/Economic Update	*Prepared 2012*
Charlotte-Mecklenburg	*Growth Framework*	*Adopted 2010*
	FY 2013-2017 Capital Improvements, including 10-Year Needs for Water and Sewer Projects	*Updated 2012*
	Water Quality Buffer Implementation Guidelines	*Updated October 2011*
	Floodplain Ordinance	*Adopted 2012*
Union County	*Water Allocation Policy*	*Updated 2012*
	Sewer Policy	*Updated 2012*
	Union County Water and Sewer Extension Ordinance	*Updated 2012*
	Carolina Thread Trail Master Plan	*Adopted 2011*
	Union County Land Use Ordinance	*Adopted 2008*

Jurisdiction/Area	Document	Year
	Union County Thoroughfare Plan	*Updated 2008*
	Union County 2025 Comprehensive Plan	*Adopted October 2010*
	Comprehensive Water and Wastewater Master Plan	*December 2011*
	US 74 Corridor Revitalization Study	*Underway*

*Bolded documents include the Monroe Connector/Bypass

Growth Trends and Factors

A review of critical growth factors and trends indicates that Union County maintains a number of advantages relative to other suburban jurisdictions in the region. These growth trends and factors are discussed in detail in Appendix B. First, Union County has more land available for development than Mecklenburg, Gaston or Cabarrus counties. Union County has the highest median income of all surrounding counties, it has affordable housing relative to its median income level, and it has one of the best school districts in the region based on SAT scores and graduation rates. In terms of commute times, the interesting trend is that despite having one of the highest average commute times over the last decade, Union County has grown faster than any other county in the region. This finding suggests that factors other than accessibility to jobs are encouraging households to choose to locate in Union County. For the past decade, Union County has exhibited strong growth, and the factors driving those trends are poised to continue attracting growth to Union County regardless of whether the Monroe Connector/Bypass is constructed.

These findings are further supported by the analysis of the Operations Research and Education Laboratory of the Institute for Transportation Research and Education at North Carolina State University's February 28, 2007 *Land Use Study Final Report 2006-2007*. In its research on behalf of the Union County Public Schools, it described the leading factor of growth in Union County as its location within the Charlotte-Mecklenburg region. The Operations Research and Education Laboratory of the Institute for Transportation Research and Education determined the western area of Union County continues to experience a substantial population increase as a result of its desirable location. Marvin, Waxhaw, Weddington, Wesley Chapel and other western Union County suburbs continue to experience high demand for single-family homes. The report also listed the following other factors contributing to growth in Union County:

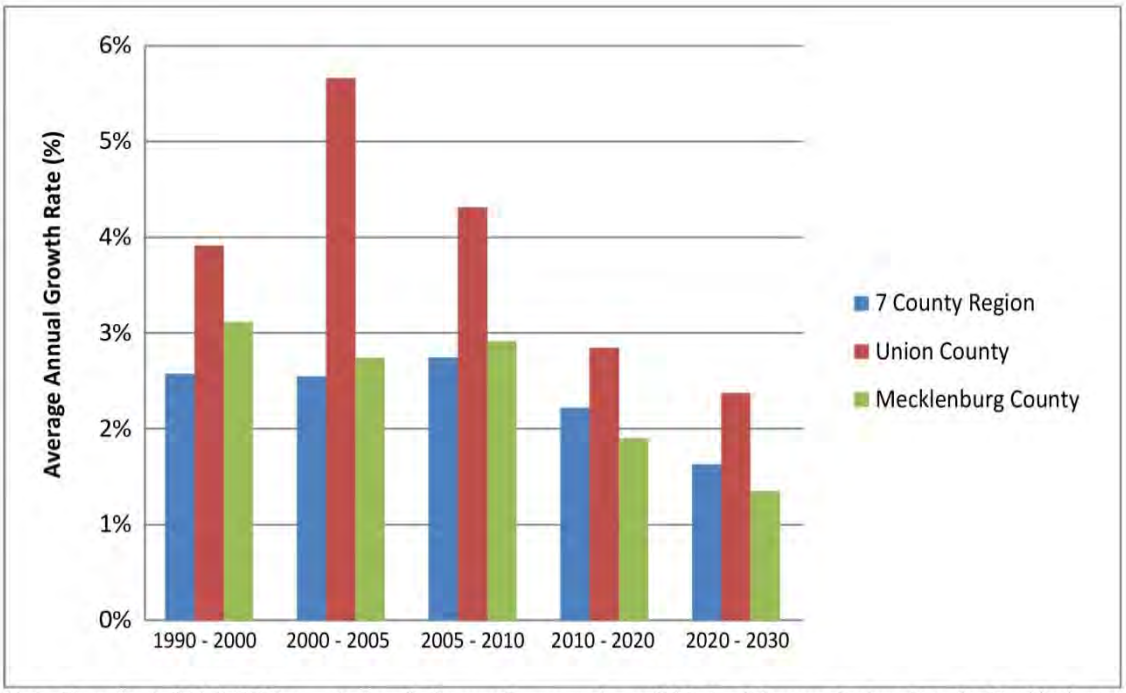
- Low taxes
- Good quality schools
- Comparatively reasonable land prices.

The report described the availability and cost of undeveloped land as a factor of future growth in the western part of the county. It concluded that a reduction in raw land would lead development in the eastern part of the county. The report described the eastern expansion of growth towards Monroe as constrained by a lack of easy access to Charlotte and Mecklenburg County.

Lastly, a review of current growth trends and projected growth trends suggests that while growth has slowed in Union County since 2005, it has still grown at a pace above the regional average. While the

MPO projections still foresees a growth rate above the regional average into the future, the projected growth rate is expected to decline dramatically. To reach the projected 337,317 estimate of population by 2030, growth in Union County would have to slow to an average annualized growth rate of 2.6 percent, based on the 2010 Census count. Figure 1[6] shows the differences in average annual growth rates across the five different periods (1990 to 2000, 2000 to 2005, 2005 to 2010, 2010 to projected 2020 and projected 2020 to projected 2030). The difference between 2000-2005, 2005-2010, 2010-2020 and 2020-2030 average annual growth rates reflects a typical "s-curve" of decreasing growth rates over time as a population base expands.

Figure 1: Average Annualized Growth Rates Comparison



Note: The adopted MUMPO forecasts for whole counties are only available for Cabarrus, Gaston, Lincoln, Mecklenburg, Rowan, Union and York Counties.
Sources: US Census 2000 and 2010, MUMPO 2009 Socioeconomic Forecasts

Specific Updates from Prior Quantitative ICE Analysis

Jurisdictions within Portions of Goose and Sixmile Creek Watersheds

Based on the interviews and review of documents provided by local jurisdictions, this section outlines the new information that prompted modifications to the future land use scenarios compared to the prior Quantitative ICE analysis.

Charlotte/Mecklenburg County: There were no major changes to growth expectations or land use plans. Local planners did note one subdivision and zoning update of a 24-acre parcel on land that previously was identified as Industrial or Undeveloped in the future scenarios of the last Quantitative ICE analysis. The area is now expected to develop as High Density Residential in the future under any scenario.

[6] Figure 1 compares growth rates to a 7 county region as the TAZ level forecasts for whole counties are only available for Cabarrus, Gaston, Lincoln, Mecklenburg, Rowan, Union and York Counties.

Matthews: There were no major changes in growth expectations or land use plans. Local planners did note one zoning change and one planned land use change affecting about 275 acres of land. These changes affected land that was previously identified as Low Density Residential Development or Undeveloped in the future scenarios of the last Quantitative ICE analysis. These areas were now expected to develop as Commercial, High Density Residential or Low Density Residential Development in the future under any scenario.

Mint Hill: There were no major changes in growth expectations but some changes to land use plans as a small area plan has been developed for the area around Lawyers Road and I-485 (see Figure 2).[7] The entire small area plan covers over 1,200 acres of land. In the prior Quantitative ICE analysis, most of this area was already designated as developed, as either Commercial or Low Density Residential. With the new information, some of the land previously identified as Low Density Residential is now identified as Medium Density Residential, Commercial, Institutional or Undeveloped (in the case of those areas identified as Open Space in the Small Area Plan). Mint Hill staff indicated in their interview that the developer will use best management practices to minimize stormwater impacts to Goose Creek.

Stallings: There were no major changes in growth expectations, land use plans or zoning that would necessitate adjustments to the ICE land use scenarios.

Indian Trail: There were no major changes in growth expectations or land use plans. One zoning change involves a 28-acre development. In the prior Quantitative ICE analysis, this area had been identified as a Low Density Residential Area. This area is now being zoned as Commercial and is expected to develop as Commercial under any scenario.

Fairview: The town has adopted a new land use plan with some important changes. Specifically the town has added some commercial nodes at major intersections and is working with the County on expanding water and sewer availability at the US 601 and NC 218 intersection. The new land use plan calls for a commercial district at this intersection as well as at NC 218 and Mill Grove Road (SR-1525) and at US 601 and Lawyers Road (SR-1612). The new land use plan also calls for a new Industrial node along Price Tucker Road (SR-1603) and at NC 218 and Old Dutch Road (SR-1542). All of these new nodes are expected to develop with or without the Monroe Connector/Bypass. In the prior Quantitative ICE analysis, these areas were expected to be Low Density Residential and Undeveloped areas. These areas are now expected to develop as Commercial and Industrial areas under any scenario.

Union County: The County has adopted a new land use plan that provides more detailed information on growth expectations in the eastern end of the county if the proposed project is built (see Figure 3)[8]. Growth expectations are not changing in the Goose and Sixmile Creek watersheds, thus there were no changes to the land use conditions in the watersheds due to this new information.

Jurisdictions outside of Goose Creek and Sixmile Creek Watersheds

Wesley Chapel: There were no major changes in growth expectations, land use plans or zoning that would necessitate adjustments to the ICE land use scenarios.

Stallings: There were no major changes in growth expectations, land use plans or zoning that would necessitate adjustments to the ICE land use scenarios.

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[7] *Lawyers Road & I-485 Small Area Plan*, Future Land Use Map
[8] *Union County 2025 Comprehensive Plan*, p 33

Monroe: There were no major changes in growth expectations or land use plans that would necessitate adjustments to the ICE. Local planners noted that there were zoning changes affecting parcels totaling about 80 acres that were previously identified as Low Density Residential in the previous Quantitative ICE analysis but that would now be expected to develop as Institutional and Commercial under any scenario.

Wingate: There were no major changes in expectations, land use or zoning requiring adjustments to the ICE. The previously Quantitative ICE analysis used the town zoning to determine the most appropriate allocation and density of development under a No-Build Scenario. For the Build Scenario in the prior Quantitative ICE analysis, the study team incorporated many of the proposed zoning changes noted in the Strategic Plan for Economic Development, Town of Marshville, Town of Wingate (2008) as this plan assumes construction of the Monroe Connector/Bypass. These assumptions appear to remain reasonable and valid based on discussions with local planners.

Marshville: There were no major changes in growth expectations, land use plans or zoning that would necessitate adjustments to the ICE land use scenarios (see Wingate discussion above).

Figure 2: Lawyers Road and I-485 Small Area Plan, Land Use

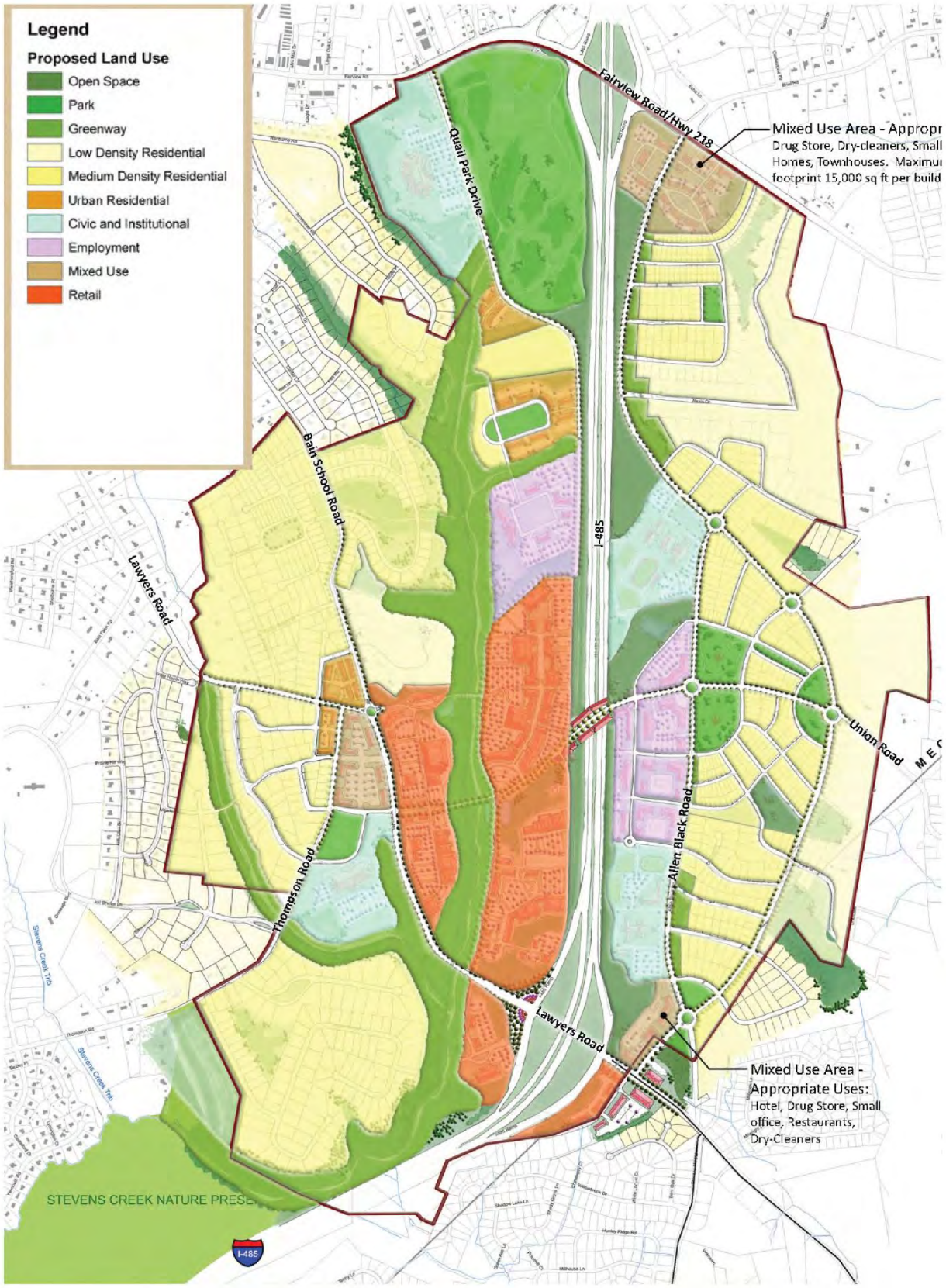
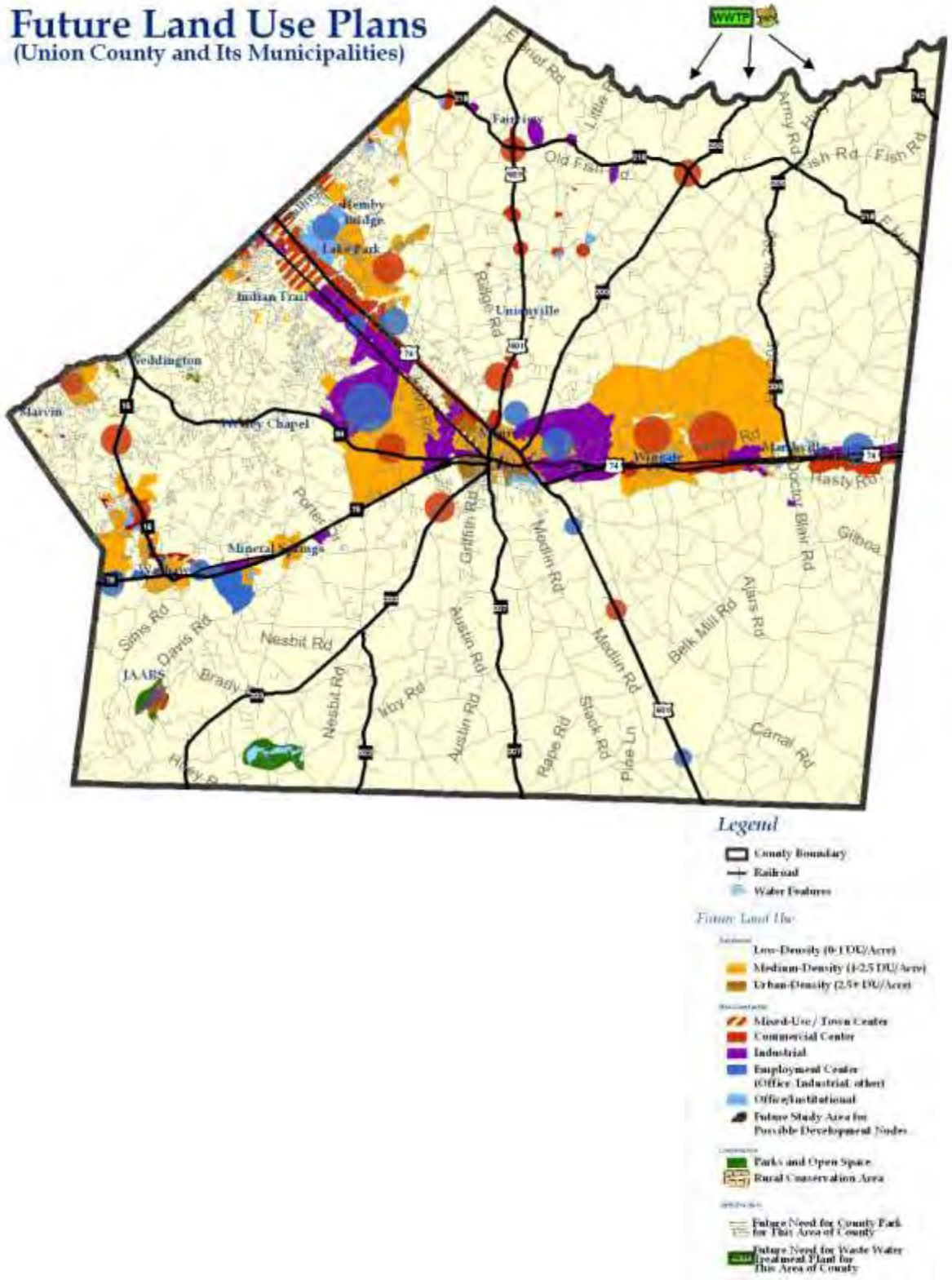


Figure 3: Union County Future Land Use Plan



3.5 Existing Land Use

How Was Existing Land Use Modeled?

Existing land use was developed using parcel-based data from both Mecklenburg and Union counties combined with zoning layers from all the local jurisdictions and the NCGAP[9] land cover dataset, which is based on 1992 aerial photography. The existing land cover is largely a combination of these three data sets, with developed land based on current parcel data and the North Carolina Gap Analysis Project (NC-GAP) data filling in the land cover types where parcels are undeveloped. Each parcel was classified as developed or undeveloped. Undeveloped properties included vacant land and farms. For parcels in the developed category, each was assigned one of five land use categories based on its zoning category and land use attributes from the parcel assessment records. The five categories were:

1. Low Density Residential
2. Medium Density Residential
3. High Density Residential
4. Commercial
5. Industrial/Office/Institutional.

Spot checks for the assessment were conducted by comparing recent aerial photography (2010) of the Study Area with the assessed land use. In addition to the zoning and parcel land use attributes, Union County provided a list of parcels that had applied for tax deferral based on agricultural use. This list was used to categorize farm properties as undeveloped. Aerial photography was used to identify farm properties in Mecklenburg County and also to check for other farms in Union County that were not included in the farm deferral list provided by the County.

Once each parcel was assigned to one of these five development categories or the undeveloped category, the parcel polygon feature class was converted to a raster image. A raster is a rectangular grid where each cell or pixel within the grid represents one unit of area and contains a value (which in this analysis represents land use). For this analysis, all rasters were formatted with a 30x30 meter cell size to match the NCGAP land cover dataset. Each raster cell is a 30x30 meter square, or about one quarter of an acre. For undeveloped properties, the NCGAP raster dataset was used to fill in the natural and farm land covers within those areas. Since parcels do not cover all land in the Study Area, a provision had to be made to account for areas outside parcel boundaries. Since nearly all land not included within a parcel boundary is a road right-of-way, these areas were categorized as transportation uses. Figure 4 illustrates how the existing land use raster was developed. It shows for an example area how the parcels were categorized and converted to a raster and then the undeveloped areas were filled in with the NC-GAP land cover.

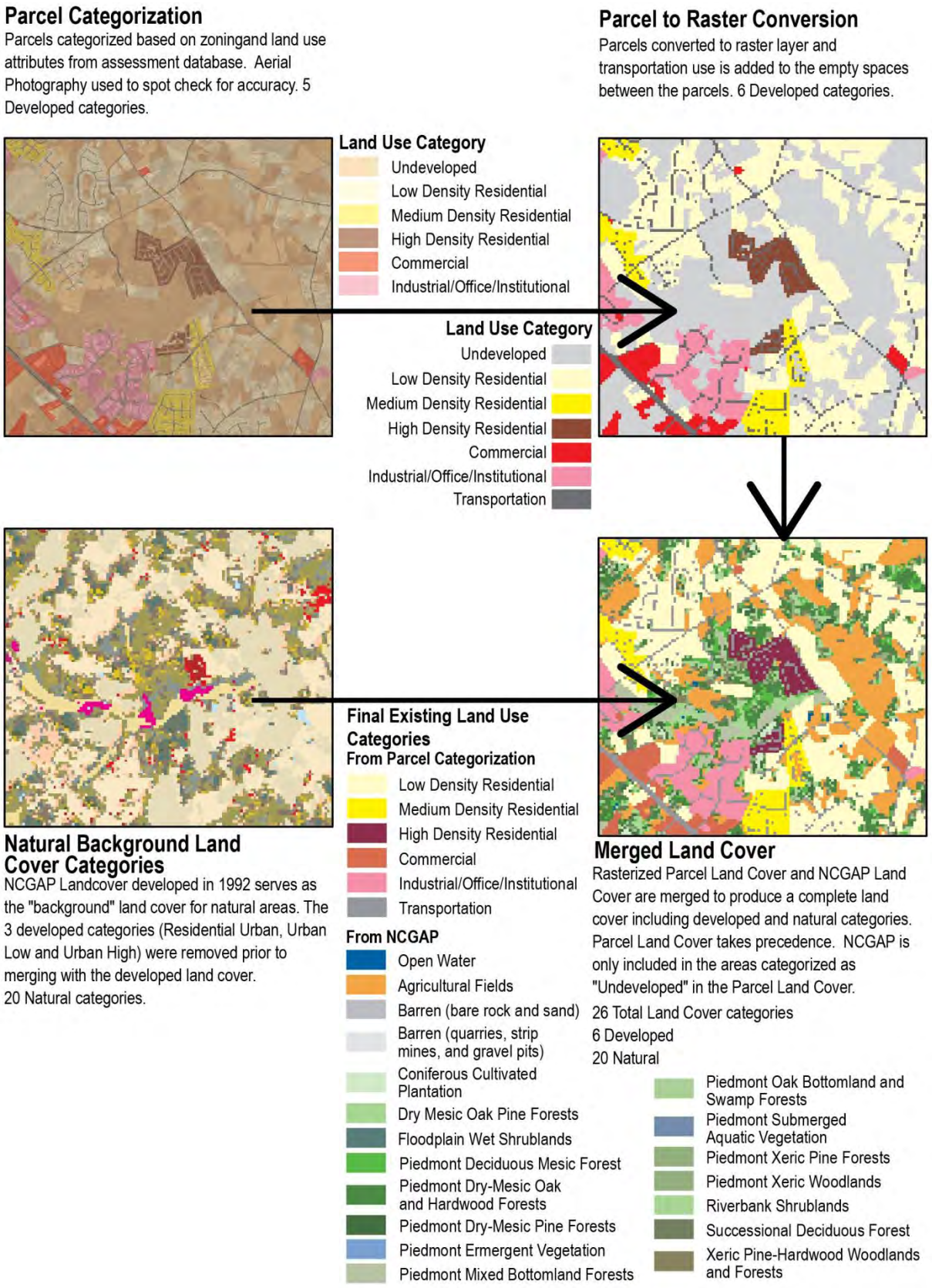
The resulting land cover is a raster image consisting of over 900,000 individual cells, each cell categorized into one of 26 land use categories. The 26 land cover categories consist of: 5 developed

[9] The Gap Analysis Program is a national program with the mission of developing key datasets needed to assess biological diversity across the nation. The North Carolina Gap Analysis Project (NCGAP) was a state affiliate based at the North Carolina Cooperative Fish and Wildlife Research Unit and charged with developing those data for the state. A map of North Carolina's land cover was developed using Landsat TM satellite imagery acquired in 1991 and 1992.

categories, 1 transportation category, 2 farm categories, 16 vegetation categories from the NCGAP land cover, and 2 barren categories from the NC-GAP land cover. Existing land use, or Baseline condition, is presented in Map 3. To simplify the display of the land cover, many categories have been aggregated into larger categories in Maps 3, 17 and 19. These aggregated categories are:

- Agricultural Fields: includes both the Agricultural Fields and the Agricultural Pasture/Hay and Natural Herbaceous.
- Barren: includes both Barren (bare rock and sand) and Barren (quarries, strip mines, and gravel pits).
- Forested: includes Coniferous Cultivated Plantation (natural / planted), Successional Deciduous Forests, Piedmont Xeric Pine Forests, Piedmont Dry-Mesic Pine Forests, Piedmont Xeric Woodlands, Piedmont/ Mountains Dry-Mesic Oak and Hardwood Forests, Piedmont Mesic Forest, Xeric Pine-Hardwood Woodlands and Forests.
- Other Natural: includes Piedmont/Mountain Submerged Aquatic Vegetation, Piedmont/Mountain Emergent Vegetation, Riverbank Shrublands, Floodplain Wet Shrublands.

Figure 4: Land Use Categorization Process



4.0 REVIEW OF SOCIOECONOMIC PROJECTIONS

To assess potential impacts from induced development, two future land use scenarios are needed: a No-Build that reflects the future without the proposed project and a Build that reflects the future with the proposed project. Research on induced growth impacts of transportation investments indicates that typically induced development impacts fully arise within eight years of the opening of new roads or new capacity.[10] Therefore, if the proposed project is expected to be open to traffic before 2020, a 2030 horizon year would be an appropriate and reasonable analysis year. Since the prior Quantitative ICE analyzed 2030 conditions, it would also be appropriate to maintain that analysis year to make comparisons easier.

Since the Quantitative ICE analysis is looking at land use changes at the watershed level, the next question is how to estimate future growth under either scenario at that level of detail. Many entities, such as state level demographic agencies, private forecasters such as Woods and Poole, and even universities, produce projections of population and employment at the county, regional or state level, and these projections could be used to estimate growth in the study area. However, none of these sources provide detail on where that growth may occur below the level of individual counties. Metropolitan Planning Organizations (MPOs) develop similar projections of population and employment and, due to their federally mandated planning efforts, their projections typically include much smaller geographic divisions. MPO projections, therefore, represent the only best available resource for population and employment projections at the necessary geographic and temporal scales to reasonably estimate quantitative land use impacts of transportation projects.

4.1 What Is an MPO?

MPOs have been required under federal law since the early 1970s. Federal regulations requires any Census Bureau defined urbanized area (UZA) of at least 50,000 people to have an MPO to develop regional transportation plans and programs through a continuing, cooperative and comprehensive (3-C) transportation planning process. An MPO is required to develop a number of planning documents to guide the planning and funding of transportation improvements across the metropolitan region. To address the long-range transportation needs of a region, MPOs are required under federal regulations to estimate and accommodate the mobility needs for persons and goods in their Metropolitan Transportation Plans (MTP). This requirement, therefore, necessitates estimating the long-range travel needs of their respective regions. As such, most MPOs use some form of travel demand modeling to estimate the long-range travel needs for their regions and help in addressing other policy concerns such as transportation conformity (through emissions estimates), estimation of freight movement and of non-motorized trips. Most MPOs, including those in the Charlotte region, use a standard four-step travel demand model while a few MPOs have begun using more advanced modeling techniques such as activity-based models.

What Is the Metrolina Regional Travel Demand Model and How Does It Relate to the MPO Projections?

The main reason that MPOs prepare regional socioeconomic projections is to operate a regional travel demand model (TDM). The TDM is used to project future travel demand for use in transportation planning activities. In the Metrolina region, the TDM is called the Metrolina Regional Model (MRM).

[10] Cervero, Robert. "Road Expansion, Urban Growth and Induced Travel: A Path Analysis." *Journal of the American Planning Association*. Vol. 69, No. 2. Spring 2003, p 158.

This model is used for the four major tasks that MPOs must complete as part of their federally mandated planning responsibilities:

1. Identifying existing transportation conditions and deficiencies on the major segments of the transportation network within the region
2. Identifying future transportation conditions and deficiencies on the major segments of the transportation network within the region
3. Prioritizing projects for inclusion in LRTPs and a plan of implementation for inclusion in the Transportation Improvement Plan
4. Demonstrating conformity to the National Ambient Air Quality Standards established by the U.S. Environmental Protection Agency (EPA), under the Clean Air Act, for the EPA designated non-attainment area(s) within the region (also known as the air conformity process).

Based on the *Metrolina Regional Travel Demand Model Memorandum of Agreement*, CDOT is the custodian for the MRM and all its constituent parts (network files, socioeconomic data and projections, programming scripts, trip tables and any other files necessary to run the model). The MRM is the main tool used by state, regional and local planning agencies to assess regional travel patterns. The MRM covers the following areas, also shown in Map 4:

- Cabarrus-Rowan Metropolitan Planning Organization (CRMPO): Cabarrus and Rowan Counties
- Gaston Urban Area Metropolitan Planning Organization (GUAMPO): Most of Gaston County
- Mecklenburg-Union Metropolitan Planning Organization (MUMPO): All of Mecklenburg and most of Union County
- Part of the Lake Norman Rural Planning Organization (LNRPO): Iredell, Lincoln and Cleveland Counties and the remainder of Gaston County
- Part of the Rocky River Rural Planning Organization (RRRPO): Stanly and Anson Counties and the remainder of Union County
- All of York County and part of Lancaster County, South Carolina, including all areas within the Rock Hill-Fort Mill Area Transportation Study (RFATS, the MPO for eastern York County).

As custodian of the model, CDOT leads the model team and leads the model development and maintenance process, including all its constituent parts such as socioeconomic projections. Most CDOT staff members who oversee the model are also staff to MUMPO.

In addition to the above tasks, the MPO and others may use the travel demand model or its component parts to complete other planning or analytical tasks related to land use, transportation or environmental planning within the region. Often, in completing the necessary environmental studies, DOTs or others will use MPO socioeconomic projections and travel demand models for traffic forecasting or land use analysis as the MPO projections and travel demand models are often the only readily available source or tools available to complete the necessary analyses. As shown in Figure 5, the regional travel demand model is a "Four-Step Model" that uses the projections of population, households and employment as one key input file.

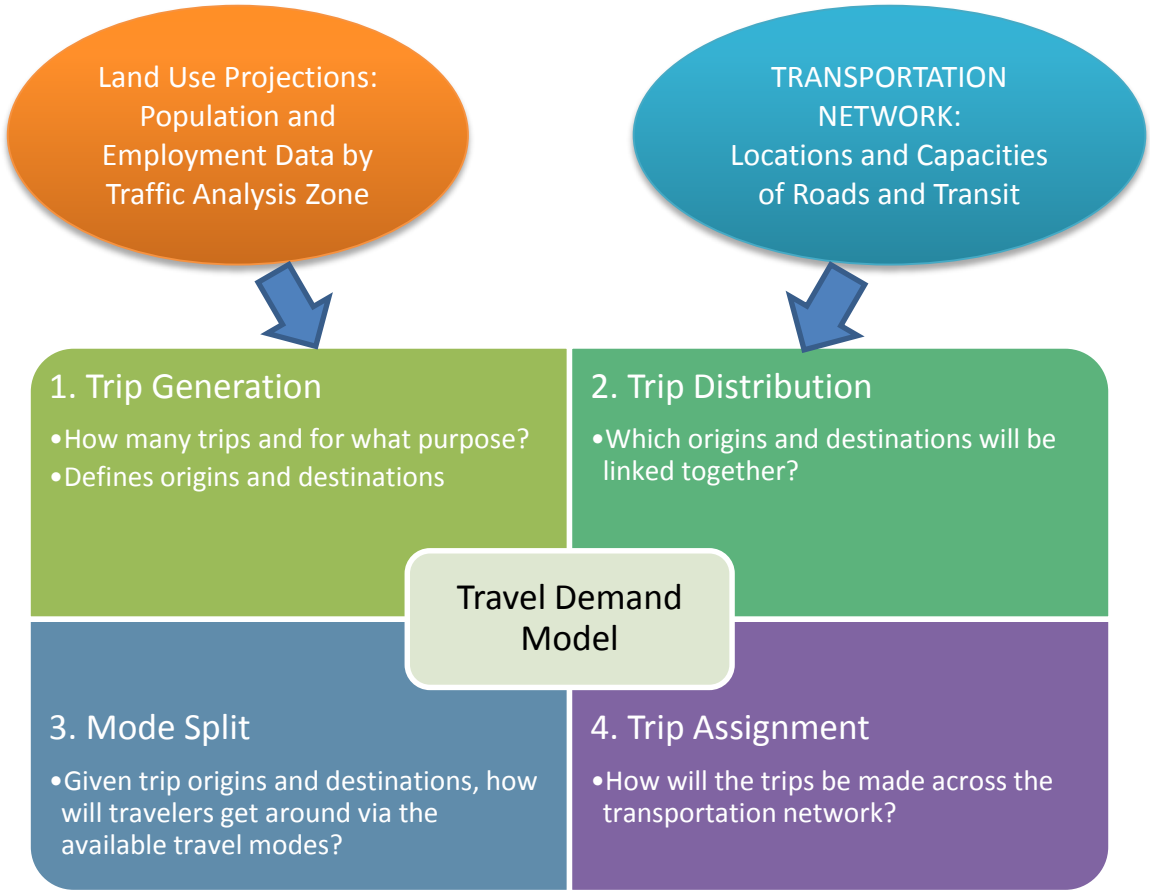
In most MPOs that use a Four-Step Model, the MPO develops the socioeconomic projections through some combination of projecting of historical trends, build-out capacity and other methods as appropriate for the specific region. To properly develop traffic forecasts, these socioeconomic projections must be provided at small geographic scales, thus the projections are allocated from a regional level, to a county

level and finally to smaller geographic areas called Traffic Analysis Zones (TAZs). The TAZ projections typically include data for a base year (with data based on Census counts and other survey resources) and future horizon years based on the MPO forecasting process. The data for each year typically includes, for each TAZ,

- the number of households
- number of persons within households
- number of persons within group quarters (i.e. dorms, prisons or other non-household living arrangements)
- median income for households
- the number of students (sometime divided into sub-categories by age group)
- number of employees (typically divided into multiple sub-categories by type of employment).

The regional travel model uses this data in Step 1 of 4 to predict how many trips and what type of trips are generated in each TAZ. The MRM TAZs for the Future Land Use Study Area (or FLUSA, the study area defined for the purposes of the ICE report) are shown in Map 5 to provide a sense of scale for these important geographic subdivisions. Also shown in Map 5 is the distinction between TAZs within the jurisdiction of MUMPO and those TAZs under the jurisdiction of another MPO or RPO. Of the 383 TAZs partially or fully within the FLUSA, 349 are within the jurisdiction of MUMPO, while the remaining 34 are under the jurisdiction of the RRRPO. Each planning organization is the final authority of the socioeconomic projections at the TAZ level for the TAZs under its jurisdictions. As discussed in Section 3.2, the socioeconomic projections developed for the Metrolina region have been developed through an extensive and highly cooperative regional projection process.

Figure 5: Four-Step Travel Demand Model and Inputs



TAZs are delineated by the MPO working from Census data on population and employment and criteria set by the FHWA. These criteria recommend minimum populations of 600 persons or workers but they generally recommend approximately 1,200 persons or workers per TAZ. Additionally, FHWA recommends or requires that TAZs meet the following criteria[11]:

- Compactness: TAZs should be compact in nature.
- Nesting and boundaries: TAZs must nest within a county and must not cross county or state boundaries. Where possible, TAZs should follow city or town boundaries.
- Maximize contiguity: TAZs should be contiguous across each county without any missing slivers.
- Include all water and land: TAZs must include all area within the territory of a county; water bodies must be part of a TAZ.
- Unique and identifiable: TAZs must have unique identifiers and each MPO must have a unique identifier.

A TDM generates trip "productions" based on household location and characteristics, and trip "attractions" based on the employment data, which represent not only job destinations but also shopping

[11] FHWA CTPP Data Products. March 2010. "TAZ Delineation Business Rules." http://www.fhwa.dot.gov/planning/census_issues/ctpp/data_products/tazddbrules.cfm

and other activities that attract household trips. The overall number of productions and attractions are balanced, providing a set of trip origins and destinations, which is then taken into Step 2 of the Travel Demand Model for Trip Distribution – the linking of the origins and destinations into trips. At this point, the model begins to use a separate input file that represents the network of available roadways in the region, including data about the capacity, speeds, and other characteristics of each road or highway.

Other modes of transportation such as public transit are also taken into account in Step 3 of the model, which estimates the division of all trips across the available travel modes. The final "loading" of trips onto the network happens in an iterative process in Step 4 of the model, in which trips are distributed across all of the roads in the network and the impacts of congestion on travel patterns are incorporated.

What is both important and relevant to the ICE analysis process is the fact that the socioeconomic projections (the projection of where population and employment will be in the future) are a distinct input to the travel demand model from the transportation network. Consequently, the extent to which the socioeconomic projections represent the land use impacts of any given project cannot be answered by solely looking at the transportation network used in the travel demand model or its outputs. Instead, it requires examining the process and data used by the MPO in developing the population and employment projections. The assumptions behind the MRM socioeconomic projections are discussed below.

4.2 How Did the MPO and CDOT Develop the Projections?

It is important to note that regional socioeconomic models and projections are somewhat fluid in their development. Factors and variables may be created in the development stage that are either applied narrowly or omitted due to data limitations or other aspects of the extremely complex process of creating future land use projections at regional, county, and TAZ levels. This is one factor that caused confusion in the past quantitative ICE analysis and which could persist in spite of the additional information provided here. As such, it is necessary not only to conduct a very careful review of how the models were designed, but more importantly, how they were ultimately used in developing socioeconomic projections. This is necessary in order to understand fundamental questions regarding the role of the Monroe Connector/Bypass in the ultimate socioeconomic projections. For this reason, the following discussion reviews not just the model processes, but also reviews the model results and includes information from CDOT, who created and applied the many of these models. These reviews are needed to understand the true meaning and bases of the regional projections and to develop a full understanding of the projections and their appropriate use in other analyses.

Review of Projection Versions

As custodian of the MRM, CDOT and MUMPO staff oversaw the various regional socioeconomic projection processes and updates that have occurred over the last decade. As the discussions below shows, the projection process is a continuous and evolving process, so it is important to document exactly which datasets are used for any different purposes and different planning efforts.

The current MRM 2011 v 1.1 uses projections finalized in 2009 and is used as the basis for air conformity approvals for the 2035 Long-Range Transportation Plan (LRTP) adopted May 3, 2010. These current projections (hereafter called the 2009 Projections) were the latest update to projections that were first developed beginning in 2003. Table 4 summarizes the various socioeconomic projections, the associated file naming conventions, the month and year the projections were completed, associated MRM versions and the base and horizon years for each socioeconomic projection dataset. Figure 6 shows the timeline of

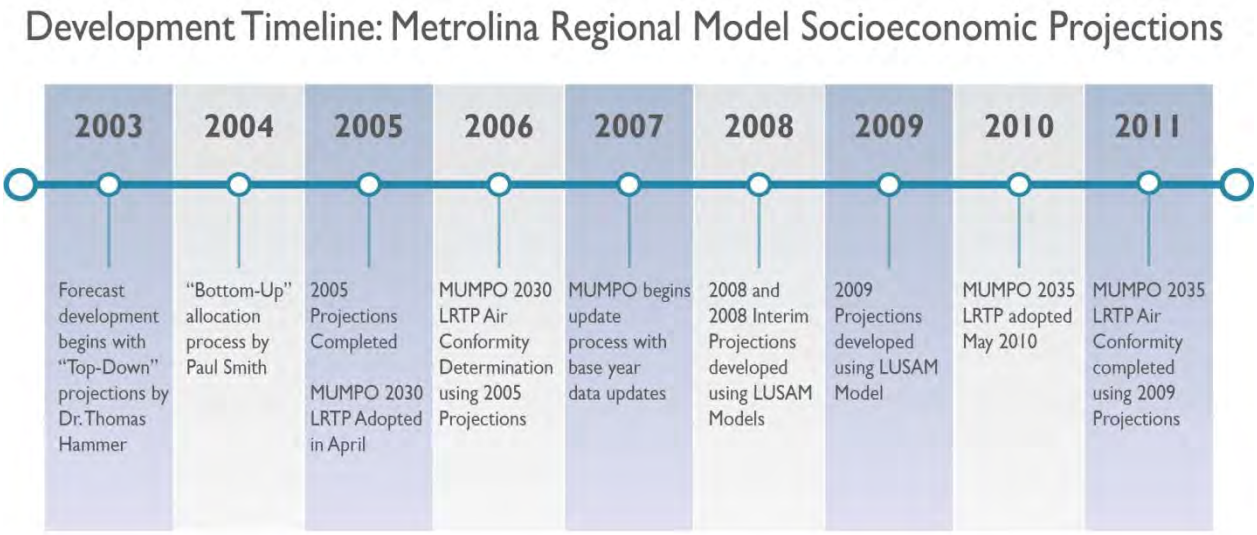
when the projections were developed relative to the adoption of each MUMPO LRTP. The Projection Names shown in the table and figure are not an official name but are used in this document for ease of reference. Each socioeconomic projection dataset includes projections for ten-year increments, with five-year increments interpolated between horizon years. Thus for the 2009 Projections (which were used in the 2035 LRTP), the horizon years were 2015, 2025 and 2035, but interpolated projections were also available for 2020 and 2030. Similarly, for the 2005 Projections (which were used in the 2030 LRTP), the horizon years were 2010, 2020 and 2030, but interpolated projections were also available for 2015 and 2025.

In the 2003-2004 timeframe, MUMPO and its regional partners at other MPOs and Rural Planning Organizations (RPOs) prepared the TAZ-level 2030 projections of population, households and employment in support of the development of the 2030 LRTP. The projections originally developed for this purpose were completed in 2005 and became the projections used in the official Metrolina Travel Demand Model 2005 version 1 (MRM05v1) and all versions of the model through MRM06v1.1.

Table 4: MRM Socioeconomic Projection Versions

Projection Name	TAZ File Name	Projections Completed	Use for LRTP Conformity Determination	Associated Model Version	Base and Horizon Years
2009 Projections	SE_*Year*_091028	October 2009	MUMPO 2035 LRTP	MRM 09 v1.0 MRM 11 v1.0 MRM 11 v1.1	Base: 2005 Horizon: 2015, 2025, 2035
2008 Interim Projections	SE_*Year*_081119_ MUMPO_interim	November 2008	None	None	Base: 2005 Horizon: 2015, 2025, 2035
2008 Projections	SE_*Year*_081024	October 2008	RFATS 2035 LRTP	MRM 08 v1.0	Base: 2005 Horizon: 2015, 2025, 2035
2005 Projections	SE_*Year*_taz2934	May 2005	MUMPO 2030 LRTP	MRM 05 v1.0 MRM 06 v1.0 MRM 06 v1.1	Base: 2000 Horizon:2010, 2020, 2030

Figure 6: Timeline of MRM Projection Development



Subsequent to the adoption of the 2030 LRTP, MUMPO conducted an update process for their projections in 2008-2009 and extended their projections to 2035. These updates used the 2005 Projections as a critical input as described below. All of these updates used a spreadsheet model system called a Land Use Allocation Model (LUSAM) to develop the 2008 and 2009 Projections. The details of this process are described in later sections.

The first of these updates was completed and incorporated into MRM 08 v1.0, which was the official model used to support the 2035 LRTP for the Rock Hill-Fort Mill Transportation Study Area. CDOT continued to update the regional projections based on new information and developed interim projections in 2008 for use in the Northeast Transit Corridor planning process. These projections are known as the 2008 Interim Projections. These projections were further updated and finalized in 2009 and eventually incorporated into the 2035 LRTP adopted May 3, 2010 and modeled using Metrolina Travel Demand Model 2009 version 1 (MRM09v1). Subsequent Metrolina Travel Demand Model versions (MRM11v1, MRM11v1.1) also use these same projections.

The FEIS Quantitative ICE (developed in 2009 and completed in 2010) used the 2008 Interim Projections, as they were the most up-to-date projections available at the time of that analysis. Given that CDOT has updated its projections since that report, it would be most appropriate to use the 2009 Projections. The following sections describe the 2009 Projections and the various inputs and processes used to develop those projections, as well as describing the prior process for developing projections. The purpose of this review is to fully disclose and explain what, if any, impact the Monroe Connector/Bypass had on the 2009 Projections to determine the most appropriate way to use those projections in the update of the ICE analysis.

2008 and 2009 Projections (LUSAM Process)

In 2008, CDOT, MUMPO and other regional MPOs began development of their 2035 LRTPs and in doing so, needed to update population and employment projections for 2015 and 2025 and develop a TAZ level projection for 2035. The initial step was to develop the socioeconomic base year of 2005 by reviewing recent development activity and updating TAZ level data on households, population and employment estimates as of 2005. Next, CDOT staff developed a spreadsheet model system called a Land Use Allocation Model (LUSAM) to consider multiple factors as part of the projection process. CDOT documented how the model worked in an internal draft document titled *Metrolina Regional Travel Demand Model LUSAM: Land Use Allocation Model Technical Documentation* dated December 4, 2007.

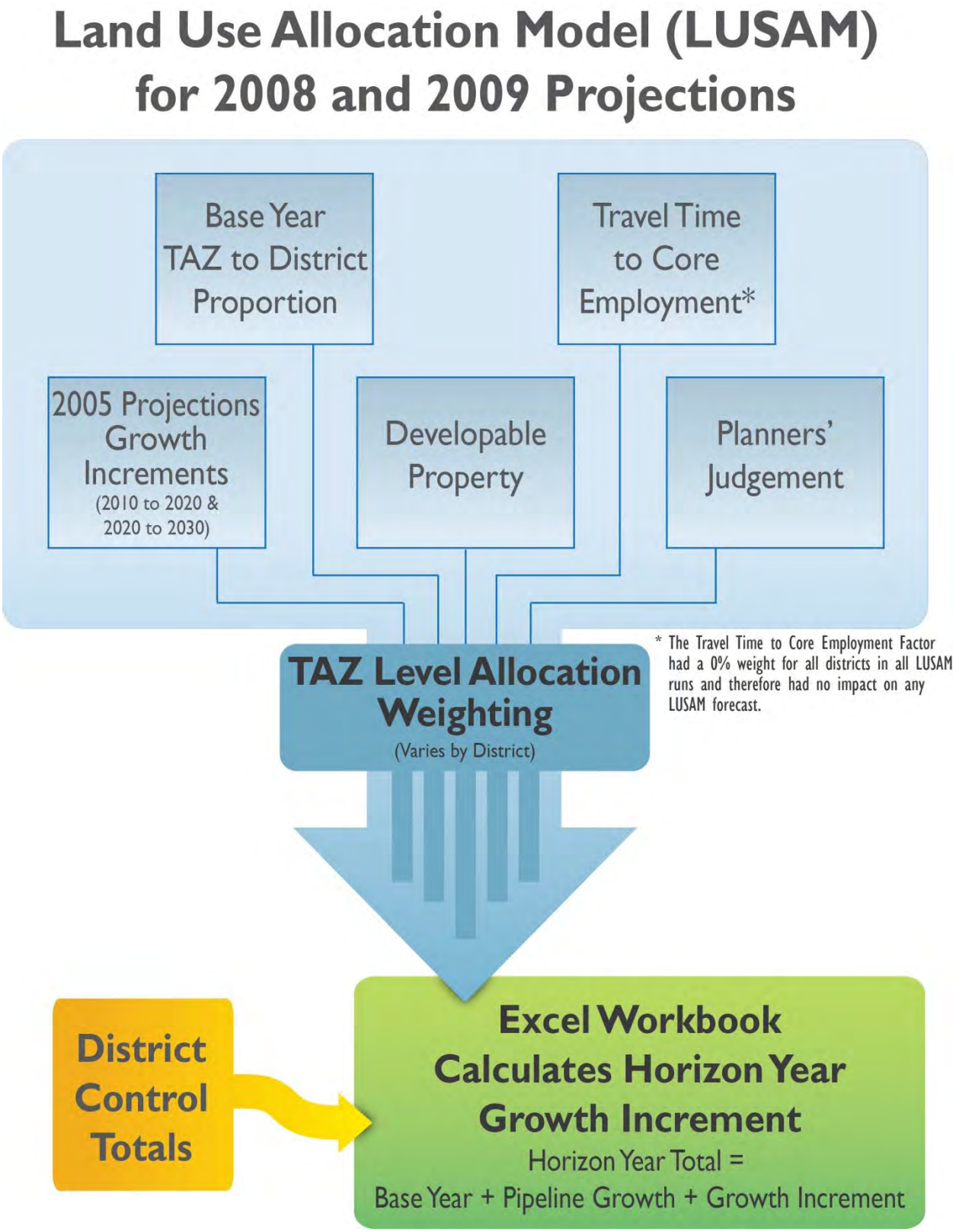
The LUSAM model uses a number of inputs to generate the future projections of households and employment for each TAZ and uses a district level approach to determining the factors considered in the distribution of the households and employment to each TAZ. The LUSAM model requires TAZs to be grouped into districts with up to 32 districts defined in the model. This simplifies the process of entering model weights, targets and factors. The model outputs its horizon year projections in an iterative process, such that each horizon year projection builds upon the next. Each iteration requires the input of base year values. For the first iteration, which produced the 2015 projections, the 2005 base year was used as the base year in all LUSAM model runs. For later LUSAM model iterations, the prior model output was used. Thus, for the 2025 horizon year, the 2015 output would be input as the base year and for the 2035 horizon year, the 2025 output would be input as the base year. The LUSAM model uses a district level targeting approach, where target household, population and employment values are set for each horizon year and the model attempts to adjust the projections such that the totals for the TAZs within each district would

equal the district target. LUSAM aggregates the base TAZ data into the same districts as the targets. The difference between the target and base is allocated by percentages to the TAZs within the district and a new TAZ land use dataset is created. These targets were developed independent of the LUSAM model and the inputs to those are discussed later.

Figure 7 provides a visual representation of the LUSAM model process. The model would use up to five weighted factors to determine how to allocate the district level target of growth to each TAZ within the district. The growth increment would then be added to the base year plus the pipeline growth (the number of households or jobs under construction or approved for construction) to yield to total for the horizon year. The five factors available in the LUSAM workbook are described below; however, as applied in the projection process, not all factors were used:

- **2005 Projections Growth Increment:** The change (growth) over time from an earlier projection (e.g. – projections for a new 2015 dataset would use the same growth allocation as an earlier projection between 2010 and 2020). In practice, the 2005 Projections growth increments for 2010 to 2020 and 2020 to 2030 were used as the input for this factor. Thus, the 2008 Interim and 2009 Projections relied on the growth increments in the 2005 Projections.
- **Base Year Proportion:** The same proportion of TAZ to District as in the base TAZ file (e.g. if TAZ "1" has 100 retail employees of the 1000 retail employees in the district – it would receive 10 percent of all new retail employees)
- **Developable Property:** This is based on an estimate of households or jobs per acre (and total acres). Relative development density is a primary input to this category. It differs across categories and across geographies, for example, employment density by acre is considerably higher in the center city than in suburbs.
- **Travel Time to Core Employment:** The estimated travel time to downtown Charlotte under peak highway congestion conditions. This factor was inverted as shorter travel times are preferred over longer. In the LUSAM Models for the 2008 Interim and 2009 Projections the weight applied to this factor was zero. Therefore, this factor was never used.
- **Planners' Judgment:** A direct 1-5 scale rating that could be applied to specific TAZs to reflect highly popular or unpopular TAZs for residential or non-residential development.

Figure 7: Visualization of LUSAM Workbook Process



The LUSAM model also incorporated "Pipeline" data by TAZ. The number of households or jobs under construction or planned could be added to a specific TAZ. Similarly, known decreases, such as that for a factory being closed, could be subtracted from a particular TAZ. Pipeline data would be added or subtracted to the base prior to allocation from districts.

The LUSAM model allowed for a weighting of the factors by each district. Thus, one district could have its entire weight based on the previous projections while another could have its entire allocation weight based on planners' judgment. The basic allocation equation is essentially the same for all categories and households are used in the example below.

$$
\begin{aligned}
&HH_future_{taz} \\
&= HH_base_{taz} + HH_pipeline_{taz} \\
&+ (HH_target_{dist} - (HHbase_{dist}_HH_pipeline_{dist}) * \\
&(Wgt1 * (\Delta HH_y2 - y1_{taz} / \sum \Delta HH_y2 - y1) \\
&+ Wgt2 * (HH_base_{taz} / \sum HH_base) \\
&+ Wgt3 * (Vacant_res_{taz} / \sum Vacant_res) \\
&+ Wgt4 * (TravTime_{taz} / \sum TravTime) \\
&+ Wgt5 * (PlannersJudgment / \sum PlannersJudgment))
\end{aligned}
$$

Where:

HH_future_{taz}	Future (projection) year TAZ households
HH_base_{taz}	base year TAZ households
$HH_pipeline_{taz}$	Pipeline households added to TAZ between base year & future year
$\Delta HH_y2\text{-}y1_{taz}$	Change in no. of HH in TAZ between y1 and y2 in "old" projection set
$\sum \Delta HH_y2\text{-}y1$	Change in no. of HH in district (sum of all TAZ) between y1 and y2 in old projection set
HH_base_{taz}	No. of base households in district
$\sum HH_base$	Sum of base households for district
$Vacant_res_{taz}$	Vacant residential acres for TAZ
$\sum Vacant_res$	Sum of vacant residential acres for district
$TravTime_{taz}$	Reciprocal of travel time to core employment for TAZ
$\sum TravTime$	Sum of reciprocal of travel time to core employment for district
$PlannersJudgment_{taz}$	Planners Judgment value (1-5) for TAZ
$\sum PlannersJudgment$	Sum of Planners Judgment values for district
Wgt1 ... Wgt5	Weights (0 – 1 for each factor, weights must sum to 1.0)

The 2008 Projections were the first projections developed using the LUSAM methodology. These projections were developed and used for the Rock Hill-Fort Mill Area Transportation Study 2035 LRTP air quality conformity analysis. The 2008 Projections were not used for any planning purposes within the MUMPO or RRRPO regions. Also, these projections were not used in development of the 2008 Interim or 2009 Projections, either. Therefore, they were not analyzed as part of this report.

The 2008 Interim Projections were the projections provided to NCTA for use in the FEIS Quantitative ICE analysis. The model inputs show that for the 2008 Interim Projections the major focus of adjustment was on Mecklenburg County, with the remainder of the region largely relying on the growth projections from the 2005 Projections to guide the LUSAM adjustments. Of the factors in the model, the Travel Time

to Core Employment is not used at all for any district for any horizon year. For all areas outside Mecklenburg County, the previous projections (2005 Projections, which were used in the 2030 LRTP) were the main factor in the household and population projections. For employment projections outside Mecklenburg County, the previous projections had the highest weighting but some weight (10-25 percent) was placed on the estimate of available land and densities. Within Mecklenburg County, projections of households and population were based on a mixture of the previous projections, available land and density and planners' judgment, with the exact weighting varying from district to district within the county.

The 2009 Projections are the most recently completed projections that have been fully adopted and used in regional air conformity analysis. These projections are very similar to the 2008 Interim Projections and, in fact, LUSAM runs were only used in Mecklenburg County to adjust between the 2008 Interim Projections and the 2009 Projections. Only minor adjustments were made in Union County and only to employment. Within Mecklenburg County, projections of households and population were based on a mixture of the previous projections, available land and density and planners' judgment, with the exact weighting varying from district to district within the county.

To illustrate how the LUSAM workbook produces the projections, Figure 8 shows the LUSAM process with district targets and changes for household projections for all TAZs in the Fairview District for the 2015 horizon year from the 2009 and 2008 Interim Projections LUSAM Model run. Fairview was chosen because it is partially located within the Goose Creek watershed and provides information on how population projections within the watershed were developed. The example is somewhat simplified as there are no pipeline household adjustments and 100 percent of the weight is on the Old Projection factor. Pipeline households would be any planned or under construction households in a TAZ. The process begins with the base year households, which are the number of households in each TAZ in 2005. The model then adds the pipeline households to the base year households. Next, the model works to distribute the households from the district level targets to the TAZ level using the weighted factors. In the example of Marshville, the full weight is placed on the distribution from the Old Projections (the 2005 Projections used in the 2030 LRTP). Thus, in the example shown below, TAZ 9032 captures 5.4 percent of the district household growth in the Old Projections. Thus, it receives that same percentage of the district household growth from the new, targeted growth (5.4% x 688 = 37 households). Thus, the household projection for 2015 for TAZ 9032 is 164 households.

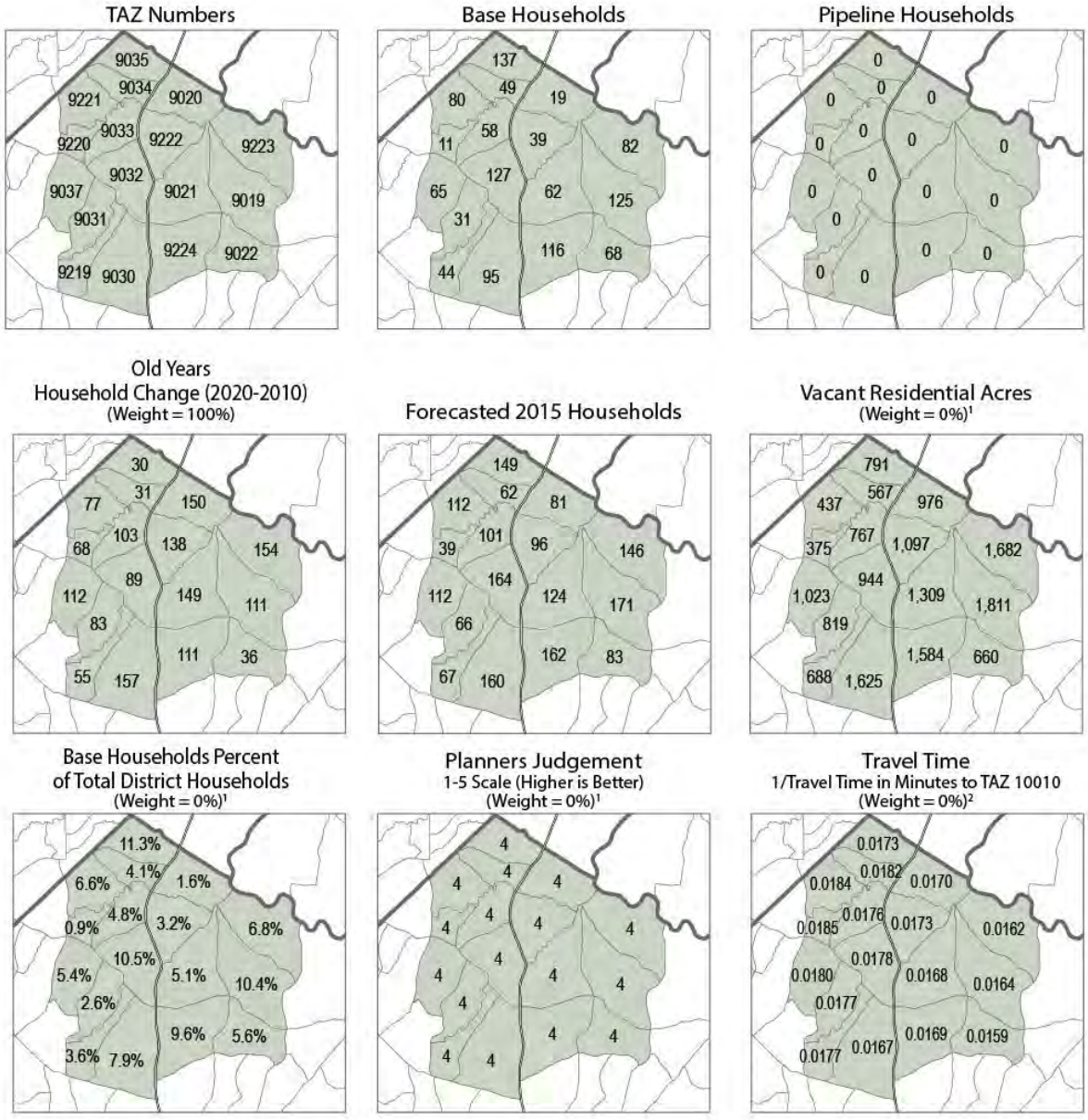
Based on these inputs and the LUSAM process, the Monroe Connector/Bypass could only have affected the LUSAM model through four possible inputs:

- The Planners' Judgment Factor
- The Travel Time to Core Employment Factor
- The Old Projections Growth Increments Factor (2005 Projections)
- District Level Targets.

As discussed above, however, the Travel Time to Core Employment Factor was not used (its weight was zero percent) for any LUSAM runs. Furthermore, the Planners' Judgment Factor was not used at all in Union County for any LUSAM run. Thus, based on the weighting of factors, the Monroe Connector/Bypass could not have influenced the projections through these two factors.

Thus, to fully assess whether the 2008 Interim or 2009 Projections were affected by the Monroe Connector/Bypass, one must fully understand the 2005 Projections (since the allocation of those projections guided the allocation of the newer projections) and the District Level Targets.

Figure 8: LUSAM Example, Fairview, 2009 and 2008 Interim Projections, 2015 Horizon Year



Fairview District		Fairview District Old Forecasts	
2005 Base HHs	1,208	2010 Forecasted HHs	1,845
2015 Target HHs	1,896	2020 Forecasted HHs	3,499
Difference	688	Difference	1,654

TAZ 9032 Example Calculation

$2005\ Base\ HHs + Pipline\ HHs + ((Old\ Years_{TAZ}/Old\ Years_{Dist}) \times HH_Target_{Dist}) = 2015\ HH\ Forecast$

$127 + 0 + ((89 / 1{,}654) \times 688) = 164\ HHs$

[1] These factors were not used at all in Union County for the 2008 Interim or 2009 Forecasts. These variables were used in Mecklenburg County forecasts with the weights varied by district.

[2] While the LUSAM includes values for the Travel Time to Core Employment factor, the factor was not used for any forecast. The weight applied to it in all cases was 0%. It is shown here for the purposes of full transparceny.

Development of the 2005 Projections (Used in the 2030 LRTP)

The 2005 Projections (which were used in the 2030 LRTP) were developed through a process with three main components, a Top-Down projection, a Bottom-Up projection and input from an advisory group on the final projections. Each component in the process had a key role, as shown in Table 5. The development of the TAZ-level projections relied first on the Top-Down process to project future growth at the regional level and then allocate the regional growth to the county level. A subsequent Bottom-Up process allocated the county-level growth to the TAZ level within each county. Different parts of the Metrolina region used different approaches to the Bottom-Up process, but for the MUMPO area, which included most of Union County, a process prepared by Paul Smith of UNC-Charlotte provided the initial allocation. As was the case with the Top-Down projections, the Bottom-Up steps used input from local planners and jurisdictional representatives to review and refine the projections prior to adoption.

Table 5: Roles, Factors and Accessibility Considerations of the MRM Socioeconomic Projection Process Components

	Roles	Projection Factors	Accessibility Considerations
Macroeconomic (Top-Down) Projections **Completed by Dr. Thomas Hammer**	Projects regional household, population and employment totals and sets county level control totals	**Regional Projection** National population and employment trends linked by economic sector to regional trends	None
		County Level Allocation Past economic and demographic trends Economic and demographic conditions (as of 2003) Influence of income on growth Proximity Land availability Past land use and infrastructure policies	Explicitly includes two major road projects: • NC 16 Freeway to Lincoln County • Garden Parkway Only considers proximity in linear terms (county centroid to county centroid); no use of roadway networks
Household and Employment Allocation: (Bottom-Up) Process **Completed by Paul Smith, UNC-Charlotte**	Distributes growth from county-level to the Traffic Area Zones level	Developable Residential Land Redevelopable Residential Land Recent Population Change Travel Time to nearest Employment Center Water Availability Sewer Availability Expert Panel (High Growth Areas) Growth Policy Factor	Considers travel time from each TAZ to the NEAREST employment center, NOT regional employment centers Uses the TDM network, including the Monroe Connector/Bypass, but only in travel time to nearest employment calculations for final period (2020-2030).
Advisory/ Expert Input	County representatives agree on final county totals based on Top-Down process Local planners refine the Bottom-Up allocation based on adopted plans and local land use expertise; serves as a reality check on the allocation	Discretionary	Reflects local advisors' expectations (in 2003-2004) of whether new roads would be built Reflects the assumptions in adopted land use plans at the time regarding the anticipated road network

Regional Socioeconomic Projection and County Level Allocation (Top-Down Process)

The process to develop regional socioeconomic projections and allocate them to the county level (known as the Top-Down process) was a rigorous, research-based approach to developing a regional and county level projection of households and employment. Led by Dr. Thomas Hammer and documented in his report to the region titled *Demographic and Economic Forecasts for the Charlotte Region* (hereafter referred to as the "Hammer Report"), Dr. Hammer developed a long-range regional growth projection based on economic factors in the Charlotte region.

Dr. Hammer described his model as a demand-side model where the model determined economic employment (earnings) from a breakdown of different employment groups based on their link to national employment trends. The model also assumed by 2030, population demographic changes would constrain regional earnings. His report described large transportation projects and public policy land use or development controls as supply-side factors that do not necessarily contribute to the growth demand, but act as limits or constraints to where growth might occur at smaller scale projections.[12] Therefore, Dr. Hammer's projections were not sensitive to large transportation projects such as the construction of the Monroe Connector/Bypass.

Dr. Hammer's process started with descriptions of the national economy and regional economy to quantitatively link the economies based on worker earnings, referred to as employment. His modeling broke the regional economy into a 42-industry classification scheme to quantitatively link to the national economy. The procedure separated employment in each regional industry into a "basic" component and a "population-serving" component to quantitatively link the regional industry employment trends to national industry employment trends. Separate quantitative analysis was performed to create a linkage between the basic component of employment between the regional and national trends and the "population-serving" component of employment between the regional and national trends. The two separate quantitative linkages were combined to develop overall industry profiles for the region. Demographic projections were obtained by finding a regional population profile for each future year that yielded a labor force consistent with expected employment level.[13] The process yielded region-wide employment and demographic totals that became control totals to help determine where in the region the overall growth would occur.

The region-wide employment and household totals were allocated among the counties and districts with the aid of 35 equations to identify factors used in the determination of county level growth shares of the regional industry growth total. These equations included three for demographic variables of upper, middle and low-income housing, and 32 equations for employment by sector. These equations were calibrated on the experience of 227 counties in 29 separate U.S. metropolitan areas chosen for their comparability to the Charlotte region. The modeling allocation process also included factors such as available land in each county and location proximity between employment and households. The location proximity was incorporated by weighting an inverse function of distance to the county for which a variable was being measured to another county. However, the model omitted such supply side factors of large-scale transportation projects, new land use policies and provision of infrastructure, and natural land constraints

[12] Hammer Report, p 10
[13] Hammer Report, p 7

on development. Table 6 summarizes Dr. Hammer's description of the capacity of his projection and allocation model to capture growth influences.

Table 6: Capacity of Allocation Model to Capture Growth Influences

	Demand Side	Supply Side
Growth Factors Covered	• Past economic & demographic trends • Existing economic & demographic conditions • Economic-demographic linkages • Influence of income on growth patterns • Location	• Land area and land availability (as estimated on the basis of development magnitudes) • Past land use and infrastructure policies (to the extent they register in past growth)
Growth Factors Omitted	• Refinements ○ Some measures could be improved such as distance and area descriptors	• New or altered public policies governing land use and the provision of infrastructure • Large-scale transportation projects • Natural land constraints on development (if not strongly reflected in past growth)

Hammer Report, p 14

Dr. Hammer provided ranges of population and employment projections to account for variability and error in the model. He specifically noted, ". . . the upper and lower limits that express the ranges are specifically intended to express 90 percent or 95 percent confidence intervals. They cover only the year 2030, but could be extended to other years using the same proportions of past 2002 growth involved in their derivation"[14]. He obtained the upper and lower limits of growth by adding and subtracting amounts from the "most-likely" projection shown in Table 7.

> *The additions or subtractions at each geographic level equal a common percentage times the difference between the most likely values for 2030 and the actual values for 2002. Thus, the greater the expected growth, the wider the error margin, on the logic that unforeseen supply-side influences will operate mainly by reallocating growth rather than affecting urban development already present.*[15]

Dr. Hammer noted that different percentage margins are appropriate at different geographic levels, since the potential for error increases as area size decreases. He stated that "[s]mall margins are appropriate for the region as a whole because supply-side factors exert little influence at that scale." He calculated regional margins for population and employment by adding and subtracting 10 percent of the most likely 2002-2030 growth. He further noted that "[a]t the county level and district levels, the calculations involve larger downside margins than upside margins, on the argument that land use policies and environmental factors can have larger effect in diverting growth than in attracting development over and above location based demands." He obtained the county ranges from the 2030 most-likely projection, by applying a 25 percent deduction of the 2002-2030 most-likely growth and a 15 percent addition to the 2002-2030 most-likely growth.[16] Table 7 shows Dr. Hammer's 2030 population projection ranges.

[14] Hammer Report, p 66
[15] Hammer Report, p 66
[16] Hammer Report, p 66

Table 7: Dr. Hammer's Population Projection for the Charlotte Region

County	2030 Population		
	Lower	Most-Likely	Upper Limit
Anson County	36,967	40,847	43,175
Cabarrus County	247,142	283,115	304,699
Cleveland County	125,373	134,563	140,077
Gaston County	235,228	249,261	295,071
Iredell County	227,287	259,906	279,477
Lincoln County	113,206	128,857	138,247
Mecklenburg County	1,051,400	1,157,311	1,220,858
Rowan County	183,747	200,639	210,774
Stanly County	80,171	87,366	91,682
Union County	268,543	312,147	338,309
Cherokee County	83,228	93,168	99,132
Chester County, SC	52,278	58,306	61,923
Lancaster County, SC	91,781	101,680	107,619
Union County, SC	38,480	41,466	43,258
York County, SC	272,096	305,228	334,080

Hammer Report, p 67

Regional Projection and County Allocation (Top-Down Process) and the Monroe Connector/Bypass

Correspondence from interested parties suggests that Dr. Hammer's regional projections implicitly included the Monroe Connector/Bypass and therefore the regional projections should be used as the basis for a Build scenario or should be recalculated for the purposes of the Quantitative ICE.[17] Specifically, one comment suggests that Dr. Hammer's analysis assumed that there would be sufficient infrastructure available to accommodate any future growth and that this assumption implies that the Monroe Connector/Bypass is therefore assumed in the socioeconomic projections. As detailed above, supply side constraints were not a factor in Dr. Hammer's projections.[18] The following quotes from Dr. Hammer's report show that his process did not assume construction of the Monroe Bypass/Connector in projecting socioeconomic projections for the region or in allocation to the county level.

> *The strengths of the model approach include its objectivity and ability to capture a wide variety of relationships and spatial interactions. Its weaknesses derive from the severe limits on types of variables that can be feasibly collected for large sample model calibration. Because whole classes of variables must be omitted, the factors driving the model (other than regional totals) are limited to earlier values of the target variables themselves – i.e. to demographic and economic descriptors – plus functions of distance,*

[17] Letter from Southern Environmental Law Center to Jennifer Harris, NCTA, November 30, 2012, p 19.
[18] Hammer Report, p 11

> *land area and density. The most important omissions are factors that typically must be measured at a fine-grain level of detail (and often are hard to quantify in a relevant fashion) such as land use controls, natural land characteristics and availability of infrastructure. Since these factors mostly affect the supply of land suitable for development, and since the factors that allocation models do cover are most predictors of development demand, the limitations of such constructs can be summarized by calling them demand-side models*[19].
>
> *Two circumstances allow demand-side models to capture some supply-side influences. First such models can express the general role of land availability using crude measures that consider total land area (minus large-scale deductions like the military installations, wetlands and parks) and existing development density. Second because the model equations operate partly by extrapolation and are pegged to replicate past conditions in the subject areas, they implicitly cover all supply-side factors to the extent that future impacts of these factors equal past impacts.*[20]
>
> *But what models of the given type cannot do is capture the influence of exceptionally large infrastructure projects or shifts to more or less stringent development controls. They basically assume that the tendency of public actions to restrict or encourage growth will resemble the conditions prevailing in the calibration period (at the present meaning the 1990s).*[21]

Other comments from correspondence suggest that the "proximity factor" used by Dr. Hammer implicitly assumes an improved transportation network.[22] Dr. Hammer's proximity factor cannot include the transportation network. Since Dr. Hammer used the growth rates that occurred in the county between 1990 and 2000 to calibrate his model equations and there has been no controlled access freeway built in Union County in the last two decades, his projections, therefore, could not have assumed construction of a limited access roadway like the Monroe Connector/Bypass. Further, 2000-2010 growth that occurred in the region moved Union County's population rank among regional counties from sixth in 2000 to fourth in 2010. This growth occurred without a freeway. Thus, a freeway (even less so a toll-road), is not a factor contributing to the extremely high growth occurring in Union County. Rather Dr. Hammer describes major infrastructure projects as an influence that will operate by mainly reallocating growth rather than affecting the urban development that is already present.[23] As discussed in Section 3.3, this conclusion is not exclusive to the analytical work performed by Dr. Hammer.

Correspondence from interested parties also suggests that the county level population projections and employment projections should be re-calculated to exclude the Monroe Connector/Bypass.[24] Again, Dr. Hammer's model to allocate the region growth to County population and employment projections was not

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[19] Hammer Report, p 10
[20] Hammer Report, p 10-11
[21] Hammer Report, p 11
[22] Letter from Southern Environmental Law Center to Jennifer Harris, NCTA, November 30, 2012, p 19.
[23] Hammer Report, p 66
[24] Letter from Southern Environmental Law Center to Jennifer Harris, NCTA, November 30, 2012, p 19.

sensitive to a large-scale transportation project like the Monroe Connector/Bypass as he described in his report.[25]

> *In North Carolina, county-level forecasts from a calibrated allocation model should ordinarily be reliable – to the extent any forecast is reliable – with little or no adjustment for omitted supply-side influences. But supply-side factors gain potential importance at progressively smaller geographic scales, so the question is how far below the county level a model application should extend.*

Later in the report, Dr. Hammer notes how he adjusted outputs from the model to account for a particular major highway project that he believed would influence growth in a particular county.

> *The present approach is designed to avoid any need for ad hoc adjustment of results (other than systematic reconciliation with bottom-up, supply-side forecasts, if these are available). However, one after the fact adjustment has occurred here to improve the validity of the numbers in an area relevant for a particular planning project. The failure of the top-down forecasting procedure to acknowledge the impacts of special infrastructure development was judged a critical weakness in eastern Lincoln County, where the upgrading of Route 16 to a freeway will clearly yield growth increments over and above those predicted by demand-side model. This situation has been addressed by advancing the population forecast for one sub-district of Lincoln County from 2035 to 2025 and advancing the forecasts for two other Lincoln sub-districts from 2029 to 2025*[26].

Finally, explaining the ranges of population and employment projections shown in his tables, Dr. Hammer noted how he adjusted model results for the upper limit of the projections for East Gaston, Southwest Gaston, North York districts for the proposed toll road over the Catawba River.

> *The second factor is the possibility that a toll expressway will be constructed across the Catawba River to link southern Gaston County with western Mecklenburg. Such a facility would have substantial development impacts on East Gaston, Southwest Gaston, North York and the two counties in aggregate. These potential impacts are incorporated into the upper-limit population and employment values as explained in the footnotes to tables 11 and 12. Adjustments of this nature are not provided for the Route 16 freeway in Lincoln County because the impacts of this facility have already been incorporated into the forecasts, as discussed near the end of Section I. There are also not adjustments for completion of the I-485 beltway around Charlotte because it is not clear whether or how the beltway will alter district-level development patterns relative to what has already been predicted.*[27]

It should be noted that no changes were made to the "most likely" or "lower-limit scenarios" for Gaston and Mecklenburg Counties, based on the proposed toll facility. In summary, Dr. Hammer's analytical approach estimated regional and county growth within the Metrolina Regional Travel Demand model

[25] Hammer Report, p 11
[26] Hammer Report, p 12-13
[27] Hammer Report, p 69

area. This projection was designed to establish regional and county level household, population and employment control totals and as such was not influenced by projects that primarily impact accessibility within one county such as the Monroe Connector/Bypass. This means Dr. Hammer's regional and county projections would not have changed with or without the construction of the project.

MUMPO 2030 LRTP Household, Population and Employment Allocation Process (Bottom-Up Process)

In 2004, CDOT hired Paul Smith and his team from the UNC-Charlotte Center for Applied GIS to create a model to allocate households, population and employment from the county level to the TAZ level. The methodology of the process is described in Mr. Smith's report *Mecklenburg-Union Metropolitan Planning Organization Population Projections and Employment Allocations, 2000-2030*. Mr. Smith's process focused on the household (and by default population) allocation and the allocation of population-chasing employment. Population-chasing employment is that employment associated with retail and services that tend to follow population growth. Non-population-chasing employment was distributed solely based on the input of staff and expert panel participants. Mr. Smith's allocation process started with the county-level control totals developed in the Top-Down process, existing baseline data (2000), and the influence of the of land development factors chosen and ranked by expert panels. Within Union County there were eight land development factors used to assess the attractiveness and capacity of each TAZ in the county to draw future growth. These variables are listed in Table 8.

Table 8: Union County Land Development Factors

Factor	Weight by Year of Allocation		
	2010	2020	2030
Developable Land	3	3	3
Travel Time to Employment	3	3	3
Water	2	2	2
Sewer	2	2	2
Redevelopable Land	2	3	3
Population Change	3	1	Not used
Expert Panel	2	2	2
Growth Policy	1	1	1

Mr. Smith used a raster cell based analysis system where Union County was split into a set of 500 feet by 500 feet grid cells and the value for each land development factor was calculated for each grid cell. Each land development factor would also be normalized to a 0 to 1 scale and weighted so that all scores could be combined into a composite score. The composite grid scores were calculated for each cell and then averaged across each TAZ to calculate land attractiveness scores for each TAZ. The TAZ land attractiveness scores were used to derive the available residential acreage to be consumed during each allocation period. The 2005 Projections (which were used in the 2030 LRTP) were developed for 2010, 2020 and 2030. Thus for each allocation period (2000-2010, 2010-2020, 2020-2030) land development factors were calculated and normalized then weighted and the composite score calculated for each cell. Finally, for each TAZ, an average of the composite scores for all cells within each TAZ was calculated. Higher scores reflected higher attractiveness and would result in higher acreage consumed, until a TAZ reached its calculated maximum capacity. Allowable development densities per TAZ multiplied by the

derived residential acres to be consumed were used to calculate the number of households in each TAZ. Historical household size was used to generate TAZ population at each allocation period. Existing development and available land acted as limits on further growth. Thus, while the available developable land served as a land development factor, it also served as a constraint in the model to ensure that growth in a TAZ was predicted within its capacity to accept development. Once the developable land within a TAZ was consumed, future development would be assigned to TAZs with lower composite scores in subsequent iterations. The land development factors and corresponding weights that were used in the Union County portion of the model are shown in Table 8.

The modeled predictions were subject to feedback and adjustment from the panel of experts. These experts reviewed and adjusted projections as documented in *Land Use and Socioeconomic Data and Projections for the Greater Charlotte* Region. No specific changes to household, population or employment projections are documented in the report but the overall process of expert panel input is reviewed. Expert panel review is a common and recommended method in long-range projection to improve the acceptance of projections by political entities and data users.[28] Within Union County, however, no changes were made to the household and population projections as developed by Paul Smith at the TAZ level for the horizon years of 2010, 2020 and 2030. These projections were included as the socioeconomic projections for the adopted MUMPO 2030 LRTP.

Consultation with CDOT staff indicates that there was no influence from the Monroe Connector/Bypass on growth expectations associated with these projections (Appendix A). The travel time to employment factor did include the Monroe Connector/Bypass in the road network used to calculate travel times for the final period, but the assessment of CDOT staff was that the methodology used to calculate that factor would have minimized any impact of the Monroe Connector/Bypass on the 2005 Projections (which were used in the 2030 LRTP). Furthermore, a review of Mr. Smith's results shows no indications of population or employment growth clusters along the project corridor. If the 2005 Projections had included growth expectations associated with the Monroe Connector/Bypass, one would expect to see higher than average population and employment growth and density in TAZs along the project corridor. There are no indications of such clusters of growth along the project corridor in Mr. Smith's results.

Review of the Travel Time to Employment Factor within the Bottom-Up Process

Since May 2012, NCTA has worked with CDOT staff and Paul Smith to reanalyze the travel time factor to determine if the factor affected the 2005 Projections (which were used in the 2030 LRTP) in a way that would indicate those projections include the induced growth effects of the proposed project. Specifically, NCTA engaged Paul Smith and CDOT staff in a reevaluation of the factor beginning in June 2012 and Paul Smith completed his analysis and reported his results to NCTA in September 2012.

The travel time to employment factor for Mr. Smith's model used an estimate of travel time to the nearest employment center. Mr. Smith defined an employment center as any location with 5,000 jobs within a ½-mile area. Travel time was calculated using a composite approach, combining travel speed information from the Metrolina Region Travel Demand Model (MRM), a GIS shapefile of existing roads and assumed

[28] Smith, Stanley K., Tayman, Jeff, Swanson, David A. *State and Local Population Projections: Methodology and Analysis.* Kluwere Academic/Plenum Publishers, New York, 2001. p 358

walking speed of 2.5 miles per hour. [29] The MRM was used to estimate travel speeds for all roads within the MRM network. For the 2010 and 2020 horizon years, the 2010 model network was used and for the 2030 horizon year the 2025 model network was used. Using the speed assumptions above, travel times to the nearest employment center were then calculated for each horizon year (2010, 2020 and 2030). These travel times were then normalized to a 0 to 1 scale and averaged across each TAZ to determine the score for each TAZ.

The Monroe Connector/Bypass was included in the 2025 MRM network and thus the speed of that facility influenced the travel time to employment factor for the 2020 to 2030 period. Map 6 shows the original travel times calculated using this methodology. These travel times formed the basis of the original Travel Time to Employment Factor used in the Bottom-Up allocation process. As illustrated in the map and detailed in the discussion that follows, the Monroe Connector/Bypass does have a minor influence on the travel time used as an input to the Bottom-Up allocation process as indicated by the area of travel times of less than 10 minutes around the proposed project from Unionville-Indian Trail Road to Rocky River Road. The map also shows that many employment centers were used as destination points for the analysis in Mecklenburg and Union Counties. Notably, none of these employment centers are in the Goose or Sixmile Creek watersheds. The closest employment centers within the FLUSA are at the following locations:

- US 74 and Rama Road in Charlotte
- Monroe Road and Sardis Road in Matthews
- US 74 at NC 51 in Matthews
- US 74 just west of Seacrest Short Cut Road in Monroe
- Downtown Monroe
- US 74 at Sutherland Ave in Monroe
- Along Secrest Avenue, north of US 74 in Monroe.

The methodology to calculate the travel time to employment for the Bottom-Up allocation calculated travel times to the *nearest* employment center, not to major destinations such as downtown Charlotte. The average distance from an employment center for the MUMPO study area Mr. Smith analyzed was only 3.8 miles, while the greatest distance was 14 miles. Thus, the methodology was a relatively localized analysis of travel time. Freeway type facilities, such as the proposed 20-mile long Monroe Connector/Bypass, tend to serve longer trip lengths. As such, the travel time to employment center analysis methodology would largely miss the travel time savings that would accrue to longer trips like those most likely to occur on the Monroe Connector/Bypass. Lastly, the location of the employment centers Mr. Smith used relative to the Monroe Bypass/Connector would tend to minimize the travel time savings the project could provide. A number of employment centers are located in and around downtown Monroe, as seen in Map 6, and since the proposed project bypasses the downtown Monroe area, Mr. Smith's travel time analysis would largely not account for travel time savings associated with the project in central and eastern Union County.

[29] FHWA guidance on signal design recommends using 3 to 5 feet per second (2 to 2.7 mph) walking speeds in developing pedestrian clearance times for signal timings. FHWA. Traffic Signal Timing Manual. Chapter 5, Section 5.3.3. http://ops.fhwa.dot.gov/publications/fhwahop08024/chapter5.htm

Revising the Travel Time to Employment Factor without the Monroe Connector/Bypass

Since May 2012, NCTA worked with CDOT staff and Paul Smith to rerun the MRM model and the Bottom-Up allocation process with a revised MRM network that did not include the Monroe Connector/Bypass. NCTA requested the analysis to compare the results to the original 2005 Projections to determine whether removal of the proposed project would affect the results. CDOT staff obtained the 2025 MRM model used to calculate the travel speeds for the original travel time to employment factor analysis and revised the network by removing the Monroe Connector/Bypass. They subsequently reran the travel demand model with the revised network to get new speed data for the transportation network that did not include the Monroe Connector/Bypass. Mr. Smith then incorporated this new speed data into his other speed assumptions and recalculated the travel times used to develop the travel time to employment factor score for each TAZ. He then recalculated the composite attractiveness scores and subsequently reapplied his allocation model with the new composite attractiveness scores to determine if there would be any differences in population or employment allocations with the new travel time results.

When Mr. Smith removed the Monroe Connector/Bypass from his analysis, it resulted in minor changes to the travel times and composite attractiveness index. Out of 256 TAZs in the MUMPO analysis area of Union County, most had little to no change in travel time to employment centers when the Monroe Connector/Bypass was removed from the network:

- 150 TAZs (59 percent) had no change in their travel time
- 85 TAZs (33 percent) had a travel time increase of less than 1 minute
- 21 TAZs (8 percent) experienced a travel time increase of 1 minute or more
- The maximum change for a TAZ was 5.7 minutes, and the average change throughout Union County was 16 seconds.

The areas with increased travel time are shown in Map 7. The areas with the greatest increase in travel time are in western Union County, centered around the proposed corridor between Stallings and Monroe. The impact of this travel time change is highly localized around the western end of the Monroe Connector/Bypass.

As seen in Map 7, there are no changes in the travel time factor for any TAZ in the Sixmile Creek watershed. For Goose Creek watershed, most TAZs see less than a 30-second increase in travel time, while three TAZs see between a 30-second and 3-minute increase in travel time.

As described above, the model uses travel time to employment as one of several weighted factors in the calculation of composite grid attractiveness scores, which are averaged across a TAZ to derive the percentage of available acreage to be consumed by TAZ for each period. Mr. Smith used the recalculated travel time to employment factor to recalculate the grid attractive scores and TAZ scores for the 2020 to 2030 period. When the composite attractiveness scores were recalculated to include the revised travel time results above and then further averaged for each TAZ, the results showed that most TAZs had little to no change in attractiveness score. Of those that did change, the result was a reduction in attractiveness scores, as increased travel time would result in lower attractiveness to development. Out of 256 TAZs in the MUMPO portion of the study area:

- 150 TAZs (59 percent) had no change in composite attractiveness score
- 92 TAZs (36 percent) had a reduction of less than 1 percent
- 14 TAZs (5 percent) had a reduction of 1 percent or more change in composite score

- The greatest Composite Score reduction is 3.9 percent, and the average Composite Score reduction is 0.21 percent.

Changes in composite attractiveness scores by TAZ, calculated by Mr. Smith, are shown in Map 8. The geographic distribution of the changes roughly parallels those in the travel time map.

As seen in Map 8, there are no changes in composite land development factor for any TAZ in the Sixmile Creek watershed. For Goose Creek watershed, most TAZs see less than a 0.5 percent decrease in their composite factor, while three TAZs see between a 0.5 and 2 percent decrease in their composite land development factor.

Next, Mr. Smith reapplied the allocation model to determine specifically if the change in travel times and composite scores would result in a different allocation of households and employment. The allocation model uses the composite scores to determine the percentage of available land in each TAZ that would be consumed by growth. The higher the composite score the higher the percentage of available land that would be consumed. The model would then multiply the percentage consumed by the actual available land in each TAZ to determine the acreage of land consumed within each TAZ. Then the acreage would be multiplied by the development density for each TAZ (calculated from tax and zoning records) to determine the actual number of households to be added to each TAZ for each period. Thus any change in composite score could potentially change the percentage of land consumed and thus the number of households added to any given TAZ.

When Mr. Smith reran the allocation model with the new composite scores, the results showed that the land use projections were identical to those produced in his original report; in other words the results did not change. For the 106 TAZs where the change in travel time led to a reduction in their composite attractiveness index, the allocation model in the original allocation (i.e. before the Monroe Connector/Bypass was removed) had calculated that those TAZs would use 100 percent of available land by 2030. For those same TAZs, when the new allocation model was run (i.e. after the Monroe Connector/Bypass was removed) the lower attractiveness scores did not reduce their attractiveness in the allocation model enough to cause the allocation model to request less than 100 percent of the developable land within each of those TAZs by 2030. These 106 TAZs already had relatively high composite scores as they were in areas with sewer and water availability, where growth policy was favorable and where Expert Panel members expected growth already. The relatively small reduction in composite attractiveness that resulted from the changes in travel time did not reduce the score for these TAZs enough to reduce the percentage of land the model would consume. In addition, many of these TAZs had little available land to fill in the 2020 to 2030 period. This result is logical given that the areas where travel time and composite scores changed have experienced extensive growth since 1990 and thus are likely to reach build out sooner than most other areas of the County.

These results show clearly that removal of the Monroe Connector/Bypass from the travel time to employment factor had no effect on the results of the 2005 Projections. Therefore, it is clear that the Bottom-Up portion of the 2005 Projections was insensitive to the presence or absence of the proposed project. Since this factor was the only factor that explicitly included the project in either the Top Down or Bottom Up, it is clear that the 2005 Projections are insensitive to the presence or absence of the proposed project. As such, it is reasonable to conclude, that the proposed project had no influence on the "Old Projections" factor used in the LUSAM process for the 2008 and 2009 Projections.

Relevance to Goose and Sixmile Creek Watersheds

As noted above and seen in Maps 7 and 8, the re-evaluation of the Travel Time to Employment Center factor resulted in minimal changes to that factor for Goose Creek watershed and no changes to that factor for Sixmile Creek watershed. Similarly, the re-evaluation of that factor resulted in minimal changes to that the composite land development factor for Goose Creek watershed and no changes to the composite factor for Sixmile Creek watershed. Most important, though, is that the re-evaluation of the results of the 2005 Projections using the revised Travel Time to Employment Factor showed absolutely no change in the final results for any TAZ in Goose Creek or Sixmile Creek watersheds. Since this factor was the only factor that explicitly included the project in either the Top Down or Bottom Up, it is clear that the 2005 Projections are insensitive to the presence or absence of the proposed project. As such, it is reasonable to conclude, that the proposed project had no influence on the "Old Projections" factor used in the LUSAM process for the 2008 and 2009 Projections for Goose and Sixmile Creek watersheds.

District Level Targets

The only remaining area that the Monroe Connector/Bypass could have influenced the LUSAM process would be through the district level targets. The household, population and employment targets used in the LUSAM models were developed based on the following inputs:

- Interpolation and extrapolation of the previous projections (2005 Projections, which were used in the 2030 LRTP)
- NC State Data Center Demographic Projections (Summer 2007)
- Hammer Report Five-Year Projections.

As previously documented, neither the Hammer Report nor the 2005 Projections (which were used in the 2030 LRTP) were influenced by the Monroe Connector/Bypass growth expectations. The NC State Data Center develops its projections based on trend growth over the previous two decades drawing from both Census counts and estimates. The projections are then developed using the most appropriate smoothing model that best fits the trend line data.[30] Since these projections rely entirely on trend data, there is no influence in these projections from proposed transportation improvements. Therefore, it is reasonable to conclude that the district level targets were unaffected by any influence from growth associated with the Monroe Connector/Bypass.

Review of Projection Results

An examination of density levels along the project corridor is illustrative regarding the relationship (or lack thereof) between the proposed project and the MPO projections of households, population and employment. Map 9 shows the household density by TAZ in 2030 from the 2009 Interim Projections. The household density levels in TAZs along the proposed project corridor in the 2030 projections are similar to the household densities of surrounding TAZs. If the projections were representative of a Build Scenario then one would expect to see higher household density levels along the project corridor, particularly at interchange locations. Map 10 shows the employment density by TAZ in 2030 from the 2009 Interim Projections. The employment density levels in TAZs along the proposed project corridor in the 2030 projections are similar to the densities of surrounding TAZs. If the projections were representative of a

[30] Smoothing models use historical data on past population or employment conditions and apply exponential functions that best fit those past trends to then forecast future conditions.

Build Scenario then one would expect to see higher employment density levels along the project corridor, particularly at interchange locations. Overall, the density pattern in the 2009 Projections shows no signs of influence from the Monroe Connector/Bypass. Furthermore, CDOT staff indicated that growth impacts of the proposed road were not a consideration in the projection process.

4.3 How Have Other Studies Used the MRM Socioeconomic Projections

The NCTA hired other consultants and researchers to perform work on traffic and revenue studies to obtain investment ratings for Toll Revenue Bonds. The work performed consisted of a Preliminary Traffic and Revenue Study, an Independent Economist Evaluation of the Socio-economic Estimates Underlying the Study of the Feasibility of the Proposed Monroe Connector/Bypass, and a Comprehensive Traffic and Revenue Study. This section will provide a summary of the work and the relevance to the research performed and used in the Quantitative ICE analyses.

WSA, Proposed Monroe Connector Preliminary Traffic and Revenue Study, Final Report, October 11, 2006

The NCTA hired Wilbur Smith Associates (WSA) to conduct a preliminary traffic and revenue study for the proposed Monroe Connector. The purpose of the study was to determine the feasibility of pursuing toll financing for construction of the Monroe Connector and/or Monroe Bypass. WSA assumed that the proposed project would provide significant time savings for travelers moving between I-485 south of Charlotte and Monroe or points south and east based on their analysis of travel conditions on US 74 in 2006 and travel demand model analysis of travel speeds in their study area. It should be noted that WSA completed this preliminary study in 2006 before analysis for the EIS had begun. WSA used the 2005 Projections socioeconomic data set (which were used in the 2030 LRTP) as it was the most recent projection available at the time of their study.

WSA collected traffic counts in the project corridor and used the information to re-calibrate the Metrolina Regional TDM model and provide traffic scenarios for No-Build, Build (Toll Free) and Build (Tolled) scenarios. They also updated the network within the model to account for proposed transportation improvements. WSA also collected information regarding regional and corridor income characteristics to aid in the development of estimated values of time for potential users of the toll facility. WSA stated that this is a critical parameter used to assess a motorist's willingness to pay for tolls and use the facility.

WSA concluded that the Monroe Connector/Bypass would help reduce congestion in the study area even with the planned widening of US 74. Its preliminary traffic and revenue study concluded that pursuing project financing with tolling was feasible and would be best served by combining the Monroe Connector and Bypass in a proposed toll financed project.

WSA's analysis relied upon the socioeconomic projections incorporated in the Metrolina Regional TDM. They concluded that the population projections contained in the Metrolina Regional TDM at that time were directly related to the growth rate of traffic predicated by the model. They indicated that the Monroe Connector/Bypass is included in the model and influences the growth projections therein. However, WSA did not perform a Build versus No-Build analysis for purposes of determining the project influence on the socioeconomic conditions in its study area. Furthermore, WSA provided no basis for the assumption that the Monroe Connector/Bypass influenced the growth projections in the model nor did they provide any documentation to justify the assumption. WSA's report clarified that its work was performed without the

benefit of an independent economic review of the socioeconomic projections. WSA also acknowledged that such work would typically be required to support project financing.

In summary, this report was a preliminary traffic and revenue study and conducted prior to the DEIS Qualitative ICE and FEIS Quantitative ICE analyses. Furthermore, as shown through the analysis by Mr. Paul Smith discussed in section 4.4, the Monroe Connector/Bypass did not influence the 2005 Projections (which were used in the 2030 LRTP).

Kenan Institute of Private Enterprise, Technical Memorandum, Proposed Monroe Connector/Bypass Comprehensive Traffic and Revenue Study, Initial Report of Independent Economist, September 28, 2009

In subsequent work on the traffic and revenue studies, the WSA team, in consultation with NCTA, hired the Kenan Institute of Private Enterprise at the University of North Carolina's Kenan-Flagler Business School (Kenan Institute) in 2009 to develop a set of TAZ projections specifically for the Monroe Connector/Bypass Traffic and Revenue Study. The Kenan Institute developed their projections based on Dr. Hammer's 2003 projections for regional and county growth, a review of the MUMPO Bottom-Up process to allocate county and district growth from Dr. Hammer's projections to TAZs; a review of recent economic, employment and population trends and estimates produced by other organizations; a regional scan of the project area; and, interviews with planners, developers and business/economic experts within the region. The Kenan Institute Report, entitled *Initial Report of Independent Economist* (Appendix C), was used in the development of WSA's *Comprehensive Traffic and Revenue Study*, October 22, 2010.

The main objective of the Kenan Institute Report was to determine the socioeconomic conditions that would be prevalent in its project study area with the construction of the Monroe Connector/Bypass toll road. As part of its work, the Kenan Institute conducted an independent economic review of the 2008 Interim Projections, which were the most up to date TAZ level projections available at the time of their study. The Kenan Institute's corridor study area for evaluation and analysis is shown in Map 11.

Map 11 also includes the Qualitative and Quantitative ICE analysis areas. One key observation is the Kenan Institute's study area is much smaller than the either the Qualitative or Quantitative ICE study areas. The Quantitative ICE study boundary was established to evaluate effects on the natural environment in consultation with resource agencies and is focused on impacts to watersheds and protected species. The Kenan Institute's study area appears to have been established based on the project's travel time savings during peak travel times. The Kenan Institute study area is 132,436 acres compared to the Quantitative ICE study area of 202,000 acres or 66 percent of the Quantitative ICE study area. This observation also highlights that the area of influence of change in socioeconomic projections is much less than the project area, the county and the region as a whole. In other words, the Kenan Institute analysis and resulting study area provide further evidence that the Monroe Connector/Bypass would have little to no effect on regional or county level growth. As seen in Map 11, the Kenan Institute study area included only very small portions of either Sixmile or Goose Creek watersheds. The report notes that the corridor was "an analyst's construct approximating the area where travel behavior is most likely to be influenced by the new roadway."[31] This would suggest that their conclusion was that there would be little to no effect on travel behavior or growth in the Goose Creek or Sixmile Creek watersheds.

[31] Appendix C, p 2, Footnote 3

The Kenan Institute reviewed the 2008 Interim Projections and determined that for the purposes of forecasting traffic for Toll Revenue Bond issuance, adjustments would be required to develop socioeconomic projections that were reasonable but did not overestimate traffic forecasts. The Kenan Institute made two adjustments to the socioeconomic estimates. "The first was to make region-wide adjustments consistent with the national growth expectations. The second was to reallocate growth in Union County in line with development factors and constraints."[32]

The Kenan Institute's analysis determined that the growth in the 2008 Interim Projections needed to be adjusted to account for the extended recession, which it determined was not accounted for in the projections. Based on its research, the Kenan Institute lowered the TAZ level projections by 8.7 percent to account for the national economic correction, which suggests that as growth resumes, the gross domestic product is expected to be 91.3 percent as high as it would have been at the same time in the absence of the national crisis.[33]. Table 9 shows the original 2008 Interim Projections of household and population, the Kenan Institute adjustments for the national economic correction, and their project specific adjustments.

Table 9: Household and Population Projections for the Corridor Study Area (132,436 acres)

Year	MRM 2008 Interim Projections		Kenan Adjustments for "National Correction"		Kenan Adjustments due to Project	
	Households	Population	Households	Population	Households	Population
2005	42,595	120,054	42,595	120,054	42,595	120,054
2010	49,393	140,267	45,164	128,258	45,346	128,732
2015	56,454	161,371	51,556	147,364	51,968	148,486
2020	62,479	178,152	57,056	162,689	57,974	165,207
2025	68,407	194,812	62,469	177,902	63,869	181,775
2030	74,497	211,973	68,029	193,573	69,843	198,613

Looking within the project corridor, the Kenan Institute accepted the allocation of growth by the MPO in Mecklenburg County. However, it reallocated the projected population growth within Union County away from the line of high growth in the southwest quadrant of the county to the Connector/Bypass corridor because of the project. A portion of the expansion in several high growth TAZs in the northeastern quadrant of the county was also reallocated towards the corridor. The Kenan Institute made these adjustments based on results of interviews with local planners, analysis of growth trends in the area, and analysis of water and sewer demand and capacity in the area. The Kenan Institute report notes that many of the regional planners could not recall critical details of the regional and TAZ level socioeconomic projection and allocation modeling and reasoning behind specific projections. They also concluded from the interviews that a few biases may have entered into the Union County small area projections. Dr. Appold specifically noted the line of growth in southwest Union County along and south of NC 75 that did not appear to be appropriate given limitations on growth in that area.[34]. However, that the Kenan Institute found it necessary to reallocate growth to account for the influence of the Monroe

[32] Appendix C, p 29
[33] Appendix C, p 24
[34] Appendix C, p 24-25

Connector/Bypass is consistent with the contention that the existing projections did not represent a Build Condition for the Monroe Connector/Bypass.

Table 10 provides a comparison between the MRM 2008 Interim Projections in the corridor to the overall adjustments made by the Kenan Institute.

The set of projections in the second column of Table 10, shown under the heading Kenan National Correction Adjusted, was calculated by multiplying the MPO projection for 2030 by 8.68 percent (the same reduction that the Kenan Institute used to adjust the projection for all TAZs). This calculation allowed a comparison of the Kenan Institute adjustments within the corridor due to the project (third column set of projections) with projections adjusted due to the national correction. Thus, the last column set in the table shows how the project would increase growth by zones in the corridor of the Kenan Institute study area. It is important to note that the Kenan Institute did not conduct a "Build versus No-Build" analysis, but only created a scenario of a 2030 projections of population and households with the project.

Although the growth rate difference in the entire corridor is rather small (3 percent), the tables show the substantial difference in the allocation of growth between the western corridor zones to the eastern corridor zones. This re-allocation of growth by zone is very similar to the growth patterns in the DEIS Qualitative ICE and FEIS Quantitative ICE. Therefore, the Kenan Institute reallocation of adjusted regional growth in Union County supports the Quantitative ICE conclusions regarding the project's influence on accelerated growth in central and eastern Union County.

For the Sixmile Creek watershed, only a small portion falls within Zone 1 of the Kenan study area. As noted in Table 10, this zone saw limited adjustment from the Kenan analysis, suggesting that this zone would have little to no change associated with the proposed project. A small portion of Zones 1 and 2 fall within the Goose Creek watershed. As noted in Table 10, these zones saw limited adjustment from the Kenan analysis, suggesting that these zones would have little to no change associated with the proposed project. Thus, the Kenan Institute adjustments and choice of study area, strongly suggest that there would be little to no indirect land use changes in either Goose or Sixmile Creek watersheds associated with the proposed project.

Table 10: Change in Household and Population Projections within the Corridor Study Area

Year	MRM 2008 Interim Projections[1]		Kenan "National Correction" Adjusted		Kenan Project Adjusted[1]		Change in Kenan Projection due to project in 2030 (%)	
	Households	Population	Households	Population	Households	Population	Households	Population
Corridor								
2005	42,595	120,054	42,595	120,054	42,595	120,054		
2030	74,497	211,973	68,029	193,573	69,843	198,613	3%	3%
Zone 1								
2005	14,118	38,774	14,118	38,774	14,118	38,774		
2030	19,307	55,413	17,631	50,603	17,730	50,871	1%	1%
Zone 2								
2005	11,017	30,859	11,017	30,859	11,017	30,859		
2030	16,676	47,280	15,228	43,176	15,474	43,842	2%	2%
Zone 3								
2005	7,617	20,404	7,617	20,404	7,617	20,404		
2030	11,369	30,980	10,382	28,291	11,074	30,225	7%	7%
Zone 4								
2005	6,164	19,084	6,164	19,084	6,164	19,084		
2030	17,827	51,435	16,279	46,970	16,455	47,580	1%	1%
Zone 5								
2005	3,679	10,933	3,679	10,933	3,679	10,933		
2030	9,318	26,865	8,509	24,533	9,110	26,095	7%	6%

[1] Appendix C Table 11

One may argue that the Kenan Institute concluded that the growth in the corridor area would reallocate outside Union County without the project. However, the Kenan Institute acknowledged that it did not conduct a no-build versus build analysis. It also acknowledged that its analysis relied upon the regional growth allocation to the counties, which did not consider supply-side factors such as large infrastructure projects. Lastly, the Kenan Institute's study area of 132,436 acres is much smaller than the area of Union County. Therefore, any conclusion the Kenan Institute report made regarding a No-Build Scenario was not reached with the same degree of analytical work performed in developing the adjusted projections.

A final point regarding the reports prepared by the Kenan Institute for the project is the complimentary narratives regarding Dr. Hammer's methodologies, models and projections of region and county

population and employment described in his report, *Demographic and Economic Forecasts for the Charlotte Region*, 2003.

> *Our basic assessment of the MPO socio-economic projections is twofold. First, although the region-wide projections were prepared with an unusual degree of competency and care, they may have been over-adapted to new information during the boom years which followed.*[35]
>
> *The large area projections performed by Thomas Hammer and summarized above appear to be thoughtfully and carefully constructed.*[36]
>
> *Recognizing that no projection is completely accurate (error bounds are discussed in the full report), our judgment is that Thomas Hammer, the consultant hired by MUMPO to estimate county and sub-county population and employment for selected years, has the most credible methodology of any known population and employment projection. His estimation process relies on Census data, the quantified detailed experiences of similar metropolitan regions, and extensive feedback from knowledgeable regional (Charlotte) informants. We feel that his estimates, modified with the best available information about development subsequent to his work, form the best possible basis for NCTA decision-making.*[37]

WSAs, Final Report, Proposed Monroe Connector/Bypass Comprehensive Traffic and Revenue Study, October 22, 2010

WSA's Comprehensive Traffic and Revenue Study (T&R Study), begun in 2009, was a follow up to the preliminary study performed in 2006. This research was conducted parallel to but separate from the NEPA analyses conducted for the FEIS and ROD. The report was not completed until after issuance of the ROD. The T&R Study used the Kenan Institute's socioeconomic projections of population, household and employment described above as inputs to the Metrolina Regional TDM. WSA also conducted an Origin-Destination Study in the project study area to identify current travel patterns and trip characteristics. They also supplemented NCDOT traffic counts with further counts during March 2009. WSA also updated the proposed transportation projects into the transportation network. Finally, based on traffic counts, WSA adjusted the model during a calibration process to achieve model predictions better aligned with current traffic observations.

WSA's T&R Study Report also compared population projections from the 2005 Projections (which were used in the 2030 LRTP), the 2008 Interim Projections, and the projections developed by the Kenan Institute in 2009 within the corridor. WSA found that the three different population projections for the corridor in the year 2030 closely correlate. For example, in 2009, the Kenan Institute estimated the 2030 population in their study area to be 198,613. This projection clearly included the effects of the project. However, the information WSA extracted from the 2005 Projections estimated the 2030 population in their study area to be 210,900. The information WSA extracted from the 2008 Interim Projections estimated the 2030 population in their study area to be 211,973. As previously discussed, none of the

[35] Appendix C, p 4
[36] Appendix C, p 23
[37] Appendix C, p 3

MRM socioeconomic projection versions included growth effects from the project. All of these projection results are within seven percent and suggest a strong correlation between different projection versions. Since the Kenan Institute's charge in developing their projections was to err on the side of not overestimating traffic so as to provide a conservative estimate for financing purposes, it would not necessarily be appropriate to use those adjusted projections as a basis for environmental impacts analysis. Finally, WSA's T&R Study did not construct a No-Build versus Build scenario to analyze the effects of the project on the study area. However, they did break down the project zones to more precisely describe where increased growth was likely to occur. This work is similar to the work conducted in the FEIS Quantitative ICE analysis and the implications from their analyses regarding the areas most likely to see additional growth due to the project are similar to the conclusions of the DEIS Qualitative ICE and FEIS Quantitative ICE.

4.4 How Do the MRM Socioeconomic Projections Compare to Other Projections?

The ICE Guidance recommends using adopted regional projections authored by MPOs where available.[38] Yet it would be best to compare those projections to others before using them. Therefore, it is instructive to compare the MPO projections to other population projections for the area. Projections from other sources show a wide range of future growth trends for Union County. Two of the most commonly cited privately developed projections are from Woods & Poole and Global Insights. Both firms use cohort-component projections, a demographic projection method that focuses on fertility, mortality and net migration to estimate total population by year. The Global Insight model incorporates the predictions of a regional macroeconomic model, thereby incorporating some economically driven assumptions of jobs growth into the process. The North Carolina State Data Center also generates population projections using a time series trends projection process. Table 11 summarizes five different projections of population to 2030 from four different sources:

1. MRM 2009 Projections (developed between 2004 and 2009)
2. Global Insights Projections (developed in 2009)
3. Woods & Poole Projections (developed in 2009)
4. NC State Data Center Projections (developed in 2009)
5. NC State Data Center Projections (developed May 2011).

As all of the projections operate from either demographic trend projection or economic modeling projections; they do not incorporate expectations of transportation infrastructure development except to the extent that past infrastructure development has affected past trends. One key to understanding the differences in these projections is to compare the actual change in each five-year increment. The demographically driven approaches used by Woods & Poole and the NC State Data Center produce very similar changes in each five-year increment of their projections, whereas the Global Insights and MPO projections, which are more economically driven models, show significant differences in each five-year increment of changes.

As to the actual projection of future population in Union County, the highest projection is from the NC Data Center in 2009, which projected a 2030 population of 400,683. The NC Data Center's projection

[38] NCDOT & NCDENR, 2001a, p III-16

from 2011, however, predicts a 2030 population of 271,289, the lowest of all the projections. The Global Insights projection from 2009 predicts a 2030 population of 393,407, while Woods & Poole from 2009 predicts a 2030 population of 283,433. The MRM 2009 Projections fall generally in the middle of all these projections, predicting a 2030 population of 337,314 for Union County. Most interesting is how closely the MPO projections predicted the 2010 populations (based on actual 2010 Census counts) of Mecklenburg and Union Counties. In the case of Mecklenburg County, the MPO projection for 2010 population of 931,666 (Table 11) is only 1.3 percent higher than the actual 2010 Census count of 919,628. In the case of Union County, the projected population in 2010 of 200,450 is only 0.4 percent lower than the actual 2010 Census count of 201,292. This compares favorably to other projections completed prior to 2010. The Global Insights projections from 2009 overestimated population in Mecklenburg and Union Counties by four percent and nine percent respectively. The Woods & Poole projection from 2009 underestimated population for Mecklenburg and Union Counties by 0.3 percent and two percent respectively. The NC State Data Center projections from 2009 underestimated Mecklenburg County population by one percent and overestimated Union County population by four percent. Given that these other projections were all completed about one year prior to the horizon year in question (the 2010 Census counts) whereas the MRM Socioeconomic projections were largely completed two years prior (and the underlying work dates back to 2004), the MRM socioeconomic projections for Mecklenburg and Union Counties compare favorably.

Table 11: Comparison of Population Projections

Global Insights (2009)									
	Mecklenburg	Change	Annualized % Change	Union	Change	Annualized % Change	Region*	Change	Annualized % Change
2005	806,834			161,765			1,314,553		
2010	956,823	149,989	3.5%	219,690	57,925	6.3%	1,570,976	256,423	3.6%
2015	1,065,308	108,485	2.2%	263,298	43,608	3.7%	1,749,656	178,680	2.2%
2020	1,171,442	106,134	1.9%	303,978	40,680	2.9%	1,920,865	171,209	1.9%
2025	1,275,768	104,326	1.7%	349,186	45,208	2.8%	2,097,412	176,547	1.8%
2030	1,382,406	106,638	1.6%	393,407	44,221	2.4%	2,280,808	183,396	1.7%
Woods & Poole (2009)									
	Mecklenburg	Change	Annualized % Change	Union	Change	Annualized % Change	Region*	Change	Annualized % Change
2005	802,400			160,876			1,307,329		
2010	916,747	114,347	2.7%	197,554	36,678	4.2%	1,497,063	189,734	2.8%
2015	1,000,055	83,308	1.8%	218,988	21,434	2.1%	1,630,535	133,472	1.7%
2020	1,084,264	84,209	1.6%	240,490	21,502	1.9%	1,765,570	135,035	1.6%
2025	1,168,900	84,636	1.5%	261,995	21,505	1.7%	1,901,371	135,801	1.5%
2030	1,253,544	84,644	1.4%	283,433	21,438	1.6%	2,037,236	135,865	1.4%
MRM 2009 Projections									
	Mecklenburg	Change	Annualized % Change	Union	Change	Annualized % Change	Region*	Change	Annualized % Change
2005	837,862			168,728			1,369,445		
2010	931,666	93,804	2.15%	200,450	31,722	3.51%	1,544,779	175,334	2.44%
2015	1,025,004	93,338	1.93%	231,986	31,536	2.97%	1,719,218	174,439	2.16%
2020	1,111,254	86,250	1.63%	266,612	34,626	2.82%	1,891,996	172,778	1.93%
2025	1,196,999	85,745	1.50%	301,053	34,441	2.46%	2,063,849	171,853	1.75%
2030	1,271,300	74,301	1.21%	337,314	36,261	2.30%	2,221,345	157,496	1.48%
NC State Data Center (2009)									
	Mecklenburg	Change	Annualized % Change	Union	Change	Annualized % Change	Region*	Change	Annualized % Change
2005	796,529			159,726			1,298,879		
2010	911,252	114,723	2.7%	210,069	50,343	5.6%	1,518,920	220,041	3.2%
2015	996,414	85,162	1.8%	257,378	47,309	4.2%	1,706,871	187,951	2.4%
2020	1,081,577	85,163	1.7%	304,688	47,310	3.4%	1,894,854	187,983	2.1%
2025	1,166,740	85,163	1.5%	351,996	47,308	2.9%	2,082,842	187,988	1.9%
2030	1,253,198	86,458	1.4%	400,683	48,687	2.6%	2,274,700	191,858	1.8%

NC State Data Center (2011)									
	Mecklenburg	Change	Annualized % Change	Union	Change	Annualized % Change	Region*	Change	Annualized % Change
2005	802,998			160,260			1,305,092		
2010	923,144	120,146	2.8%	202,200	41,940	4.8%	1,510,094	205,002	3.0%
2015	1,009,658	86,514	1.8%	219,522	17,322	1.7%	1,634,793	124,699	1.6%
2020	1,095,857	86,199	1.7%	236,778	17,256	1.5%	1,758,306	123,513	1.5%
2025	1,182,056	86,199	1.5%	254,034	17,256	1.4%	1,881,818	123,512	1.4%
2030	1,268,257	86,201	1.4%	271,289	17,255	1.3%	2,005,336	123,518	1.3%

* The Regional projections here are for a four county region of Cabarrus, Gaston, Mecklenburg and Union Counties. This is due to data limitations from the various sources.

4.5 How Accurate are the MPO Projections?

Projecting socioeconomic conditions, and any projection of the future, is an uncertain process fraught with the potential for error. Available evidence on socioeconomic projection indicates that "forecast errors are generally larger for small places [such as an individual TAZ] than for large places; are generally larger for places that have very high [such as Union County] or negative growth rates than they are for places that have moderate, positive growth rates; generally increase with the length of the projection horizon; and vary from one launch year to another."[39] Errors for long-range socioeconomic projection can also be quite high, especially for smaller geographies. For county level projections of 25 years, the typical mean algebraic percentage errors are about 30 percent while for census tracts (which are typically larger than TAZs) errors are typically 45 percent for the same period.[40] Thus, despite the best efforts of researchers and forecasters, the error rates for long-range projections are still quite high and thus any projection or estimate of induced and cumulative effects must be considered the best estimate within a wide range of error. The accuracy of projected growth under any future scenario could be affected by many variables. These include individual owner or developer actions, the timing of or changes in utility provision, changes in local or state regulations on land use and, most importantly, changes in national or regional economic conditions. While the potential for error is high, the techniques used by the MPO are the best available and provide the best available data for projecting population and employment conditions in the future.

4.6 Conclusions

What Influence Did the Monroe Connector/Bypass Have on the MPO Projections?

As discussed above, an assessment of the MRM socioeconomic projections reveals the following regarding the influence of the Monroe Connector/Bypass on the projections:

- The proposed project did not affect the Travel Time to Core Employment factor in the LUSAM process as this factor had zero weight for all districts for all LUSAM runs (see Appendix A email from Anna Gallup).

[39] Smith, Stanely K., Tayman, Jeff, Swanson, David A. *State and Local Population Projections: Methodology and Analysis.* Kluwere Academic/Plenum Publishers, New York, 2001. p 292
[40] Smith, Tayman, Swanson, p 340

- The proposed project did not affect the Planners' Judgment factor in the LUSAM process as this factor had zero weight for all districts in Union County for all LUSAM runs.
- The proposed project was included in the Travel Time to Employment factor used by Paul Smith in developing the 2005 Projections, but a reassessment of that factor without the proposed project shows that the project had no influence on the projection results.
- The proposed project did not affect Dr. Hammer's projections of households and employment that were used in the 2005 Projections for county level control totals and were used in the 2008 Interim and 2009 Projections for developing the district level targets.
- There is no evidence or indication that any other factor in the LUSAM process or the other projection processes was influenced by the proposed project and communications with CDOT staff indicate that the proposed project was not a consideration in development of the projections.
- A review of the results of the projections shows no signs that the proposed project influenced the projections.

Based on this review, the overall evidence suggests that the MRM socioeconomic projections are insensitive to the presence or absence of the proposed project in the land use models used to develop the projections. The methodology used by CDOT and MUMPO to develop the projections is effectively insensitive to the Monroe Bypass/Connector and other large transportation projects. In the methodology used by Dr. Hammer, specific adjustment had to be made to account for the expected growth-induced by large roadway projects in the Top-Down process. As the sensitivity analysis of Paul Smith's Travel Time to Employment Factor showed, the proposed project made no difference in the Bottom-Up allocation process. Thus, the methodology used does not incorporate the full accessibility impacts of major roadway projects. Consequently, if the ICE analysis were to follow the exact same methodology as the MRM socioeconomic projections to calculate induced growth impacts of the Monroe Connector/Bypass, then the result would be to find no induced growth. However, the qualitative ICE analysis and all other studies point to localized land use impacts occurring with the Build Alternative, particularly in eastern Union County. Therefore, it would be inappropriate to use the MPO socioeconomic projection and allocation methods to attempt to estimate induced growth or induced land use changes associated with the Monroe Bypass/Connector. As described in Section 5, the study team has chosen other methodologies to estimate induced growth and induced land use changes associated with the proposed project.

How Did the Quantitative ICE Use the MPO Projections?

Based on the above review of the assumptions and variables used in the Top-Down and Bottom-Up processes, the inputs and variables used in the LUSAM models, a review of the actual results of the various projection versions, and a re-evaluation of the 2005 Projections without the project, we concluded that the MUMPO models did not incorporate the induced land use effects of the Monroe Connector/Bypass. Furthermore, in comparison to other projections for Union County, the MPO projections appear to be reasonable and in the middle of the range of available projections. Since the MPO projections are also the only source that provides growth projections at a small geographic scale, which is critical to a Quantitative ICE analysis, the MPO projections appear to be the best resource to developing a starting point for future land use conditions in the study area.

A review of the actual distribution of growth in the projections indicates that there is no pattern of development along the proposed project corridor that would suggest that the proposed project was considered in the projection development. Furthermore, a review of how other entities have used the MRM Projections for Traffic and Revenue analyses shows that minor adjustments were made to the MRM socioeconomic projections to account for the presence of the Monroe Connector/Bypass. These adjustments generally consisted of increases in household and employment in eastern portions of the study area. These conclusions suggest that additional analysis is needed to estimate the induced land use effects of the project. As described in Section 4, this Quantitative ICE analysis used the MPO projections as control totals, along with various other information, to develop a scenario without the project or its growth inducing impacts (i.e., the No-Build Scenario). The study team then estimated the induced growth potential of the project and added that estimated induced growth to the No-Build land use scenario to create a new scenario that represents future conditions with the project and its growth inducing impacts (i.e. the Build Scenario).

The original ICE study examined two build scenarios, one with an interchange at US 601 (the RPA) and one without an interchange at US 601. As no net difference was found between the RPA and the alternative without the US 601 interchange, only one build scenario was used in this analysis.

5.0 INDUCED GROWTH ASSESSMENT AND FUTURE LAND USE SCENARIOS

To assess the induced growth potential of the proposed project and compare, quantitatively, the land use conditions with and without the proposed project, two land use scenarios were developed. The Build Scenario would represent the best estimate of land development conditions with the proposed project and its growth inducing impacts. The No-Build Scenario would represent the best estimate of land use conditions without the proposed project or its growth inducing impacts. As noted above, a reference point for the future growth of the study area was needed from which to base the two scenarios and that reference point was the MPO socioeconomic projections. The sections below describe specifically how each scenario was created and how the projections were used in the development of those scenarios.

5.1 How Did the ICE Analysis Project Land Use without the Proposed Project?

To estimate the land use conditions in 2030 without the proposed project or its growth-inducing impacts, the study team used three main inputs:

- Stream buffer regulations
- Land use plans or zoning ordinances (as appropriate per the research phase)
- MPO socioeconomic projections of growth.

All undeveloped parcels were isolated from the process to develop the Existing Land Use Scenario and these parcels were considered available for development unless specifically excluded by regulations. These parcels were then compared to the areas designated for stream buffers and the zoning and land use plans for the various communities to determine the potential use and density for each parcel. Then, based on the growth estimates in the TAZ level projection, the total amount of development was estimated for 2030. The specific steps and methods are detailed below.

Lands Excluded from Development

Prior to allocating growth, stream buffers were excluded from the subset of developable parcels because development within these areas is prohibited by local and/or state regulations. Buffers were developed based on the Post Construction Ordinance regulations and NCDENR's *Site Specific Water Quality Management Plan for the Goose Creek Watershed* (NCDENR, 2009). These regulations vary somewhat between jurisdictions but generally require the following buffers: 30 feet on streams draining areas less than 50 acres; 35 feet on streams draining more than 50 acres and less than 300 acres; 50 feet on streams draining areas more than 300 acres less than 640 acres; and 100 feet plus the floodplain on streams draining more than 640 acres. Special rules apply in the Goose Creek watershed where undisturbed riparian buffers within 200 feet of waterbodies within the 100-year floodplain and within 100 feet of waterbodies that are not within the 100-year floodplain are now required.[41] Buffers were developed on all streams in the National Hydrographic Dataset available for the area.[42] While it is possible to obtain an exemption to these restrictions, it is assumed that mitigation requirements would offset any impacts.

[41] North Carolina Department of Environment and Natural Resources (NCDENR). 2009. Site Specific Water Quality Management Plan for the Goose Creek Watershed.
[42] U.S. Geological Survey Water Resources Division and U.S. Department of Agricultural Natural Resources Conservation Service (USGS & USDA). 1999. National Hydrography Dataset, Watershed Boundaries Dataset.

Residential Development Allocation

Once the total land available for development was determined, the next step was to estimate the level of development needed to accommodate future household growth. The study team used the projected household growth from the MPO 2009 Projections. For each TAZ, the total undeveloped (vacant or agricultural) area was determined based on the parcel categorization completed for the Existing Land Use Scenario (see Section 2.1). For the future scenario, each undeveloped parcel was re-categorized into one of the five development categories (low density residential, medium density residential, high density residential, commercial, or industrial/office/institutional) based on the future land use plans and zoning of the local jurisdictions. For residential properties, the land use categories equated to the following densities:

- Low Density Residential – two dwelling units (DU) per acre or fewer
- Medium Density Residential – greater than two DU per acre but fewer than five
- High Density Residential – five or more DU per acre.

Household growth by TAZ based on the MUMPO's projections is depicted in Map 12. The allocation for residential growth followed a four-step process, as detailed below.

Step 1 - Identification of TAZ Build-Out Capacity: The total acreage of currently undeveloped land that is zoned or planned for future residential development based on local land use plans was calculated for each TAZ to determine the total build-out capacity of that TAZ. Based on local future land use plans, each parcel was assigned a residential land use category, and the total number of possible dwelling units was determined.

Step 2: - Identification of Projections by TAZ: The build-out capacity values calculated in Step 1 were then compared to the household growth in the MUMPO TAZ projections.

Step 3 - Density Adjustments for Over-Capacity TAZs: Where projected growth based on MUMPO's TAZ projection exceeded capacity (determined in Step 1 above), spot checking was done to determine where infill development could be expected to increase density, and parcels were reclassified to a higher residential density appropriately to allow the projected growth to "fit" within the TAZ area.

Step 4 - Distribution of Growth for Under-Capacity TAZs: Where projected growth was equal to or less than capacity, a "percentage of capacity factor" was calculated by dividing the projected growth by the capacity. This factor was used to determine the reduction of the potential build-out area necessary to represent the projected level of growth.

Rather than selecting some parcels to build-out and others to remain undeveloped, the methodology spreads the growth across a proportionate amount of every potential parcel. This provides a more fragmented land use projection than that which might actually occur; therefore, it is a conservative estimate (i.e., overestimate), in terms of coverage, of the areas that may have future development. Given that TAZ boundaries are smaller than watershed boundaries, distributing growth to control totals within the TAZs does not appear to potentially skew the indirect or cumulative effects results for watersheds.

It should be noted that only a portion of each developable parcel was converted to development for the future land use scenario, as described below, so that the total acres of development in each TAZ was maintained according to the projections. For example, if a TAZ had 1,000 acres of currently undeveloped parcels categorized for low density residential growth in the future (two DU per acre), the TAZ would have capacity for 2,000 households. If the TAZ was expected, based on the MPO projections, to add

1,000 households in the future, the TAZ would be filling only 50 percent of its capacity. Thus, a 50 percent reduction factor would be applied to all currently undeveloped parcels in that TAZ categorized for future low density residential development. Therefore, each of those parcels in that TAZ would be reduced in size by 50 percent to reflect the expectation that growth under the 2030 No-Build scenario will only fill 50 percent of the total capacity of low density residential development in that TAZ, and the remaining 50 percent was classified as undeveloped. These undeveloped areas retained the previously assigned NCGAP land cover category (as listed in Section 2.1).

Non-Residential Development Allocation

A similar process was completed for future non-residential development. All currently undeveloped parcels with non-residential zoning or future land use designations were summarized at the TAZ level to calculate the difference between projected growth and capacity.

The MPO TAZ projections include projections for the number of new employees by economic sector for each TAZ. Those sectors were aggregated into Office, Retail or Industrial/Warehouse/Distribution employment growth. Total employment growth by TAZ is depicted in Map 13. Projected new employees were used to calculate new acres of employment-related development using the Social Cost of Alternative Land Development Scenarios (SCALDS) model values provided in the NCDOT's ICE Guidance for assessing future land use (NCDOT & NCDENR, 2001b, p. A-14). These model values are presented in Table 12.

Table 12: Non-Residential Land Use by Employment

Employment Type	Employees/Acre
Office	52.32
Retail	21.78
Industrial/Warehousing/ Distribution	16.33

As with the residential land use analysis, the resulting values from the conversion of employees to acres of land developed were compared to the total capacity for each land use in each TAZ. Reduction factors were calculated in similar fashion to the residential process. These reduction factors were then applied to the non-residential parcels. As with residential development, the growth was spread across a portion of all developable parcels rather than selecting which parcels would develop and which would not within each TAZ.

Once both residential and non-residential development had been accounted for in the parcel and TAZ analysis, the "reduced" parcels categorized by land use were converted to 30x30-meter raster and overlaid on the existing land cover raster to create a new 2030 No-Build scenario raster image.

5.2 How Was Project-Induced Growth Estimated?

As National Cooperative Highway Research Program (NCHRP) Report 423A notes:

> *When a transportation project or policy makes it easier to access certain locations, these places can become attractive to more or different types of development. However, improving accessibility does not guarantee that land use changes will follow. The type, amount, and timing of land use changes will also depend upon the state of the regional economy, the current levels of accessibility, the types of development permitted by land*

> *use regulations, the availability of services such as sewer and water, the desirability of the area for development, and other factors.*[43]

This statement suggests that induced growth impacts of major road projects will be dependent upon five major factors:

- The state of the regional economy
- Current levels of accessibility
- The types of development permitted by land use regulation
- The availability of sewer and water
- The desirability of an area for development.

Thus, in some cases, induced growth impacts of specific projects may be negligible. The Monroe Connector/Bypass would certainly improve travel times to eastern Union County; however, most of the county is already highly accessible with a well-connected roadway network and no major barriers limiting access from Union County to the major employment centers in Mecklenburg County. Various studies have shown that accessibility improvements of highway projects have had diminishing impacts on land values since the 1950s. This is logical—as the national and regional highway systems have been more fully built out, the addition of any single additional link in the network provides a diminishing return to the overall accessibility of any given area. Boarnet and Haughwout note that:

> *As more highways are built, and the metropolitan highway network matures, the incremental effect on accessibility from new or improved highways decreases, thus accounting for a smaller change in land prices due to any access premium.*
>
> *New evidence suggests that metropolitan highway projects still influence land use in the way that theory predicts. The important difference between the new evidence and earlier studies is that the geographic scale of the land use effect appears to be somewhat smaller. A new highway or improvement might importantly reduce travel times in the immediate vicinity of a project, even if the resulting changes in metropolitan-wide transportation accessibility are small. Hence the land use effects of modern highway projects likely operate over a very fine geographic scale, rather close to the project.*[44]

Therefore, other factors that might affect land use change, such as utility availability and planned and zoned land uses were also analyzed to estimate the potential induced impacts of the project. The methods used to estimate the induced growth potential of the proposed project can be summarized as a combination of the following analytical techniques:

- a scenario writing approach to identify areas most likely to see induced growth based on planning information and interviews
- a build-out analysis to see which areas had the most capacity for induced growth

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[43] NCHRP Report 423A. *Land Use Impacts of Transportation: A Guidebook.* Washington DC: National Academy Press, 1999.

[44] Boarnet, Marlon G. and Haughwout, Andrew F. *Do Highways Matter? Evidence and Policy Implications of Highways' Influence on Metropolitan* Development. The University of California Transportation Center, Berkley, CA. August 2000. http://escholarship.org/uc/item/5rn9w6bz. p. 9

- an accessibility analysis to see which areas would most benefit from the proposed project and thus most likely to see induced growth
- a Hartgen Analysis to estimate potential commercial growth at interchange areas.

This combination of approaches was deemed most appropriate as the local land use regulatory restrictions varied dramatically across the FLUSA and a more direct gravity model approach would likely overstate growth in some areas and understate it in others by missing the regulatory restrictions. The accessibility analysis did not consider that the cost of a toll would offset the value of the time saved using the road and therefore that portion of the analysis may actually overstate the potential for induced growth.

Build Land Use Scenario

This Quantitative ICE examines potential effects of the alternative DSA D, which was the Recommended, Preferred Alternative (RPA) for the Monroe Connector/Bypass in the Final Environmental Impact Statement (FEIS). NCTA found no reason to change the conclusions previously reached by NCTA and its agency partners as to the RPA when evaluating changes in the study area since the publication of the ROD and therefore this ICE report analyzes only the RPA in the Build Land Use Scenario.

Improvements in Accessibility/Travel Time

An analysis of accessibility was completed to determine the areas most likely to see development increases attributable to the Monroe Connector/Bypass. The main areas of employment in the region are in Mecklenburg County; therefore, improving accessibility (as measured by travel time) to I-485 and the major employment centers in Mecklenburg County would be the main reason for changes in development patterns. This assertion is supported by the Qualitative ICE Assessment and the ICE discussion in the Draft EIS. To identify the areas with substantially improved accessibility, an estimate of the improvement in travel time to the US 74/I-485 interchange attributable to the proposed project was calculated for the FLUSA.

Map 14 shows the changes in driving time under the Build scenario compared to the No-Build scenario. This analysis was completed using the Network Analyst extension of ArcGIS and a general roadway network with posted speed limit attributes. The travel time from all intersections within the Study Area to the I-485/US 74 interchange was calculated in both the No-Build and Build scenarios. The scenarios are compared on the basis of traffic operating at posted speed limits. The difference in travel time to each intersection was calculated, and the result was converted to a raster surface using the Inverse Distance Weighted method. The resulting map shows the estimated travel time improvement that the Monroe Connector/Bypass will provide to the study area, given the assumptions noted above. The results are not intended to represent the exact travel time savings that the project would provide to the study area. It is mostly an illustrative tool for determining which areas will see the greatest and least accessibility improvements because of the proposed project. The analysis shows improvement in accessibility, especially east of Monroe and around Wingate due to the proposed project. There are also improvements for some sections of Unionville along NC 200 (Morgan Mill Road). Notably, neither Goose Creek nor Sixmile Creek watersheds see sizeable travel time savings from the proposed project, which would strongly suggest that these watersheds would be highly unlikely to see project-induced growth.

Map 15 shows the changes in driving time for the Goose and Sixmile Creek watersheds in more details. As seen in the map, Sixmile Creek sees little to no travel time benefit from the proposed project. The southern portions of Goose Creek appear to reap some travel time benefits based on this drive time analysis. The southern portions of the watershed show potential improvements in travel time of between

one and three minutes. The methodology used in this analysis may overestimate the benefits to these portions of the study area. The analysis estimated travel time benefits to the I-485/US 74 Interchange since access to I-485 was regularly noted as a key benefit of the proposed project. These portions of the Goose Creek watershed have more direct access to I-485 via Idlewild Road, Lawyers Road and NC 218 and drivers originating from the southern portions of the Goose Creek watershed would likely find shorter travel times to I-485 via these roads than via the proposed project.

Scenario Writing and Build Out Analyses

Other factors considered in the allocation of growth in the project area with the Monroe Connector/Bypass included the availability of water and sewer, and the inclination of local jurisdictions to new development. Availability of sewer service in the future was determined by using Future Public Sewer System coverage from the NC Center for Geographic Analysis. Map 16 shows the estimates of existing and future availability of sewer service in the FLUSA. Existing sewer service is relatively limited north of the proposed project, particularly east of Rocky River Road. In the future, sewer service is expected to be extended into Fairview and northern parts of Unionville, but these areas are relatively far from the proposed project and do not coincide with areas that see travel time savings from the proposed project. East of Morgan Mill Road, sewer service exists around each interchange and in the future sewer service is expected to be expanded especially north and south of Wingate. These areas coincide with areas that would benefit substantially from the travel time savings of the proposed project. These areas would logically be the most likely to see some induced land use changes associated with the proposed project.

The inclination of local jurisdictions toward new development is also critical to the likelihood of induced land use changes and induced growth. Based on the interviews and review of planning documents, the localities in the western portions of the study area, particularly Indian Trail and Stallings, are less interested in fostering significant growth within their jurisdictions. Unionville, while not opposed to new development, is not interested in increasing densities and would prefer to maintain its rural character, though they are planning for a commercial node at the US 601 interchange with the proposed project.

Other jurisdictions, however, are more interested in fostering growth and development associated with the proposed project. Union County, as noted above, has a new land use plan that specifically recommends residential development north of Wingate and east of Monroe that is expected to occur with the proposed project. Additionally, Wingate and Marshville have plans to encourage development around the interchange areas within their jurisdictions. These observations were suggested in the Qualitative ICE Assessment and Draft EIS, and are supported by the GIS analysis and interviews conducted for the quantitative ICE analysis. Based on this improved accessibility, as well as the availability of sewer service, the areas east of Monroe and north of Wingate, in the eastern portions of the Study Area, are most likely to see increased growth as a result of the project.

As for the Sixmile Creek watershed, most of the watershed is already served by sewer and water service it is nearly built out already. Furthermore, the watershed is already well served by I-485, so the addition of a new freeway far from the watershed would be unlikely to spur additional development.

For Goose Creek, about half of the watershed has sewer and water service currently. The remainder of the watershed is expected to get sewer and water service in the future, which would be expected to spur additional development. The town of Fairview, which covers the majority of the undeveloped property in the watershed currently, does not plan to encourage moderate to high density residential development nor does it plan to encourage substantial commercial or industrial development. As the watershed is already

served by a well-connected roadway system that connects it easily to I-485, the addition of a freeway that is largely farther from the watershed than I-485 would be unlikely to spur additional development.

Hartgen Analysis of Interchanges

In addition to the accessibility analysis described above, a "Hartgen analysis" was completed for each interchange area to gauge potential for development, using methods researched by Dr. David Hartgen.[45] A Hartgen analysis reviews the traffic volumes, distance to nearest towns, and access to sewer and water services to gauge the potential for induced development at interchanges in rural areas. The results of that analysis indicated that all interchanges except the Forest Hills School Road interchange have at least moderate potential for commercial development. Thus, the Build scenario analysis indicates that more dense growth would be expected where accessibility will improve and other needed infrastructure will be available in the future. Results of this analysis are shown in Appendix D.

As none of the interchange areas are within the Sixmile Creek or Goose Creek watersheds, the Hartgen Analysis is not applicable to the analysis of project-induced development in those watersheds.

Project-Induced Growth Allocation

The preceding analysis identified the general locations and types of development that the proposed project would induce in a Build Scenario. The amount of additional development was determined based on the availability of land in the vicinity of proposed interchanges, the density allowed by zoning and land use plans for the jurisdictions and the capacity for additional development. Capacity for additional development is limited primarily by the access to sewer services. Thus, those areas around the interchanges that are not expected to receive sewer service in the future were not considered for higher density uses. Most new commercial development was allocated in the immediate vicinity of interchanges or at major crossroads nearby. Additional residential development or increases in residential density were allocated in areas near (within roughly two to three miles) but not immediately adjacent to interchanges. The resulting adjustments in parcel level land use from the 2030 No-Build scenario was then converted to a 30x30 meter raster land cover and overlaid on the 2030 No-Build raster.

Finally, one method often considered in induced growth analysis is the possible reallocation of growth within a study area. As accessibility improves in the eastern parts of Union County, the expanded opportunities for development may result in less development in the western portions of the FLUSA in a Build Scenario, relative to a No-Build Scenario, as new development may prefer less costly land and more growth friendly jurisdictions. Other ICE analyses have sometimes taken a reallocation approach to the issue of induced growth. In this case, the study team has specifically chosen not to reallocate growth, but instead to add the estimated induced growth over and above that growth expected under a No-Build Scenario. With this assumption, the ICE analysis is taking a more conservative approach to assuming higher possible cumulative effects across the entire study area.

Induced land use changes in the area of US 74 at the western terminus of the project were expected to be limited. Under the No-Build Scenario, 84 percent of the land within one mile of the interchange is already developed and many of the remaining undeveloped areas are within or near regulated riparian buffers and would therefore be more difficult to develop. Thus, most of the land in the vicinity of this interchange is already developed or planned for development and there would be little opportunity for additional

[45] NCDOT & NCDENR, 2001a, p. IV-27

development under the Build Scenario. Additionally, the proposed project does not provide substantial time savings to major regional employment centers from this area and would therefore be unlikely to spur development in this area.

At Indian Trail-Fairview Road, approximately 50 acres of additional industrial development was expected with the Build scenario. This is consistent with the Indian Trail's zoning and land use plans for the interchange area to become a major industrial park.

At Unionville-Indian Trail Road, Indian Trail land use plans projected a village center as the focal point of the interchange area. Land use plans called for additional commercial space to take advantage of the interchange and medium density residential using Traditional Neighborhood Design (TND) principles. TND principles include building developments with a range of housing types, a well-connected street system, integrated public spaces and some mix of uses. Land use changes under the Build scenario were a shift from residential to commercial for about 50 acres and increases in residential density affecting about 100 acres.

At Rocky River Road, an addition of approximately 50 acres of commercial land use was expected, with about half being converted from a different use compared to the No-Build, consistent with City of Monroe's Rocky River Land Use Corridor Plans (November 2008) for additional commercial development in this area should the proposed project be built.

At US 601, an additional 100 acres of commercial development, with about half being converted from residential use compared to the No-Build, was expected and was consistent with the City of Monroe zoning and plans for areas near this interchange. About 100 acres of residential land use were expected to increase in density. While this was not consistent with existing zoning for the area, it was projected that additional residential density would follow commercial development in the vicinity of this interchange.

At Morgan Mill Road, additional commercial development of less than 50 acres was expected just south of the interchange, mostly converted from residential compared to the No-Build scenario. In addition, about 50 acres of increased residential density was expected in the Build scenario. Also, less than 50 acres of industrial land use, converted from residential as compared to the No-Build, was expected, which was consistent with existing land use and zoning.

At Austin Chaney Road, additional industrial/office development of about 100 acres, plus additional commercial development of about 50 acres was expected. Most of these additions would replace residential development as compared to the No-Build scenario. Additional or increased residential density of about 150 acres was also expected. These were generally consistent with the *Strategic Plan for Economic Development, Town of Marshville, Town of Wingate* (2008) indicating that this interchange area should be a focal point for non-residential development in eastern Union County. In addition, approximately 1,000 additional acres of Low Density Residential development is expected in the areas north of Wingate and east of Monroe. This is generally consistent with the expected land use changes identified in the updated Union County Comprehensive Plan.

At Forest Hills School Road, only new residential development was expected as the results of Hartgen Analysis indicated poor conditions for commercial development. About 100 acres of additional or higher density residential development was expected around this interchange.

Project-Induced Growth Estimates for Goose and Sixmile Creek

Using the analytical tools above, project-induced growth was estimated for the entire study area and allocated to different parts of the study area. The results of that analysis indicated that there would not be any project-induced growth within the Goose or Sixmile Creek watersheds. These results are due to the fact that these two watersheds are in the western portion of the study area and travel times from those watersheds to major regional employment centers see little to no change from the proposed project. Therefore, there are no project-induced growth estimated to occur within these two watersheds.

Legacy Park Proposal

The resource agencies and others have questioned whether the Quantitative ICE should consider the effects associated with the proposed Legacy Park development in eastern Union County and include them in one or both of the future land use scenarios. The proposed Legacy Park is a potential industrial park and intermodal shipment terminal advocated by the former economic development agency for Union County (Union County Partnership for Progress) and mentioned in several regional reports, including the NCDOT Seven Portals Study. The potential development was proposed to be sited north and east of Marshville, along and north of the CSX railroad. Estimates from the Union County Partnership for Progress of the full build-out of the proposed industrial park and rail terminal included up to 5,000 acres of development and up to 20,000 jobs on site.

The Qualitative ICE and the previous Quantitative ICE addressed this development as not being reasonably foreseeable as there were no definite project plans or financing behind the project. Research by the Kenan Institute at the same time as the Quantitative ICE indicated that the proposal did not have any funding commitment and needed to surmount a significant number of hurdles before becoming a reality.[46]

These hurdles include:

- a feasibility study to determine potential site constraints,
- infrastructure including water and sewer,
- a company interested in developing such a facility at a distance from the core of the Charlotte region,
- funding for feasibility studies, infrastructure development and other pre-development activities.

Further research by the study team since the FEIS has reinforced the conclusion that Legacy Park is currently not a reasonably foreseeable development, particularly in the timeframe of the ICE analysis (see interview summaries in Appendix A). There are a few factors that do indicate planning for the project is continuing. For example, the most recent Union County Water and Wastewater Master Plan (2011) does include provisions for ensuring sufficient capacity to provide service if Legacy Park is built, but the plan includes no actions items or financing recommendations for providing the specific water or sewer lines to directly serve the site. Three localities (Anson County, Marshville and Wingate) have adopted resolutions supporting the proposal, but these localities do not have jurisdiction over most of the proposed site.

[46] Appendix C, p 34-35

The vast majority of evidence at this time suggests the proposal is highly speculative and unlikely to develop in a foreseeable timeframe, if ever. In an interview with the project's main sponsor, staff from the Union County Partnership for Progress indicated that planning for the project is "dead" and that they felt the project was highly speculative and unlikely to develop. Their most optimistic estimate was that if the Monroe Connector/Bypass were built there might be a 25 percent chance of some industrial development at the proposed site.

In an interview with Richard Black, the Planning Director for Union County, it was noted that the site of the proposed development was marked for rural residential development in the most recent Union County Land Use Plan. The first draft of that plan did include industrial planned land use at the site of the proposal, but the planned land use was changed as Planning Commissioners and others felt the Legacy Park proposal was too speculative and highly unlikely to occur. Furthermore, the current zoning for most of the site is rural residential. Mr. Black also noted that his impression was that the proposal hinged on the participation of CSX Transportation and, in particular, the development of an intermodal (rail-truck) terminal at the site to spur connected industrial development.

The project team corresponded with CSX staff who noted that the site was topographically well suited to development and situated in a manner that would make it easy to develop rail-served industrial development or an intermodal terminal. They noted that they have previously marketed the site to a number of customers but that none had showed interest. As to the development of an intermodal terminal, CSX staff noted that they did not see the level of market demand necessary to proceed with a feasibility study at this time.

Finally, the project team communicated with Dr. Stephen J. Appold, Assistant Professor at the Kenan Institute at UNC-Chapel Hill. Dr. Appold has been involved with CDOT and the Metrolina Region on new Top-Down projections and has worked on logistics studies for the State Logistics Task Force. Dr. Appold noted that the anchor tenant for Legacy Park has expressed interest but made no commitment. He noted that the location of Legacy Park is distant from the main traffic flows in the region and that even if the Monroe Connector/Bypass were constructed as a non-toll facility, it would not be clear that Legacy Park would develop as a logistics node. Additionally, Dr. Appold noted that while many proposed developments may cite large potential "build out" projections, such projections are often inflated and that many proposals never reach their build out and some may never attract any tenants or users at all.[47]

In August 2013, officials with the Monroe-Union County Economic Development Department indicated they were revamping the Legacy Park proposal to pursue a smaller development in the range of 200-300 acres. NCTA will contact Chris Platé of Monroe-Union County Economic Development to discuss this issue and to assess the level of planning that has occurred.

The totality of information points toward the likelihood that Legacy Park is a highly speculative proposal that is unlikely to see development within the time horizon of the ICE analysis (2030) with or without the Monroe Connector/Bypass. Therefore, no development associated with Legacy Park has been incorporated into any future land use scenarios for this analysis. However, NCDOT and FHWA will continue to monitor the Legacy Park proposal and other proposed development projects throughout the NEPA process.

[47] Letter from Dr. Stephen J. Appold to Jamal Alavi, NCDOT, May 29, 2013, p 3-4.

US 74 Revitalization Study

Beginning in 2011, Union County, and the Towns of Stallings, Indian Trail and Monroe worked together to begin development of the US 74 Revitalization Study. The study completed a draft plan in 2013 and those draft recommendations are currently under review and consideration. The study team reviewed the draft US 74 Revitalization Study and its recommendations for their potential impact to future land use scenarios. Since the study is still draft and has not been adopted and since the land use and other recommendations would result in minimal changes to the land use scenario results, the study team determined it was not reasonably foreseeable to incorporate the draft plan recommendations into any future land use scenario.

6.0 UPDATED LAND USE RESULTS

6.1 What Are the Land Use Results for the Entire Study Area?

The following section outlines the updated results from the three updated scenarios, the 2010 Existing (Baseline), the 2030 No-Build, and the 2030 Build scenario.

Table 13: Updated Land Use Scenario Results

Land Use	Updated Baseline (2010)		Updated 2030 No-Build			Updated 2030 Build		
	Total Area (acres)	% of Total Area	Total Area (acres)	% of Total Area	Change in % from Baseline	Total Area (acres)	% of Total Area	Change in % from No-Build
Total Residential	71,500	35%	97,900	48%	13%	99,700	49%	1%
Low Density	*55,600*	*28%*	*79,500*	*40%*	*12%*	*80,600*	*40%*	*0%*
Medium Density	*12,900*	*6%*	*14,900*	*7%*	*1%*	*15,600*	*8%*	*1%*
High Density	*3,100*	*2%*	*3,500*	*2%*	*0%*	*3,500*	*2%*	*0%*
Commercial	3,900	2%	5,600	3%	1%	5,900	3%	0%
Industrial/Office/Institutional	7,100	4%	8,700	4%	1%	8,800	4%	0%
Transportation	12,700	6%	12,800	6%	0%	13,900	7%	1%
Total Developed	**95,200**	**47%**	**125,000**	**62%**	15%	**128,200**	**63%**	**2%**
Total Agricultural	**52,900**	**26%**	**37,500**	**19%**	-8%	**35,500**	**18%**	**-1%**
Total Forested	**51,900**	**26%**	**37,700**	**19%**	-7%	**36,500**	**18%**	**-1%**
Total Other	**1,900**	**1%**	**1,800**	**1%**	0%	1,800	1%	**0%**
TOTAL	**202,000**	**100%**	**202,000**	**100%**	0%	**202,000**	**100%**	**0%**

Notes: Results have been rounded to the nearest 100 acres and whole percent. Differences were calculated prior to rounding. Totals may appear not to equal the sum of the parts because of rounding.

6.2 What are the Land Use Results for Goose and Sixmile Creek Watersheds?

The results of all three scenarios for the Sixmile Creek watershed are shown in Table 14.

Table 14: Updated Land Use Scenario Results, Sixmile Creek Watershed

Land Use	Updated Baseline (2010)		Updated 2030 No-Build			Updated 2030 Build		
	Total Area (acres)	% of Total Area	Total Area (acres)	% of Total Area	Change in % from Baseline	Total Area (acres)	% of Total Area	Change in % from No-Build
Total Residential	900	52%	1,100	69%	17%	1,100	69%	0%
Low Density	*200*	*13%*	*300*	*16%*	*3%*	*300*	*16%*	*0%*
Medium Density	*600*	*37%*	*700*	*44%*	*8%*	*700*	*44%*	*0%*
High Density	*0*	*3%*	*100*	*9%*	*6%*	*100*	*9%*	*0%*
Commercial	0	0%	0	1%	1%	0	1%	0%
Industrial/Office/Institutional	0	2%	0	2%	0%	0	2%	0%
Transportation	200	12%	200	12%	0%	200	12%	0%
Total Developed	**1,100**	**66%**	**1,400**	**83%**	**17%**	**1,400**	**83%**	**0%**
Total Agricultural	**100**	**7%**	**100**	**4%**	**-3%**	**100**	**4%**	**0%**
Total Forested	**400**	**27%**	**200**	**13%**	**-14%**	**200**	**13%**	**0%**
Total Other	**0**	**0%**	**0**	**0%**	**0%**	**0**	**0%**	**0%**
TOTAL	**1,600**	**100%**	**1,600**	**100%**	**0%**	**1,600**	**100%**	**0%**

Notes: Results have been rounded to the nearest 100 acres and whole percent. Differences were calculated prior to rounding. Totals may appear not to equal the sum of the parts because of rounding.

The results of all three scenarios for the Goose Creek watershed are shown in Table 15. The Update 2010 Baseline Land Use is illustrated in Map 3. Map 17 illustrates the No-Build Scenario land use conditions and Map 18 shows the raw land use changes in the Goose and Sixmile Creek watersheds and surrounding areas.

Map 19 shows the Build Scenario land use conditions and Map 20 shows the raw land use change in the Goose and Sixmile Creek watersheds and surrounding areas. These results are analyzed in the indirect and cumulative impacts review below.

Table 15: Updated Land Use Scenario Results, Goose Creek Watershed

Land Use	Updated Baseline (2010)		Updated 2030 No-Build			Updated 2030 Build		
	Total Area (acres)	% of Total Area	Total Area (acres)	% of Total Area	Change in % from Baseline	Total Area (acres)	% of Total Area	Change in % from No-Build
Total Residential	10,600	39%	13,900	51%	12%	13,900	51%	0%
Low Density	*10,400*	*39%*	*13,100*	*48%*	*10%*	*13,100*	*48%*	*0%*
Medium Density	*100*	*1%*	*800*	*3%*	*2%*	*800*	*3%*	*0%*
High Density	*0*	*0%*	*0*	*0%*	*0%*	*0*	*0%*	*0%*
Commercial	0	0%	600	2%	2%	600	2%	0%
Industrial/Office/Institutional	100	0%	100	1%	0%	100	1%	0%
Transportation	1,400	5%	1,400	5%	0%	1,400	5%	0%
Total Developed	**12,100**	**45%**	**16,100**	**59%**	**15%**	**16,100**	**59%**	**0%**
Total Agricultural	**5,800**	**21%**	**4,400**	**16%**	**-5%**	**4,400**	**16%**	**0%**
Total Forested	**9,100**	**34%**	**6,500**	**24%**	**-9%**	**6,500**	**24%**	**0%**
Total Other	**100**	**0%**	**100**	**0%**	**0%**	**100**	**0%**	**0%**
TOTAL	**27,000**	**100%**	**27,000**	**100%**	**0%**	**27,000**	**100%**	**0%**

Notes: Results have been rounded to the nearest 100 acres and whole percent. Differences were calculated prior to rounding. Totals may appear not to equal the sum of the parts because of rounding.

6.3 What Are the Indirect Land Use Impacts for Goose and Sixmile Creek Watersheds?

Table 14 shows the indirect land use differences between the Updated No-Build and Updated Build scenarios for Sixmile Creek watershed. Table 15 shows the indirect land use differences between the Updated No-Build and Updated Build scenarios for Goose Creek watershed. The Build Scenario has no measurable difference in effect on the amount of developed land in the Goose Creek or Sixmile Creek watersheds, which are known to support the endangered Carolina heelsplitter. The comparisons between the 2030 No-Build and Build finds no difference for Goose Creek and Sixmile Creek for any land use.

6.4 How Was Impervious Surface Estimated?

In order to determine the amount of impervious surface in the FLUSA and by watershed under all the land use scenarios, each land use category was assigned an assumed level of impervious surface. This step of the analysis followed guidance in the Soil Conservation Service (SCS) TR-55 Manual. The SCS TR-55 Manual is widely used for drainage studies and runoff calculations. Land use categories with their associated percentage of impervious coverage applied in this quantitative ICE analysis are presented in Table 16.

Table 16: Percent Impervious Surface for Each Land Use Category

Land Use Category	% Impervious using SCS TR-55 Manual
Commercial	85%
Industrial/Office/Institutional	70%
High Density Residential	38%
Medium Density Residential	25%
Low Density Residential	20%
Transportation	100%
Agricultural and Natural	0%

Source: SCS, 1986

These percentages were applied to the land use acreages, and results are summarized here. The 2010 Quantitative ICE analyses included a Water Quality Analysis based on the results of the 2010 Quantitative ICE for Land Use. To determine the need for additional water quality modeling, the results of the impervious surface analysis from the 2013 Quantitative ICE are compared to the results from the 2010 Quantitative ICE to determine if the changes are substantial enough to necessitate rerunning the water quality modeling. Table 17 shows the changes in impervious surface between the original 2007 Baseline (from the 2010 report) and the updated 2010 Baseline results (from the 2013 report). The updated Existing 2010 Land Use shows that Goose and Sixmile Creek watersheds have seen little to no change in impervious surface percentage since 2007.

Table 17: Updated 2010 Baseline Imperviousness Compared to Previous 2007 Baseline Imperviousness

Watershed Name	Original Impervious Cover	Updated Impervious Cover	Difference in Percentages
Sixmile Creek	25%	26%	1%↑
Goose Creek	13%	13%	No Change

Notes: Results have been rounded to the nearest one whole percent. Differences were calculated prior to rounding. Totals may appear not to equal the sum of the parts because of rounding.

Table 18 shows the changes in impervious surface between the original No-Build (from the 2010 report) and the updated No-Build results (from the 2013 report). Sixmile Creek and Goose Creek show an increase of one full percentage point. These shifts are due to factors noted in Section 1.7, such as the changes in expected development at the Lawyers Road interchange with I-485. Overall, the updated results are similar to the previous results.

Table 18: Updated 2030 No-Build Imperviousness Compared to Previous No-Build Imperviousness

Watershed Name	Original Impervious Cover	Updated Impervious Cover	Difference in Percentages
Sixmile Creek	30%	31%	1%↑
Goose Creek	17%	18%	1%↑

Notes: Results have been rounded to the nearest one whole percent. Differences were calculated prior to rounding. Totals may appear not to equal the sum of the parts because of rounding.

Table 19 shows the changes in impervious surface between the original Build (from the 2010 report) and the Updated Build results (from the 2013 report). Both Sixmile Creek and Goose Creek show an increase of one percent over the previous results. Therefore, the results are similar to the previous results. This suggests that additional water quality modeling would find the same results as the prior water quality modeling, given the standard errors associated with both land use projections and water quality modeling. The indirect and cumulative effects of these impervious surface results are discussed further in Section 6.6.

Table 19: Updated 2030 Build Imperviousness Compared to Previous 2030 Build Imperviousness

Watershed Name	Original Impervious Cover	Updated Impervious Cover	Difference in Percentages
Sixmile Creek	30%	31%	1%↑
Goose Creek	17%	18%	1%↑

Notes: Results have been rounded to the nearest whole percent. Differences were calculated prior to rounding. Totals may appear not to equal the sum of the parts because of rounding.

6.5 What Are the Indirect Impervious Surface and Cumulative Water Quality Impacts?

Indirect Impervious Surface Impacts

Impervious surface was calculated as described above. The changes in impervious surface from Baseline to No-Build and No-Build to Build in the updated analysis are show in Table 20. In all cases, the total impervious area was calculated from the raw land use results and then rounded to the nearest percent.

Table 20: Percent Impervious Surface by Watershed and Alternative

Watershed Name	2010 Baseline Impervious Cover	2030 No-Build Impervious Cover	Change from Baseline to 2030 No-Build[1]	2030 Build Impervious Cover	Change from 2030 No-Build to 2030 Build[1]
Sixmile Creek	26%	31%	5%	31%	No Change
Goose Creek	13%	18%	5%	18%	No Change

[1] Changes were calculated prior to rounding and therefore do not match exactly the difference shown in the table results.

Table 21: Percent Impervious Cover Results from 2010 Report Compared to 2013 Report

Watershed Name	Impervious Cover Results from 2010 Report				Impervious Cover Results from 2013 Report				Difference in Change in Build from No-Build between 2010 Report and 2013 Report
	2007 Baseline	2030 No-Build	2030 Build	Change in Build from No-Build	2010 Baseline Updated	2030 No-Build Updated	2030 Build Updated	Change in Build from No-Build	
Sixmile Creek	25%	30%	30%	0%	26%	31%	31%	0%	0%
Goose Creek	13%	17%	17%	0%	13%	18%	18%	0%	0%

Notes: Results have been rounded to the nearest one whole percent. Differences were calculated prior to rounding. Totals may appear not to equal the sum of the parts because of rounding.

As shown in Table 21, the change in percent impervious surface has no change from 2030 No-Build to 2030 Build. In addition, the percent impervious cover results from the 2010 Report to the 2013 Report also shows no change.

Cumulative Water Quality Impacts

Sixmile Creek and Goose Creek watersheds include three streams that are impaired in some capacity according to water quality ratings established by the NCDENR, Division of Water Quality (DWQ). These watersheds and their impaired waters are documented in Table 22. The impervious surface level for these watersheds is not expected to change from the Build to the No-Build condition. Given that there is no difference in induced impact, no induced water quality impacts are expected in these watersheds.

Table 22: 2012 Clean Water Act §303(d) Impaired Streams by Watershed

Watershed Name	Impaired Stream or Water Body	Impaired Reasons (Year)
Sixmile Creek	Sixmile Creek (Source to NC/SC Line)	Category 5 Fair Bioclassification (2006)
Goose Creek	Duck Creek (Source to Goose Creek)	Category 4b Fair Bioclassification (2008)
	Goose Creek (Source to SR 1524)	Category 4b Turbidity
	Goose Creek (SR 1524 to Rocky River)	Category 4b Fair Bioclassification (1998)
		Category 4t Fecal Coliform Violation

Source: 2012 NCDENR 2012 North Carolina 303(d) Integrated Report

These results are the same as the results of the original Quantitative ICE. The model calibration completed for the Quantitative ICE Water Quality Analysis (FEIS Appendix I) used the Nash-Sutcliffe coefficient, as recommended by the American Society of Civil Engineers, to estimate how well the hydrological model fit observed stream flows. The analysis at the calibration stage and at the validation stage both returned a 0.78, which indicated a very good fit. Since the land use results have changed very little, and are well within the typical variability of hydrological modeling, then new water quality modeling would be highly unlikely to show any differences from the prior results.

6.6 What are the Indirect and Cumulative Impacts to Plant Species?

Michaux's sumac, Schweinitz's sunflower, and the smooth coneflower are federally listed as endangered plant species. The sumac and sunflower are listed for both Mecklenburg and Union counties, but the coneflower is listed only for Mecklenburg County.[48] There are known populations of Schweinitz's sunflower in the FLUSA, and populations of the species have been found in the vicinity of the proposed alignment for the Monroe Connector/Bypass. An evaluation of potential indirect and cumulative effects to the species is summarized below.

Michaux's sumac grows in sandy or rocky open woods on sandy or sandy loam soils with low cation-exchange capacities and appears to depend upon some form of disturbance to maintain the open quality of

[48] NC Natural Heritage Program. "Data Services." Updated January 9, 2009.

its habitat.[4950] Most extant populations can be found on open disturbed areas, such as railroad, road, and utility rights-of-way that are periodically maintained and/or managed for the species. The only known occurrence of Michaux's sumac in the FLUSA was last observed in 1794 and no populations were found in surveys of suitable habitat in the FLUSA. The survey methodology is discussed in the Biological Assessment. [51] As no populations of the species have been found in the FLUSA, it is not anticipated that the Monroe Connector/Bypass project will have any indirect or cumulative effects on the species.

There are no know populations of smooth coneflower in the FLUSA. Based on the ICE analysis, indirect effects are not anticipated in the Mecklenburg County portion of the FLUSA, therefore no ICEs are anticipated for this species.

Historically, it is believed that Schweinitz's sunflower occupied open prairie and Post Oak-Blackjack Oak Savannas that were maintained by relatively frequent fire.[52] FLUSA-wide, physical investigation of all suitable habitat within forest gaps was beyond the scope of this ICE analysis. In addition, the sunflower is an opportunistic species that can colonize even disturbed areas. Therefore, indirect effects to Schweinitz's sunflower are addressed through examining the conversion of land exhibiting habitat characteristics that would support the species. The NCGAP land cover categories included in the analysis were:

- Agricultural Pasture/Hay and Natural Herbaceous
- Barren (subcategory quarries, strip mines, and gravel pits)
- and Barren (subcategory bare rock and sand).

Utilizing these entire categories as potential habitat is a conservative assessment (overestimates potential impacts), since only the ecotonal edges of these land covers could provide potential habitat for the species. Although this species could eventually inhabit some of the lands converted to developed land use[53], such land use categories were not included in the analysis to present a more conservative estimate of the amount of suitable habitat loss. Table 23 presents the results of this analysis.

Table 23: Total Conversion of Pasture/ Hay Natural Herbaceous and Barren Land Cover to Developed Land

	Baseline (acres)	2030 No-Build (acres)	2030 Build (acres)	Change in 2030 with No-Build (acres)	Change in 2030 with Build (acres)
Acres	33,000	23,000	21,700	-10,000	-11,300
% of Baseline	-	-	-	-30%	-34%

Notes: Results have been rounded to the nearest 100 and whole percent. Differences were calculated prior to rounding. Totals may appear not to equal the sum of the parts because of rounding.

With the 2030 No-Build, there is an estimated 30 percent decrease in land cover types presumed to

[49] USFWS. *Michaux's Sumac Recovery Plan*. 1993. Atlanta, GA: p 30.
[50] Suiter, D. Endangered Species Biologist, USFWS. Raleigh, NC. Personal Communication regarding Draft 5-year status review of Michaux's sumac. Telephone: Feb. 2 and 18, 2010.
[51] The Catena Group for NCTA, *Biological Assessment of Carolina Heelsplitter (Lasmigona decorata) and Designated Critical Habitat, Schweinitz's Sunflower (Helianthus schweinitzii), Michaux's Sumac (Rhus michauxii), and Smooth Coneflower (Echinacea laevigata)*, Monroe Connector/Bypass, May 25, 2010.
[52] USFWS. *Schweinitz's Sunflower Recovery Plan*. 1994. Atlanta, GA: p 28.
[53] For example, utility rights of way, which are periodically maintained could provide habitat for the Schweinitz's sunflower, whereas frequently maintained lawns and landscape areas would not provide suitable habitat.

provide potential suitable habitat for the Schweinitz's sunflower. The incremental effect with the 2030 Build scenario is approximately a four percent decrease in potential suitable habitat (34 percent versus 30 percent). This decrease in habitat combined with changes in land use resulting from reasonably foreseeable infrastructure projects may potentially result in effects to Schweinitz's Sunflower.

The land use analysis indicates a significant increase in development and residential growth throughout the FLUSA regardless of construction of the proposed project. Figure 21 depicts changes in land use projected to occur under the No-Build scenario as compared to the current Baseline condition in relationship to known Sunflower populations. Figure 22 illustrates changes in land use from the No-Build to Build scenarios, such as from Residential to Non-Residential (commercial, industrial, etc.) relative to known populations of the Sunflower. Land use around EO# 31, EO# 78, and EO# 18 is not anticipated to change as a result of the project. Land use near EO# 5 is expected to change generally from Undeveloped and Residential to Non-Residential, but since this population is believed to be extirpated, no indirect impacts are anticipated.

There are also several categories of land use change near EO# 77 and EO# 230. While the specific locations of these EO are not anticipated to incur changes in land use, due to their proximity to areas that are projected to experience induced changes in land use, EO# 230 and EO# 77 could potentially be indirectly affected, as they have an increased risk of degradation due to the projected increase in density of nearby development. However, water and sewer service is currently available throughout this area (Cockerhan 2010, Union County Engineering, pers. comm.); therefore, installation of potential additional infrastructure for these services is not expected. In addition, Union Power does not plan to relocate their utility lines near these populations for the Monroe Connector/Bypass. Power line relocation is not typically necessary in response to residential, commercial, or light industrial / office development. NCDOT Division 10 also recently resurfaced and widened the shoulders of Secrest Shortcut Road and does not foresee a need for further road widening to accommodate future development (Thompson 2010a, pers. comm.). Furthermore, these populations are within NCDOT and Union Power ROW and both agencies have agreed to preserve these populations in place. As such, no indirect effects are anticipated to the known populations.

The Build scenario is anticipated to result of in a maximum loss of four percent of potentially suitable habitat within the FLUSA compared to the No Build. A large portion of the four percent estimate includes fringe ecotones, primarily along the edges of agricultural fields that are generally maintained. Such areas are typically not where Schweinitz's Sunflower is found in the FLUSA; they are typically found within NCDOT ROW and utility easements. As such, the 4 percent loss of habitat is not "high-quality" habitat per se. Further, overall there is, and will continue to be, sufficient suitable habitat in the form of NCDOT ROW and utility easements throughout the FLUSA for Schweinitz's Sunflower to colonize. Therefore, it is not anticipated that the project will have indirect effects on the species.

6.7 Changes in Traffic Patterns

The ICE shows that some limited growth would take place (mostly in the eastern part of the FLUSA) if the Monroe Connector/Bypass is built. For this reason, it was necessary to evaluate how growth caused by the project would influence traffic patterns in the FLUSA.

The evaluation used the Metrolina Regional Model (MRM). The model was used to calculate raw traffic volumes under three scenarios:

- The No-Build Scenario
- A Build Scenario using MUMPO's 2009 projected traffic (original socioeconomic data)
- A Build Scenario that adds the effects of the growth projected in the ICE (additions made to the original socioeconomic data based on results of the ICE analysis).

The details of the evaluation are summarized below. The basic conclusions reached were that the added traffic caused by induced growth in the project area had little effect on the overall function of the area road network (on average, traffic increased by about 1,400 vehicles per day on roads intersecting the proposed Monroe Connector/Bypass (Y-line roads).

The volumes reported are raw model volumes that have not been fully calibrated or adjusted per standard traffic engineering principles. These volumes therefore do not represent a fully calibrated forecast of No-Build and Build traffic conditions, but because they were developed the same way from the same MRM version, the difference between them can help reveal the induced traffic impacts of the project. For the No-Build Scenario, the MRM 11 v1.1 was revised to remove the Monroe Connector/Bypass from the model network and the model was run using the 2009 Projections for the socioeconomic input. As documented in Section 4, the 2009 Projections were used to develop the No-Build scenario and therefore were used in this analysis to represent the No-Build Scenario.

For the Build Scenario, two scenarios were run to compare the differences with and without the estimated growth impacts of the proposed project. In the first scenario, the MRM 11 v1.1 was used with the Monroe Connector/Bypass in the model network and the model was run using the 2009 Projections for the socioeconomic input. For the second Build Scenario the MRM 11 v1.1 was used with the Connector/Bypass in the model network and the model was run using an adjusted version of the 2009 Projections for the socioeconomic input. The land use differences identified in the Build Scenario ICE analysis were reviewed at the TAZ level and, based on the localized density assumptions, estimates of the additional household and employment attributable to the additional development anticipated under a Build Scenario were developed at the TAZ level. These estimates of additional households and employment were then added to the 2009 Projections to create a 2009 ICE Projections version. These adjustments added, on net, approximately 4,900 households and 3,800 employees to TAZs within the FLUSA. The raw model volumes from the MRM are shown in Appendix E. Table 24 shows a comparison of the regional vehicle miles traveled (VMT) and vehicle hours traveled (VHT) under the same three scenarios.

The segment level volumes in Appendix E show that when comparing the two Build scenarios run in the model, the project's induced growth does add to the volume level on the Monroe Connector/Bypass, US 74 and intersecting roadways. The highest percent change is along the Y-Line corridors, where there would be some road segments that would see sizeable percentage increase relative to a Build Scenario without the project-induced growth. Yet, the volume increase for any given road segment is less than

3,500 AADT. On average, each roadway segment only sees an additional 1,400 vehicles per day. Along the US 74 and Monroe Connector/Bypass corridors, the percent increase is much lower, less than five percent in most cases. The eastern end of US 74 sees the greatest percentage increases, but again, most of these segments see relatively modest AADT increases of less than 5,000 vehicles per day. Also of note, is the comparison between the Build (2009 Projections) and the Build (Adjusted Projections) volume along the US 74 corridor. Under both scenarios, volume on the US 74 corridor drops by between 8 and 36 percent, depending on the segment, meaning that under the Build Scenario, with or without project-induced growth, US 74 would see substantially less traffic than under a No-Build Scenario.

With respect to total vehicle miles traveled within Union County, the Build Scenario with project-induced growth shows total VMT three percent higher than the Build Scenario without project-induced growth and eight percent higher than the No-Build Scenario. At the regional level, however, the difference is only one percent relative to the No-Build. For vehicle hours traveled, within Union County, the Build Scenario with project-induced growth is three percent higher than the No-Build and four percent higher than the Build without project-induced growth.

Table 24: County and Regional Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT)

County		Union	Mecklenburg	All Others	Regional Total
No-Build	VMT	9,253,669	44,616,030	51,580,950	105,450,650
	VHT	307,176	1,659,686	1,533,217	
Build (2009 Projections)	VMT	9,612,887	44,747,461	51,525,166	105,885,514
	VHT	302,260	1,664,994	1,529,494	
Build (Adj. Projections)	VMT	9,948,279	44,745,210	51,543,589	106,237,079
	VHT	315,582	1,665,283	1,529,690	
No-Build vs Build (2009 Projections)	% Change VMT	4%	0%	0%	0%
	% Change VHT	-2%	0%	0%	
No-Build vs Build (Adj. Projections)	% Change VMT	8%	0%	0%	1%
	% Change VHT	3%	0%	0%	
Build (2009 Projections) vs Build (Adj. Projections)	% Change VMT	3%	0%	0%	0%
	% Change VHT	4%	0%	0%	

With respect to total vehicle miles traveled within Union County, the Build Scenario with project-induced growth shows total VMT three percent higher than the Build Scenario without project-induced growth and eight percent higher than the No-Build Scenario. At the regional level, however, the difference is only one percent relative to the No-Build. For VHT, within Union County, the Build Scenario with project-induced growth is three percent higher than the No-Build and four percent higher than the Build without project-induced growth.

Overall, these forecasted traffic levels indicate that the induced growth impacts of the proposed project will add to the total volume of traffic in Union County and to the total vehicle miles traveled and vehicle hours traveled. Roads that connect to the Monroe Connector/Bypass will likely see some increases in traffic. Overall, however, the increases in traffic are modest and would not likely create substantial congestion issues within the design year of the project, particularly given that the impacts will be spread across the many miles of transportation facilities throughout Union County. Since most of the additional

development in a Build Scenario is expected in the eastern portions of the study area, the additional volumes mostly fall on roadways east of US 601. Therefore, there are little to no increases in traffic volumes associated with induced development in the Goose Creek and Sixmile Creek watersheds.

US 601 North of Monroe Connector/Bypass

Questions had been raised on how the Monroe Connector/Bypass would affect traffic on US 601 north of the project area. This is of special concern as US 601 passes through portions of the Goose Creek Watershed.

There are plans to widen US-601 south of the Monroe Connector/Bypass. While traffic throughout Union County is projected to increase through the design year of the project, widening of the sections of US 601 north of Ridge Road are not included in the constrained long-range transportation plan for MUMPO. The proposal to widen the section between Ridge Road and Lawyers Road was considered in the 2035 MUMPO Long Range Transportation Plan, but the project is ranked 261 out of 307projects considered and was left unfunded The widening south of the bypass has been incorporated into the ICE analysis. US 601 north of the Monroe Bypass to the Union/Cabarrus Line includes the area that crosses Stewarts Creek, Crooked Creek and Goose Creek watersheds. Since the indirect and cumulative land use results show no increase in development along US 601 north of Stewarts Creek, one would not expect to see any substantial increase in traffic volume along the US 601 corridor north of Stewarts Creek. It is more likely that for the segments of US 601 north of Stewarts Creek, traffic volumes would probably decrease in a Build Scenario relative to a No-Build Scenario due to through trips diverting off of NC 218 and US 601 to the Monroe Connector/Bypass for longer distance travel between counties or across the region.

To evaluate any potential traffic impacts to US 601, raw traffic model data was analyzed under No-Build and Build Scenarios to determine whether the proposed project might affect the likelihood that US 601 might require widening in the future. Map 23 shows a comparison of the traffic volumes on US 601 north of the Ridge Road, with and without the proposed project. In the Build Scenario with the induced development included, traffic volumes are expected to mostly decrease to between 5,300 and 13,000 vehicles per day (VPD). The only segment that increases compared to the No-Build Scenario north of Ridge Road is the segment between Ridge Road and Sykes Mill road, where volumes would increase by approximately 2 percent or 300 VPD. All other segments decrease in volume between 3 to 13 percent (300 to 1,200 VPD). Since the Build Scenario is likely to see a reduction, overall, in volumes north or Ridge Road, the proposed project would be unlikely to increase the need to widen US 601 north of Ridge Road. Furthermore, for a rural two-lane road, the projected traffic volumes are below the Annual Average Daily Traffic (AADT) threshold of 15,000 (+/- 5,000) at which widening might be recommended. Therefore, there is no expectation that the traffic impacts associated with induced development from the Monroe Connector/Bypass would necessitate any improvements to US-601 north of Ridge Road.

Do the Indirect and Cumulative Impacts to Traffic Affect Endangered Species

Based on the analysis above, there are no indications that any increases in traffic associated with the project would cause indirect or cumulative effects to federally listed species. Since traffic increases are expected to be limited to the eastern portions of the study area, away from Goose and Sixmile Creek watersheds, it is unlikely that any increases in traffic would affect the Carolina heelsplitter Critical Habitat. Traffic increases noted above would be unlikely to affect federally listed plant species as there is no clear channel through which those increases would impact the plant species in the study area.

6.8 What Are the Indirect and Cumulative Impacts to the Carolina Heelsplitter

Within the FLUSA, the Carolina heelsplitter is found only in the Goose Creek and Sixmile Creek watersheds. As shown in previous sections of direct and indirect effects, no measureable differences in impervious surface were found between the 2030 No-Build and 2030 Build within the Goose Creek or Sixmile Creek watersheds. Therefore, there are no indirect effects on the species associated with the Monroe Connector/Bypass project. As there are no indirect effects, the project does not contribute an incremental effect that would yield potential cumulative effects. Therefore, there would be no cumulative effect to the Carolina heelsplitter or Critical Habitat Unit 1 associated with project-induced changes to land use or impervious surface because of the proposed project.

6.9 Conclusions

As with any attempt to project future growth or development, there are limitations to the accuracy and certainty of the results of these analyses. Most of these analyses rely on the land use projections developed using recommended methods as described in the NCDOT ICE Guidance[54]. Specifically, the land use projections rely on the socioeconomic projections developed by CDOT, and therefore the results are only as accurate as those projections. Projection of socioeconomic conditions, and any projection of the future, is an uncertain process fraught with the potential for error. Despite the best efforts of researchers and forecasters, the error rates for long-range projections are still quite high and thus any projection or estimate of induced and cumulative effects must be considered the best estimate within a wide range of error. The accuracy of growth projections under any future scenario could be affected by many variables. These include individual owner or developer actions, the timing of or changes in utility provision, changes in local or state regulations on land use and, most importantly, changes in national or regional economic conditions. While the potential for error is high, the techniques used by the MPO are the best available and provide the best available data for trying to project population and employment conditions in the future.

As discussed above, the MRM socioeconomic projections appear to be robust in light of their basis in empirical research and the accuracy of the 2009 Projections in comparison to 2010 Census data, and while the potential for error is still large, these projections are the best resource available to estimate future growth in the study area. The methods used to distribute land use effects are based on reasonable assumptions to produce a valid comparative analysis, but these methods also result in high, conservative estimates of effects.

Carolina Heelsplitter

Direct Impacts

- Updated field surveys within the project area found no new populations, thus there is no change in the anticipated direct effects of the project, which were minimal based on the analysis of the BA.

[54] NCDOT & NCDENR, 2001a

Indirect Impacts

- There are no changes in land use within the Sixmile Creek and Goose Creek watersheds from the No-Build to the Build scenarios, thus there are no indirect land use impacts attributable specifically to the projects.
- Since there are no differences in land use between the No-Build and Build scenarios, there are also no differences in the impervious surface levels between the No-Build and Build scenarios in both watersheds.
- With regard to percent impervious cover as an indicator for water quality effects and effects to aquatic species, findings show no difference in percent impervious cover between the 2030 Build and 2030 No-Build for the two watersheds. Thus there are no changes in the indirect water quality impacts.

Cumulative Impacts

- There are substantial increases in development from the Baseline condition to both the No-Build and Build conditions, but these changes would occur with or without the proposed project. Therefore, there are no indirect impacts from the proposed project in the two watersheds and thus there are no cumulative land use impacts from the proposed projects in the two watersheds.
- There are substantial increases in development from the Baseline condition to both the No-Build and Build conditions leading to substantial increases in impervious surface levels, but these changes would occur with or without the proposed project. Therefore, there are no indirect impacts from the proposed project in the two watersheds and thus there are no cumulative impervious surface impacts from the proposed projects in the two watersheds.
- There are substantial increases in development from the Baseline condition to both the No-Build and Build conditions leading to substantial increases in impervious surface levels and possibly reductions in water quality, but these changes would occur with or without the proposed project. Therefore, there are no indirect impacts from the proposed project in the two watersheds and thus there are no cumulative water quality impacts from the proposed projects in the two watersheds.
- Mecklenburg and Union Counties, and communities in the Goose Creek and Sixmile Creek watershed, have developed regulations to reduce the cumulative effect of development on water quality in these sensitive watersheds. These regulations include the Site Specific Water Quality Management Plan for the Goose Creek Watershed, the Goose Creek Water Quality Recovery Program Plan for the Fecal Coliform TMDL, and Charlotte-Mecklenburg Water Quality Buffer Implementation Guidelines.
- Overall, as the land use and impervious surface results are only slightly different from the results of the original Quantitative ICE, additional water quality modeling is not necessary, as these differences are not large enough to see substantial differences compared to the prior water quality results.

Carolina Heelsplitter Critical Habitat

Direct Impacts

- Since the project footprint has not changed and the Critical Habitat definition has not changed, there are no changes in the anticipated direct effects of the project to Critical Habitat Area 1, which were minimal based on the analysis of the BA.

Indirect Impacts

- There are no changes in land use within the Sixmile Creek and Goose Creek watersheds from the No-Build to the Build scenarios, thus there are no indirect land use impacts attributable specifically to the projects.
- Since there are no differences in land use between the No-Build and Build scenarios, there are also no differences in the impervious surface levels between the No-Build and Build scenarios in both watersheds.
- With regard to percent impervious cover as an indicator for water quality effects and effects to aquatic species, findings show no difference in percent impervious cover between the 2030 Build and 2030 No-Build for the two watersheds. Thus, there are no changes in the indirect water quality impacts.

Cumulative Impacts

- There are substantial increases in development from the Baseline condition to both the No-Build and Build conditions, but these changes would occur with or without the proposed project. Therefore, there are no indirect impacts from the proposed project in the Goose Creek watershed and thus there are no cumulative land use impacts from the proposed projects in the watershed.
- There are substantial increases in development from the Baseline condition to both the No-Build and Build conditions leading to substantial increases in impervious surface levels, but these changes would occur with or without the proposed project. Therefore, there are no indirect impacts from the proposed project in the Goose Creek watershed and thus there are no cumulative impervious surface impacts from the proposed projects in the watershed.
- There are substantial increases in development from the Baseline condition to both the No-Build and Build conditions leading to substantial increases in impervious surface levels and possibly reductions in water quality, but these changes would occur with or without the proposed project. Therefore, there are no indirect impacts from the proposed project in the Goose Creek watershed and thus there are no cumulative water quality impacts from the proposed projects in the watershed.
- Mecklenburg and Union Counties, and communities in the Goose Creek watershed, have developed regulations to reduce the cumulative effect of development on water quality in these sensitive watersheds. These regulations include the Site Specific Water Quality Management Plan for the Goose Creek Watershed, the Goose Creek Water Quality Recovery Program Plan for the Fecal Coliform TMDL, and Charlotte-Mecklenburg Water Quality Buffer Implementation Guidelines.
- Overall, as the land use and impervious surface results are only slightly different from the results of the original Quantitative ICE, additional water quality modeling is not necessary, as these differences are not large enough to see substantial differences compared to the prior water quality results.

Schwinetzer's Sunflower

Direct Impacts

- Updated field surveys within the project area found no new populations, thus there is no change in the anticipated direct effects of the project.

Indirect Impacts

- For the 2030 Build, findings indicate a four percent greater decrease of land exhibiting habitat characteristics that might support the Schweinitz's sunflower as compared to the change predicted for the 2030 No-Build based on results of this study.
- These indirect effects are the same as previously reported in the BA.
- Therefore there are no changes in the previously conclusions regarding indirect impacts to the sunflower.

Cumulative Impacts

- Since the direct and indirect effects are the same as previously reported in the BA, there are no changes in the previously conclusions regarding cumulative impacts to the sunflower.

Michaux's Sumac

Direct Impacts

- Updated field surveys within the project area found no new populations, thus there is no change in the anticipated direct effects of the project.

Indirect Impacts

- Since no populations of this species have been found in the FLUSA, no indirect impacts are expected to occur as a result of the proposed project.

Cumulative Impacts

- Since no populations of this species have been found in the FLUSA, no cumulative impacts are expected to occur as a result of the proposed project.

Smooth Coneflower

Direct Impacts

- Field surveys within the project area found no new populations, thus there is no change in the anticipated direct effects of the project.

Indirect Impacts

- Since no populations of this species have been found in the FLUSA, no indirect impacts are expected to occur as a result of the proposed project.

Cumulative Impacts

- Since no populations of this species have been found in the FLUSA, no cumulative impacts are expected to occur as a result of the proposed project.

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Maps

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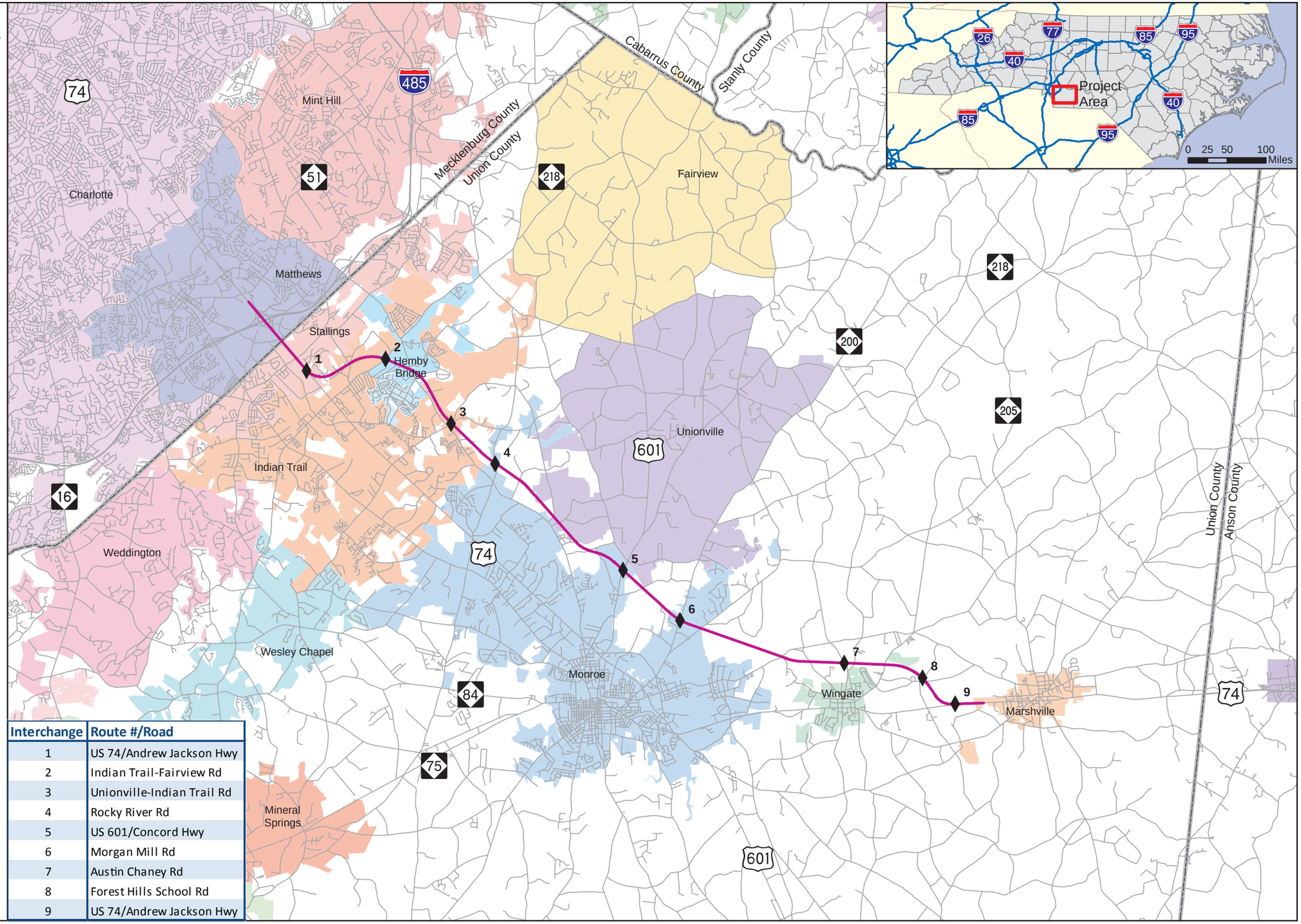
Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 1:
Project Location

Interchanges
RPA Centerline
Existing Roads



Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

NORTH CAROLINA Turnpike Authority

N W E S

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Miles

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 2: Study Area Watersheds

- Interchanges
- Recommended Preferred Alternative Centerline
- River or Stream
- FLUSA Boundary

NORTH CAROLINA Turnpike Authority

N
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Miles

Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
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7	Austin Chaney Rd
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Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 3: Updated 2010 Baseline Land Use Scenario

Existing Land Use

- Agricultural Fields
- Barren
- Commercial
- Forested
- Other Natural
- High Density Residential
- Industrial/Office/Institutional
- Low Density Residential
- Medium Density Residential
- Open Water
- Transportation

FLUSA Boundary

Watersheds

NORTH CAROLINA Turnpike Authority

N
W E
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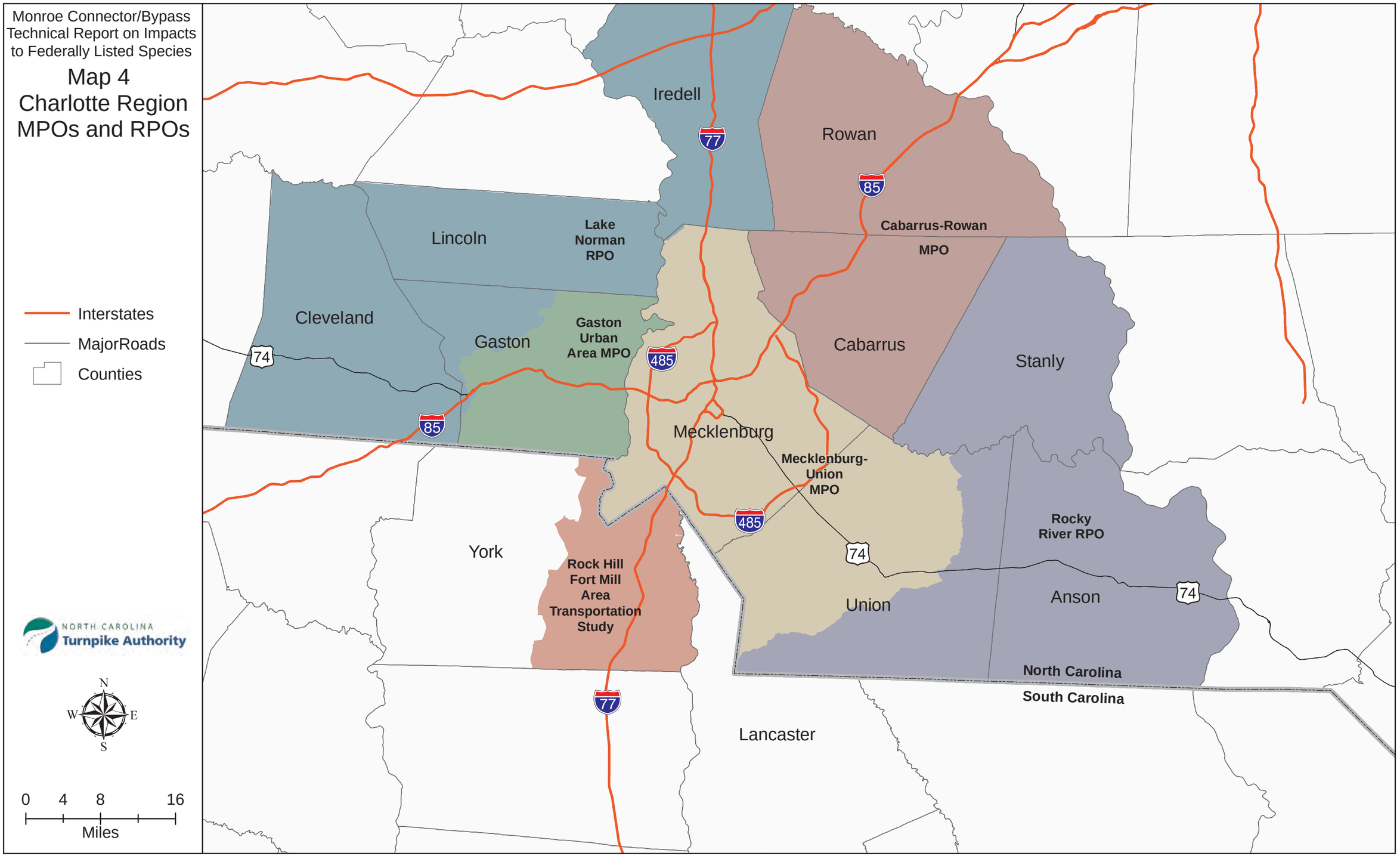
Miles

Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 4
Charlotte Region
MPOs and RPOs



NORTH CAROLINA Turnpike Authority

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 5: Metrolina Model TAZs by Planning Organization

- Interchanges
- Recommended Preferred Alternative Centerline
- MUMPO Analysis Area
- Watersheds

Metrolina Model TAZs

- MUMPO
- Other MPO or RPO

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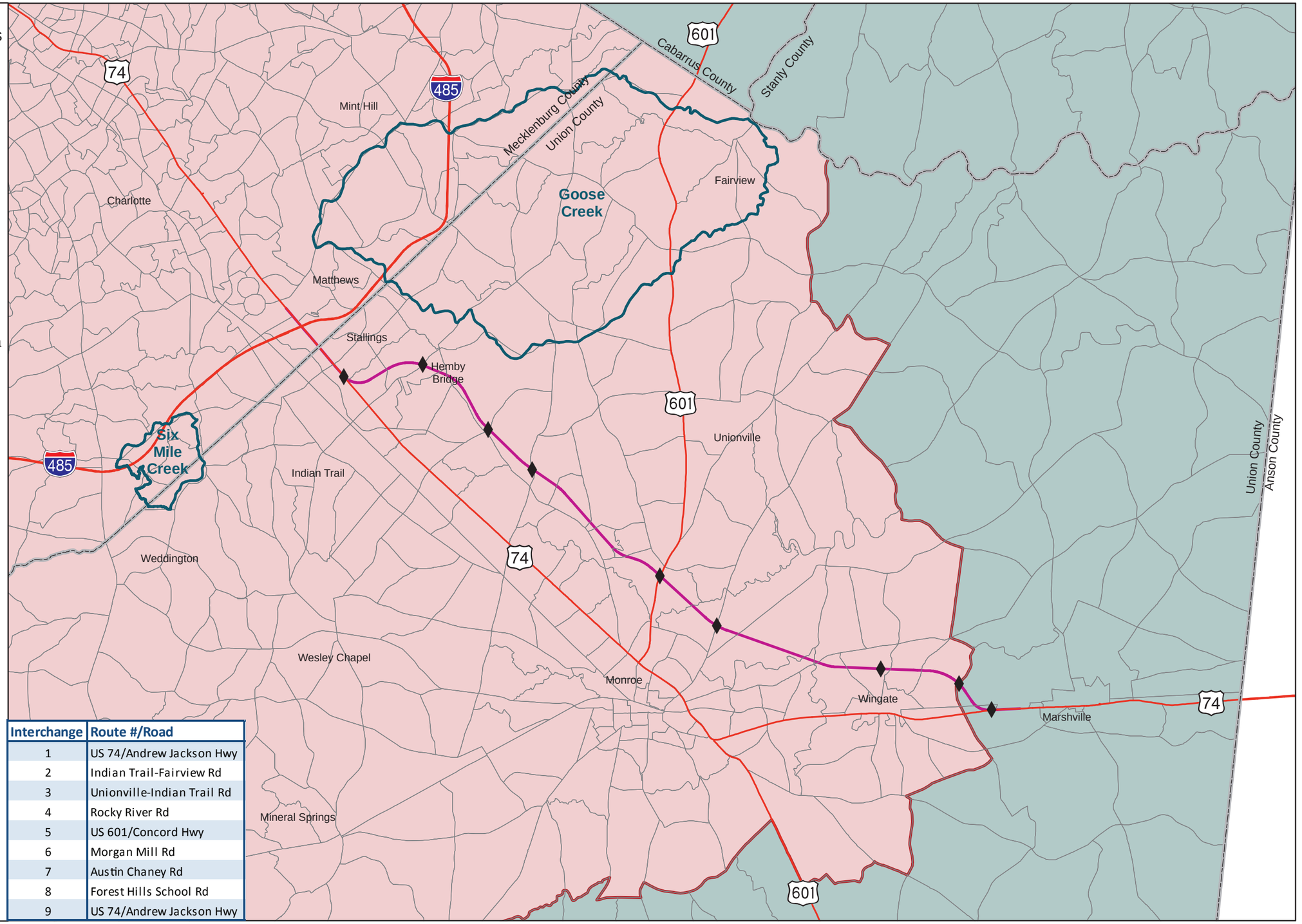
Miles



Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

Monroe Connector/Bypass Technical Report on Impacts to Federally Listed Species

Map 6:

Travel Time to Employment Center Analysis - Employment Center Location and Travel Time Results

- RPA Centerline
- Interchanges
- Watersheds
- MUMPO Analysis Area
- Employment Centers

Travel Time to Employment Center

	Minutes
<10	
10-20	
20-30	
30-40	
>40	

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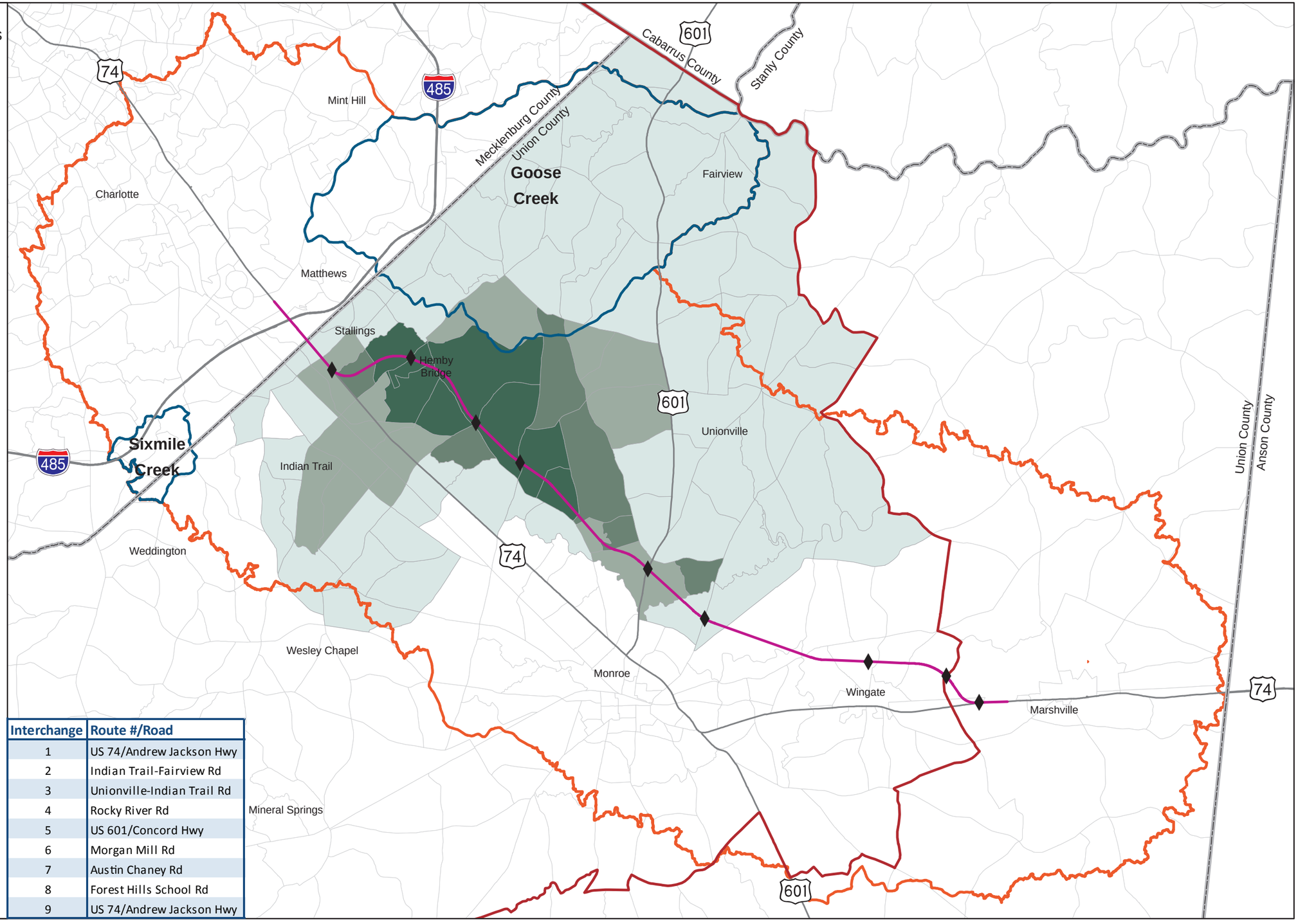
N W E S

0 1.5 3
Miles

Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

Monroe Connector/Bypass Technical Report on Impacts to Federally Listed Species

Map 7: Difference in Travel Time to Employment Centers Factor from Bottom Up Allocation



- Interchanges
- RPA Centerline
- Watersheds
- FLUSA Boundary
- MUMPO Analysis Area
- Watersheds

Travel Time to Employment Centers
Time Difference (Minutes)

- 3 to 5.7
- 1.5 to 2.99
- 0.5 to 1.49
- 0.01 to 0.49
- 0

NORTH CAROLINA Turnpike Authority

N W E S

0 1 2 4
Miles

Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

Monroe Connector/Bypass Technical Report on Impacts to Federally Listed Species

Map 8: Difference in Land Development Factor Composite Score from Bottom Up Allocation

- Interchanges
- RPA Centerline
- Watersheds
- FLUSA Boundary
- MUMPO Analysis Area
- Watersheds

Land Development Factor Composite Score

Percent Difference

- -2% to -3.86%
- -1% to -1.99%
- -0.5% to -0.99%
- -0.01% to -0.49%
- 0%

NORTH CAROLINA Turnpike Authority

N W E S

0 1 2 4 Miles

Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 9: Household Density 2030 Horizon Year

2009 Projections

- Watersheds
- FLUSA Boundary
- Interchanges
- RPA Centerline

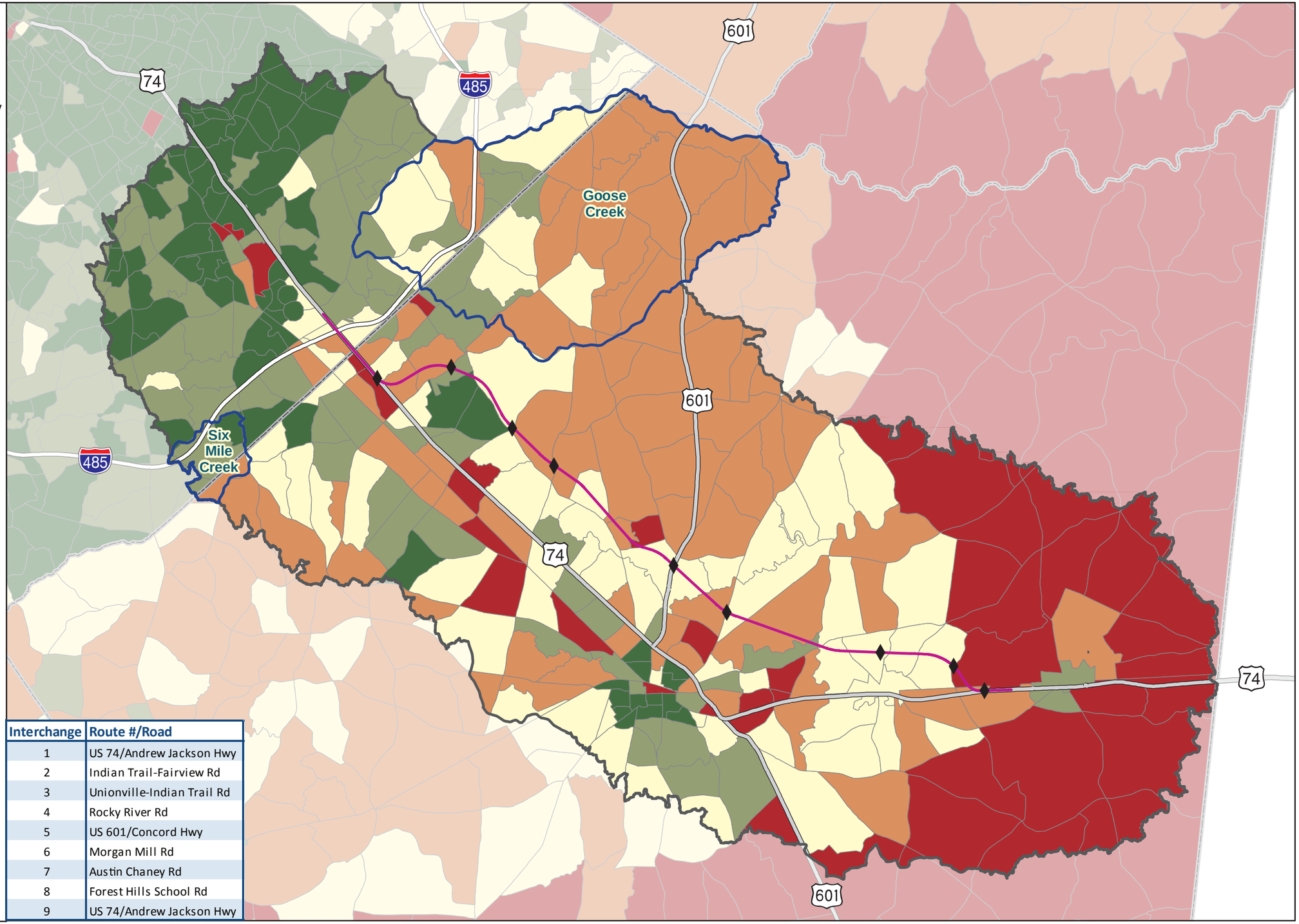
Household Density per Sq. Mile

- > 1000
- 501 - 1000
- 301 - 500
- 101 - 300
- < 100

NORTH CAROLINA Turnpike Authority

N W E S

0 1 2 4
Miles



Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
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6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 10: Employee Density 2030 Horizon Year

2009 Projections

- Watersheds
- FLUSA Boundary
- Interchanges
- RPA Centerline

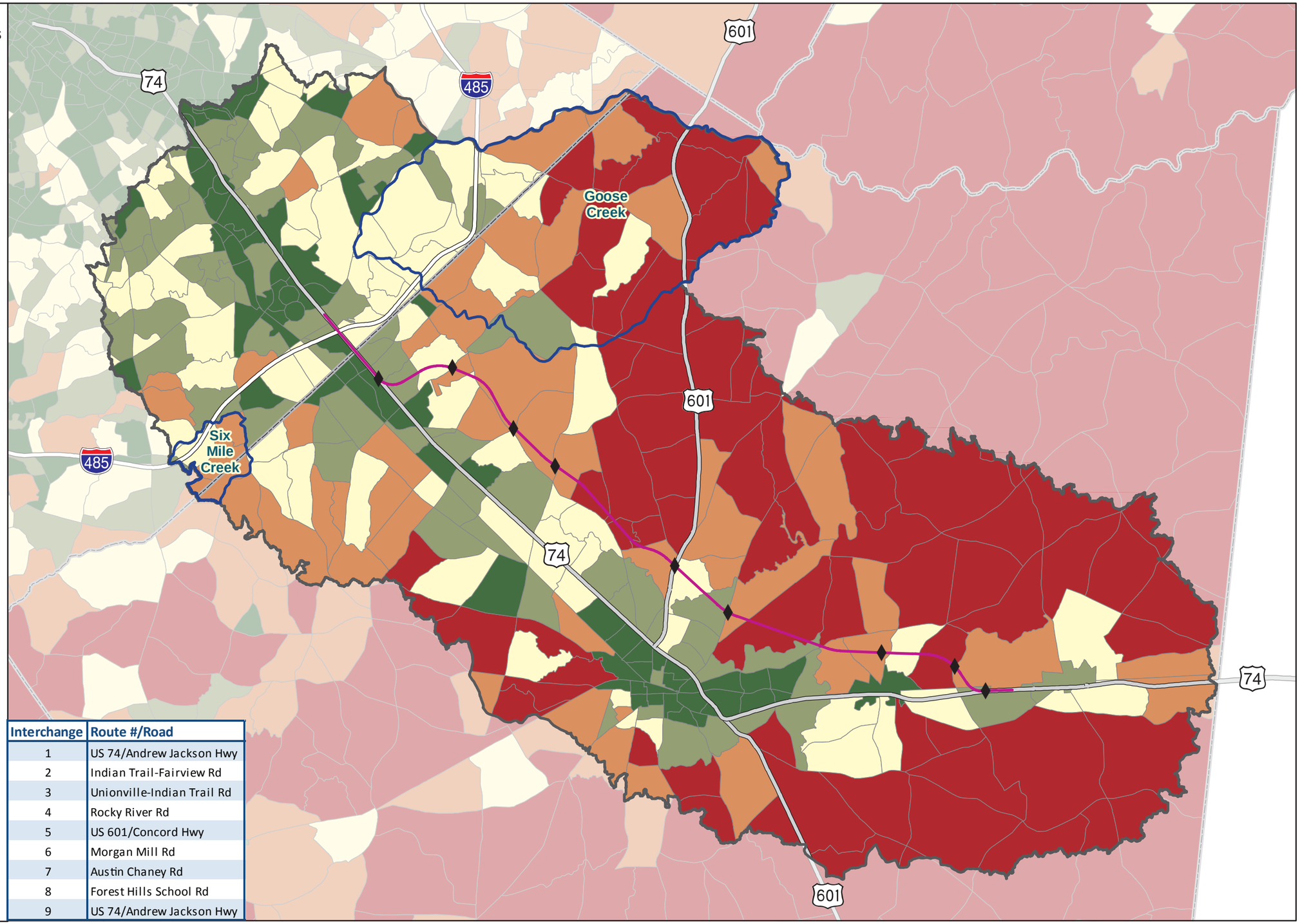
Employee Density per Sq. Mile

- > 1500
- 601 - 1500
- 301 - 600
- 101 - 300
- < 100

NORTH CAROLINA Turnpike Authority

N W E S

0 1 2 4
Miles



Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 11: Kenan Institute Study Zones and ICE FLUSAs

- Interchanges
- RPA Centerline
- Watersheds
- FLUSA (Qualitative ICE)
- FLUSA (Quantitative ICE)

Kenan Study Zones

- 1
- 2
- 3
- 4
- 5

Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

N W E S

0 1 2 4
Miles

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 12: Household Growth by TAZ

2009 Projections

Watersheds
FLUSA Boundary
Interchanges
RPA Centerline

Household Growth
2005-2030

< 0
1 - 50
51 - 100
101 - 200
201 - 500
>500

NORTH CAROLINA Turnpike Authority

N W E S

0 1 2 4
Miles

Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 13: Employment Growth by TAZ

2009 Projections

- Watersheds
- Study Area
- Interchanges
- RPA Centerline

Employment Growth 2005-2030

- < 0
- 1 - 150
- 151 - 350
- 351 - 700
- 701 - 1200
- > 1200

NORTH CAROLINA Turnpike Authority

N W E S

0 1 2 4
Miles

Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 14: Comparison of Accessibility No-Build vs Build

- Interchanges
- Recommended Preferred Alternative Centerline
- FLUSA Boundary
- Watershed Boundary

Change in Travel Time
Decrease from
No Build to Build (Min)

- 0 to 2.9
- 3 to 4.9
- 5 to 7.9
- 8 to 10

NORTH CAROLINA Turnpike Authority

N
W E
S

0 1 2 4
Miles

Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 15: Comparison of Accessibility No Build vs Build

- Interchanges
- Reccommended Preferred Alternative Centerline
- FLUSA Boundary
- Watersheds

Change in Travel Time
Decrease from
No Build to Build

- 0 to 0.9
- 1 to 1.9
- 2 to 2.9
- 3 to 10

NORTH CAROLINA Turnpike Authority

N W E S

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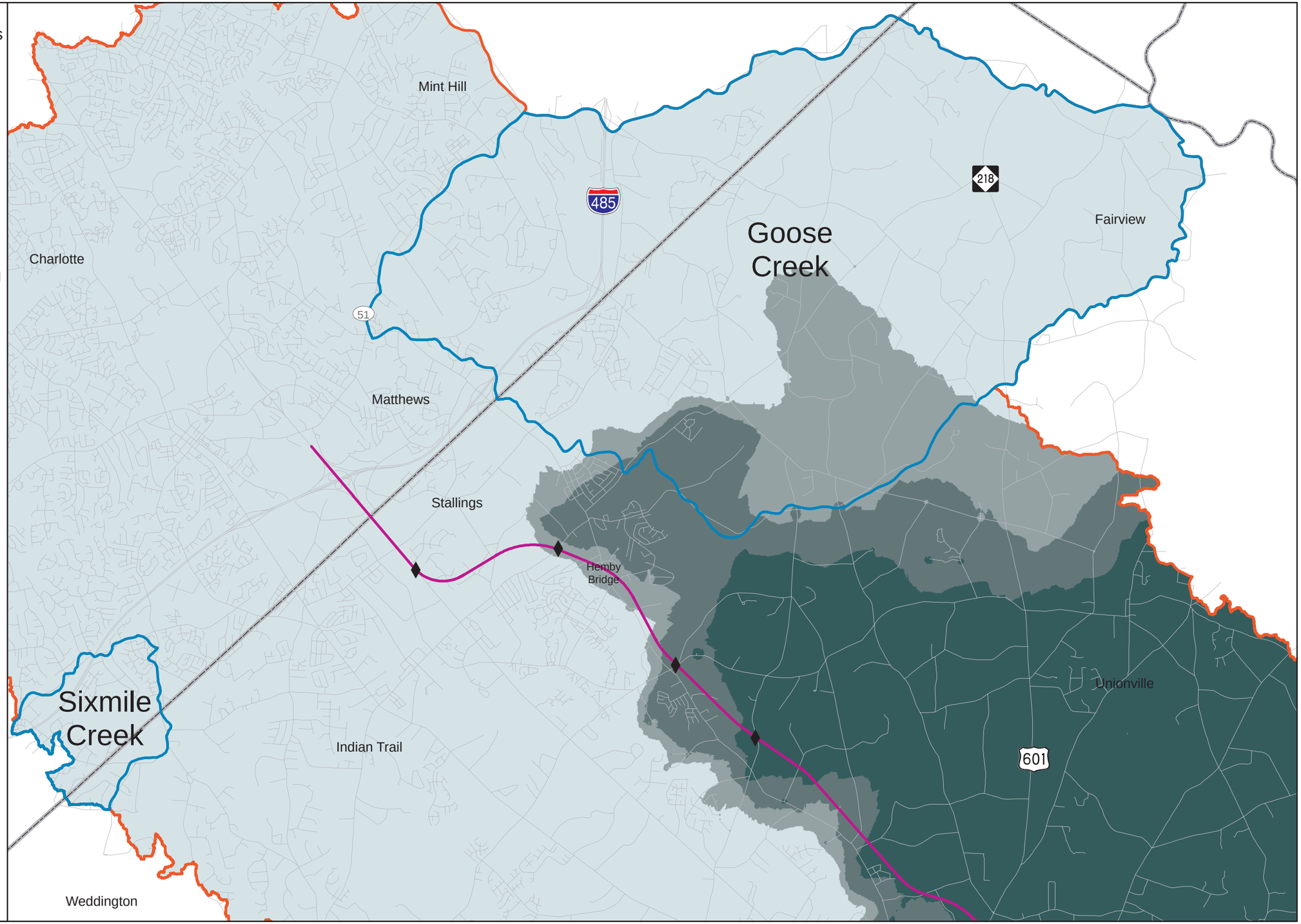

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 16: Sanitary Sewer Availability

- Interchanges
- Recommended Preferred Alternative Centerline
- Existing Roads
- Watersheds
- Future Land Use Study Area Boundary
- Current Sewer Service
- Future Sewer Service

NORTH CAROLINA Turnpike Authority

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Note: Current and future sewer service GIS layers were prepared by the NC Center for Geographic Information and Analysis and was developed by the NC Rural Center by McGill & Associates and Hobbs, Upchurch & Associates, 2004-2006. Indirect and cumulative impact analysis defers to information from local planners with regard to where future sewer service is anticipated to be made available.

Interchange	Route #/Road
1	US 74/Andrew Jackson Hwy
2	Indian Trail-Fairview Rd
3	Unionville-Indian Trail Rd
4	Rocky River Rd
5	US 601/Concord Hwy
6	Morgan Mill Rd
7	Austin Chaney Rd
8	Forest Hills School Rd
9	US 74/Andrew Jackson Hwy

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 17: Updated 2030 No-Build Land Use Scenario

No Build Land Use

- Agricultural Fields
- Barren
- Commercial
- Forested
- Other Natural
- High Density Residential
- Industrial/Office/Institutional
- Low Density Residential
- Medium Density Residential
- Open Water
- Transportation

FLUSA Boundary

Watersheds

NORTH CAROLINA Turnpike Authority

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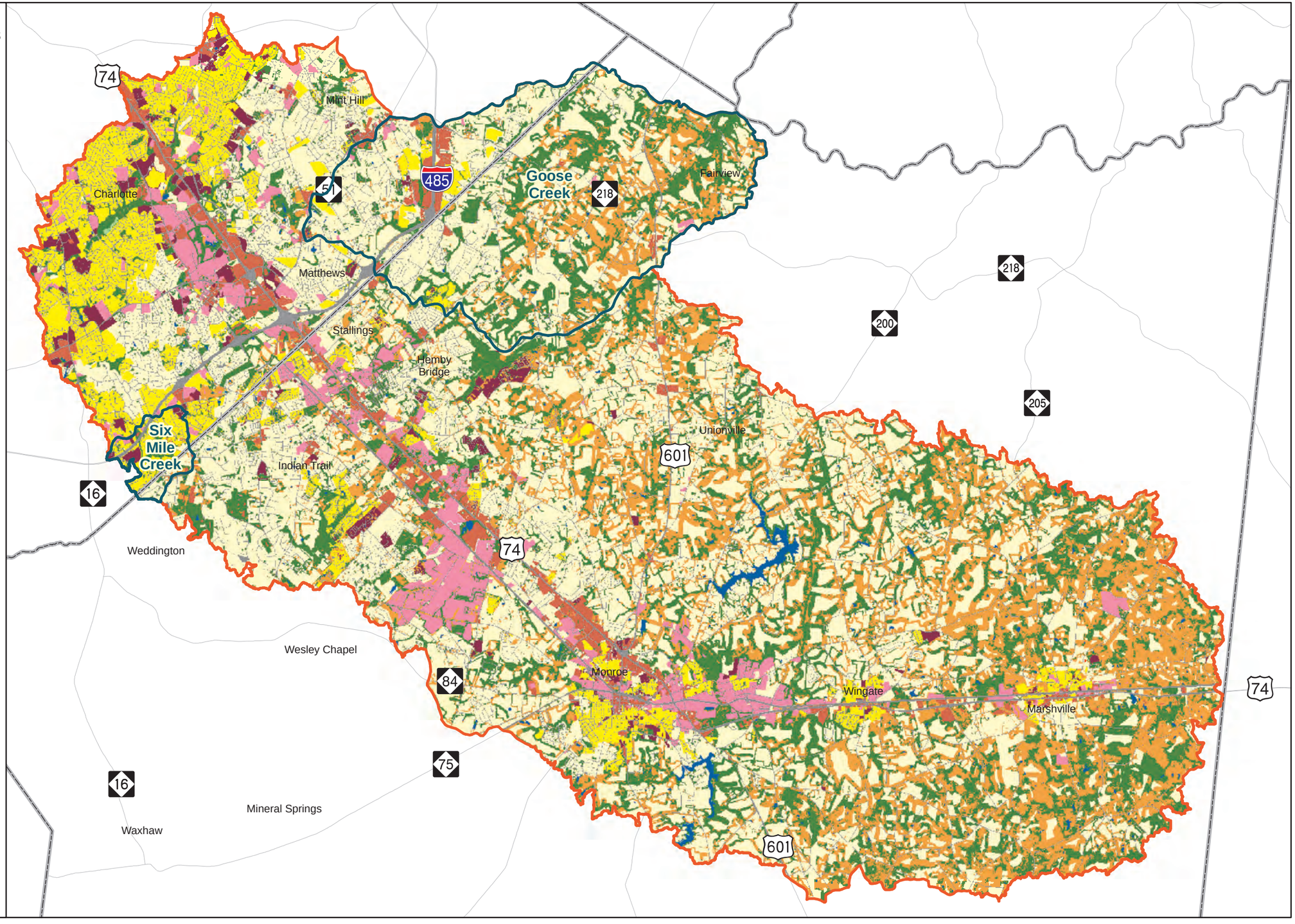

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 18:
Land Use Change

Baseline (Existing) to No-Build

Change in Land Use

- From Undeveloped to Residential
- From Lower to Higher Density Residential
- From Non-Residential to Residential
- From Residential to Non-Residential
- From Undeveloped to Non-Residential
- Other Change between Developed Land Uses

- RPA Centerline
- FLUSA Boundary
- Watersheds

NORTH CAROLINA Turnpike Authority

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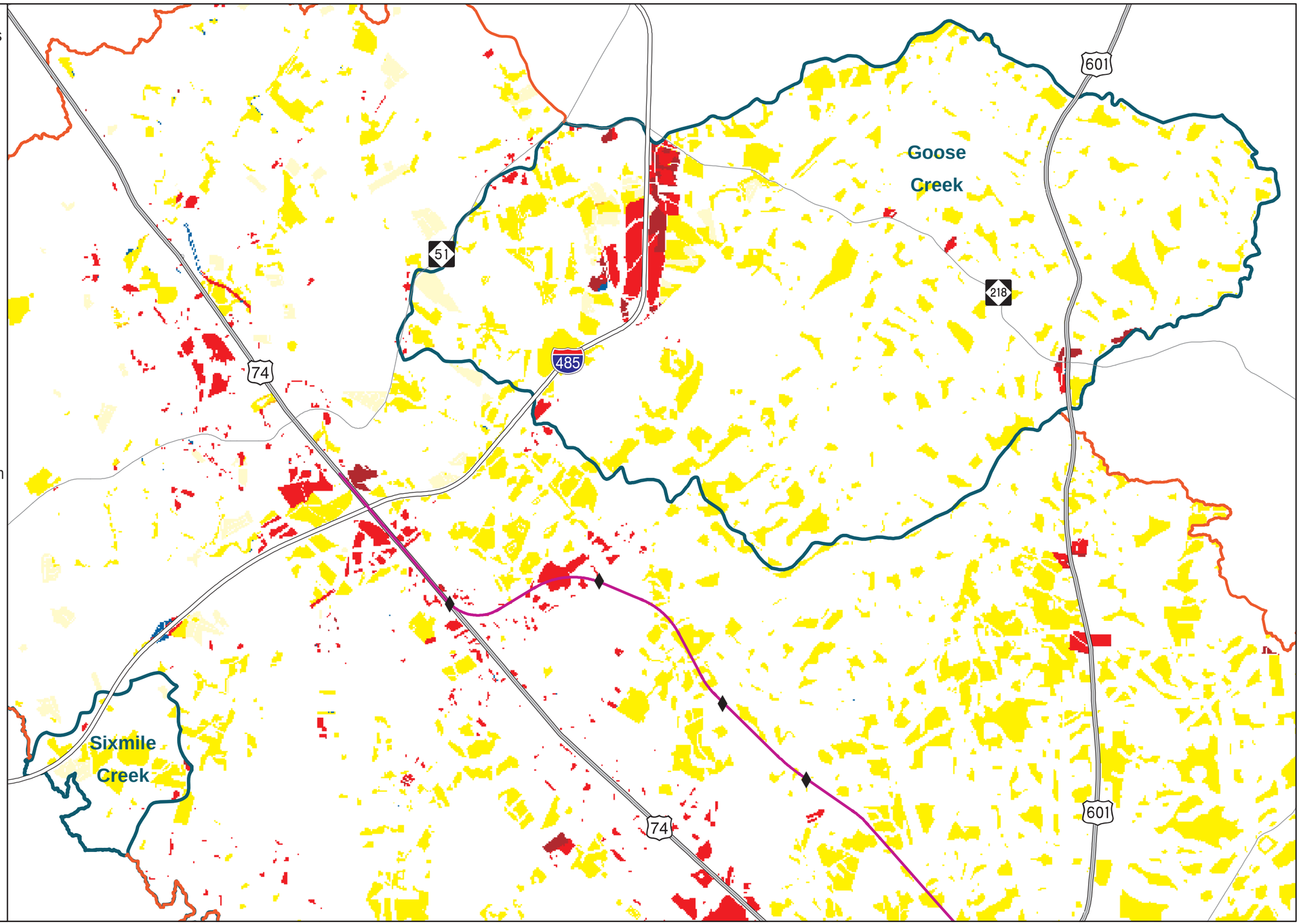

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 19: Updated 2030 Build Land Use Scenario

Build Land Use

- Agricultural Fields
- Barren
- Commercial
- Forested
- Other Natural
- High Density Residential
- Industrial/Office/Institutional
- Low Density Residential
- Medium Density Residential
- Open Water
- Transportation
- FLUSA Boundary
- Watersheds

NORTH CAROLINA Turnpike Authority

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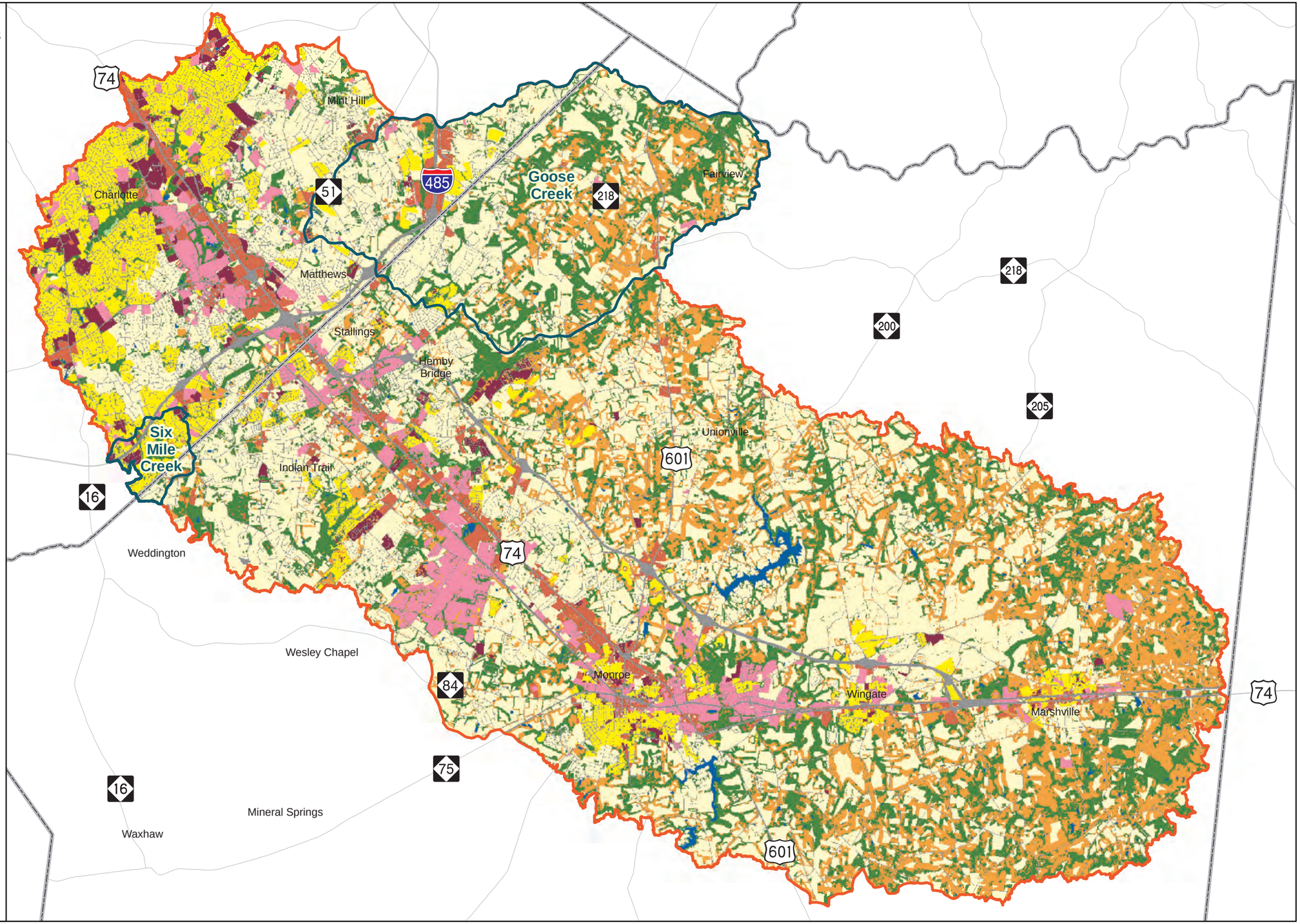

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 20:
Land Use Change

No-Build
to Build

Change in Land Use

- From Undeveloped to Residential
- From Lower to Higher Density Residential
- From Non-Residential to Residential
- From Residential to Non-Residential
- From Undeveloped to Non-Residential
- Other Change between Developed Land Uses

- FLUSA Boundary
- Watersheds

NORTH CAROLINA Turnpike Authority

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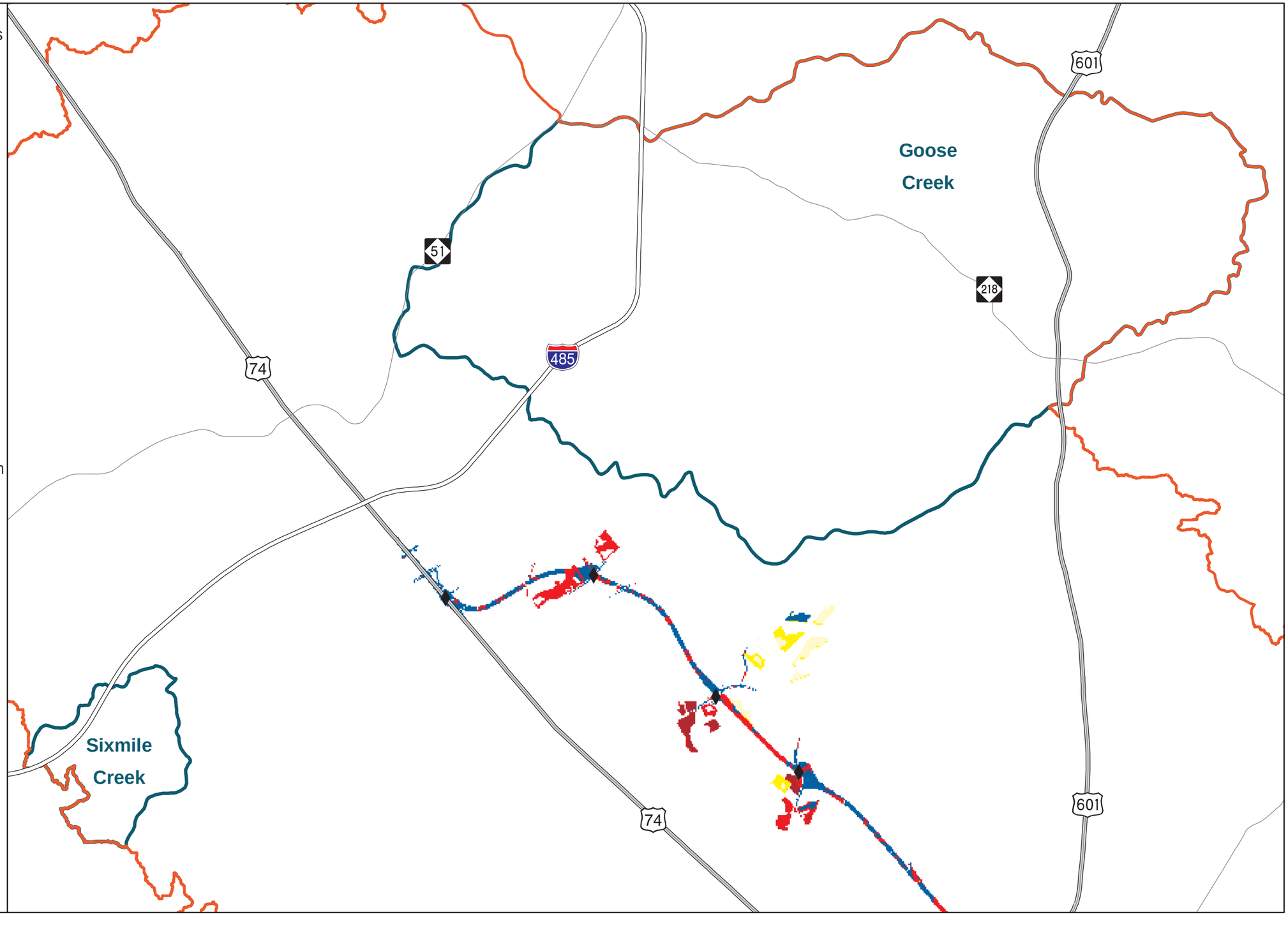

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 21:
Land Use Change

Baseline (Existing) to No-Build Effects to Sunflower Populations

Schweinitz's Sunflower Population

Change in Land Use

- From Undeveloped to Residential
- From Lower to Higher Density Residential
- From Non-Residential to Residential
- From Residential to Non-Residential
- From Undeveloped to Non-Residential
- Other Change between Developed Land Uses

FLUSA Boundary

NORTH CAROLINA Turnpike Authority

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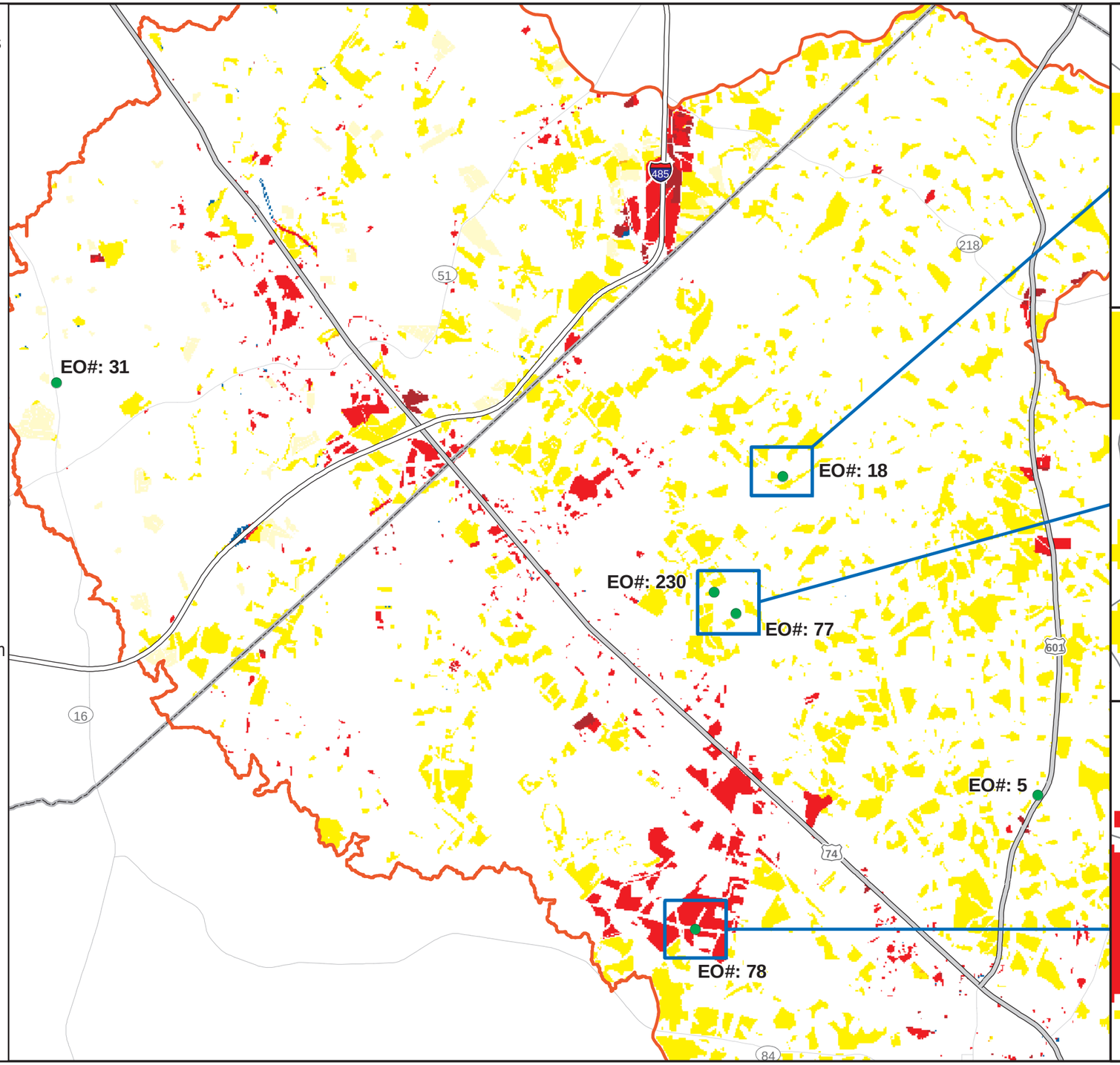

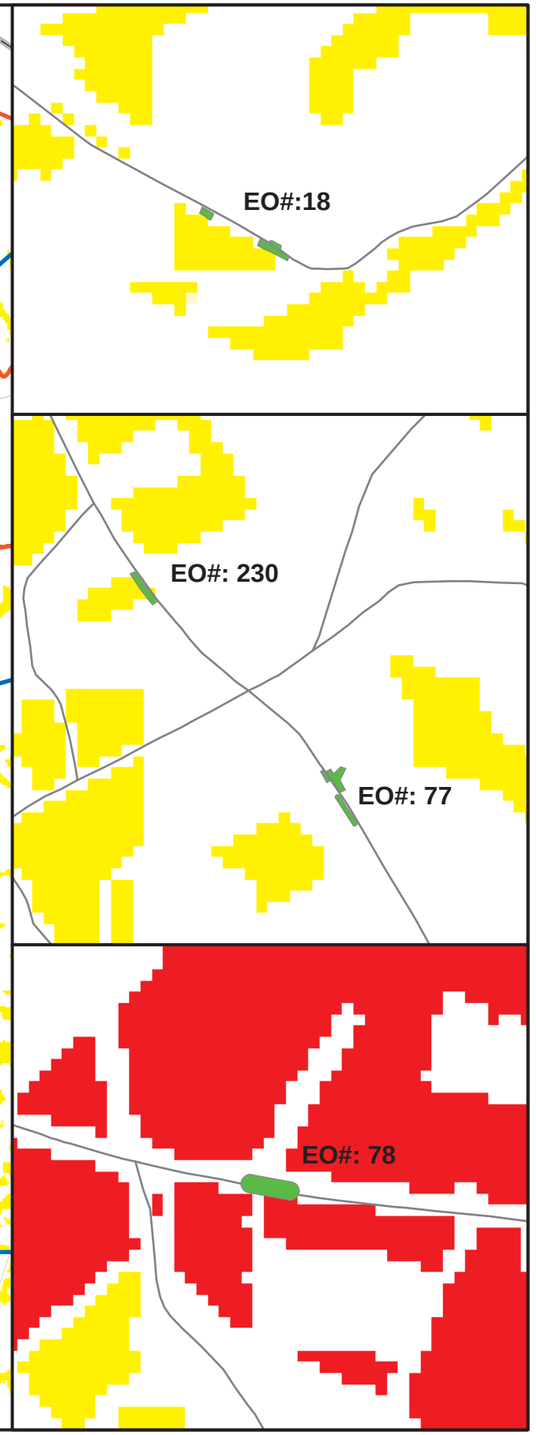

Monroe Connector/Bypass
Technical Report on Impacts
to Federally Listed Species

Map 22:
Land Use Change

No-Build to Build Effects to Sunflower Populations

- Schweinitz's Sunflower Population

Change in Land Use

- From Undeveloped to Residential
- From Lower to Higher Density Residential
- From Non-Residential to Residential
- From Residential to Non-Residential
- From Undeveloped to Non-Residential
- Other Change between Developed Land Uses

- FLUSA Boundary

NORTH CAROLINA Turnpike Authority

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Miles

EO#: 31

EO#: 18

EO#: 230

EO#: 77

EO#: 5

EO#: 78

485 51 218 601 74 16 84

EO#:18

EO#: 230

EO#: 77

EO#: 5

Monroe Connector/Bypass
Supplement to the
Biological Assessment

Map 23: Raw Model Volumes No-Build and Build Scenarios

US 601 from
Monroe Connector/Bypass
to Cabarrus County

Volume **decrease** from No-Build to Build

Volume **increase** from No-Build to Build

Raw Model Volumes

No-Build	1,000
Build	(1,000)

RPA Centerline

FLUSA Boundary

Watersheds

NORTH CAROLINA Turnpike Authority

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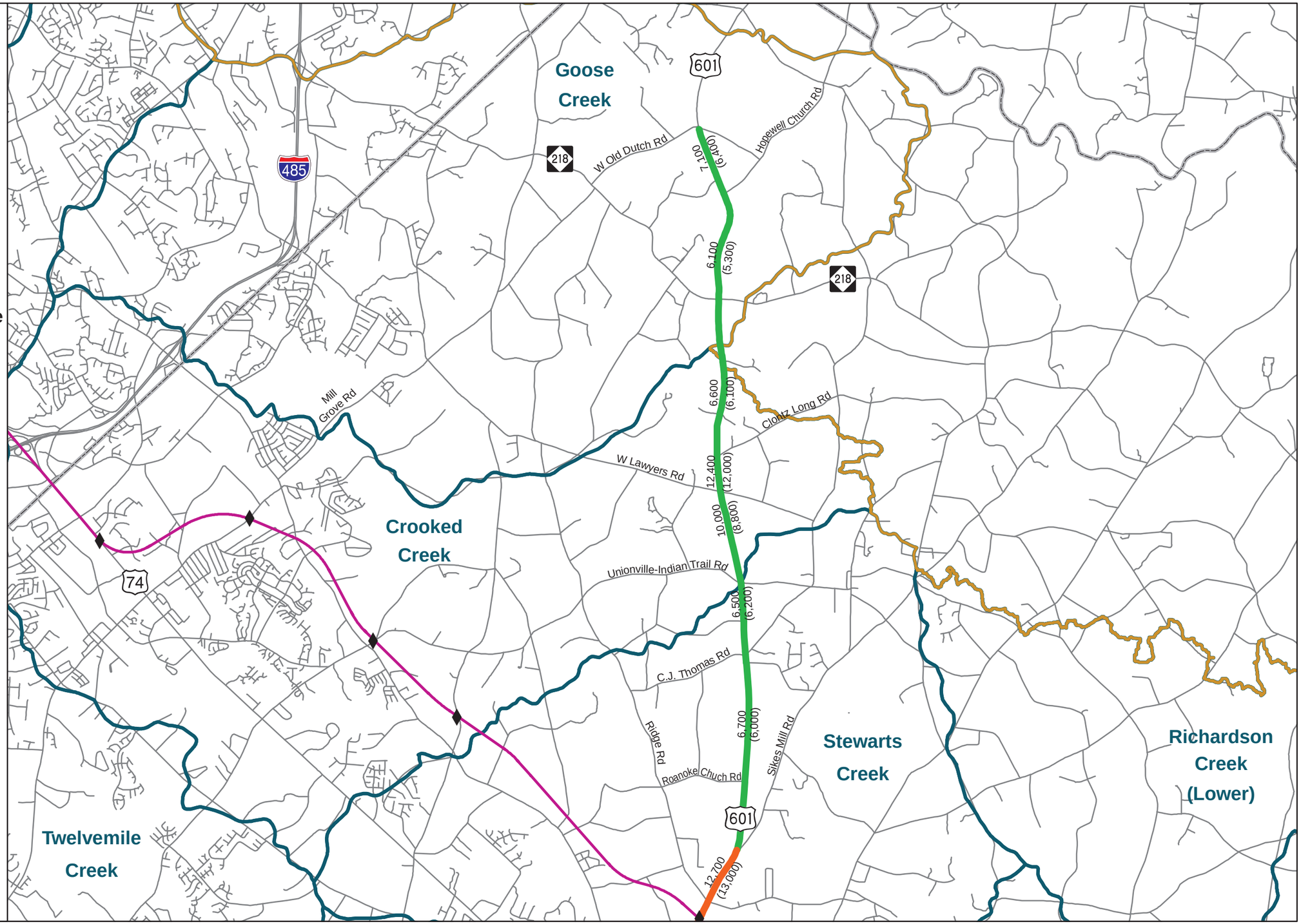

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Appendix A
Interview Summaries

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CHARLOTTE-MECKLENBURG PLANNING AND DEVELOPMENT QUESTIONNAIRE

Meeting Date: 9/14/2012
Project: R-3329/R2559 Monroe Connector
Subject: Indirect and Cumulative Impacts Quantitative Analysis Update
Meeting Type & Contact Person: Email Return of Questionnaire, Debra Campbell

Questions for Monroe Connector Planning Agencies:

1. The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview?
   RESPONSE: In terms of land use and growth management, the City updated the Centers Corridors and Wedges Growth Framework in August 2010. The "Centers and Corridors" development framework was originally introduced in 1994 and is the City of Charlotte's adopted overarching policy for organizing and guiding growth and development. The updated framework broadens the original transportation oriented focus to include other aspects of planning and development, such as public facility needs and environmental concerns. The update also provides more specific definitions and guidance for Centers and Corridors and expands the concept to provide recommendations for Wedges, as well. Visit our website for more information on the policy at http://charmeck.org/city/charlotte/planning/AreaPlanning/CentersCorridorsWedges/Pages/Home.aspx
2. Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census?
   RESPONSE: The Mecklenburg-Union Metropolitan Planning Organization (MUMPO) is working to expand its planning area boundary in response to the 2010 Census data. The Census Bureau released its 2010 urban area information in March 2012, and the impacts on MUMPO were significant. The Charlotte urbanized area (UZA) increased in population from 758,927 in 2000, to 1,249,442 in 2010, and its land area increased from 435 square miles to 741 square miles. The significance of this expansion is that UZAs are the minimum area for which an MPO is required to implement the metropolitan planning process. For more information, visit http://www.mumpo.org/.
3. Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.
   RESPONSE: Links to policy updates and documents are provided in the table below.
4. Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how?

RESPONSE: Water Quality Buffer Guidelines were revised in October 2011 and the Floodplain Regulations were updated in June 2012. For additional information, please contact Rusty Rozzelle with the Storm Water Services Department at 704.336-5449.

5. What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects?

   RESPONSE: Below is a summary table of the development activity within the Southeast Corridor Area. More specific data can be found on our website at www.planning.org or contacting Evan Lowry for the GIS data at 704.336-8323.

Acrobat Document

Summary of Development Data

6. Have long-term growth expectations changed since the previous interview and if so how?

   RESPONSE: No significant growth changes are expected for this area.

7. Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?
   a. If so, does this updated plan reflect conditions in the future with or without the Monroe Connector?

   RESPONSE: Long-term land use and transportation growth projections within the MUMPO Long-Range Transportation Plan include the Monroe Connector.

8. We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community?
   a. Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis?

   RESPONSE: No.

9. Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations?

   RESPONSE: No changes to long-term growth expectations other than growth in the shorter term is expected to be slower than originally anticipated. Please contact Charlotte-Mecklenburg Utilities at 704-399-2221 for more detailed information about utility infrastructure capacity.

10. Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)
    a. Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox?
    b. Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances?

c. How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans?

RESPONSE: Many of the principles within the "Green Growth Toolbox" are incorporated into The Environment Chapter of the General Development Policies (click here GDPs) which are used to develop our land use plans and other development regulations.

Our department is currently in the process of assessing and reorganizing our current Zoning Ordinance to respond to the rapid growth in our community and to provide for more sustainable development. This process is an opportunity to consider "Green Growth Toolbox" principles.

Table 1. List of Local Plans and Policies Collected for ICE Reports

Jurisdiction	Document	Year
Goose Creek Watershed	Site Specific Water Quality Management Plan for the Goose Creek Watershed	2009
City of Charlotte	Zoning Ordinance (City of Charlotte)	2009
Charlotte-Mecklenburg	Tree Ordinance (Update)	2010
	Independence Boulevard Area Plan	2011
	Centers Corridors and Wedges Growth Framework	2010
	Zoning Ordinance	Updated 2008
	East District Future Land Use Map	Adopted 2007
	Adopted Area Plan Infrastructure Implementation Recommendations	2007
City of Monroe	Land Development Plan	Last Modified
	Stormwater Management Ordinance	Modified 2007
	Zoning Code (Floodplain Permits)	Modified 2008
	City of Monroe Code of Ordinances	1994
	City of Monroe, Downtown Master Plan	2008
Town of Indian Trail	Unified Development Ordinance	2008
	The Villages of Indian Trail – A Plan for Managed Growth and Livability	2005
	Downtown Master Plan	2006
	Post Construction Storm Water Ordinance	2007
Town of Unionville	Zoning Ordinance	Adopted
	Land Use Plan	Adopted 2006
Town of Fairview	Land Development Plan	Adopted 2005
	Flood Plain Ordinance	Modified 2009
	Land Use Ordinance	Adopted 2005
Town of Stallings	Land Use Ordinance	Updated 2009
	Post Construction Ordinance	Adopted 2008
Town of Mint Hill	Zoning Ordinance	Minor
	Post Construction Ordinance	Adopted 2007
	Comprehensive Transportation Plan	2008
Town of Marshville	Land Use Ordinance	Updated 2007
	Land Use Plan	2004

Jurisdiction	Document	Year
Town of Wingate	Land Use Ordinance	Updated 2008
Towns of Marshville and Wingate	Strategic Plan for Economic Development, Town of Marshville, Town of Wingate	2008
Town of Weddington	Land Use Plan	Adopted 2006
	Temporary Development Ordinance	Adopted 2008
Village of Wesley Chapel	Land Use Plan	Adopted 2003
	Floodplain and Stormwater Ordinance	Adopted 2005
	Village of Wesley Chapel Land Use Plan	2003
City of Matthews	Zoning Code	Modified 2008
	Post Construction Ordinance	Adopted 2007
Union County	Land Use Plan Map	Updated 2006
	Zoning Map	Updated 2007
	Comprehensive Plan Update: Transportation Analysis and Strategies	2008a
	Land Use Ordinance	2008b
	2009 Draft Comprehensive Plan	2009
Mecklenburg-Union Metropolitan Planning Organization (MUMPO)	2030 Long Range Transportation Plan and Air Quality Conformity Determination	2007
	2035 Draft Long Range Transportation Plan	2009
NCDENR	Site Specific Water Quality Management Plan for the Goose Creek Watershed	2009
North Carolina Department of Environment and Natural Resources Division of Water Quality (NCDENR-DWQ)	National Pollutant Discharge Elimination Permit System Permit Number NCS000395 (Mecklenburg County and the Towns of Cornelius, Davidson, Huntersville, Matthews, Mint Hill, and Pineville Jurisdictional Areas)	2005
NCDOT	Marshville Comprehensive Transportation Plan Study	2009a
Town of Matthews	Downtown Matthews Master Plan and Design Guidelines	1997
	Subdivision Ordinance	2003
	Zoning and Post Construction Ordinances	Undated
Villages of Marvin and Wesley Chapel, Towns of Waxhaw and Weddington, and Centralina Council of Governments	Western Union County Local Area Regional Transportation Plan	2009

TOWN OF FAIRVIEW PLANNING AND DEVELOPMENT QUESTIONNAIRE

Meeting Date: 9/11/2012
Project: R-3329/R2559 Monroe Connector
Subject: Indirect and Cumulative Impacts Quantitative Analysis Update
Meeting Date, Type, & Contact Person: 9/11/2012, Phone Interview with Ed Humphries, Land Use Administrator
Baker Attendees: Kristi Suggs & Heath Caldwell

Questions for Monroe Connector Planning Agencies:

1. The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview?

   Updates/amendments have been made to the Land Use Ordinance see web link listed in Question # 3.

2. Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census? No it wasn't available when changes were made.

3. Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.

   1.) Land Use Ordinance amendment link: http://fairviewnc.gov/land%20use.htm 2.) Land Use Revised Map (2010) see link: http://fairviewnc.gov/LandUse/FutureLandUseMap.pdf

4. Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how? No

5. What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects? No developments have been approved or proposed since 2008. Most likely due to lack of utilities (water/sewer). However, Union County is proposing to implement sewer at the NC601 and NC218 intersection and the Town has initiated the planning phase for a downtown business plan.

6. Have long-term growth expectations changed since the previous interview and if so how?

   No

7. Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?

   Amendments only see Question #3.

   a. If so, does this updated plan reflect conditions in the future with or without the Monroe Connector? Changes do not reflect bypass.

8. We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community? Growth is anticipated to continue to be slow. The Town feels that the bypass will impact their future growth, but are unsure at this time of how it will affect them. Currently Hwy 218 is often used to bypass the traffic congestion along Hwy 74 in Union County. The implementation of the bypass would provide another alternative around the Hwy 74 municipal corridors. Its

implementation may divert travelers along Hwy 218 to use the bypass; however, the toll on the bypass may deter some from its use and opt for Hwy 218. Also,

a. Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis? Yes

9. Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations? Union County is proposing to add a sewer treatment plant in the downtown area of Fairview to provide sewer to the intersection of NC601 and NC218 for limited commercial development. See Union Cnty Comprehensive Water and Wastewater Master Plan.

10. Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)
    a. Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox? No, but would use it if needed.

    b. Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances? Have incorporated clustering for areas where higher density residential is allowed; however, the subdivision would need to provide sewer, otherwise lots must be at least one acre for septic.

    c. How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans? Would favor this type of development if it would be feasible.

SEE UNION COUNTY FOR GIS INFORMATION.

TOWN OF MARSHVILLE PLANNING AND DEVELOPMENT QUESTIONNAIRE

Meeting Date: 9/12/2012
Project: R-3329/R2559 Monroe Connector
Subject: Indirect and Cumulative Impacts Quantitative Analysis Update
Meeting Type & Contact Person: Personal Interview with Amanda Reid, Town Manager & Diane Dil, Centralina COG Planner
Meeting Place: Town of Marshville, NC: Town Hall

Questions for Monroe Connector Planning Agencies:

1. The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview? Sidewalk Implementation along Hwy. 74 corridor – approved in 2012. Infrastructure Development Plan for implementation by FY2014 (Attached map shows current system. Upgrades in capacity and connection would move toward surround areas and Bypass, see #9 for additional information.)

2. Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census?

   MUMPO Urbanized Area Plan now includes Marshville based on 2010 Census. See link: http://www.mumpo.org/PDFs/Resources/MUMPO_Urbanized_Area.pdf

3. Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.

   Updates to zoning plan (see attached GIS shapefiles) otherwise no updates applicable to planning, natural resources, etc.

4. Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how? No.

5. What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects? Subdivision – Gulf Bay Estates (E. Union & Brewer St.)

6. Have long-term growth expectations changed since the previous interview and if so how?

   No.

7. Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?

   No.

   a. If so, does this updated plan reflect conditions in the future with or without the Monroe Connector? Current Land Use Plan does not include the Bypass; however, when

revised it is anticipated that the Bypass will be reviewed and it is possible that a Bypass Corridor Plan may be proposed.

8. We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community? MUMPO is revising the Urbanized Area Map to include Marshville. See link http://www.mumpo.org/PDFs/Resources/MUMPO_Urbanized_Area.pdf and http://www.mumpo.org/mpo-planning-area-boundary-expansion

    a. Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis? It is foreseen that the implementation of the Bypass will not affect the implementation of Marshville into the MPO. However, future growth in Marshville is dependent upon the implementation of the Bypass. The Bypass would provide a more direct route that would offer residents the ability to commute to Charlotte and surrounding towns for work. Also it would open up the possibility of industrial/commercial/business development because of the increased accessibility that is currently restricted due to congestion along Hwy 74.

9. Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations? Marshville is currently working to assess and update their long term infrastructure plan. Marshville currently purchases its water from Anson County and its sewer capacity from both Anson and Union Counties. Marshville is hoping to increase capacity through upgrades and additional infrastructure, as well as address aging infrastructure. The implementation of the Bypass would create a priority for the Town to increase their capacity requirements. However, if it was not implemented, it is foreseen that the upgrades and capacity increases would still be needed, but would not be a priority. Addressing aging infrastructure would then become the priority.

10. Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)
    a. Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox? No, but interested.

    b. Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances? No.

    c. How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans? It is possible, but would be dependent on cost/benefit/ and priorities of the Town.

TOWN OF MATTHEWS PLANNING AND DEVELOPMENT QUESTIONNAIRE

Meeting Date: 9/10/2012
Project: R-3329/R2559 Monroe Connector
Subject: Indirect and Cumulative Impacts Quantitative Analysis Update
Meeting Type & Contact Person: Personal Interview with Kathi Ingrish, Planning Director
Meeting Place: Town of Matthews, NC: Town Hall – Planning Department

Questions for Monroe Connector Planning Agencies:

1. The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview? Matthews developed an Economic Development Program and approved an Economic Development Incentive Grants Policy in 2012. - http://www.matthewsnc.com/LinkClick.aspx?fileticket=0ys-IUU48Us%3d&tabid=290. A draft Downtown Master Plan has been proposed and should go to Council in 2013 for approval. The draft document is located at http://www.matthewsnc.com/LinkClick.aspx?fileticket=T9l7O9MFCXo%3d&tabid=106. The Zoning Ordinance is being revised into a Unified Development Ordinance. The draft chapters are located: http://www.matthewsnc.com/Departments/PlanningandDevelopment.aspx
   A draft land use plan has been proposed and should go to council for approval in 2013. The draft document is located http://www.matthewsnc.com/LinkClick.aspx?fileticket=MXdR6YzUJL0%3d&tabid=106

2. Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census?
   The Draft Land Use Plan references the 2010 Census information.

3. Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.

   PCCO – Redevelopment of existing built upon area established prior to 1979 was exempt from the implementation of stormwater detention; however, this has been amended to include existing built upon area established prior to 1990.

   CATS/Lynx Line: In 2011, the Southeast Transit Corridor along Independence Blvd to I-485 in Matthews was revised (see the Independence Boulevard Area Plan http://ww.charmeck.org/Planning/Land%20Use%20Planning/IndependenceBlvd/Adopted_Plan.pdf). As result the center rapid transit lane will no longer continue east past Crownpoint Executive Dr. into Matthews to I-485. Currently CharMeck, NCDOT and Matthews are in discussion of how to best provide alternative transit to ease congestion along Independence. Currently the rapid transit outlook for implementation into Matthews is undecided.

4. Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how? Mecklenburg County is in the process of updating the FEMA maps (anticipated for implementation in 2013). Currently, the Town of Matthews is waiting to see how the County plans to implement the updates in the revised Floodplain Ordinance. Mecklenburg County hosted an Open House for municipalities on Sept. 19th and is hosting a one for the general public on Sept. 26th.

5. What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects? 1. Economic Development Program has been approved to implement an Incentive Grant Policy to encourage business relocation and/or expansion (See http://matthewsnc.gov/LinkClick.aspx?fileticket=0ys-IUU48Us%3d&tabid=290) 2. Crestdale Neighborhood Project (See attached Power Point) 3. Zoning Ordinance revisions see website link http://matthewsnc.gov/Departments/PlanningandDevelopment/CurrentItems.aspx, http://matthewsnc.gov/Departments/PlanningandDevelopment/PendingZoningActions.aspx, & http://matthewsnc.gov/Departments/PlanningandDevelopment/PendingZoningActions/CompletedZoningActions.aspx 4. Liberty Health Senior Retirement Community at I-485 & Hwy 74. 5. JCPenney at Windsor Sq. on Independence (Fall 2012) 6. Proposed Harris Teeter Corp. Center on 15 acres between Matthews and Mint Hill. 7. Sports Plex will (http://matthewsnc.gov/LinkClick.aspx?fileticket=QTrV-4S_0OA%3d&tabid=222). Additional Projects see http://matthewsnc.gov/TownGovernment/OngoingProjects.aspx

6. Have long-term growth expectations changed since the previous interview and if so how?

   No.

7. Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?

   Yes, see above.

   a. If so, does this updated plan reflect conditions in the future with or without the Monroe Connector? Plans reflect the implementation of the Monroe Bypass but are likely to still be incorporated even if the Bypass is not built.

8. We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community?

   Focus on denser growth along Independence, the implementation of roadway connectivity to provide alternative routes to ease congestion on Ind. Blvd. and to reduce emergency vehicle response times, and provide rapid transit alternatives within community and into CharMeck.

   a. Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis? These changes are currently needed and are to be implemented with or without the Bypass; however, if the Bypass is built the connection at I-485 will cut off Independence Commerce Drive and connectivity to Steven's Mill Rd for EMS. The connection cut off will increase the priority level for implementation of connectivity in this area.

9. Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations? Implementation of a pump station on the north side of Independence to provide services for the proposed Retirement Community at I-485 & Hwy 74. The health care facility is paying to implement the facility to serve their community and the surrounding area of Crooked Creek. The facility is to be adopted and maintained by CharMeck Utilities.

10. Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)

a. Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox? No.

b. Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances? Not formally, but authorized the implementation of alternative pavement to be implemented at fire station. See Meck County for PCCO provisions and SWIM buffers

c. How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans? See Meck County. Would like to implement and adopt some standards into the Zoning Ordinance.

TOWN OF MINT HILL PLANNING AND DEVELOPMENT QUESTIONNAIRE

Meeting Date: 9/14/2012
Project: R-3329/R2559 Monroe Connector
Subject: Indirect and Cumulative Impacts Quantitative Analysis Update
Meeting Type & Contact Person: Personal Interview with John Hoard, Planner
Meeting Place: Town of Mint Hill, NC: Town Hall – Planning Department

Questions for Monroe Connector Planning Agencies:

1. The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview? No.

2. Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census?

   No

3. Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.

   1.) Consolidated land use, zoning, PCCO, ESC, etc into a Unified Development Ordinance (UDO) in 2011 (see link: http://nc-minthill2.civicplus.com/documents/9/Mint%20Hill%20UDO%20(Pre-Formatted%20version%202)%20revised%2010-28-2011.PDF) 2.) Lawyers Road and I-485 Small Area Plan was adopted by Board in 2011. (See link: http://www.minthill.com/index.aspx?NID=329) 3.) Pedestrian Master Plan adopted in 2011 (see link: http://www.minthill.com/documents/53/Mint%20Hill%20Pedestrian%20Plan_Final%20Adopted.PDF)

4. Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how? Mecklenburg County now administers the Goose Creek Management Plan.

5. What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects? 1.) Proposed mall complex to be implemented in 2014. See Small Area Plan (Question #3) for Mall location 2.) Small scale Corporate Center (See Small Area Plan for concept) east of I-485 along Allen Black Road – currently no sewer or water in area and without them it is not feasible.

6. Have long-term growth expectations changed since the previous interview and if so how?

   No

7. Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?

   1.) No, See Question #3

   a. If so, does this updated plan reflect conditions in the future with or without the Monroe Connector? The existing land use plan does not consider the implementation of the bypass and its implementation would not have any effect on the plan either.

8. We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community? Implementation of the mall in the Small Area Plan could increase growth in the area.

    a. Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis? No.

9. Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations? Mecklenburg County is proposing to add water and sewer (see Mecklenburg County's Master Plan) in areas of the proposed small scale corp center as well as other areas, within the next 10 yrs. The proposed mall (See small area plan) is going to implement its own utilities.

10. Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)
    a. Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox? Yes, has reviewed it.

    b. Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances? LID policies are incorportated through the Meck Co. PCCO

    c. How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans? N/A

CITY OF MONROE PLANNING AND DEVELOPMENT QUESTIONNAIRE

Meeting Date: 9/11/2012
Project: R-3329/R2559 Monroe Connector
Subject: Indirect and Cumulative Impacts Quantitative Analysis Update
Meeting Type & Contact Person: Personal Interview with Doug Britt, Senior Planner
Meeting Place: City of Monroe, NC: Town Hall – Planning Department

Questions for Monroe Connector Planning Agencies:

1. The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview? 1.) Lake Twitty Buffer rules (See Question #4) 2.) US 74 Corridor Revitalization Plans (see Question #3)

2. Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census? Not at this point. The City is currently looking at development and settlement patterns based on the 2010 Census Data, but the analysis has not been completed.

3. Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.

   1.) Stormwater Mgmt – Updates to NPDES Phase II Permit 2.) Zoning Ordinance Revisions (2010) (see link: http://wwwnew.monroenc.org/services.php?cat=269) 3. Updates to Flood Damage Prevention in Zoning Ordinance – (2009) 3.) US 74 Corridor Revitalization Plan is in planning stage and likely to be adopted by Monroe in 2013. Plan was initiated because of the proposed implementation of the Bypass. The City does not think that the Plan would be applicable without the implementation of the Bypass. (see link: http://www.us74corridor.com/)

4. Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how? Lake Twitty Buffer is currently being reevaluated for possible revisions. A study committee has been established to look at other sources of water contamination besides waterfront property. Current buffer requirement is 35-LF from high water mark.

5. What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects? No major residential developments have been approved. Conditional District developments are attached. The ones that are highlighted are new commercial developments or major expansions.

6. Have long-term growth expectations changed since the previous interview and if so how?

   Probably slower than expected in 2009; however, growth forecasts and pattern studies have not been completed. Census data from 2000 and 2010 show higher growth rates in the western part of the County than in Monroe.

7. Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?

   No. City is completing the US-74 Corridor Revitalization Plan

   a. If so, does this updated plan reflect conditions in the future with or without the Monroe Connector? It assumes that the Monroe Connector will be built.

8. We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community? _____

   The City anticipates fewer subdivisions. The City is now requiring a Conditional District rezoning approval for all new subdivisions.

   a. Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis? No difference because the requirement is independent of the bypass' implementation.

9. Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations? No changes. Planning staff anticipates that growth patterns will be similar with low-density residential and commercial properties at intersections. Key growth determinants are the availability of water and sewer, not the bypass.

10. Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)
    a. Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox? Not at this point.
    b. Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances? Not at this point.
    c. How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans? Would like to incorporate but have not looked into it yet.

TOWN OF STALLINGS PLANNING AND DEVELOPMENT QUESTIONNAIRE

Meeting Date: 9/14/2012
Project: R-3329/R2559 Monroe Connector
Subject: Indirect and Cumulative Impacts Quantitative Analysis Update
Meeting Type & Contact Person: Personal Interview with Brian Matthews, Town Manager and Lynne Hair, Town Planner
Meeting Place: Town of Stallings, NC: Town Hall

Questions for Monroe Connector Planning Agencies:

1. The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview? No

2. Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census? UDO see Question #3.

3. Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.

   Unified Development Ordinance was adopted in 2012 and zoning classifications have been updated to reflect the UDO. http://www.stallingsnc.org/index.asp?Type=B_BASIC&SEC={EAFB9747-6826-4F31-A906-A92106F4A745}) PCCO was updated in 2010. (See link: http://www.stallingsnc.org/vertical/Sites/%7B052C66EC-317E-4C0C-8034-D2D91E376211%7D/uploads/%7B8FB70B1A-5CF9-431E-AE96-CC7046981817%7D.PDF)

4. Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how? No. But the Goose creek Water Quality Recovery Program Plan for fecal coliform TMDL was revised in 2010 (see link http://www.stallingsnc.org/vertical/Sites/%7B052C66EC-317E-4C0C-8034-D2D91E376211%7D/uploads/%7BDDCE5BCD-6CE2-4165-8630-F985790B9AE6%7D.PDF)

5. What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects? Two residential developments and a small scale commercial development are proposed: the 2nd Phase of Fairhaven to begin soon with a new developer at Stevens Mill Rd., 2nd Phase of Chestnust Place Subdivision, and 2nd phase of Shops at Chestnut Place on Matthews Weddington Rd. http://gis2.stallingsnc.org/ZoningCases/

6. Have long-term growth expectations changed since the previous interview and if so how?

   Expect long term growth to continue but at a slower pace due to slow economy not bypass dependent. However, commercial property owners along 74 in the area of the proposed bypass seem to be in a holding phase while awaiting the outcome of the bypass and possible easement buyouts. Multiple owners are holding tax payments.

7. Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?

UDO see Question #3.

a. If so, does this updated plan reflect conditions in the future with or without the Monroe Connector? UDO assumes that the bypass will be built.

8. We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community? 1.) US-74 Corridor Revitalization Study is underway and is a joint effort among the municipalities and County agencies. Study is along US-74 from I-485 through Monroe. 2.) Economic conditions have slowed growth.

   a. Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis? The proposed implementation of the bypass prompted the study. It is foreseen that the revitalization effort for Hwy 74 is not dependent upon the bypass; however, the implementation of the bypass would most likely make the need for the revitalization of US-74 a more significant priority.

9. Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations? Town is to release an RFP for the preparation and mapping their stormwater inventory in the next couple of months. No new roads are proposed or being built; however, improvements are proposed for the intersection of Potter Rd and Old Monroe Rd to ease traffic congestion. Funding is in place.

10. Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)
    a. Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox? No.

    b. Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances? Not outside of what has been implemented in the revised PCCO.

    c. How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans? Possible, but implementation would be in the future.

UNION COUNTY PLANNING AND DEVELOPMENT QUESTIONNAIRE

Meeting Dates: 9/12/2012 & 9/19/2012
Project: R-3329/R2559 Monroe Connector
Subject: Indirect and Cumulative Impacts Quantitative Analysis Update

- **Meeting Date, Type, & Contact Person: 9/12/2012, Personal Interview with Amy Helms, Water and Land Resources Division Manager & Scott Huneycutt, Engineering Division Mgr.**
  Meeting Place: Union County Government Center, NC
- **Meeting Date, Type, & Contact Person: 9/19/2012, Personal Interview Dick Black, Planning Director**
  Meeting Place: Union County Planning Dept., NC

Questions for Monroe Connector Planning Agencies:

1. The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview? 1.) Revised Floodplain Ordinance (2010) for Union County (see Land Use Ordinance sections 389 and 400A at http://www.co.union.nc.us/Portals/0/Planning/Documents/UC_LAND_USE_ORD.pdf) 2.) Water and Sewer Ordinance (2012) – (see http://www.co.union.nc.us/Portals/0/Ordinances/Volume4/Vol4_137-160.pdf) 3.) 2025 Comprehensive Plan (2010) http://www.co.union.nc.us/Portals/0/Planning/Documents/2025CompPlan.pdf 4.) US – 74 Revitalization Study (see link http://www.us74corridor.com/#!__page-0) 5.) Draft Carolina Thread Trail Master Plan for Union County and Participating Municipalities (2011) (See link: http://www.co.union.nc.us/Portals/0/Planning/plans/CarolinaThreadTrail-UnionCountyDraftPlan.pdf) 6.) In the process of rewriting the Zoning Ordinance and it is anticipated to be adopted in Dec. 2013.

2. Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census? Yes, the Water and Wastewater Comprehensive Master Plan

3. Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.

   See Question #1. Additionally Union County Thoroughfare plan was not included, but was revised in 2004. http://maps.co.union.nc.us/gis/standardmaps/thoroughfares.pdf

4. Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how? Floodplain Ordinance revisions: see Question #1

5. What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects? 1.) No new subdivisions or non-residential developments except for a rezoning to implement an Asphalt Plant between Hwy 601 & Hwy 200, close to Rollins Rd. 2.) County is working with local towns to perform a joint planning initiative at the Bypass interchanges; however, there are no definite plans available at this time.

6. Have long-term growth expectations changed since the previous interview and if so how?

Water & Wastewater Master Plan used an approx. 2.5% growth projection. The updated Comprehensive Plan expectation was to slow growth so its outlook is most likely similar to what is currently expected if incorporating the current economic conditions.

7. Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?

   Yes. See #1. Legacy Park was not included in the Union County Master Plan. Its implementation is most likely dependent upon the implementation of the Bypass.

   a. If so, does this updated plan reflect conditions in the future with or without the Monroe Connector? The implementation of the Bypass was assumed. The County feels that its implementation will have a more direct effect on the surrounding towns due to its location within the municipalities' jurisdiction. However, they also feel that if the bypass is not implemented the area at interchange node #8 (in Union Co. jurisdiction) would be affected and would reduce growth in this area.

8. We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community? 1.) Growth within the County and its municipalities is dependent on the availability to water and sewer. On Sept. 17, 2012, the County Commission lifted the requirements of the WW Allocation Plan from 2009 that limited infrastructure capacity. See http://www.co.union.nc.us/Portals/0/publicinformation/News/2012/water%20policiy.pdf and http://www.co.union.nc.us/Portals/0/publicinformation/News/2012/sewer%20policiy.pdf) 2.) Municipalities along Hwy 74 are more interested in development and growth where the more rural towns to the West of the County, except for Waxhaw, seemed to be more focused on slowing/managing growth.

   a. Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis? Growth in the eastern part of the County, Wingate & Marshville, will definitely be limited without the implementation of the Bypass. Without the Bypass these areas will be less accessible and less attractive to growth and development. For the rest of the County, future growth would likely slow without the implementation of the bypass, but would be more dependent upon the availability of water and sewer.

9. Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations? Comprehensive Water and Wastewater Master Plan (2011) (See link: http://www.co.union.nc.us/Portals/0/PublicWorks/Documents/UCComprehensiveWWMasterPlan.pdf) See Question 8 also.

10. Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)
    a. Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox? No.
    b. Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances? Cluster development

c. How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans? Since currently in the process of rewriting the Zoning Ordinance it is likely that these principles will be incorporated.

SEE LINK FOR GIS UPDATES.
http://www.co.union.nc.us/Departments/GISMaps/DownloadableData.aspx

Table 1. List of Local Plans and Policies Collected for ICE Reports

Jurisdiction	Document	Year
Goose Creek Watershed	Site Specific Water Quality Management Plan for the Goose Creek Watershed	2009
City of Charlotte	Zoning Ordinance (City of Charlotte)	2009
Charlotte-Mecklenburg	Zoning Ordinance	Updated 2008
	East District Future Land Use Map	Adopted 2007
	Adopted Area Plan Infrastructure Implementation Recommendations	2007
City of Monroe	Land Development Plan	Last Modified
	Stormwater Management Ordinance	Modified 2007
	Zoning Code (Floodplain Permits)	Modified 2008
	City of Monroe Code of Ordinances	1994
	City of Monroe, Downtown Master Plan	2008
Town of Indian Trail	Unified Development Ordinance	2008
	The Villages of Indian Trail – A Plan for Managed Growth and Livability	2005
	Downtown Master Plan	2006
	Post Construction Storm Water Ordinance	2007
Town of Unionville	Zoning Ordinance	Adopted
	Land Use Plan	Adopted 2006
Town of Fairview	Land Development Plan	Adopted 2005
	Flood Plain Ordinance	Modified 2009
	Land Use Ordinance	Adopted 2005
Town of Stallings	Land Use Ordinance	Updated 2009
	Post Construction Ordinance	Adopted 2008
Town of Mint Hill	Zoning Ordinance	Minor
	Post Construction Ordinance	Adopted 2007
	Comprehensive Transportation Plan	2008
Town of Marshville	Land Use Ordinance	Updated 2007
	Land Use Plan	2004
Town of Wingate	Land Use Ordinance	Updated 2008
Towns of Marshville and Wingate	Strategic Plan for Economic Development, Town of Marshville, Town of Wingate	2008
Town of Weddington	Land Use Plan	Adopted 2006
	Temporary Development Ordinance	Adopted 2008

Jurisdiction	Document	Year
Village of Wesley Chapel	Land Use Plan	Adopted 2003
	Floodplain and Stormwater Ordinance	Adopted 2005
	Village of Wesley Chapel Land Use Plan	2003
City of Matthews	Zoning Code	Modified 2008
	Post Construction Ordinance	Adopted 2007
Union County	Land Use Plan Map	Updated 2006
	Zoning Map	Updated 2007
	Comprehensive Plan Update: Transportation Analysis and Strategies	2008a
	Land Use Ordinance	2008b
	2009 Draft Comprehensive Plan	2009
Mecklenburg-Union Metropolitan Planning Organization (MUMPO)	2030 Long Range Transportation Plan and Air Quality Conformity Determination	2007
	2035 Draft Long Range Transportation Plan	2009
NCDENR	Site Specific Water Quality Management Plan for the Goose Creek Watershed	2009
North Carolina Department of Environment and Natural Resources Division of Water Quality (NCDENR-DWQ)	National Pollutant Discharge Elimination Permit System Permit Number NCS000395 (Mecklenburg County and the Towns of Cornelius, Davidson, Huntersville, Matthews, Mint Hill, and Pineville Jurisdictional Areas)	2005
NCDOT	Marshville Comprehensive Transportation Plan Study	2009a
Town of Matthews	Downtown Matthews Master Plan and Design Guidelines	1997
	Subdivision Ordinance	2003
	Zoning and Post Construction Ordinances	Undated
Villages of Marvin and Wesley Chapel, Towns of Waxhaw and Weddington, and Centralina Council of Governments	Western Union County Local Area Regional Transportation Plan	2009

TOWN OF UNIONVILLE PLANNING AND DEVELOPMENT QUESTIONNAIRE

Meeting Date: 9/11/2012
Project: R-3329/R2559 Monroe Connector
Subject: Indirect and Cumulative Impacts Quantitative Analysis Update
Meeting Type & Contact Person: Personal Interview with Sonya Gaddy, Land Use Administrator
Meeting Place: Town of Unionville, NC: Town Hall

Questions for Monroe Connector Planning Agencies:

1. The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview? No

2. Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census? No

3. Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.

   Land use Ordinance has been amended. A listing of the amendments is located: http://www.unionvillenc.com/Unionville_LUO_EXCEPT_Table_of_Uses_2012.pdf. They are listed in chronological order. Revised Table of Uses is located: http://www.unionvillenc.com/Unionville_Table_of_Uses_2012.pdf

4. Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how? No.

5. What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects? Only a few minor subdivisions of large parcels into 1 to 3 lots.

6. Have long-term growth expectations changed since the previous interview and if so how?

   No

7. Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?

   Land Use Ordinance has been revised see #3. Future Land Use Map has been revised to expand future commercial area at major town intersections and a downtown area. Both commercial and downtown areas will be zoned as B2 and B4. See attached maps.

   a. If so, does this updated plan reflect conditions in the future with or without the Monroe Connector? These areas of growth are not dependent on the Connector nor do they reflect future conditions with the Monroe Connector.

8. We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community? No

   a. Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis? No difference.

9. Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations? Unionville does not supply water or sewer to its residents. This is done by the County.

10. Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)
    a. Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox? No
    b. Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances? The Town is focused on keeping growth within its jurisdiction on a more rural / low density residential scale. Therefore there may be low impact policies that mirror their growth model in place however, if was not specifically done to implement low impact design.
    c. How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans? Doubtful unless it is already being implemented.

VILLAGE OF WESLEY CHAPEL PLANNING AND DEVELOPMENT QUESTIONNAIRE

Meeting Date: 9/12/2012
Project: R-3329/R2559 Monroe Connector
Subject: Indirect and Cumulative Impacts Quantitative Analysis Update
Meeting Type & Contact Person: Personal Interview with Josh Langen, Planning and Zoning Administrator
Meeting Place: Village of Wesley Chapel, NC: Town Hall

Questions for Monroe Connector Planning Agencies:

1. The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview? No.

2. Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census? No.

3. Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.

   1.) Currently updating the land use regulations, should go into effect in 2013. 2.) Flood Damage Prevention Ordinance – Sept 2009 (see link: http://ci.wesley-chapel.nc.us/vertical/sites/%7B1AD59A02-0FFA-4E56-AC61-69E74B4BE4D0%7D/uploads/%7B513CED6E-9189-4B42-939E-87BE2C4C2F54%7D.PDF) 3.) Zoning Ordinance – Jan 2012 (see link: http://ci.wesley-chapel.nc.us/index.asp?Type=B_BASIC&SEC={BF55F5F6-009B-41A5-B267-1B80CD83B572}&DE={59F8B1C6-D960-4A28-A7C9-72B74B83CCF4}) 4.) Subdivision Ordinance – Nov 2011 (see link: http://ci.wesley-chapel.nc.us/index.asp?Type=B_BASIC&SEC={603B4986-6A11-4DB6-8F14-DF82F1E52684}&DE={EE63CE8B-C29F-4716-AC1D-FA5BDA5A784F}) 4.) Transportation Plan – Nov 2009 (see ftp site link)

4. Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how? No.

5. What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects? None in the Monroe Bypass study area.

6. Have long-term growth expectations changed since the previous interview and if so how?

   No

7. Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?

   See Question #3.

   a. If so, does this updated plan reflect conditions in the future with or without the Monroe Connector? Current Land Use Plan does not include the Bypass; however, it is unknown at this time whether or not the revised plan will include it.

8. We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community? No.
   a. Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis? N/A

9. Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations? No. (See Union County Plan)

10. Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)
    a. Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox? No
    b. Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances? No
    c. How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans? Very high

TOWN OF WINGATE PLANNING AND DEVELOPMENT QUESTIONNAIRE

Meeting Date: 9/6/2012
Project: R-3329/R2559 Monroe Connector
Subject: Indirect and Cumulative Impacts Quantitative Analysis Update
Meeting Type & Contact Person: Personal Interview with Patrick Niland, Town Manager
Meeting Place: Town of Wingate, NC: Town Hall

Questions for Monroe Connector Planning Agencies:

1. The August 2009 interview covered land use and economic development trends, growth management and natural resource protection – in general, have any of these dynamics affecting future land use changed since the previous interview? No

2. Have any changes to future land use plans, transportation plans or other plans, policies or projections been made that incorporate information from the 2010 Census? No;

3. Have new or amended land use regulations been developed since August of 2009? Please see the list we have provided of documents we collected and reviewed during the previous environmental documentation effort. Are there any updates to those plans or regulations? If there have been any changes, please provide specific web link or a copy of the document.

   The Town of Wingate is currently in the process of updating the existing land use plan with suggestions outlined in the "Wingate 2020 Plan: Comprehensive Plan and Concept Plan" that was finalized in 2010. http://wingate.govoffice.com/index.asp?Type=B_BASIC&SEC={5B007DF2-4E4D-417C-8EF6-B350DC723896}

4. Has the local regulation of natural resources (including stream buffers) changed since August 2009? If so, how? No

5. What can you tell us about any proposed or approved developments that have come to light since the August 2009 interviews? What information is available about any of these planned or approved developments that are not built yet? Can you provide any details and locations for these projects? The Wingate Mixed Used Center has been proposed and would be located on the southern side of the Monroe Connector at Interchange #7. The project is currently in the planning stage. A copy of the concept plan is attached. This project would likely not be implemented if the Connector was not constructed or the off-ramp at interchange #7 was not implemented.

6. Have long-term growth expectations changed since the previous interview and if so how?

   No

7. Has the city/town/county updated its Comprehensive Plan or Land Use plan since August 2009?

   The Comprehensive Plan was updated in 2010 and includes projections through 2020. See the following link http://wingate.govoffice.com/vertical/sites/%7B97E181A6-5F3F-4B46-B6D8-5965A146C00C%7D/uploads/%7B0DB1E1AF-A103-4DCC-9B69-2E50719CFC1D%7D.PDF

   a. If so, does this updated plan reflect conditions in the future with or without the Monroe Connector? This Plan acknowledges that the Monroe Connector has been proposed and anticipates that it will be implemented. However, the plan highlights land use updates for the downtown area of Wingate, park and recreation facilities, and a commercial highway area. These updates are very likely to be implemented even if the connector is not.

8. We are reviewing and considering the predictions of future growth (2030 forecast year) included in the previous EIS. Are there any other factors that have changed since August 2009 that might affect the level of future growth and the location of that growth in your community? Wingate University has experienced increased growth and it is anticipated to continue with this trend. The increase in student enrollment and activity is currently putting increased pressures along US-74, since it is the main corridor for access to the University.

    a. Do these changes reflect the future with the Monroe Connector/Bypass, without the Monroe Connector/Bypass, or is there no difference on that basis? Without the Connector, congestion on US-74 will continue to increase within downtown area of Wingate.

9. Have there been any changes in capacity of utility infrastructure or expectations about the future capacity since the last round of interviews? Do any of those changes affect growth expectations? The implementation of utility infrastructure, including sewer, water, gas, and fiber optic has continued to increase. It is anticipated that the implementation of utility infrastructure will be focused to the north of the downtown area to the connector corridor. The implementation of infrastructure in this area is strategic for growth. However if the connector is not implemented, it is anticipated that growth and the implementation of infrastructure will still continue; however, it will decrease in scale and priority. Proposed sewer improvements / projects are outlined in the Water and Sewer Master. Mr. Niland will provide a copy of the plan.

10. Are you or other planners or development review staff familiar with the North Carolina Wildlife Resources Commission "Green Growth Toolbox"? (http://216.27.39.101/greengrowth/)
    a. Have you attempted to implement any of the practices, ordinances or other policies recommended by the toolbox? No.

    b. Have you attempted to incorporate any other low-impact design type policies into zoning, subdivision or other land development ordinances? Yes, the existing Ordinance requires lower impacts to development through the implementation of cluster development and requirements for open space.

    c. How would you rate the likelihood of incorporating any low-impact design principles in future regulations or plans? Would likely increase the implementation as the Town's growth increases.

Mr. Niland stated that Wingate is currently in the planning process to implement a Comprehensive Pedestrian Plan. Also, GIS layers for the Comprehensive land use plan are available. Mr. Niland stated that he would have this information compiled onto a CD and mail it to the Charlotte Office.

Project: R-3329/R2559 Monroe Connector

Subject: Indirect and Cumulative Impacts Quantitative Analysis
Meeting Date/Time: 6/19/2012, 2:30pm
Meeting Location: CDOT Offices, 7th Floor Small Conference Room

Attendees:

Anna Gallup – Program Manager, Metrolina Regional Model
Joe McLelland – Metrolina Regional Modeler
Martin Kinnamon – Metrolina Regional Modeler
Scudder Wagg - Baker Engineering
Lorna Parkins - Baker Engineering
Jamal Alavi – NCDOT, Transportation Planning Branch (by phone)

Meeting Notes:

Lorna began the meeting noting the unusual circumstances regarding the 4th Circuit Court ruling and that the focus of the meeting was to review in detail the process of developing the socioeconomic forecasts, in particular the travel time to employment factor, but also the general process and the level of involvement of the Expert Panel and others in determining the final forecasts. Lorna asked if the MUMPO staff were comfortable with how Baker staff had used the socioeconomic forecasts as a basis for the No Build Scenario given the inclusion of the Monroe Connector/Bypass project in the travel time to employment factor. Joe and Anna indicated that the effect of travel time on the allocation was negligible.

In discussing the overall process of developing the socioeconomic forecasts, Anna and Joe noted that they were the lead staff members at CDOT at the time the forecasts were developed and oversaw the contract that Paul Smith had to develop the bottom up forecasts. They were heavily involved in the review process of the forecasts and in reviewing the methodologies that Paul Smith was using.

Anna and Joe noted that the bottom up process went through multiple iterations of developing the land development factors, producing forecasts from them and then reviewing and adjusting those forecasts by the expert panels.

Anna and Joe noted as well that the land use modeling aspect of Paul Smith's work was intended to be a complete model that could be reused in future years to update and reassess bottom up forecasts as conditions changed, but the final model was never completed and the documentation of his process was never finalized due to schedule constraints and difficulties in automating many aspects of the process.

Additionally, they noted that the land use model was never calibrated to any historical data (such as 1990 to 2000 historical change at the census tract level).

The land use model used an ArcInfo GRID to develop the land development factors to provide a finer grain of detail than was possible at the TAZ polygon level. Parcel level data was used in Mecklenburg County and aerial imagery in Union County to populate some of the details for these GRIDs.

For the travel time to employment factor, Joe noted that the original intent was to use a gravity type model, where larger employment centers had a larger impact on the results. In the end, however, Paul Smith used an approach that only considered the nearest employment center, which meant that the travel time factor had a minimal impact on the overall results. Joe noted that the use of the nearest employment centers approach in calculating travel time meant that the effect of the Monroe Connector's inclusion in the roadway network would be very small, perhaps near zero for most TAZs, because the employment centers to which the travel times were calculated were all in or near Monroe, while the roadway project would bypass Monroe.

On the inputs to the travel time to employment factor, Joe noted that the input roadway network was based on a network that did not include the eastern portion of the Monroe Bypass. Paul Smith was responsible for travel time estimation beyond the border of the MUMPO travel demand model of the time period (2003-2004). MUMPO staff did provide speed values from their models which Mr. Smith applied to the roadway network he used to calculate the travel times. The 2010 forecast model was used to develop speeds for the 2010 and 2020 land use forecasting and the 2010 model did not include the Monroe Connector. The 2025 forecast model was used to develop speeds for the 2030 forecasts and this model did include the Monroe Connector.

Joe and Anna noted, however, that the geographic limits of their analysis at the time period limited any impact that the Monroe Connector would have had on the land use allocation to the east of NC 200. The MUMPO bottom up process was only applied to the MUMPO portions of the region and for Union County this only included areas around and to the west of Monroe. Therefore none of the bottom up process in question affected the population or employment allocations in the eastern areas of Union County under the Rocky River RPO jurisdiction. Furthermore, the allocation process within the MUMPO area was restricted by the control totals developed during the top down process. Therefore, the land development factors only affected how population and employment were allocated within the MUMPO portion of Union County.

Joe and Anna were not involved in the Rocky River RPO bottom up process, but their understanding was that they used an expert panel process to allocate population and employment across TAZs and they did not attempt any empirical process like MUMPO. They were also constrained by the control totals developed by the top down process.

Expert panels did play a significant role for the MUMPO process. These panels made determinations for some of the land development factor inputs (i.e. the growth areas) but they also reviewed the first iteration output of Paul Smith's land use model and made substantial adjustments to the TAZ population and employment totals. Furthermore, Joe and Anna noted that all the Non-Population Chasing Employment was hand set by staff and/or expert panel input. For Union County the expert panel included 3-4 persons and Dick Black was one participant they remember being involved but there is no documentation of any of the participants and neither Anna nor Joe could remember other participants.

MUMPO did begin an update process based on new Census estimates from 2005. The purpose of this update was to update the base year forecasts to 2005 and to update the future year forecasts based on pipeline growth and updated trends based on Census estimates of growth, input from the state demographer and other projections such as Woods and Poole forecasts. This update did not affect the data used in the ICE study, however, since this update was not fully completed and approved when the MUMPO forecasts were provided to Baker.

Regarding the top down forecasting process, Anna and Joe also noted that there was a Regional Reconciliation process to adjust those forecasts among the counties in the region. This reconciliation process resulted in some forecasted growth shifting away from Union County toward other counties to ensure more equity in the forecasted growth across all jurisdictions.

Follow Up Call

Meeting Date/Time: 6/21/2012, 9:30am
Meeting Location: Phone Call

Attendees:

Anna Gallup – Program Manager, Metrolina Regional Model
Scudder Wagg - Baker Engineering

Meeting Notes:

Scudder asked about the update to the forecasts that is underway. Anna mentioned that the Kenan Institute staff at UNC Chapel Hill will be doing the top down portion of the study this time and that UNC Charlotte GIS staff will likely be involved in the bottom up process again, at least for Mecklenburg County. The updated forecasts are not expected for at least 6 months, more likely 9 months.

Scudder asked to verify whether she and other MUMPO staff were comfortable with the manner in which Baker staff used the MUMPO socioeconomic forecasts to develop a No Build land use scenario for the Monroe Connector ICE study area. Anna said that she and her staff were comfortable with that use of their data as the basis for a No Build scenario because of the manner in which the forecasts were developed for Union county in the 2003 to 2004 time period. Specifically the shifting of growth during the regional reconciliation process and the assumptions used by the expert panel to develop the land development factors and to adjust the forecasts all pointed towards the reasonableness of using the forecasts as the basis for a No Build scenario. Further, as discussed in the June 19th meeting, the one technical element of the bottom-up forecasting process that included the Monroe Connector was carried out in such a way that the effect on TAZs in Union County would be at or close to zero.

Follow Up Communications

Communications Date/Time: 10/9/2013 to 10/24/2013
Via Email

Correspondents:

Anna Gallup – Program Manager, Metrolina Regional Model
Joe McLelland – Metrolina Regional Modeler
Scudder Wagg – Baker Engineering

Meeting Notes:

Scudder asked Anna and Joe to provide a succinct explanation for the reason the Travel Time to Core Employment Factor was originally included in the LUSAM model design but then was not used in any of the LUSAM model runs as it was given a weight of zero in all model runs. Joe explained that in designing LUSAM, travel time to core employment was anticipated to be a useful variable. In practice, it was difficult to implement without substantial additional programming effort. The travel time table in the various LUSAM versions was a test, hand-prepared version of travel time data using the old MUMPO model (the model that predates the 2035 MUMPO LRTP process). The TAZ did not always match the TAZ in the model used for the 2035 LRTP, nor did the table include TAZ in eastern Union County. The long-range plan schedule did not permit sufficient time to develop and test the travel time component. Therefore, in the interest of keeping the LRTP on schedule and conversing effort, CDOT staff and MUMPO chose to give the travel time coefficient a weight of zero in the LUSAM models. Thus, the travel time to core employment variable was never used in the LUSAM models to develop future projections.

Project: R-3329/R2559 Monroe Connector

Subject: Indirect and Cumulative Impacts Quantitative Analysis, Legacy Park Development
Meeting Date/Time: 9/27/2012, 2:30pm
Meeting Location: Conference Call

Attendees:

Melanie O'Connell Underwood – Union County Partnership for Progress, Interim Director
Gretchen Carson – Union County Partnership for Progress
Scudder Wagg - Baker Engineering
Ken Gilland - Baker Engineering

Meeting Notes:

On Thursday, September 27, 2012, Gretchen Carson and Interim Director Melanie O'Connell Underwood of Union County Partnership for Progress (Partnership) spoke with Scudder Wagg and Ken Gilland of Michael Baker Engineering (Baker) with regards to the Legacy Park Project.

The discussion began with the Partnership asking what had prompted the call. Baker stated that the call was prompted by recent queries by parties associated with the Monroe Connector/Bypass legal case, environmental agencies, and the Charlotte Observer, all of which had asked if the project had been included in the past quantitative indirect and cumulative effects (ICE) study and if it would be included in any updates to the ICE study.

Ms. Carson answered that she and Director O'Connell had recently met with the past director (Maurice Ewing) to make sure that they had all available information about the Legacy Project. There is currently no work underway for the project due to the current economic conditions and the delay in construction of the Monroe Connector/Bypass. No offers have been made on any parcels in the area, and there are currently no plans to request land use plan changes or develop infrastructure plans to support Legacy Park. No financing plans have been developed for Legacy Park. Currently, the Partnership considers the project dead.

It is the case that the area proposed for Legacy Park appears to be suitable for development. Currently, there are no intensive housing developments in the area proposed for the park. CSX has noted to the Partnership that the long, straight railroad alignment in this area would accommodate sidings and the site offers potential benefits with the anticipated expansion of the Port of Wilmington. Anson County and the Town of Marshville have passed resolutions of support for the project. The Union County Planning Department is aware of the project but to date no changes in land use plans or zoning have been adopted or proposed to accommodate the full proposal. The current infrastructure is sufficient to support existing development and some future development but will not support the size or scale of the proposed Legacy Park.

Baker asked, what were the chances of Legacy Park being developed with or without the construction of the Connector. The Partnership answered that there was no chance of Legacy Park being constructed if the Monroe Connector/Bypass were not built. If the Connector/Bypass were built, the chances that some portion of the proposed Legacy Park might develop was about 25 percent in the next 5 to 10 years; however no phasing plan or feasibility study would be developed unless the bypass is constructed.

Baker asked about proposed project phasing if Legacy Park were built. The Partnership answered that of approximately 5,000 acres identified on the Partnership website as comprising Legacy Park, it was anticipated that the first phase of the project would cover approximately 300 acres, but that number was subject to change. The figure was based on preliminary discussions with CSX about one particular tract. The Partnership asked if they could go to the next phase of project development (an environmental study)

would CSX think this was a good idea and were informed that the railroad did not believe current conditions warranted advancing the project. Nothing was purchased and no landowners were directly contacted.

The Partnership stated that if Union County were approached by a developer or business, that they would be open to exploring future prospects. There had been one small rail project in the Legacy Park area in the past few years, but it was not associated with Legacy Park.

The Partnership stated that they were merging with the Monroe Economic Development Council and might cease to exist within a year.

Baker asked about other planned development. The Partnership answered that four communities in the area (Indian Trail, Stallings, Mint Hill, and Mathews) were looking into the possibility of pooling resources to encourage future developments in the form of a business park. A future meeting will determine anticipated next steps in this very preliminary effort.

The Partnership asked if Baker was aware of the Strategic Plan for Economic Development, Town of Marshville, Town of Wingate, and Baker answered that the plan had informed the potential build scenario for that portion of the ICE study area.

Project: R-3329/R2559 Monroe Connector

Subject: Indirect and Cumulative Impacts Quantitative Analysis
Meeting Date/Time: Various (e-mail communications between 11/29/12 and 11/30/12)

Attendees:

Vance E. Bennett – CSX
Jim Van Derzee: CSX
Scudder Wagg - Baker Engineering

Communication Notes:

The purpose of this communication was to better understand the role of CSX in the Legacy Park development and gather information on the expectations of CSX staff regarding the potential for development of the site. Scudder began the discussion by asking:

> *Our staff spoke with Melanie Underwood and Gretchen Carson about the potential for development and one specific item they noted was that they had spoken recently to CSX staff about possibly conducting an environmental study of the site to advance project development but that CSX staff felt the current conditions did not warrant such action. Can you confirm this or provide any information as to why that decision was made? Also, if there is any additional information you can provide about the likelihood and possible timing of any development at Legacy Park we would greatly appreciate it. Specifically, we would want to know your assessment of whether and how much of the site might be developed by 2030 if the Monroe Connector/Bypass were built and if it were NOT built. Any specific reasons for your assessment would also be helpful.*

Jim responded with the following:

> *This is very difficult to speculate. There are two separate, largely unrelated, development opportunities at Legacy Park for CSX.*
>
> *1. **Rail-Served Industrial Development Projects** The property is adjacent to a CSX main line, which would enable sidetrack construction to serve new industries that locate to the property. Because we don't know what types of industries will locate there, we cannot determine the road access requirements and whether or not the Bypass would make a difference. As far as the timing, this could happen as soon as a project starts that is a suitable fit for Legacy Park, which is impossible to predict. I've offered Legacy Park to numerous industrial development projects, but none have pursued it yet. As CSX's Manager Industrial Development, this is my primary role with Legacy Park.*
> *2. **Construction of a new intermodal** facility that would transfer shipping containers between railcars and trucks. Because the local shipment would be made by truck, the road accessibility is critical to making this work. There are many other challenges that need to be overcome before I would recommend proceeding with an environmental study. As CSX's Director Intermodal Port Strategy, this is Vance's primary role with Legacy Park.*
>
> *I recommend that the environmental study be done after a need has been clearly determined.*

Vance responded by noting the following regarding the possible new intermodal facility:

> *Jim's comments are correct and I would just like to add that CSX normally would conduct a market assessment before an environmental study is conducted to measure the current*

and future if CSX was to build an Intermodal facility at any location. I would suggest that be considered if you have not done so already.

Later Vance further clarified regarding the need and process for doing a market assessment:

CSX would take the lead on such a study if it were a CSX planned facility. In this case, since it is a private terminal facility it would not be CSX's call on developing that research. If it were however, CSX would typically hire a consultant like RS&H, Moffat & Nichol or Tran-Systems to develop such a report.

Lastly, in response to a request to rate the quality of the Legacy Park site for rail-served industrial development and for the potential for the intermodal terminal development, Jim responded:

[O]verall, I rate the Legacy Site very high, with the potential to land some large industrial development projects. Its topography, rail access, and geographic location make this one of the best sites in the greater Charlotte area.

As for the other challenges with the intermodal opportunity, we do not currently have the necessary combination of shipment volume and distance to make rail work.

Project: R-3329/R2559 Monroe Connector

Subject: Indirect and Cumulative Impacts Quantitative Analysis, Legacy Park Development
Meeting Date/Time: 10/2/2013, 1:00pm
Meeting Location: Conference Call

Attendees:

R. Christopher Platé – Executive Director, Monroe-Union County Economic Development
Gretchen Carson – Project Manager, Monroe-Union County Economic Development
Scudder Wagg - Baker Engineering
Ken Gilland - Baker Engineering

Meeting Notes:

On Wednesday, October 2, 2013, Chris Platé and Gretchen Carson of Monroe-Union County Economic Development (MUCED) spoke with Scudder Wagg and Ken Gilland of Michael Baker Engineering (Baker) with regards to the Legacy Park Project.

The discussion began with the Baker staff explaining Baker's role in the overall environmental documentation process and discussing the need to consider all reasonably foreseeable development in the study area. Mr. Wagg began by asking about the current status of the Legacy Park proposal. Mr. Platé said the original proposal is dead but that the MUCED is working on plans for a smaller scale, rail-served industrial park with some manufacturing. The anticipated size at full build out would be between 200 and 400 acres with individual facilities of 50,000 to 200,000 square feet. The rough area in which this development would occur would be between the CSX railroad to the south, Stegall Road to the west and Gaddy Road to the east. Mr. Platé noted that this area already has some industrial activity and access to the rail line and the few large parcels in the area would make it a good fit for a small industrial park. He noted that there is the potential to add two additional parcels that would allow frontage on US 74.

He also noted that the proposal is very long term as there is insufficient utility infrastructure at the site currently. Sewer, water, fiber optic and gas utilities would all need to be provided and the cost and financing of such infrastructure has not been determined yet. MUCED is continuing to work on the project by securing options on the properties in the area and coordinating with localities such as Marshville to get utility infrastructure improvements including in local capital improvement plans.

In general, Mr. Platé noted that the focus of his agency and the county in general is more on economic development in the western portions of the county, in particular on box distribution facilities in and around Monroe and Indian Trail. If the bypass is built, Mr. Platé felt there would be some opportunities for industrial and distribution facility development along the corridor, particularly around Monroe at US 601 and Morgan Mill. Near the eastern end of the corridor, Mr. Platé felt that higher end residential was likely in the vicinity of Wingate. Wingate and Marshville currently lack the water and sewer capacity to allow for more intensive development.

As to the focus of the economic development team, Mr. Platé noted they are focusing equine industries in the area of Waxhaw, office development in Stallings along and near I-485, and more industrial development in Indian Trail and Monroe. In Fairview, Mr. Platé noted that the town had interest in seeing some small scale retail development around the US 601 and NC 218 intersection. He anticipated the development would be up to 4 to 5 small parcels focused on fast food, convenience store and related retail. He did note that the town had interest in very small scale industrial development that might have limited impacts, but Mr. Platé noted that any development faces serious hurdles in the Fairview area due to limitations from environmental issues and lack of sewer.

In the Marshville area, Mr. Platé felt that there would be limited growth in the short term with or without the bypass. Mr. Platé noted that the town had very old infrastructure with limited sewer capacity.

Appendix B
Growth Trends and Factors Technical Memorandum

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Monroe Connector/Bypass
(R-3329/R-2559)

Union County Growth Factors
Technical Report

DRAFT

Prepared for the North Carolina Turnpike Authority

NORTH CAROLINA
Turnpike Authority

A Division of North Carolina Department of Transportation

Prepared by Michael Baker Engineering, Inc.

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August 13, 2013

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1.0 GROWTH TRENDS IN UNION COUNTY

Two key questions that arose during review of the previous ICE analyses and during litigation are summarized as follows:

1. Why has Union County grown so quickly in the past even without major transportation improvements like the Monroe Connector/Bypass?
2. Why, if the socioeconomic forecasts are to be accepted, is Union County likely to continue to grow at an above average rate for the next 30 years with or without major transportation improvements like the Monroe Connector/Bypass?

Put more succinctly: "Why would Union County have such robust growth in the absence of new transportation infrastructure?" The short answer is that the factors that caused Union County to experience higher growth than any other regional county since 1990 are still in place and are likely to continue to result in higher than average growth. This section summarizes the growth trends of Union County and other regional counties and reviews some of the literature regarding why some counties grow more quickly than others do.

Analyzing regional growth dynamics requires establishing a set of counties to which one can compare growth patterns. Many definitions of the Charlotte metropolitan region exist, but the most common and applicable for an analysis of the Monroe Connector/Bypass are the following:

- The Census Bureau defines the Charlotte-Gastonia-Rock Hill, NC-SC Metropolitan Statistical Area (MSA) to include Mecklenburg, Union, Gaston, Cabarrus and Anson Counties in North Carolina and York County in South Carolina.
- The Census Bureau defines the Charlotte-Gastonia-Salisbury, NC-SC Combined Metropolitan Statistical Area (CMSA) to include all of the above counties plus Iredell, Lincoln, Rowan, Stanly and Cleveland Counties in North Carolina and Chester and Lancaster Counties in South Carolina.
- The Charlotte Regional Partnership, a regional economic development advocacy organization, defines the metropolitan area as including all of the above CMSA counties plus Catawba and Alexander Counties in North Carolina and Chesterfield County in South Carolina.
- The Charlotte DOT manages the MRM, a regional travel demand model for the metropolitan area that includes socioeconomic forecasts of population and employment at the TAZ level. The socioeconomic forecasts for the metropolitan area cover all of Mecklenburg, Union, Gaston, Cabarrus, Lincoln, Rowan and Stanly Counties plus portions of Iredell and Cleveland Counties in North Carolina and all of York County and portions of Lancaster County in South Carolina.

NCTA and its consultants determined that the CMSA was the most appropriate for comparison purposes. Table 1 summarizes the population and growth in the CMSA counties in the region from 1990 to 2010. It also shows the MRM forecast coverage for each. The MSA definition excludes counties, such as Iredell and Lincoln, each of which have captured more than three percent of regional growth in the last two decades. The CMSA definition includes a number of counties that have captured relatively small percentages of regional growth and currently have a limited relationship to the overall regional growth dynamics. Based on MPO and NC State Data Center forecasts, some of these counties are expected to see substantial increases in population in the future and therefore they will be included in the analysis. Of important note in Table 1 is the percent of CMSA population growth from 1990 to 2010. These percentages show how much of the overall growth of the region each county has captured.

Table 1: Population and MRM Forecast Status for CMSA Counties

County	State	MRM Forecast Coverage	Population					
			1990	2000	2010	1990 to 2010 Growth	% Growth 1990-2010	% of CMSA Population Growth 1990-2010
MSA Counties								
Mecklenburg	NC	Whole	511,433	695,454	919,628	408,195	79.5%	45.3%
Union	NC	Whole	84,211	123,677	201,292	117,081	139.0%	13.0%
Gaston	NC	Whole	174,769	190,365	206,086	31,317	17.7%	3.5%
Cabarrus	NC	Whole	98,935	131,063	178,011	79,076	79.9%	8.8%
York	SC	Whole	131,497	164,614	226,073	94,576	71.9%	10.5%
Anson	NC	None	23,474	25,275	26,948	3,474	12.9%	0.4%
CMSA Counties								
Iredell	NC	Partial	93,205	122,660	159,437	66,232	71.6%	7.4%
Lincoln	NC	Whole	50,319	63,780	78,265	27,946	55.5%	3.1%
Rowan	NC	Whole	110,605	130,340	138,423	27,818	25.2%	3.1%
Stanly	NC	Whole	51,765	58,100	60,585	8,820	17.0%	1.0%
Chester	SC	None	32,170	34,068	33,140	970	3.0%	0.1%
Lancaster	SC	Partial	54,516	61,351	76,652	22,136	40.6%	2.5%
Cleveland	NC	Partial	84,958	96,287	98,078	13,120	15.8%	1.5%
		Total	**1,501,857**	**1,897,034**	**2,402,618**	**900,761**	**60.0%**	

Source: US Census 1990, 2000 and 2010, MRM Socioeconomic Forecasts

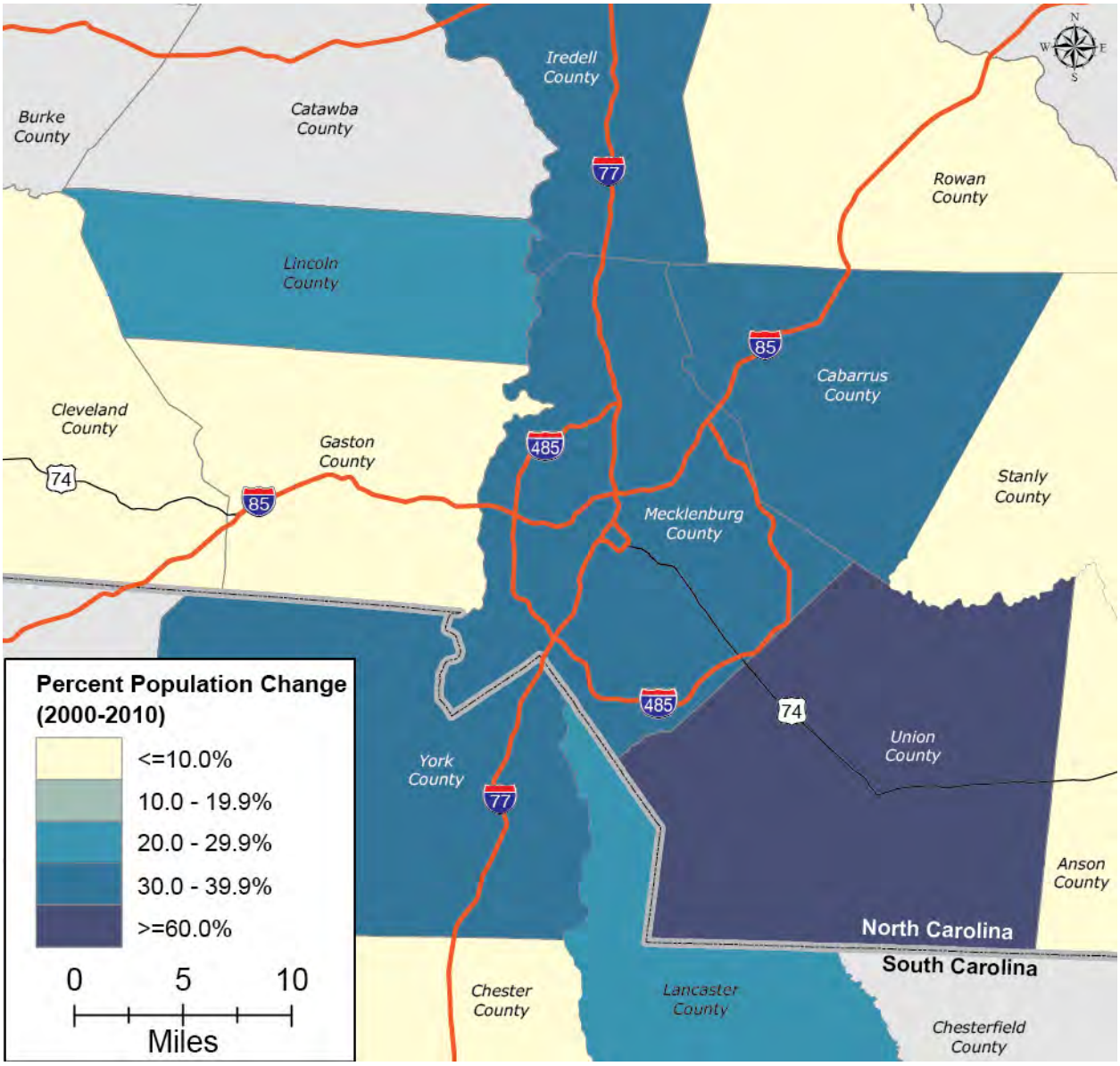
As seen in Table 1 and Figure 1, Union County has experienced the highest population growth rate in the study area since 1990. Specifically, the county witnessed a 46.9 percent population increase (39,466) from 1990 to 2000 and a 62.8 percent increase (77,615) from 2000 to 2010. Meanwhile, the CMSA experienced 26.3 percent growth and 26.7 percent growth, respectively, over the same period. In 2010, Union County accounted for 8.4 percent of the study area's total population, up 2.8 percent since 1990. The rate of population growth in Union County has been quite high for many years. From 1990 to 2000, the average annualized growth rate was 3.9 percent. That average annualized growth rate rose significantly, to 5.7 percent from 2000 to 2005 and then fell back to 4.3 percent from 2005 to 2010. In each period, however, Union County has been the fastest growing county in the region (by percentage growth).

This high growth rate does not mean, however, that Union County has captured most of the regional growth. As Table 1 shows, Mecklenburg County has captured 45.3 percent of the regional population growth over the last 20 years. Its growth rate has been lower, however, as it was growing from a much larger population base. Union County captured the second largest share of regional population growth, with 13 percent, while York captured 10.5 percent and Cabarrus 7.4 percent. No other county captured more than 5 percent of the regional population growth over the last 20 years. Some counties, such as Lancaster County, experienced significant growth in percentage terms, but only captured small percentages of the region's overall growth.

Historic data, therefore, suggests that Mecklenburg, Union, York, Cabarrus and Iredell Counties would capture most of the regional growth over the next 20 to 30 years. Nevertheless, dynamics that have encouraged this pattern of growth may or may not continue to exist. Therefore, understanding some of the dynamics underlying why those counties have captured a substantial share of regional growth and

whether they may continue to capture a substantial share of regional growth is critical to understanding which counties are poised to grow in the future.

Figure 1: Population Growth in CMSA Counties, 2000 to 2010



1.1 Hammer Report and Regional Forecasts

Methods and Regional Forecast Results

Dr. Thomas Hammer completed a detailed analysis and regional forecasting process for the region in 2003 analyzing historic growth in 227 counties within 29 separate metropolitan areas and modeling those trends to identify the predictive factors that drive regional growth and the distribution of that growth

across the regional jurisdictions.[1] Trends are a significant driver of county-level shares of growth, but the model developed by Dr. Hammer isolates the factors that differentiate growth dynamics at the county level, which requires greater complexity than examining trends in isolation. In other words, Dr. Hammer's model attempted to isolate the factors that most strongly affected whether a county saw higher or lower growth than a trend line projection would forecast. Importantly, the Hammer Report notes the following:

> *People trying to imagine . . . what the world will be like decades in the future – can easily be drawn into focusing upon what should occur rather than what is most likely to occur. Urban planners and others with a professional or personal stake in shaping the future are particularly susceptible. (The strong preference of many planners for bottom-up forecasting comes from the flattering notion that they, through the design of land use controls and mass-transit facilities, will be telling future development where to go.) Forecasts can verge into being prescriptive rather than predictive, and while prescriptive forecasts have their value, the present investigator is not in that business. So the approach described here mandates the use of allocation relationships established through formal analysis of empirical data. Statistical calibration confers advantages of realism as well as objectivity, because the interactions of urban activities over space are so complex and multifaceted that it is very hard to specify the existence, much less the magnitude, of relationships without recourse to historical evidence. (p. 4)*

Dr. Hammer's initial step was to develop a total population and employment forecast for the region overall. This step used an input-output economic model to estimate the overall employment and population based on national economic trends, local industrial sector analysis and local and national demographic trends. These regional level forecasts were driven by large-scale economic trends and demand side influences as opposed to supply side influences such as existing and future transportation infrastructure or utilities or restrictive land use policies[2]. It is important to stress that these projections, which developed future employment and population, did not include the Monroe Connector/Bypass. Table 2 outlines the regional forecast of population resulting from Dr. Hammer's analysis of economic and demographic trends. While the growth forecast seems very high at first glance, compared to other large growing regions in the south, the growth forecast is quite reasonable. Dr. Hammer notes:

> *Given the present forecast for the Charlotte region and its performance since 1990, the region's highest 30-year percent change in population will be an 83% gain for the period from 1990 to 2020. The 30-year percent changes for the region will then trend downward to 73% for the 2005-2035 interval. Thus, Charlotte will not come within thirty percentage points of the increases posted by the three monsters of the south [Dallas, Houston and Atlanta]. In fact, the Charlotte region's peak gain of 83% during 1990-2020 will only be midway between the national growth rate of 33% for that period and Atlanta's 30-year record of 134% for 1970-2000. So the future expansion of the Charlotte region will be robust but by no means unprecedented. (p 27)*

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[1] Hammer, Thomas, *Demographic and Economic Forecasts for the Charlotte Region*, Prepared for the charlotte Department of Transportation, December 8, 2003.

[2] The Hammer Report formed part of the basis of the MPO forecasts which served as control totals for the No-Build scenario of the Quantitative ICE. The Build scenario, however, did specifically analyze how transportation improvements would change accessibility in the FLUSA and thus impact growth.

Table 2: Forecasts of Charlotte's Regional Population

Year	Population	5-Year Change	Annualized Growth Rate
2000	1,986,903		
2005	2,179,103	192,200	1.86%
2010	2,385,288	206,185	1.82%
2015	2,624,430	239,142	1.93%
2020	2,889,969	265,539	1.95%
2025	3,175,350	285,381	1.90%
2030	3,474,012	298,662	1.81%
2035	3,779,397	305,385	1.70%

Source: Hammer, 2003.

Next, the overall regional forecast was apportioned among the various jurisdictions using an allocation model that distributed the forecasted regional growth to individual counties. The model used past trends and current conditions for households (by income in three groups) and earnings by industry (in 32 groups) from 227 counties across 29 metropolitan regions across the eastern United States to guide the forecasting process. The variables used to allocate growth were limited by the feasibility of collection the necessary data for large-sample model calibration.[3] As such, the forecast model focused mostly on demand side variables such as past economic and demographic trends, existing economic and demographic conditions, the influence of income on growth patterns and the physical proximity of places. Two major supply side factors were considered:

1. The availability of land, estimated on the basis of development magnitudes and based in part on population density (available land is defined as land physically suitable for development that is vacant or developed at very low intensity);
2. The effect that land use regulations and infrastructure policies have had on past growth would influence the model to the extent that those policies affected historic growth trends.

While physical proximity, in straight-line distance, is one factor that Dr. Hammer identified in the analysis, it was indexed by the more significant factor of available land in order to provide a predictive function for growth allocation. The other significant factor in his allocation model is household income.

Dr. Hammer's final population estimates for each county are summarized below in Table 3. The values include a low, middle and high estimate for each jurisdiction. They do not constitute the final estimate of population for each county in the region as the forecasts were adjusted during a regional reconciliation process (See Section 4.4). The final adopted forecasts were generally within the ranges provided by Dr. Hammer.

Table 3 also shows the population totals for 2030 by county from the 2009 Forecasts. As one can see, many counties had forecasted populations near the upper limit of Hammer's forecast. This is an expected outcome of a regional reconciliation process as CDOT, the MPOs and local partners worked together to reach an acceptable forecast of growth for the region and for each jurisdiction. Notable deviations from

[3] Hammer Report, p 10

the Hammer Report forecast ranges are Gaston and Mecklenburg counties, where forecasted growth exceeded Dr. Hammer's forecasted range. For Cabarrus, Rowan and Union, the forecasts are in the range between the Most Likely and Upper Limit forecasts from Dr. Hammer. For Lincoln, Stanley and York counties the forecasts are between the Most Likely and Lower Limit range. Other counties do not have countywide totals from the MRM model TAZ forecasts only cover portions of Iredell, Cleveland and Lancaster counties. The TAZ forecasts do not include any portion of Anson and Cherokee in North Carolina nor Chester and Union counties in South Carolina.

Table 3: Hammer Report Population Forecast Ranges

	Hammer Report 2030 Population			2009 Forecasts 2030 Population
County	Lower	Most-Likely	Upper Limit	
Anson County	36,967	40,847	43,175	
Cabarrus County	247,142	283,115	304,699	299,948
Cleveland County	125,373	134,563	140,077	
Gaston County	235,228	249,261	295,071	312,783
Iredell County	227,287	259,906	279,477	
Lincoln County	113,206	128,857	138,247	126,425
Mecklenburg County	1,051,400	1,157,311	1,220,858	1,271,300
Rowan County	183,747	200,639	210,774	206,060
Stanly County	80,171	87,366	91,682	81,847
Union County	268,543	312,147	338,309	337,314
Cherokee County	83,228	93,168	99,132	
Chester County	52,278	58,306	61,923	
Lancaster County	91,781	101,680	107,619	
Union County, SC	38,480	41,466	43,258	
York County	272,096	305,228	334,080	301,071

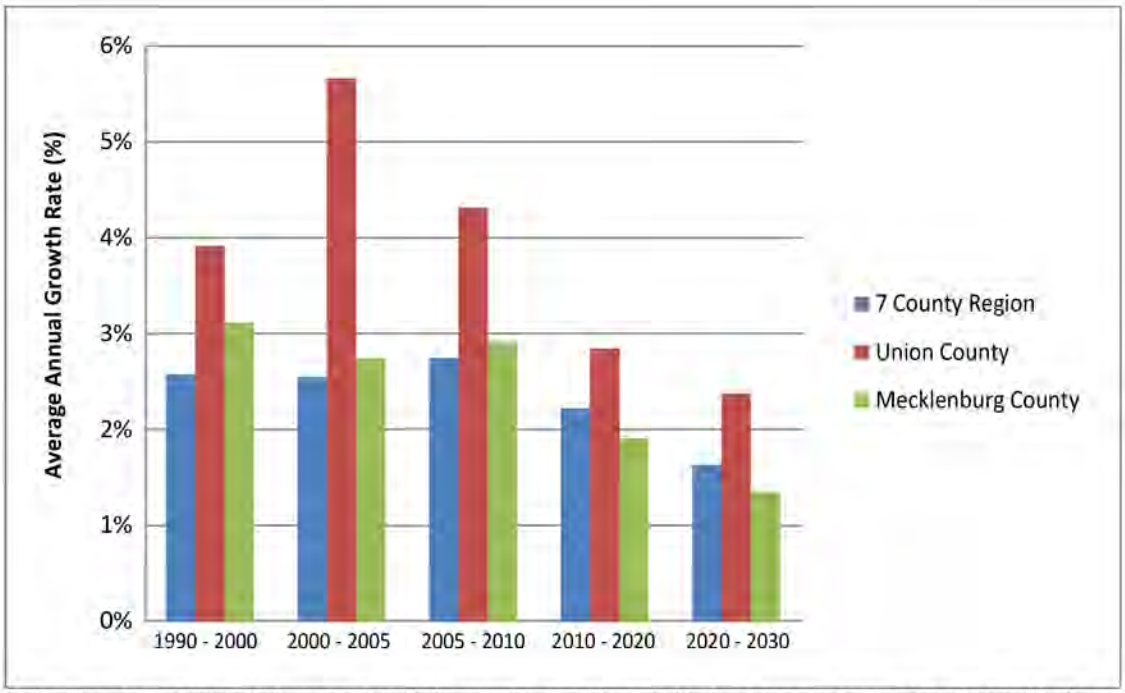
MRM TAZ Level Forecasts only cover Cabarrus, Gaston, Lincoln, Mecklenburg, Rowan, Stanly, Union and York counties in whole. Other counties are covered in part but their totals are not shown as they are not comparable to the full county forecasts from Dr. Hammer.
Source: Hammer, 2003; MRM Forecasts 2009

Review of Growth Rates

The county-level forecasts from the 2009 Forecasts place Union County's 2030 population at 337,314. As previously noted, this county level control total forecast was developed using an economically driven modeling approach that excluded major transportation infrastructure improvements from its consideration. Growth in Union County has followed the forecasted growth rather closely. As detailed in Table 4, the population of Union County from the 2010 Census is very close to the population forecast in the 2009 Forecasts; the forecast of 2010 population was 200,450, while the 2010 Census count was 201,292. Furthermore, the growth rates projected by the MRM 2030 forecasts are modest compared to historic growth in the county. To reach the forecasted 337,317 estimate of population by 2030, growth in Union County would have to slow to an average annualized growth rate of 2.6 percent, based on the 2010

Census count. Figure 2[4] shows the differences in average annual growth rates across the five different periods (1990 to 2000, 2000 to 2005, 2005 to 2010, 2010 to forecasted 2020 and forecasted 2020 to forecasted 2030). The difference between 2000-2005, 2005-2010, 2010-2020 and 2020-2030 average annual growth rates reflects a typical "s-curve" of decreasing growth rates over time as a population base expands.

Figure 2: Average Annualized Growth Rates Comparison

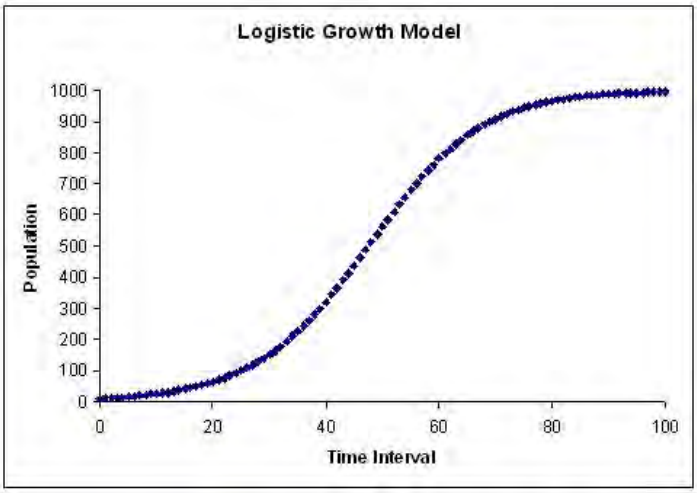


Note: The adopted MUMPO forecasts for whole counties are only available for Cabarrus, Gaston, Lincoln, Mecklenburg, Rowan, Union and York Counties.
Sources: US Census 2000 and 2010, MUMPO 2009 Socioeconomic Forecasts

An "s-curve, or logistic model, growth pattern is a common pattern of population growth seen in fast growing regions and is also commonly seen in other population growth contexts (such as new populations in ecological models). Figure 3 shows the idealized pattern of a logistic growth model. In this example, the population begins growing at a rapid rate from time interval 0 to time interval 40. This would imply a constant or rising annual growth rate, leading to each time interval adding more persons than the previous. Eventually, annual growth rates slow (from intervals 40 to 60) to a much slower rate. Eventually, in this idealized example, growth actually stops or reaches very small annual growth rates (from intervals 80 to 100) leading to a stabilization of the population size.

[4] Figure 7 compares growth rates to a 7 county region as the TAZ level forecasts for whole counties are only available for Cabarrus, Gaston, Lincoln, Mecklenburg, Rowan, Union and York Counties.

Figure 3: "S-Curve" Growth Pattern Example



Comparison to Other Forecasts

The ICE Guidance emphasizes using adopted regional forecasts authored by MPOs where available.[5] However, given the questions raised about population growth in Union County, it is instructive to look at other population forecasts for the area. Forecasts from other sources show a wide range of future growth trends for Union County. Two of the most commonly cited privately developed forecasts are from Woods & Poole and Global Insights. Both firms use cohort-component projections, a demographic projection method that focuses on fertility, mortality and net migration to estimate total population by year. The Global Insight model incorporates the predictions of a regional macroeconomic model, thereby incorporating some economically driven assumptions of jobs growth into the forecasting process. The North Carolina State Data Center also generates population projections using a time series trends forecasting process. Table 4 summarizes five different forecasts of population to 2030 from four different sources:

1. MRM 2009 Forecasts (developed between 2004 and 2009)
2. Global Insights Forecasts (developed in 2009)
3. Woods & Poole Forecasts (developed in 2009)
4. NC State Data Center Forecasts (developed in 2009)
5. NC State Data Center Forecasts (developed May 2011)

As all of the forecasts operate from either demographic trend projection or economic modeling projections; they do not incorporate expectations of transportation infrastructure development except to the extent that past infrastructure development has affected past trends. One key to understanding the differences in these forecasts is to compare the actual change in each five-year increment. The demographically driven forecast approaches used by Woods & Poole and the NC State Data Center produce very similar changes in each five-year increment of their forecasts, whereas the Global Insights and MPO forecasts, which are more economically driven models, show significant differences in each five-year increment of changes.

[5] NCDOT & NCDENR, 2001a, p III-16

As to the actual forecast of future population in Union County, the highest forecast is from the NC Data Center in 2009, which forecasted a 2030 population of 400,683. The NC Data Center's forecast from 2011, however, predicts a 2030 population of 271,289, the lowest of all the forecasts. The Global Insights forecast from 2009 predicts a 2030 population of 393,407, while Woods & Poole from 2009 predicts a 2030 population of 283,433. The MRM 2009 Forecasts fall generally in the middle of all these forecasts, predicting a 2030 population of 337,314 for Union County. Most interesting is how closely the MPO forecasts predicted the 2010 populations of Mecklenburg and Union Counties. In the case of Mecklenburg, the MPO forecast for 2010 population of 931,666 (Table 4) is only 1.3 percent higher than the actual 2010 Census count of 919,628 (Table 1). In the case of Union, the forecasted population in 2010 of 200,450 is only 0.4 percent lower than the actual 2010 Census count of 201,292. This compares favorably to other forecasts completed prior to 2010. The Global Insights forecasts from 2009 overestimated population in Mecklenburg and Union Counties by four percent and nine percent respectively. The Woods and Poole forecast from 2009 underestimated population for Mecklenburg and Union Counties by 0.3 percent and two percent respectively. The NC State Data Center forecasts from 2009 underestimated Mecklenburg County population by one percent and overestimated Union County population by four percent. Given that these other forecasts were all completed about one year prior to the forecast year in question (2010) whereas the MRM Socioeconomic forecasts were largely completed two years prior (and the underlying forecasting work dates back to 2004) the MRM socioeconomic forecasts for Mecklenburg and Union Counties compare favorably.

Table 4: Comparison of Population Projections

Global Insights (2009)									
	Mecklenburg	**Change**	**Annualized % Change**	**Union**	**Change**	**Annualized % Change**	**Region***	**Change**	**Annualized % Change**
2005	806,834			161,765			1,314,553		
2010	956,823	149,989	3.5%	219,690	57,925	6.3%	1,570,976	256,423	3.6%
2015	1,065,308	108,485	2.2%	263,298	43,608	3.7%	1,749,656	178,680	2.2%
2020	1,171,442	106,134	1.9%	303,978	40,680	2.9%	1,920,865	171,209	1.9%
2025	1,275,768	104,326	1.7%	349,186	45,208	2.8%	2,097,412	176,547	1.8%
2030	1,382,406	106,638	1.6%	393,407	44,221	2.4%	2,280,808	183,396	1.7%
Woods & Poole (2009)									
	Mecklenburg	**Change**	**Annualized % Change**	**Union**	**Change**	**Annualized % Change**	**Region***	**Change**	**Annualized % Change**
2005	802,400			160,876			1,307,329		
2010	916,747	114,347	2.7%	197,554	36,678	4.2%	1,497,063	189,734	2.8%
2015	1,000,055	83,308	1.8%	218,988	21,434	2.1%	1,630,535	133,472	1.7%
2020	1,084,264	84,209	1.6%	240,490	21,502	1.9%	1,765,570	135,035	1.6%
2025	1,168,900	84,636	1.5%	261,995	21,505	1.7%	1,901,371	135,801	1.5%
2030	1,253,544	84,644	1.4%	283,433	21,438	1.6%	2,037,236	135,865	1.4%

MRM 2009 Forecasts									
	Mecklenburg	**Change**	**Annualized % Change**	**Union**	**Change**	**Annualized % Change**	**Region***	**Change**	**Annualized % Change**
2005	837,862			168,728			1,369,445		
2010	931,666	93,804	2.15%	200,450	31,722	3.51%	1,544,779	175,334	2.44%
2015	1,025,004	93,338	1.93%	231,986	31,536	2.97%	1,719,218	174,439	2.16%
2020	1,111,254	86,250	1.63%	266,612	34,626	2.82%	1,891,996	172,778	1.93%
2025	1,196,999	85,745	1.50%	301,053	34,441	2.46%	2,063,849	171,853	1.75%
2030	1,271,300	74,301	1.21%	337,314	36,261	2.30%	2,221,345	157,496	1.48%
NC State Data Center (2009)									
	Mecklenburg	**Change**	**Annualized % Change**	**Union**	**Change**	**Annualized % Change**	**Region***	**Change**	**Annualized % Change**
2005	796,529			159,726			1,298,879		
2010	911,252	114,723	2.7%	210,069	50,343	5.6%	1,518,920	220,041	3.2%
2015	996,414	85,162	1.8%	257,378	47,309	4.2%	1,706,871	187,951	2.4%
2020	1,081,577	85,163	1.7%	304,688	47,310	3.4%	1,894,854	187,983	2.1%
2025	1,166,740	85,163	1.5%	351,996	47,308	2.9%	2,082,842	187,988	1.9%
2030	1,253,198	86,458	1.4%	400,683	48,687	2.6%	2,274,700	191,858	1.8%
NC State Data Center (2011)									
	Mecklenburg	**Change**	**Annualized % Change**	**Union**	**Change**	**Annualized % Change**	**Region***	**Change**	**Annualized % Change**
2005	802,998			160,260			1,305,092		
2010	923,144	120,146	2.8%	202,200	41,940	4.8%	1,510,094	205,002	3.0%
2015	1,009,658	86,514	1.8%	219,522	17,322	1.7%	1,634,793	124,699	1.6%
2020	1,095,857	86,199	1.7%	236,778	17,256	1.5%	1,758,306	123,513	1.5%
2025	1,182,056	86,199	1.5%	254,034	17,256	1.4%	1,881,818	123,512	1.4%
2030	1,268,257	86,201	1.4%	271,289	17,255	1.3%	2,005,336	123,518	1.3%

* The Regional forecasts here are for a four county region of Cabarrus, Gaston, Mecklenburg and Union Counties. This is due to data limitations from the various sources.

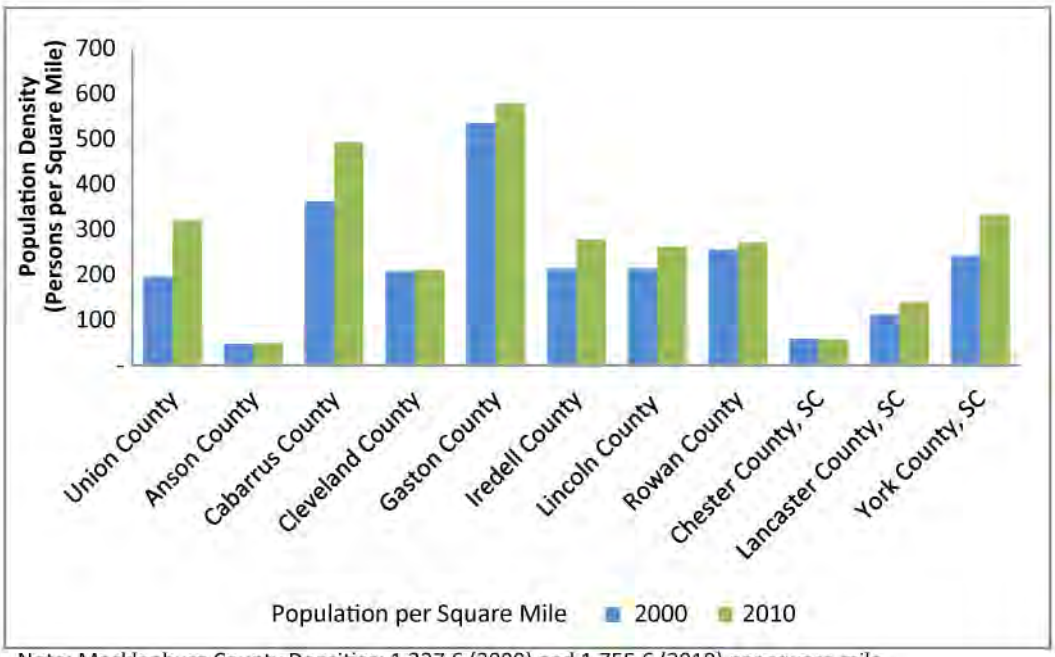
1.2 Growth Factor: Land Availability

The Hammer Report indicates that land availability is the major factor driving higher than trend line growth. The data used to capture land availability in his analysis was population and employment density. Therefore, a comparison of population density provides a rough estimate of the land availability in each jurisdiction as those counties with higher population densities would naturally have lower land availability due simply to the fact that more land was already developed.

In 2000, Union County had a population density of 196.0 persons per square mile, ranking it tenth out of 13 counties in the CMSA. In 2010, Union County's population density was 319 persons per square mile,

fifth highest of the 13 counties and only four percent lower than the fourth highest county, York (see Figure 4). For comparison, the most densely populated county in the region, Mecklenburg County, had population densities of 1,327.6 and 1,755.6 per square mile in 2000 and 2010 respectively. The vast difference in population densities between Mecklenburg County and its surrounding counties indicates that there is substantial land available for development in the less developed surrounding counties. Furthermore, the lower population density of Union County relative to Cabarrus and Gaston Counties indicates more land is likely available in Union County versus those two counties. Based on Dr. Hammer's criteria, one would expect growth to be higher in Union County than in Cabarrus or Gaston over the next 20 years. Figure 4 compares the population density for the 12 suburban counties in the CMSA. Mecklenburg is excluded from this figure to make comparison between the suburban counties clearer.

Figure 4: Population Density in the CMSA 2000 and 2010 (Excluding Mecklenburg County)

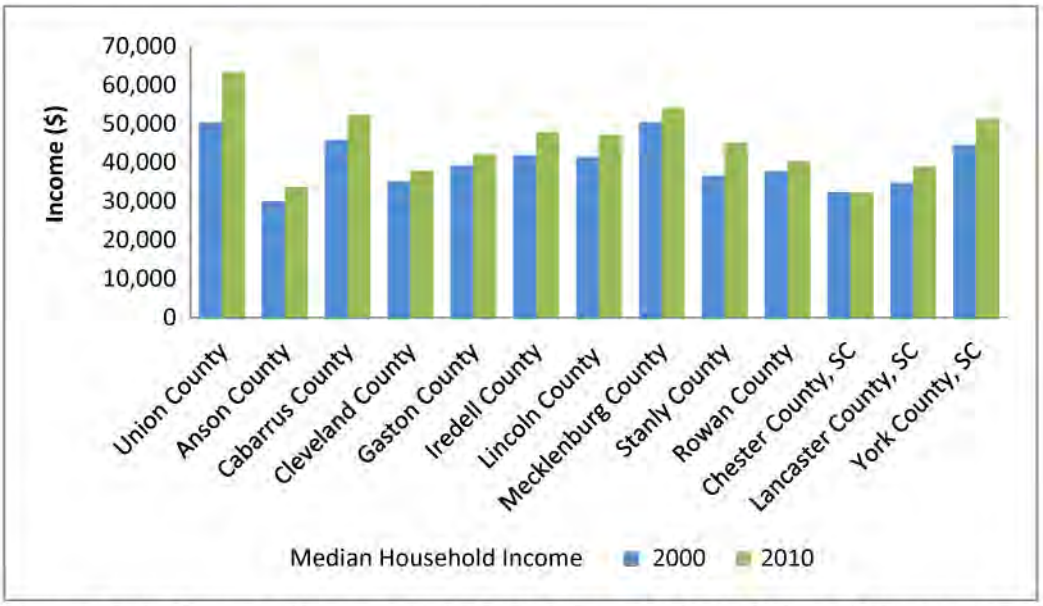


Note: Mecklenburg County Densities: 1,327.6 (2000) and 1,755.6 (2010) per square mile.
Source: US Census 2000 and 2010

1.3 Growth Factor: Income

According to the empirical study by Dr. Hammer, income differences also play a key role in attracting growth to certain counties. In particular, areas with higher median household income typically see higher than trend line growth. Union County currently has the highest median household income in the region (Figure 5). In 2000, the county's median household income ($50,354) was comparable to that of Mecklenburg County ($50,311). Based on 2010 Census Data, however, Union County has seen a 25.9 percent increase in median household income, while Mecklenburg County has seen a much more modest (7.5 percent) increase. Again, based on Dr. Hammer's criteria, one would expect Union County to grow faster than trend line growth would suggest.

Figure 5: Median Household Income in the CMSA 2000 and 2010



Source: American Community Survey 2008-2010, 3-Year Estimates, Table S2503 (Financial Characteristics)

1.4 Growth Factor: Housing Affordability

Other factors that often drive growth are housing affordability, school quality and commuting times. Dr. Hammer's report did not address these factors in his analysis, but they are commonly cited reasons for household location decisions from surveys by the National Association of Realtors[6]. According to the American Community Survey, Union County has the highest median housing costs ($1,146 per month). Furthermore, as shown in Table 5, it also has the highest median home values in the CMSA. When assessing the relative ratios of housing costs to income in each county, however, Union County is actually more affordable than Mecklenburg County and is on target with the regional median. For example, a median household in Union County spends 21.7 percent of its income on housing costs. Meanwhile, a median household in Mecklenburg County spends 23.8 percent of its income on housing costs. Union County, however, becomes substantially less affordable when one substitutes the county's median household income with the *region's* median household income. When doing so, Union County's housing stock remains the least affordable in the region, typically requiring 28.7 percent of household income.

[6] National Association of Realtors, "Profile of Home Buyers and Sellers," 2011

Table 5: Selected Housing Characteristics for the CMSA

	Union County	Anson County	Cabarrus County	Cleveland County	Gaston County	Iredell County	Lincoln County	Mecklenburg County	Stanly County	Rowan County	Chester County, SC	Lancaster County, SC	York County, SC
% Owner-occupied	83.3	65.3	74.1	66.2	68.1	74.1	74.9	61.9	69.7	69.7	76.4	73.1	72.1
% Renter-occupied	16.7	34.7	25.9	33.8	31.9	25.9	25.1	38.1	30.3	30.3	23.6	26.9	27.9
Median Home Value ($1,000)	203.2	81.7	172.2	104.8	124.5	168.2	156.7	190.9	124.0	128.7	85.8	129.4	164.7
% Single Family Detached Housing	84.9	68.2	76.6	67.5	75.0	73.0	67.9	60.3	74.9	67.5	68.5	75.0	68.1
Median Number of Rooms per Unit	6.4	5.3	5.7	5.3	5.3	5.7	5.6	5.6	5.5	5.4	5.5	5.6	5.7
Percentage of Units by Number of Bedrooms													
No bedroom	0.7	0.5	0.8	0.8	1.3	0.6	0.6	1.2	0.9	1.5	0.1	1.2	0.7
1 bedroom	2.6	5.0	4.5	4.8	5.7	3.7	2.5	10.9	5.2	3.8	4.5	3.0	5.7
2 bedrooms	14.4	30.4	24.4	31.8	30.9	24.4	27.5	25.1	27.5	31.7	32.6	27.5	24.5
3 bedrooms	49.7	52.3	47.1	52.4	47.3	50.3	53.0	39.1	54.4	48.1	48.1	52.9	48.6
4 bedrooms	22.6	10.5	17.7	8.7	12.3	16.6	12.9	19.1	9.5	11.9	11.2	12.7	16.1
5 or more bedrooms	10.0	1.4	5.5	1.5	2.5	4.3	3.5	4.5	2.7	3.0	3.5	2.7	4.3

Source: American Community Survey 2008-2010, 3-Year Estimates, Table DP04 (Selected Housing Characteristics)

The fact that Union County has higher than average housing costs is not necessarily a deterrent to growth. The higher cost for housing in Union County is also reflective of the larger size of housing units in the County. As shown in Table 5, Union County has the highest percentage of owner occupied housing, the highest percentage of single family detached housing and the highest median number of rooms per unit (a full 12 percent higher than the next highest county). Furthermore, nearly one-third of housing units in Union County have four or more bedrooms, much higher than typical for the CMSA. All of these housing characteristics suggest that the higher housing costs reflect the fact that housing in Union County is larger, newer and likely built to serve the higher income households moving to the county. Overall, then, the housing stock itself would be a positive indicator of future growth.

1.5 Growth Factor: School Quality

The quality of a school district is also an important factor driving household location decisions. Jack Dougherty[7] succinctly describes how public school quality helps to drive suburban growth:

> *"[S]hopping for schools" clearly became an important family strategy for upward mobility, as higher-salary positions increasingly depended on educational credentials, which in turn relied on the status of one's public school system. During the course of the twentieth century, suburban families became more conscious of this equation: buying a home in the "right" neighborhood in*

[7] Dougherty, Jack. "Shopping for Schools: How Public Education and Private Housing Shaped Suburban Connecticut." Journal of Urban History 28, no. 2 (March 2012): 205-224.

> *order to send their children to a "good" public school, would increase their odds of being accepted to a "top-ranked" college, and help them to land the "perfect" job.*

Other researchers have shown the strong correlation between school district quality and the value of housing, which shows the high demand for housing in good school districts. Theodore Crone notes, "home buyers seem to evaluate the quality of public education at the district level."[8] Finally, other researchers have noted that "[i]n towns where it is easy to build more housing, better quality schools do not lead to higher property values. Instead, they lead to more real estate development."[9]

Since most school districts in North Carolina and South Carolina conform to county boundaries, households, therefore, are likely to consider location decisions by county when "shopping for schools." Comparisons with York County schools are slightly more complicated as York County is divided into four separate school districts. Two major sources of data provide insight into the perceptions of quality of schools in the area, average SAT scores and the percentage of students graduating in four years. These factors are summarized in Table 6 and Table 7, respectively. SAT comparisons among the 16 school districts show that Union County has the second highest average SAT composite score and is the highest among the districts that cover whole counties. Similarly, Union County had the second highest rate of students taking the SATs, but first among districts that cover whole counties. Four-year graduation rates show the same dynamics, with Union County second overall and first among countywide school districts. These measures indicate that the Union County School District would be a highly desirable school district in which to locate for households concerned with public school quality. Therefore, demand for housing in Union County will be higher, particularly among families with school age children or families that anticipate having children in the near future.

[8] Crone, Theodore M. "Capitalization of the Quality of Local Public Schools: What Do Home Buyers Value?" Working Paper No. 06-15, Federal Reserve Bank of Philadelphia. August 2006.

[9] Sinai, Todd. "Feedback between Real Estate and Urban Economics." Journal of Regional Science, 50: 423-448. February 2010.

Table 6: Average SAT Scores for Major School Districts in the CMSA

School System	# Tested	% Tested	Math (M) Score	Critical Reading (CR) Score	Writing (W) Score	M+CR	M+CR+W
Anson County Schools	159	53.7	436	427	407	863	1270
Cabarrus County Schools	1169	65.3	522	497	483	1019	1502
Cleveland County Schools	589	58.6	500	470	451	970	1421
Gaston County Schools	1136	58.3	495	480	455	975	1430
Iredell-Statesville Schools	847	60.4	524	502	480	1026	1506
Lincoln County Schools	449	58.7	513	478	456	991	1447
Charlotte-Mecklenburg Schools	5240	68.5	507	495	480	1002	1482
Rowan-Salisbury Schools	676	51.9	495	474	453	969	1422
Stanly County Schools	339	57	495	465	442	960	1402
Union County Public Schools	1635	68.7	524	503	491	1027	1518
Chester, SC	93	27	491	451	453	942	1395
Lancaster, SC	399	54	454	440	423	894	1317
York 1	137	42	478	457	432	935	1367
York 2 - Clover	243	59	493	486	460	979	1439
York 3 - Rock Hill	645	54	482	470	455	952	1407
York 4 - Fort Mill	477	72	535	529	505	1064	1569

Sources: North Carolina State Board of Education, Accountability Services, Division SAT Report 2011; South Carolina Department of Education, Public School District Distribution Mean SAT Scores for 2011

Table 7: Four-Year Graduation Rate for Major School Districts in the CMSA

School System	Graduation Rate (%)
Anson County Schools	75.9
Cabarrus County Schools	84.1
Cleveland County Schools	73.2
Gaston County Schools	75.4
Iredell-Statesville Schools	85.1
Lincoln County Schools	81.6
Charlotte-Mecklenburg Schools	73.5
Rowan-Salisbury Schools	76.9
Stanly County Schools	77.9
Union County Public Schools	89.1
Chester, SC	73.1
Lancaster, SC	73.7
York 1	78.3
York 2 - Clover	77.3
York 3 - Rock Hill	73.5
York 4 - Fort Mill	91.2

Sources: North Carolina State Board of Education, Accountability Services Division, 4-Year Cohort Graduation Rates; South Carolina Department of Education, Annual School District Report Cards

1.6 Growth Factor: Commute Time

As the realtor survey shows, access to jobs is an important factor to household location decisions. The Census Bureau tracks travel time to work and comparisons among counties in the region are revealing. Table 8 summarized commute times for regional counties between 2000 and 2010. In 2010, the average commuting time for Union County residents (27.8 minutes) is about eleven percent higher than the regional (MSA) average of 25.1 minutes. Relative to other jurisdictions, Union County had the highest commute times in the region in 2000 and is a close third to Chester and Lancaster Counties in 2010. Compared to 2000, commute times for Union County residents and across the region are down slightly, except for Chester and Lancaster Counties in South Carolina. The raw decline in commute times is not as instructive as the relative differences compared to regional averages. The raw differences may be misleading due to changes in survey methods the Census has instituted from 2000 to 2010, specifically, the Census changed its methods in gathering data on this question. In Census 2000, questions regarding commute lengths and modes were included on the "long form", which 1 in 6 household received. For the 2010 Census, no "long form" was used and instead the American Community Survey has replaced it. The American Community Survey reaches fewer households but surveys annually. Since the survey methodology is different, direct comparisons are less revealing.

In 2000, Union County commute times were on average 29 minutes, just more than eleven percent higher than the regional average. Thus, over the last ten years, Union County has grown faster than any other county despite having some of the longest commute times in the region. Furthermore, average commute times for Union County residents have not risen dramatically, either in raw averages or in comparison to regional averages, during the past decade despite the significant growth in population within the county and region.

While it may seem counter-intuitive that households would choose to live where commute times are longer, research suggests, that within a reasonable range of commute time, households will choose locations based more on other preferences, such as school quality, neighborhood quality, affordability or other factors. In their summary of research on the impacts of transportation on land use, the National Research Council[10] noted the following:

> *Research on commuting patterns within the current distribution pattern of jobs and residences in the Los Angeles metropolitan area, however, indicates that commuting trips are two-thirds greater than would be required if workers were located in neighborhoods that minimized their commutes (Small and Song 1992). This indicates that a key assumption of location theory does not hold in practice. The excess commuting that occurs may be explained by preferences for neighborhoods with low crime rates or amenities such as schools; the difficulty of minimizing commutes for both workers in dual worker households; and other influences, such as racial discrimination (Giuliano and Small 1993; Mills 1994).*

[10] National Research Council. *Expanding Metropolitan Highways: Implications for Air Quality and Energy Use -- Special Report 245*. Washington, DC: The National Academies Press, 1995, p. 189.

Table 8: Average Commute Times for the Eight-County Region

	2010		2000	
County	**Mean Travel Time to Work**	**Difference from Regional Average**	**Mean Travel Time to Work**	**Difference from Regional Average**
Anson County	-	-	27.5	
Cabarrus County	26.0	3.6%	27.0	3.4%
Cleveland County	-	-	23.5	-
Gaston County	25.0	-0.4%	24.6	-5.7%
Iredell County	24.2	-3.6%	24.5	-6.1%
Lincoln County	-	-	27.1	3.8%
Mecklenburg County	24.7	-1.6%	26.0	-0.4%
Rowan County	23.2	-7.6%	23.3	-10.7%
Stanly County	-	-	25.3	
Union County	27.8	10.8%	29.0	11.1%
Chester County	28.1	11.9%	27.8	6.5%
Lancaster County	27.9	11.1%	27.0	3.4%
York County	24.0	-4.4%	27.2	4.2%
Charlotte MSA	25.1		26.1	

Notes: 2010 Travel Time data not available for Anson, Cleveland and Lincoln Counties.
Sources: 2000 Census Summary File 3, American Community Survey 2008-2010 3-Year Estimates Table S0802

1.7 Growth Factors Conclusions

The data presented here demonstrate a number of key points underpinning the No-Build Alternative forecast used in the Monroe Connector/Bypass ICE analysis. The forecasting process identifies the key factors that drive the distribution of growth within an economic region, and income and land availability are primary. A review of updated data from the 2010 census reveal that the MRM 2009 Forecasts are very close, despite the economic slow-down that occurred in the second half of the 2000-2010 decade, and they are the most accurate among available data sources. The 2010 Census data also show that Union County has a clear advantage among counties in the region in attracting growth on the basis of income, land availability, and several other factors that drive household location decisions. These insights provide a strong basis for the assumption in the ICE analysis that the MRM forecasts are reasonable for a No-Build Alternative. For the past decade, Union County has exhibited strong growth, and the factors driving those trends are poised to continue attracting growth to Union County regardless of whether the Monroe Connector/Bypass is constructed.

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Appendix C
Kenan Institute Report

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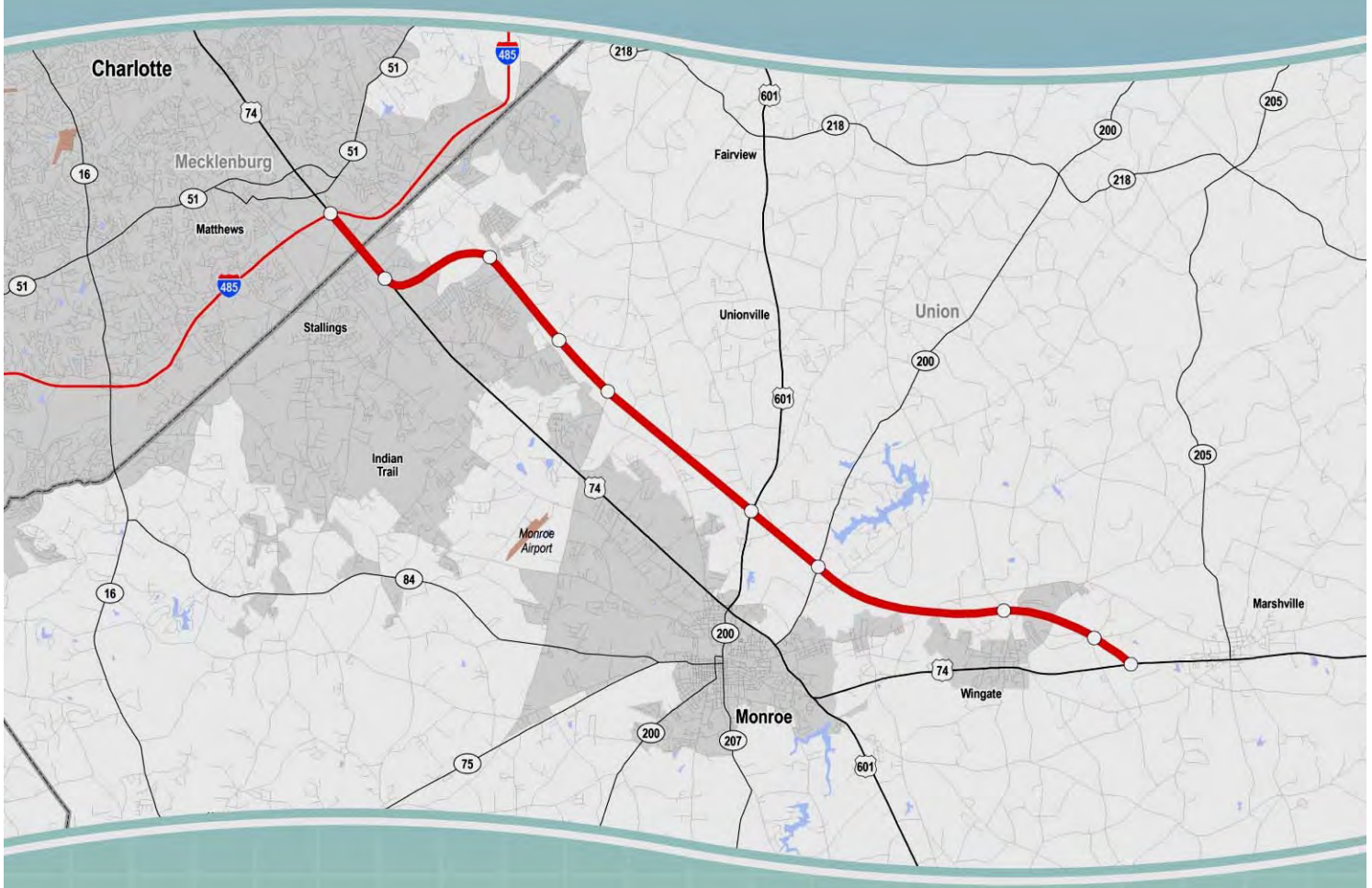
Technical Memorandum

Proposed Monroe Connector/Bypass Comprehensive Traffic and Revenue Study

Report of Independent Economist



NORTH CAROLINA
Turnpike Authority

Report of Independent Economist

Initial Report: *September 28, 2009*

Updated Report: *March 1, 2010*

Technical Memorandum

Proposed Monroe Connector/Bypass Comprehensive Traffic and Revenue Study

Initial Report of Independent Economist

Prepared For

NORTH CAROLINA Turnpike Authority

Prepared By

Kenan Institute of Private Enterprise
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ENGINEERS PLANNERS ECONOMISTS
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September 28, 2009

Evaluation of the Socio-economic Estimates Underlying the Study of the Feasibility of the Proposed Monroe Connector/Bypass

Report to North Carolina Turnpike Authority

Prepared by the Kenan Institute of Private Enterprise
University of North Carolina at Chapel Hill

for

Wilbur Smith Associates

28 September 2009

Stephen J. Appold

and

John D. Kasarda

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Evaluation of the Socio-economic Estimates Underlying the Study of the Feasibility of the Proposed Monroe Connector/Bypass

Prepared by the Kenan Institute of Private Enterprise
University of North Carolina at Chapel Hill

28 September 2009

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Evaluation of the Socio-economic Estimates Underlying the Study of the Feasibility of the Proposed Monroe Connector/Bypass

Abstract

The Charlotte Region has consistently been among the nation's most rapidly growing metropolitan areas. Much of the population and employment growth has been concentrated in Mecklenburg County, which contains the City of Charlotte. Over the past decade or so, residential growth has begun flowing over county lines, especially into Union County, exacerbating traffic congestion and intensifying the need for a rapid means of long distance travel and commuting.

Aside from long-term growth trends, the Charlotte Region has undergone a recent boom which, like the rest of the country, has been undergoing a correction which has had dramatic effect on employment and population. The economic correction is expected to have a permanent effect on the U.S. economy and thus on the Charlotte Region. Nevertheless, the region is expected to continue to grow, albeit at a somewhat slower pace than in recent years.

Union County can be expected to continue to attract a growing share of residential development. The county offers a competitive residential option bolstered by quality schools and attractive prices. The Connector/Bypass is likely to accelerate population growth in the county and the county government is adding water and wastewater infrastructure capacity to the Connector/Bypass Corridor in anticipation of rapid growth.

Evaluation of the Socio-economic Estimates Underlying the Study of the Feasibility of the Proposed Monroe Connector/Bypass

Prepared by the Kenan Institute of Private Enterprise
University of North Carolina at Chapel Hill

28 September 2009

Introduction

The North Carolina Turnpike Authority is considering the construction of a limited access tolled facility in the Charlotte metropolitan region that would reach approximately nine miles from U.S. 74 near exit 51 of the I-485 ring road in Matthews southeast to rejoin U.S. 74 between Wingate and Marshville. The proposed Connector/Bypass would serve two functions. First, it would connect a popular, rapidly-growing suburban residential area to employment concentrations in center-city ("Uptown") Charlotte, along the I-485 beltline in the University Research Park and Ballantyne, and other areas. Second, it would serve as a conduit for long distance traffic between Charlotte and areas towards the coast. That long distance traffic is primarily comprised of trucks going to and coming from the Port of Wilmington and recreational beach traffic to and from the Wilmington and Myrtle Beach resort areas. Both local and long distance traffic is hampered by insufficient roadway capacity and the resulting congestion along U.S. 74 between Matthews and Monroe in Union County. In order to accelerate the construction of the long-proposed Monroe Connector/Bypass, the North Carolina Turnpike Authority has suggested that the possibility of financing the road through a bond issue backed by tolls be considered. Map 1 shows the recommended route of the Connector/Bypass.

(Map 1 about here)

Wilbur Smith Associates has been asked to assess the feasibility of toll-backed financing for the Monroe Connector/Bypass described in the previous paragraph. Their analysis is based on 1) the Regional Travel Demand Model developed and maintained by the Mecklenburg-Union Metropolitan Planning Organization (MUMPO), 2) expert knowledge about travel behavior accumulated over several decades of analysis, 3) supplemental studies of trip origins and destinations and of traveler willingness-to-pay tolls, and 4) small area socio-economic estimates prepared by the Metropolitan Planning Organizations (MPOs). As they constitute critical inputs into the modeling process, the Kenan Institute of Private Enterprise at the University of North Carolina's Kenan-Flagler Business School has been asked to independently review the socio-economic estimates prepared under the leadership of MUMPO.

The Kenan Institute has reviewed the socio-economic estimates that were used in Wilbur Smith Associates' preliminary study of the proposed Connector/Bypass.[1] On the basis of independent analysis including the quantitative analysis of diverse

[1] "Proposed Monroe Connector Preliminary Traffic and Revenue Study, final Report," Wilbur Smith Associates for North Carolina Turnpike Authority. 11 October 2006.

sources of data and extensive interviews with knowledgeable informants, the Kenan Institute has adjusted the MPO estimates to reflect current long-term growth prospects for the region and revised small area growth expectations for Union County.

Critical questions for this report

We reviewed the employment and population growth prospects for North Carolina's Charlotte Metropolitan Region with special attention devoted to the proposed Monroe Connector/Bypass Corridor. This region consists most broadly of the 16-county Charlotte-Gastonia-Salisbury Combined Statistical Area. In the report, we focus on the overall region and, for substantive and practical reasons, on progressively smaller areas: the six-county Charlotte-Gastonia-Concord Metropolitan Statistical Area, a four-county core region (Cabarrus, Gaston, Mecklenburg, and Union Counties), and on Union County until we reach the Connector/Bypass Corridor itself. [2]

The Connector/Bypass Corridor is built up from Traffic Analysis Zones (TAZs) along the Connector/Bypass route, reaching from Matthews in southeastern Mecklenburg County through Stallings, Indian Trail, Henby Bridge, Lake Peak, Unionville, Monroe, Wingate, and Marshville in Union County.[3] The Connector/Bypass corridor also abuts or includes small portions Fairview, Weddington, and Wesley Chapel in Union County. The Connector/Bypass Corridor is a major commuter shed in the Charlotte Metropolitan Region. The Connector/Bypass has the potential to accelerate growth in this area by reducing travel time. Map 2 shows Union County municipalities and the study corridor along the proposed Connector/Bypass route.

(Map 2 about here)

Long distance traffic would either continue along U.S. 74 towards major destinations in Wilmington or turn off the Connector/Bypass at U.S. 611 to travel towards the Myrtle Beach area. The Connector/Bypass will become an important component of two North Carolina Strategic Highways Corridors: Corridor 23 which connects Charlotte and Florence SC via U.S. 74 and U.S. 601 and Corridor 24 which links Charlotte and Wilmington via U.S. 74. (The NC Department of Transportation numbers the corridors from west to east.)

Because one of the primary functions of the proposed Connector/Bypass is to connect a center of generally high-wage employment to one of several possible areas of residence, the three central questions for this report are:

[2] The Regional Travel Demand model covers an area intermediate in scope between the Combined Statistical Area and the Metropolitan Statistical Area. It includes Cabarrus, Gaston, Lincoln, Mecklenburg, Rowan, Stanly, Union, York (SC) Counties as well as parts of Cleveland, Iredell, and Lancaster (SC) Counties. The MPO region-wide projections include an area that approximates the CSA.

[3] The Corridor is an analyst's construct approximating the area where travel behavior is most likely to be influenced by the new roadway. We use it to orient our efforts and as a discussion aid. The formal traffic analysis is built on the full Traffic Demand Model region.

1) How many people will work in the core Mecklenburg County employment areas and elsewhere over the next several decades – specifically in 2010, 2015, 2020, 2025, 2030, and 2035?
2) How many people will live in the central Union County communities that may be served by the proposed expressway?
3) Because income affects the value of time and thus willingness-to-pay, what are the income levels of those working in the core Mecklenburg employment areas and commuting to central Union County?

These questions are addressed mainly in detailed datasets. We provide a general overview of the region, its recent past and future, and of our methodologies in this report while providing on overview of our adjustments and the reasoning and evidence behind them.

Because long distance commuting is common in the Charlotte Region, we consider the potential growth of all major employment centers in the region. Because Union County is only one of the residential options available to those working in the core Mecklenburg County area, we also consider the potential growth of alternative residential areas. Finally, because the number of jobs and residences in any of these areas depends upon the total in the region, we consider the growth prospects of the region as a whole.

Because the other primary function of the proposed Connector/Bypass is to facilitate long distance travel between Charlotte and selected regions, we also address two additional questions:

4) What socio-economic developments in the Charlotte Metropolitan Region and elsewhere will affect long distance freight traffic in the Connector/Bypass Corridor?

5) What socio-economic developments in the Charlotte Metropolitan Region and elsewhere will affect long distance recreational traffic in the Connector/Bypass Corridor?

These last two questions are addressed mainly, albeit incompletely, in the report narrative because they largely fall outside the Charlotte Region Travel Demand Model. Moreover, while the North Carolina Department of Transportation does maintain a dataset of traffic counts, there is apparently no statewide transportation model. The Federal Highway Administration does maintain a nationwide inter-regional transportation model but the Connector/Bypass Corridor is not a major component of that model.

Methodology

We employed two basic methodologies in preparing this report. First, we developed a set of projections for the region, beginning with national economic and population projections and an overall projection for the region and model-driven methods of employment and population allocation within the region. As a basis for these projections, we reviewed recent employment and population trends. We discuss

the prospects for the future and model employment and population at critical time periods.

The assumptions underlying the projection are supported by a review of the literature on the "competitiveness" of the region and of the trends in the key industries that form the region's economic base. We also interviewed several area experts to check our beliefs and to increase our faith in our assumptions and predictions.

Second, we reviewed a set of small area allocations of county growth totals developed under the coordination of the Mecklenburg-Union Metropolitan Planning Organization (MUMPO) in cooperation other regional planning organizations (Cabarrus-Rowan MPO, Gaston Urban Area MPO, and Rock Hill-Fort Mill MPO with the assistance of Lake Norman RPO, Rocky River RPO, and other organizations) and the constituent counties and municipalities. Because of their immediate relevance to the proposed Connector/Bypass, we concentrate on the small area projections for Union County and the Connector/Bypass Corridor, in particular.

MUMPO's small area projections were based on a formal model and then modified through a process of consultation among a panel with expert knowledge of development trends and factors in Mecklenburg and Union Counties, respectively. The result should be a set of projections which incorporates both systematic and contextual knowledge. Nevertheless, we found that key aspects of Union County's small area projections are now discounted by knowledgeable planners.

Part of our review of the MPO projections entailed an evaluation of the basic assumptions upon which the projections have been made. Another component of our review consisted of a set of interviews with planners and developers assessing the contingencies that could affect the projections.

Our basic assessment of the MPO socio-economic projections is twofold. First, although the region-wide projections were prepared with an unusual degree of competency and care, they may have been over-adapted to new information during the boom years which followed. Now, the region-wide projections need to be adjusted to reflect the large, unforeseen national and global economic correction. Second, despite the formal model underlying them, the allocations of growth among small areas (TAZs) may have been unduly influenced by the give and take of collaborative discussion. The projected Union County growth needs to be reallocated among the small areas to reflect the operative systematic development factors.

The following sections of the report describe the trends that supported the MPO projections, specific aspects of the national recent economic crisis necessitating adjustment, and outline resumed, but somewhat diminished, regional growth. The process by which the MPO forecasts were generated and how information was used to adjust the projections is also provided. Before concluding, the report discusses some information relevant to forecasting extra-regional traffic.

Past Trends in Charlotte Metropolitan Region Development

The Charlotte Metropolitan Region (here defined by the Bureau of the Census as the Charlotte-Gastonia-Concord, NC-SC Metropolitan Statistical Area) consists of six counties, Mecklenburg County NC, four adjacent counties: Cabarrus County NC to the northeast, Gaston County NC to the west, Union County NC to the southeast, and York County SC to the southwest, and one additional county, Anson County NC, to the east of Union County. The larger region of the Charlotte-Gastonia-Salisbury, NC-SC Combined Statistical Area consists of the Metropolitan Statistical Area plus seven additional micropolitan areas: the Albemarle NC Micropolitan Statistical Area (Stanly County) to the east of Mecklenburg County, the Chester SC Micropolitan Statistical Area (Chester County) to the south of York County, the Lancaster SC Micropolitan Statistical Area (Lancaster County) to the south of Mecklenburg and Union Counties, the Lincolnton NC Micropolitan Statistical Area (Lincoln County) to the northwest of Mecklenburg County, the Salisbury NC Micropolitan Statistical Area (Rowan County) to the northeast of Mecklenburg County and north of Cabarrus County, the Shelby NC Micropolitan Statistical Area (Cleveland County) to the west, and the Statesville-Mooresville NC Micropolitan Statistical Area (Iredell County) immediately to the north of Mecklenburg County.

The Charlotte Metropolitan Region covers 3,148 square miles or 6,590 square miles as the Metropolitan Statistical Areas or Combined Statistical Area, respectively, at the southwestern end of the urban Piedmont Crescent that arcs through North Carolina. The area has a mild four-season climate and a rolling topography. Map 3 provides an overview of the Charlotte Metropolitan Region.

(Map 3 about here)

The City of Charlotte in Mecklenburg County is the largest and most economically dynamic portion of the larger region. The Charlotte Region maintains a central orientation that is unusual in contemporary metropolitan geography. The revival of Charlotte's "Uptown" has strengthened the centrality of the city even as its employment core has been complemented by the University Park complex near the intersection of I-85 and I-485 and other smaller employment concentrations. The proposed Monroe Connector/Bypass will strengthen that centrality by improving access to a large, popular residential area and by improving long distance transportation to growing coastal areas .

The region has a diverse economy which is still transitioning from old to new. Charlotte is perhaps best well-known for its status as a retail banking headquarters city and was, for a time, the second-largest home of deposits nationwide. The acquisition of Wachovia by Wells-Fargo will do little to change that status as Wells Fargo has decided to maintain Charlotte as an East Coast coordination center for retail banking. Besides the Bank of America and Wells-Fargo, TIAA-CREF has a major facility in Charlotte, as do Wells Fargo Mortgage and BB&T.

Charlotte also acts as a regional service and distribution center for much of the Piedmont and, indeed, the Southeast. With its central location at the intersection of I-85 and I-77 and a busy hub airport, it is sometimes seen as a less-expensive, less-congested, and more livable alternative to Atlanta. Accordingly, both business

services (centered in Uptown, University Park, and the several smaller office parks) and distribution and warehousing (often along I-77, especially near Charlotte-Douglas Airport) are well-represented in regional employment.

The Charlotte Region is also home to both old and new manufacturing centers. Charlotte maintains the largest manufacturing center in the Carolinas. The remnants of the textile industry still serve as declining sources of employment. At the same time, advanced manufacturing in several sectors has taken root in the region with defense and high technology being well-represented. Much of the manufacturing employment is located in small dispersed concentrations around the region, including Monroe.

With an increase in population of 100,103, Charlotte added, by far, more population than any other North Carolina municipality between 2000 and 2005. (We focus on 2005 to correspond with the MPO data baseline year.) Mecklenburg added more population over the same period than any other North Carolina county except Wake. As Charlotte and Mecklenburg County are increasingly densely settled, population growth spilled over into other municipalities and counties. Union County's population expanded by 29 percent – from 123,772 to 160,048 – during that period, making Union County, the location of the Connector/Bypass Corridor, possibly the most-rapidly growing of North Carolina's 100 counties.

The region's population growth is reflected in the expansion of selected municipalities. Concord (in Cabarrus County), Indian Trail (Union County), Huntersville (north Mecklenburg County), Monroe (Union County), and Stallings (Union County) each added at least 5,000 between 2000 and 2005. Cornelius (north Mecklenburg County), Mooresville (Iredell County), , Gastonia (Gaston County), Matthews (Mecklenburg County), Kannapolis (Cabarrus County), and Mint Hill (Mecklenburg County) each added at least 3,000 during the same period.

Stallings, Marvin, Indian Trail, Wesley Chapel, Mineral Springs, Wingate, Unionville, Lake Park, Waxhaw, Weddington, Monroe, Hemby Bridge, Marshville, all in Union County, added population at at least twice the state's growth rate between 2000 and 2005. The same can be said for nearby Mint Hill and Matthews in Mecklenburg County, Pineville along the I-485 beltline, and Cornelius and Huntersville in the northern portion of the county. Mooresville in Iredell County also was a prominent growth pole. Most of these municipalities grew at a more rapid rate than Charlotte which also doubled the state's 7.9 percent growth over the period. Regional population growth is quite dispersed although there is a notable concentration of growth in Union County municipalities.

Many of these municipalities are concentrated in the Monroe Connector/Bypass corridor stretching southeast from the intersection of U.S. 74 and the I-485 beltline in Matthews. Most of the municipalities are products of Charlotte's suburban extension into Union County. Although there is a regional hospital and health complex in Monroe as well as a growing industrial area surrounding Monroe Airport, Union County's growth so far has been mainly fueled by employment growth in the City of Charlotte. Accordingly, residential land use is heavily represented while employment and retail opportunities are comparatively lacking.

The County is sometimes marketed as "South Charlotte" and, especially the area along NC 16 to the west, is often seen as an extension of the attractive residential area to the south of Uptown which reaches all the way to the Mecklenburg County line and beyond into Union County. The Union County school system is seen as an attractor for those who do not send their children to private schools. Many believe the Union County system provides a better education than that offered by Mecklenburg, which is an extremely large system educating over 137,000 students. Union County has been one of the fastest-growing counties in the state and the area from the Connector/Bypass Corridor to the west has been one of the region's most important residential growth regions.

With that brief overview as background, we more systematically discuss the historical trends in regional population, housing, and employment. We also examine the impact of these trends on land use and commuting patterns. Finally, we place Charlotte Region population and employment trends in a broader context, relativizing the rate of growth and its drivers.

Population

As of 30 June 2005, an estimated 2,124,260 people called the Charlotte Metropolitan Region (Charlotte-Gastonia-Salisbury, NC-SC Combined Statistical Area) home. That number is more than sixty percent larger was in 1980 (1,299.880), twenty five years ago. Table 1 shows population trend data for the U.S., North Carolina, its two major metropolitan areas, and selected components of the Charlotte region. North Carolina's share of the national population has been growing steadily for several decades from 2.59 percent of the national population in 1980 to 2.93 percent in 2005.

(Table 1 about here)

North Carolina's major population growth centers anchor opposite ends of the state's Piedmont I-40/I-85 growth crescent. The greater Charlotte metropolitan area (Charlotte-Gastonia-Salisbury CSA) is the larger of the two. In 1980, the Charlotte Region accounted for 22.05 percent of the state's population. By 2005, its share had increased to 24.48 percent. The Charlotte Region has been responsible for an increasing share of the population of a growing state.

The region's core has been growing more rapidly than the region as a whole. The Charlotte-Gastonia-Concord MSA accounted for 66.10 percent of the region's population in 1980. By 2005, it accounted for 71.66 percent. Within the MSA, Mecklenburg's share of the larger region's population increased steadily from 31.25 percent in 1980 to 37.77 in 2005. Union County's share of the regional population increased from 5.45 percent to 7.57 percent over the same time period. With an average annual growth rate of 3.28 percent between 1980 and 2005, Union County's population growth rate is two-thirds higher than that of the entire region. Figure 1 shows the trend in state population shares for the two metropolitan areas and selected Charlotte Region counties.

(Figure 1 about here)

Mecklenburg County has captured almost half of the region's population growth recently (rising from one-third three decades ago). Union County's share of regional population growth has risen from approximately ten percent three decades ago to nearly 15 percent in recent years as the suburban frontier has moved progressively outward. As noted above, the municipalities along the Connector/Bypass Corridor have been among the most rapidly growing in the state.

Housing

The growth in population necessitated housing construction. An annual average of over 16,957 residential building permits were issued annually for the two decades through 2005 (20,013 annually for the decade 1996-2005) in the Charlotte Region (here defined as the six-county MSA). Figure 2 shows a boom in housing between slumps in new construction in the early 1990s and early this decade before the recent strong decline. The slump continues until the present.

(Figure 2 about here)

As seen in Figure 2, housing additions closely followed population growth with Mecklenburg and Union playing prominent roles. The proportion of housing added in Mecklenburg exceeds its population size due to its attraction to smaller households. Roughly 30 percent of that county's new housing stock has been in multi-family dwellings in recent years. In contrast, nearly all of Union County's housing stock has been single-family houses.

Figure 3 shows the allocation of building since 1950 among the major regions of Union County. These regions are made up of the present boundaries of municipalities and the remaining unincorporated areas. Anticipating the discussion of a later section, growth in all areas levels off around 2006 after a rapid rise. Note the prevalence of growth in unincorporated areas. Many of these may be subsequently annexed by a municipality. Despite widespread steady growth, earlier this decade, Indian Trail, which is now the most populous municipality in Union County, shot past the City of Monroe in size. Stallings also became prominent in the early part of the decade.

(Figure 3 about here)

Figure 4 repeats the analysis for the five zones of the Connector/Bypass Corridor beginning in Mecklenburg County and working progressively southeast. (See Map 2 for the zones.) As mentioned above, as Charlotte has grown, residential development has pushed progressively further outward. Over the past decade, residential growth in Zone 1, which straddles the Mecklenburg-Union County line, has skyrocketed, nearly doubling the housing stock in that area to approximately 15,000 homes. Zone 2, inside Union County grew even more rapidly. The housing stock has grown steadily, but not as rapidly, in Zone 3 which also includes the western reaches of the City of Monroe. Zone 4, which includes central Monroe, and Zone 5, which is the area beyond Monroe, have not grown quite as quickly.

Residential growth in the outlying zones of the Connector/Bypass Corridor is likely to accelerate as the suburban frontier continues to advance and the road is constructed.

(Figure 4 about here)

We used information contained in parcel files obtained from Mecklenburg and Union Counties to calculate the residential density of newly constructed homes. Figure 5 tracks the changes in dwellings per acre from 1950 for the Connector/Bypass Corridor. Residential density was calculated from the deeded acreage for each housing unit and categorized to attenuate the effects of extreme outliers. As the suburban frontier has advanced outward, lot size has decreased. Residential density of recent new housing in the first three Connector/Bypass Corridor zones is now approximately 6 dwellings per acre. In the more distant zones, density has yet to increase. As noted above, in Union County, virtually all recent housing has been in the form of single-family dwellings. In general, Union County densities are lower than in Mecklenburg County.

(Figure 5 about here)

In line with regional and national trends, dwelling size has been on a gradual upward trajectory. The new housing in the close-in zones may be somewhat larger than in the other zones as fill-in development serves a more upscale market by compensating for the smaller lot size. Differences among regional areas are relatively small with the exception of the unincorporated portions of Union County and the Union County municipalities to the west of the Connector/Bypass Corridor (not shown). Those areas seem to attract a disproportionate share of large homes. Figure 6 charts the average size of dwelling by the year in which it was built for the Corridor.

(Figure 6 about here)

In general, housing closer in is valued more highly than housing further out – but the differential is less than what might be expected. Figure 7 graphs average contemporary tax valuations for homes according to the year they were built. The small areas and limited number of homes built in particular years lead to marked spikes in value especially in earlier years. Comparisons are complicated because the two counties use different valuation metrics. Nevertheless, consistent with the previous figures, the housing in the Connector/Bypass Corridor is less expensive, but more dense, and plentiful than in other areas of Union County.

(Figure 7 about here)

The appeal of the further reaches of the Connector/Bypass Corridor appears to be not price *per se* but "house for the money." The preceding analysis has discussed history but the past trends provide clues to future growth. As Charlotte's growth resumes and the suburban frontier advances, residential building in the Corridor is likely to be increasingly rapid with a gradual increase in density.

Employment

In 2005, an estimated 1,275,910 people worked in the Charlotte Region. Table 2 complements Table 1 by showing the trends in employment. As shown, in 2005 there was an increase of 563,000 over the number employed in 1980. North Carolina's share of national employment has increased over the last several decades from 2.68 percent in 1980 to 2.96 percent in 2005 – a somewhat more modest expansion than the population increase. In 1980, the Charlotte Region accounted for 23.28 percent of the state's employment. By 2005, its share had increased to 24.77 percent. The Charlotte Region has been responsible for an increasing share of the employment of a growing state. Regional informants suggested that the region's economic competitiveness has attracted employment and consequently driven the population changes outlined above.

(Table 2 about here)

Charlotte Region employment has fared relatively well over time and through the last recession cycle. The region's employment was flat (but barely declined) in the 2001 recession and quickly recovered. Until recently, the region has been recession-resilient.

With respect to employment too, Mecklenburg County has been growing more rapidly than the region as a whole. Most of that growth has been within Charlotte's city limits. In 1980, Mecklenburg County organizations employed 291,910. By 2005, the number had increased almost two-and-a-quarter-fold to 648,470. Mecklenburg County employment increased at an annual rate of 3.19 percent between 1980 and 2005 and of 2.63 percent between 1990 and 2005. Its share of regional employment rose from 40.97 percent to 50.82 percent. Figure 8 follows regional employment shares.

(Figure 8 about here)

A roster of the Charlotte Region's largest employers reflects its diverse economy. Banking is, of course, well represented, as is distribution, and manufacturing. The 14th-largest firm is a textile manufacturer. The list of firms also reflects the impact of population-serving employment. (Government and public education establishments have been removed from the list.) Table 3 lists the 95 firms reporting at least 1,000 employees.

(Table 3 about here)

Map 4, created from MUMPO data, shows the regional distribution of employment by TAZ. Uptown is partially obscured by the TAZ boundary lines. Other important employment concentrations, including University Park, the airport area, and areas in southwest Mecklenburg can be seen.

(Map 4 about here)

Land use

Population growth and employment increase imply the need for land. Like many metropolitan areas, the Charlotte Region has been expanding geographically faster than it has been adding population and jobs. Charlotte Region development has been fairly dispersed. Map 5 shows the physical development of the core portion of the region at selected periods of time. The maps were developed by a research effort at the University of North Carolina at Charlotte's Urban Institute. Like many metropolitan areas, expansion has extended outward rapidly. As can be seen in the series of maps, Union County and the Connector/Bypass Corridor have been key regions of development.

(Map 5 about here)

The Urban Institute's research traces whether land is developed or not over time. They did not record the nature of the land use. We supplement their longitudinal analysis with a snapshot of contemporary land use in Mecklenburg and Union Counties. Because redevelopment is slower and more costly than greenfield construction, future development is likely to fill in selected undeveloped parcels or be near the suburban frontier.

Using the parcel files for Mecklenburg and Union Counties, we made a first assessment of land use in those two counties, the Connector/Bypass Corridor, and selected other areas of the two counties. We categorized a parcel as "developable" if there was no use recorded for the piece of property or residential density was less than one dwelling per five acres and, somewhat arbitrarily, "prime developable" if such a parcel was 25 acres or more in area. A portion of that land may, in fact, be unsuitable for development because of unmeasured factors. With that caveat in mind, Table 4 summarizes the distribution of land uses in the two counties.

(Table 4 about here)

Almost two-thirds of the land in the two-county area is still eligible for development. The proportion of developable land differs between the two counties but not by much. The difference is larger with respect to the prime developable land; Union County has twice as much as Mecklenburg. More immediately, the amount and proportion of developable land increases with distance from Uptown Charlotte. Moreover, the majority of the developable land in Zone 1, which straddles the county line, is in small lots, suggesting a need for more expensive infill development. Map 6 displays the land use categories for parcels in Union County.

(Map 6 about here)

The Connector/Bypass Corridor has significant land reserves available for residential and commercial development in the form of vacant land, rural residences with a significant amount of under-utilized land, and, to a lesser extent, farmland. Over half of Corridor land remains to be developed. Most of that land is in large parcels. That availability does not imply that any particular parcel will or should be developed but it does suggest that land is available, should a demand arise through an increasing population.

Commuting patterns

Those are the major outlines of the geography, population, and employment in the Charlotte Metropolitan Region. The region is held together by automobile travel. Almost all those economically active (93.8 percent according to the 2000 Census) make their journey-to-work by automobile; almost 80 percent of those employed ride alone. Many of those traveling to work cross county lines. Map 7 summarizes regional county-to-county journeys to work as of the time of the 2000 Census.

(Map 7 about here)

Because it is the geography that most closely approximates the Connector/Bypass Corridor for which data are available, Union County is examined more closely. Of the 61,217 people living in Union County and working outside their homes, 53.3 percent worked in Union County. A proportion almost as large, 40.7 percent (24,892) commuted to Mecklenburg County. Union County added almost 10,000 commuters to Mecklenburg County (up from 14,949 according to 1990 Census counts) during the 1990s. With the growth trends over the first part of this decade, the number has been increased.

The years since the last Census have included additional residents accelerating the need for additional roadway capacity. Unfortunately, relief from improved public transportation does not seem imminent. While Charlotte has a large and successful public transportation system that has attracted national attention, the system has no plans to extend major capacity to the Connector/Bypass Corridor. For the residents of the Corridor, improved roads are the most likely solution to their transportation needs.

The Charlotte Region growth in context

Charlotte's growth can perhaps be best understood in the context of its peers. It is, however, unclear which regions may be in its peer group. As noted above, Charlotte has a diverse economy with at least three largely independent drivers. It is: a banking industry headquarters center with its related support services, a regional goods and service distribution center serving the Southeast's Piedmont region and, to a lesser extent, the entire Southeast, and a center of old and new economy manufacturing. As such, its economy and population growth have depended upon the historical strength in banking and the fortunes of two banks in particular, the overall growth of the U.S. Southeast, and upon an environment that has continued to be conducive to manufacturing, respectively.

Two peer groups were chosen using 1950 as a baseline. That year roughly marks the beginning of the geography of post-World War Two automobile and truck-based growth patterns. To be sure, those patterns have a prior history of several decades and, as can be seen in the growth patterns, subsequent factors have had their effects but 1950 is a serviceable point of departure.

The first peer group is the largest 50 metropolitan regions in 1950 (using contemporary definitions of Combined Statistical Areas). Ranked twenty-third, Charlotte is in the middle of this group. Figure 9 shows the subsequent growth

trajectories of this group. Charlotte's trajectory is highlighted. The figure indicates that although it was by no means the most rapidly-growing metropolitan region, Charlotte has raised its ranking among this group.

(Figure 9 about here)

That assessment is corroborated by the graph of regional population growth rates for the same group of regions charted in Figure 10. Charlotte's regional growth is in the "middle of the pack." The regional growth rate begins at a respectable, but moderate, rate and apparently accelerates as those of other large metropolitan regions begin to diminish over the most recent decades.

(Figure 10 about here)

A second peer group, the 25 most rapidly growing metropolitan regions since 1950, provides further evidence. Figure 11 tracks the population of these areas since 1950. Again, with its consistent growth, Charlotte is one of America's more dynamic growth poles but not among the peak performing regions.

(Figure 11 about here)

The Charlotte Region can be somewhat crudely characterized as being "towards the bottom of the top" both in size and in growth. The region's growth might be stronger if it more closely approximated a greenfield site, as some of the Western metropolitan regions such as Las Vegas do, but, as discussed above, Charlotte has a heavy representation of old economy manufacturing, such as textiles, which has been a source of employment decline for decades.

Because the region's economic competitiveness was thought to be an important source of its growth, the sources of Charlotte's competitiveness were explored with a series of shift-share analyses that decompose employment growth into the sum of national growth trends, industry-specific growth differentials, and regional competitive factors. A region can grow more quickly than average because it has a favorable industry mix, disproportionate regional strengths, or a combination of the two. Three sets of peer groups were used as the baseline for comparisons: all metropolitan areas, metropolitan areas in the Southeast, and mid-sized and smaller metropolitan areas in the Southeast. The results of the analyses are shown in Table 5.

(Table 5 about here)

Available data allows analysis across two peak-to-peak business cycles. According to the National Bureau of Economic Research's business cycle committee, the U.S. economy peaked in the third quarter of 1990 and again in the first quarter of 2001 and the fourth quarter of 2007. Although different metropolitan economies may be affected somewhat differently across the business cycle, comparing comparable positions in the business cycle avoids confusing artifacts of cyclical growth and decline with secular trends.

The first point to re-emphasize in the table is that Charlotte's economy is relatively diverse. Although Charlotte is known for banking, financial activities

account for only ten percent of total employment. That is higher than the national metropolitan average but far less than might be expected given Charlotte's prominence in the sector. In line with the Piedmont's reputation, Charlotte also has an over-representation of manufacturing employment. Education and health are comparatively under-represented.

The second point to notice is that Charlotte's sectoral mix is not especially favorable to growth. Based on national and industry growth trends alone, Charlotte's employment growth would have been lower than it was. During the first business cycle, 1990-2001, Charlotte Region employment increased by 153,117 (29.65 percent). Had Charlotte's employment been determined solely by national and sectoral trends, the increase would have been only 85,395 – 55.77 percent of what it actually was. In the second business cycle examined, 2001-2007, regional employment increased 74,328 (11.10 percent). Without Charlotte's competitive effects factored in, the employment increase would have been 33,304 – 44.81 percent of the actual increase. While the shift-share analysis cannot identify the favorable factors, the Charlotte Region obviously offers significant location benefits. Regional informants sometimes noted the cost advantage of the Charlotte Region compared to business location alternatives.

The third point to notice is that, compared to the set of all metropolitan regions, Charlotte is competitive. Its economy has performed well in a shrinking (in terms of employment) industry – financial services – because it has been the site of bank consolidation. A key question now, addressed below, is what will happen now that the region is no longer a primary employment beneficiary of the sector's mergers and acquisitions. Several industry insiders and outside observers have suggested that, in the future, banking will grow more modestly than it recently has.

Charlotte's employment in professional services has grown but, during the second business cycle examined, it has not grown as quickly as might be expected. The region has shown a negative competitive advantage in that area. Due to the slowdown in growth during the second business cycle, construction also showed negative competitive effects. The negative competitive effects for manufacturing, due to the continuing decline of legacy sub-sectors, continued throughout the entire period.

Although the region's economy has performed well, as the peer group shifts to the Southeast and then to mid-sized and smaller metropolitan areas in the Southeast, Charlotte's relative strengths appear to diminish. The regional shift effect contributes 67,722 jobs during the first business cycle and 41,024 during the second when all metropolitan areas are used as the baseline for comparison. The regional differential changes to 8,914 and 46,304, respectively, when metropolitan areas in the Southeast are used as a baseline for comparison and 26,745 and 4,646, respectively, when mid-sized and smaller southeaster metropolitan areas are used as the baseline. This suggests that Charlotte's growth is largely an outcome of larger forces that favor the mid-sized metropolitan areas of the Southeast as a group, rather than factors specific to the region. Once several of the long-time economic trouble spots of the South are excluded, Charlotte's apparent competitive differential may decline further. None of this analysis detracts from Charlotte's economic performance. Rather, it places that performance in the context of the entire region.

Summary

The preceding analysis reveals a region showing solid, but not spectacular, growth. As noted (but not demonstrated) the Charlotte Region may have undergone a cyclical boom over the past several years and portions of that boom may have been mistaken for the workings of a long-term secular trend. We now examine selected aspects of the economic crisis and their effects on the Charlotte Region and the Monroe Connector/Bypass Corridor.

The present crisis in the Charlotte Region

Following a long period of sustained, perhaps recently overheated, economic and population growth, the Charlotte Region economy has been rocked by a series of setbacks. Most notably, employment in the Charlotte MSA dropped dramatically from its peak of 813,267 to 746,753 between April 2008 and March 2009. That loss of 66,514 jobs amounted to an 8.2 percent decline in employment. The unemployment rate in the Charlotte MSA now exceeds 12 percent. That drop in employment is partly a product of a national, indeed, global economic readjustment. The national adjustment has not been quite as dramatic as that in the Charlotte Region, however. National employment decreased from a temporary peak of 139 million jobs in November 2007 to a subsequent low of 132 million in March 2009. Compared to the changes in the Charlotte Region, that is a more modest decrease of approximately 5 percent. Figure 12 compares the dramatic readjustment in Charlotte Region employment with national employment trends.

(Figure 12 about here)

While Charlotte Region employment may have reached a temporary peak in April 2008, some signs of an economic slowdown were apparent for a time beforehand. First, as noted above, professional services were growing at a less than expected rate. In fact, after a rapid increase in employment at the end of the 1990s and early 2000s, employment in the sector declined precipitously and was slow in recovering. Second, employment in the financial sector peaked in 2006 and had been slowly decreasing. Third, employment in the information sector shot up in 2005 and then declined to the level of a decade earlier. These three signs indicated a need for attention to the white collar sectors. Figure 13 charts Charlotte Region employment from 1990 through 2007. On the whole and in several sectors, however, employment continued on an upward trajectory until the precipitous drop.

(Figure 13 about here)

The effects of the impending economic slowdown began to be felt in the growth areas of the Charlotte Region, including Union County, before employment declined. Residential building began slowing down in 2006. The slowdown has impacted the entire region but, as seen in Figure 14, Union County was especially hard hit. Union County was the second-most popular county for new residences after the much more populous Mecklenburg County in 2006 but building declined more rapidly in Union County than in any other area of the region.

(Figure 14 about here)

Several difficult-to-untangle factors led to the precipitous drop in Union County building. First, as charted in Figure 15, applications for permits for residential subdivisions dropped off, partly as the result of a moratorium on such permits between Aug 15, 2005 and Oct 3, 2006 while the county reconsidered infrastructure provisions rules. Second, in some areas of the county, permits were issued up to and perhaps beyond the capacity of existing water and sewerage systems. Water and sewer capacity are discussed in detail below. Third, there was some evidence suggesting over-building. Finally, the slowdown and then decline in center city employment growth led to a softening real estate market.

(Figure 15 about here)

The number of attending and anticipated school students is one indicator of the slowing growth of the county's population. After several years of revising anticipated enrollments upwards, enrollment growth has slowed significantly. Actual Union County school enrollments have not met the expectations from the prior year for the past two years. As seen in Figure 16, projected enrollments have been revised downward during the last two years. Perhaps over-reacting to the present slump, enrollments are now expected to be relatively flat for the next five years or more.

(Figure 16 about here)

Union County housing prices have held relatively steady but sales volumes have decreased markedly from their peak in the summer of 2006. Median housing prices have averaged $189,616 for the first six months of 2009. That is approximately a 10 percent drop compared to the corresponding period one year ago. June is usually the peak month for residential closings in Union County. In June 2009, the sales of 194 residential units were completed. That compares with 261 one year earlier and with 400 and 467 for 2007 and 2006, respectively, more than twice the volume than at present. Figure 17 shows data on residential sales in Union County from January 2005 through June 2009.

(Figure 17 about here)

Dramatic downward employment change has been reflected in building, school enrollments, and real estate sales. Each of those indicators suggests that prognoses for the future need to be carefully reevaluated. There is no guarantee that earlier growth trends will resume but, as discussed below, there is a solid basis for guarded optimism.

The future: Resumed, but more modest growth

The key question for planners is not, "How bad can it get in Charlotte," but rather "How will Charlotte emerge from the present crisis?" That is, of course, undetermined but several of the most important uncertainties are beginning to be reduced. First, banking will likely continue to be a significant employer. Despite the merger of Wachovia with Wells Fargo, Charlotte will likely continue to be a major

center of retail banking. Wells Fargo has announced a desire to maintain much of Wachovia's employment as an east coast "hub." The Bank of America will also maintain a continuing presence. Employment growth in the sector is likely to be significantly slower than it has been in the past however. Charlotte will no longer benefit from continued mergers and consolidation. Technological change and overseas outsourcing will also diminish future employment growth. In addition, local observers maintain that the best-paid banking employment in corporate finance and other esoteric fields will leave the region and indeed may have already done so. The latter development is having, and will continue to have, major repercussions for the high-end real estate markets and have follow-on effects that are not fully modeled.

Ken Lewis, chairman and CEO of the Bank of America, has predicted that banking "will be a smaller industry, with fewer workers overall and claiming a smaller portion of national income and gross national product."[4] The Bureau of Labor Statistics projected a four percent national employment increase in banking over the 2006-2016 period, compared to 11 percent increase in overall national employment.[5] That assessment might be revised downward in the light of industry developments since 2006. The shift in occupational distribution within the industry is somewhat more favorable to Charlotte. The management, business, and financial occupations which comprise approximately one-fourth of the industry's employment are expected to grow more quickly. As a hub or headquarters city, Charlotte will benefit disproportionately from that growth.

Housing the headquarters of a major electricity provider and a major market in its own right, the Charlotte Region may benefit by the push towards green energy. The possible expansion may have repercussions for manufacturing as well as office functions.

Manufacturing will likely continue its on-going overall employment decline albeit at a slightly slower pace. The Bureau of Labor Statistics projects manufacturing employment decline to decelerate over the 2006-2016 period to the point that it accounts for 7.6 percent of national employment. Advanced manufacturing subsectors will likely take diverse employment trajectories with some declining sharply while others, still small, expand rapidly. As a favored relocation destination, Charlotte's manufacturing employment outlook is somewhat rosier than average.

The Bureau of Labor Statistics projects that national employment in logistics and distribution will grow by 14.8 percent between 2006 and 2016, compared to 11 percent for overall national employment. Although they comprise a small proportion of industry employment, management, business, and financial occupations along with sales and related occupations are expected to grow more quickly than the industry average. According to past residential trends, the more highly educated employees in this sector are likely to choose Union county, and thus the Connector/Bypass Corridor, as a place to live.

[4] http://www.americanbanker.com/article.html?id=20081205BFMCTJ6M
[5] Eric B. Figueroa and Rose A. Woods, (2007) "Industry Output and Employment Projections to 2016," Monthly Labor Review, November, pp. 53-85.

As discussed above, the Charlotte Region has thrived by being a competitive, cost-effective location for mature industries. The region has benefitted from a steady stream of business relocations and new establishments even during the ongoing economic downturn. While employment may decline in some industries, such as manufacturing, output is expected to increase. That means regional income growth will outpace basic employment growth and that fewer workers in these critical industries may support an increased number of employees in support sectors.

The regional projection process

The MPO socio-economic estimates and forecasts were generated in several steps. The first step entailed obtaining current estimates of population and employment. The second step was to generate long term "control" totals for the nation, region, counties, and major sub-county areas. The final step generated small area (Transportation Analysis Zone, TAZ) estimates of households, population, and employment. The initial estimates have been updated several times in the light of new information. Another update is scheduled for November 2009. The next major MPO revision of the socioeconomic estimates will likely not occur until after the 2010 Census results are tallied.

Although MUMPO was accountable for and oversaw the entire estimation process, responsibility for completing the estimates and forecasts was split. The initial estimates were compiled by several consultants. The macro-forecasts were completed by Thomas R. Hammer, an independent consultant, in a largely stand alone process while the small area forecasts for Mecklenburg and Union Counties were compiled by Paul Smith and a team of colleagues at UNC Charlotte with the aid of expert panels in both counties.

The macro forecasts applied to a 15-county (plus a portion of one more county) approximation of the Transportation Demand Model geographic area. The small area forecasts applied only to the MUMPO modeling area (then Mecklenburg County and a portion of Union County). Different small area forecasting procedures were used in the other planning regions of the model area.

Bureau of Census statistics were the basis for the then-current estimates of 2002 population and the Bureau of Labor Statistics for 2001 employment. Supplemental employment information was obtained by purchasing 2002 Dun and Bradstreet and InfoUSA data for the entire model area. These data were subsequently verified and corrected by a team at UNC Charlotte's Urban Institute who telephoned each establishment with 50 or more employees. The InfoUSA data were used for smaller establishments.

Region-wide and large area projections

The macro forecasts followed a top-down estimation procedure that had been previously successfully applied in several other regions.[6] The model works downward from sector-specific nation-wide employment projections to estimate region-wide totals and individual county (15 plus a portion of another) and district (42 sub-county and four whole county) subtotals. The districts were used to guide the small area growth allocations discussed below as closely as possible. Our discussion concentrates on region-wide totals and county subtotals.

The expected extent of the urban area at the end of the planning horizon, then 2030, was selected as the target region. Population change was assumed to be substantially employment led. This assumption is well-validated in the Charlotte context. Critical portions of the procedure (the sub-regional county and district allocation models) were calibrated on the experience of 227 counties in 29 separate Eastern U.S. metropolitan areas which were chosen for their comparability to the Charlotte region. (Each metropolitan area in the calibration sample had three or more counties and a population of 1 to 5 million – a selection procedure which placed the Charlotte region in the middle of the range.)

The forecasting process rests on an extension of the Bureau of Labor Statistics' ten-year nation-wide projections of employment, tempered by the Census Bureau's projection of population by age and sex to control for the available labor supply. The process creates national profiles of industry-specific employment for 42 (exhaustive) industry groups tracked by national statistical agencies.

The national projections were used to create region-wide projections by first separating employment in to "economic base" (regional export) and "population-serving" sectors. Region-wide basic employment was then modeled as a fraction of national employment in each of the basic sectors. The evolution of the regional capture rate was then modeled on available data reaching back to 1969 (when the Bureau of Economic Analysis started publishing detailed regional accounts) to predict the fraction of national employment that will be found in the region at critical points in the planning period.

Having projected basic employment, population-serving employment was then estimated on the basis of past relationships between the different categories of employment. Region-wide population is forecast on the basis of the trend of past relationships between basic and population-serving employment. Migration made up for the possible labor shortfalls and overflows.

The region-wide employment and population totals were allocated among counties and districts with the aid of 35 equations – three for demographic variables (upper, middle, and low-income households), 32 for employment by sector (simplified from the 42 used in national forecasts) – which were calibrated by empirically examining values in 1990 and 2000 in the 227 counties. The values for the variables were predicted in blocks according to their degree of independence from

[6] Thomas R. Hammer, Demographic and Economic Forecasts for the Charlotte Region, December 8, 2003. Preliminary reports were issued on August 2000 and December 23, 2002.

population distribution within a region with the estimated values helping to predict the values in subsequent blocks. Industrial activity variables were predicted first followed by producer services, households, and, finally, population-following employment, such as consumer services and retail.

The predictions were applied recursively to three 11-year intervals with the values for years ending in 0 or 5 interpolated using third-degree polynomials. Predictors were limited to readily available Census-based variables but many systematic unobserved influences on growth were thought to be incorporated in observable past growth trends. The predictive equations were applied to each county and to sub-county districts when counties could be divided into multiple areas with at least 50 square miles and a population of 25,000 or more. For sub-county districts, the same models were used as for the county allocation models. Detailed sub-county information based on the Census and InfoUSA data made the sub-county modeling possible.

Mecklenburg County was already relatively densely developed. Recent growth had been at the north, east, and south (but not west) fringes of the urbanized area. Four factors were found to recur in predicting development: recent population gain, recent employment gain, development density (as a measure of the space available for further development), and share of upper-income households. Corrections were made to a northward bias in the forecasts. Map 8 charts the areas predicted to have the highest development potential. Key areas of Union County were included among these. Figure 18 schematizes the forecasting process.

(Map 8 and Figure 18 about here)

Small area growth allocation

Small area projections were made on the basis of a model, the predictions of which were validated and often adjusted by panels of experts.[7] The small area projections used the data generated by the large area projections and allocated the district values among smaller areas and ultimately TAZs. Doing so entailed using additional types of data and modeling techniques. The degree to which the small area allocations were model driven is unclear from the documentation but, after examining the data in detail, it appears that a significant amount of professional judgment was involved.

The small area modeling process used Mecklenburg and Union County tax records to categorize individual parcels into five residential categories (based on density) and eight employment categories using land use and building code descriptions in the files. In Mecklenburg County, 9,143 parcels could not be classified; 6,440 of those located along major thoroughfares were classified via a windshield survey. The uses of the remaining parcels were imputed. In Union County, a similar procedure was followed. In the portion of the county then included

[7] Paul Smith, Mecklenburg-Union Metropolitan Planning Organization Population Projections and Employment Allocations 2000-2030, Center for Applied GIS, UNC Charlotte, December 31, 2004.

in MUMPO's planning region, 8,258 parcels were classified via a windshield survey. The parcel data helped link the socio-economic data, as discussed above, to land use.

In addition to the parcel data and the socio-economic data, the small area projection process entailed the collection of data on school locations and enrollments in order to pinpoint education-related employment and data on the registration of commercial vehicles. The latter was used to help locate employment facilities.

Small area population projections were made based on existing baseline data, district area control totals and the influence of a set of land development factors chosen and ranked by the expert panels selected for Mecklenburg and Union Counties. The procedure used followed procedures prescribed by Metrolina Regional Land Use Technical Advisor (RLUTA). Aggregate land development factors were modeled for each of the set of 500' x 500' grid cells superimposed upon the MUMPO portion of Union County and for each of the set of 250' x 250' grid cells superimposed upon Mecklenburg County. Composite scores grid cell scores were averaged for each TAZ to calculate TAZ attractiveness scores. Development densities per TAZ were used to derive the number of households in each TAZ and converted into residential acres consumed per TAZ. Historical household size was used to generate TAZ population at the critical time periods. Existing development and available land acted as brakes on further growth. The modeled predictions were subject to feedback from the expert panels. Table 6 provides an overview of the land development factors used in allocating residential growth to small areas.

(Table 6 about here)

After the macro forecasting was completed, the employment data was collapsed into eight employment categories: 1) a broad category containing Manufacturing, Industrial, Warehousing, Telecommunications, Utilities, 2) Retail, 3) Highway Retail, 4) Low Traffic Service, 5) High Traffic Service, 6) Office and Government, 7) Banking, and 8) Education. Each of these employment sectors was assigned a percentage value tapping the degree to which it was population chasing. Population chasing employment was allocated to TAZs in the same proportion as population distribution. In those cases when there was insufficient space in a particular TAZ for the forecasted employment growth, the additional employment was allocated to a neighboring TAZ. Non-population chasing employment was allocated among TAZs by a consensus discussion of the expert panels of available land and evolving location patterns. The Mecklenburg County figures were adjusted on the recommendation of the Planning Commission.

Analysis of the information driving the predictions

We performed three checks on the socio-economic projections compiled by MUMPO. First, we compared the MPO estimates with those generated by other organizations. Second, we examined the MPO estimates in the light of subsequent macroeconomic events affecting the entire nation through quantitative analysis of available data and interviews with knowledgeable informants. Third, we conducted a regional scan consisting of direct observation, geographic analysis, and interviews. As stated at the beginning of this report, the results of this checking procedure

indicate that the MPO forecasts are, with some deviation, generally consistent with those of other organizations incorporating less region-specific knowledge. They also suggest a need to adjust the MPO projections to conform to the current long-term national growth outlook. In addition, the regional scan strongly suggests a need to reallocate the adjusted regional growth within Union County.

Comparison among county-level forecasts

A comparison of projections from three additional sources shows that different forecasting organizations generate similar results. Woods and Poole and Global Insight provide county-level bases of comparison for the MUMPO socio-economic forecasts. Both private firms update their forecasts for each U.S. county every year. The basic methodologies are similar. Both organizations perform cohort-component projections. All need to rely on the same sources of information. The main differences would be the assumptions about the changes in the basic demographic rates of fertility, mortality, and migration. The Global Insight model differs from that of Woods and Poole in that the population projections follow the predictions of a regional macroeconomic model. The state government uses the Global Insight forecasts in its budgeting process. The North Carolina State Data Center also generates population projections.[8]

We compared the recently performed projections of regional and county households, population, and employment for a four-county central zone of the Charlotte area, Mecklenburg County, and Union County. Employment projections differ more widely than household and population forecasts because each method defines employment slightly differently – at the extremes from full-time-equivalents to each person-establishment link no matter how few hours worked. A four-county region is used because Global Insight data was not available for South Carolina. Table 7 provides a summary of the household, population, and employment forecasts for the four-county area and the central Mecklenburg and Union Counties.

(Table 7 about here)

The population projections are put side by side in Figure 19. The State Data Center projections reach to 2029. The projections were extended from 2029 to 2035 by assuming a constant county-specific rate of population growth rate equivalent to the average growth rate over the 2019-2029 period. The four projections shown are broadly similar. Global Insight projects the highest population in 2035. The MPO projection is close and Woods and Poole projects the lowest number. The Global Insight projection is almost 14 percent higher for the four-county core area than the Woods and Poole expectation. Woods and Poole also projects fewer people in Mecklenburg, the region's dominant core county, and in Union County than the other sources. Woods and Poole, however, projects the highest proportional concentration of population in Mecklenburg County. The State Data Center projections correspond closely to those of Global Insight with the exception that the SDC expects Mecklenburg County to be less dominant than any of the other organizations.

[8] State employment projections, produced in cooperation with the Bureau of Labor Statistics, forecast only ten years beyond the base year and only for the entire state. They were not used in the comparative analysis.

(Figure 19 about here)

We also compared the employment projections produced by Woods and Poole and Global Insight with those produced by the MPO process. Figure 20 tracks the employment projections of each organization for the same geographic units as the population projections. Here the Woods and Poole projections are higher than the Global Insight projections. The two firms use different definitions of employment so that the projections are not strictly comparable. The MPO, however, projects greater relative employment dispersion out of Mecklenburg County than either of the two firms.

(Figure 20 about here)

Unfortunately, because each organization used different sectoral classifications, we are not able to separate out and compare the projections for "economic base" employment from that, such as retail and consumer services, that follows population. Figure 21 shows Global Insight's projected employment trajectories of selected broad NAICS-based sectors. Business and professional services is expected to become the largest single sector within about a decade, replacing transportation, trade, and utilities. (Unfortunately, that combined category includes disparate sectors.) As noted above, the Charlotte Region has not been especially competitive in business services. Even before the present crisis and the restructuring of the banking industry, the growth in financial sector employment was expected to be modest. Despite an optimistic outlook for advanced manufacturing, manufacturing employment will likely continue to slowly decline.

(Figure 21 about here)

The available top-down projections of population and employment for the next several decades largely coincide. To the extent they can be compared, the independent projections agree in all but detail. The consensus among the projections is continued strong regional growth fueled by high-end employment and migration. Conversations with macro-economists suggest that the region faces short-term obstacles but that the long-term prospects are solid.

A revised national economic outlook

The large area projections performed by Thomas Hammer and summarized above appear to be thoughtfully and carefully constructed. Much has occurred since his task was completed in 2003. First, the Charlotte Region experienced quite a boom fueled by a positive impact in bank consolidation and a favorable macroeconomic climate. As a result employment increased more rapidly than expected in the region and population expanded rapidly, particularly in Union County which became the most rapidly growing county in North Carolina for several years. The rapid growth placed strains on infrastructure capacity and perhaps led to overbuilding. It is possible that in revising the socio-economic projections upward, as seen in the comparisons of Mecklenburg County in Figures 22 and 23, a cyclical increase in economic activity may have been mistaken for an upwardly moving trend.

(Figure 22 and Figure 23 about here)

Second, this boom has since ended. Growth has been flat, perhaps even negative, as discussed above. Certainly, in the case of employment, there has been a dramatic drop in regional jobs, as seen above in Figure 12. The danger for projecting socio-economic values is that both boom and bust cycles are incompletely separated from long-term trends.

Third, there has been a large-scale national "correction" resulting in what is said to be the worst recession in over 50 years. Long-term national growth expectations have been revised significantly downward. Figure 24 lines up several Congressional Budget Office projections of national GDP. As in the cases illustrated, CBO projections typically fall between those of the White House and the Blue Chip consensus (which is the average of about 50 forecasts by private-sector economists). The CBO projections assume a rather rapid recovery with no "lost decade." At this point, guardedly optimistic prognoses appear to be warranted.

(Figure 24 about here)

The March 2009 CBO projections assume a relatively rapid economic recovery before the national economy is restored to a steady real growth rate of approximately 2.2 percent annually. (See Figure 25.) The estimate of long-term real economic growth is now approximately three-tenths of a percentage point lower than it was in January 2005 and almost a point lower than it was in January 2001.

(Figure 25 about here)

Recent analysis suggests that even with no long-term decline in productivity, the effects of the national correction will result in a long-term setback to growth. As growth resumes, GDP is expected to be approximately 91.3 percent as high as it would have been at the same time in the absence of the national crisis. In other words, the crisis is expected to lower national GDP 8.7 percent in perpetuity.

Regional scan of small area growth allocation

In order to evaluate the small area estimates and forecasts generated by the MPOs, we conducted a regional scan which consisted of direct observation of building and built-up areas and interviews with regional planners and developers, some of whom wished to remain anonymous. The regional planners interviewed were knowledgeable about growth trends in their and the neighboring localities. However, even when they had direct or indirect input into the MPO small area forecasting process, critical details in the process could not be recalled and the reasoning behind specific projections could not be reconstructed.

It was difficult to find someone willing to claim "ownership" of the projection process. Key personnel have sometimes moved on and could not be interviewed. In contrast to the situation in the Triangle Region where municipal planners were closely involved in the MPO projection process, municipal personnel sometimes seemed unaware of the MPO projections. In some of those cases, municipal personnel had

developed their own projections. In most cases, however, the municipalities did not have the technical capability to develop projections.

Union County small area projections were given close scrutiny because most of the Connector/Bypass Corridor and almost all the Corridor's projected growth are in that county. Discussions with regional planners revealed that, in the course of several revisions, a few biases may have entered into the Union County small area projection process described above.

In particular, the current MPO projections forecast rapid residential growth in the southwestern quadrant of Union County. The forecasted population growth is shown in Map 9. Note especially the "line of growth" to the south of NC 73 between the county's western border with Lancaster County, SC and the area just south of Monroe.

(Map 9 about here)

Interviewed region-wide and Union County planners did not know the basis for the growth expectations in the southwest quadrant. As discussed further below, there is still sufficient developable land in closer in portions of the county. There is little infrastructure capacity in that portion of the county and no active plans to provide it. The southwestern quadrant of the county is not particularly accessible. The western end of the county, near Waxhaw, is accessible via U.S. 521 (a four-lane highway) running through Lancaster County's panhandle and there are plans to widen NC 16 from the Mecklenburg County line to Waxhaw but that area of the county would still not be the most accessible. Moreover, the development that has occurred has been on relatively large lots and recent sentiment has been to strengthen growth controls.

The municipalities in the eastern and western portions of Union County, that is, on either side of the Corridor have shown increasing resolve in limiting residential development. While that stance may subside over time as land value increases, there is little pressure for it to do so quickly. The relevant municipalities provide few services which would become more cost effective with growth and they have reputations as being oriented towards preserving a rural atmosphere by limiting residential development. Map 6 above illustrates an approximation of the developable land in Union County. There is ample land still available in close-in areas.

As a partial check on the MPO growth projections in the county, we examined the outcome of another projection process. The Urban Institute at UNC Charlotte has projected the evolution of current land use trends in Charlotte Region forward. The results are presented in Map 10. Their model does not examine small area population or employment (although the model is constrained by county totals of both). The model takes accessibility and past patterns of land development into account but does not incorporate political factors. Their simulations of future development in Union County predict a more even pattern of development and considerably more infill development than the MPO projections.

(Map 10 about here)

Union County Water and Wastewater Usage and Capacity

The availability of water and wastewater capacity has emerged as a major consideration with the potential to affect the magnitude, timing, and geographic allocation of Union County population and employment growth. In recognition of the issue, Union County commissioned an update of its water and sewer capacity plans in 2005. These plans have been subsequently revised. The capacity issues are complicated by the number of organizations and contingencies involved. Because of their possible constraining influence on Connector/Bypass Corridor growth, we examined the issues in detail. Our basic assessment is that, discounting the uncertainties in implementing capital improvement plans, infrastructure capacity additions will support growth in the Connector/Bypass Corridor.

Responsibility for water and wastewater infrastructure in Union County is split between the county itself, the City of Monroe, and the Town of Marshville. The county out-sources portions of its responsibilities to Monroe, the Charlotte Metropolitan Utility Department (CMUD), and Anson County while participating in a joint-venture water supply with Lancaster County, SC. The City of Monroe will soon purchase water from Union County and is planning on participating in a future joint venture to add water capacity. Marshville maintains its own water distribution and wastewater collection networks but purchases water from Anson County and sends wastewater to the City of Monroe through an agreement with the County.

Water and wastewater processing capacity is already acting as a constraining factor on Union County residential and business growth. Additional capacity is being actively pursued and the first additions should become available within two years. Real estate developers who have been granted water and sewer permits will be encouraged to “use it or lose it” in order to more efficiently utilize existing capacity.

Union County is divided into two main water basins centered on the Catawba River which runs just to the west in Lancaster County, SC and the Yadkin Pee-Dee River which runs through Anson County to the east, respectively. Four sub-watershed areas, mandated by the state to protect drinking water supplies, are in the Yadkin Pee-Dee watershed in and near the City of Monroe. Map 11 shows the location of the basins and watersheds.

(Map 11 about here)

Collectively, Union County can now supply up to an estimated total of 31 million gallons of water per day. Map 12 charts the major water supply areas of Union County. The grey area in the center of the map is served by the City of Monroe. As noted above, Marshville also has its own service area. The “west” water supply area reaches far over the water basin divide, necessitating an Inter-Basin Transfer (IBT) agreement which allows up to 6.5 million gallons per day to be drained on the east side of the divide. The IBT agreement may be revised to allow more transfer in the medium term but will likely be reduced in recognition of downstream water needs over the long term.

(Map 12 about here)

The primary source of water for the county is the Catawba Water Treatment Plant serving the "west" water supply area. The plant which has been operated by the Lancaster County Water and Sewer District in Lancaster County SC since 1991 as a cross-state joint venture between Union and Lancaster Counties. In 2004, the capacity of the facility was expanded from 18 million gallons per day to 36 million gallons per day. By contract, Union County can draw up to 18 million gallons per day from the plant. By informal agreement somewhat more can be drawn from the plant because Lancaster County does not use its full share. Union County itself operates no water treatment plants at this time.

The second-largest source of water in the county is owned by and operated for the benefit of the residents of the City of Monroe. Approximately 11 million gallons per day can be taken from three reservoirs owned by the City of Monroe: Lake Monroe, Lake Twitty, and Lake Lee. The three lakes are in the protected watershed areas illustrated in Map 11 and are in the Yadkin Pee-Dee Basin.

Anson County serves as the source of the remaining supply. Under an agreement with Anson County, 1.9 million gallons per day can be drawn from the Yadkin Pee-Dee River to serve the Wingate-Marshville area. However, only approximately half that volume can be physically drawn at this time. Marshville's water is bought directly from Anson County and is transported through 8" and 6" water mains which are separate from the system serving elsewhere in Union County. The town has contracted for 1 million gallons per day of capacity but is only using approximately 300,000 gallons per day. The Pilgrim's Pride plant near Marshville is served directly by Union County.

The average day demand for water in Union County is approximately 18 million gallons per day, divided into 8.3, 9.0, and .3 million gallons per day by the County, Monroe, and Marshville, respectively. Peak demand can be higher, effectively placing the county near or at capacity, particularly in the western portion of the county. Accordingly, irrigation restrictions are put in place during the spring and summer months to ensure that water users have consistent water supplies during peak water usage months.

Given the anticipated increase in demand, three projects to enlarge water supply capacity are in various stages of development. Most immediately, the pipeline serving the U.S. 74 East area from Anson County will be upgraded to pump 6.0-7.0 million gallons per day. A contract is imminent and work is expected to be completed within two years. The County anticipates renegotiating the legal capacity of the pipeline to 6.0 million gallons per day concurrent with the completion of the physical upgrades. Anson County's 16 million gallons per day capacity plant at Blewett Falls Lake has ample excess supply to serve the revised limit.

Second, an expansion of the Catawba Water Treatment Plant, now in the design phase, is being considered and tentatively slated for completion by 2014. The expansion will add 9 million gallons per day of capacity to the western region of Union County. County planners hope to begin construction on the plant expansion within a year which would mean that the additional capacity would be available within five years. Those two improvements could increase water supply capacity from 31 to 45 million gallons per day.

Third, a new Northern Source water treatment plant, drawing from the Pee-Dee Yadkin River Basin, has been proposed for the northeastern portion of Union County. The plant will be a joint venture but neither the partners nor the total capacity have been determined. The City of Monroe and Mecklenburg County are likely to partner with Union and Anson Counties in the construction of the plant which could provide 35 million gallons per day of water to Union County at final build out. Construction is estimated to take eight years with a go-ahead hopefully coming by late summer 2010. Initial capacity should be available by 2018.

There are no plans to significantly increase water supply to the southern half of Union County. Lancaster County SC has proposed building a 16" water main line to a 750,000 gallon tank to be built near the state line south southeast of Waxhaw. Completion time is uncertain. If built, that pipeline could be available to serve southern Union County water needs. Union County planners have had no interaction with Lancaster County personnel over that pipeline, however.

The City of Monroe is not expected to expand its water treatment capacity but will begin purchasing 1.99 million gallons per day from Union County in 2014. A representative of the Town of Marshville believes present infrastructure could serve the contractual capacity should the need arise. Table 8 summarizes the forecasted water supply capacity and water demand in Union County across systems.

(Table 8 about here)

Union County is heavily dependent upon wastewater treatment facilities because the soil has poor percolation properties. Union County residents can access a total of 18.9 million gallons per day of wastewater treatment capacity. The Monroe Wastewater Treatment Facility, owned by the City of Monroe, is the largest treatment plant in the county. It services the city and the U.S. 74 East region of Wingate and Marshville in an agreement to provide 2.65 million gallons per day of capacity. (A portion of Marshville's sewerage is treated by Anson County.) The Monroe facility has a capacity of 10.4 million gallons per day.

The County operates two major wastewater treatment plants: Twelve Mile Creek (6.0 million gallons per day capacity) and Crooked Creek (1.9 million gallons per day capacity), both in western Union County. In addition, the county maintains three small package treatment plants which serve individual subdivisions or small clusters of facilities. One additional inactive wastewater treatment plant is owned by the county but no longer used because it cannot meet raised quality standards.

In addition, the County, through a contractual agreement with the Charlotte Metropolitan Utility Department, provides 1.0 million gallons per day of purchased capacity at Charlotte's McAlpine Creek Wastewater Treatment plant. An additional 2.0 million gallons per day is reserved at that facility for future use.

Average daily demand on wastewater treatment facilities is approximately 12 million gallons per day. Sewer capacity in the western part of the county has been allocated to maximize the state regulated capacity. New projects cannot be permitted for sewer capacity in this area until additional capacity is available. The capacity

cushion in the Twelve Mile and Crooked Creek plants is in fact more than fully claimed by approved projects, leaving most of the available capacity in Monroe and the area to the east served by the city's facility. Consequently, as mentioned above, the County is also attempting to regain control over permitted capacity that will not be used quickly.

Finally, the County has also discussed development of a new wastewater treatment plant in the eastern portion of the County, providing more opportunity for development in eastern areas. The City of Monroe has no plans to expand its wastewater facilities. Existing and planned capacity and demand are summarized in Table 9. Table 10 summarizes available information about existing county wastewater facilities.

(Table 9 and 10 about here)

A portion of the Goose Creek drainage sub-basin has been determined to be ecologically sensitive in order to preserve important wildlife. (See Map 13.) Restrictions have been placed on allowable surface runoff resulting in development restrictions near streams. The restrictions imply a density of approximately .25 dwelling units per acre over 8,400 acres of vacant land.

(Map 13 about here)

Despite the constraints on development posed by the short supply of water and wastewater infrastructure, the County is moving forward to aggressively expand capacity to meet potential demand, with portions of the far reaches of the Corridor receiving additional service first. County planners anticipate that future growth will concentrate in the Corridor and are making infrastructure investments accordingly. The Goose Creek sub-basin restrictions may also steer some additional residential development towards the Connector/Bypass Corridor.

Adjustments to the MPO projections

On the basis of the comparisons among forecasts, the information from recent national forecasts, and the regional scan examining small area development factors and patterns, two adjustments were made to the MUMPO socio-economic estimates. The first was to make region-wide adjustments consonant with the national growth expectations. The second was to reallocate the anticipated growth in Union County in line with development factors and constraints.

Taking the three main macro-economic events discussed above into account, we adjusted the current MPO forecasts by taking the ratio of two CBO forecasts (January 2005 and March 2009) for particular years to represent the effect of new information on national growth expectations. The January 2005 CBO forecast was used to approximate the expectations as of the time the latest (current) MPO projections were made. The March 2009 CBO forecast was used to approximate current expectations. Figure 24 above compares several CBO projections.

That adjustment was applied to the MPO estimates of future employment, population, and households. That is, the MPO estimates for 2005 were assumed to be accurate and all subsequent estimates were revised downward by multiplying the MPO estimates by an adjustment factor. The exact adjustment factor differs slightly during the projected period of readjustment. Given the significant loss of regional employment, reports of out-migration, and unsold housing stock, the adjustment is reasonable.

We note that the MPO process adjusted Thomas Hammer's growth estimates by allocating less projected growth to Mecklenburg and, especially, Union Counties than he had estimated. The remaining growth was allocated to the surrounding counties not covered by MUMPO. The reallocation was part of a consensus discussion about future growth trends. The MPO adjustment of several years ago provides an extra cushion for the growth decline experienced in Union County recently.

Employment-led migration is the major factor driving population growth in the Charlotte Region and supporting its expanding economy. As national growth slows, immigration into the U.S., which now comprises approximately 44 percent of national population growth will likely slow with a consequent effect on Charlotte's growth. The Charlotte region has been a major destination for recent immigrants and has the largest concentration of Hispanics in North Carolina.[9] Indications are that immigration has slowed and return migration has accelerated as the U.S. economy has sputtered. Fertility may also decline in response to the economic slowdown.

In making the adjustments, we experimented with a number of options for recalculating a regional capture rate (proportion of national population and employment in the region). Options included using sector-specific employment projections and housing cost differentials. In the end, we opted for assuming that current capture rate trends would continue in a manner roughly consistent with that assumed by the MPO process. Thus, large area forecasts were all adjusted by a similar proportion. We decided to maintain the allocation of growth among counties estimated by the MPO process.

The MPO allocation of population and employment growth among small areas (TAZs) was largely accepted outside Union County. In accordance with the discussion in a previous section, adjustments were made to the Union County MPO small area projections. County growth was reallocated away from the line of high growth in the southwest quadrant of the county, discussed above, to the Connector/Bypass Corridor. That adjustment was in line with discussions with regional and county planners about growth expectations and water and sewer infrastructure provision plans. A portion of the expansion in several high growth TAZs in the northeastern quadrant of the county was also reallocated towards the Corridor.

[9] John D. Kasarda and James H. Johnson, Jr. (2006) *The Economic Impact of the Hispanic Population on the State Of North Carolina*. Kenan Institute for the North Carolina Bankers Association, January.

Projected growth was increased in the Corridor, especially in the area beyond Monroe which will be well-served by the Connector/Bypass. Water and sewer infrastructure will be improved in that area most quickly. Moreover, the two municipalities in the area, Wingate and Marshville, have expressed an eagerness to attract additional residents and employment.

The resulting, Kenan Institute-adjusted, projections are summarized in Figures 26 and 27 and Table 11. Map 2 above identifies the zones used in the summary analysis. The table and figures include the original MPO projections along with the corrected figures. A careful examination shows the impact of the region-wide and small area adjustments. The region-wide adjustment decreased the projected households, population, and employment. The small area adjustments partially counteracted that reduction for the Corridor by reallocating small area growth.

(Figures 26 and 27 and Table 11 about here)

It should be emphasized again that the growth summarized in the analysis rests on three key infrastructure prerequisites: additional water supply, added wastewater processing capacity, and the Connector/Bypass. Although the construction prospects for each are promising, and in some cases, underway, should any of the three improvements not be materialized, growth will likely move elsewhere. Given the existing rush hour congestion on U.S. 74 and limitations on other commuting routes, if the Connector/Bypass not be built, much of the projected residential development will likely largely shift to another county.

Long distance transportation needs

In addition to local commuters and regional traffic, the U.S. 74 corridor handles a significant volume of extra-regional traffic. The beaches near Wilmington and Myrtle Beach are significant attractors for passenger traffic. The port in Wilmington is a significant generator of truck traffic, some of which may come to Charlotte along the U.S. 74 corridor. At the same time, Charlotte is a major distribution center which also serves coastal areas and the less densely populated region in between. Traffic counts may provide the best available indicator of the volume of traffic but provide little indication of the origin and destination of that traffic or of the travel drivers.

This significant amount of traffic largely falls outside the Regional Travel Demand Model. Unfortunately, no good source of data for the drivers of long distance travel through the U.S. 74 corridor exists. Accordingly, there are only partial models of corridor freight traffic and none for passenger traffic. We summarize the information we found below. Our aim is not to forecast traffic but to provide information that might be used in that process.

Long distance passenger traffic

The Department of Transportation provides traffic counts for important sections of North Carolina highways. So far, only annual estimates are provided but

the Wilmington area will begin a program of seasonal counts in order to begin assessing the magnitude of tourist traffic. Those data will not be available for at least a year.

We view beach traffic as a function of the population of the Charlotte Region and the supply of accommodations in the resort areas. The costs of travel have an indirect effect by helping to determine the long-run supply of accommodations. Traffic counts provide indications of the volume of traffic but not its origin. Models of Charlotte-based traffic would need to be adjusted in order to take the travelers who are using Charlotte as a point on a through route into account.

Crash data, compiled by the North Carolina State Highway Patrol for the period 2004-2008 provides some indication of the magnitude of non-local traffic and the seasonality of through traffic via information on the origin of the involved vehicles. Approximately 12 percent of the recorded crashes along U.S. 74 between I-485 and NC 205 at Marshville involve out-of-state vehicles, suggesting that a similar percentage of traffic along the Monroe corridor is extra-regional. This is the segment of U.S. 74 that is also most likely to carry commuter and other regional traffic in addition to long distance travelers. A portion of the North Carolina vehicles would also be from outside the Charlotte Region but we have no finer-grained information than state of vehicle registration.

Fifty-five percent of the out-of-state vehicles were registered in South Carolina, suggesting that U.S. 74 provides important access to the core Charlotte area for South Carolina residents. Almost 14 percent of the vehicles registered out-of-state originated in locations where a routing through Charlotte suggests that the drivers may have been travelling to or from beach resorts.

We found some evidence of seasonality in the crash data with accidents peaking in November and December. With the data we have available, it is difficult to separate the effects of road conditions from increased tourist traffic. These results are not reported.

Long distance truck traffic

The Monroe Connector/Bypass will serve long distance truckers in addition to local commuters, other regional traffic, and long distance passengers. The Federal Highway Administration's nation-wide Freight Analysis Framework-2 (FAF2) is one of the few sources of projections of long distance freight flows. FHWA informants caution that FAF2 is an imperfect, but nonetheless valuable, tool. Informants at the North Carolina Department of Transportation confirmed that they state did not maintain a state-wide traffic or freight model. The MPOs have interests in freight movements but have not yet developed workable models.

FAF2 is built up from 2002 baseline data which is projected forward using Global Insight's proprietary models. The Global Insight models are based largely on various government data sources including input-output tables compiled by the Bureau of Economic Analysis. Estimates of traffic and truck traffic along the U.S. 74 corridor are summarized in Table 12. Estimated traffic along regional highways is

shown in Maps 14 and 15. Our interest here is not to verify the projected counts but rather to outline the socio-economic factors that drive those traffic counts.

(Table 12 and Maps 14 and 15 about here)

Freight flows depend upon the total level of economic production (and consumption), the geographic distribution of production, and the geographic distribution of consumption with the function of freight traffic being to move products from their place of production to (or near) their place of consumption. Because intermediate products comprise a large proportion of total shipments, input-output relationships are key to linking origins and destinations. Because an increasing proportion of U.S. consumption originates overseas (and a smaller but growing proportion of U.S. production is consumed overseas), trends in global production and world trade are central to understanding domestic freight shipments.

Freight flows, including those along the U.S. 74 corridor, are subject to revision as new information pertaining to national and regional economies becomes available. As discussed elsewhere in this report, the national economy has suffered a severe setback which is likely to reduce the economic activity in any one year by approximately 9 percent indefinitely. Ceteris paribus, our expectation is that the predicted freight flows would be decreased by a similar magnitude.

FAFs models on the geographic location of production and consumption likely extend current trends. National current account (imports v. exports) trends have been judged unsustainable by several economists. All other things being held equal, that would likely shift production to domestic sites, reducing port-related traffic for a given level of national economic activity. We expect current trends in the competitiveness of the Charlotte Region and the beach areas as locations for production and consumption to continue.

Possible developments affecting trucking in the U.S.74 Corridor: the North Carolina International Terminal and Legacy Park

The North Carolina State Ports Authority has proposed developing a new ocean container port south of Wilmington, near Southport. If built, the North Carolina International Terminal (NCIT) could have a significant impact on truck traffic along U.S. 74 and the Monroe Connector/Bypass. The most relevant information about the NCIT is summarized in the *Pro Forma Business Plan for North Carolina State Ports Authority*, 15 March 2008.[10] The document is in the process of being updated but the new results will not be released for another several months. The updated version is likely to forecast slower growth than initially predicted and therefore recommend more finely stepped development phases than initially planned.

[10] Pro Forma Business Plan for North Carolina State Ports Authority, 15 March 2008 (http://spa.ncports.com/web/ncports.nsf/4a87ff3bf2c03cc38525646f0072ffa9/6d28af86ed9d134585257419005017ca/$FILE/NCIT%20Pro%20Forma.pdf). A companion document lists planning assumptions (http://spa.ncports.com/web/ncports.nsf/4a87ff3bf2c03cc38525646f0072ffa9/6d28af86ed9d134585257419005017ca/$FILE/NCIT%20Planning%20Assumptions.pdf).

The main driver behind the Ports Authority proposal is the rapid increase in trans-Pacific container traffic which has overwhelmed West Coast port capacity. Much of what arrives on the West Coast is bound for the Midwest. Therefore, the expectation is that, as the Panama Canal widening is completed in 2014 or 2015, a portion of the post-Panamax vessels will bypass West Coast ports for a direct voyage to the east. As it turns out, none of the major East Coast ports enjoys a significant time advantage over the others for Panama Canal traffic so that port processing efficiency, the size of the local market, and land transport connections to other markets may determine the distribution of traffic among East Coast ports.

The first phase of NCIT, handling one million twenty-foot equivalent units (TEUs) annually, could be operational by 2017 or 2018. At full build out eight to ten years later, the port could handle four million TEUs annually. The North Carolina Department of Transportation has begun a highway needs reconnaissance study that will likely be complete within two years. The U.S. Corps of Engineers has begun a study of the costs of dredging a channel to the port. The initial study is scheduled to be completed by May 2010 and would need to be followed by another two to three year study to satisfy the mandates of an Environmental Impact Assessment before construction could begin.

The port's primary orientation would likely not be Charlotte but the "deep hinterland" markets in the Midwest which are 500 or more miles inland. Accordingly, a planning goal is to move half of all containers inland via CSX' rail line to Charlotte and beyond, with the other half travelling by truck. At full capacity the intended 50/50 modal split would result in approximately 10,000 rail movements annually and 900,000 port-related truck movements. Some of those truck movements would travel via I-40 to the I-95 corridor and possibly further north. Nevertheless, the port would likely generate a significant amount of truck traffic along the U.S. 74 intrastate highway.

Trucking firms have expressed doubts about the efficacy of intermodal shipments over short differences, such as that between NCIT and the Charlotte Region. All Charlotte-bound containers might end up being shipped by truck. Truck shipments would entail just one inter-modal transfer: from ship to road.

Alternatively, if sufficient increases in efficiency are made in inter-modal transfers to make a rail link for Charlotte-bound containers cost-effective, truck traffic on the Monroe Connector/Bypass might still increase if CSX agrees to participate in the Legacy Park "freight village" proposed for Marshville. In that case, Charlotte-bound ocean containers could be loaded onto a rail shuttle service stopping at Legacy Park outside Marshville where they would be transferred to trucks for final delivery in the Charlotte Region or elsewhere in the Piedmont Crescent.

Legacy Park is a proposed 5,000-acre industrial and commercial park located to the east of Marshville. The southern boundary of the proposed park runs along U.S. 74 and is adjacent to the CSX rail line to Wilmington. The first phase of the project, if implemented, would include a rail-road intermodal facility on about 250 acres and tracts of between 150 and 250 acres served by rail. Smaller tracts as well as light industrial and flex space are also planned. Figure 28 provides schematic overviews.

At present, the park has attracted the attention of regional planners but has no tenants and no funding commitments have been made.

(Figure 28 about here)

State transportation planners have confirmed that CSX is considering a new inter-modal yard in the Charlotte Region because the capacity of its existing facilities is becoming increasingly strained. They have not yet expressed a desire to locate a facility in Union County. It is likely that a facility near Marshville would have to offer significant cost advantages to counter-balance its inconvenient location away from the main industrial concentrations of Charlotte and the broader North and South Carolina Piedmont.

Before becoming a reality, NCIT still needs to surmount a significant number of hurdles. Among these are decreased growth in container traffic, possible construction cost increases, and the need to coordinate many interdependent investments. Any one of these issues could scuttle NCIT.

First, according to the study cited above, East Coast ports will likely have sufficient capacity to handle projected demand until 2022 or 2025. Several factors point towards slower growth in container traffic than has been forecasted in recent years. These include 1) a general slowdown in economic growth which may last significantly longer than the ongoing crisis, 2) pressures to revalue the Chinese reminbi (yuan) because of the continuing trade surplus, 3) upward pressures on Chinese labor costs in the fast-growing coastal areas which are approaching regional capacity (tapping larger pools of inland labor will require heavy infrastructure investments and institutional reforms), and 4) increasing fuel costs which will likely push producers closer to markets. The last three factors favor Latin American, especially Mexican locations over Asian locations. Should such locations increase in competitiveness with respect to Asian sources, imports that might otherwise be arriving in the U.S. by sea might be shipped via truck or an inland rail network. These considerations have already raised concerns about the efficacy of the Panama Canal expansion.

Second, initial cost estimates, in the study cited above, total $2.5 billion in order to make the port fully operational. If costs rise significantly, the NCIT may no longer be cost-effective. The “pro forma” assumed that dredging costs would be something over $500 million. Based on recent Corps of Engineers’ experience, several commentators have suggested that they could top $2 billion alone and that cost would make the project’s overall benefit-cost ratio unfavorable. The project’s future could rest on the outcome of the Corps of Engineers’ study that is just beginning.

Third, NCIT has no established competitive advantage. Creating one will require a series of linked public and private investments including over $181 million for roadway improvements (given foreseeable conditions this might need to be a tollway) and over $127 million in railway improvements. At least $731 million in public investment across multiple levels of government will be needed. The coordination problems are not trivial. All levels of government face limited budgets and competing needs. CSX, a critical partner, has expressed a willingness to talk but

has not yet committed to the project. Although the Ports Authority remains committed, NCIT lost a key champion with Governor Easley's retirement from office.

In any event, NCIT may be in the weakest competitive position of any East Coast port. It will be the "last in." Other ports enjoy significant established user bases. Several of these ports have significant capacity enhancement programs in place. Norfolk's rail-based "Heartland Express," which is nearing completion, may have a significant advantage over other ports in meeting Midwest demand. Existing analysis suggests that NCIT would offer marginal competitive advantage beyond the limited markets of North Carolina metropolitan areas. On the other hand, should the Ports Authority satisfy cost constraints and succeed in coordinating the full range of needed coastal and inland investments, NCIT has the potential to restructure East Coast shipping patterns.

Conclusion

The prospects for population and employment growth in the Charlotte Region are strong. The Charlotte Region is a growing region within a growing state. The Region competes successfully with metropolitan areas nationally for employment in growing sectors and has a quality of life that earns it many accolades. Independently prepared forecasts all suggest that regional growth, based on a diverse economy and sustained in-migration, can be expected to continue.

The core area of Charlotte (Uptown) is the region's prime location for highly salaried employment. The core area provides attractive office locations, a central location in the region that is reinforced by transportation routes, and easy access to an airport that offers excellent connections to many important metropolitan areas. These features help increase the attractiveness of the region to contemporary firms. The I-485 loop provides access to supplemental employment centers including University Park in the northeast and Ballantyne in the southwest along with the I-77 airport/industrial area. Even with a possible maturing of private sector employment, especially that in banking, the core Charlotte area will likely continue to grow as a center for well-paid employment.

A caveat with respect to that last sentence needs to be emphasized. Informants told us that the very high-end of the income distribution would likely be thinner in Charlotte in the coming years. While Charlotte will likely remain a center for retail banking operations, the highest skill work in corporate finance has already departed for New York. We have not made adjustments to the estimated mean income because the current estimates stem from a period which preceded much of the banking boom in Charlotte and because this recent development does not have a direct impact on the Monroe Connector/Bypass Corridor.

Mecklenburg County has absorbed much of the residential growth and the accompanying support employment in retail, hospitality, and retail. This can be expected to continue. Mecklenburg County still has ample developable land. Over the past decade or so, residential growth has accelerated in Union County which is often marketed as "Charlotte South" in reference to the upscale residential districts just across the county border. The strong orientation of growth towards the Uptown

Charlotte suggests that the completion of a rapid access road through the corridor will likely accelerate growth within the corridor itself.

The proposed Monroe Connector/Bypass will likely act as a channel for residential growth. Past trends suggest that residential density of new housing within the corridor will increase gradually over time and that residential development will continue to focus on the moderately high end of the housing market. Interviews suggest that some of the development in the corridor occurred in anticipation of the highway's completion. Growth rates may accelerate once the economy recovers and concrete steps towards construction are taken.

Forecast reliability

Socio-economic forecasting is an inexact process. The available evidence across projection efforts indicates that "forecast errors are generally larger for small places [such as TAZs] than for large places; are generally larger for places that have very high [such as Union County] or negative growth rates than they are for places that have moderate, positive growth rates; generally increase with the length of the projection horizon [which stretched to 25 years in this case]; and vary from one launch year to another."[11] The evidence suggests that the accuracy of forecasts does not necessarily improve by using more complex models.

These errors can be substantial. Typical mean algebraic percentage errors (a commonly used measure of forecast accuracy) are approximately 30 percent for 25-year county-level projections and 36 percent for 30-year projections. For Census tracts, a unit of geography roughly equivalent to TAZs, the average errors may be 45 percent and 54 percent for 25-year and 30-year projections, respectively.[12] Therefore, any projection of the Charlotte Region needs to be bracketed with a wide confidence interval, particularly on the up-side for small local areas, such as TAZs. The growth projections for specific areas in the Monroe Connector/Bypass Corridor can be both positively and negatively affected by the actions of individual land owners and developers as well as the timing of utility provision and perturbations in regional economic growth rates.

[11] Stanley K. Smith, Jeff Tayman, and David A. Swanson, *State and Local Population Projections: Methodology and Analysis*, Plenum Publishers (2001), p. 292.
[12] Smith, Tayman, and Swanson, p. 340.

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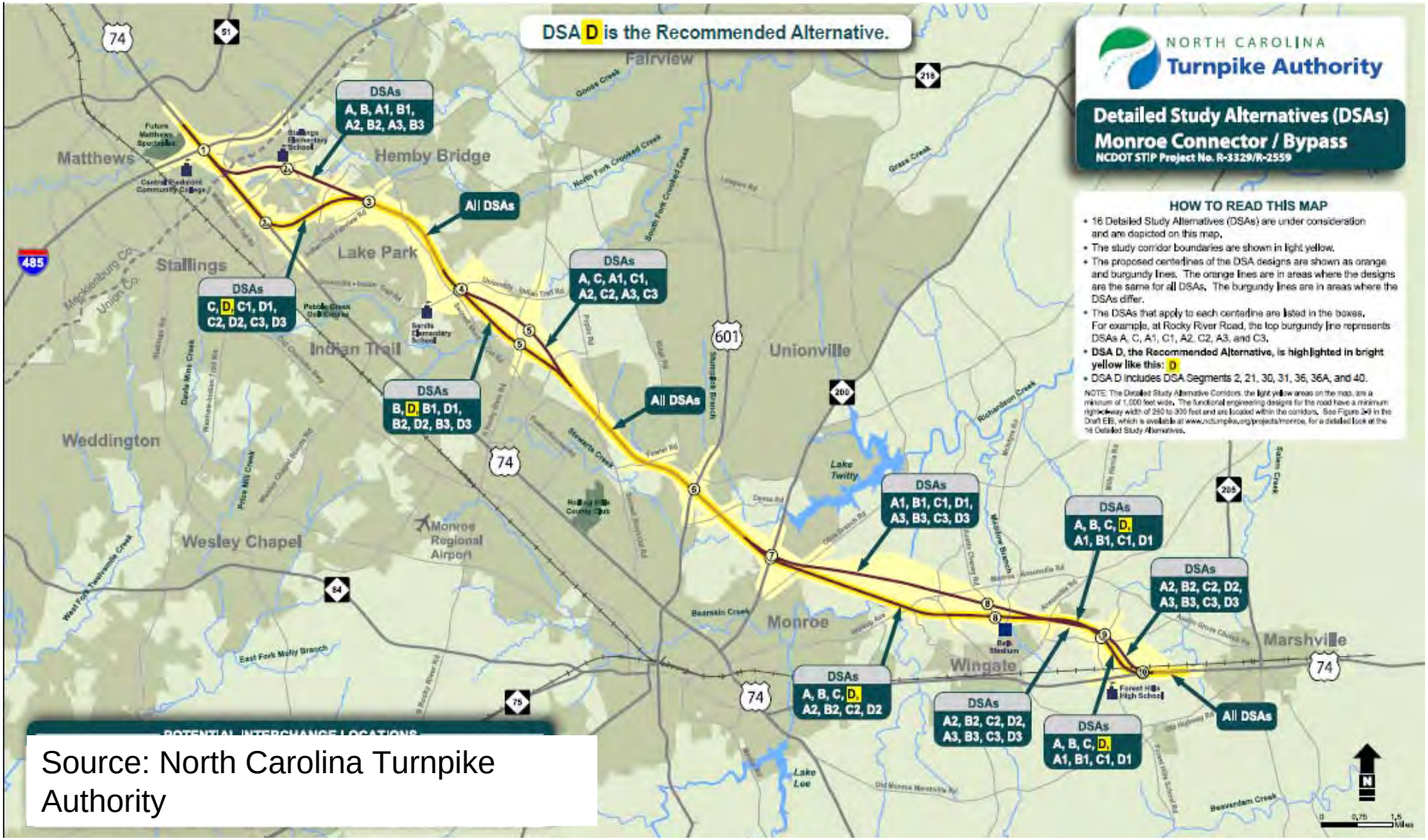
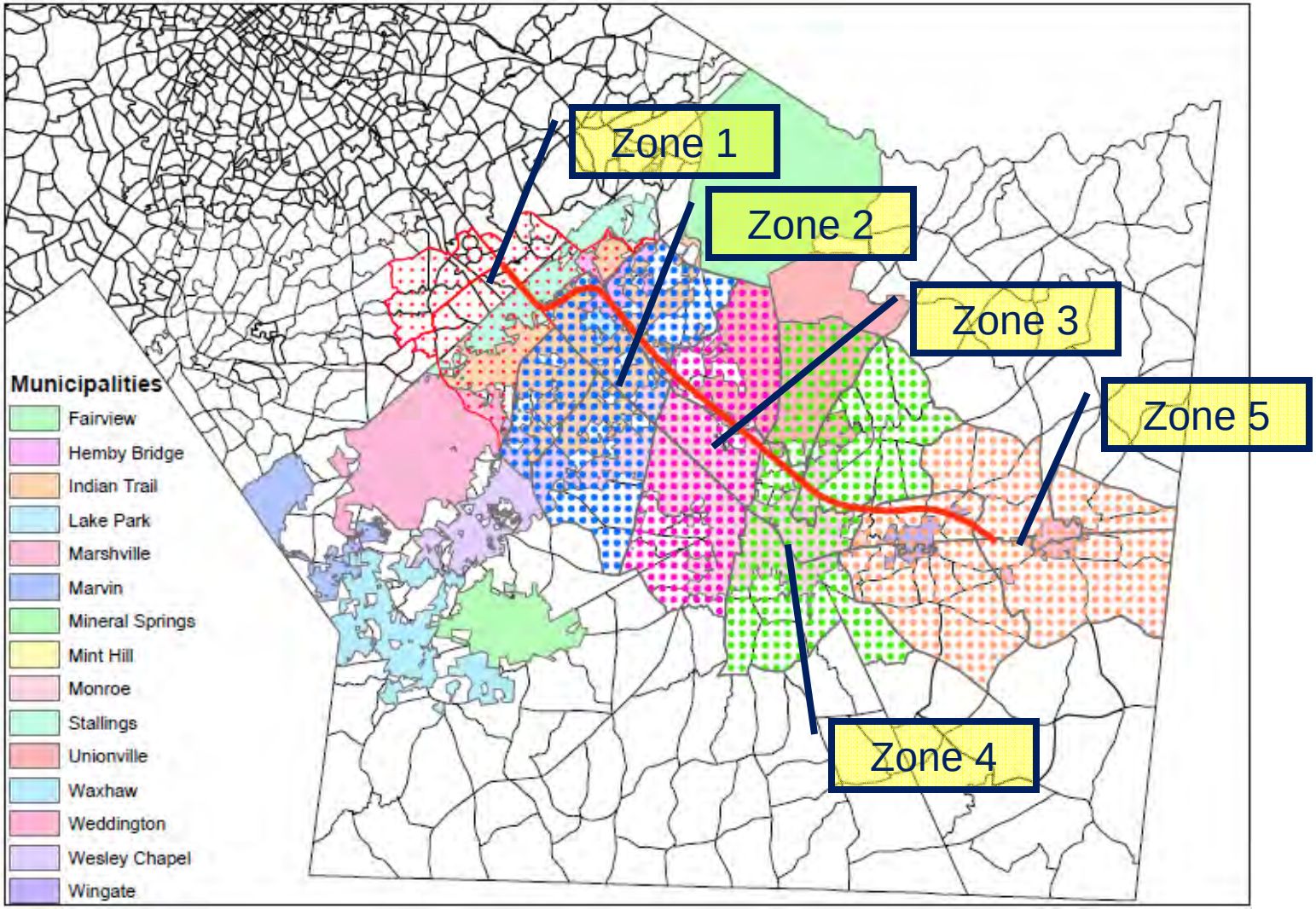
Map 1

Monroe Connector/Bypass Route



Map 2

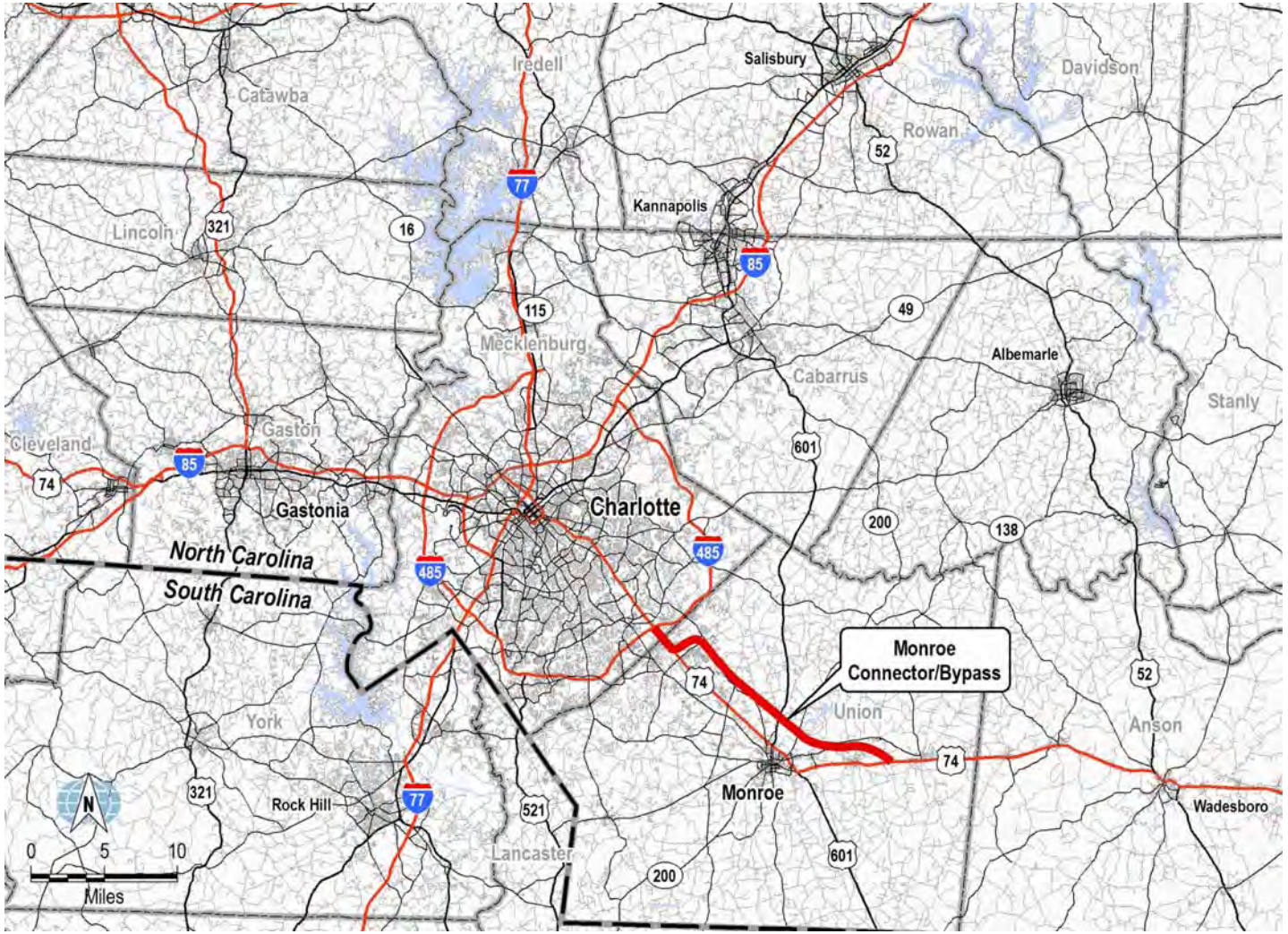
Monroe Connector/Bypass Corridor, Municipalities, and Corridor Zones



Source: Kenan Institute analysis of MUMPO and Union County data

Map 3

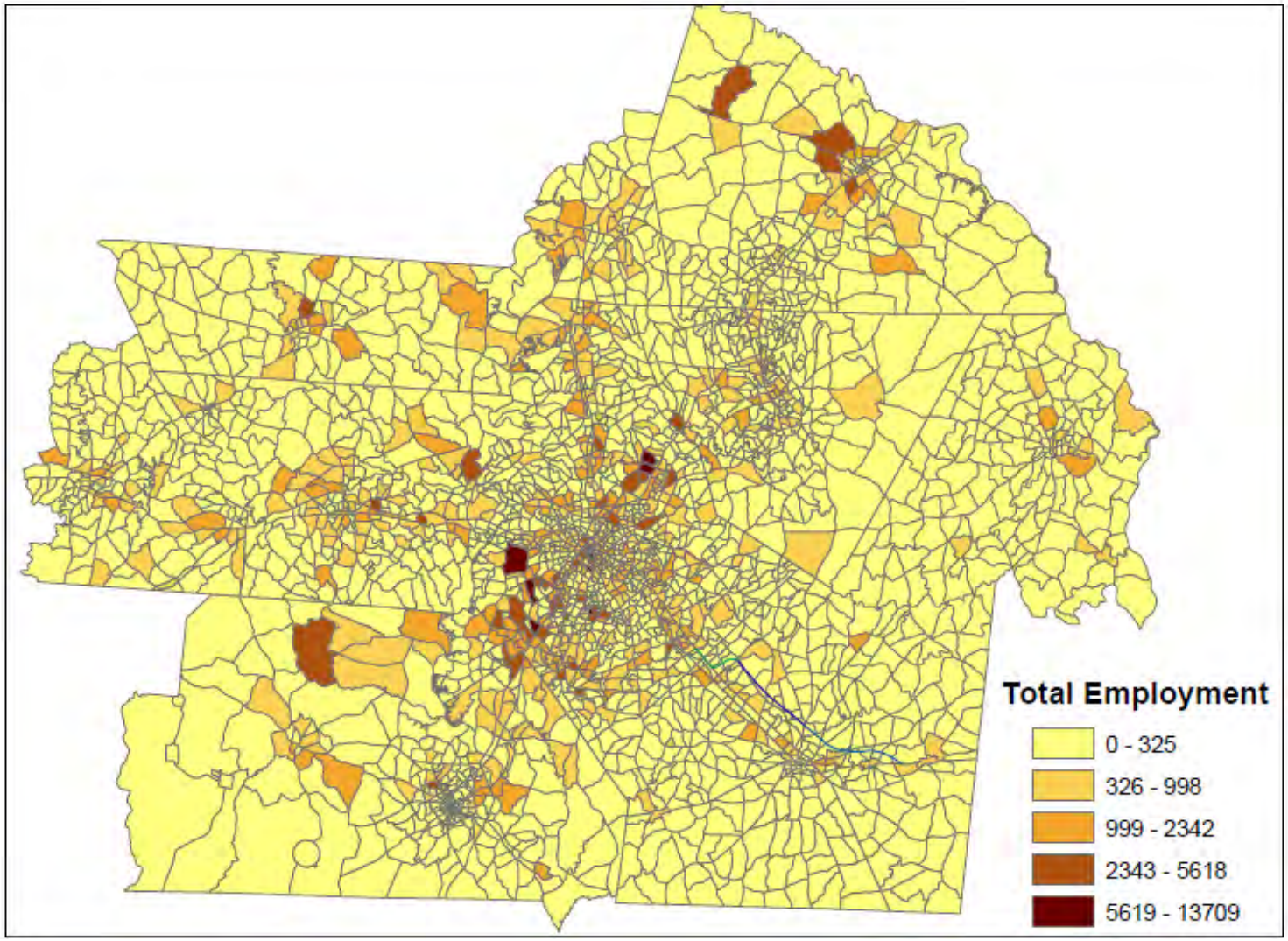
Overview of Charlotte Region



Source: Wilbur Smith Associates

Map 4

Regional Employment Concentrations

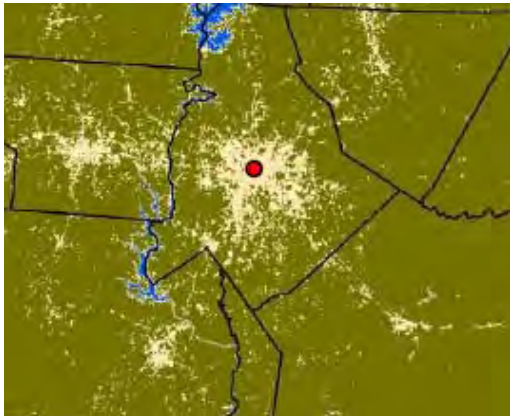


Source: Kenan Institute analysis of MUMPO data

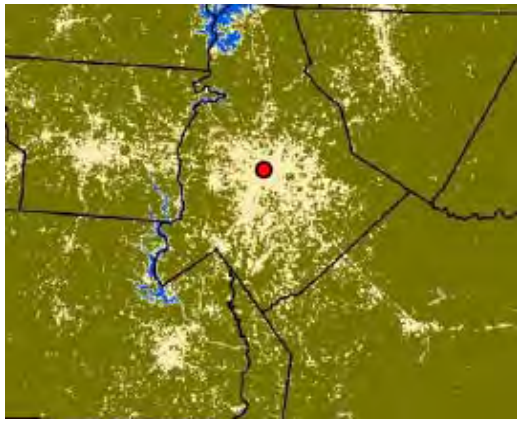
Map 5

Regional Land Consumption over Time

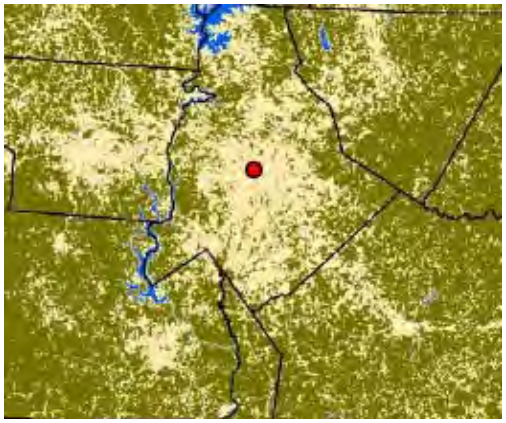
1976



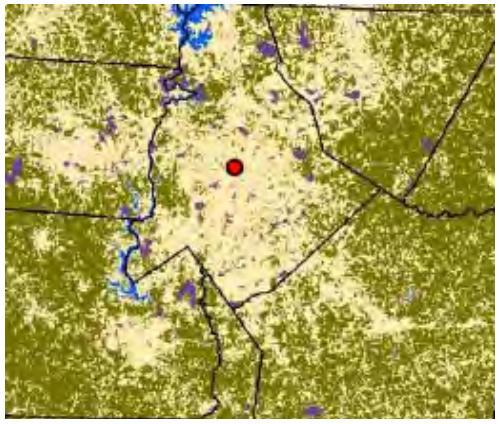
1986



1996



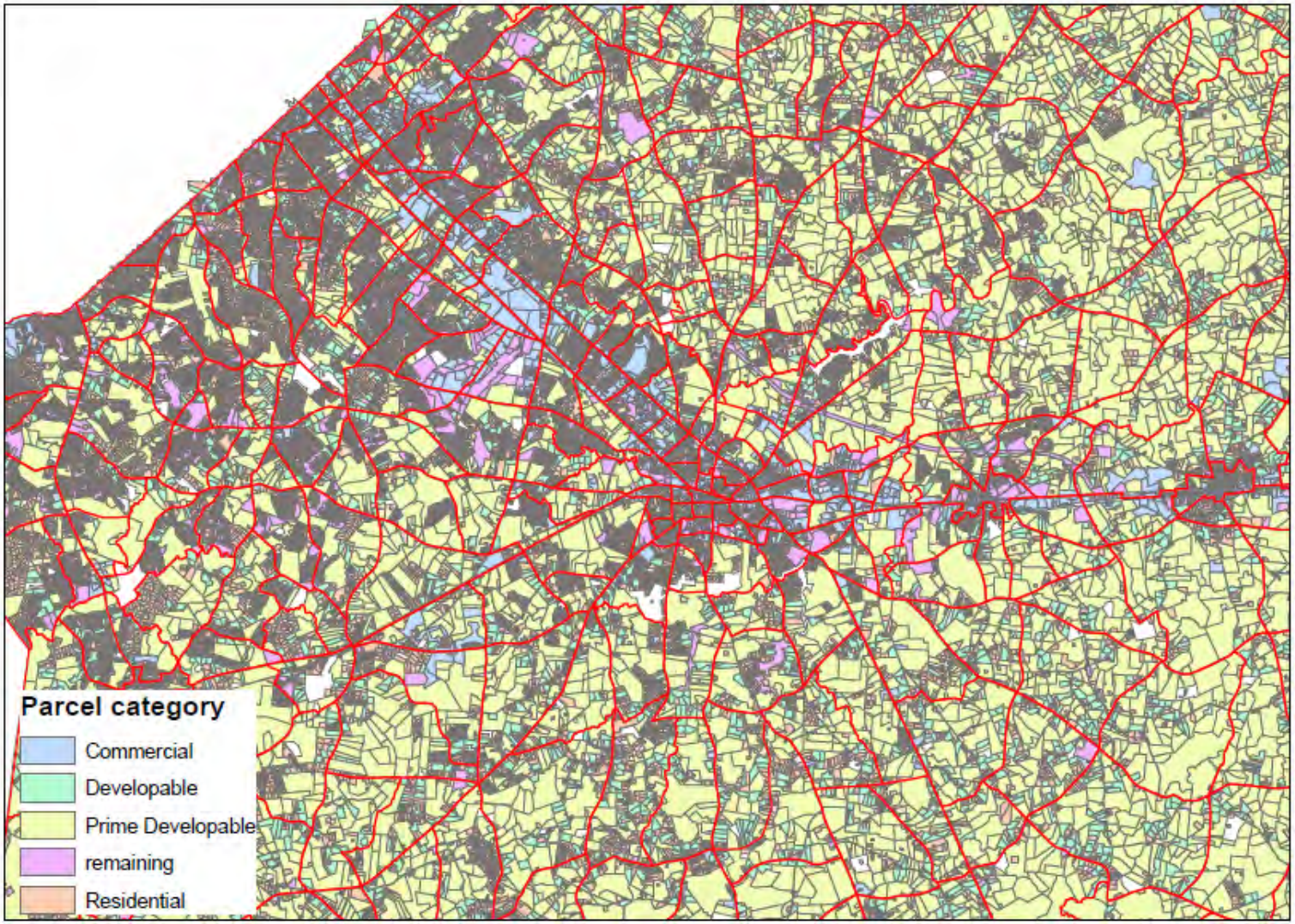
2006



Source: RENCI at University of North Carolina, Charlotte

Map 6

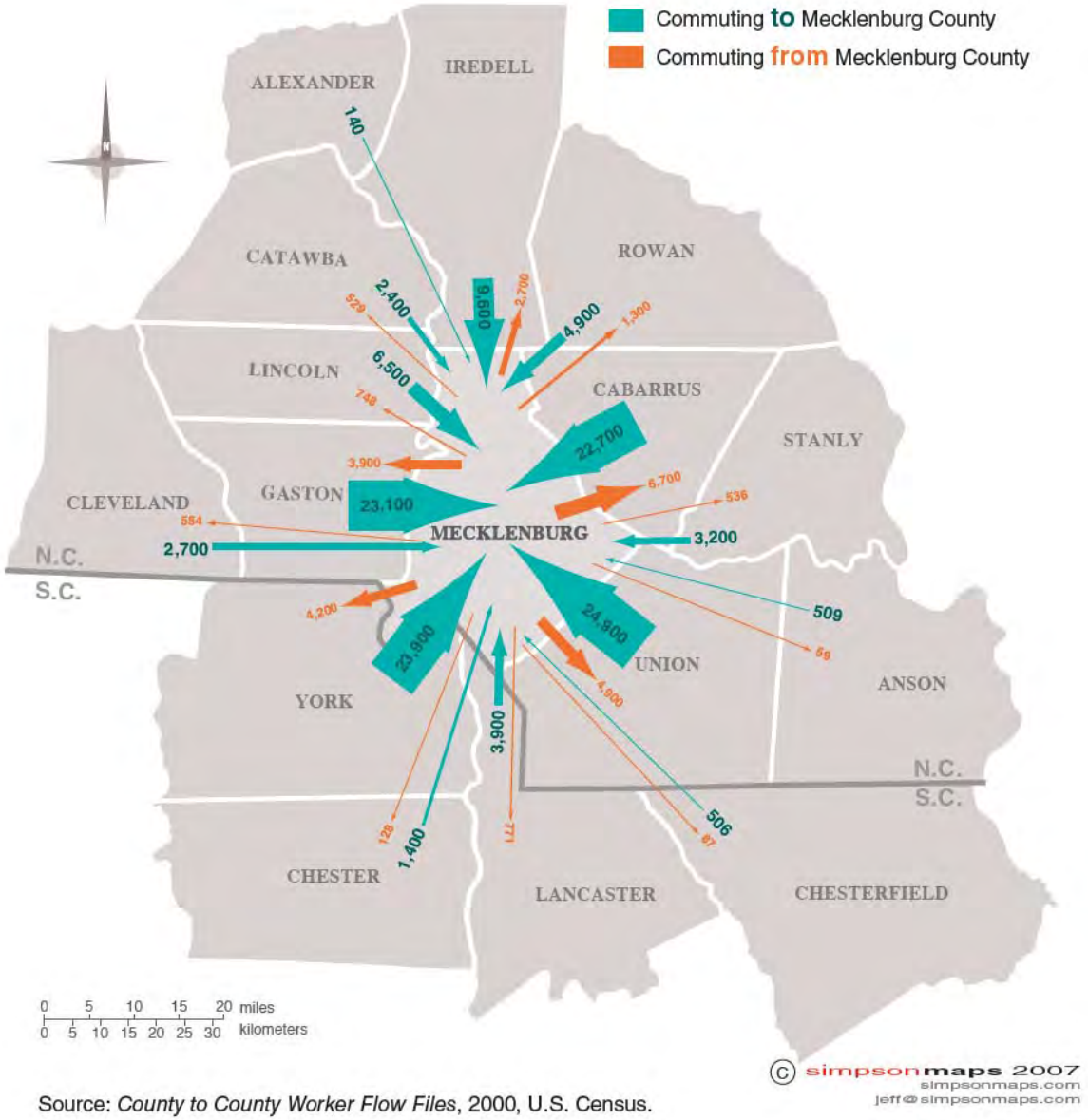
Land Use in Union County



Source: Kenan Institute analysis of MUMPO and Union County data

Map 7

Charlotte / Mecklenburg Commuting Patterns, 2000



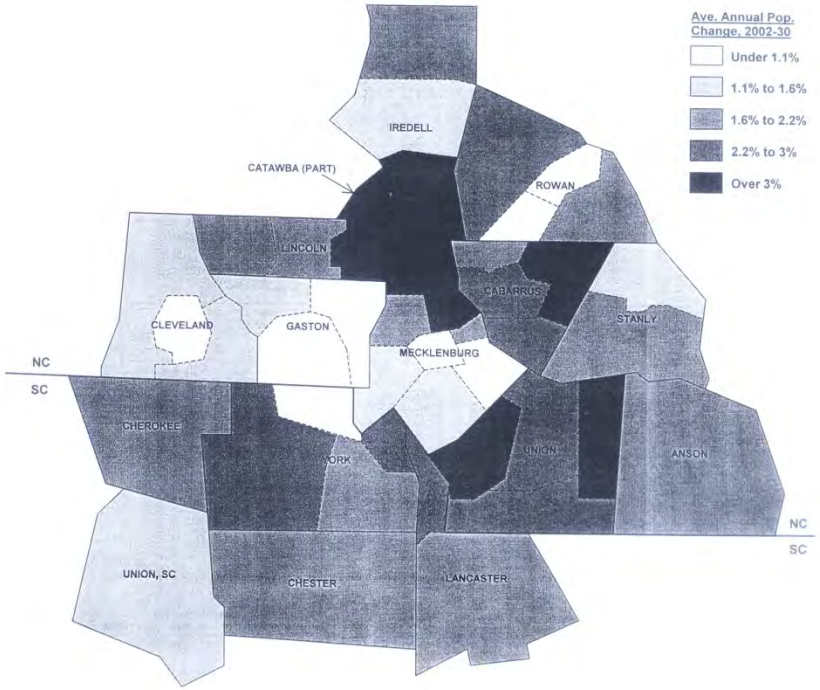
Source: *County to County Worker Flow Files*, 2000, U.S. Census.

Courtesy of Charlotte Chamber of Commerce

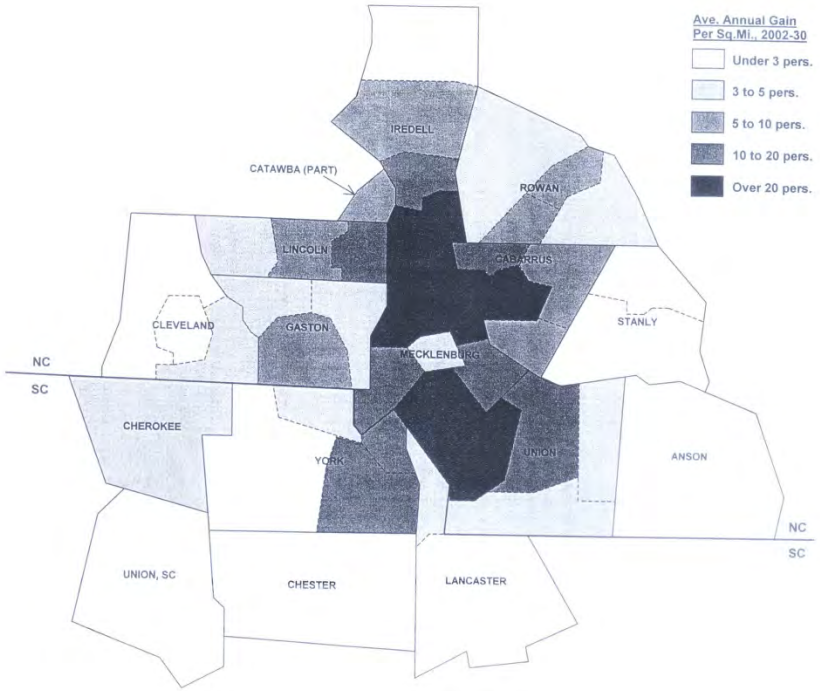
Map 8

MPO Projected District Population Change, 2002-2030

Average Annual Population Growth



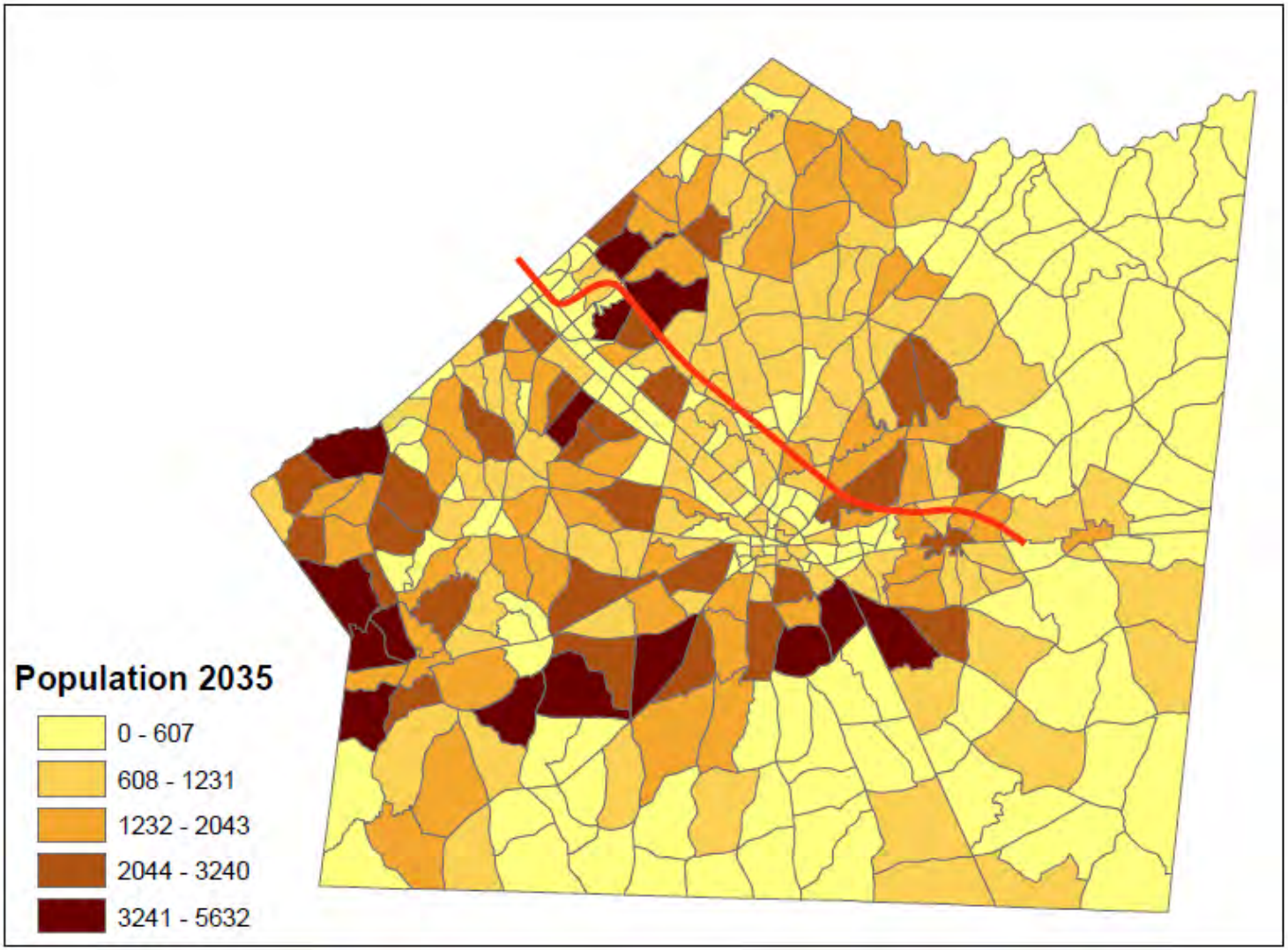
Average Annual Density Increase



Source: Hammer, Demographic and Economic Forecasts for the Charlotte Region, 2003

Map 9

MPO Small Area Population Projection for Union County

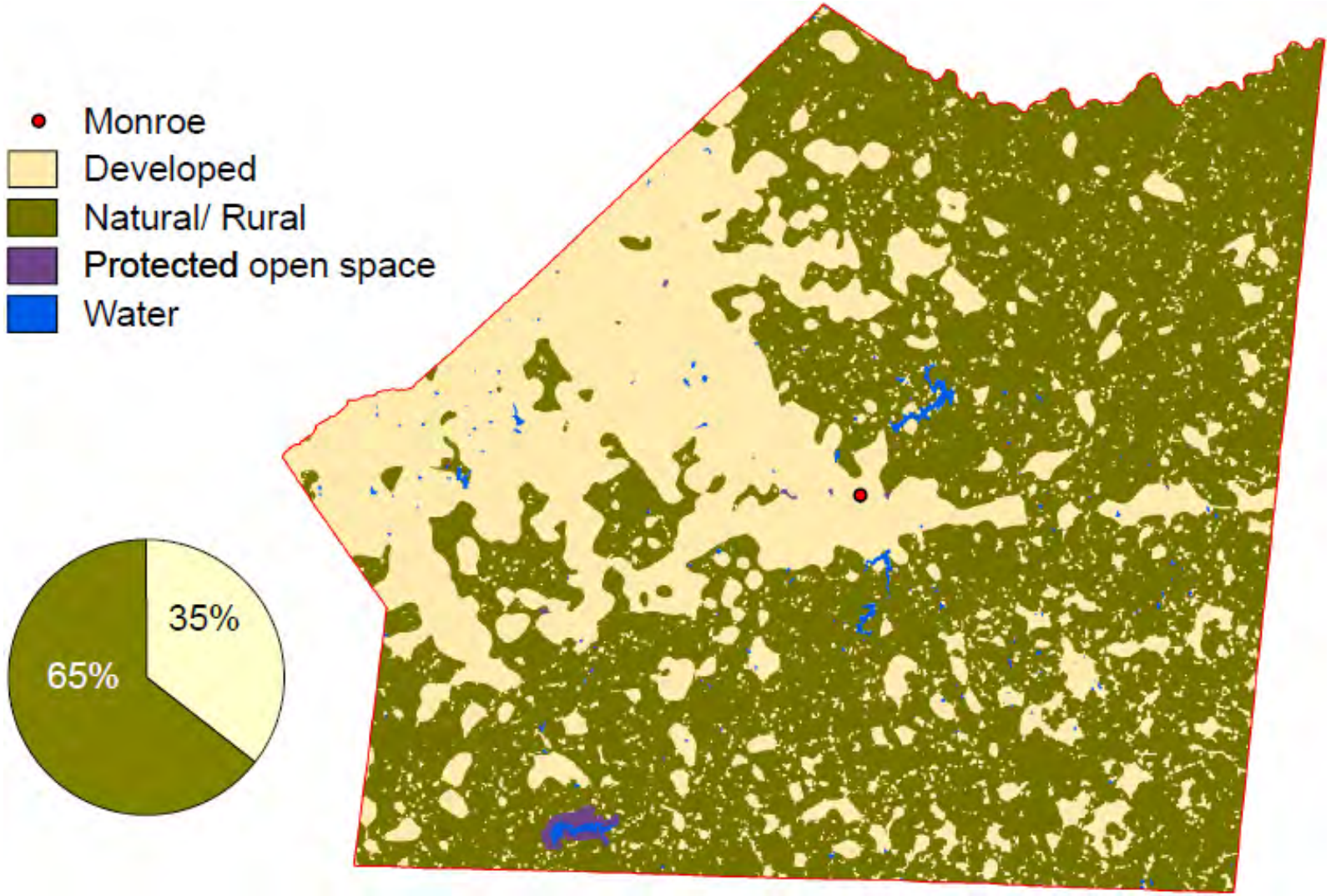


Source: Kenan Institute analysis of MUMPO data

Map 10

Union County Land Consumption Projections

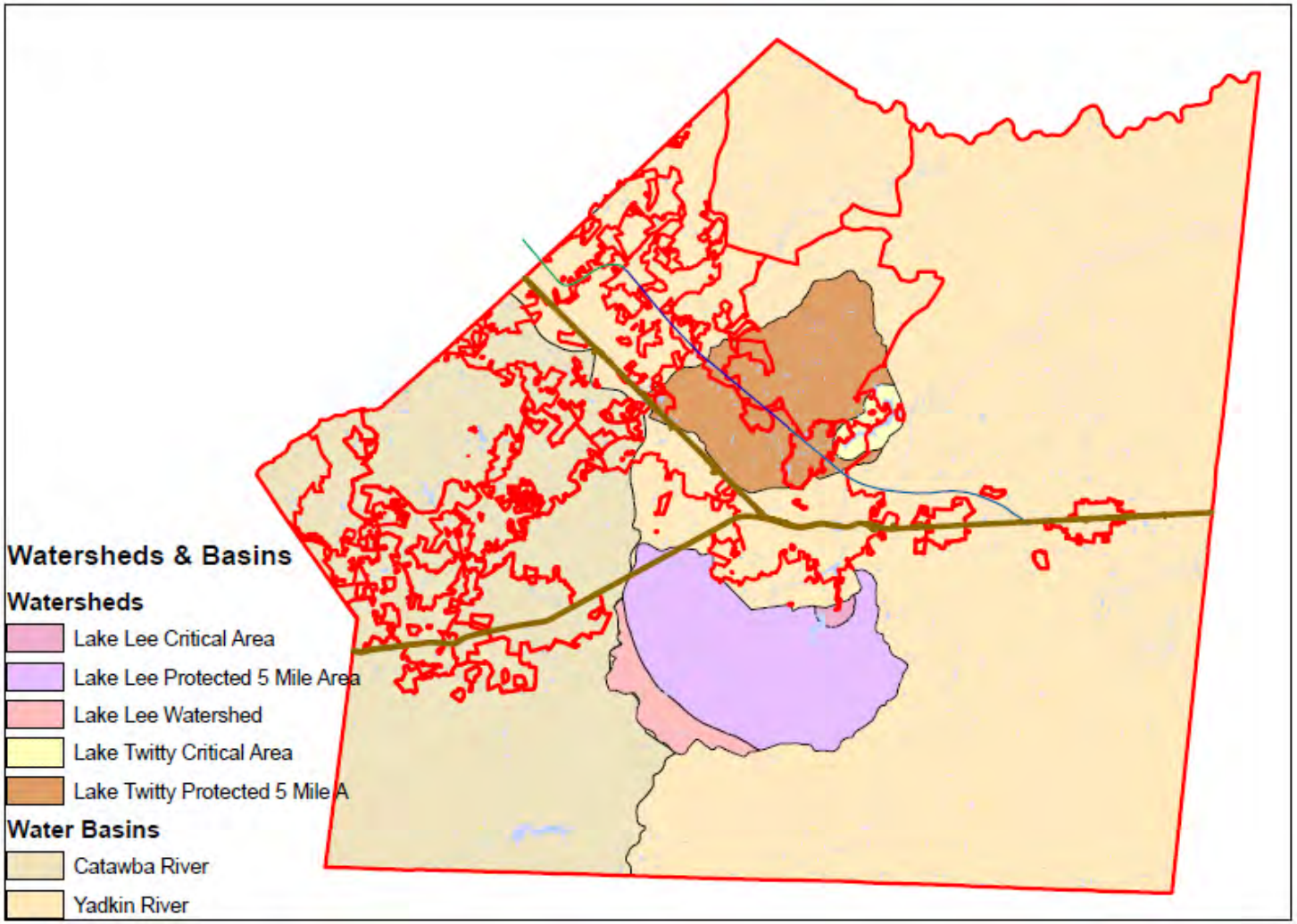
(predicted 2030)



Source: RENCI at University of North Carolina, Charlotte

Map 11

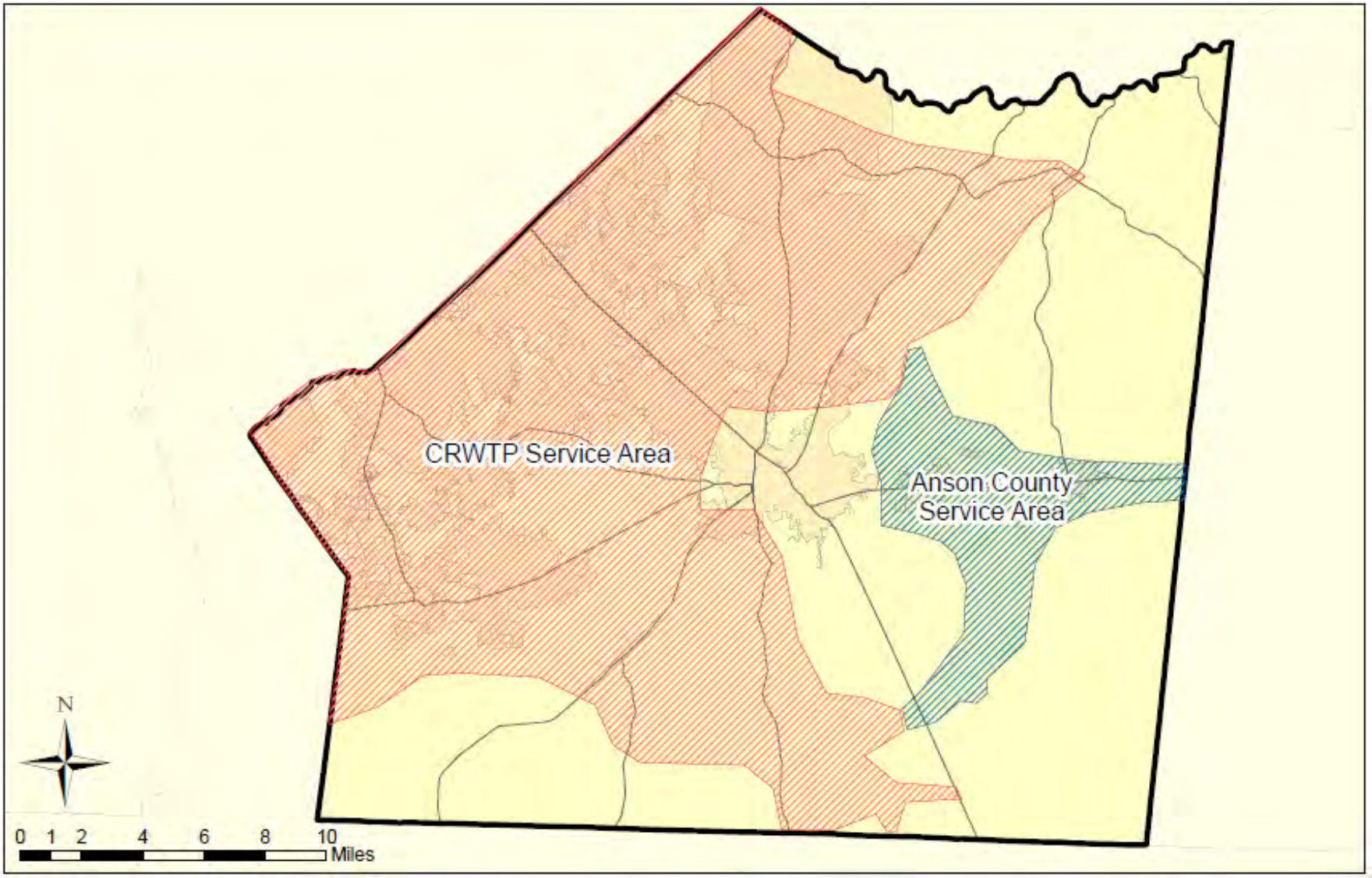
Union County Watersheds and Water Basins



Source: Kenan Institute analysis of Union County data

Map 12

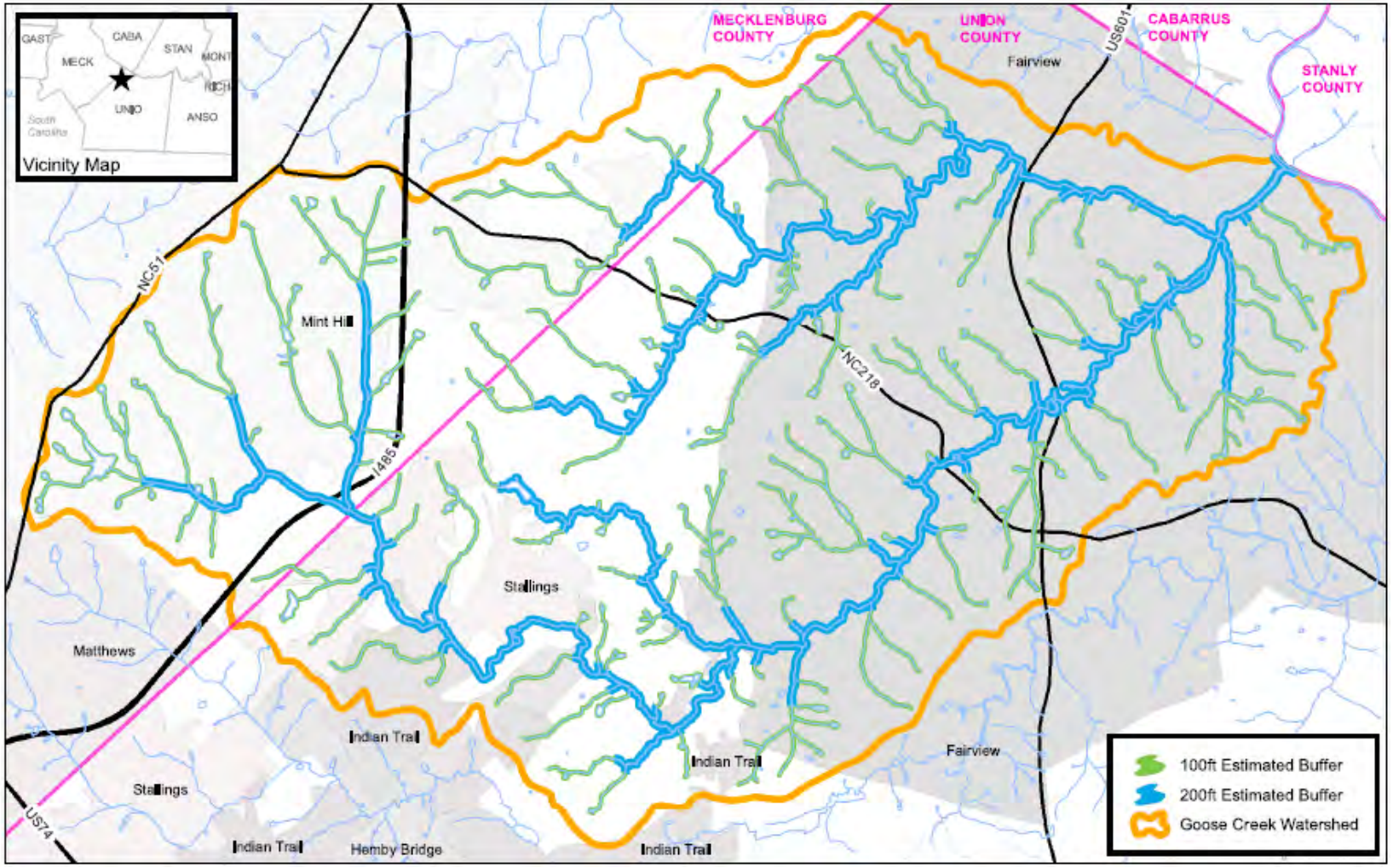
Union County Water Service Areas



Source: Union County Department of Public Works,
http://www.co.union.nc.us/Portals/0/PublicInformation/News/2009/07-09/2.pdf

Map 13

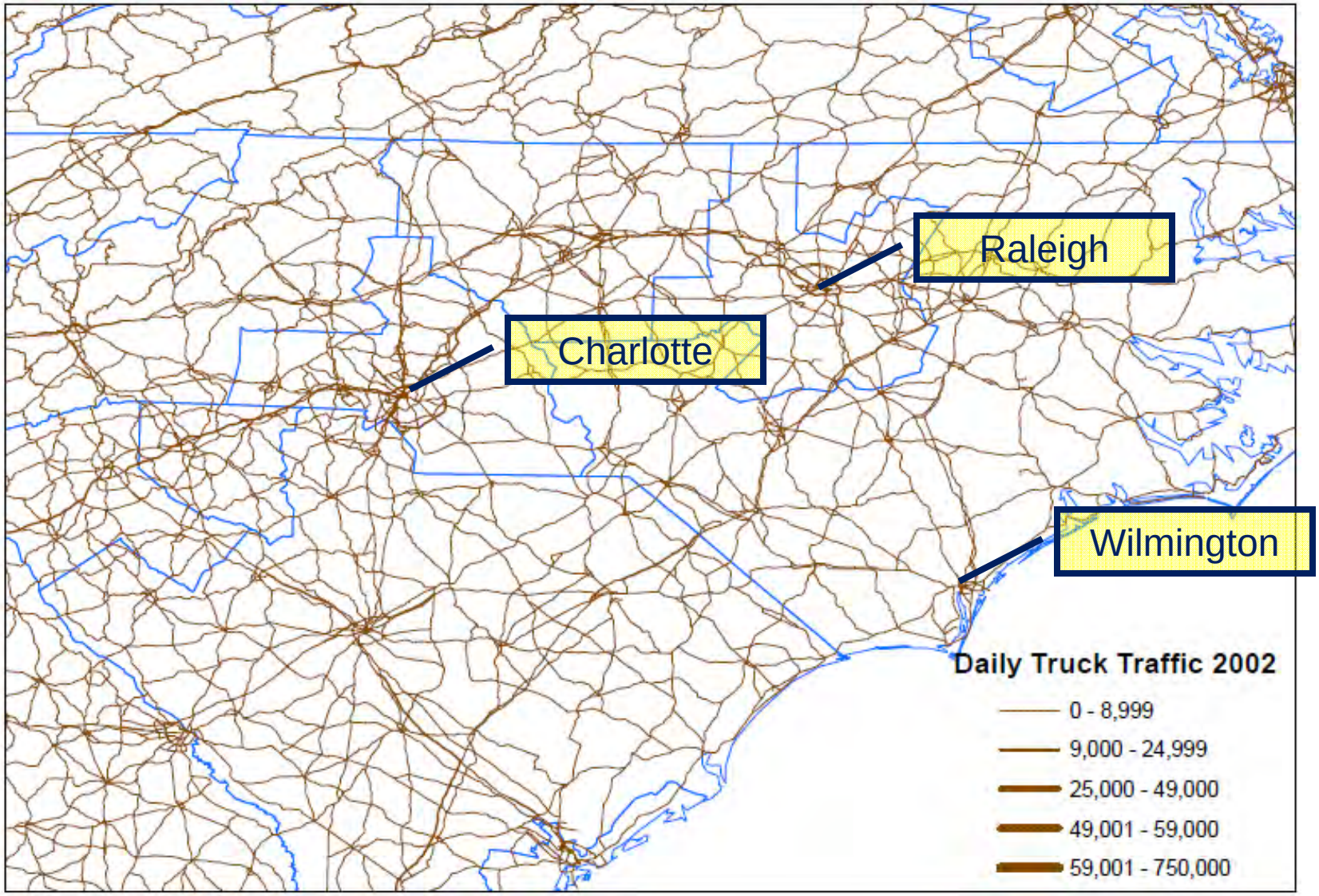
Goose Creek Watershed Buffers



Source: North Carolina Department of Water Quality, http://h2o.enr.state.nc.us/csu/documents/goosecreek_proposed_MAP3_BUFFERS_2feb09_website.pdf

Map 14

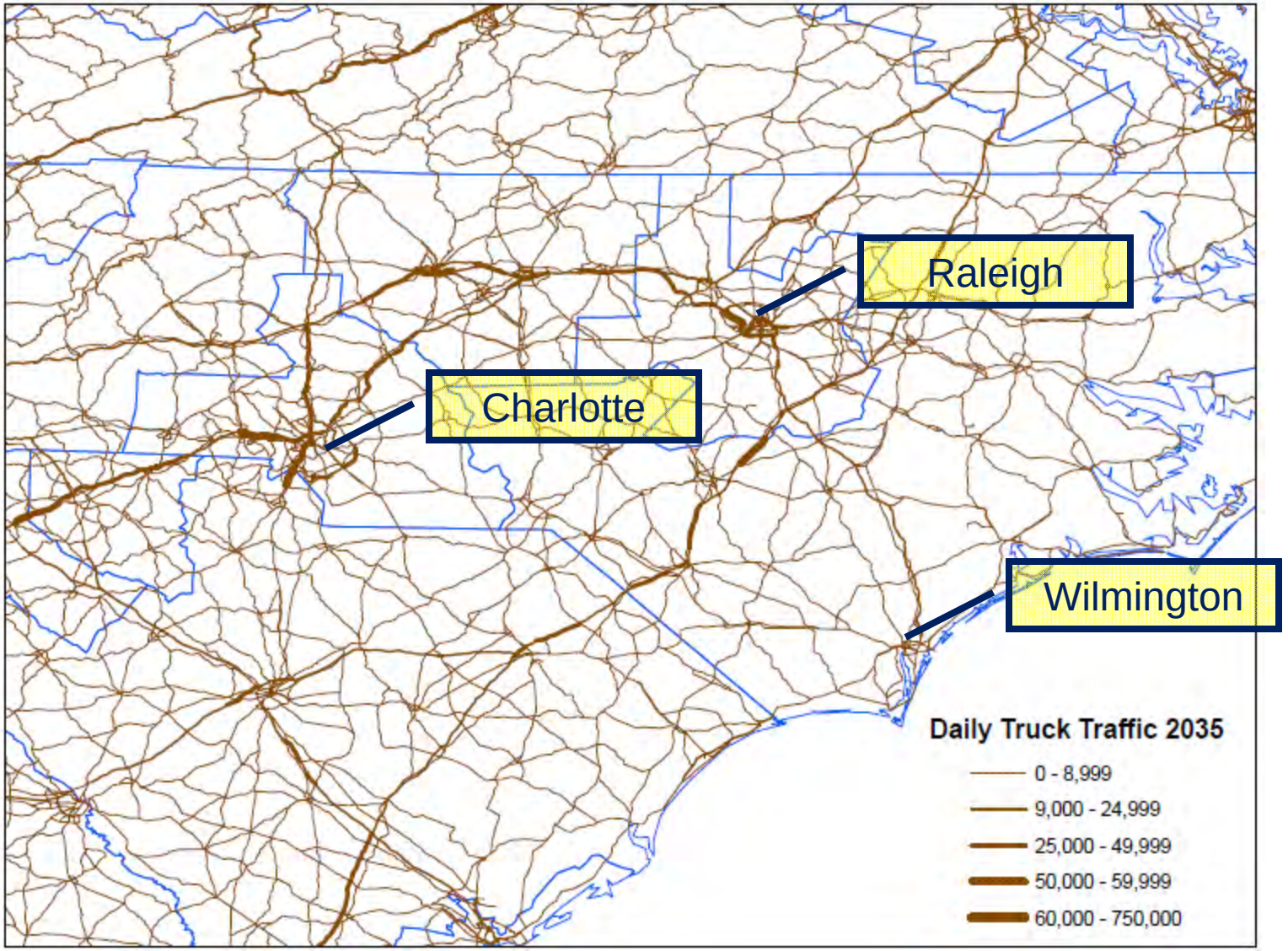
Regional Truck Traffic, 2002



Source: Kenan Institute analysis of Freight Analysis Framework 2 data

Map 15

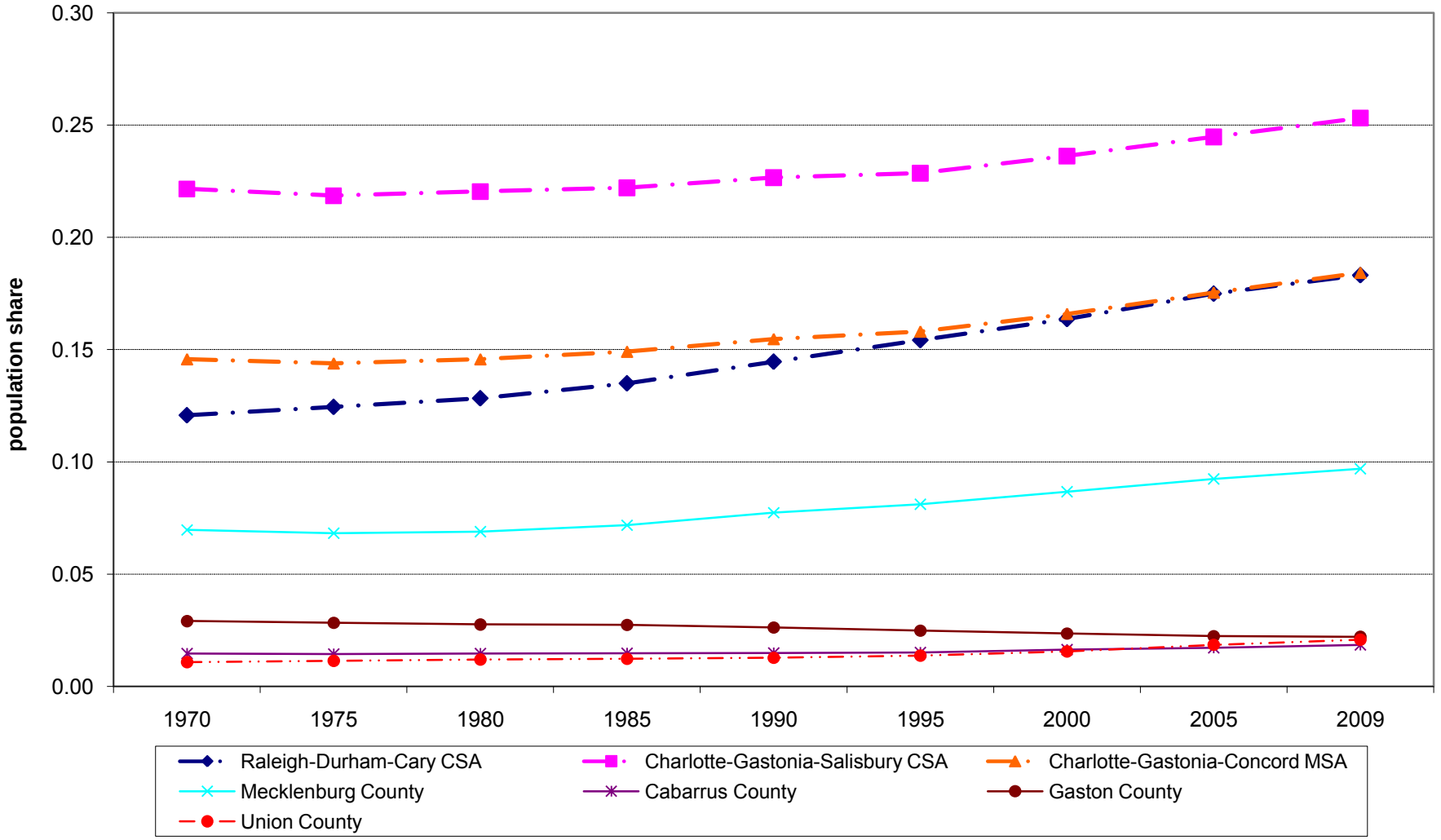
Regional Truck Traffic, 2035



Source: Kenan Institute analysis of Freight Analysis Framework 2 data

Figure 1

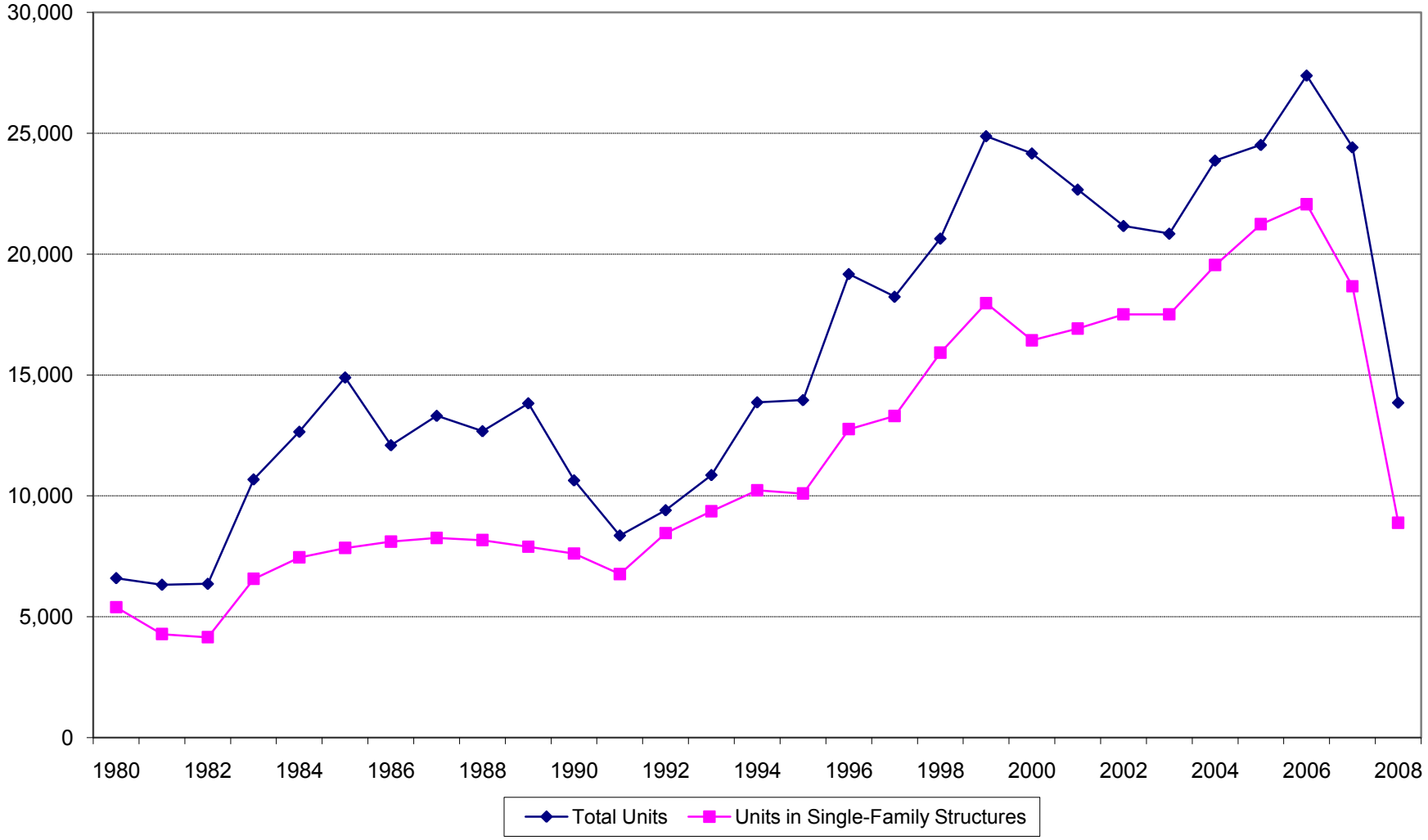
Selected Regional Shares of North Carolina Population



Source: Kenan Institute of Woods and Poole compilation of Census data

Figure 2

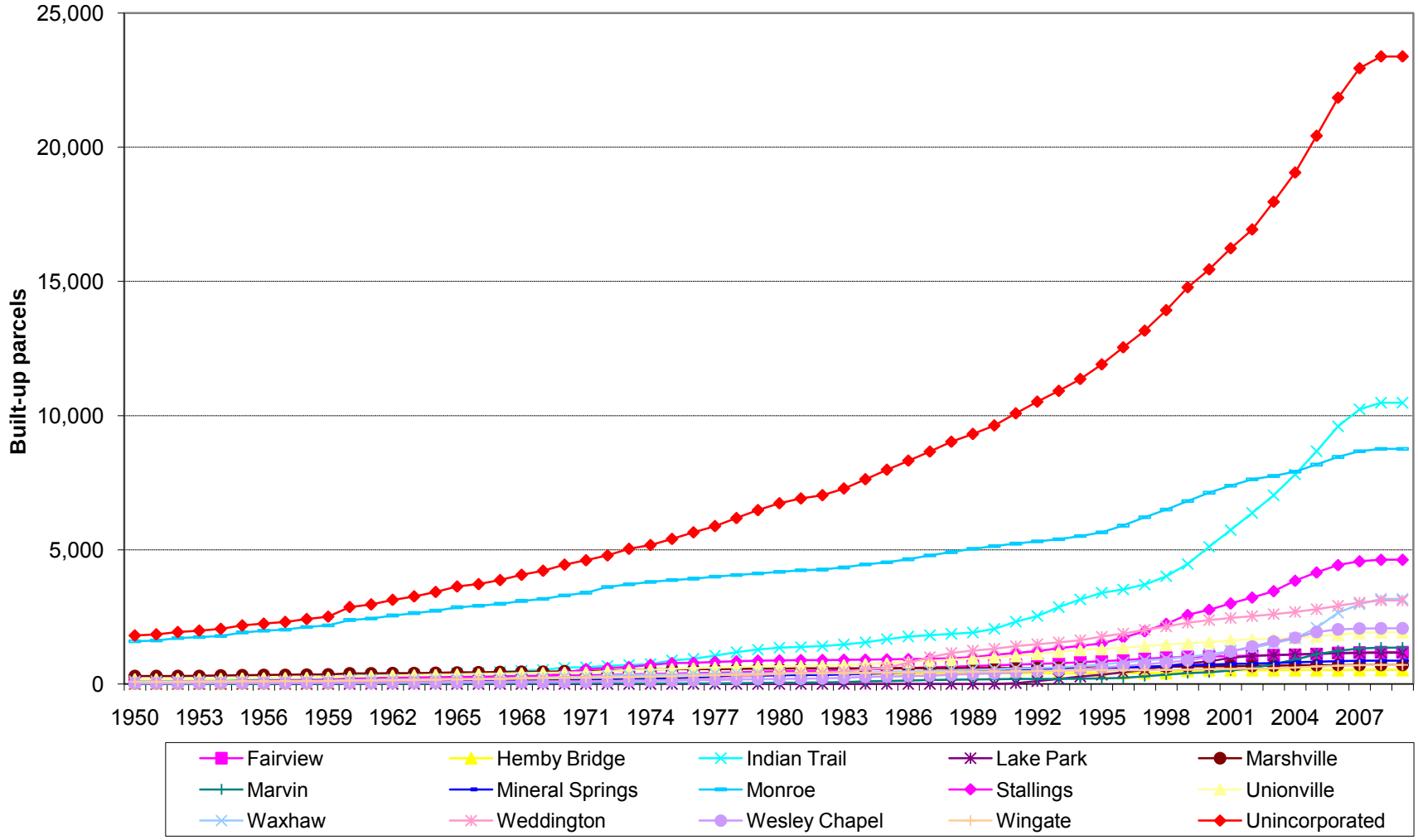
Housing Permits in Six-County Charlotte Region



Source: Kenan Institute analysis of HUD data

Figure 3

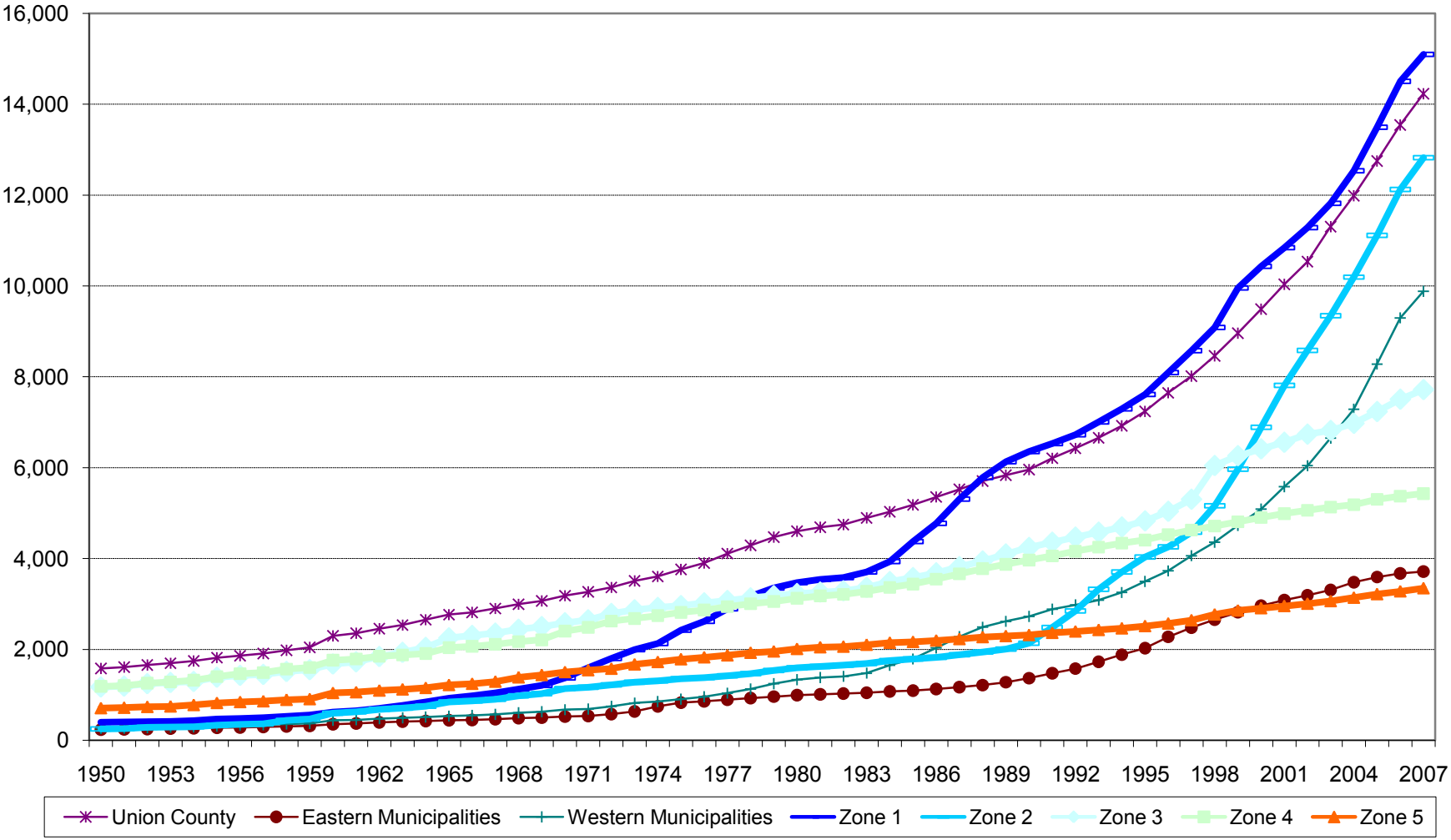
Residential Development in Union County by Municipality



Source: Kenan Institute analysis of Union County data

Figure 4

Dwellings in Mecklenburg and Union Counties

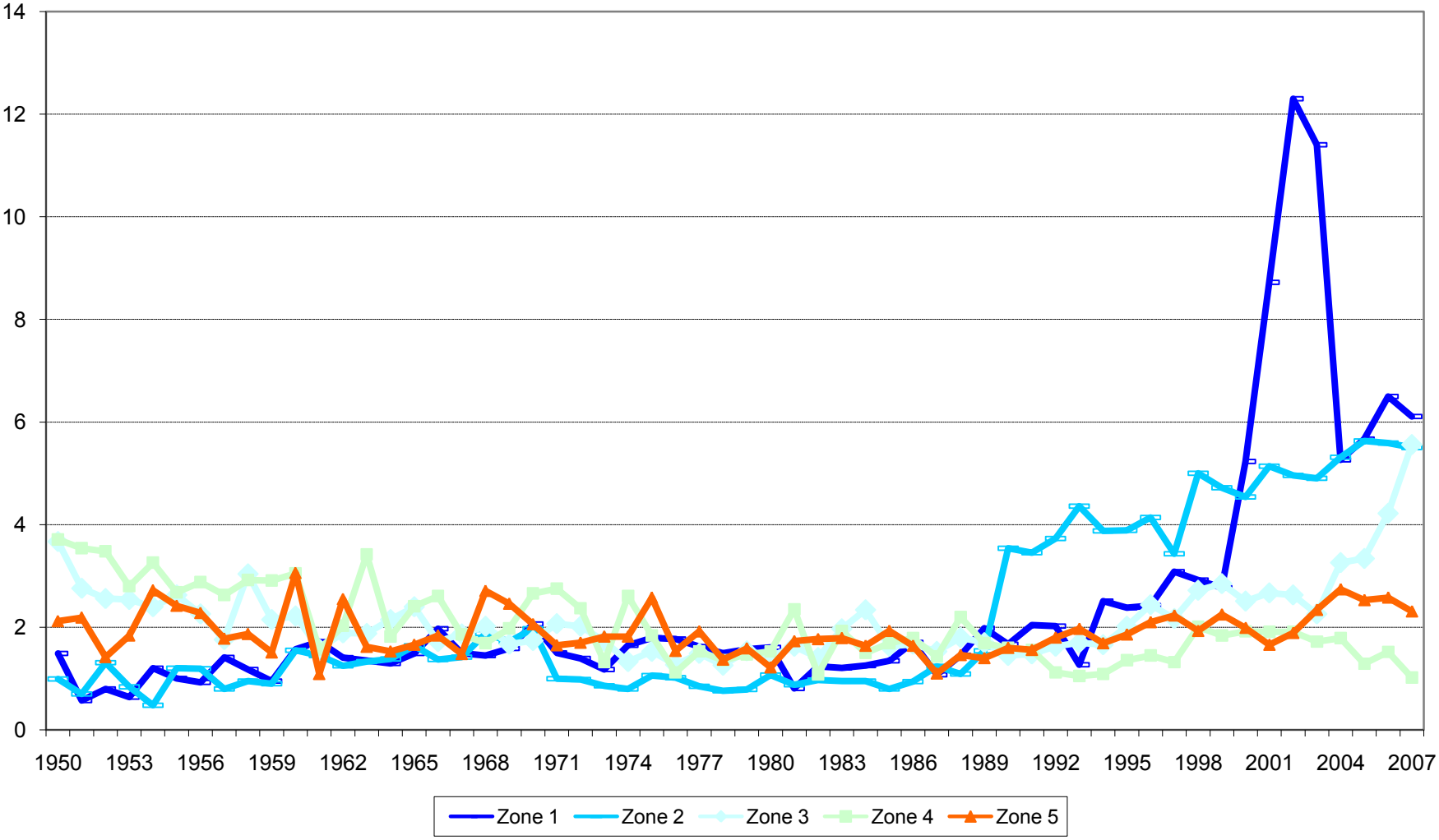


Source: Kenan Institute analysis of Mecklenburg and Union County data

Note: See Map 2 for definitions of Zones

Figure 5

Dwellings per Acre in Corridor Zones

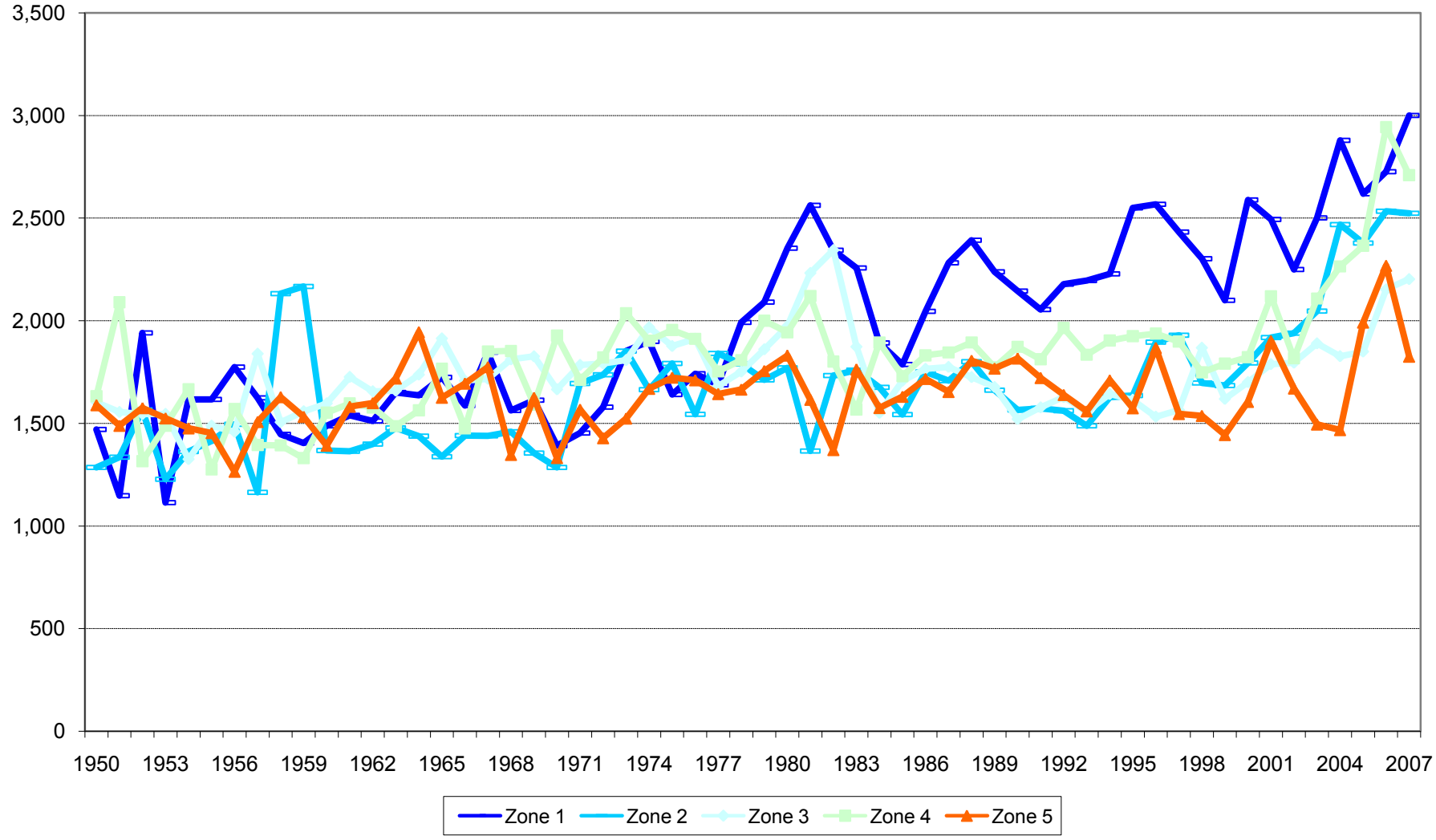


Source: Kenan Institute analysis of Mecklenburg and Union County data

Note: See Map 2 for definitions of Zones

Figure 6

Dwelling Size in Corridor Zones

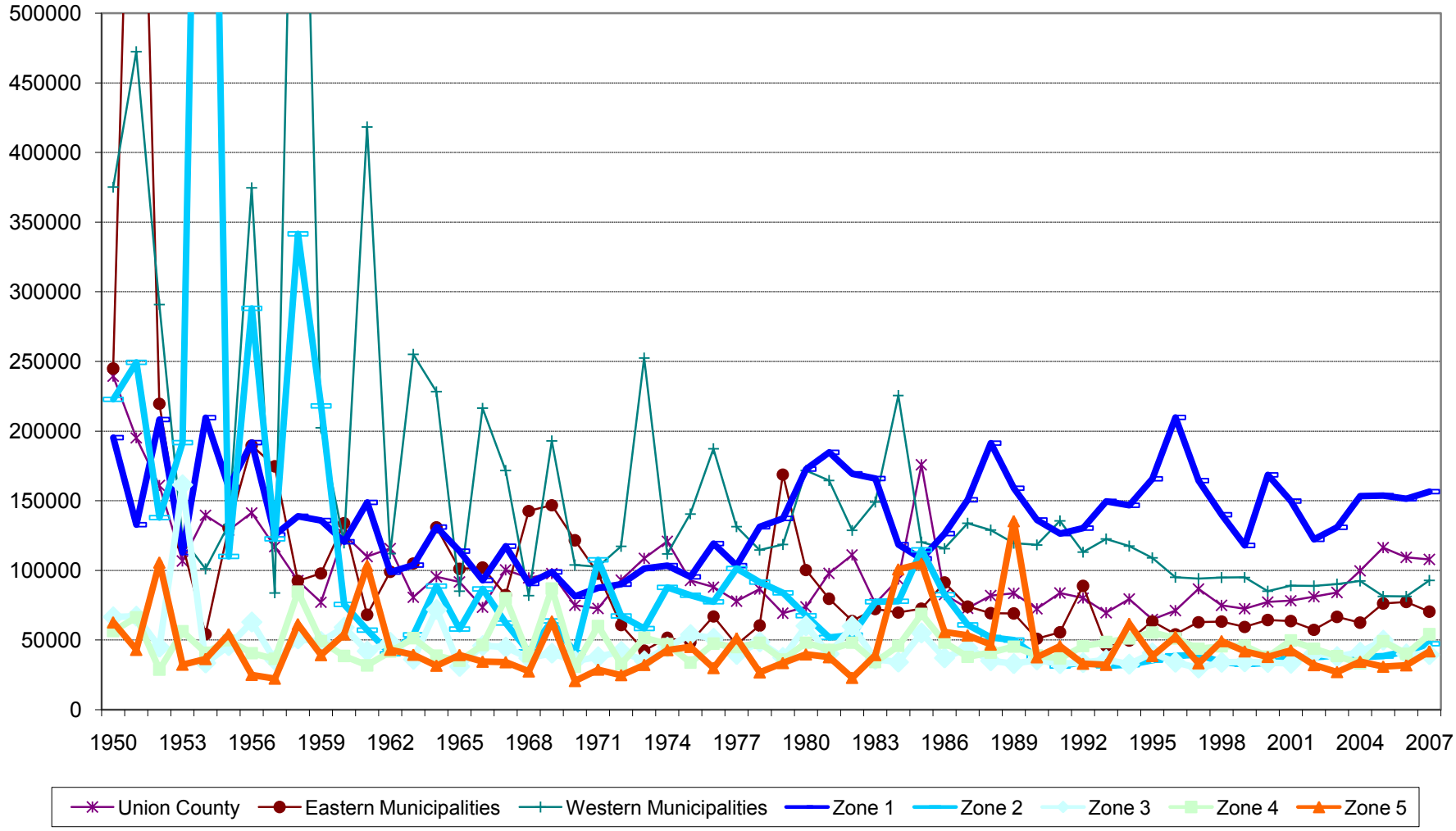


Source: Kenan Institute analysis of Mecklenburg and Union County data

Note: See Map 2 for definitions of Zones

Figure 7

Value of Housing in Mecklenburg and Union Counties

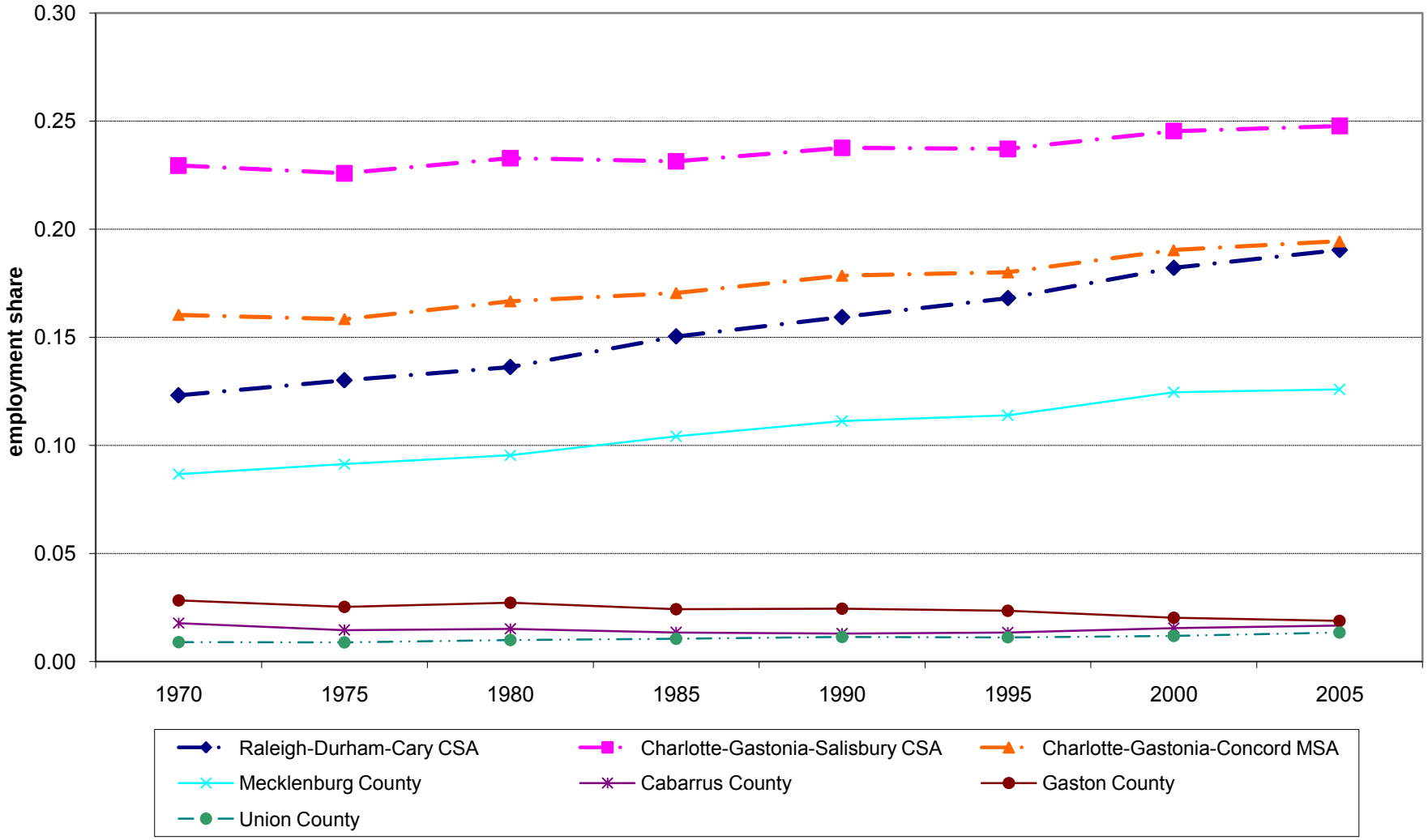


Source: Kenan Institute analysis of Mecklenburg and Union County data

Note: See Map 2 for definitions of Zones

Figure 8

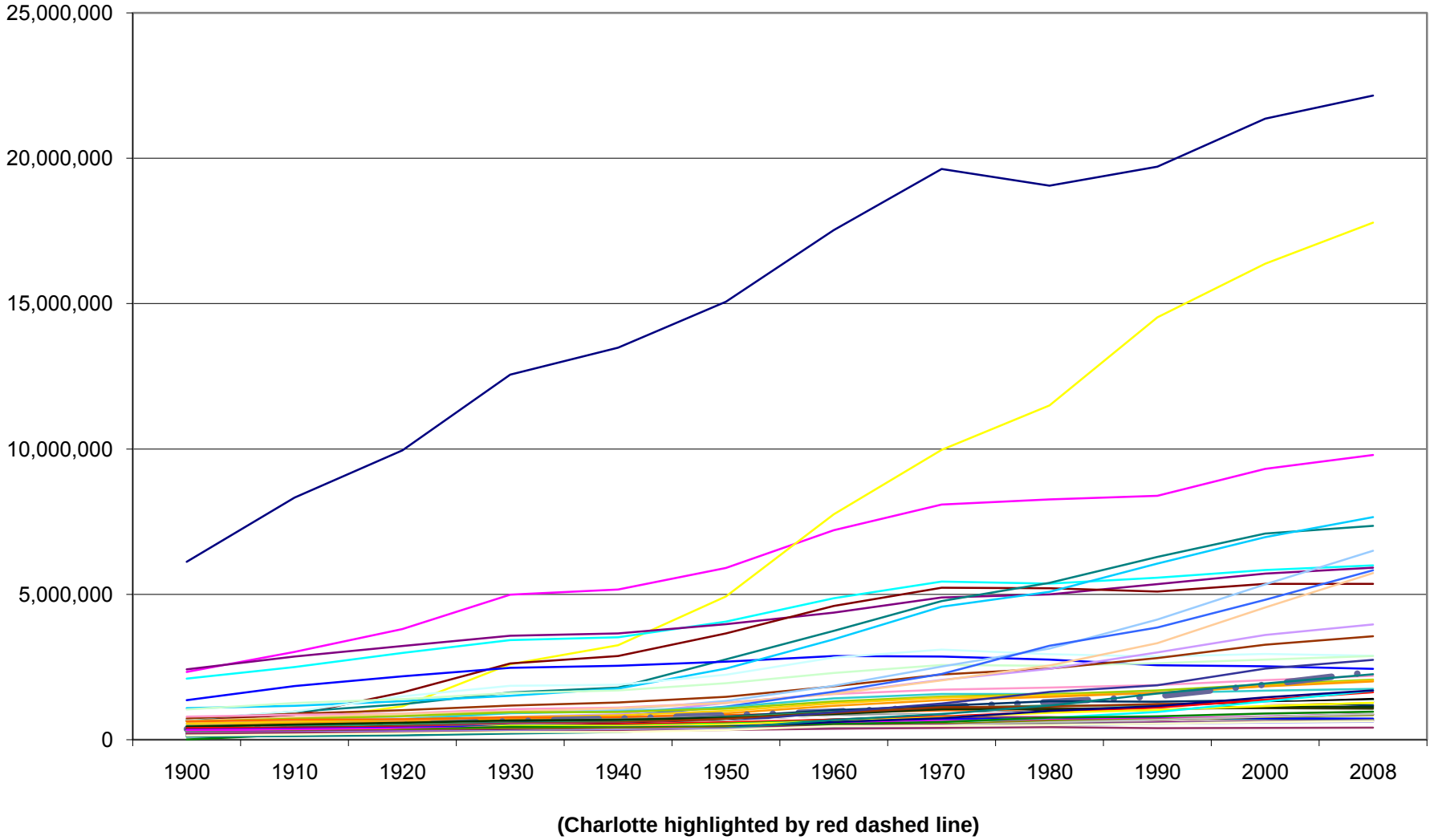
Selected Regional Shares of North Carolina Employment



Source: Kenan Institute analysis of Woods and Poole compilation of Census data

Figure 9

Population of the Largest 50 1950 Metropolitan Regions, 1900-2000

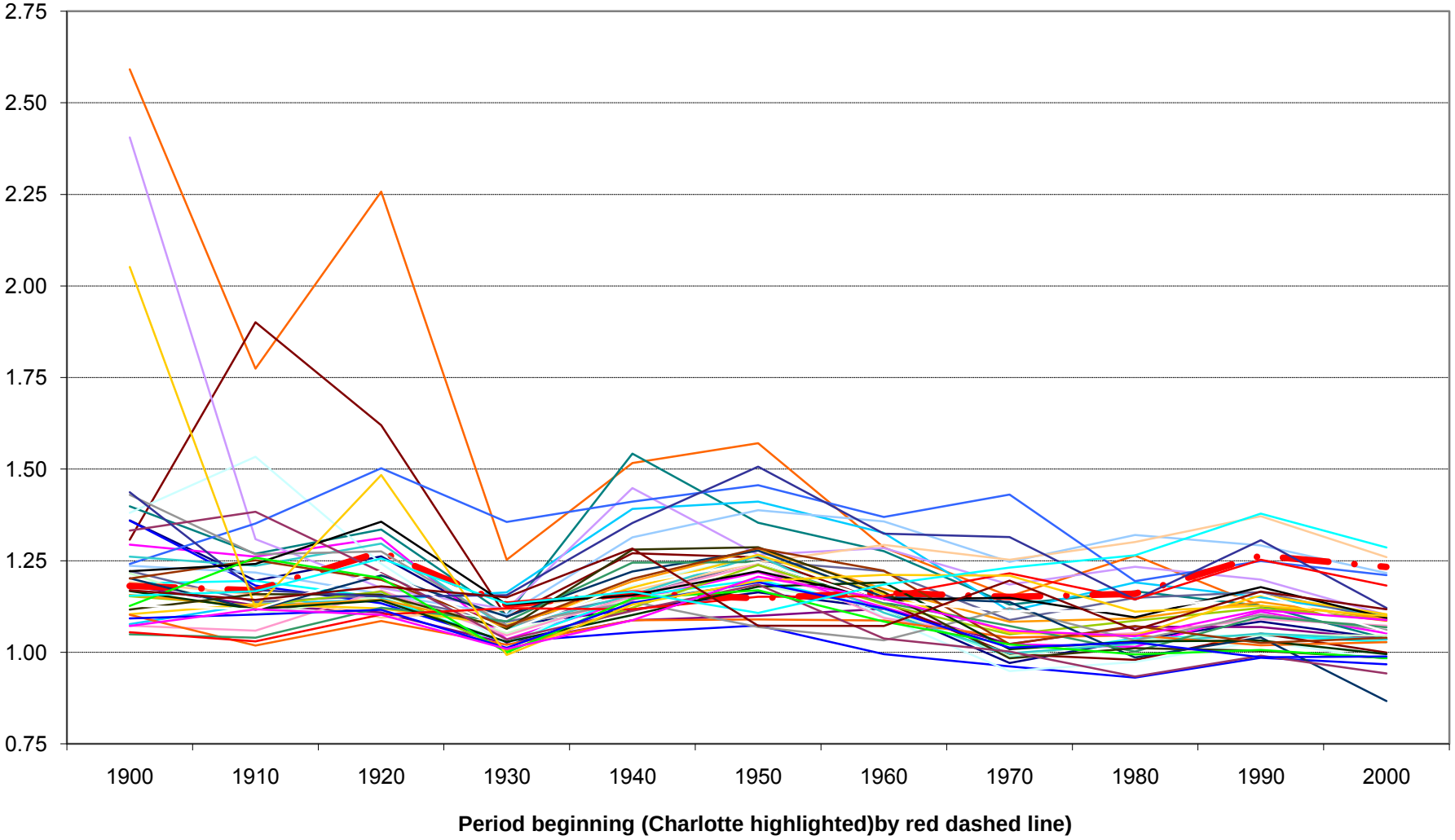


(Charlotte highlighted by red dashed line)

Source: Kenan Institute analysis of Census data

Figure 10

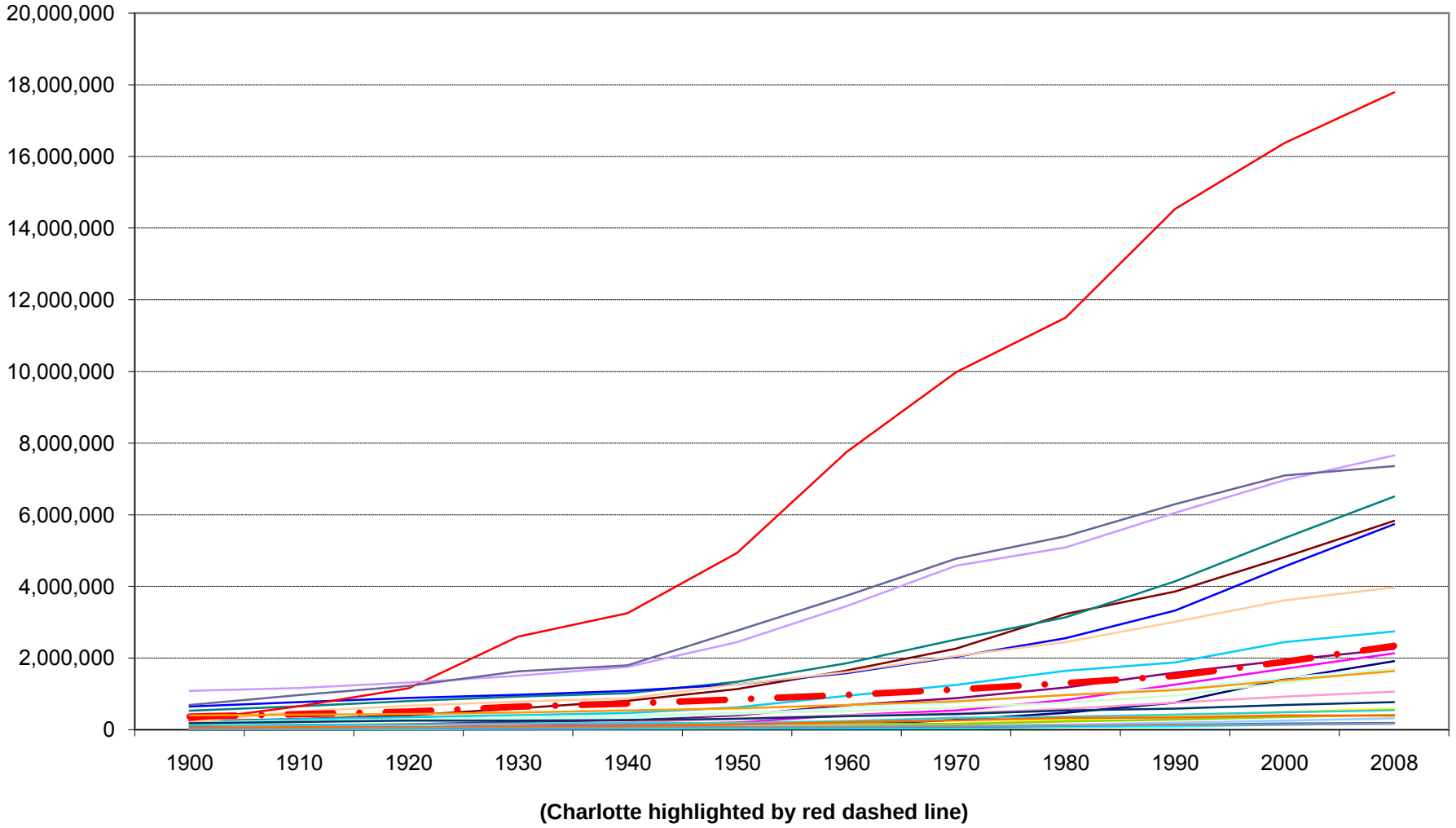
Population Growth among the Largest 50 1950 Metropolitan Regions, 1900-2000



Source: Kenan Institute analysis of Census data

Figure 11

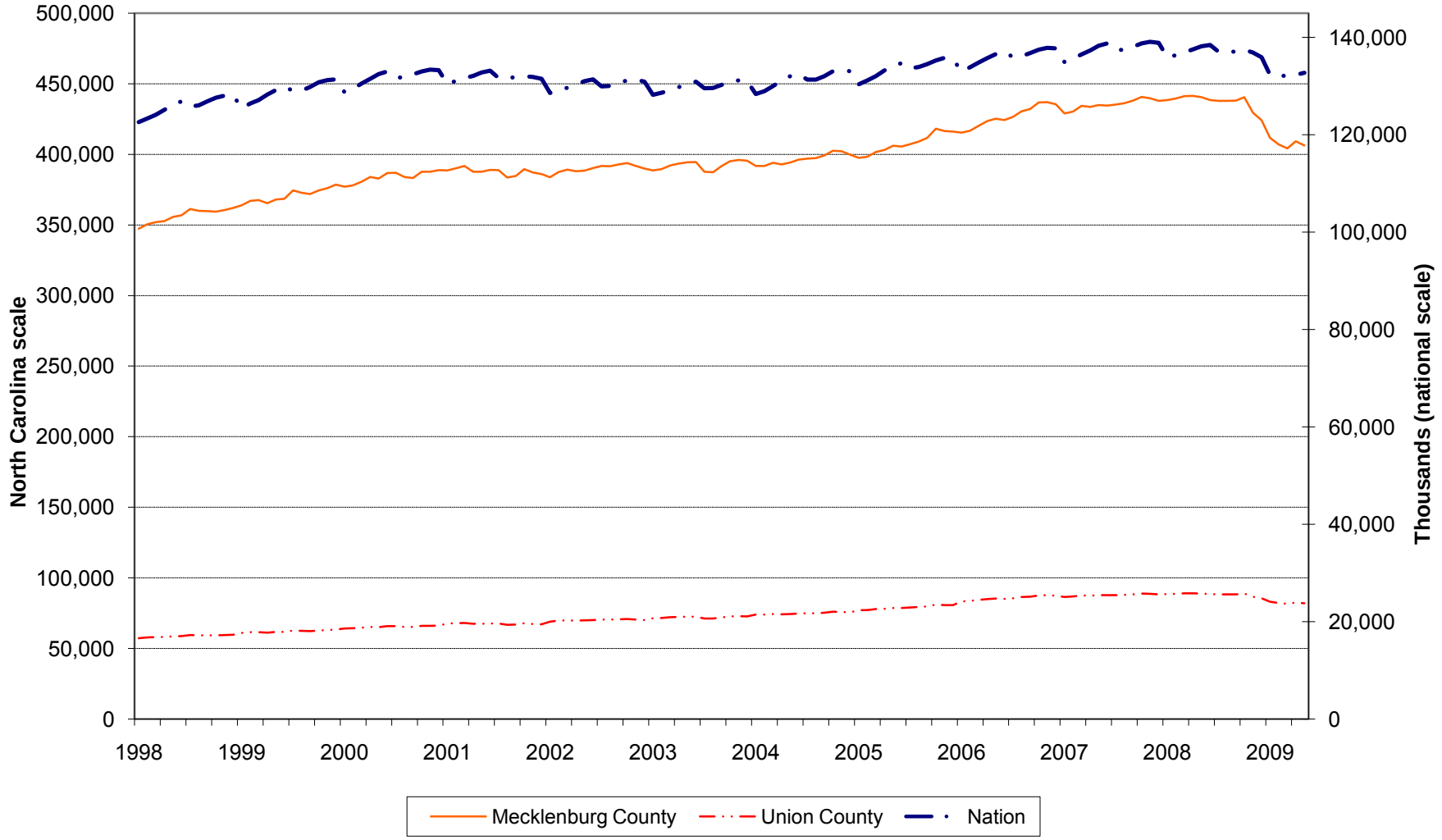
25 Most Rapidly Growing Metropolitan Regions, 1950-2008



Source: Kenan Institute analysis of Census data

Figure 12

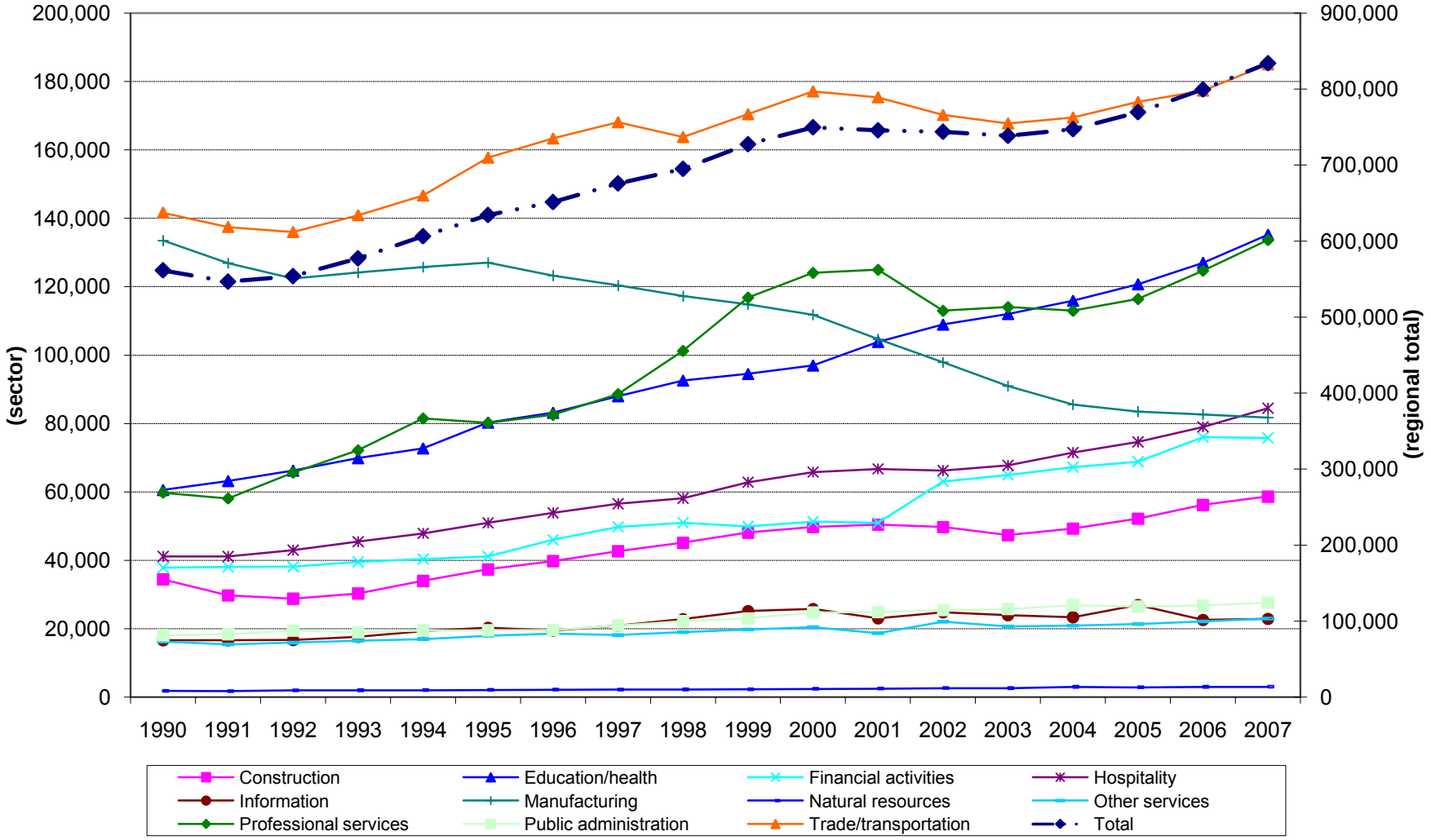
Non-Farm Employment in Selected Areas



Source: Kenan Institute analysis of Bureau of Labor Statistics data

Figure 13

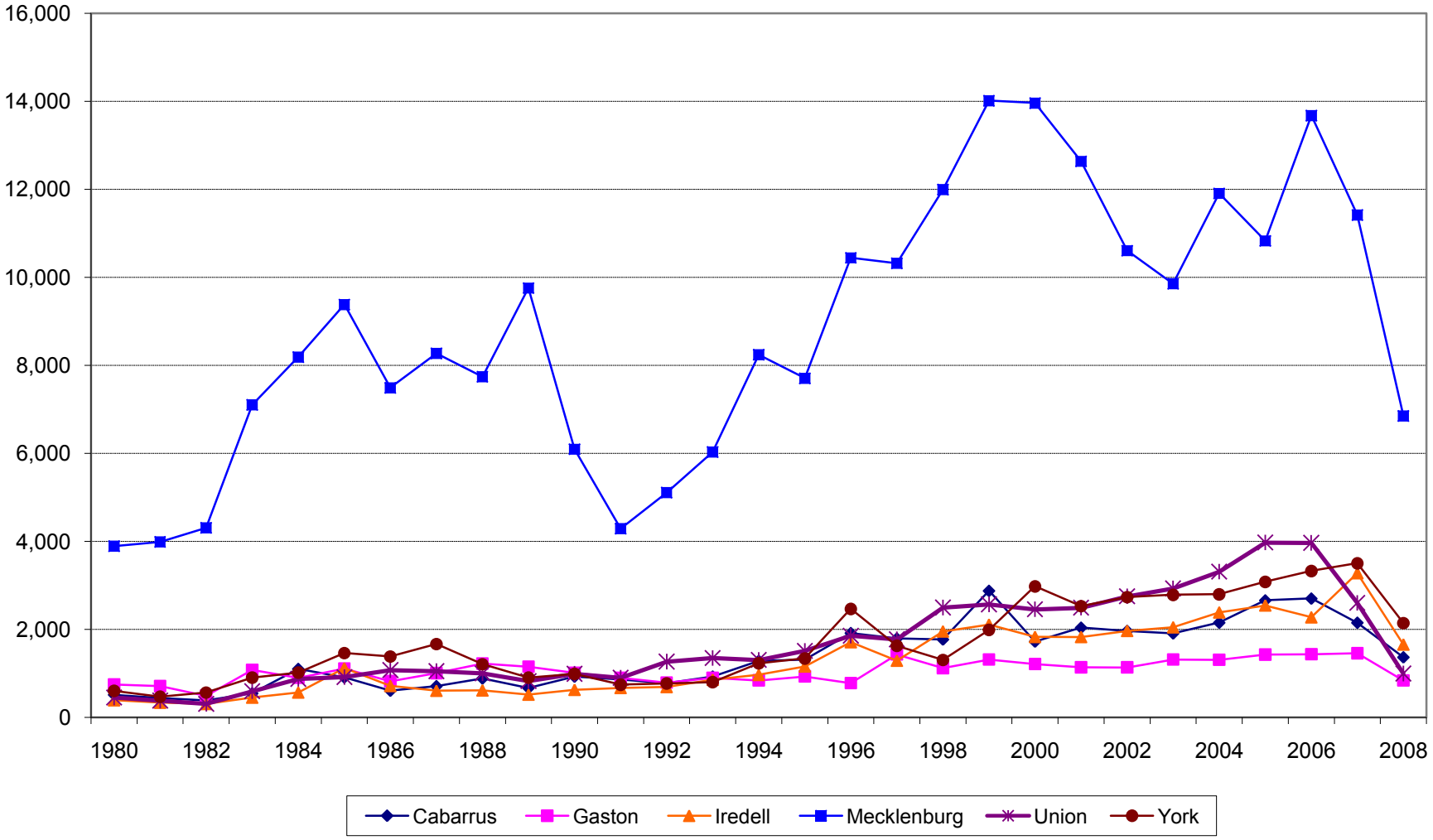
Charlotte Region Employment by Sector, 1990-2007



Source: Kenan Institute analysis of Bureau of Labor Statistics data

Figure 14

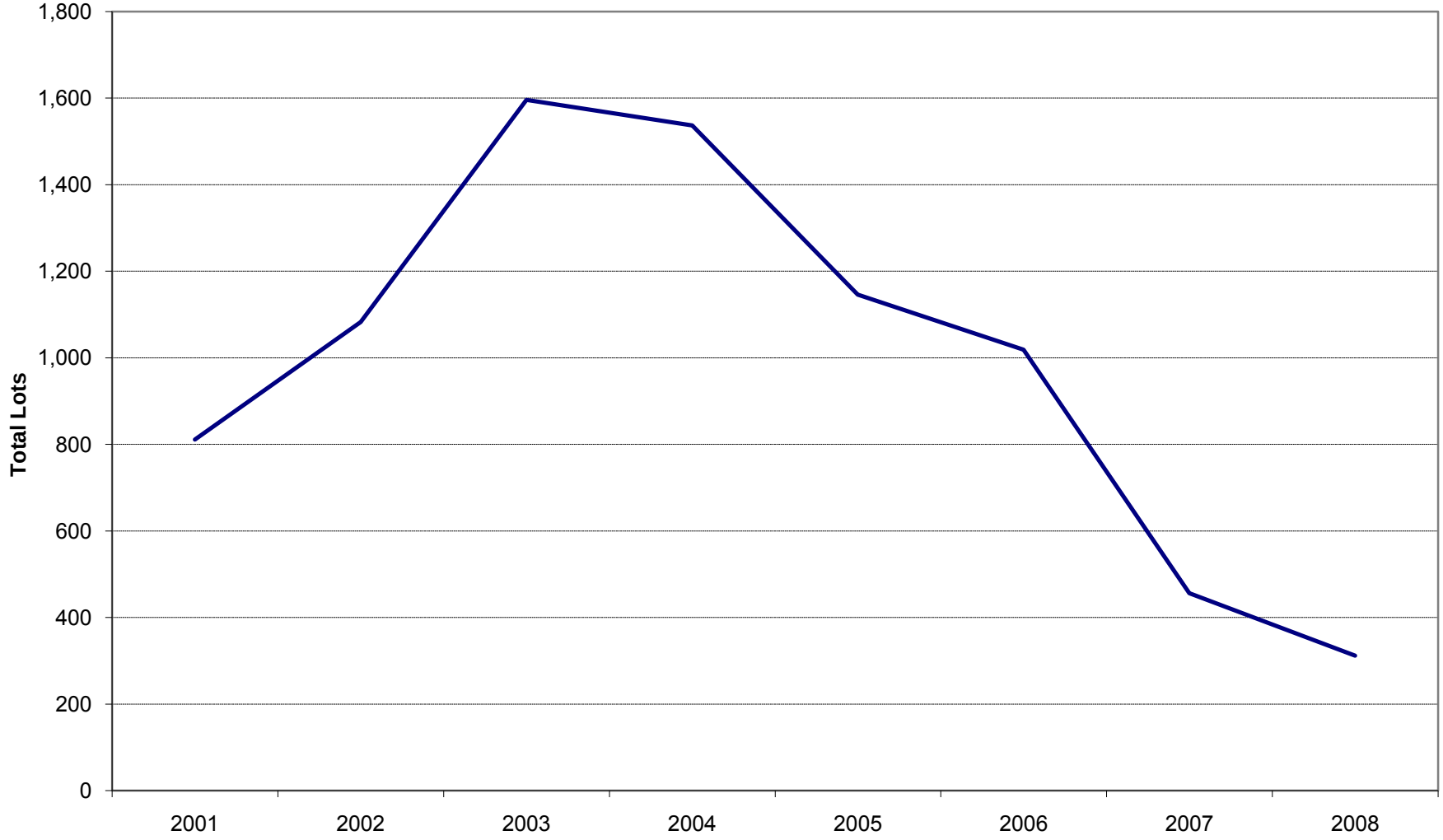
Housing Permits in Charlotte Region by County



Source: Kenan Institute analysis of HUD data

Figure 15

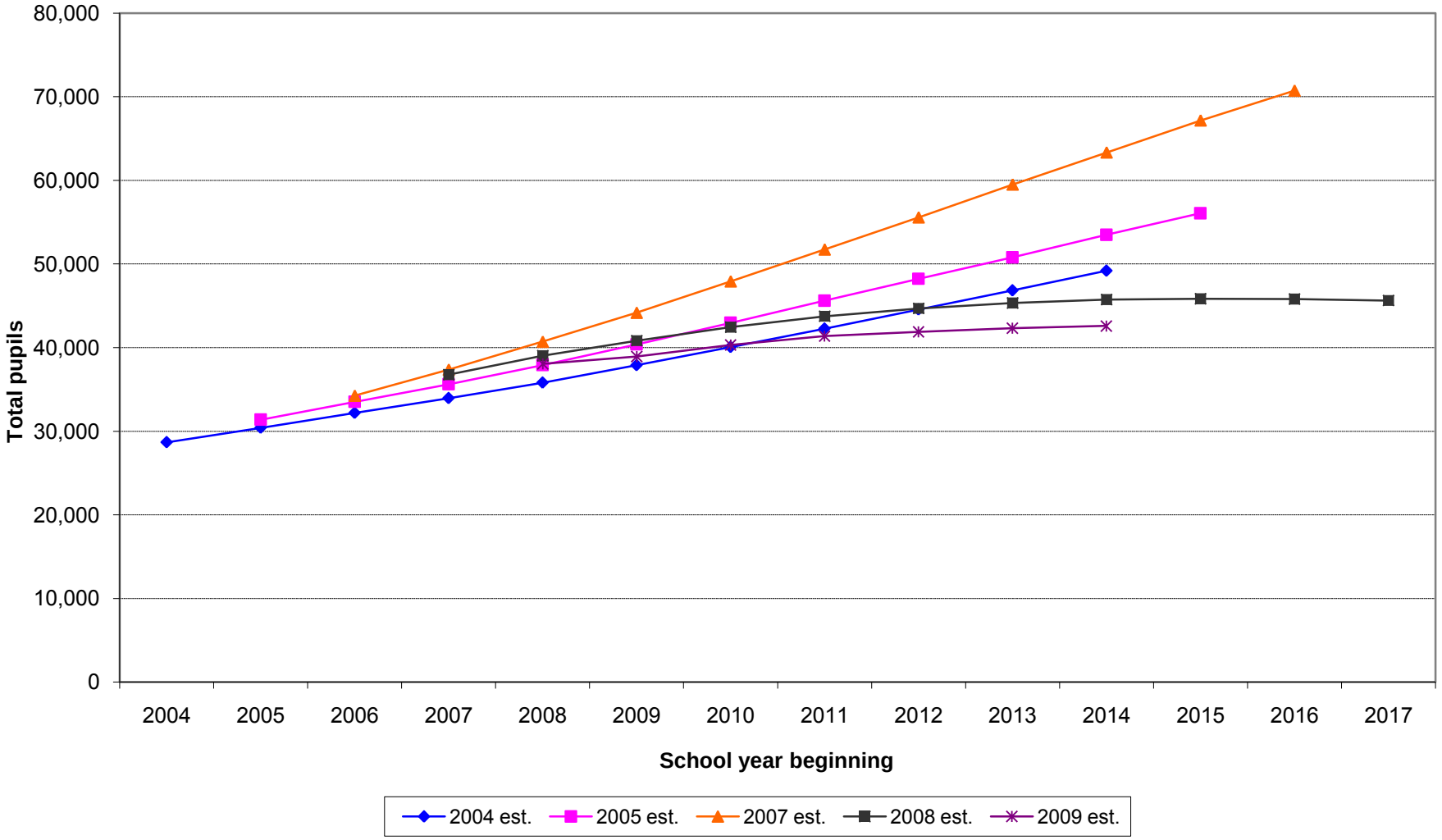
Union County Subdivision Approvals



Source: Kenan Institute analysis of Union County data

Figure 16

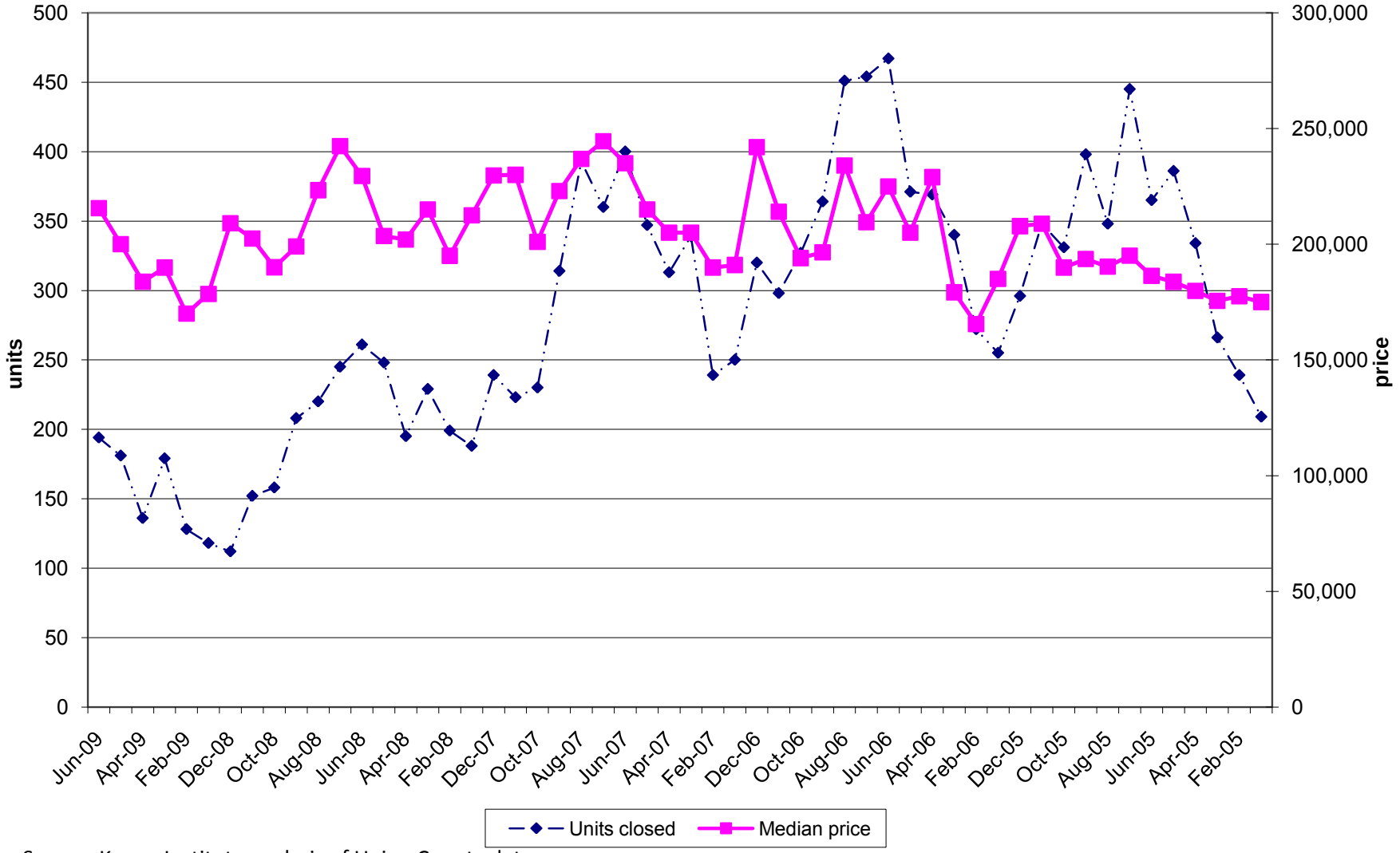
Trends in Union County Pupil Forecasts



Source: Kenan Institute analysis of Union County School District data

Figure 17

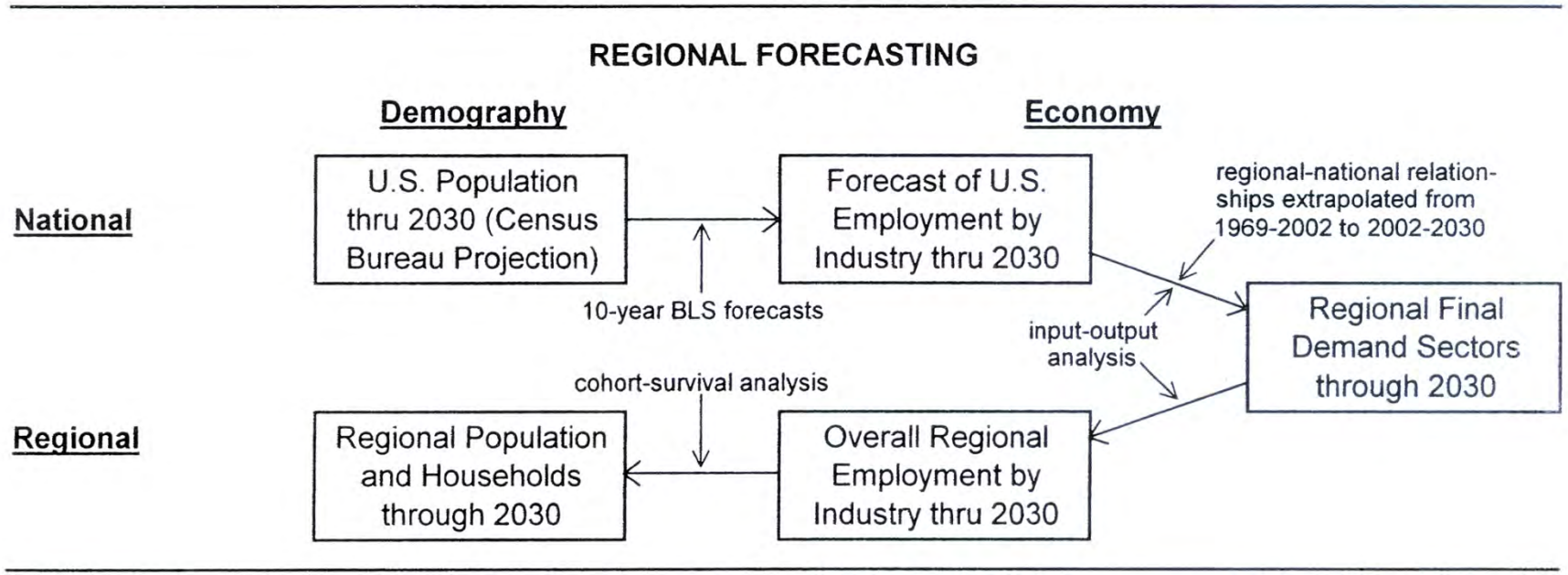
Union County Residential Real Estate Closings, 2005-2009



Source: Kenan Institute analysis of Union County data

Figure 18

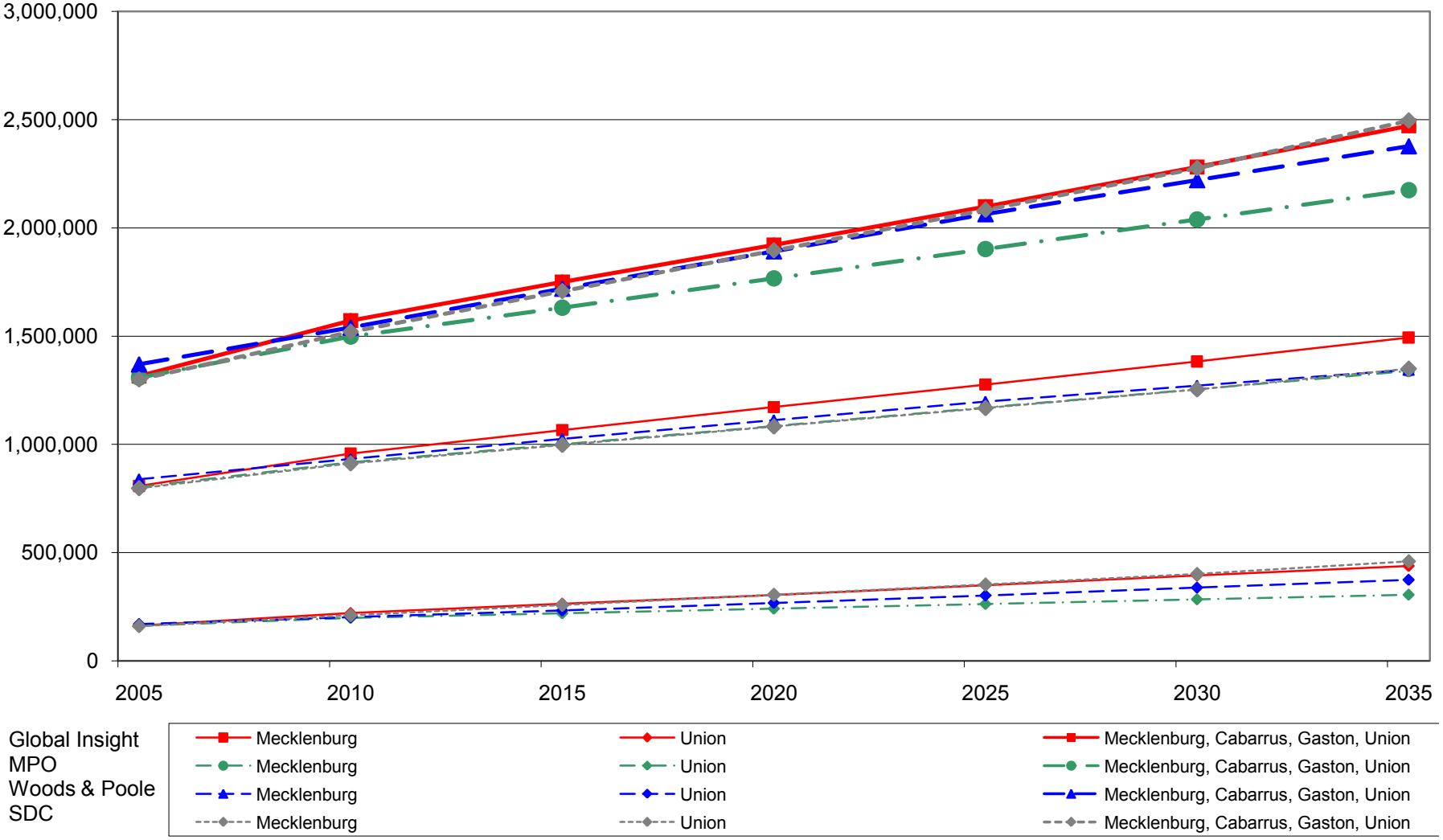
Overview of Regional Projection Process



Source: Hammer, Demographic and Economic Forecasts for the Charlotte Region, 2003

Figure 19

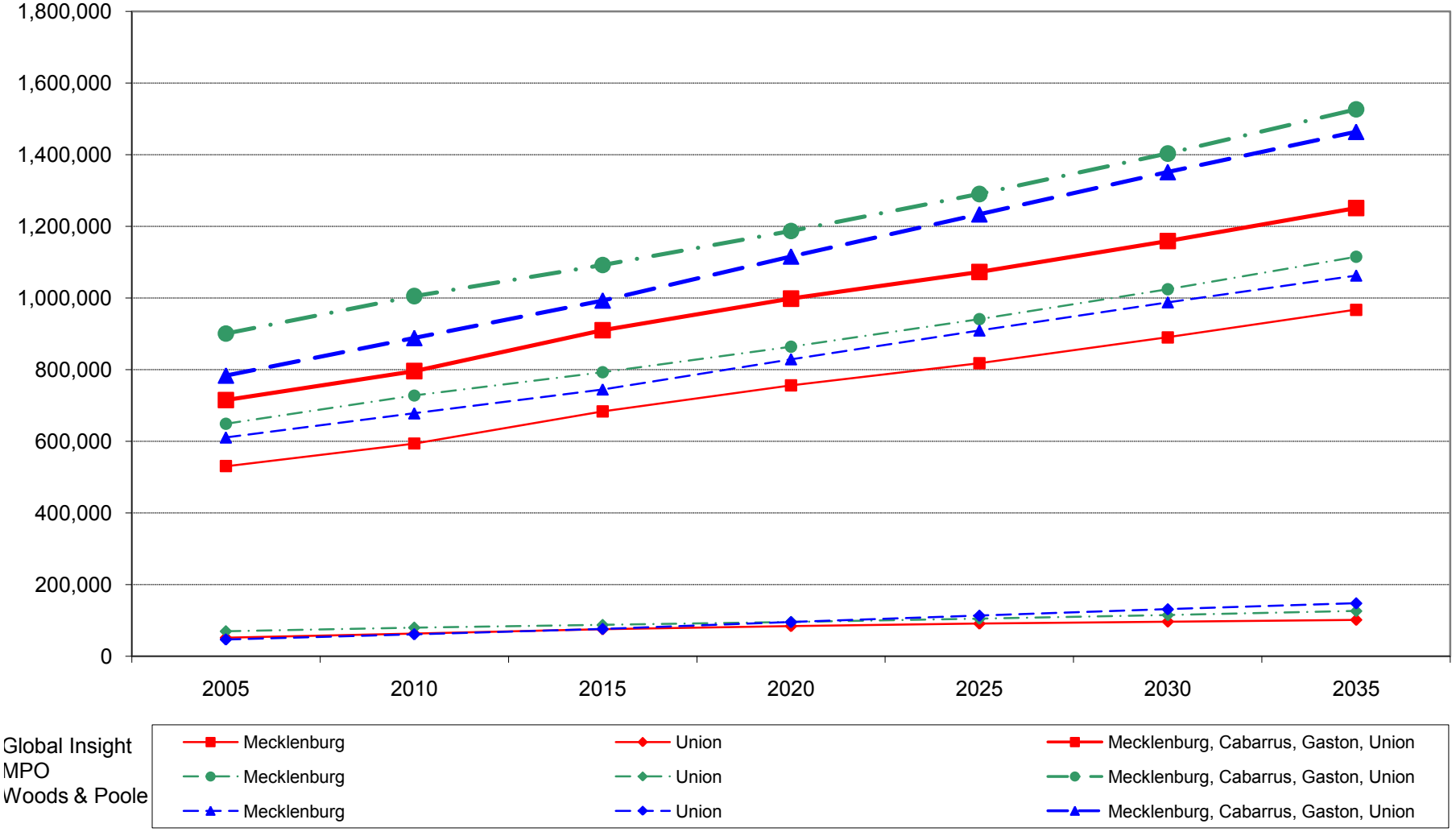
Comparison of Population Projections



Source: Kenan Institute analysis of data compiled from multiple sources

Figure 20

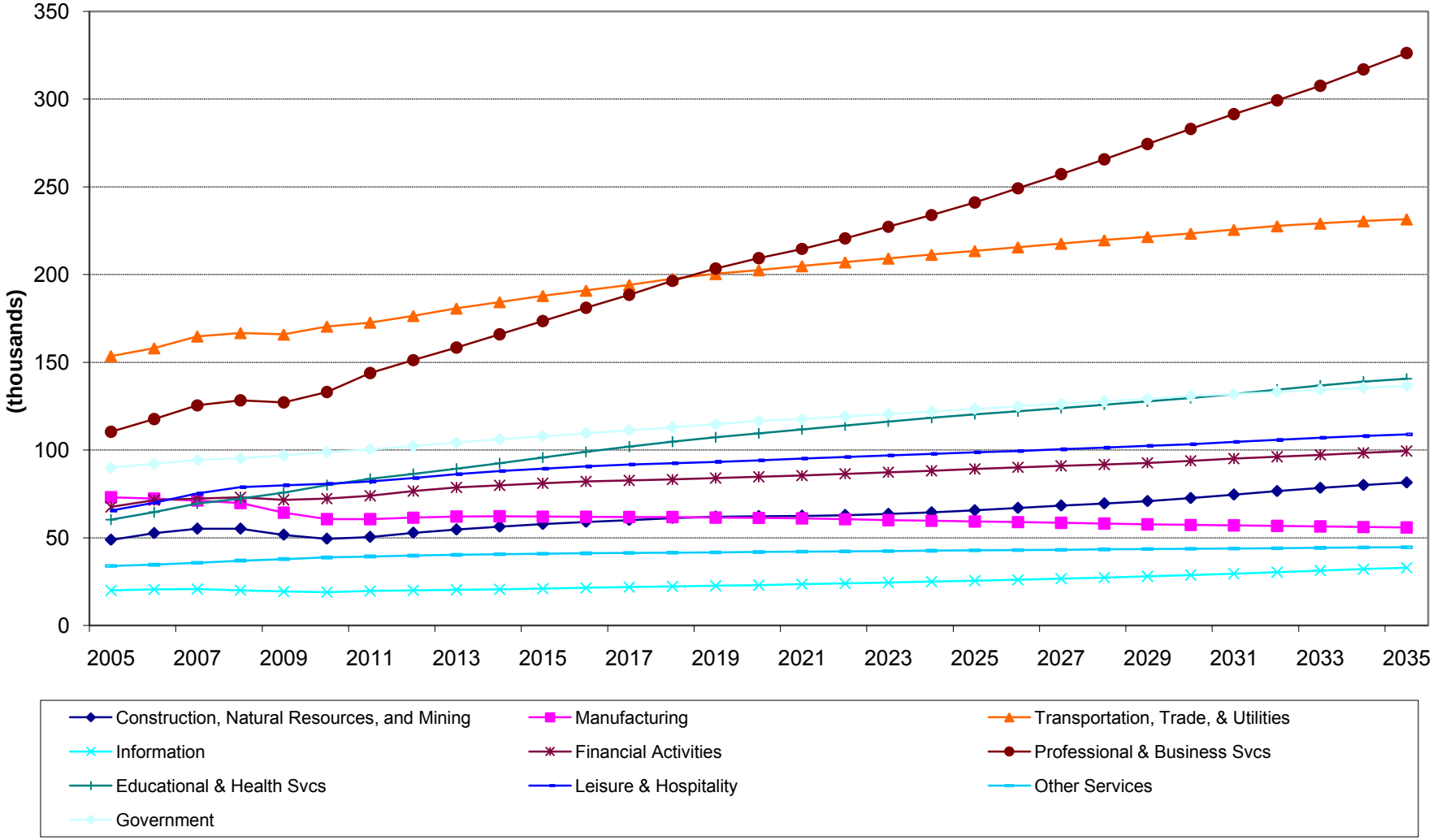
Comparison of Employment Projections



Source: Kenan Institute analysis of data compiled from multiple sources

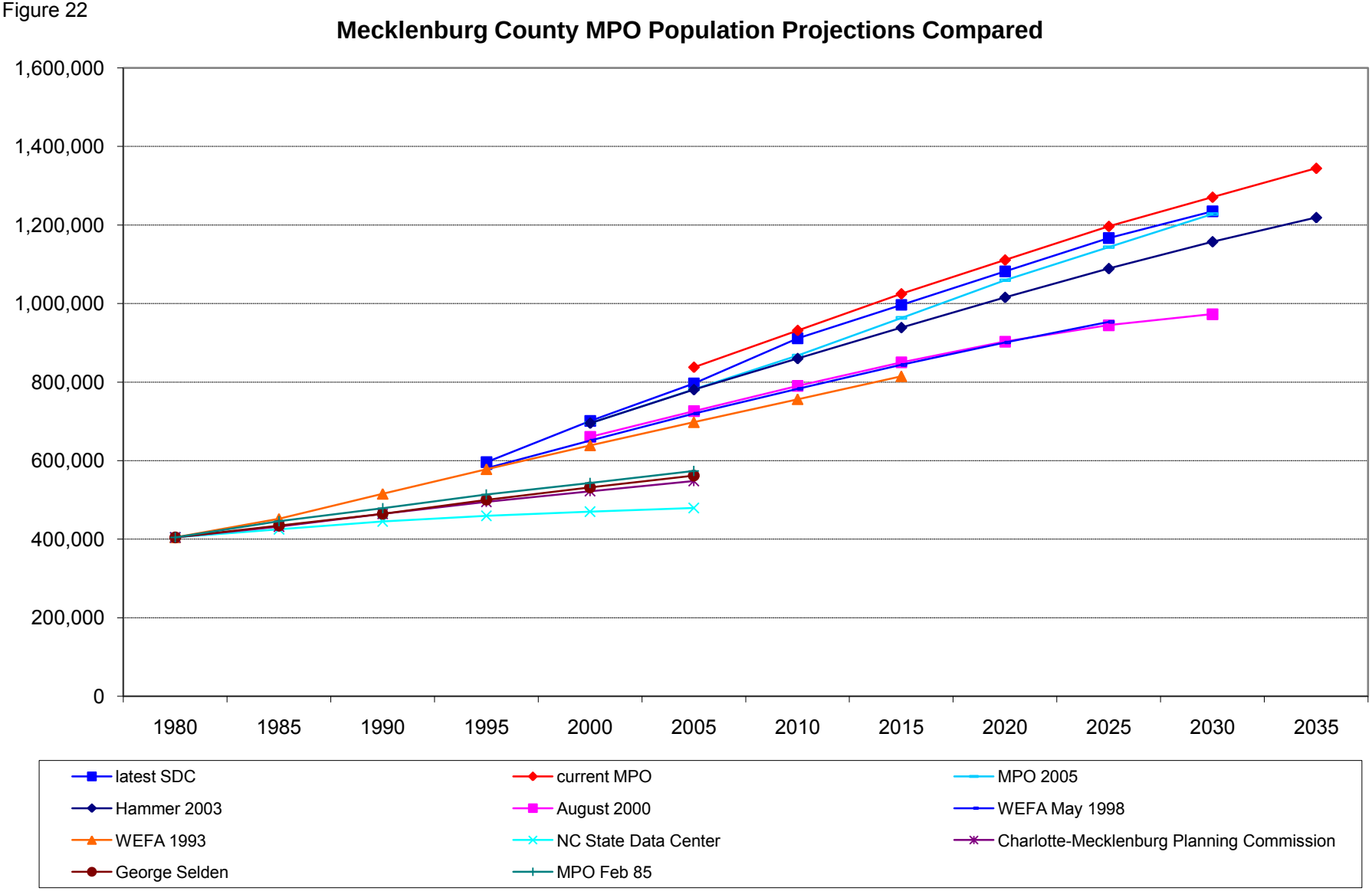
Figure 21

Projected Four-County Employment, Super Sectors



Source: Kenan Institute analysis of Global Insight data

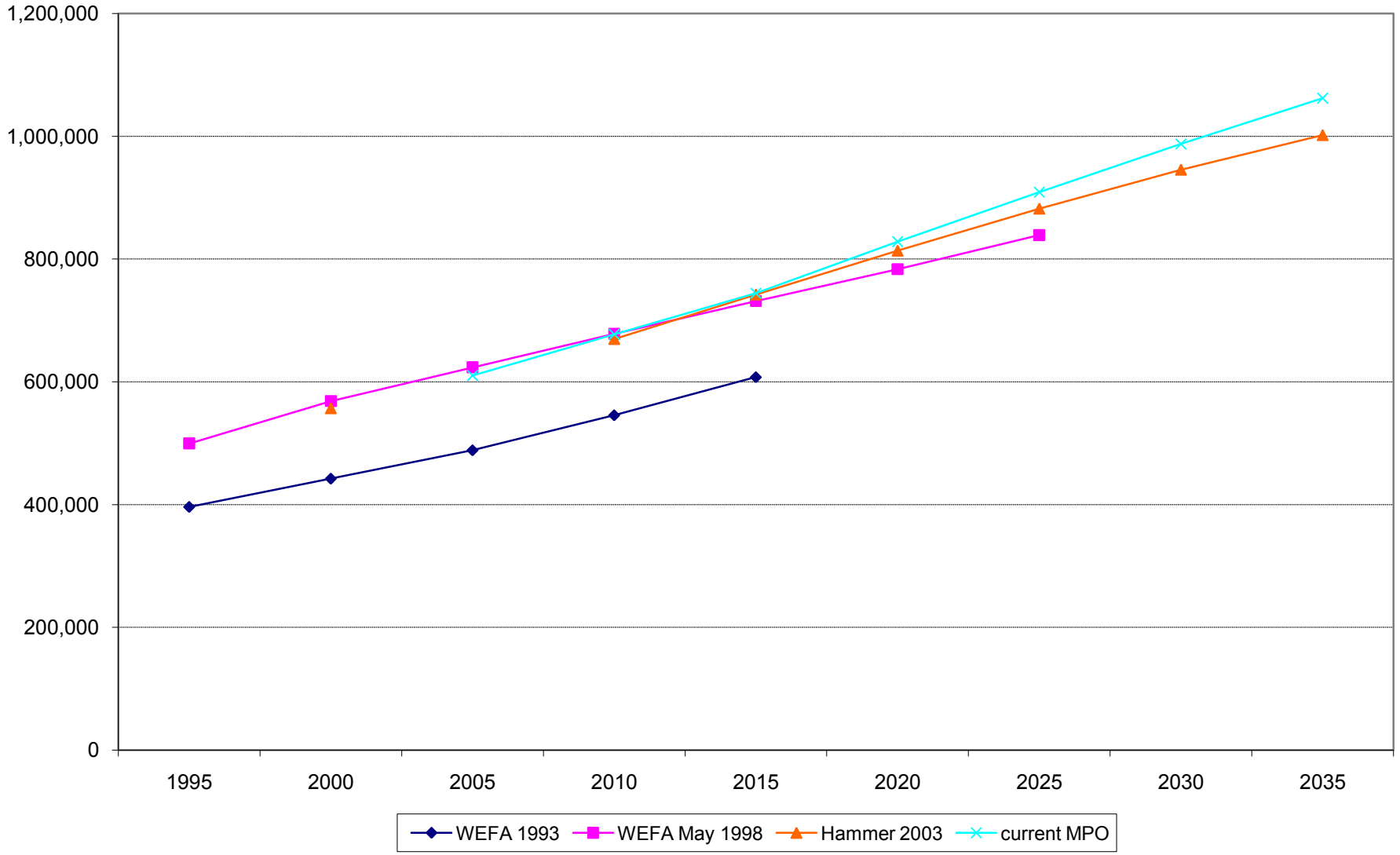
Figure 22



Source: Kenan Institute analysis of data compiled from multiple sources

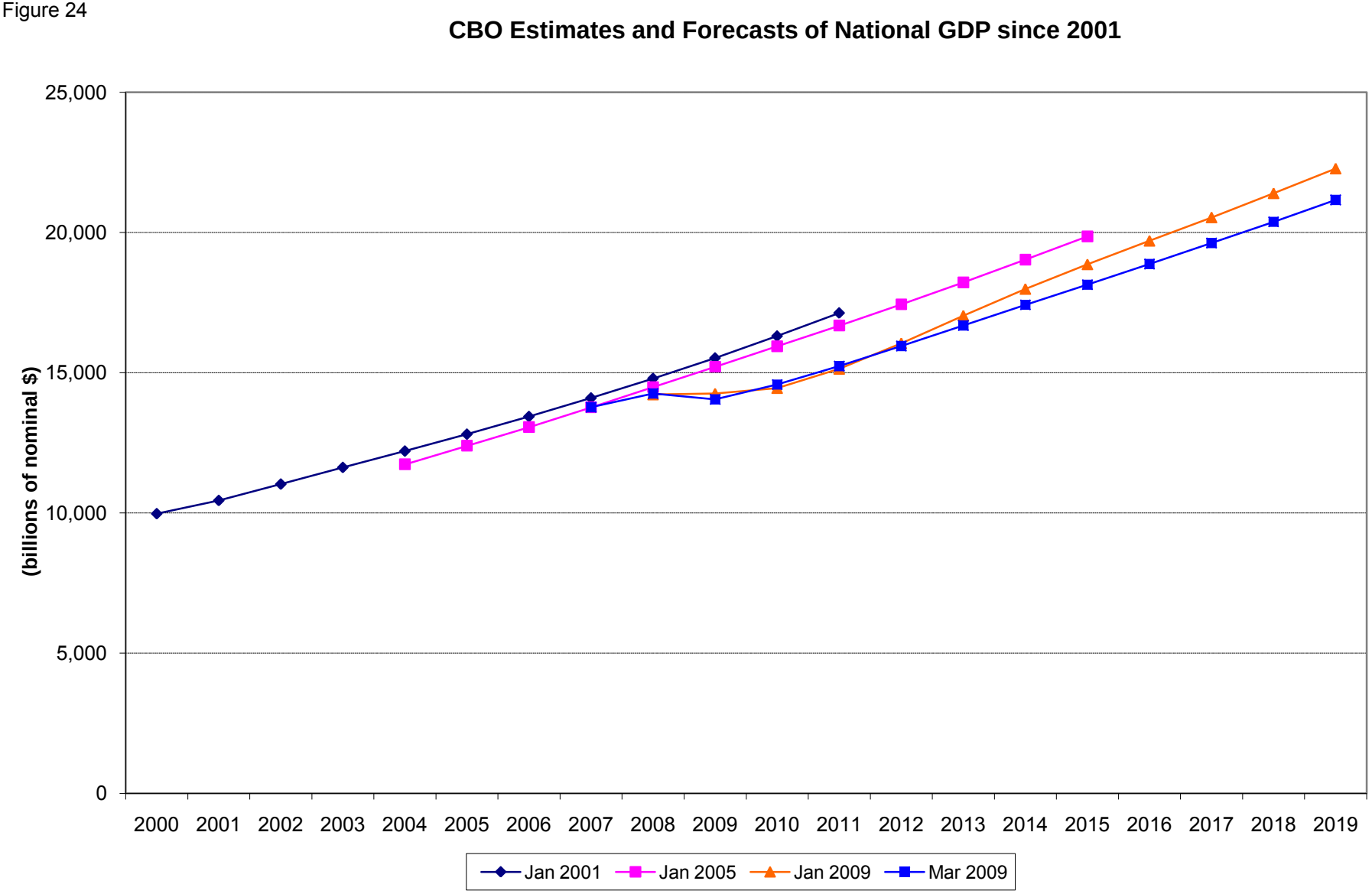
Figure 23

Mecklenburg County MPO Employment Forecasts Compared



Source: Kenan Institute analysis of compiled MPO data

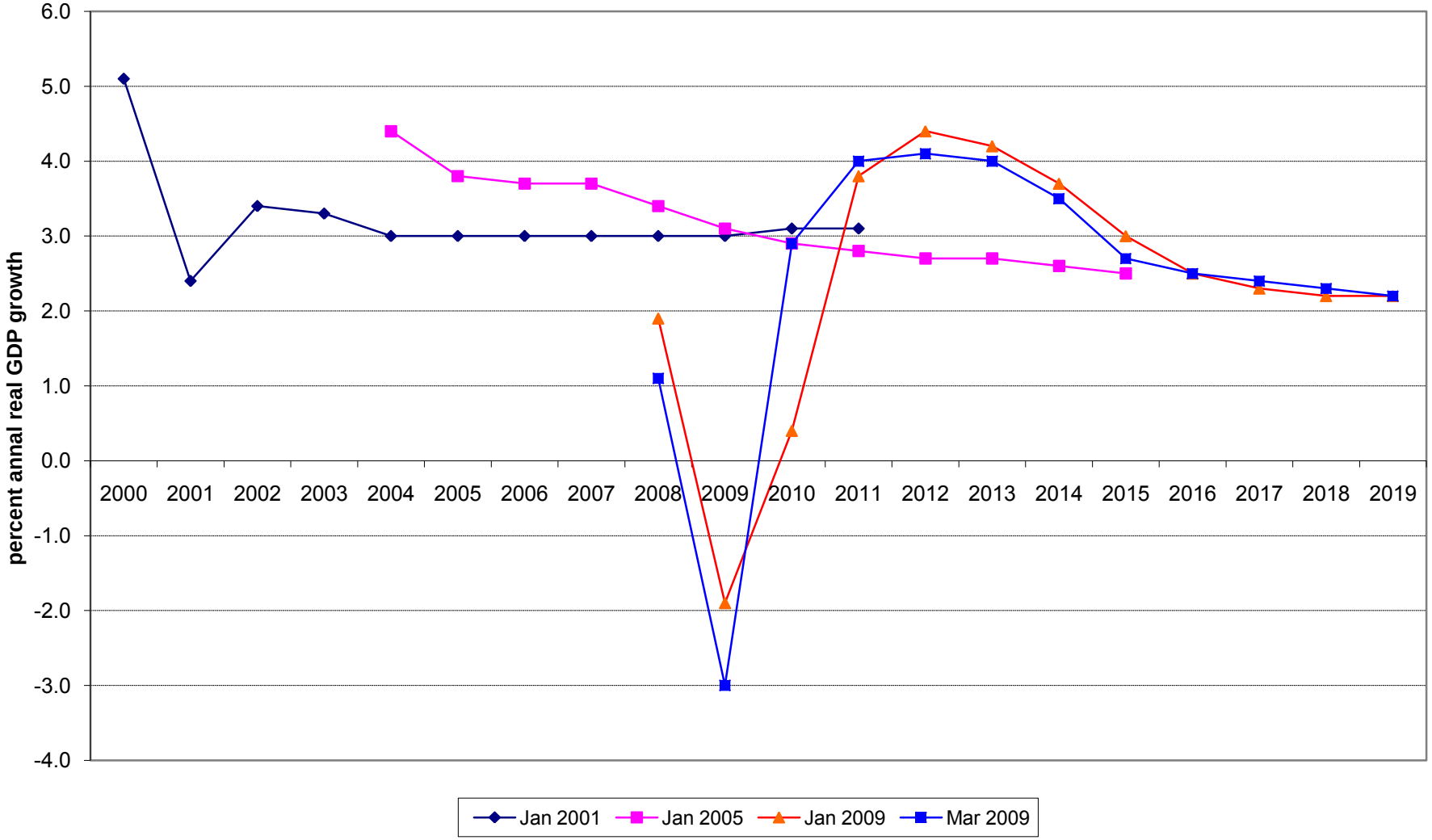
Figure 24



Source: Kenan Institute analysis of compiled CBO data

Figure 25

CBO Estimates and Forecasts of Real GDP Growth Rates

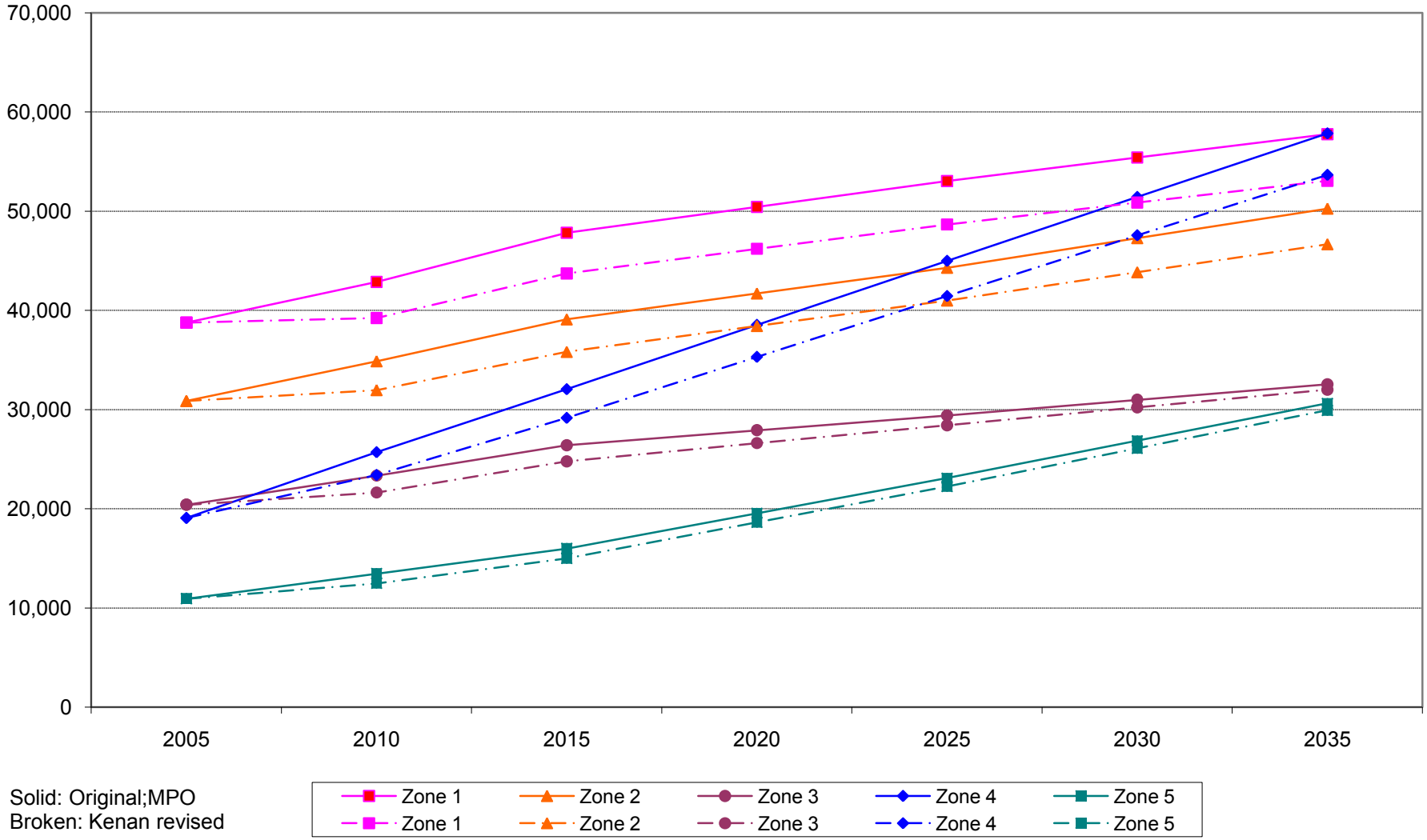


Source: Kenan Institute analysis of compiled CBO data

Figure 26

Comparison of Corridor Zone Population Estimates

30 July 2009



Solid: Original;MPO
Broken: Kenan revised

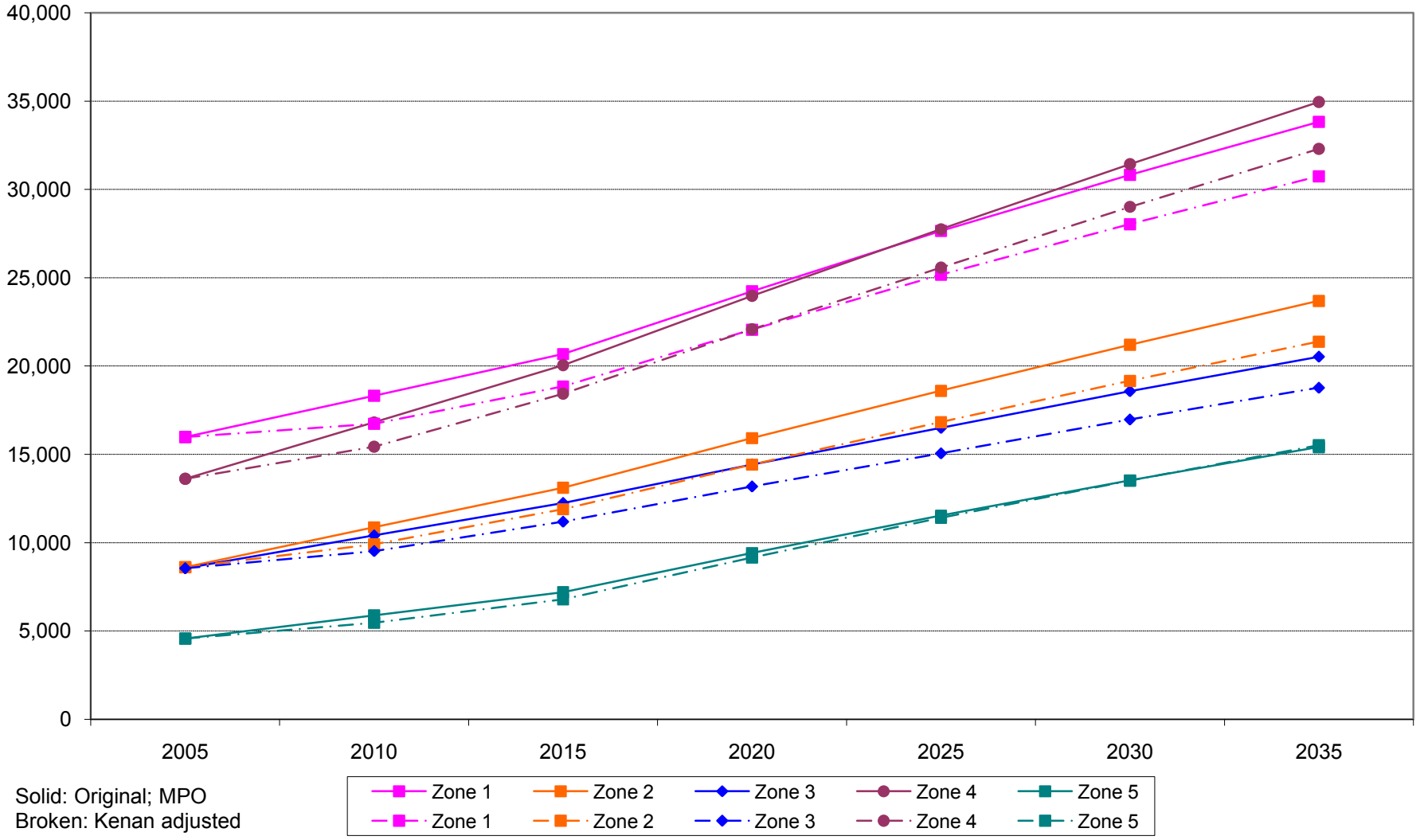
Source: Kenan Institute analysis of MPO data

Note: See Map 2 for definitions of Zones

Figure 27

Comparison of Corridor Zone Employment Estimates

30 July 2009



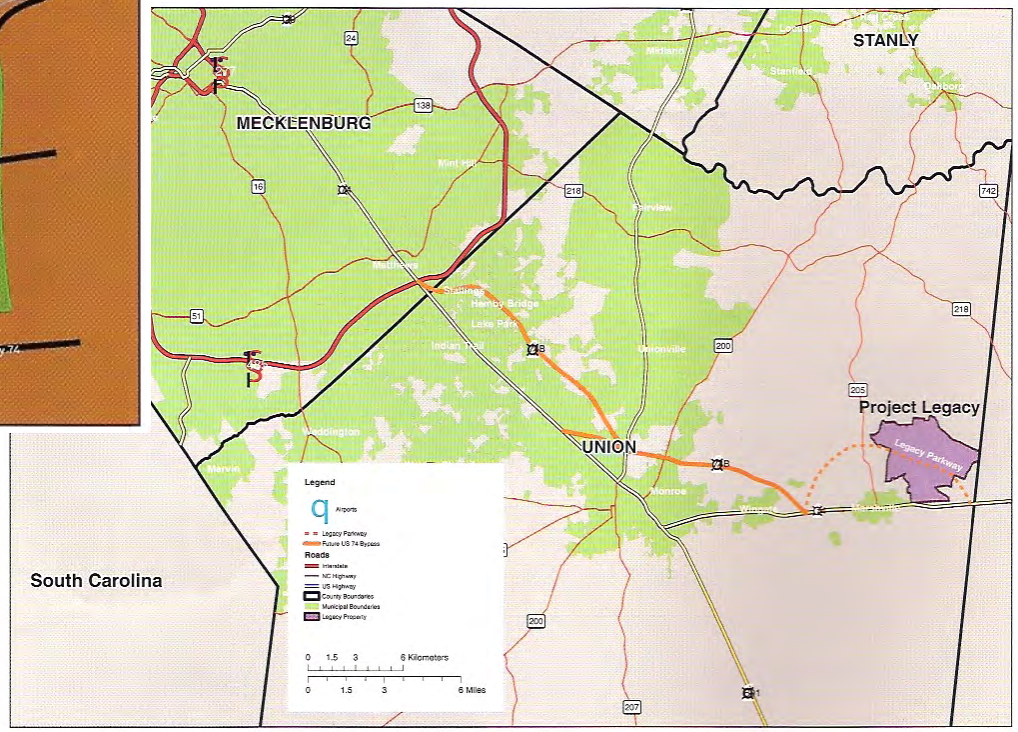
Solid: Original; MPO
Broken: Kenan adjusted

Source: Kenan Institute analysis of MPO data

Note: See Map 2 for definitions of Zones

Figure 28

Proposed Legacy Park



Source: Union County Partnership for Progress http://www.unioncpp.com/pdfs/LegacyBusinessParkBrochure.pdf

Table 1: Historical Population Trends of Selected Areas

Total Population (thousands)

	1970	1975	1980	1985	1990	1995	2000	2005
United States	203,982.31	215,465.21	227,225.62	237,924.75	249,622.81	266,278.39	282,194.31	295,895.90
Southeast Region	44,054.11	48,773.73	52,874.78	56,199.13	59,516.12	64,601.94	69,495.90	74,009.25
North Carolina	5,106.70	5,535.44	5,896.17	6,254.00	6,664.02	7,344.67	8,079.78	8,679.09
Raleigh-Durham-Cary CSA	616.66	688.98	756.57	844.12	963.81	1,132.86	1,322.26	1,518.41
Charlotte-Gastonia-Salisbury CSA	1,131.49	1,210.03	1,299.88	1,389.08	1,510.47	1,679.19	1,908.84	2,124.26
Charlotte-Gastonia-Concord MSA	744.26	796.51	859.26	932.35	1,030.95	1,160.70	1,340.23	1,522.19
Mecklenburg County	355.72	377.50	406.20	448.88	515.61	596.04	700.79	802.40
Union County	55.09	62.98	70.79	76.71	84.77	100.60	125.53	160.88

Population Shares

Share of United States

United States	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Southeast Region	0.2160	0.2264	0.2327	0.2362	0.2384	0.2426	0.2463	0.2501
North Carolina	0.0250	0.0257	0.0259	0.0263	0.0267	0.0276	0.0286	0.0293
Raleigh-Durham-Cary CSA	0.0030	0.0032	0.0033	0.0035	0.0039	0.0043	0.0047	0.0051
Charlotte-Gastonia-Salisbury CSA	0.0055	0.0056	0.0057	0.0058	0.0061	0.0063	0.0068	0.0072
Charlotte-Gastonia-Concord MSA	0.0036	0.0037	0.0038	0.0039	0.0041	0.0044	0.0047	0.0051
Mecklenburg County	0.0017	0.0018	0.0018	0.0019	0.0021	0.0022	0.0025	0.0027
Union County	0.0003	0.0003	0.0003	0.0003	0.0003	0.0004	0.0004	0.0005

Share of North Carolina

North Carolina	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Raleigh-Durham-Cary CSA	0.1208	0.1245	0.1283	0.1350	0.1446	0.1542	0.1637	0.1750
Charlotte-Gastonia-Salisbury CSA	0.2216	0.2186	0.2205	0.2221	0.2267	0.2286	0.2362	0.2448
Charlotte-Gastonia-Concord MSA	0.1457	0.1439	0.1457	0.1491	0.1547	0.1580	0.1659	0.1754
Mecklenburg County	0.0697	0.0682	0.0689	0.0718	0.0774	0.0812	0.0867	0.0925
Union County	0.0108	0.0114	0.0120	0.0123	0.0127	0.0137	0.0155	0.0185

Share of Charlotte CSA

Charlotte-Gastonia-Salisbury CSA	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Charlotte-Gastonia-Concord MSA	0.6578	0.6583	0.6610	0.6712	0.6825	0.6912	0.7021	0.7166
Mecklenburg County	0.3144	0.3120	0.3125	0.3231	0.3414	0.3550	0.3671	0.3777
Union County	0.0487	0.0520	0.0545	0.0552	0.0561	0.0599	0.0658	0.0757

Source: Woods and Poole from Census data

Table 2: Historical Employment Trends of Selected Areas

Total Employment (thousands)

	1970	1975	1980	1985	1990	1995	2000	2005
United States	91,281.59	98,906.57	114,231.29	124,509.76	139,380.79	148,982.80	166,758.67	174,176.36
Southeast Region	19,254.16	21,642.23	25,378.31	28,242.71	32,067.62	35,492.78	39,981.13	42,683.39
North Carolina	2,468.51	2,647.47	3,059.88	3,409.93	3,928.10	4,380.50	4,924.91	5,150.34
Raleigh-Durham-Cary CSA	303.95	344.48	416.82	512.87	625.71	736.46	896.85	980.59
Charlotte-Gastonia-Salisbury CSA	566.34	597.87	712.47	789.06	933.35	1,038.65	1,208.48	1,275.91
Charlotte-Gastonia-Concord MSA	395.83	419.39	509.92	581.33	701.36	788.83	937.32	1,001.31
Mecklenburg County	214.02	241.78	291.91	355.36	436.99	499.07	613.61	648.47
Union County	22.12	23.44	30.51	36.00	44.57	49.04	58.59	69.22

Employment Shares

Share of United States

United States	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Southeast Region	0.2109	0.2188	0.2222	0.2268	0.2301	0.2382	0.2398	0.2451
North Carolina	0.0270	0.0268	0.0268	0.0274	0.0282	0.0294	0.0295	0.0296
Raleigh-Durham-Cary CSA	0.0033	0.0035	0.0036	0.0041	0.0045	0.0049	0.0054	0.0056
Charlotte-Gastonia-Salisbury CSA	0.0062	0.0060	0.0062	0.0063	0.0067	0.0070	0.0072	0.0073
Charlotte-Gastonia-Concord MSA	0.0043	0.0042	0.0045	0.0047	0.0050	0.0053	0.0056	0.0057
Mecklenburg County	0.0023	0.0024	0.0026	0.0029	0.0031	0.0033	0.0037	0.0037
Union County	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003	0.0004	0.0004

Share of North Carolina

North Carolina	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Raleigh-Durham-Cary CSA	0.1231	0.1301	0.1362	0.1504	0.1593	0.1681	0.1821	0.1904
Charlotte-Gastonia-Salisbury CSA	0.2294	0.2258	0.2328	0.2314	0.2376	0.2371	0.2454	0.2477
Charlotte-Gastonia-Concord MSA	0.1604	0.1584	0.1666	0.1705	0.1785	0.1801	0.1903	0.1944
Mecklenburg County	0.0867	0.0913	0.0954	0.1042	0.1112	0.1139	0.1246	0.1259
Union County	0.0090	0.0089	0.0100	0.0106	0.0113	0.0112	0.0119	0.0134

Share of Charlotte CSA

Charlotte-Gastonia-Salisbury CSA	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Charlotte-Gastonia-Concord MSA	0.6989	0.7015	0.7157	0.7367	0.7514	0.7595	0.7756	0.7848
Mecklenburg County	0.3779	0.4044	0.4097	0.4504	0.4682	0.4805	0.5078	0.5082
Union County	0.0391	0.0392	0.0428	0.0456	0.0478	0.0472	0.0485	0.0543

Source: Woods and Poole from Census data

Table 3: Major Employers in the Charlotte Metropolitan Region

	Company	EmplNo		Company	EmplNo
1	Carolinas Healthcare System*	26,283	49	Invista	1,600
2	Wells Fargo/Wachovia Corp	20,000	50	Microsoft Corp	1,600
3	Bank Of America*	13,960	51	Ross Stores Inc	1,600
4	Wal-Mart Stores Inc	13,192	52	Ina Usa Corp	1,575
5	Presbyterian Regional Healthcare Corp*	9,000	53	Burger King Corp	1,540
6	Delhaize America Inc/Food Lion Llc	8,658	54	Best Western	1,500
7	Duke Energy Corp*	7,757	55	Carolina Restaurant Group Inc*	1,500
8	US Airways	5,955	56	Chick-Fil-A	1,500
9	Lowe's Companies Inc*	5,900	57	Home Depot Inc	1,500
10	US Postal Service	5,400	58	Piedmont Medical Center*	1,500
11	Adecco	5,000	59	Rite Aid Corp	1,500
12	Harris Teeter Inc*	4,700	60	Intercontinental Hotels Group	1,450
13	Freightliner Corp LLC	4,540	61	Lance Inc*	1,450
14	Parkdale Mills Inc	3,600	62	Brinker International	1,440
15	Compass Group*	3,518	63	Allen Tate Co Inc*	1,400
16	At&T North Carolina	3,290	64	Shaw Energy	1,400
17	Caromont Health Inc	3,230	65	Affinia Group Inc	1,389
18	Corestaff Services	2,900	66	Pizza Hut Inc	1,380
19	Belk Inc*	2,700	67	Ingersoll-Rand Co	1,350
20	Tiaa-Cref	2,650	68	Yum Brands Inc	1,320
21	Philip Morris Usa	2,600	69	RSI Home Products Inc	1,300
22	Labor Ready Inc	2,545	70	Sherrill Furniture Co	1,300
23	Bi-Lo Llc	2,538	71	Hendrick Automotive Group*	1,277
24	CVS Caremark Corp	2,500	72	Starbucks Coffee Co	1,260
25	United Parcel Service	2,500	73	Frye Regional Medical Center	1,247
26	Marriott International	2,475	74	Conbraco Industries Inc	1,212
27	Hickory Springs Manufacturing Co	2,410	75	American & Efird Inc	1,200
28	Target Stores	2,400	76	Charlotte Pipe & Foundry Co*	1,200
29	Family Dollar Stores Inc*	2,373	77	Tyson Foods Inc, Fresh Retail Div	1,200
30	JC Penney Corp Inc	2,300	78	Vanguard Group Inc, The	1,200
31	Hilton	2,175	79	Shurtape Technologies, LLC	1,150
32	Carowinds	2,110	80	Catawba Valley Medical Center*	1,100
33	Commscope Inc	2,100	81	Ati Allvac	1,090
34	Time Warner Cable	2,100	82	Charlotte Observer, The	1,077
35	IBM Corp	2,000	83	Weyerhaeuser Co	1,061
36	Windstream Communications	2,000	84	Gap Inc	1,050
37	Ymca Of Greater Charlotte*	2,000	85	Applebee's International Inc	1,020
38	Century Furniture Industries	1,980	86	Allstate Insurance Co	1,000
39	Pharr Yarns Inc	1,980	87	American Red Cross	1,000
40	Wells Fargo Mortgage	1,899	88	Comporium Group	1,000
41	BB&T	1,865	89	Convergus Corp	1,000
42	Bojangles' Restaurants Inc	1,800	90	Hewitt Associates	1,000
43	Subway	1,800	91	Kelly Services Inc	1,000
44	Rowan Regional Medical Center*	1,729	92	Maersk Companies	1,000
45	Iredell Memorial Hospital Inc*	1,650	93	Mcgee Brothers Co Inc	1,000
46	Wg (Bill) Hefner Veterans Affairs Medical Center	1,626	94	Show Pros Entertainment Services Of Charlotte Inc*	1,000
47	Mcdonald's Corp	1,625	95	Sprint	1,000
48	Alex Lee Inc	1,620			

Charlotte's Largest Employers is based on a survey conducted in June 2008 by the Charlotte Chamber of Commerce and Central Piedmont Community College. One hundred and eight firms employ 500 or more people with Mecklenburg County. Of there firms, 45 are headquartered in Charlotte-Mecklenburg and are indicated by an asterisk.

http://www.charlottechamber.com/index.php?src=gendocs&ref=LargestEmployers&category=Business_Profile&submenu=CommProfile

Table 4: Land Use in Mecklenburg and Union Counties

	Residential	Commercial	Developable	Prime Developable	Remaining	Total	Developed	All developable
City of Charlotte	25,650	27,509	26,125	14,766	6,952	101,002	53,159	40,891
Northern Mecklenburg County Municipalities	6,249	2,463	8,632	7,161	1,068	25,572	8,711	15,792
Southern Mecklenburg County Municipalities	4,725	2,236	4,885	5,575	578	17,998	6,960	10,460
Unincorporated areas of Mecklenburg County	12,059	4,036	24,155	35,708	1,943	77,902	16,095	59,863
Eastern Union County Municipalities	6,862	1,199	3,168	14,389	469	26,087	8,061	17,557
Western Union County Municipalities	14,127	719	1,784	10,650	2,203	29,482	14,846	12,434
Unincorporated areas of Union County	41,426	2,582	24,959	153,714	4,110	226,791	44,008	178,673
Corridor Zone 1	6,342	1,672	2,128	2,079	852	13,072	8,013	4,207
Corridor Zone 2	9,115	4,614	2,332	8,382	3,472	27,915	13,729	10,714
Corridor Zone 3	7,085	2,321	2,121	9,557	1,025	22,110	9,406	11,678
Corridor Zone 4	8,036	2,174	2,251	17,744	2,077	32,281	10,209	19,995
Corridor Zone 5	5,464	2,277	3,139	24,483	1,697	37,060	7,740	27,622
Corridor Total	36,041	13,057	11,971	62,245	9,123	132,436	49,098	74,216
Mecklenburg County	50,446	36,821	65,238	64,231	10,845	227,581	87,267	129,469
Union County	96,692	16,980	40,442	239,976	15,602	409,690	113,671	280,418
Two-county total	147,138	53,800	105,679	304,207	26,446	637,270	200,938	409,886

	Residential	Commercial	Developable	Prime Developable	Remaining	Total	Developed	All developable
City of Charlotte	25.40%	27.24%	25.87%	14.62%	6.88%	100.00%	52.63%	40.49%
Northern Mecklenburg County Municipalities	24.44%	9.63%	33.75%	28.00%	4.18%	100.00%	34.07%	61.76%
Southern Mecklenburg County Municipalities	26.25%	12.42%	27.14%	30.97%	3.21%	100.00%	38.67%	58.11%
Unincorporated areas of Mecklenburg County	15.48%	5.18%	31.01%	45.84%	2.49%	100.00%	20.66%	76.84%
Eastern Union County Municipalities	26.30%	4.60%	12.14%	55.16%	1.80%	100.00%	30.90%	67.30%
Western Union County Municipalities	47.92%	2.44%	6.05%	36.12%	7.47%	100.00%	50.36%	42.17%
Unincorporated areas of Union County	18.27%	1.14%	11.01%	67.78%	1.81%	100.00%	19.40%	78.78%
Corridor Zone 1	48.51%	12.79%	16.28%	15.91%	6.52%	100.00%	61.30%	32.18%
Corridor Zone 2	32.65%	16.53%	8.36%	30.03%	12.44%	100.00%	49.18%	38.38%
Corridor Zone 3	32.05%	10.50%	9.59%	43.23%	4.64%	100.00%	42.54%	52.82%
Corridor Zone 4	24.89%	6.73%	6.97%	54.97%	6.43%	100.00%	31.63%	61.94%
Corridor Zone 5	14.74%	6.14%	8.47%	66.06%	4.58%	100.00%	20.89%	74.53%
Corridor Total	27.21%	9.86%	9.04%	47.00%	6.89%	100.00%	37.07%	56.04%
Mecklenburg County	22.17%	16.18%	28.67%	28.22%	4.77%	100.00%	38.35%	56.89%
Union County	23.60%	4.14%	9.87%	58.57%	3.81%	100.00%	27.75%	68.45%
Two-county total	23.09%	8.44%	16.58%	47.74%	4.15%	100.00%	31.53%	64.32%

Source: Kenan Institute analysis of Mecklenburg and Union county parcel data

Table 5: Shift-Share Analysis of Charlotte Region Employment

Panel A: Baseline Analysis (All Metropolitan Areas)

Period 1: 1990 third quarter to 2001 first quarter; All MSAs as baseline

Industry	Charlotte (MSA) Employment 1990 Q3	Charlotte (MSA) Employment 2001 Q1	Total MSA Employment 1990 Q3	Total MSA Employment 2001 Q1	Charlotte (MSA) Employment Change	National Growth Share	Industry Mix Effect	Regional Shift Effect	Percent of Regional Shift
Natural resources	1,786	2,345	1,175,788	914,807	559	349	(745)	955	1.4%
Construction	35,030	49,211	3,814,378	4,387,453	14,181	6,837	(1,574)	8,918	13.2%
Manufacturing	133,854	109,207	12,489,283	11,884,635	(24,647)	26,124	(32,604)	(18,167)	-26.8%
Trade/transportation	137,588	170,492	19,181,065	21,726,623	32,904	26,852	(8,593)	14,644	21.6%
Information	16,568	25,096	2,005,535	2,443,580	8,528	3,233	385	4,909	7.2%
Financial activities	38,004	50,438	5,766,290	6,608,090	12,434	7,417	(1,869)	6,886	10.2%
Professional services	61,279	126,705	9,026,145	14,138,520	65,426	11,960	22,749	30,718	45.4%
Education/health	33,447	51,759	8,765,410	12,240,960	18,312	6,528	6,734	5,050	7.5%
Hospitality	42,708	63,964	7,884,380	9,460,268	21,256	8,335	201	12,720	18.8%
Other services	16,203	20,367	2,618,300	3,115,303	4,164	3,162	(87)	1,088	1.6%
All	516,467	669,584	72,726,574	86,920,239	153,117	100,796	-15,402	67,722	1

Period 2: 2001 first quarter to 2007 fourth quarter; All MSAs as baseline

Industry	Charlotte (MSA) Employment 2001 Q1	Charlotte (MSA) Employment 2007 Q4	Total MSA Employment 2001 Q1	Total MSA Employment 2007 Q4	Charlotte (MSA) Employment Change	National Growth Share	Industry Mix Effect	Regional Shift Effect	Percent of Regional Shift
Natural resources	2,345	2,848	914,807	1,094,395	503	154	306	43	0.1%
Construction	49,211	58,390	4,387,453	5,411,284	9,179	3,242	8,241	(2,305)	-3.4%
Manufacturing	109,207	81,177	11,884,635	9,238,891	(28,030)	7,195	(31,506)	(3,718)	-5.5%
Trade/transportation	170,492	183,987	21,726,623	22,869,439	13,495	11,233	(2,265)	4,527	6.7%
Information	25,096	22,224	2,443,580	2,002,646	(2,872)	1,653	(6,182)	1,656	2.4%
Financial activities	50,438	75,872	6,608,090	6,864,313	25,434	3,323	(1,367)	23,478	34.7%
Professional services	126,705	135,283	14,138,520	15,985,466	8,578	8,348	8,204	(7,974)	-11.8%
Education/health	51,759	76,283	12,240,960	14,898,160	24,524	3,410	7,826	13,288	19.6%
Hospitality	63,964	84,404	9,460,268	10,942,891	20,440	4,214	5,810	10,415	15.4%
Other services	20,367	23,444	3,115,303	3,339,337	3,077	1,342	123	1,612	2.4%
All	669,584	743,912	86,920,239	92,646,822	74,328	44,114	-10,810	41,024	1

Panel B: Summary Charlotte Region Competitive Effects with Selected Baselines

	First period	Second period
All MSAs	67,722	41,024
Southern MSAs	8,914	46,304
Mid-sized Southern MSAs	26,745	4,646

Source: Kenan Institute analysis of Bureau of Labor Statistics data

Table 6: Land Development Factors Used in Mecklenburg and Union County Small Area Residential Growth Forecasts

Positive
- Existing and planned water service
- Existing and planned sewer service
- Available land
- Population growth 1990-2000
- Residential building permit activity since 2000
- Transit stations, station areas
- Proximity to employment centers (5,000 or more employees located within .5 miles of each other)
- Travel time to core employment areas
- Waterfront within .5 miles
- Planned transportation improvements

Negative
- Undesirable land uses (industrial)
- Congestion
- Sewer treatment facilities

Absolute Avoidance
- Protected open space
- Floodways
- Surface Water Improvement and Management (SWIM) buffers
- Airport

Note: relative weights not reported.

Source: Smith, Mecklenburg-Union Metropolitan Planning Organization Population Projections and Employment Allocations 2000-2030, Center for Applied GIS, UNC Charlotte, 2004

Table 7: Comparisons of Charlotte Region County-level Projections

	Global Insight estimates			Woods & Poole estimates			MPO County control totals			NC State Data Center		
Population	Mecklenburg	Union	Mecklenburg, Cabarrus, Gaston, Union (total)	Mecklenburg	Union	Mecklenburg, Cabarrus, Gaston, Union (total)	Mecklenburg	Union	Mecklenburg, Cabarrus, Gaston, Union (total)	Mecklenburg	Union	Mecklenburg, Cabarrus, Gaston, Union (total)
2005	806,834	161,765	1,314,553	802,400	160,876	1,307,329	837,844	168,728	1,369,427	796,529	159,726	1,298,879
2010	956,823	219,690	1,570,976	916,747	197,554	1,497,063	931,591	200,290	1,539,304	911,252	210,069	1,518,920
2015	1,065,308	263,298	1,749,656	1,000,055	218,988	1,630,535	1,024,722	231,986	1,718,936	996,414	257,378	1,706,871
2020	1,171,442	303,978	1,920,865	1,084,264	240,490	1,765,570	1,110,893	266,617	1,891,585	1,081,577	304,688	1,894,854
2025	1,275,768	349,186	2,097,412	1,168,900	261,995	1,901,371	1,196,462	301,053	2,063,312	1,166,740	351,996	2,082,842
2030	1,382,406	393,407	2,280,808	1,253,544	283,433	2,037,236	1,270,724	337,317	2,220,724	1,253,198	400,683	2,274,700
2035	1,492,923	437,911	2,470,736	1,338,177	304,813	2,173,121	1,344,366	373,403	2,377,207	1,348,998	459,565	2,494,864

Households	Mecklenburg	Union	Mecklenburg, Cabarrus, Gaston, Union (total)	Mecklenburg	Union	Mecklenburg, Cabarrus, Gaston, Union (total)	Mecklenburg	Union	Mecklenburg, Cabarrus, Gaston, Union (total)
2005	317,065	56,755	507,873	320,678	57,382	512,746	350,032	59,090	549,138
2010	367,676	75,711	593,520	372,567	71,700	597,064	376,536	70,282	604,353
2015	411,491	92,151	665,899	412,042	80,624	659,600	402,878	81,418	663,411
2020	454,123	108,146	735,918	449,878	89,217	719,610	437,498	93,786	730,813
2025	490,244	124,813	799,492	486,526	97,534	777,746	471,583	105,974	797,385
2030	528,012	140,618	865,433	520,959	105,429	832,499	501,534	118,886	857,923
2035	566,513	155,507	930,886	553,294	112,919	884,042	530,879	131,624	917,577

Employment	Mecklenburg	Union	Mecklenburg, Cabarrus, Gaston, Union (total)	Mecklenburg	Union	Mecklenburg, Cabarrus, Gaston, Union (total)	Mecklenburg	Union	Mecklenburg, Cabarrus, Gaston, Union (total)
2005	530,215	51,347	714,674	648,470	69,219	900,288	610,386	46,375	783,239
2010	593,404	62,766	795,454	727,289	79,473	1,004,844	677,675	60,991	888,087
2015	683,069	74,938	909,552	792,592	86,926	1,091,639	744,435	75,796	992,835
2020	756,025	83,727	997,770	863,510	95,207	1,186,411	828,620	94,969	1,115,734
2025	817,687	90,802	1,072,008	940,486	104,409	1,289,879	909,005	113,056	1,233,416
2030	889,909	96,408	1,158,841	1,024,008	114,629	1,402,817	987,521	130,877	1,351,339
2035	967,004	101,254	1,250,625	1,114,586	125,966	1,526,054	1,062,193	147,578	1,463,844

Table 8: Union County Water Capacity and Demand

Union County Water Capacity	2005	2010	2015	2020	2025
Catawba Water Treatment Plant	36.00	36.00	36.00	36.00	36.00
Union County share	18.00	18.00	27.00	32.00	39.00
City of Monroe share (included in Union share)			1.99	1.99	1.99
City of Monroe Water Supply	11.00	11.00	11.00	11.00	11.00
Anson County for Union County	1.00	1.90	6.00	6.00	6.00
Anson County for Marshville	1.00	1.00	1.00	1.00	1.00
Northern Source				8.00	21.00
Total Treatment Capacity Installed	31.00	31.90	45.00	58.00	78.00

Union County Water Demand	2005	2010	2015	2020	2025
Union County Demand (mgd)	8.30	12.69	23.33	25.93	33.02
City of Monroe Water Demand	9.00	10.43	12.10	14.02	16.26
Marshville (from Anson County)	0.30	0.35	0.40	0.47	0.54
Total Demand	17.60	23.47	35.83	40.42	49.82

Source: Documents and interviews with Marshville, Monroe, and Union County officials

Table 9: Union County Wastewater Capacity and Demand

Union County Wastewater Average Daily Flow Projections	2005	2007	2010	2015	2020	2025
Twelve Mile WWTF	2.15	2.93	5.36	7.16	7.77	7.85
Monroe WWTF	6.64	7.04	7.71	9.80	11.38	13.30
City of Monroe Share	4.93	5.33	6.00	7.30	8.88	10.80
Union County Share	1.71	1.71	1.71	2.50	2.50	2.50
Marshville Share	0.10	0.10	0.10	1.10	2.10	3.10
Anson County (for Marshville)	0.19	0.19	0.19	0.19	0.19	0.19
Crooked Creek WWTF	1.13	1.19	0.96	0.94	0.84	0.84
Olde Sycamore WWTF	0.04	0.04	0.04	0.04	0.04	0.04
Tallwood Estates WWTF	0.03	0.03	0.20	0.20	0.20	0.20
Grassy Branch WWTF	0.02	0.02	0.02	0.02	0.02	0.02
North Union County WWTF				2.54	4.71	6.27
CMUD	0.50	0.50	1.10	1.69	1.69	1.69
Total Demand	10.70	11.94	15.58	22.58	26.84	30.40

Union County Wastewater Averege Daily Capacity	2005	2007	2010	2015	2020	2025
Twelve Mile WWTF	2.50	6.00	6.00	9.00	9.00	9.00
Monroe WWTF	10.40	10.40	10.40	10.40	10.40	10.40
Union County Share	2.65	2.65	2.65	2.65	2.65	2.65
Marshville Share	0.20	0.20	0.20	0.20	0.20	0.20
Anson County (for Marshville)	0.38	0.38	0.38	0.38	0.38	0.38
Crooked Creek WWTF	1.90	1.90	1.90	1.90	1.90	1.90
Olde Sycamore WWTF	0.15	0.15	0.15	0.15	0.15	0.15
Tallwood Estates WWTF	0.05	0.05	0.05	0.05	0.05	0.05
Grassy Branch WWTF	0.05	0.05	0.05	0.05	0.05	0.05
North Union County WWTF				5.00	6.00	9.00
CMUD	3.00	3.00	3.00	3.00	3.00	3.00
Total Capacity	15.43	18.93	18.93	26.93	27.93	30.93

Source: Documents and interviews with Marshville, Monroe, and Union County officials

Table 10: Union County Wastewater Treatment Facilities

Twelve Mile Creek Water Reclamation Facility, located at 8299 Kensington Drive, was permitted to discharge up to 3.0 MGD of treated wastewater through up until September 2007. Following a substantial expansion of capacity, it has been permitted to discharge 6.0 MGD since. Twelve Mile Creek serves Waxhaw as well as portions of Indian Trail, Stallings and Weddington. Twelve Mile effluent is discharged into Twelve Mile Creek, which is part of the Catawba River Basin. Since January 2008, Twelve Mile has distributed bulk "reclaimed" water to authorized users in order to reduce demand upon the potable water supply.

Crooked Creek Water Reclamation Facility, located at 4015 Sardis Church Road, is permitted to discharge up to 1.9 MGD of treated wastewater. Crooked Creek serves the Indian Trail, Lake Park and Stallings areas. Crooked Creek effluent is pumped over 17,000 feet to discharge into the North Fork Crooked Creek which lies in the Yadkin Pee Dee River Basin. Since January 2008, the Crooked Creek facility has also distributed bulk "reclaimed" water to authorized users in order to reduce demand upon the potable water supply.

Olde Sycamore Water Reclamation Facility, located off Highway 218 and Rock Hill Church Road, is permitted to discharge up to .150 MGD of treated wastewater. It serves the Olde Sycamore Golf Community. Olde Sycamore effluent is pumped from a storage pond onto the Olde Sycamore Golf Course for irrigation.

Tallwood Estates Wastewater Treatment Plant, located within and serving the Tallwood Subdivision off Brief Road, is permitted to discharge up to .05 MGD of treated wastewater. Tallwood effluent is discharged to Clear Creek, which lies in the Yadkin Pee Dee River Basin.

Grassy Branch Wastewater Treatment Plant, located at 1629 Old Fish Road, is permitted to discharge up to .05 MGD of treated wastewater. Grassy Branch serves the Unionville Elementary, Piedmont Middle and Piedmont High Schools as well as the Loxdale and Smithfield Subdivisions. Grassy Branch effluent is discharged to Crooked Creek which lies in the Yadkin Pee Dee River Basin.

Hunley Creek Wastewater Treatment Plant, located at 6913 Stevens Mill Road, was permitted to discharge up to .231 MGD of treated wastewater until discharge permit limits changed. The facility which served the subdivisions of Shanamara, Hunley Creek, Willowbrook, and Stevens Mill, discharged into Goose Creek, which lies in the Yadkin Pee Dee River Basin, until May 2006.

Source: Union County Department of Public Works documents

Table 11: Summary Comparison of MPO Socio-economic Estimates with Kenan Institute Revised Estimates

	Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
# TAZs	2,934	210	48	37	42	53	30

Current MPO data

Households							
	Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	786,871	42,595	14,118	11,017	7,617	6,164	3,679
2010	865,401	49,393	15,179	12,418	8,696	8,530	4,570
2015	949,954	56,454	16,508	13,819	9,771	10,898	5,458
2020	1,045,707	62,479	17,482	14,738	10,300	13,227	6,732
2025	1,140,211	68,407	18,431	15,647	10,811	15,526	7,992
2030	1,231,516	74,497	19,307	16,676	11,369	17,827	9,318
2035	1,321,587	80,488	20,162	17,691	11,907	20,102	10,626

Population							
	Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	1,993,662	120,054	38,774	30,859	20,404	19,084	10,933
2010	2,216,216	140,267	42,886	34,865	23,333	25,712	13,471
2015	2,463,714	161,371	47,825	39,085	26,403	32,060	15,998
2020	2,709,021	178,152	50,443	41,699	27,913	38,545	19,552
2025	2,952,842	194,812	53,037	44,291	29,400	44,997	23,087
2030	3,189,018	211,973	55,413	47,280	30,980	51,435	26,865
2035	3,423,784	229,028	57,765	50,254	32,541	57,842	30,626

Employment							
	Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	1,005,946	51,306	15,981	8,601	8,543	13,615	4,566
2010	1,142,362	62,270	18,319	10,862	10,399	16,812	5,878
2015	1,296,818	73,259	20,679	13,105	12,236	20,046	7,193
2020	1,452,023	87,951	24,230	15,914	14,424	23,976	9,407
2025	1,599,213	101,999	27,650	18,591	16,489	27,745	11,524
2030	1,746,550	115,538	30,821	21,201	18,568	31,430	13,518
2035	1,886,721	128,395	33,824	23,690	20,522	34,950	15,409

Source: Kenan Institute analysis of MUMPO data

Note: See Map2 for definitions of Zones

Table 11: Summary Comparison of MPO Socio-economic Estimates with Kenan Institute Revised Estimates

Kenan Institute adjusted MPO data

	Households Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	786,871	42,595	14,118	11,017	7,617	6,164	3,679
2010	791,304	45,346	13,891	11,388	8,060	7,764	4,243
2015	867,527	51,968	15,096	12,667	9,168	9,897	5,140
2020	954,935	57,974	16,021	13,589	9,814	12,099	6,451
2025	1,041,241	63,869	16,919	14,492	10,433	14,273	7,752
2030	1,124,600	69,843	17,730	15,474	11,074	16,455	9,110
2035	1,206,857	75,740	18,531	16,444	11,697	18,614	10,454

	Population Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	1,993,662	120,054	38,774	30,859	20,404	19,084	10,933
2010	2,026,471	128,732	39,244	31,954	21,633	23,421	12,480
2015	2,249,865	148,486	43,721	35,809	24,783	29,173	15,000
2020	2,473,882	165,207	46,210	38,423	26,622	35,322	18,630
2025	2,696,523	181,775	48,661	40,991	28,421	41,454	22,248
2030	2,912,200	198,613	50,871	43,842	30,225	47,580	26,095
2035	3,126,583	215,340	53,059	46,668	32,014	53,669	29,930

	Employment Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	1,005,946	51,306	15,981	8,601	8,543	13,615	4,566
2010	1,044,592	57,046	16,736	9,904	9,516	15,434	5,456
2015	1,184,258	67,138	18,845	11,886	11,181	18,432	6,794
2020	1,326,019	80,881	22,060	14,413	13,177	22,080	9,151
2025	1,460,391	94,009	25,164	16,817	15,053	25,571	11,404
2030	1,594,963	106,690	28,031	19,156	16,971	29,015	13,517
2035	1,722,954	118,718	30,744	21,381	18,771	32,299	15,523

Source: Kenan Institute analysis of MUMPO data

Note: See Map2 for definitions of Zones

Table 11: Summary Comparison of MPO Socio-economic Estimates with Kenan Institute Revised Estimates

Absulute adjustment (MPO - adjusted)

Households	Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	0	0	0	0	0	0	0
2010	74,097	4,047	1,288	1,030	636	766	327
2015	82,427	4,486	1,412	1,152	603	1,001	318
2020	90,772	4,505	1,461	1,149	486	1,128	281
2025	98,970	4,538	1,512	1,155	378	1,253	240
2030	106,916	4,654	1,577	1,202	295	1,372	208
2035	114,730	4,748	1,631	1,247	210	1,488	172

Population	Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	0	0	0	0	0	0	0
2010	189,745	11,535	3,642	2,911	1,700	2,291	991
2015	213,849	12,885	4,104	3,276	1,620	2,887	998
2020	235,139	12,945	4,233	3,276	1,291	3,223	922
2025	256,319	13,037	4,376	3,300	979	3,543	839
2030	276,818	13,360	4,542	3,438	755	3,855	770
2035	297,201	13,688	4,706	3,586	527	4,173	696

Employment	Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	0	0	0	0	0	0	0
2010	97,770	5,224	1,583	958	883	1,378	422
2015	112,560	6,121	1,834	1,219	1,055	1,614	399
2020	126,004	7,070	2,170	1,501	1,247	1,896	256
2025	138,822	7,990	2,486	1,774	1,436	2,174	120
2030	151,587	8,848	2,790	2,045	1,597	2,415	1
2035	163,767	9,677	3,080	2,309	1,751	2,651	-114

Source: Kenan Institute analysis of MUMPO data

Note: See Map2 for definitions of Zones

Table 11: Summary Comparison of MPO Socio-economic Estimates with Kenan Institute Revised Estimates

Proportional adjustment (adjusted / MPO)

Households	Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2010	0.9144	0.9181	0.9151	0.9171	0.9269	0.9102	0.9284
2015	0.9132	0.9205	0.9145	0.9166	0.9383	0.9081	0.9417
2020	0.9132	0.9279	0.9164	0.9220	0.9528	0.9147	0.9583
2025	0.9132	0.9337	0.9180	0.9262	0.9650	0.9193	0.9700
2030	0.9132	0.9375	0.9183	0.9279	0.9741	0.9230	0.9777
2035	0.9132	0.9410	0.9191	0.9295	0.9824	0.9260	0.9838

Population	Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2010	0.9144	0.9178	0.9151	0.9165	0.9271	0.9109	0.9264
2015	0.9132	0.9202	0.9142	0.9162	0.9386	0.9100	0.9376
2020	0.9132	0.9273	0.9161	0.9214	0.9537	0.9164	0.9528
2025	0.9132	0.9331	0.9175	0.9255	0.9667	0.9213	0.9637
2030	0.9132	0.9370	0.9180	0.9273	0.9756	0.9251	0.9713
2035	0.9132	0.9402	0.9185	0.9286	0.9838	0.9279	0.9773

Employment	Region	Total Corridor	Corridor Zone 1	Corridor Zone 2	Corridor Zone 3	Corridor Zone 4	Corridor Zone 5
2005	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2010	0.9144	0.9161	0.9136	0.9118	0.9151	0.9180	0.9282
2015	0.9132	0.9164	0.9113	0.9070	0.9138	0.9195	0.9445
2020	0.9132	0.9196	0.9104	0.9057	0.9135	0.9209	0.9728
2025	0.9132	0.9217	0.9101	0.9046	0.9129	0.9216	0.9896
2030	0.9132	0.9234	0.9095	0.9035	0.9140	0.9232	0.9999
2035	0.9132	0.9246	0.9089	0.9025	0.9147	0.9241	1.0074

Source: Kenan Institute analysis of MUMPO data

Note: See Map2 for definitions of Zones

Table 12: FHWA Estimates of Traffic for U.S. 611 and U.S. 74

	U.S. 611 North of Monroe	U.S. 611 South of Monroe	U.S. 74 West of Monroe	U.S. 74 East of Monroe
	64999	63595	65001	62223
Length of arc (miles).	7.35	11.31	2.74	3.82
Contains the designated primary sign route for the arc.	U601	U601	U74	U74
Contains the local street name for the arc.				Monroe Bypass
Describes the rural/urban classification of the arc.	Rural	Rural	Large urbanized area (population 200,000 or more)	Large urbanized area (population 200,000 or more)
Identifies the assigned functional class of each arc.	Rural minor arterial	Rural principal arterial - Other	Urban principal arterial - Other	Rural principal arterial - Other
Special subnetwork for the National Highway System.			Non-Interstate STRAHNET	Non-Interstate STRAHNET
Information about the FAF 2.2 link.	Not on NHS Other FAF 2.2 routes	Not on NHS National Network (NN) route	National Network (NN) route	National Network (NN) route
2002 estimates				
HPMS annual average daily traffic for year 2002	7,800	11,000	49,000	29,000
Year 2002 truck volume based on HPMS average truck percentage	635	1,577	6,895	2,339
FAF 2.2 truck flow based on freight demand model and FAF 2.2 O-D database	238	554	2,157	955
Local truck traffic that is not part of FAF 2.2 flow	397	1,023	4,738	1,384
Estimated capacity using HCM 2000 methodology	2,371	2,153	6,246	3,213
Service flow volume/hour	936.00	1430.00	1715.00	2073.50
2002 volume to capacity ratio	0.395	0.664	0.275	0.645
2002 congested speed miles/hour	39.50	39.17	42.84	42.79
2002 link delays in hour	0.026	0.072	0.000	0.000
2035 forecasts				
Annual average HPMS daily traffic. Estimated using the HPMS traffic growth factor	18,871	16,309	101,091	48,083
Year 2035 truck volume based on HPMS average truck percentage and traffic growth	1,522	2,327	14,267	3,965
FAF 2.2 truck flow based on freight demand model and FAF 2.2 O-D database	345	1,026	3,453	1,646
Local truck traffic that is not part of FAF 2.2 flow	1,177	1,301	10,814	2,319
Estimated capacity using HCM 2000 methodology	2,565	2,180	6,245	3,389
Service flow volume/hour	2264.52	2120.17	3538.18	3437.93
2035 volume to capacity ratio	0.883	0.972	0.567	1.015
2035 congested speed miles/hour	27.53	30.73	42.82	38.24
2035 link delays in hour	0.112	0.152	0.000	0.011
2035 / 2002 AADT	2.4194	1.4826	2.0631	1.6580
2036 / 2002 AADTT	2.3969	1.4756	2.0692	1.6952
2037 / 2002 long distance AADTT	1.4496	1.8520	1.6008	1.7236
2038 / 2002 local AADTT	2.9647	1.2717	2.2824	1.6756

Source: U.S. Department of Transportation, FHWA, FAF2 Highway Link and Truck Data and Documentation: 2002 and 2035

Technical Memorandum

Proposed Monroe Connector/Bypass Comprehensive Traffic and Revenue Study

Updated Report of Independent Economist

Prepared For

NORTH CAROLINA Turnpike Authority

Prepared By

Kenan Institute of Private Enterprise
University of North Carolina at Chapel Hill

ENGINEERS PLANNERS ECONOMISTS
WilburSmith ASSOCIATES

March 1, 2010

Evaluation of the Socio-economic Estimates Underlying the Study of the Feasibility of the Proposed Monroe Connector/Bypass – Supplemental work

Kenan Institute of Private Enterprise

1 March 2010

The Kenan Institute of Private Enterprise completed an evaluation of the socio-economic forecasts for the Proposed Monroe Connector/Bypass in September 2009. The estimates, produced under the leadership of the Mecklenburg Union Metropolitan Planning Organization (MUMPO) are an important input to the Traffic and Revenue Study for the proposed Connector/Bypass. Our audit of the MUMPO socio-economic data, corroborated by interviews and data analysis, found a rigorous procedure for generating large area (county and sub-county) estimates but an insufficiently documented procedure for allocating residential and employment growth among small areas (Traffic Analysis Zones). In addition, the original MPO projections appeared to have been modified in reaction to the region's rapid growth over much of the last decade without adequate consideration of the long-term sustainability of the short-term acceleration of growth.

On the basis of extensive discussions with knowledgeable local and state informants and on the basis of analysis of many sources of systematic data, we recommended a significant downward revision in the overall MUMPO population and employment growth expectations and a reallocation of expectations for residential growth within Union County towards the turnpike corridor. The former adjustment is roughly consonant with the original, pre-boom MPO projections and in line with expectations for national economic growth but somewhat less strongly downward than some knowledgeable informants had recommended. The latter adjustment was more subjective, based largely on the consensus of interviewees that residential growth prospects in the southwestern quadrant of the county had been over-stated in the MPO estimates and on the infrastructure provision program of Union County which is centered on the Connector/Bypass Corridor. Further information about the MPO estimation process and about our adjustments is available in "Evaluation of the Socio-economic Estimates Underlying the Study of the Feasibility of the Proposed Monroe Connector/Bypass," dated 28 September 2009.

Wilbur Smith Associates recently requested supplemental work on the Kenan Institute analysis. A delay between the completion of our data collection and progress on the Connector/Bypass project raised the possibility that, while the Charlotte region has suffered a serious setback which could affect regional growth and travel patterns, recent information could change assessments of the state of the economy and its likely course over the next several years. Accordingly, we considered developments over the several months since our initial analysis was completed by scanning the regional news media for reports of recent developments, re-interviewing select informants, and gathering the most recent available quantitative data.

The situation in the Charlotte region remains decidedly bleak. A partially completed high-rise condominium development, reportedly untouched for many months, with the mechanicals and interior walls installed but without the external skin, served as a grim backdrop for one of our interviews. Several large Uptown office buildings have been completed over the past several months but they were reportedly largely empty.

Nevertheless, not all indications are negative. We have revised our estimates for 2010 Union County population upward to 186,819, which is approximately two percent more than the previous figure. The same proportional adjustment should apply to household counts. We have decided not to adjust the Union County employment figures and not to adjust the Mecklenburg figures. Unfortunately, the data, method, and time available do not allow us to allocate the increased estimated population within the county. The newly available information does not suggest that later year estimates need to be modified.

Our decision was based largely on the strength of two indicators in combination.

- Charlotte region job announcements are positive. Over the past several months, companies have announced plans to add 2,100 new jobs to the region.[1] None of these jobs have yet materialized and many of them likely never will. Nevertheless, the volume of announcements compares favorably with the recent past and with some other key metropolitan areas.
- More immediately, Union County School enrollments, while slowing quickly, did not slow as quickly as we had expected last summer.[2] Figure 1 shows the slowing, yet continuing, growth trend.

Most indicators and analyses suggest a continuing economic slump with the likelihood of slow recovery. Employment trends through December 2009 are shown for the State, Mecklenburg County, and Union County in Figure 2. Declines in Mecklenburg and Union Counties have not been as steep as in the State as a whole (right scale) but they have been substantial. Visually, it almost appears as if the pre-2005 employment growth trend has been re-established in Mecklenburg County after a several-year boom. The last data point certainly should not be over-interpreted in any case but, unfortunately, trends at the end of 2009 were not in a positive direction.

Traffic estimates for Uptown Charlotte have been generally flat for the last several years. Lynx Line ridership has fallen substantially from its peak. These have been interpreted as indicators of a weak employment situation (not shown).

[1] http://www.wsoctv.com/news/22040850/detail.html

[2] Even most elementary school districts in Union County are relatively large and the districts are periodically redrawn to match capacity and demand. We have not yet been able to definitively state the degree to which enrollment increases imply new in-migration.

Figure 3 charts the trend in Mecklenburg and Union County residential building permits over the last three decades. Less than 600 building permits were issued in Union County in 2009. That was less than 60 percent of the total for 2008, less than one fourth of the number issued in 2007, and less than one seventh of the number issued in 2006. We do, however, note a slight uptick in permits issued at the end of last year, as seen in Figure 4, in both counties and our informants related an increase of inquiries on the part of builders and developers in Union County. Again, this latest data point should not be over-interpreted. No significant action has been seen. Data for the U.S. 74 corridor in Mecklenburg County also suggests some, but significantly slowed, building activity (not shown).

Recent trends in Union County residential real estate sales can be seen in Figure 5. These include both new and existing homes. Completing last year's data suggests an ongoing slowdown in Union County home sales despite recent government incentives. Sales at the beginning of 2010 are slower than they were a year earlier.

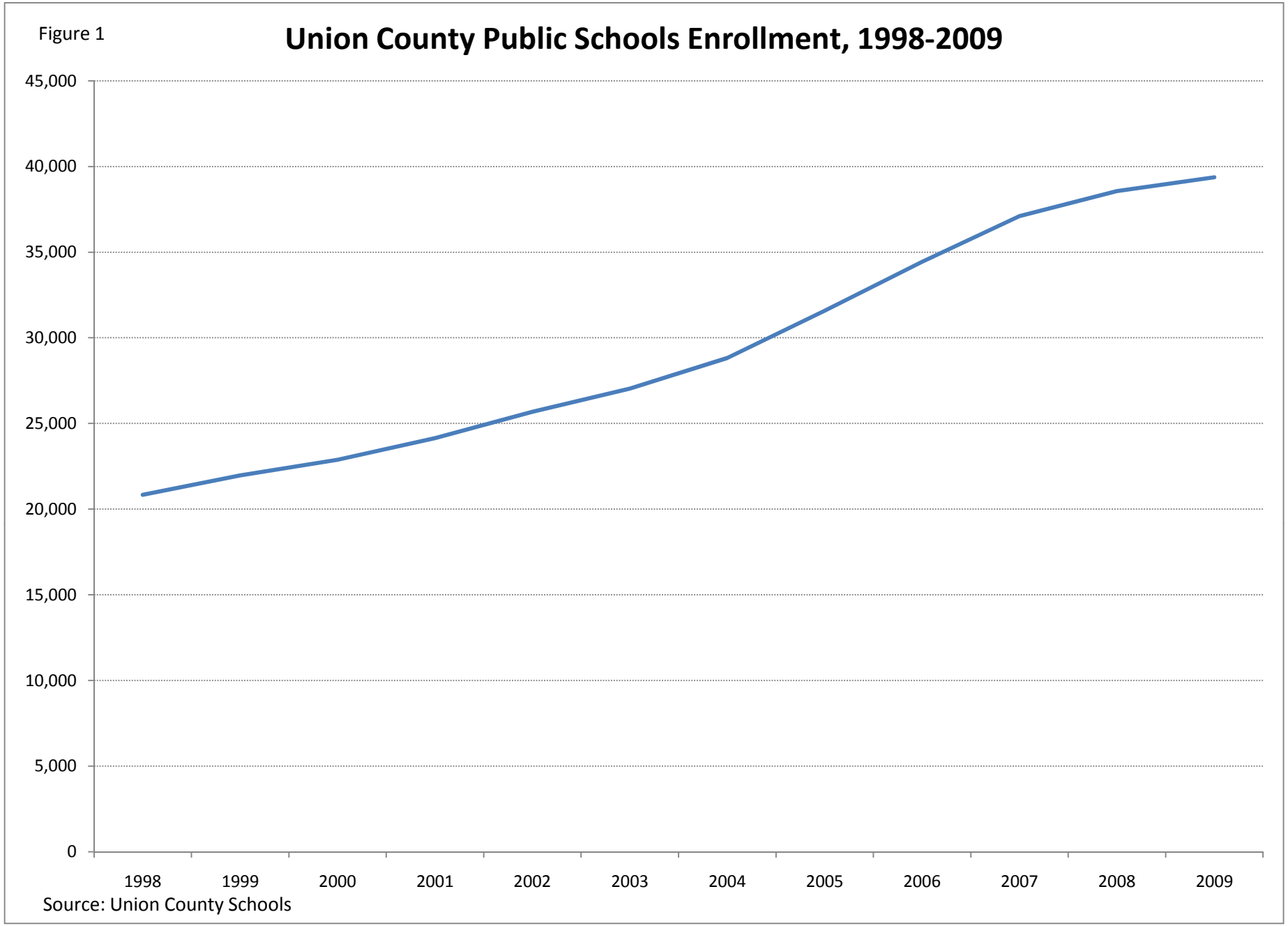
In order to place our estimates in the context of the multitude of available population projections, we review portions of the discussion in our full report, cited above, adding new commentary. Our mandate was to review and possibly adjust the socio-economic estimates prepared by MUMPO. The decennial Census is the most accurate source of population and housing information. The most recent data were gathered almost ten years ago. The 2010 data, to be collected this month and next, will not be available in its most basic form for another year. Given the unexpectedly rapid growth earlier in the decade and subsequent employment decline in the Charlotte region, any population estimates run the risk of significant error.

Recognizing that no projection is completely accurate (error bounds are discussed in the full report), our judgment is that Thomas Hammer, the consultant hired by MUMPO to estimate county and sub-county population and employment for selected years, has the most credible methodology of any known population and employment projection. His estimation process relies on Census data, the quantified detailed experiences of similar metropolitan regions, and extensive feedback from knowledgeable regional (Charlotte area) informants. We feel that his estimates, modified with the best available information about developments subsequent to his work, form the best possible basis for NCTA decision-making.

Commercially available population estimates are also of generally high quality but we find they are less able to capture the degree of cross-county suburbanization – the factor which has been the primary driver for Union County population growth. Moreover, many projection methods are unable to adequately capture recession-driven declines in in-migration. Local informants have assured us that such downturns are real – as indicated by the decrease in employment and rapidly slowing growth in the school population. Our assessment is that all available recent population estimates have likely over-reacted to the mid-decade acceleration in regional employment and have not yet incorporated adequate corrections. The 2010 Census data will provide a new solid basis for further projections.

Our assessment of the outlook for the Charlotte Region and Union County remains positive. The region and, more recently, Union County offers advantages that have attracted employment and residents. The recent boom may have passed, but the Charlotte region has been a growth center for at least a century and we see no reason that it will not continue to be – albeit possibly at a pace more consistent with the last several decades, rather than a few select recent years.

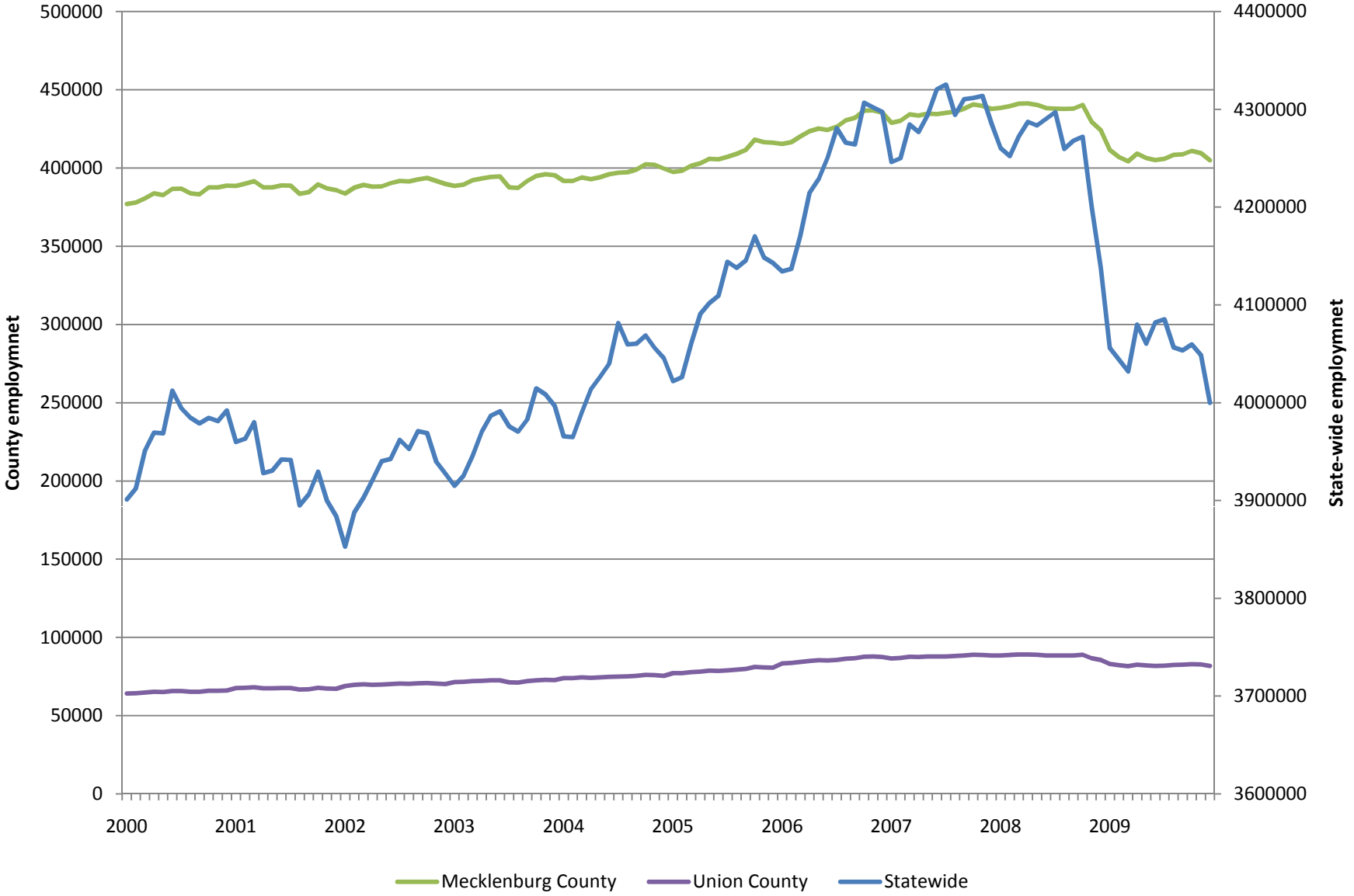
Figure 1



Source: Union County Schools

Figure 2

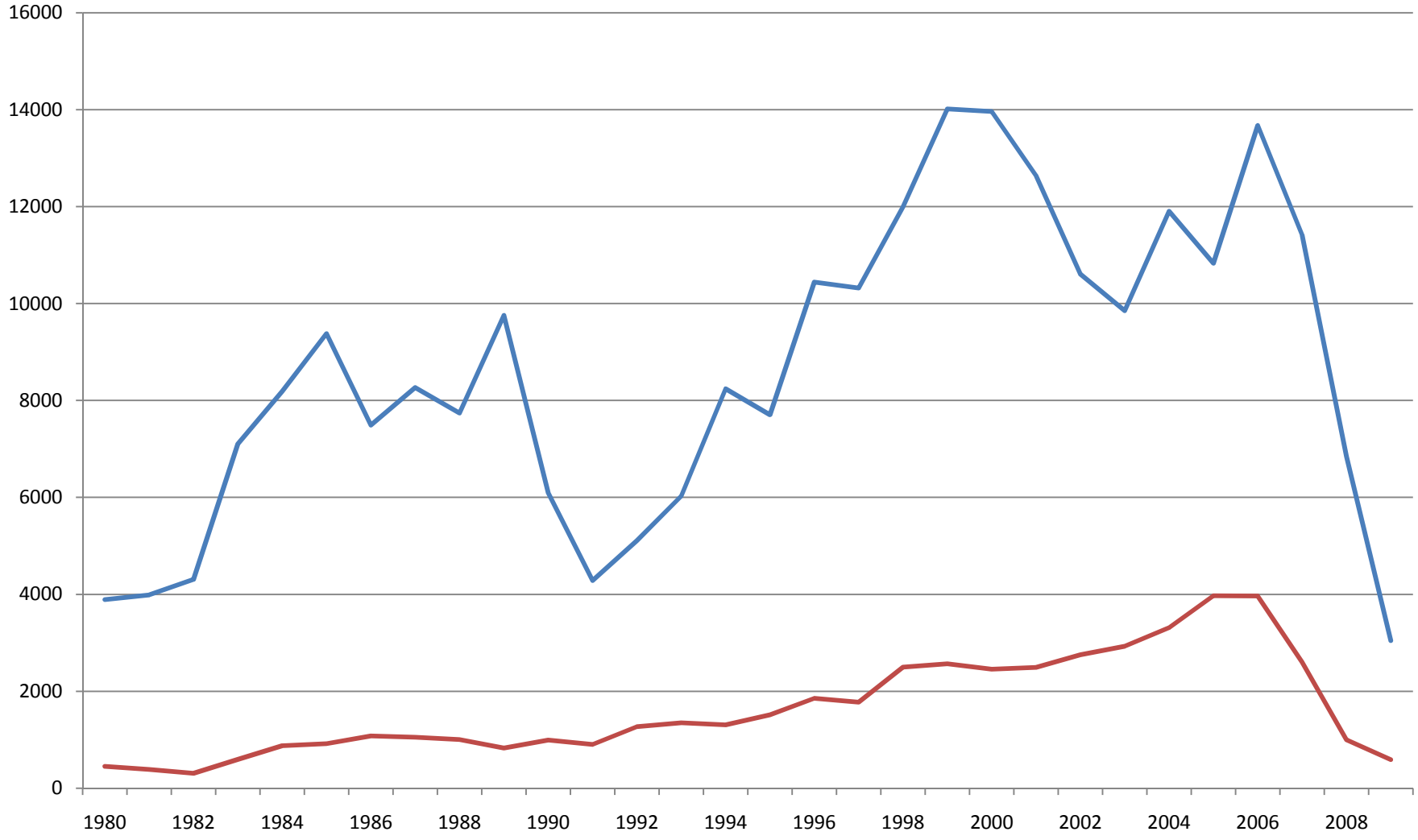
Recent employment trends



Source: N.C. Employment Security Commission

Figure 3

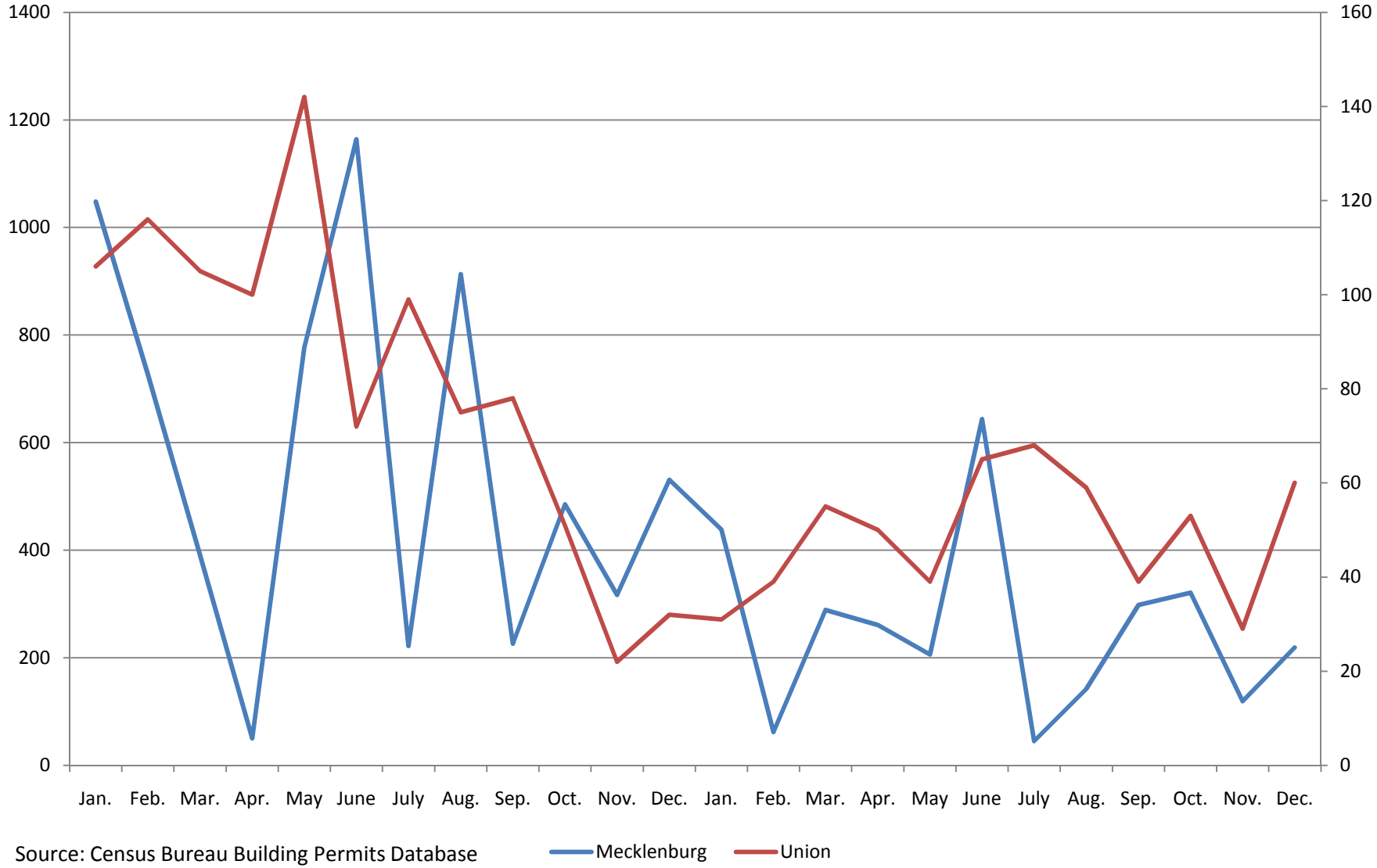
Total Annual Building Permits Issued



Source: Census Bureau Building Permits Database

Figure 4

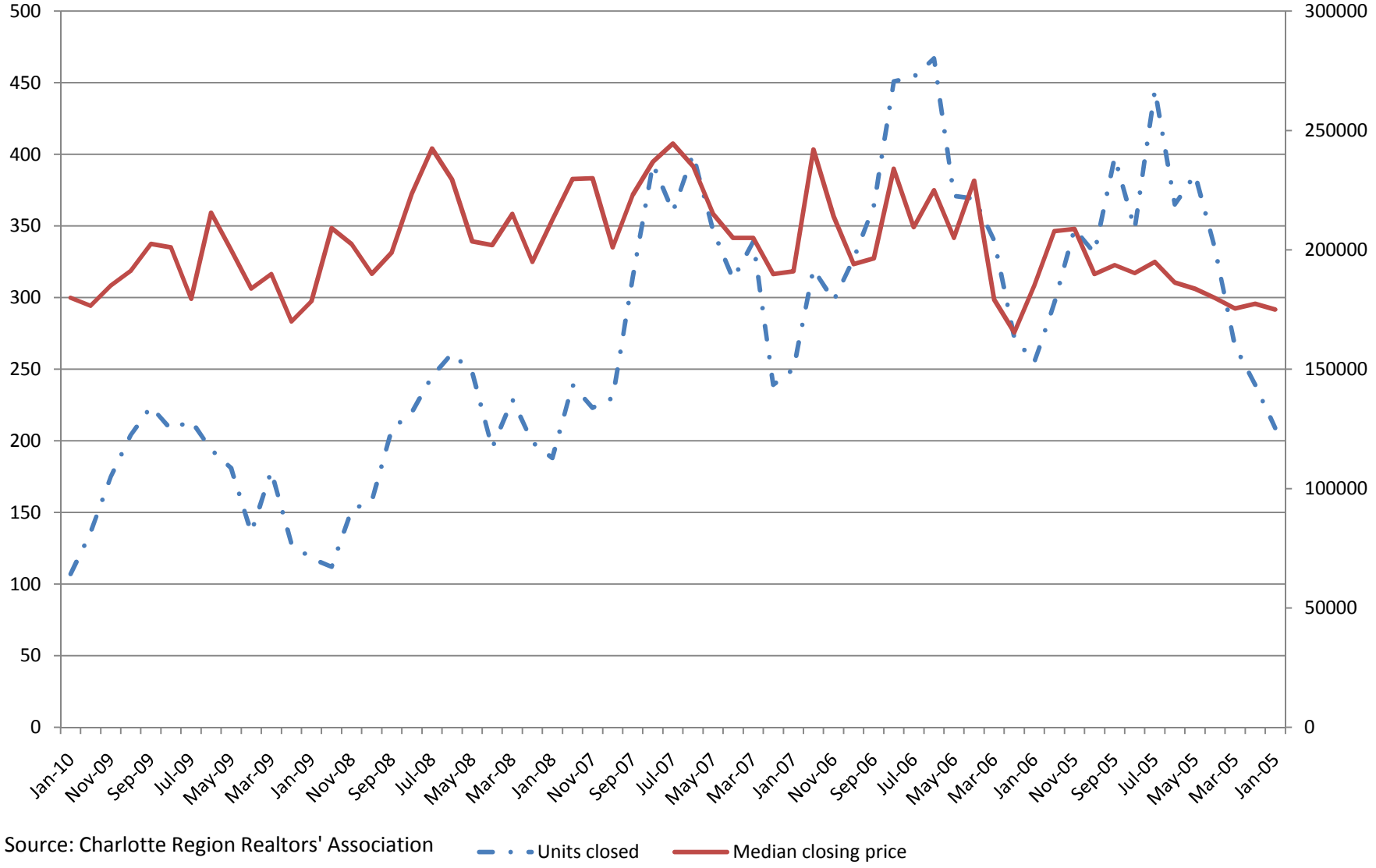
Total Residential Building Permits, Jan 2008-Dec 2009



Source: Census Bureau Building Permits Database

Figure 5

Union County Residential Real Estate Closings, January 2005-January 2010



Source: Charlotte Region Realtors' Association

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Appendix D
Hartgen Analysis

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Hartgen Analysis of Interchanges

	Crossing Road	Characteristics				Suitable Development			
		Crossing Road Traffic Volumes	Distance from Nearest Town Center	Distance from Public Water and Sewer	Distance to Interstate Highway	Motel	Gas Station	Fast-Food Restaurant	Sit-Down Restaurant
1	US 74 Business	95,600	1.8	0	1.5	Good	Fair	Good	Good
2	Indian Trail-Fairview Road	25,700	1.4	0	3.5	Good	Fair	Good	Good
3	Unionville-Indian Trail Road	18,200	1.1	0	5.7	Good	Fair	Good	Poor
4	Rocky River Road	16,100	1.1	0	7.1	Good	Fair	Good	Poor
5	Concord Highway	54,300	2.1	0	11.0	Good	Fair	Good	Poor
6	Morgan Mill Road	20,400	2.1	0	12.7	Good	Fair	Good	Poor
7	Austin Chaney Road	17,400	0.9	0	16.7	Fair	Good	Fair	Poor
8	Forest Hills School Road	3,600	1.9	0	18.6	Poor	Poor	Poor	Poor
9	US 74 Business	37,100	1.9	0	19.6	Fair	Fair	Fair	Poor

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Appendix E
MRM Raw Model Volume Traffic Comparison

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Road Segment(s)		No-Build AADT	Build (2009 Forecasts)	
			AADT	% Change No-Build to Build (2009 Forecasts)
MCB Segments	US 74 to Indian Trail-Fairview Rd	n/a	62,500	n/a
	Indian Trail-Fairview Rd to Unionville-Indian Trail Rd	n/a	52,900	n/a
	Unionville-Indian Trail Rd to Rocky River Rd	n/a	47,200	n/a
	Rocky River Rd to US 601	n/a	44,100	n/a
	US 601 to NC 200 (Morgan Mill Rd)	n/a	39,500	n/a
	NC 200 (Morgan Mill Rd) to Austin Chaney Rd	n/a	32,500	n/a
	Austin Chaney Rd to Forest Hills School Rd	n/a	22,600	n/a
	Forest Hills School Rd to US 74	n/a	20,000	n/a
US 74 Segments	I-485 to Stallings Rd	83,500	n/a	n/a
	Stallings Rd / Monroe Bypass to Indian Trail Rd. North	83,500	61,400	-26%
	Indian Trail Rd. North to Unionville Indian Trail Rd. West	60,300	48,200	-20%
	Unionville Indian Trail Rd. West to Faith Church Rd.	61,700	50,100	-19%
	Faith Church Rd. to Sardis Church Rd.	54,000	45,800	-15%
	Sardis Church Rd. to Chambers Dr.	44,500	37,300	-16%
	Chambers Dr. to N. Rocky River Rd.	42,200	35,800	-15%
	N. Rocky River Rd. to Fowler Secrest Rd.	42,900	36,200	-16%
	Fowler Secrest Rd. to Rolling Hills Dr.	42,900	29,400	-31%
	Rolling Hills Dr. to Round Table Rd.	40,900	29,400	-28%
	Round Table Rd. to Williams Rd.	46,700	35,200	-25%
	Williams Rd. to Hanover Dr.	62,600	41,600	-34%
	Hanover Dr. to Dickerson Blvd.	62,600	41,600	-34%
	Dickerson Blvd. to Secrest Shortcut Rd.	62,600	53,300	-15%
	Secrest Shortcut Rd. to Secrest Shortcut Rd.	68,000	56,200	-17%
	Secrest Shortcut Rd. to Concord Ave.	68,000	56,200	-17%
	Concord Ave. to US 601	69,500	57,800	-17%
	US 601 to Stafford St.	65,800	57,100	-13%
	Stafford St. to Boyte St.	63,700	55,000	-14%
	Boyte St. to NC 200	62,900	54,300	-14%
	NC 200 to Walkup Ave.	63,300	55,200	-13%
	Walkup Ave. to S. Sutherland Ave.	62,200	54,600	-12%
	S. Sutherland Ave. to Venus St.	61,600	52,700	-14%
	Venus St. to E. Franklin St.	62,000	53,100	-14%
	E. Franklin St. to US 601 / N. Medical Center Campus	70,200	60,600	-14%
	US 601/Metro Medical Center Campus to S. Secrest Ave.	38,800	30,400	-22%
	S. Secrest Ave. to S. Bivens Rd.	44,900	37,000	-18%
	S. Bivens Rd. to Bivens St.	33,800	26,000	-23%
	Bivens St. to Austin Chaney Rd.	34,700	27,300	-21%
	Austin Chaney Rd. to Forest Hills School Rd. North	27,800	19,800	-29%
	Forest Hills School Rd. North to MCB	19,400	10,600	-45%

Road Segment(s)		No-Build AADT	Build (2009 Forecasts)	
			AADT	% Change No-Build to Build (2009 Forecasts)
-Y- Lines	**Indian Trail-Fairview Rd (North of MCB)**		21,500	
	Indian Trail-Fairview Rd (South of MCB)		7,400	
	Unionville-Indian Trail Rd (North of MCB)		14,000	
	Unionville-Indian Trail Rd (South of MCB)		12,800	
	Rocky River Rd (North of MCB)		12,100	
	Rocky River Rd (South of MCB)		17,800	
	US 601 (North of MCB)		20,700	
	US 601 (South of MCB)		18,000	
	NC 200 (Morgan Mill Rd) (North of MCB)		14,700	
	NC 200 (Morgan Mill Rd) (South of MCB)		18,500	
	Austin Chaney Rd (North of MCB)		10,300	
	Austin Chaney Rd (South of MCB)		14,000	
	Forest Hills School Rd (North of MCB)		700	
	Forest Hills School Rd (South of MCB)		2,100	

Road Segment(s)		Build (Adjusted Forecasts)				
		Raw Model AADT	Change No-Build to Build (Adj. Forecasts)	% Change No-Build to Build (Adj. Forecasts)	Change Build (2009 Forecasts) to Build (Adj. Forecasts)	% Change Build (2009 Forecasts) to Build (Adj. Forecasts)
MCB Segments	US 74 to Indian Trail-Fairview Rd	63,100	n/a	n/a	600	1.0%
	Indian Trail-Fairview Rd to Unionville-Indian Trail Rd	54,400	n/a	n/a	1,500	2.8%
	Unionville-Indian Trail Rd to Rocky River Rd	48,600	n/a	n/a	1,400	3.0%
	Rocky River Rd to US 601	46,300	n/a	n/a	2,200	5.0%
	US 601 to NC 200 (Morgan Mill Rd)	42,400	n/a	n/a	2,900	7.3%
	NC 200 (Morgan Mill Rd) to Austin Chaney Rd	35,800	n/a	n/a	3,300	10.2%
	Austin Chaney Rd to Forest Hills School Rd	23,800	n/a	n/a	1,200	5.3%
	Forest Hills School Rd to US 74	20,400	n/a	n/a	400	2.0%
US 74 Segments	I-485 to Stallings Rd	n/a	n/a	n/a	n/a	n/a
	Stallings Rd / Monroe Bypass to Indian Trail Rd. North	61,400	-22,100	-26%	0	0%
	Indian Trail Rd. North to Unionville Indian Trail Rd. West	48,400	-11,900	-20%	200	0%
	Unionville Indian Trail Rd. West to Faith Church Rd.	50,200	-11,500	-19%	100	0%
	Faith Church Rd. to Sardis Church Rd.	46,100	-7,900	-15%	300	1%
	Sardis Church Rd. to Chambers Dr.	38,100	-6,400	-14%	800	2%
	Chambers Dr. to N. Rocky River Rd.	35,500	-6,700	-16%	-300	-1%
	N. Rocky River Rd. to Fowler Secrest Rd.	37,300	-5,600	-13%	1,100	3%
	Fowler Secrest Rd. to Rolling Hills Dr.	30,300	-12,600	-29%	900	3%
	Rolling Hills Dr. to Round Table Rd.	30,300	-10,600	-26%	900	3%
	Round Table Rd. to Williams Rd.	35,900	-10,800	-23%	700	2%
	Williams Rd. to Hanover Dr.	42,000	-20,600	-33%	400	1%
	Hanover Dr. to Dickerson Blvd.	42,000	-20,600	-33%	400	1%
	Dickerson Blvd. to Secrest Shortcut Rd.	54,700	-7,900	-13%	1,400	3%
	Secrest Shortcut Rd. to Secrest Shortcut Rd.	56,900	-11,100	-16%	700	1%
	Secrest Shortcut Rd. to Concord Ave.	56,900	-11,100	-16%	700	1%
	Concord Ave. to US 601	58,600	-10,900	-16%	800	1%
	US 601 to Stafford St.	57,900	-7,900	-12%	800	1%
	Stafford St. to Boyte St.	55,800	-7,900	-12%	800	1%
	Boyte St. to NC 200	55,100	-7,800	-12%	800	1%
	NC 200 to Walkup Ave.	56,300	-7,000	-11%	1,100	2%
	Walkup Ave. to S. Sutherland Ave.	55,600	-6,600	-11%	1,000	2%
	S. Sutherland Ave. to Venus St.	54,200	-7,400	-12%	1,500	3%
	Venus St. to E. Franklin St.	55,200	-6,800	-11%	2,100	4%
	E. Franklin St. to US 601 / N. Medical Center Campus	63,400	-6,800	-10%	2,800	5%
	US 601/Metro Medical Center Campus to S. Secrest Ave.	33,400	-5,400	-14%	3,000	10%
	S. Secrest Ave. to S. Bivens Rd.	41,400	-3,500	-8%	4,400	12%
	S. Bivens Rd. to Bivens St.	29,300	-4,500	-13%	3,300	13%
	Bivens St. to Austin Chaney Rd.	31,900	-2,800	-8%	4,600	17%
	Austin Chaney Rd. to Forest Hills School Rd. North	24,500	-3,300	-12%	4,700	24%
	Forest Hills School Rd. North to MCB	12,400	-7,000	-36%	1,800	17%

Road Segment(s)		Build (Adjusted Forecasts)				
		Raw Model AADT	Change No-Build to Build (Adj. Forecasts)	% Change No-Build to Build (Adj. Forecasts)	Change Build (2009 Forecasts) to Build (Adj. Forecasts)	% Change Build (2009 Forecasts) to Build (Adj. Forecasts)
-Y- Lines	**Indian Trail-Fairview Rd (North of MCB)**	21,500			0	0%
	Indian Trail-Fairview Rd (South of MCB)	7,800			400	5%
	Unionville-Indian Trail Rd (North of MCB)	15,400			1,400	10%
	Unionville-Indian Trail Rd (South of MCB)	14,100			1,300	10%
	Rocky River Rd (North of MCB)	13,900			1,800	15%
	Rocky River Rd (South of MCB)	19,400			1,600	9%
	US 601 (North of MCB)	22,900			2,200	11%
	US 601 (South of MCB)	18,600			600	3%
	NC 200 (Morgan Mill Rd) (North of MCB)	15,800			1,100	7%
	NC 200 (Morgan Mill Rd) (South of MCB)	19,500			1,000	5%
	Austin Chaney Rd (North of MCB)	13,600			3,300	32%
	Austin Chaney Rd (South of MCB)	17,200			3,200	23%
	Forest Hills School Rd (North of MCB)	1,500			800	114%
	Forest Hills School Rd (South of MCB)	2,400			300	14%