Gaston East-West Connector

Revised Final Quantitative Indirect and Cumulative Effects Analysis

Gaston and Mecklenburg Counties
North Carolina
STIP No: U-3321
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Prepared for the North Carolina Turnpike Authority,

NORTH CAROLINA Turnpike Authority

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Executive Summary

ES-1 Background

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 controlled-access toll road extending from I-85 west of Gastonia in Gaston County to I-485 near the Charlotte-Douglas International Airport in Mecklenburg County. The proposed project (STIP Project U-3321) is known both as the "Gaston East-West Connector" and as the "Garden Parkway." For this study, the project is referred to as the Gaston East-West Connector.

The Draft Environmental Impact Statement (DEIS) for the Gaston East-West Connector was published in April 2009. A qualitative assessment of potential indirect and cumulative effects was performed for the Gaston East-West Connector DEIS (LBG, 2009). The qualitative assessment was focused on steps one through five of the eight-step process for ICE assessment outlined in the NCDOT/ North Carolina Department of Environment and Natural Resources *Guidance on Indirect and Cumulative Impact Assessment of Transportation Projects in North Carolina*. Steps one through five include defining study area boundaries, identifying community trends and goals, identifying resources for analysis, describing cause and effect relationships and identifying potential impacts for analysis.

A quantitative indirect and cumulative effects assessment was requested by other agencies in comments on the DEIS, with the specific areas of concern being water quality and wildlife habitat impacts. Other agencies and the public had no comments on the Qualitative ICE study, except for recommending the completion of a Quantitative ICE study. Based on the results of the qualitative assessment and consideration of the public and agency comments on the DEIS, FHWA and NCTA decided to conduct a quantitative assessment of potential indirect and cumulative effects for the FEIS.

While the qualitative assessment was focused primarily on steps one through five of the eight-step process, this quantitative assessment is focused on steps six through eight (analyze impacts, evaluate analysis results, and assess consequences and develop mitigation). The purpose of this quantitative assessment is to: 1) provide a detailed analysis of the potential indirect land use, water resources and wildlife habitat impacts of the Preferred Alternative; 2) provide a detailed analysis of the potential cumulative land use, water resources and wildlife habitat impacts that could results from the combination of the direct and indirect impacts of this project with the impacts of other reasonably foreseeable actions by others; and 3) to disclose mitigation measures that could be used to offset any adverse indirect and/or cumulative effects identified by the assessment.

The land use change forecasts developed for this study may be used to provide inputs to the water quality modeling proposed to address the requirements of NCDENR Division of Water Quality's policy document entitled *Cumulative Impacts and the 401 Water Quality Certification and Isolated Wetlands Program* (NDWQ, 2004).

ES-2 Methodology

ES-2.1 Study Area Boundaries and Timeframe

The study are defined in the qualitative ICE study consisted of portions of southern Gaston County, northern York County, western Mecklenburg County and eastern Cleveland County. The study area boundaries presented in the qualitative ICE assessment were refined as part of the preparation of this quantitative assessment. The study area boundaries were altered to encompass the entirety of Hydrologic Unit Code (HUC) 12-digit subwatersheds (See Figure 1). The study area consists of the following HUC 12 subwatersheds:

- Upper Crowders Creek (030501011501)
- Lower Crowders Creek (030501011504)
- Catawba Creek (030501011502)
- Mill Creek-Lake Wylie (030501011505)
- Duharts Creek-South Fork Catawba River (030501020605)
- Lake Wylie-Catawba River (030501011406)
- Paw Creek-Lake Wylie (030501011404)
- Beaverdam Creek (030501011503)
- Fites Creek-Catawba River (030501011405)[1]

The future analysis year for the quantitative ICE assessment is 2035 to coincide with the 2035 long-range transportation plans for the Gaston Urban Area Metropolitan Planning Organization (GUAMPO), the Mecklenburg-Union Metropolitan Planning Organization (MUMPO) and the Rock Hill-Fort Mill Area Transportation Study (RFATS) (GUAMPO, 2010; MUMPO, 2010 and RFATS, 2010). The analysis year for the 2009 qualitative ICE assessment was 2030 because the current long-range plans at that time had a horizon year of 2030.

ES-2.2 Land Use Change

To analyze the potential indirect effects of the Preferred Alternative on patterns of future household and employment growth, a gravity model analysis was conducted using travel time information from the April 13, 2006 version of the Metrolina travel demand model. Gravity models are used often in transportation and travel modeling. They are based on the observation that the overall attractiveness of an area to potential residents is a function of the capacity of an area for development (vacant developable land in valued and affordable locations) and accessibility to employment and activity centers. The model produces quantified results that can serve as the basis for assessing land use change. The gravity model formulation essentially holds that all other factors influencing development held constant, growth will shift towards areas with the greatest relative accessibility improvement as a result of the project. As discussed further below,

[1] Subsequent to the August 2010 version of the Quantitative ICE report circulated with the FEIS, the North Carolina Division of Water Quality (NCDWQ) requested that the Fites Creek- Catawba River subwatershed be added to the study area. The Fites Creek subwatershed was initially excluded from the study area due to a lack of substantial changes in travel times for the majority of this area with the completion of the Gaston East-West Connector.

coordination with MPOs and county planning departments led to the decision to use the gravity model approach to estimate the No Build condition because the Build condition was reflected in the prevailing demographic forecasts.

Demographic projections in the Metrolina travel demand model for the study area are developed by GUAMPO, MUMPO and York County/RFATS and used in their long-range transportation plans (LRTPs). The most recent MPO LRTPs and demographic forecasts at the time of this study were for the year 2035. A series of interviews with the MPOs and county planning departments in the study area was conducted to determine whether the 2035 forecasts should serve as the No Build condition or Build condition for this ICE study. Interviews were held with planners from GUAMPO, MUMPO, RFATS, Gaston County, Mecklenburg County and York County. Summaries of each meeting are provided in Appendix A. All three of the MPOs with responsibility for developing the demographic forecasts for the study area confirmed that the Gaston East-West Connector was assumed to be completed in the allocation of future growth to specific zones. During the demographic forecasting efforts for the Metrolina model, additional growth was added in areas that were expected to become more attractive to development with the project, including southern Gaston County and northern York County. This means that the indirect land use effect of the project is already reflected in the forecasts. Therefore, the Metrolina model forecasts should be used to represent the Build condition. All the participants concurred that the forecasts represent the Build condition and it was reasonable to use the gravity model approach to redistribute households and employment for the No Build condition.

Once the No Build and Build distribution of households and employment were established, these estimates were converted into potential changes in land use based on the average density of proposed or existing development in the study area.

ES-2.3 Water Resources

Impervious surface cover is an accepted indicator for assessing the potential for water quality impacts as a result of future development. Impervious surface cover increases runoff volumes, which in turn can affect stream stability and water quality indicators. Existing impervious surface cover in the study area was assessed using Feature Analyst, a GIS program that converts shading in aerial photography into measurable vector polygons. To project future growth in impervious surface cover for the No Build and Build conditions associated with future household and employment growth, the NRCS TR-55 manual percent impervious surface factors for various types of development were used (e.g. residential, commercial/industrial). The impact assessment methodology also accounted for the impervious surface growth associated with the Gaston East-West Connector (e.g. the direct impact) and with other reasonably foreseeable transportation projects in the study area.

ES-2.4 Wildlife Habitat

Forest cover and the size and configuration of undisturbed habitat blocks are the key indicators for assessing potential upland wildlife habitat impacts. As with impervious surface cover, tree cover was delineated using Feature Analyst. A range of potential impacts of future development on tree cover were estimated in order to appropriately

reflect the uncertainty involved in predicting the exact location of future development. The low end estimate assumed development would be prioritized away from tree cover, while the high end estimate assumed development would be prioritized in areas with tree cover. Direct impacts to tree cover from the Gaston-East Connector and other reasonably foreseeable transportation projects in the study area were also accounted for.

In addition to the tree cover impact assessment described above, an analysis was performed to identify interior forest habitat and assess the direct impacts and indirect edge effects of the proposed project on interior forest habitat. For analysis purposes, an edge effect distance of 300 feet was selected for this study to identify potential interior forest habitat areas. An edge effect distance of 300 feet is supported by the relevant literature on FIDS (such as certain neotropical migrant birds) and has been used for other transportation project NEPA evaluations (e.g. Intercounty Connector FEIS, Maryland).

To assess existing conditions, an edge effect zone of 300 feet was created around existing roadways, development and other open areas (e.g. large waterbodies, agricultural fields etc.). Forested areas outside of the existing conditions edge effect zone were indentified as the forest interior habitat blocks. The edge effects of the proposed project were then superimposed on the existing conditions mapping to determine the incremental increase in edge effects and habitat fragmentation impacts.

ES-3 Potential Indirect and Cumulative Effects

ES-3.1 Land Use Change

Up to 3,300 additional households and 300 fewer jobs are anticipated in the study area as a result of the indirect development shifts associated with the project. This is not new growth or lost growth, but rather represents households and employment that would have located elsewhere in the Metrolina region under the No Build condition. The overall indirect effect of the project for the study area as a whole is relatively small in comparison to the growth in households (47,500) and employment (37,400) expected between 2005 and the 2035 No Build condition.

The indirect effects of the project are not distributed evenly throughout the study area. The project generally increases growth relative to the No Build in the zones along the alignment in southern Gaston County and northern York County. These areas would experience an increase in relative accessibility that would, all other factors held constant, make these zones more attractive for development as a result of the project. Figures 8 and 9 show the change in households and employment from the No Build condition to the Build condition based on the gravity model methodology.

In terms of land conversion, the indirect land use effect of the project is an approximately 1.3 percent increase in the total area of residential land (or 1,100 acres) and a 0.3 percent decrease in the total employment-related land (or 100 acres) compared to the No Build condition. Cumulative land conversion to developed uses under the Build

condition totals 27,500 acres (16,900 acres of residential land conversion and 10,600 acres of employment land conversion, see Tables 5 and 6).

ES-3.2 Water Resources

The Preferred Alternative would directly add approximately 600 acres of impervious surface cover to the study area, with the largest increase (200 acres) in the Upper Crowders Creek subwatershed. As discussed in the FEIS, the design of the Preferred Alternative would incorporate stormwater treatment measures to reduce the potential for impacts to the affected watersheds. The changes in the distribution of households and employment resulting from the Preferred Alternative could add 300 acres of impervious surface cover to the study area, or a one percent increase over the No Build condition (See Table 9). The largest indirect increases in impervious surface cover are projected for the Catawba Creek subwatershed (300 acres) and the Lower Crowders Creek subwatershed (200 acres).

The combination of past actions (e.g. existing impervious cover), other actions (the No Build condition) and the direct and indirect effects of the Preferred Alternative is predicted to be a total acreage of impervious surface cover in the study area of 35,000 or 20.6 percent. The incremental effect of the Preferred Alternative accounts for 900 acres or about 6.8 percent of the cumulative increase in impervious surface cover from existing conditions. Although some unavoidable decreases in water resource quality are expected in the watersheds with the greatest growth, the incremental water quality impacts of future growth would be less than past growth due to the stormwater treatment and riparian buffer policies in the study area.

While impervious surface cover provides a useful metric for assessing potential cumulative effects, it is not possible to conclude from an analysis of impervious surface cover alone whether or not violations of water quality standards will occur at specific downstream locations. As part of the application for a Section 401 Water Quality Certification for the proposed project, additional modeling of pollutant loadings will be conducted in accordance with NCDENR Division of Water Quality's policy document entitled *Cumulative Impacts and the 401 Water Quality Certification and Isolated Wetlands Program* (NCDWQ, 2004).

ES-3.4 Wildlife Habitat

The Preferred Alternative would directly impact 1,000 acres of tree cover, 300 acres of which would occur in the Upper Crowders Creek subwatershed. The Preferred Alternative would directly impact 290 acres of forested interior habitat and result in indirect edge effects potentially reducing the quality of an additional 480 acres of forest interior habitat within 300 feet of the right-of-way. Depending on the specific locations chosen for future development, the indirect changes in the development patterns associated with the Preferred Alternative could increase tree cover loss by up to 1,300 acres. The greatest potential for indirect effects on forest cover is within the Catawba Creek subwatershed.

The combination of past actions (e.g. existing tree cover), other actions (the No Build condition) and the direct and indirect effects of the Preferred Alternative is predicted to

be a total acreage of tree cover in the study area of 88,300 to 74,100 acres. This represents a cumulative loss of forest cover of 11,200 to 25,200 acres or a percent decrease of 11 to 26 percent from existing conditions. The actual impacts will depend on the specific location of each new development, although the actual number will likely be closer to the low estimate. The incremental effect of the Preferred Alternative accounts for 900 to 2,300 acres of the cumulative loss of forest cover from existing conditions. Planning strategies to minimize potential impacts to wildlife habitat include encouraging higher density development in appropriate locations and preserving contiguous habitat blocks that provide the highest quality habitat.

ES-4 Mitigation

The basic requirement to consider mitigation measures is established in the CEQ NEPA regulations (40 CFR 1502.16 (h)). Compensatory mitigation for the direct impacts of the Preferred Alternative to regulated resources (e.g. wetlands and streams) is discussed in the FEIS. With respect to mitigation for indirect and cumulative effects related to land use change, both the NCDOT ICE Guidance and FHWA's *Interim Guidance: Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process*, note that it is necessary to identify mitigation actions beyond the control of the transportation agencies. While such mitigation cannot be committed to be implemented as part of the project, the purpose of identifying the mitigation is to inform the affected local jurisdictions and other reviewers of the EIS. Mitigation for the indirect and cumulative effects on land use, water resources and tree cover identified by this study could be reduced in magnitude through implementation and enforcement of the following planning strategies. As noted in the text below, many of these strategies are already beginning to be implemented in the study area.

- **Zoning/Comprehensive Planning** to support higher density development in planned growth areas and to discourage growth in environmentally sensitive areas. Gaston County has adopted a Unified Development Ordinance that provides new flexibility for higher density development, including Traditional Neighborhood Development (TND) and a streamlined development process. York County is in the process of developing a Unified Development Ordinance. Open Space Planning is also an important part of protecting key wildlife habitat areas. York County completed an Open Space Plan in 2009.

- **Growth Management** through restrictions on the expansion of infrastructure. Water and sewer service should be strictly tied to areas designated for growth in local land use plans. There is some evidence of consideration of this type of policy in parts of Gaston County. For example, Gaston County's "Existing Initiatives Map" identifies areas where sewer service should not be extended, including a portion of the South Fork Crowders Creek watershed.

- **Riparian buffers**. Existing riparian buffer policies applicable to the study area are discussed in Section 3.3.1. These policies are a key aspect of water resources protection.

- **Stream Restoration**. Many urban streams have been straightened, channelized, piped and buried, and/or stripped of native vegetation. Stream restoration

policies would directly improve habitat and water quality by addressing erosion and sedimentation issues.

- **Land Acquisition/Conservation Easements**. Conservation easement programs, such as the Gaston Conservation District Land Preservation Program are another strategy for preserving high quality wildlife habitat that can be implemented by the private or public sector. The mapping of interior forest patches conducted for this study provides information that could be used to prioritize areas for conservation planning and land acquisition investments.

1.0 Introduction and Background

1.1 Project Description

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 controlled-access toll road extending from I-85 west of Gastonia in Gaston County to I-485 near the Charlotte-Douglas International Airport in Mecklenburg County. The proposed project (STIP Project U-3321) is known both as the "Gaston East-West Connector" and as the "Garden Parkway." For this study, the project is referred to as the Gaston East-West Connector.

The purpose of the Gaston East-West Connector is to improve east-west transportation mobility in the area around the City of Gastonia, between Gastonia and the Charlotte metropolitan area, and particularly to establish direct access between the rapidly growing areas of southeast Gaston County and western Mecklenburg County. The project is intended to address transportation problems resulting from the limited number of crossings of the Catawba River between Gaston and Mecklenburg counties and a lack of east-west roadways in southern Gaston County. With continued growth expected in southern Gaston County and western Mecklenburg County, the demand for connectivity between the two counties will increase and existing congestion on the primary existing east-west roadways (I-85 and US 29-74) will worsen.

The Draft Environmental Impact Statement (DEIS) for the Gaston East-West Connector was published in April 2009. Based on the analyses presented in the DEIS and the comments received from other agencies and the public, NCTA and FHWA have identified Detailed Study Alternative (DSA) 9 as the Preferred Alternative. The Preferred Alternative is a four-lane limited-access toll facility connecting I-85 in Gaston County to I-485 in Mecklenburg County, including new bridge crossings over the South Fork and Catawba Rivers. In addition to the freeway-to-freeway interchanges at I-85 and I-485, the Preferred Alternative includes eight interchanges providing local access at the following locations (listed from west to east):

- US 29-74
- Linwood Rd (SR 1133)
- US 321
- Robinson Rd (SR 2416)
- NC 274 (Union Rd)

- NC 279 (South New Hope Rd)
- NC 273 (Southpoint Rd)
- Dixie River Rd (SR 1155)

The design of the Preferred Alternative has been refined since the DEIS, including design changes made to minimize environmental impacts. In particular, the interchange at Bud Wilson Rd (SR 2423) considered in the DEIS has been eliminated and the footprints of four of the interchanges (Robinson Rd, NC 274 (Union Rd), NC 273 (Southpoint Rd), and I-485) have been reduced.

1.2 Definitions

A comprehensive evaluation of the impacts of federal actions on the environment is grounded in the National Environmental Policy Act (NEPA) and its implementing regulations. Council on Environmental Quality (CEQ) regulations for the implementation of NEPA specifically require that environmental impact statements include the evaluation of indirect and cumulative effects along with the disclosure of potential direct impacts. This study uses the terms "indirect effects" and "cumulative effects", however, the terms "impact" and "effect" are synonymous under NEPA, and can be beneficial or adverse (40 C.F.R. §1508.8).

As a guide to the evaluation of indirect effects and cumulative impacts under NEPA, the CEQ regulations and other relevant sources provide definitions of direct, indirect and cumulative effects:

Direct impacts are "caused by the action and occur at the same time and place. (40 C.F.R. §1508.8)

Indirect effects are those effects that ". . . are caused by the action and are later in time and farther removed in distance, but are still reasonably foreseeable." Indirect effects "may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems."(40 C.F.R. §1508.8(b)).

The North Carolina Department of Transportation/ Department of Environment and Natural Resources *Guidance on Indirect and Cumulative Impact Assessment of Transportation Projects in North Carolina* outlines three types of indirect effects:

- *Encroachment-Alteration Effects* - alteration of the behavior and function of the affected environment caused by project encroachment (physical, chemical, or biological) on the environment.

- *Induced Growth Effects* - changes in the intensity of the use to which land is put that are caused by the action/project. These changes would not occur if the action/project does not occur. For transportation projects, induced growth is attributed to changes in accessibility caused by the project.

- *Induced Growth Related Effects* - alteration of the behavior and function of the affected environment attributable to induced growth.

Cumulative effects are "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." (40 C.F.R. §1508.7). According to the FHWA's *Interim Guidance: Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process*, cumulative impacts include the total of all impacts to a particular resource that have occurred, are occurring, and will likely occur as a result of any action or influence, including the direct and reasonably foreseeable indirect impacts of a proposed project (FHWA, 2003).

1.3 Eight-Step Process for Evaluating Indirect and Cumulative Effects

The assessment of potential indirect and cumulative effects (ICE) for the Gaston East-West Connector Project has been conducted in accordance with the eight-step process outlined in the NCDOT/NCDENR *Guidance on Indirect and Cumulative Impact Assessment of Transportation Projects in North Carolina* (NCDOT, 2001). The eight-step process presented in the NCDOT/NCDENR Guidance was based on the eight-step process developed for National Cooperative Highway Research Program (NCHRP) Report 403: *Guidance for Estimating the Indirect Effects of Proposed Transportation Projects* (Transportation Research Board, 1998). The eight-step process provides a structured framework for defining study area boundaries, identifying important trends and issues, and analyzing the potential for land use change and related environmental impacts on valued and vulnerable resources. Each of the eight steps is described briefly below.

- *Step 1 – Define the Study Area Boundaries.* Set appropriate study area boundaries for the analysis of indirect and cumulative effects as well as the timeframe for the analysis.
- *Step 2 – Identify the Study Area Communities' Trends and Goals.* Gather information on community trends and goals in the study area, focusing on socioeconomic and land use issues.
- *Step 3 – Identify Resources for Analysis.* Identify specific valued, vulnerable or unique elements of the natural environment that will be analyzed in the assessment of indirect and cumulative effects.
- *Step 4 –Describe Cause and Effect Relationships.* Identify all the potential impact-causing activities of the project and select specific impact-causing activities for analysis.
- *Step 5 – Identify Potential Impacts For Analysis.* Compare the impact-causing activities developed in Step 4 with the inventory of goals in Step 2 and the resources in Step 3.
- *Step 6 – Analyze Impacts.* Determine the magnitude and location of the potential impacts identified in Step 5.
- *Step 7 – Evaluate Analysis Results*. Evaluate the uncertainties in the methodology used to evaluate impacts, in order to better understand the analysis results.

- *Step 8 – Assess Consequences and Develop Mitigation.* When an impact conflicts with a goal from Step 2 or a resource from Step 3, assess the consequences of that impact and develop strategies and potential mitigation to address it accordingly.

The eight-step analysis process is fully consistent with the Council on Environmental Quality's *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ, 1997) and the essential elements of the process have been adapted by several states in addition to North Carolina.

1.4 2009 Qualitative Indirect and Cumulative Effects Assessment

A qualitative assessment of potential indirect and cumulative effects was performed for the Gaston East-West Connector DEIS (LBG, 2009). The qualitative assessment was focused on steps one through five of the eight-step process and noted that the decision of whether or not an additional quantitative analysis was warranted would be made following the public review of the DEIS. The major components of the qualitative indirect and cumulative effects assessment are summarized below, for additional detailed information refer to the full report available on the project website.

- *Step 1 – Define the Study Area Boundaries*. A study area was defined that included most of Gaston and parts of Cleveland, Mecklenburg, and York (SC) Counties. The factors considered in identifying the study area included commutesheds, environmental features, local expert interviews and political boundaries. A temporal boundary spanning from 1989 to 2030 was established for the assessment. The year 1989 is the year the Gaston East-West Connector concept was first identified on the Gaston Urban Area Thoroughfare Plan. The year 2030 is the horizon year for the Gaston Urban Area Metropolitan Planning Organization (GUAMPO) 2030 Long Range Transportation Plan (2030 LRTP) (May 2005), and the Mecklenburg-Union MPO (MUMPO) 2030 LRTP (Amended September 2005). The year 2030 is the analysis year for the traffic studies conducted for the DEIS and is consistent with the 20-year outlook typically used in transportation planning.

- *Step 2 – Identify the Study Area Communities' Trends and Goals*. A review of planning documents for the study area was conducted, as well as interviews with professional staff in the areas of planning, engineering, real estate development, and environmental advocacy to identify important trends and goals. The interviews included representatives from GUAMPO, City of Gastonia Planning Department, Town of Belmont Planning Department, Gaston Economic Development Commission, Bessemer City Planning Department, Gaston County Chamber of Commerce, Charlotte-Mecklenburg Planning Department, Charlotte-Douglas International Airport, York County, Real Estate and Building Industry Coalition, Catawba Riverkeeper, Crowders Mountain State Park, and Allen Tate Realty.

- *Step 3 – Identify Resources for Analysis*. Information was gathered on land use and valued or vulnerable environmental resources in the study area. The resources considered included waterbodies, wetlands, natural heritage sites, air

quality, noise, cultural resources and agricultural land. A detailed socioeconomic profile of the study area communities was also developed. A grid-cell based composite map was created based on the occurrence of notable features in the study area.

- *Steps 4 and 5 –Describe Cause and Effect Relationships and Identify Potential Impacts For Analysis*. Steps four and five of the eight-step process were addressed through a grid-cell based mapping analysis of the intersection between areas with sensitive notable features and areas with growth potential. Changes in travel times resulting from the project were incorporated in the analysis to represent areas that may become more accessible and therefore more attractive to development. Potential indirect and cumulative effects were described qualitatively taking into account the information gained from the interviews and the information gathered on notable features and growth trends.

1.5 Purpose of this Quantitative Indirect and Cumulative Effects Assessment

A quantitative indirect and cumulative effects assessment was requested by other agencies in comments on the DEIS, with the specific areas of concern being water quality and wildlife habitat impacts. Other agencies and the public had no comments on the Qualitative ICE study, except for recommending the completion of a Quantitative ICE study. Based on the results of the qualitative assessment and consideration of the public and agency comments on the DEIS, FHWA and NCTA decided to conduct a quantitative assessment of potential indirect and cumulative effects for the FEIS.

While the qualitative assessment was focused primarily on steps one through five of the eight-step process, this quantitative assessment is focused on steps six through eight (analyze impacts, evaluate analysis results, and assess consequences and develop mitigation). The purpose of this quantitative assessment is to: 1) provide a detailed analysis of the potential indirect land use, water resources and wildlife habitat impacts of the Preferred Alternative; 2) provide a detailed analysis of the potential cumulative land use, water resources and wildlife habitat impacts that could results from the combination of the direct and indirect impacts of this project with the impacts of other reasonably foreseeable actions by others; and 3) to disclose mitigation measures that could be used to offset any adverse indirect and/or cumulative effects identified by the assessment.

The land use change forecasts developed for this study may be used to provide inputs to the water quality modeling proposed to address the requirements of NCDENR Division of Water Quality's policy document entitled *Cumulative Impacts and the 401 Water Quality Certification and Isolated Wetlands Program* (NDWQ, 2004).

2.0 Methodology

2.1 Study Area Boundaries

The study area boundaries presented in the qualitative ICE assessment were refined as part of the preparation of this quantitative assessment. The study area boundaries were

altered to encompass the entirety of Hydrologic Unit Code (HUC) 12-digit subwatersheds. The HUC 12 subwatershed boundaries used to define the study area were based on the Natural Resources Conservation Service National Cartography & Geospatial Center's Watershed Boundary Dataset. The 1:24,000 scale Watershed Boundaries Dataset provides a seamless national coverage of HUC 12 boundaries and has been subject to an extensive quality review process to ensure accuracy and compliance with the "Federal Standard for Delineation of Hydrologic Unit Boundaries." [2] The study area consists of the following HUC 12 subwatersheds:

- Upper Crowders Creek (030501011501)
- Lower Crowders Creek (030501011504)
- Catawba Creek (030501011502)
- Mill Creek-Lake Wylie (030501011505)
- Duharts Creek-South Fork Catawba River (030501020605)
- Lake Wylie-Catawba River (030501011406)
- Paw Creek-Lake Wylie (030501011404)
- Beaverdam Creek (030501011503)
- Fites Creek-Catawba River (030501011405)[3]

Projected changes in travel times as a result of the project were also considered in refining the study area boundaries. Transportation projects can influence the uses to which land is put primarily by changing relative access to land, with access measured by changes in travel times between trip origins (e.g., home) and trip destinations (e.g., work). Regional travel demand models, in this case the Metrolina Travel Demand Model, can be used to estimate travel times between the numerous origin-destination pairs in a region. Traffic Analysis Zones (TAZs) are the geographic units used in travel demand models to organize land use data, as measured by households and employment. As explained in greater detail in Section 2.3.2, the Metrolina Travel Demand Model was used to measure the indirect effect of the project vis-à-vis changes in comparative accessibility of TAZs under existing, No Build, and Build conditions.

Figure 1 shows the qualitative ICE study area in relation to the revised quantitative ICE study area and watershed boundaries. The rationale for the changes to the study area boundaries is discussed by county in Sections 2.1.1 through 2.1.4, below.

2.1.1 Gaston County

In Gaston County, a small portion of the northwest corner of the qualitative ICE study area was removed, including the northern half of Bessemer City and part of Gastonia.

[2] For more information on the Watershed Boundary Dataset refer to http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/index.html

[3] Subsequent to the August 2010 version of the Quantitative ICE report circulated with the FEIS, the North Carolina Division of Water Quality (NCDWQ) requested that the Fites Creek- Catawba River subwatershed be added to the study area. The Fites Creek subwatershed was initially excluded from the study area due to a lack of substantial changes in travel times for the majority of this area with the completion of the Gaston East-West Connector. However, adding the Fites Creek subwatershed to the study area is reasonable to capture the potential local-level land use effects in the vicinity of the interchange between the Gaston East-West Connector and NC 273. The southern end of the Fites Creek subwatershed is within 1/2 mile of the proposed interchange with NC 273.

The transportation modeling conducted for the project with the Metrolina Travel Demand Model shows that the TAZs in these areas would not experience any substantial change in travel times as a result of the Gaston East-West Connector and thus are unlikely to experience growth pressures attributable to the project. The reason this area would not experience substantial changes in accessibility is that it is already in close proximity to I-85, which is the existing primary east-west roadway and crossing of the Catawba River in Gaston County.

The study area was expanded to the north to include the entirety of the Duharts Creek-South Fork Catawba River subwatershed (030501020605). The expanded area includes parts of Gastonia, Lowell, McAdenville, Ranlo and Spencer Mountain. This expansion of the study area was made only for the purpose of including the entire watershed in the study area, not because of accessibility changes in this area. At the request of NCDWQ, the study area was also expanded to include the entire Fites Creek- Catawba River subwatershed (030501011405).

2.1.2 Mecklenburg County

In Mecklenburg County, the study area was expanded to include the entire Paw Creek-Lake Wylie subwatershed (030501011404). Although there are not substantial accessibility changes for this watershed, it does contain part of two important No Build condition projects-- the Charlotte-Douglas International Airport third runway and intermodal freight facility. As noted previously, the Fites Creek- Catawba River subwatershed (030501011405) was also added to the study area, including the portion of the subwatershed in Mecklenburg County.

A portion of the study area to the east of I-485 was removed based on the results of the projected travel time improvements being the greatest around and to the east of the Gaston East-West Connector's interchange with I-485. The subwatersheds in this location (030501030103- Upper Sugar Creek and 030501030108- Steele Creek) are within a heavily developed portion of the City of Charlotte and would be unlikely to experience further environmental impacts from land use change because the majority of the land in these subwatersheds is already developed. While a portion of the Charlotte-Douglas International Airport is within the Upper Sugar Creek watershed, the primary considerations in terms of cumulative impacts (the new runway and the proposed intermodal facility) are not and remain within the study area for the quantitative ICE assessment.

2.1.3 Cleveland County

The study area was expanded approximately one-mile farther into Cleveland County in order to include the entirety of the Upper Crowders Creek subwatershed (030501011501).

2.1.4 York County

In York County the study area was expanded to the south to include the entirety of the following HUC 12 subwatersheds:

- Lower Crowders Creek (030501011504)
- Mill Creek-Lake Wylie (030501011505)
- Beaverdam Creek (030501011503)

A small portion of the study area south of Clover, South Carolina was removed. The proposed project would be unlikely to alter accessibility and land use patterns in this area because of the availability of an alternate crossing of Lake Wylie (SC 49). Intuitively, the greatest potential for indirect land use effects in York County would be the area in between SC 557/ SC 49 and North Carolina-South Carolina border.

2.1.5 Relating Traffic Analysis Zones to Watershed Boundaries

In order to summarize potential indirect and cumulative effects by watershed it was necessary to establish a relationship between TAZ boundaries (the unit of geography used for demographic projections) and watershed boundaries. The study area contains 153 TAZs in their entirety, plus portions of 122 additional TAZs (See Figure 2). Many of the TAZs follow subwatershed boundaries relatively closely, but others contain portions of multiple subwatersheds. For analysis purposes, the 275 TAZs intersecting the study area were split into 387 new zones in such a way that each zone corresponded to exactly one subwatershed and one Metrolina Model TAZ. Household and employment forecasts for the Metrolina Model TAZs were allocated to the 344 zones in proportion to area. For example, a zone consisting of 25 percent of the land area of its "parent" Metrolina Model TAZ was assigned 25 percent of the total households and employment of the parent TAZ. The assumption with this methodology is that future growth will be spread relatively evenly within each TAZ. This assumption is appropriate in the absence of information indicating the specific locations of new development and is unlikely to substantially affect the results for the study area as a whole.

2.1.6 Assessment of Study Area Boundary Based on Qualitative Analysis Results

Results from the Land Use Forecasting (Section 3.0) concluded changes to land use within the Study Area Boundary (as defined in the initial stages of this analysis) as well as elsewhere within the Metrolina Region. This suggested that perhaps the Study Area Boundary should be modified. According to the NCDOT ICI Guidance (Volume II, pp. III-5-III-6), commuteshed is a technique to assist in determining a study area boundary. The guidance suggests that when using the commuteshed threshold technique, a study area should take the travel time savings of the project alternatives into account the setting the study area to coincide with the area accessible under the alternative that provides the greatest travel time savings. Section 2.4.2 discusses regional accessibility (travel time savings) and helps to confirm that the Study Area Boundary appropriately includes areas that are expected to experience the greatest travel time savings. Therefore, the basic extent of the Study Area Boundary established in the qualitative ICE study does not need to be modified based on the analysis results contained in this report. As noted in Sections 2.1.1 through 2.1.4, minor refinements were made to the study area boundary for purposes of better matching watershed boundaries.

2.2 Analysis Year

The future analysis year for the quantitative ICE assessment is 2035 to coincide with the 2035 long-range transportation plans for the Gaston Urban Area Metropolitan Planning Organization (GUAMPO), the Mecklenburg-Union Metropolitan Planning Organization (MUMPO) and the Rock Hill-Fort Mill Area Transportation Study (RFATS) (GUAMPO, 2010; MUMPO, 2010 and RFATS, 2010). The analysis year for the 2009 qualitative ICE assessment was 2030 because the current LRTPs at that time had a horizon year of 2030.

2.3 Future No Build Condition Projects

As part of a cumulative impact analysis, it is important to consider the impacts of the other transportation projects and land development attributable to population and employment growth. Other projects and developments need to be included in the analysis if they are "reasonably foreseeable." This section explains which projects/actions were included in the No Build condition.

2.3.1 Other Transportation Projects

For purposes of cumulative environmental impacts, fiscally constrained projects with the potential to have environmental impacts (e.g. new alignment and widening projects) were identified from the 2035 LRTPs for the three MPOs comprising the study area (GUAMPO, MUMPO and RFATS). In addition, the South Carolina Department of Transportation's 2010-2015 STIP was reviewed to determine if additional projects in York County outside the boundary of RFATs needed to be considered in the assessment. Currently unfunded transportation projects included in the LRTPs were not considered reasonably foreseeable. Projects such as bridge replacements without widening, reconstruction of existing roadways without adding additional travel lanes, and the addition of turning lanes at intersections were not included because these types of projects would not affect the quantitative metrics being used in this study (impervious surface cover and tree cover).

The locations of the projects included in the No Build condition assessment are shown in Figure 3. Tables 1 and 2 summarize the No Build condition projects from the 2035 LRTPs for GUAMPO and MUMPO, respectively. One project was identified within the small portion of the study area that overlaps with the RFATS area boundary—widening of Pole Branch Road from two-lanes to three-lanes from SC 274 to the North Carolina-South Carolina Stateline (2.4 miles). No major projects in the South Carolina portion of the study area outside of the RFATs area boundary were identified from the 2010-2015 STIP.

Table 1
Transportation Projects Included in No Build Condition
Gaston Urban Area Metropolitan Planning Organization

GUAMPO Project ID	Name	Description	Distance (Miles)*	Existing Facility	Year
U-5103	Titman/ Cramerton Road	Widen existing two-lane road to three-lane, and construct new three-lane connector from NC 279 (S. New Hope Rd.) to US 29/74 (Wilkinson Blvd.	2.6	Two-Lane Road	2015
U-3425	Myrtle School Road	Widen two lane road to three lanes from US 29/74 (Franklin Blvd.) to Hudson Blvd.	1.8	Two-Lane Road	2015
U-2713	Linwood Road	Widen existing facility to three lanes with some relocation from Crowder's Creek Rd. to US 29/74 (Franklin Blvd.)	2.2	Two Lane Road	2025
7	NC 279 (S. New Hope Road)	Widen existing two-lane road to four-lane divided from Titman Road to Union-New Hope Road	3.8	Two-Lane Road	2025
8	NC 274 (Union Road)	Widen the existing two-lane facility to five lanes and construct a new four-lane divided realignment from Robinson Rd. to Beaty Rd.	2.5	Two-Lane Road	2025
14	US 29/74 South Fork Catawba River Bridge No. 82	Widen existing four-lane bridge on Wilkinson Blvd to six-lanes, and widen existing four-lane cross section to six-lanes from Market St to Alberta St	1.2	Four-Lane Bridge	2025
11b	Belmont-Mount Holly Central Loop	Construct new, four-lane divided facility from Wilkinson Blvd. to the proposed Gastonia-Mt. Holly Connector or to the Belmont Mt. Holly Loop Link if the Gastonia-MT. Holly Connector is not built	4.34	NA	2035
U-3633	NC 273 (South Main Street)	Widen existing two-lane facility to four lanes from south of Catawba Drive to Highland Street at Rankin Avenue	1.0	Two-Lane Road	2015

*Note: Total distance from GUAMPO 2035 LRTP project descriptions. The portions of these No Build transportation projects outside the watershed-based study area boundaries were not included in the cumulative effects assessment.

Table 2
Transportation Projects Included in No Build Condition
Mecklenburg-Union Metropolitan Planning Organization

MUMPO Index Number/ NCDOT STIP Number	Name	Description	Distance (Miles)*	Existing Facility	Year
3311/ U-3411	West Blvd Extension	New road (2 lanes) from Steele Creek Rd to I-485	0.66	N/A	2015
3312	West Blvd Extension	Widening (4 lanes) from Steele Creek Rd to I-485	0.66	Two-Lane Road (by 2015)	2025
3157/ U-5116	Little Rock Road	Relocation (4 lanes) from Flintrock Rd to Freedom Dr (NC 27)	0.55	N/A	2015
22	Fred D. Alexander Boulevard	New road (4 lanes) from Freedom Dr (NC 27) to Brookshire Blvd (NC 16)	1.88	N/A	2015
3003	Freedom Drive (NC 27)	Widening (4 lanes), Edgewood Rd to Toddville Rd	1.5	Two-Lane Road	2015
502	Dixie River Rd./NC 160 Connector	New road (2 lanes), NC 160 to Dixie River Rd	1.3	N/A	2015

*Note: Total distance from the MUMPO 2035 LRTP project descriptions. The portions of these No Build transportation projects outside the watershed-based study area boundaries were not included in the cumulative effects assessment.

2.3.2 Household and Employment Growth

The cumulative effects analysis considers reasonably foreseeable public and private developments by using population and employment forecasts for the No Build and Build conditions. The data sources and methodology used in developing the household and employment forecasts are described in Section 2.4.1. Known major development proposals were incorporated by the MPOs and local government planners at the time the household and employment forecasts were made.

2.4 Land Use Forecasting

This section explains the methodology used to analyze future land use change in the study area. The assessment of the Build condition is based on the TAZ demographic projections prepared by the planning organizations in the study area for the Metrolina Travel Demand Model. The No Build condition is estimated using a gravity model

approach that reallocates household and employment growth based on relative accessibility changes. Household and employment projections at the TAZ-level are converted into changes in land use based on the average density of proposed or existing development in the study area.

2.4.1 Household and Employment Forecasts

The Metrolina travel demand model area includes all of Gaston County, Mecklenburg County, York County (SC), Union County, Cabarrus County, Rowan County, Lincoln County, and Stanly County. It also includes portions of Iredell County, Cleveland County, and Lancaster County (SC). Figure 4 shows the ICE study area in relation to the area covered by the Metrolina travel demand model. The study area represents approximately 248 square miles or 6 percent of the total land area covered by the model.

The April 13, 2006 version of the 2030 Metrolina travel demand model was used in the traffic forecasting for the Gaston East-West Connector because this was the most current version available at the time the updated forecasting activities began (See DEIS Appendix C: Supporting Traffic Information for Chapter 2- Alternatives Considered). Since the preparation of the DEIS traffic forecasts, the Metrolina travel demand model and associated demographic data has been updated for 2035 to support the 2035 LRTPs for the MPOs in the region.

TAZ-level demographic projections in the Metrolina travel demand model for the study area are developed by GUAMPO, MUMPO and York County/RFATS. As explained in GUAMPO's 2035 LRTP, a regional socioeconomic development committee was formed to develop the previous 2030 forecasts. This committee, along with the assistance of the University of North Carolina at Charlotte's Urban Land Institute, developed a methodology utilizing economic forecasts, local building permit trends, census data, and local land development knowledge such as current and future land use, utility improvements, economic development potential and land availability. The 2030 socioeconomic forecasts were compiled through the use of an expert panel, made up of local planners, real estate representatives, economic developers and utility providers (GUAMPO, 2010).

For the 2035 LRTP, updated forecasts were prepared by GUAMPO, MUMPO and the York County Department of Planning and Development. For the GUAMPO area, an initial 2035 forecast was developed by extrapolation from the growth rates used in the previous 2030 forecast. The forecast was then refined based on land availability and known development projects. Finally, the forecasts were reviewed and modified by local government members before being approved by the GUAMPO Technical Coordination Committee and Transportation Advisory Committee on March 12, 2008 and March 25, 2008, respectively (GUAMPO, 2010). Updated forecasts were also prepared by MUMPO and RFATS, also taking into account known development proposals (MUMPO, 2010 and RFATS, 2010).

A series of interviews with the MPOs and county planning departments in the study area was conducted to determine whether the updated 2035 forecasts should serve as the No Build condition or Build condition for this ICE study. Interviews were held with planners from GUAMPO, MUMPO, RFATS, Gaston County, Mecklenburg County and York

County. Summaries of each meeting are provided in Appendix A. All three of the MPOs with responsibility for developing the demographic forecasts for the study area confirmed that the Gaston East-West Connector was assumed to be completed in the allocation of future growth to specific zones. During the demographic forecasting efforts for the Metrolina model, additional growth was added in areas that were expected to become more attractive to development with the project, including southern Gaston County and northern York County. This means that the indirect land use effect of the project is already reflected in the forecasts. Therefore, the Metrolina model forecasts should be used to represent the Build condition. All the participants concurred that the forecasts represent the Build condition and it was reasonable to use the gravity model approach to redistribute households and employment for the No Build condition.

2.4.2 Regional Accessibility Analysis

To analyze the potential indirect effects of the Preferred Alternative on patterns of future household and employment growth, a gravity model analysis was conducted using travel time information from the April 13, 2006 version of the Metrolina travel demand model. Gravity models are used often in transportation and travel modeling. They are based on the observation that the overall attractiveness of an area to potential residents is a function of the capacity of an area for development (vacant developable land in valued and affordable locations) and accessibility to employment and activity centers, among other things. The model produces quantified results that can serve as the basis for assessing land use change.

The reasonableness of the general areas where growth pressures would be the greatest with the project was confirmed through the interviews with local planning staff (See Appendix A) and through consideration of the travel time information for the study area. Figure 7-2 in the DEIS shows that the largest travel time savings accrue to TAZs along the Gaston East-West Connector alignment and travel time savings decrease with increasing distance from the project. Detailed mapping of travel time contours for specific origin-destination pairs in the project area is provided in Appendix C of the Addendum to the Final Alternatives Development Report. These maps show a greater travel time savings with the project for areas along the alignment (such as the Belmont Peninsula) when compared to other areas (e.g. Gastonia).

The results from this analysis confirm that not only all areas expected to achieve the greatest travel time savings (greater than 11 minutes) are included within the Study Area Boundary, but the Study Area Boundary also includes all areas expected to achieve a travel time savings greater than 5 minutes and even some areas expected to achieve less than five minutes travel time savings.

Transportation Improvements and Accessibility

Accessibility refers to “the number of opportunities available within a certain distance or travel time” (Hanson, 1995). As movement becomes less costly, either in terms of time or money, between any two places, accessibility increases. The propensity for interaction between any two places increases as the cost of movement between them decreases. Accessibility can also be understood as the attractiveness of a place of origin (how easy it is to get from there to all other destinations) and as a destination (how

easy it is to get to there from all other origins and destinations). Consequently, the structure and capacity of the transportation network affect the level of accessibility in a given area. The accessibility of places can have an impact on land value, and hence the use to which land is put. Holding all other factors constant, the gravity model formulation assumes that areas where accessibility increases as a result of a transportation project will be relatively more attractive for development than if the project had not been built.

Studies have found that the effect of highways on land prices has been diminishing over time since early studies of the first segments of the interstate system in the 1950s. Boarnet and Haughwout (2001) note that studies have shown that incremental improvements in areas that already possess highway access have reduced the magnitude of the influence of highways on land development activity:

> 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 (Boarnet and Haughwout, 2000).

Other Factors Influencing Development Shifts

While accessibility changes are a necessary condition for transportation improvements to influence land development, they are not sufficient to stimulate land use change in the absence of other conditions supportive of such development. Other factors influencing the likelihood of regional development shifts include:

- *Land availability and price* - Development cannot take place without the availability of land of a quality and price suitable for development. Property values are de-facto indicators of the potential for land use change because investment decisions revolve around market prices. Land prices are likely to reflect a parcel's suitability for development (favorable topography), the availability of other suitable parcels in the area, the attractiveness of the location and many of the other factors listed below. An abundance of suitable, low priced land may be indicative of potential development if other factors are present. A scarcity of land or high price does not necessarily indicate a lower probability of development, however. If other factors described here are favorable, high-density development may occur where land is scarce or high priced.

- *State of the regional economy* - Even if changes in accessibility are great, development is not likely to occur if the regional economy will not support new jobs and households, if credit or financing is not readily available, or if firms conclude that the availability of labor, suppliers, or local markets for goods, are not sufficient.

- *Infrastructure* - In addition to transportation infrastructure, other infrastructure such as water and sewer service is important in supporting development.

- *Location attractiveness and amenities* - Good schools and access to recreational opportunities are important considerations in household location decisions.

- *Local political/regulatory conditions* - Low business, property and sales tax rates, the availability of incentives for development, such as tax abatements and a regulatory environment that is favorable to business are factors favorable to development. The speed, ease, or predictability of the development review process can also impact development costs and is a factor to be considered.

- *Land use controls* - Development is shaped by zoning ordinances and other land use controls. These controls influence the amount of land available for various uses, the densities permitted, and the costs of development. However, pressures for development can prompt communities to alter land use controls.

Gravity Model Methodology

The version of the gravity model being used for this study was presented by Hirschman and Henderson in the 1990 Transportation Research Record article, *Methodology for Assessing Local Land Use Impacts of Highways*. This form of the model states that:

$G_j = G_t * V_jA_j/\sum V_iA_i$

Where

G_j = household (or employment) growth in each TAZ j

G_t = total household (or employment) growth expected for the region as a whole (in this case the Metrolina model region).

V_j = (L_j x V_a x V_b x V_c x …..) the product of vacant land and other factors of location suitability and attractiveness.

A_j = accessibility index (composite weighted travel time to employment centers (or employment and residential centers) from subregion j).

The first step in the evaluation is the estimation of accessibility so that the change in regional accessibility attributable to the Preferred Alternative can be evaluated against the No Build condition.

The standard formulation of an accessibility index for transportation analysis is derived by multiplying the employment (trip attractions) in each zone by the friction factors calculated between each zone and all other zones based on skim times and trip purpose. The accessibility index (A_j) for a given TAZ j is calculated as follows:

$A_j = \sum E_i/T_{ij}^a$

Where

E_i = employment in each TAZ i

T_{ij} = the travel time between TAZ j and each other TAZ i

a = exponential time-impedance parameter, found to equal 2.0 in most calibrated applications of the technique

For this evaluation the accessibility measure for home-based work trips was used since household locations decisions are most often based on commute times to employment centers. To evaluate the effect of accessibility on the location decision of employers, a composite accessibility index was formulated to incorporate centers of employment and residential activity in the weighting of travel time changes. This is designed to reflect the importance to employers of proximity to both households (labor and customers) and other employers (suppliers, service providers, customers).

$A_j = \sum ((H_i + E_i)/T_{ij}^a)$

Where

E_i = employment in each TAZ i

H_i = households in each TAZ i

T_{ij} = the travel time between TAZ j and each other TAZ i

This index can be used to measure the change in accessibility of each zone to employment in all other zones when the Preferred Alternative is compared to the No Build Alternative. The accessibility indices from the Metrolina travel demand model for the Build condition establishes a baseline to which the No Build condition was compared to estimate the difference in accessibility. All TAZs within the Metrolina model region were evaluated (See Figure 4). Zone-to-zone travel times used in the evaluation represent congested travel times for home-based trips to work during the PM peak period. Based on the results of the planning organization interviews, the 2035 forecast household and employment levels were used as the Build condition (the initial baseline) and the No Build condition derived based on the difference in accessibility between the Build and No Build conditions.

Hirschman and Henderson describe a method for incorporating factors other than to accessibility into the gravity model appropriate for an area that has been evaluated as part of a transportation demand modeling effort (Hirschman and Henderson, 1990). In many regions (including the ICE study area for this project), the transportation planning process requires that regional growth totals be allocated to individual traffic analysis zones so that future trip patterns can be estimated. In the process of this population forecasting, local officials take planned projects, and the capacity and attractiveness for

future development into account when allocating regional growth. When applying a gravity model it is not necessary, therefore, to measure the individual elements that make up V_j explicitly for each subregion. Values for V_j can be derived implicitly once baseline A_j values have been calculated because values for total regional growth (G_t) and growth in each zone (G_j) are known in the baseline condition and reflect consideration of zone development attractiveness and potential. Once baseline V_j values have been derived it becomes possible to calculate growth in a zone for scenarios where accessibility changes by holding the V_j values constant. An analyst can run the gravity model for each accessibility change scenario by varying the accessibility scores while holding all other factors constant.

One important limitation implicit in this application of the gravity model is that there is no constraint on the growth a zone can experience. To address this limitation, a separate analysis of developable land was performed for the subset of TAZs that comprise the study area and the household and employment allocations to certain TAZs were reduced based on the expectation that build-out conditions would occur (See Section 2.4.4).

2.4.3 Existing Conditions Land Use

Mapping of existing land use in the study area was developed based on GIS parcel data for Gaston, Mecklenburg and York counties combined with spot checking against 2009 NAIP orthophotography. Three basic categories of land use were delineated:

- Residential (development associated households)
- Commercial, industrial, office, schools and government institutions (development associated with employment).
- All other land (including agricultural uses, vacant parcels and transportation right-of-ways).

For Gaston and Mecklenburg counties, the available parcel data contained detailed information on the use of each property from tax assessments that was used to classify parcels into the three categories listed above. For York County, this detailed parcel use information was not available and the classification of parcels to land use categories was accomplished based on GIS layers depicting zoning districts and residential subdivisions and manually using the orthophotography.

Figure 5 illustrates the land use classification mapping by parcel for the study area.

2.4.4 Future Land Use Change Projections

In order to assess potential impacts on environmental resources resulting from future development, it is necessary to convert the No Build and Build condition household and employment projections into estimates of land use change. This section explains the residential and employment land conversion methodologies and the methodology used to estimate buildable land and limit the level of development that could reasonably be accommodated within each zone.

Direct Project Land Conversion

Direct land conversion resulting from the Preferred Alternative was calculated using the preliminary engineering right-of-way boundaries.

Residential Land Conversion

The acreage of land that would be converted to residential-related uses in the future was projected based on density information from a GIS database of 44 approved developments in Gaston County provided by the Gastonia City Planning Department. The database includes developments in the vicinity of the Gaston East-West Connector corridor, including the Presley development (2.4 units per acre[4]), Stagecoach Station (3.1 units per acre) and Crowder's View (3.3 units per acre). Excluding five developments consisting solely of apartments, the weighted average density (by land area) of the remaining developments in the database was 3.2 units per acre. The exclusion of apartments helps ensure that the average density is conservative. In addition, given that slightly lower densities could be expected in other portions of the study area not covered by the Gaston County database (e.g. parts of York County), this density was lowered to an even 3.0 units per acre for the purpose of projecting future residential land conversion. Residential land conversion for the No Build and Build conditions was calculated for each zone in the study area by dividing the growth in households from 2005 to 2035 by the density factor of 3.0.

Employment Land Conversion

A comparable database of recent commercial and industrial developments was not available for the purpose of making projections about employment density. Therefore, the existing density of employment was calculated based on the study area employment estimates for 2005 and the area of land devoted to commercial, industrial or institutional uses (based on the methodology described in Section 2.4.3). The employment density factor for the study area is 3.5 employees per acre of commercial/industrial/institutional land. This factor is considered conservative (likely to overestimate rather than underestimate) potential impacts because it is skewed by large parcels containing substantial areas of undeveloped land. Employment-related land conversion for the No Build and Build conditions was calculated for each zone in the study area by dividing the growth in employment from 2005 to 2035 by the density factor of 3.5.

Buildable Land Estimates

As noted in Section 2.4.2, the gravity model formulation used to reallocate households and employment based on changes in accessibility did not include any cap on the amount of development that could occur in any one TAZ. To account for development constraints in the TAZ-level household and employment allocations for the study area, an analysis of buildable land by zone was conducted. The following constraints were excluded from the buildable land area:

[4] This density calculation is based on the acreage of the entire Presley site, which also includes 750,000 square feet of commercial development. The density of the just the residential portion of the site would likely be higher.

- *Existing roads and right-of-ways*- estimated using a 100-foot buffer on the centerline of interstates and a 30-foot buffer on the centerline of all other road types. For the Build condition assessment only, the right-of-way boundary of the Preferred Alternative was added as a constraint on buildable land.
- *Existing developed land*- based on the impervious surface estimates described in Section 2.5.2.[5]
- *Wetlands*- based on the USFWS National Wetlands Inventory mapping.
- *Rivers, streams and lakes*- based on the USGS National Hydrography Dataset and the applicable riparian buffer requirements for the study area (e.g. 50-foot buffer zone on the Catawba River/Lake Wylie in North Carolina and York County, South Carolina and a 100-foot buffer on perennial tributaries of the Catawba River in York County).
- *100-year floodplain*- based on FEMA's Digital Flood Insurance Rate Maps (DFIRMs) for Gaston, Mecklenburg and York counties.
- *Conserved land*- including properties in the North Carolina "Lands Managed for Conservation and Open Space" database, Conservation Tax Credit Properties and the proposed Berewick Regional Park. Major land areas in this category within the study area include Crowders Mountain State Park, Daniel Stowe Botanical Garden, and a Catawba Land Conservancy conservation easement along Catawba Creek.

While additional constraints could be considered, the data necessary to analyze the selected constraints listed above was readily available for the study area and provides a reasonable approximation of constrained land. The amount of household and employment growth was reduced in certain zones under both the No Build and Build conditions so that the total buildable land area for that zone would not be exceeded. The excess households and employees were not reallocated to other zones with remaining capacity in the study area. The households and employment that would not "fit" in the built-out zones were assumed to either occur at a much higher density than assumed by the simple land conversion analysis or would occur elsewhere in the region (outside the ICE study area).

2.5 Environmental Resources for Analysis

Water resources and wildlife habitat were selected as the resources for analysis in this quantitative ICE assessment based on the comments received on the DEIS and coordination with the resource agencies at Turnpike Environmental Agency (TEAC) meetings held on August 12 and September 8, 2009. Farmland was considered as a potential resource for detailed analysis, but ultimately rejected as explained in Section 2.5.1. The methodologies used to assess water resources and wildlife habitats are explained in Sections 2.5.2 and 2.5.3, respectively. The analysis of both water resources and wildlife habitat relies on land conversion estimates as a data input.

[5] Developed parcels were not used as the basis for defining existing developed land because of the possibility of larger rural residential parcels being subdivided in the future.

2.5.1 Farmland

Farmland is important as an industry, as open space and as a wildlife habitat for certain species (e.g. grassland birds). The U.S. Census of Agriculture data for the area of land in farms in 1987 and 2007 are summarized by county below.

- Gaston County- 37,561 acres in 2007, compared to 40,937 acres in 1987 (a decrease of 3,376 acres or 8.2 percent).
- Mecklenburg County- 19,135 acres in 2007, compared to 35,929 acres in 1987 (a decrease of 16,794 acres or 46.7 percent).
- York County- 124,176 acres in 2007, compared to 128,718 acres in 1987 (a decrease of 4,542 acres or 3.5 percent).

Within Gaston County, many of the agricultural areas are located in the northern portions of the county that have not experienced substantial development pressures. Therefore, the proportional loss of farmland in southern in Gaston County is likely greater than the county-level Census of Agriculture data suggest due to suburban residential development associated with the growth of Charlotte. A Voluntary Agricultural District program began in Gaston County in 2004 with the objective of protecting and conserving the agricultural open space.

Farmland was not selected as a resource for detailed analysis because farmland is not a major land use throughout most of the study area and there are methodological issues with distinguishing active farmland from other types of open undeveloped land based on aerial photography. However, some indication of the potential for impacts to agricultural land in the future as a result of land conversion associated with household and employment growth can be obtained from Tables 5 and 6. Specific impacts to agricultural lands will depend on the decisions of individual land owners as influenced by land prices and the economics of farming.

In addition to Gaston County's existing Voluntary Agricultural District Program, farmland conservation policies that could be considered by local governments include agricultural protection zoning, cluster developments, conservation easements, farmland mitigation requirements, and Transfer of Development Rights (TDR).[6]

2.5.2 Water Resources

Impervious surface cover is an accepted indicator for assessing the potential for water quality impacts as a result of future development. Impervious surface cover increases runoff volumes, which in turn can affect stream stability and water quality indicators. Numerous studies have found that first order to third order streams with watersheds exceeding 10 percent impervious surface cover exhibit impacted stream quality. Streams with watersheds exceeding 25 percent impervious surface cover typically exhibit degraded conditions and often do not meet water quality standards (Center for Watershed Protection, 2003).

[6] See the "Farmland Protection Toolbox" http://www.farmlandinfo.org/documents/27761/fp_toolbox_02-2008.pdf

Existing Conditions

Existing impervious surface cover in the study area was assessed using Feature Analyst, a GIS program that converts shading in aerial photography into measurable vector polygons. The analysis was conducted with 2007 aerial photography for the study area. The resulting polygons were compared for accuracy against the most recent available (2009) aerial photography. The comparison revealed that Feature Analyst provided a reasonable estimate of impervious surface cover associated with development, but that it also incorrectly identified many agricultural areas and wetlands as impervious. Therefore, the impervious surface layer was manually edited to remove the incorrectly categorized areas.

Impacts from Future Household and Employment Growth

To project future growth in impervious surface cover for the No Build and Build conditions associated with future household and employment growth, the NRCS TR-55 manual percent impervious surface factors were used. For residential development, the impervious surface percent applicable to the anticipated average density of future development (1/3 acre per household) is 30 percent (SCS, 1986). For employment-related development, an impervious surface percentage of 70 percent was selected based on the NRCS TR-55 manual percent impervious surface cover factor for commercial development.

Impacts from Other Transportation Projects

Impervious surface cover associated with the No Build transportation projects was estimated based on the length of the project and the number of new travel lanes specified in the LRTPs for the study area. The impervious surface estimates for the No Build projects assume 12-foot travel lanes and six-foot shoulders.

Direct Impacts

The direct increase impervious surface cover associated with the proposed project was also accounted for in the analysis based on the right-of-way boundaries for the Preferred Alternative. The right-of-way was estimated to consist of 34.29 percent impervious cover based on a typical section for the Preferred Alternative (96-feet of impervious surface out of the 280-foot right-of-way width).

2.5.3 Wildlife Habitat

Existing Conditions

Forest cover and the size and configuration of undisturbed habitat blocks are the key indicators for assessing potential upland wildlife habitat impacts. As with impervious surface cover, tree cover was delineated using Feature Analyst. The resulting polygons were reviewed in comparison to 2009 aerial photography and found to reasonably represent tree cover without the need for manual post-processing. Note that the existing tree cover estimates include street trees in urban areas, not just undeveloped upland forest areas.

Impacts from Future Household and Employment Growth

A range of potential impacts of future development on tree cover was estimated in order to appropriately reflect the uncertainty involved in predicting the exact location of future development. The low estimate of potential tree cover impacts assumed that development would be prioritized away from forested areas. In this scenario, all the unconstrained non-forested land in a TAZ would develop first. Only when this supply of land was exhausted would impacts to forest cover occur to accommodate the remaining land conversion projected for the TAZ. If sufficient unconstrained non-forested land was available in a TAZ to accommodate future growth, no impacts to forest cover for that TAZ were included in this low-end estimate. In actuality, future development of forested areas will likely be closer to the low end of the range than the high estimate discussed below because deforested areas are typically preferred for development over forested areas as lands historically cleared for agriculture bear many of the same traits (e.g., relatively well-drained, relatively flat, etc.) that makes the land suitable for development.

The high estimate of tree cover impacts assumed that future land conversion would occur in forested areas first, and would only affect non-forested areas when all the unconstrained forest cover in a zone was developed (see Section 2.4.4 for the methodology used to identify constrained vs. unconstrained land). For example, if there were 20 acres of unconstrained forest in a zone and 40 acres of expected land conversion, all 20 acres of forest were assumed to be impacted. If the acreage of unconstrained forest in a zone was greater than the acreage of land conversion, all of the land conversion was assumed to occur in the forested portion of the zone.

Impacts from Other Transportation Projects

The impacts of the No Build condition transportation projects on tree cover were estimated by taking in account the approximate width of the new or widened roadways based on the LRTP project descriptions. The No Build transportation project pavement "footprint" was widened by 20 feet on either side of each roadway to account for potential impacts from roadway construction, slope limits and clear zones.

Direct Impacts

The direct impacts of the Preferred Alternative on tree cover were calculated using the right-of-way boundaries as the approximate limit of impacts.

Wildlife Habitat Edge Effects and Fragmentation

In addition to the tree cover impact assessment described above, an analysis was performed to identify interior forest habitat and assess the direct impacts and indirect edge effects of the proposed project on interior forest habitat. This section provides background information on habitat fragmentation and edge effects and describes the specific methodology applied for this project.

Background

When interior forest and/or grassland habitat areas are converted to edges as a result of fragmentation, several types of indirect effects can occur. These indirect effects may include increased penetration of light and wind into the forest and the establishment of invasive plants and other competing and predatory species. Particularly for forested habitats, changes in the microclimate (air temperature, humidity, wind, solar radiation, soil temperature, soil moisture, etc.) tend to occur along the newly created edge. Microclimate changes are small scale variations caused by the alteration of the forest's physical characteristics, including tree height, percent canopy closure and forest structure (Reifsnyder et al., 1971; Chen and Franklin, 1997). As a result, changes in the microclimate have the potential to affect species diversity and density within the habitat edge area.

The creation of forest edge has the potential to increase nest predation on birds (Gates and Gysel, 1978; Wilcove, 1985), tree mortality as a result of windthrow and exposure (Chen et al., 1999; Essen, 1994), and the alteration of nutrient cycling (Gieger, 1965). Populations of opportunistic and adaptable species, such as raccoons, foxes, opossums and feral and domestic dogs and cats tend to increase in fragmented landscapes. The resulting edge effect can allow predation and nest parasitism to penetrate further into the forest interior. As a result, species with sensitive breeding areas can be affected. At the same time, other species that benefit from edge habitat can experience increased abundance from the creation of additional edge habitat.

The creation of edge habitat has the potential for non-native plant species to encroach into the habitat area interior, potentially restricting the growth of native plant species, limiting structural diversity and disrupting the natural succession processes. Typical methods employed during construction to prevent the introduction of weedy and invasive species include prompt seeding and mulching of all disturbed areas and frequent cleaning of all equipment.

As a result of edge effects, fragmentation of larger blocks of forest has been shown to cause a decrease in those species collectively known as forest interior dwelling species (FIDS). These species rely on large forest tracts to breed successfully (Robbins, 1979). Patch size has been shown to correlate to the number and type of species present within the forest interior. The larger the patch size of the interior forest, the greater the quantity and diversity of FIDS present. Smaller patch sizes tend to have less FIDS and more edge dwelling species (Forman, 1986). The larger patch sizes have more diverse microhabitats, with the necessary food sources, nesting sites, and required cover to protect FIDS from predator species (McIntyre, 1995).

Methodology

The extent of habitat edge effects varies considerably between different species and across habitat types. In addition, habitat edge effects tend to attenuate gradually with increased distance from the edge (e.g. areas closest to the edge are affected to a greater extent then areas farther from the edge). For analysis purposes, an edge effect distance of 300 feet was selected for this study to identify potential interior forest habitat areas. An edge effect distance of 300 feet is supported by the relevant literature on FIDS

(such as certain neotropical migrant birds) and has been used for other transportation project NEPA evaluations (e.g. Intercounty Connector FEIS, Maryland).

To assess existing conditions, an edge effect zone of 300 feet was created around existing roadways, development and other open areas (e.g. large waterbodies, agricultural fields etc.). Forested areas outside of the existing conditions edge effect zone were indentified as the forest interior habitat blocks. The edge effects of the proposed project were then superimposed on the existing conditions mapping to determine the incremental increase in edge effects and habitat fragmentation impacts.

The potential impacts of future household and employment growth on forest interior habitat was not assessed quantitatively due to the uncertainty involved in predicting the exact spatial arrangement of development, which is key to determining the size of the future "edge effect zone." Fragmentation impacts from future growth were qualitatively considered in light of the range of tree cover impacts.

2.6 Rounding

As discussed in greater detail in Section 4.0, the assessment of indirect and cumulative effects involves numerous assumptions that introduce uncertainty into the analysis. The exact level of uncertainty is not possible to quantify. There is no estimate available of the "margin of error" associated with the future household and employment forecasts made by the MPOs or with the shifts in growth made using the gravity model. Despite the inability to assign a specific margin of error, all results have been rounded to hundreds of acres to reflect the uncertainty inherent in any land use change forecasting exercise. The decision to round the results to the nearest 100 acres was made based on the general uncertainty associated with predicting the location and density of future household and employment growth and consideration of the varying resolutions of the input GIS data. Many of the datasets used in the ICE assessment, such as the HUC 12 watershed boundaries and conserved lands, are at 1:24,000 scale. The tree cover and impervious surface cover layers created for this study are also considered to be appropriate for mapping at a 1:24,000 scale. The horizontal positional error typically associated with datasets at a 1:24,000 scale is plus or minus 40 feet. The rounding of the results to the nearest 100 acres takes into account this level of positional error and the unquantifiable potential for error associated with predicting future demographic levels.

3.0 Potential Indirect and Cumulative Effects

3.1 Household and Employment Growth

Tables 3 and 4 summarize the results of the gravity model assessment of shifts in the location of household and employment growth for the study area based on the accessibility changes associated with the Preferred Alternative. Up to 3,300 additional households and 300 fewer jobs are anticipated in the study area as a result of the indirect development shifts associated with the project. This is not new growth, but rather represents households and employment that would have located elsewhere in the Metrolina region under the No Build condition. At the regional scale household and

employment totals remain constant between the No Build and Build conditions. The overall indirect effect of the project for the study area as a whole is relatively small in comparison to the growth in households (47,500) and employment (37,400) expected between 2005 and the 2035 No Build condition.

In absolute terms, the largest increase in households and employment attributed to the proposed project is in the Catawba Creek subwatershed, while the largest percentage change from the No Build condition to the Build condition is projected for the Beaverdam Creek subwatershed. Note that for the subwatersheds showing a "decrease" from the No Build to Build condition, this represents a decrease in future growth, not a decrease relative to existing conditions. For example, the forecasts for the Upper Crowders Creek subwatershed show 2035 employment under the Build condition as 900 jobs or 6.3 percent less than the No Build condition. However, even under the Build condition the Upper Crowders Creek subwatershed is expected to experience growth in employment of 6,400 (a 90 percent increase) between 2005 and 2035.

Figures 6 and 7 show household and employment growth by zone from 2005 to 2035 under the No Build condition. Several of the zones with the largest household growth expected under the No Build condition are adjacent to Lake Wylie or the South Fork Catawba River, a pattern consistent with recent trends and developments. Concentrations of substantial employment growth under the No Build condition include the area around the Bessemer City industrial park and around the Charlotte-Douglas International Airport, which is located northeast of the proposed interchange between the Gaston East-West Connector and I-485.

Figures 8 and 9 show the change in households and employment from the No Build condition to the Build condition based on the gravity model methodology. The project generally increases growth relative to the No Build in the zones along the alignment in southern Gaston County and northern York County. These areas would experience an increase in relative accessibility that would, all other factors held constant, make these zones more attractive for development as a result of the project. Areas along the I-85 corridor would not experience as large of an accessibility improvement and as a result show less growth under the Build condition than under the No Build condition. The gravity model formulation shifts households and employment towards those areas with the greatest accessibility (travel time) improvements.

Figures 10 and 11 show the total change in households and employment from 2005 to the 2035 Build condition (e.g. the forecasted growth from the 2035 Metrolina model). Note that all the areas showing a No Build to Build condition "decrease" in Figures 8 and 9 still grow overall between 2005 and 2035 under the Build condition.

ble 3
Gravity Model Estimated Change in Households by Watershed
No Build Compared to Build

	2005	2035 No Build	2035 Build	No Build to Build Difference	Percent Difference
Beaverdam Creek-Catawba River	1,800	2,700	3,100	400	14.8%
Catawba Creek	15,000	22,000	23,800	1,800	8.2%
Duharts Creek-South Fork Catawba River	12,700	22,700	22,700	-100	-0.4%
Lake Wylie-Catawba River	2,600	6,600	6,700	200	3.0%
Lower Crowders Creek	6,600	11,200	12,500	1,300	11.6%
Mill Creek-Lake Wylie	3,100	6,800	7,200	400	5.9%
Paw Creek-Lake Wylie	7,300	11,800	11,700	0	0.0%
Upper Crowders Creek	11,300	18,800	18,500	-300	-1.6%
Fites Creek-Catawba River	6,400	11,700	11,200	-400	-3.4%
Study Area Total	66,800	114,300	117,400	3,300	2.9%

Note: Results have been rounded to the nearest 100 households. Differences were calculated prior to rounding. Study area total calculated based on rounded values.

Table 4
Gravity Model Estimated Change in Employment by Watershed
No Build Compared to Build

	2005	2035 No Build	2035 Build	No Build to Build Difference	Percent Difference
Beaverdam Creek-Catawba River	1,700	2,500	2,900	300	12.0%
Catawba Creek	10,700	12,900	13,300	400	3.1%
Duharts Creek-South Fork Catawba River	21,400	27,500	27,400	-100	-0.4%
Lake Wylie-Catawba River	3,500	8,700	8,300	-400	-4.6%
Lower Crowders Creek	2,300	3,200	3,600	300	9.4%
Mill Creek-Lake Wylie	1,700	4,000	4,000	100	2.5%
Paw Creek-Lake Wylie	10,100	18,400	18,300	0	0.0%
Upper Crowders Creek	7,000	14,300	13,400	-900	-6.3%
Fites Creek-Catawba River	6,700	11,000	11,000	0	0.0%
Study Area Total	65,100	102,500	102,200	-300	-0.3%

Note: Results have been rounded to the nearest 100 employees. Differences were calculated prior to rounding. Study area total calculated based on rounded values.

3.2 Land Use Change

Tables 5 and 6 summarize residential and employment-related land use change based on the gravity model projected changes in the distribution of households and employment within the study area. For the study area as whole, the indirect land use effect of the project is an approximately 1.3 percent increase in the total area of residential land and a 0.3 percent decrease in employment-related land. The largest absolute difference in land conversion between the No Build and Build conditions is projected for the Catawba Creek subwatershed.

Table 5
Residential Land Conversion by Watershed
No Build Compared to Build

	Total Area (Acres)	Existing Residential Land (Acres)	2005-2035 No Build Land Conversion (Acres)	2005-2035 Build Land Conversion (Acres)	No Build to Build Difference (Acres)	Percent Change in Total Residential Land, No Build to Build
Beaverdam Creek-Catawba River	12,200	5,200	300	400	100	1.8%
Catawba Creek	20,700	10,500	2,300	2,900	600	4.7%
Duharts Creek-South Fork Catawba River	25,300	9,700	3,400	3,300	0	-0.8%
Lake Wylie-Catawba River	10,500	3,000	1,300	1,400	100	2.3%
Lower Crowders Creek	36,700	16,700	1,500	2,000	400	2.7%
Mill Creek-Lake Wylie	15,000	6,800	1,200	1,400	100	2.5%
Paw Creek-Lake Wylie	11,900	4,100	1,500	1,500	0	0.0%
Upper Crowders Creek	26,500	10,800	2,500	2,400	-100	-0.8%
Fites Creek-Catawba River	11,000	3,200	1,800	1,600	-100	-4.0%
Grand Total	169,800	70,000	15,800	16,900	1,100	1.3%

Note: Results have been rounded to the nearest 100 acres. Differences were calculated prior to rounding. Study area total calculated based on rounded values.

Table 6
Employment Land Conversion by Watershed
No Build Compared to Build

	Total Area (Acres)	Existing Employment Land (Acres)	2005-2035 No Build Land Conversion (Acres)	2005-2035 Build Land Conversion (Acres)	No Build to Build Difference (Acres)	Percent Change in Total Employment Land, No Build to Build
Beaverdam Creek-Catawba River	12,200	700	200	300	100	11.1%
Catawba Creek	20,700	2,700	600	800	100	6.1%
Duharts Creek-South Fork Catawba River	25,300	3,600	1,700	1,700	0	0.0%
Lake Wylie-Catawba River	10,500	1,800	1,500	1,400	-100	-3.0%
Lower Crowders Creek	36,700	1,300	300	400	100	6.3%
Mill Creek-Lake Wylie	15,000	300	700	700	0	0.0%
Paw Creek-Lake Wylie	11,900	3,300	2,400	2,400	0	0.0%
Upper Crowders Creek	26,500	3,100	2,100	1,800	-300	-5.8%
Fites Creek-Catawba River	11,000	2,100	1,200	1,200	0	0.0%
Grand Total	169,800	18,900	10,700	10,700	-100	-0.3%

Note: Results have been rounded to the nearest 100 acres. Differences were calculated prior to rounding. Study area total calculated based on rounded values.

3.2.1 Consistency with Local Land Use Plans

Gaston County

The substantial growth projected for the southeast portion of Gaston County (including the indirect land use effects of the proposed project) is largely consistent with local plans for Gaston County. Gaston County's 2002 Comprehensive Plan shows the areas surround the Gaston East-West Connector interchanges with US 321 and NC 279 as development target areas where future growth should be directed. In addition, bypass-dependent development target areas shown at several other interchanges along the corridor. Gaston County's Unified Development Ordinance will be essential in ensuring that form of new developments match local planning objectives for compact, mixed-use developments that preserve open space.

Mecklenburg County

The analysis results show that the proposed project does not substantially change the household and employment levels for the portion of Mecklenburg County within the study area. This overall result was consistent with the expectations of Mecklenburg County planners interviewed as part of this study (See Appendix A). As a result, the potential for inconsistency with local plans for Mecklenburg County is low. The additional growth expected with the project on the north side of the interchange with Dixie River Road is consistent with the Dixie Berryhill Strategic Plan for the development of this area (Charlotte-Mecklenburg Planning Department, 2003).

York County

York County's 2025 Comprehensive Plan calls for rural residential and agricultural land use in the northern portions of the county within the study area, with concentrations of commercial and industrial land use along the US 321 corridor. There is potential for the substantial growth pressures without the proposed project (the No Build household and employment estimates) to be inconsistent with the objective of maintaining a primarily rural character in this area. The additional growth in this portion of York County with the proposed project would incrementally add to this potential inconsistency. The priority recommendations of the 2025 Comprehensive Plan are currently being implemented with an Interim Development Ordinance while a Unified Development Ordinance is developed. In addition to the potential for changes in requirements for new developments under a Unified Development Ordinance, growth in northern York County will also be strongly influenced by the provision of utilities to new developments. In interviews conducted for this study, York County planners indicated that some utility providers would be acquired by the county and it was uncertain whether county ownership would increase or decrease the expansion of water and sewer service areas.

3.3 Water Resources

3.3.1 Impacts of Past and Present Actions

Overview of Development History

The ICE study area is located within the Catawba-Wateree River basin. The two subbasins that intersect the study area are the South Fork Catawba River (HUC 03050102) and the Upper Catawba River (HUC 03050101). The water resources within the ICE study area have a long history of changes resulting from human activities.

European settlement of portions of the study area began in the early 1800's and included land clearing for agriculture. Development and related impacts to water resources likely intensified with the establishment of three textile mills in Gaston County between 1845 and 1848—events that marked the beginning of period of industrial growth (Gaston County, 2010). The development of Charlotte as a railroad hub in the 1850's was also a key turning point for the area.

Construction on the dam on the Catawba River that would form Lake Wylie began in 1900 and was completed in 1904. This dam was destroyed by the 1916 flood, but rebuilt

and enlarged by 1926 (Catawba Riverkeeper, 2010). The Duke Energy hydropower impoundments along the Catawba River have provided numerous opportunities in the area for recreation and economic growth, but also pose unique management challenges. By slowing the flow of water, nutrient availability increases and algae may have more time to grow than they would in a free-flowing river system (NCDWQ, 2004). The Federal Energy Regulatory Commission (FERC) is currently undertaking a hydropower relicensing review of Duke Energy's operations.[7] The conditions of the new license may change the way the lakes are operated.

Within the past 40 years, substantial improvements in water resource conditions have resulted from a combination of the control of point sources under the Clean Water Act and the decline of textile industry. However, rapid population growth and the associated increases in impervious surface cover have posed new challenges to protecting surface water quality. For example, for the Catawba River basin as a whole, urban and built up land cover increased by 183,000 acres or 52 percent over the 15-year period from 1982 to 1997 (NCDWQ, 2004).

Existing Percent Impervious Cover

Based on 2007 conditions, 12.8 percent of the ICE study area consists of impervious surface cover (See Table 9 and Figure 12). The calculation of percent impervious cover by watershed (one indicator of potential stream quality) shows that the Beaverdam Creek, Upper Crowders Creek and Lower Crowders Creek subwatersheds on the western side of the study area consist of less than ten percent impervious surface cover at 5.7, 6.0 and 5.7 percent, respectively. The Paw Creek and Lake Wylie-Catawba River subwatersheds on the eastern side of the study area exhibit the highest percent impervious cover in the study area at over 20 percent. The remaining watersheds in the study area have a percent impervious cover within the range of 10 percent to 20 percent.

Existing Water Quality

Table 7 provides an overview of the Draft 2010 303(d) list of impaired waterbodies within the North Carolina portion of the study area, while Table 8 covers the 2008 303(d) list for the South Carolina portion of the ICE study area.

Several segments of Crowders Creek and Catawba Creek are listed as impaired for aquatic life support based on the condition of macroinvertebrate and/or fish communities. The impairment is likely due to impacts from urban stormwater runoff and waste water treatment systems. A fecal coliform Total Maximum Daily Load (TMDL) was established for Crowders Creek in 2004 (NCDWQ, 2004).

Lake Wylie was formerly listed as impaired for nutrients and a TMDL was established in 1991. The TMDL was implemented primarily through point-source load allocations established by the Lake Wylie Nutrient Management Plan (NCDWQ, 2004). As of the 2010 North Carolina integrated assessment, the main body of Lake Wylie within the study area is in attainment with water quality standards. However, the South Fork

[7] Final Environmental Impact Statement for the Catawba-Wateree Hydroelectric Project (Project No. 2232-522) http://www.ferc.gov/industries/hydropower/enviro/eis/2009/07-23-09.asp

Catawba River arm is impaired for aquatic life support based on copper concentrations and high temperature. Lake Wylie is also listed as impaired for copper in South Carolina, and the Crowders Creek arm of Lake Wylie is impaired for recreational uses by fecal coliform.

In York County, Beaverdam Creek is listed as impaired for aquatic life support based on turbidity and macroinvertebrate community conditions. A TMDL for fecal coliform was established in the Beaverdam Creek watershed in 2001 (SDHEC, 2001). The primary source of the fecal coliform impairment was identified by SDHEC as runoff from grazed pasture land.

Table 7
Impaired Waterbodies in the North Carolina Portion of the ICE Study Area

Assessment Unit	Name	Location	Use(s) Impaired	Cause(s) of Impairment
11-(123.5)b	South Fork Catawba River Arm of Lake Wylie		Aquatic Life Support	Copper High water temperature
11-129-(15.5)	South Fork Catawba River	From a point 0.4 mile upstream of Long Creek to Cramerton Dam and Lake Wylie at Upper Armstrong Bridge	Aquatic Life Support	Turbidity Low pH
11-130a	Catawba Creek	From source to SR2446, Gaston	Aquatic Life Support	Ecological/biological Integrity Benthos
11-130b	Catawba Creek	From SR2446, Gaston to SR2439, Gaston	Aquatic Life Support	Ecological/biological Integrity Benthos
11-130c	Catawba Creek	FromSR2439 to Lake Wylie	Aquatic Life Support	Ecological/biological Integrity FishCom
11-135-2	McGill Creek	From source to Crowders Creek	Aquatic Life Support	Ecological/biological Integrity Benthos
11-135a	Crowders Creek	From source to SR 1118	Aquatic Life Support	Ecological/biological Integrity Benthos Ecological/biological Integrity FishCom
11-135c	Crowders Creek	From State Route 1122 to State Route 1131	Aquatic Life Support	Ecological/biological Integrity FishCom Ecological/biological Integrity Benthos
11-135d	Crowders Creek	From State Route 1131 to State Route 1108	Aquatic Life Support	Ecological/biological Integrity FishCom
11-135e	Crowders Creek	From State Route 1108 To NC 321	Aquatic Life Support	Ecological/biological integrity Benthos
11-135f	Crowders Creek	From State Route 321 to State Route 2424	Aquatic Life Support	Ecological/biological Integrity Benthos

Assessment Unit	Name	Location	Use(s) Impaired	Cause(s) of Impairment
11-135-10-1	South Crowders Creek	From source to South Fork Crowders Creek	Aquatic Life Support	Low Dissolved Oxygen

Source: North Carolina 2010 303 (d) List

Table 8
Impaired Waterbodies in the South Carolina Portion of the ICE Study Area

Name and Location	Station	Use(s) Impaired	Cause(s) of Impairment
LAKE WYLIE AB MILL CK ARM AT END OF S-46-557	CW-197	Aquatic Life Support	Copper
BROWN CREEK AT S-46-228 (GUINN ST), 0.3 MI WEST OF OLD NORTH MAIN STREET IN CLOVER, SC	CW-105	Aquatic Life Support	Turbidity
BEAVERDAM CK AT S-46-152 8 MI E OF CLOVER	CW-153	Aquatic Life Support	Turbidity
BEAVERDAM CREEK AT BRIDGE ON S-46-64 3.2 MI ENE OF CLOVER	RS-06020	Aquatic Life Support	Biological integrity
CROWDERS CK AT S-46-564 NE CLOVER	CW-023	Aquatic Life Support	Copper
CROWDERS CREEK AT S-46-1104	CW-024	Aquatic Life Support	Biological integrity
LK WYLIE, CROWDERS CK ARM AT SC 49 AND SC 274	CW-027	Recreation	Fecal Coliform

Source: South Carolina 2008 303 (d) List

Stormwater Management Policies

Authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program regulates pollutant discharges with the goal of protecting water quality. The program is overseen by U.S. EPA and is generally implemented by states.

The City of Charlotte received a Phase I NPDES stormwater permit in 1993. Phase I of NPDES applies to medium and large municipal separate storm sewer systems (MS4s) with populations of 100,000 or more, certain industrial sources, and construction activities involving five or more acres of land disturbance. In 2005, the remainder of Mecklenburg County outside the limits of Charlotte was issued a Phase II NPDES permit. Phase II of NPDES expanded Phase I of the NPDES Storm Water Program to additional urbanized MS4s and construction sites disturbing equal to or greater than one but less than five acres of land.

Gaston County and York County are both designated NPDES Phase II areas and have established local requirements for the stormwater treatment aspects of proposed developments.

Riparian Area Protection Policies

Riparian buffer is a term used to describe lands adjacent to streams and comprised of an area of native trees, shrubs, and other vegetation. Vegetative buffers are effective at treating stormwater runoff and maintaining stream bank stability. The loss of riparian buffers can reduce water quality, diversity of wildlife, and fish populations.

Permanent riparian buffer protection rules were enacted by North Carolina for the main stem of the Catawba River and its main stem lakes below Lake James south to the North Carolina/South Carolina border (15 NCAC 02B.0243-0244). The buffer protection rules apply within 50 feet of all riparian shorelines along the Catawba River main stem and the seven main stem lakes. The buffer is 50 feet wide and is measured from the waters edge (at full pond in the lakes) and has two zones. Zone 1 is the 30 feet nearest the water and Zone 2 is 20 feet landward of Zone 1. Grading and clearing of vegetation in Zone 1 is not allowed except for certain uses. The outer 20-foot zone (Zone 2) can be cleared and graded but must be revegetated to maintain diffuse flow to Zone 1. Certain activities (including road crossings) may be allowable with mitigation but must first be reviewed and given written approval by NCDWQ. If it can be shown that there are "no practical alternatives" to the proposed activity, a variance may be allowed with mitigation (NCDWQ Web site: http://h2o.enr.state.nc.us/nps/documents/FactSheet7-29-04.pdf).

The City of Charlotte and Mecklenburg County have initiated stream buffer ordinances through the Charlotte- Mecklenburg "Surface Water Improvement & Management (S.W.I.M) program". There are three different buffer sizes (35', 50', and 100') in Mecklenburg County depending on the size of the drainage area.

In 2009, York County adopted a riparian buffer policy applicable to the shoreline of Lake Wylie and Catawba River, as well as perennial streams draining to the Catawba River (York County, 2009). A 50-foot riparian buffer zone is established for Lake Wylie and perennial streams, while a 100-foot riparian zone is established for the Catawba River.

3.3.2 Impacts from Other Actions (No Build Alternative)

As shown in Table 9, future development under the No Build Alternative is expected to increase impervious surface cover by over 12,000 acres over existing conditions for the study area as a whole. Approximately 100 acres of the No Build condition increase in impervious cover is attributed to other specific transportation projects, the majority is associated with household and employment growth. Several watersheds would exceed thresholds that suggest the potential for stream and water quality impacts as a result of development under the No Build Alternative. The percent impervious surface cover in the Upper Crowders Creek subwatershed would increase from 6.0 percent to 14.3 percent. Four subwatersheds which currently have less than 25 percent impervious cover would approach or exceed 25 percent impervious cover under the No Build condition—Catawba Creek, Duharts Creek-South Fork Catawba River, Lake Wylie-

Catawba River and Fites Creek-Catawba River. The level of development projected for the study area suggests some unavoidable degradation of water resource quality is likely in the areas with the greatest growth. However, the impact per acre of new impervious surface is expected to be substantially less than for past development due to new stormwater permitting requirements. The enforcement of riparian buffer policies in the study area is also likely to have a beneficial offsetting effect in counteracting some of the stormwater impacts of future growth. Improvements to the management of point source pollutant discharges (including wastewater treatment plants) are also expected to continue in the future.

3.3.3 Direct Impacts from the Preferred Alternative

The Preferred Alternative would add approximately 600 acres of impervious surface cover to the study area, with the largest increase (200 acres) in the Upper Crowders Creek subwatershed. As discussed in the FEIS, the design of the Preferred Alternative would incorporate stormwater treatment measures to reduce the potential for impacts to the affected watersheds.

3.3.4 Indirect Effects from the Preferred Alternative

The changes in the distribution of households and employment resulting from the Preferred Alternative could add 300 acres of impervious surface cover to the study area, or a one percent increase over the No Build condition (See Table 9). The largest indirect increases in impervious surface cover are projected for the Catawba Creek subwatershed (300 acres) and the Lower Crowders Creek subwatershed (200 acres). Two subwatersheds are projected to have an indirect decrease in impervious surface cover as a result of the Preferred Alternative—Lake Wylie-Catawba River and Upper Crowders Creek. As noted in the discussion of the No Build condition, although some impacts would still occur, the incremental water quality impacts of these shifts in growth would be less than past growth due to the stormwater control and riparian buffer policies in the study area.

3.3.5 Potential for Cumulative Effects

Table 9 shows the cumulative effect of past actions (e.g. existing impervious cover), other actions (the No Build condition) and the direct and indirect effects of the Preferred Alternative. The combination of these effects is predicted to be a total acreage of impervious surface cover in the study area of 35,000 or 20.6 percent. The incremental effect of the Preferred Alternative accounts for 900 acres or about 6.8 percent of the cumulative increase in impervious surface cover from existing conditions. One subwatershed with impervious surface cover currently less than 10 percent would be at or exceed 10 percent in the Build condition—Upper Crowders Creek. As noted in the discussion of the No Build condition, although some unavoidable decreases in water resource quality are expected, the incremental water quality impacts of future growth would be less than past growth due to the stormwater water and riparian buffer policies in the study area.

While impervious surface cover provides a useful metric for assessing potential cumulative effects, it is not possible to conclude from an analysis of impervious surface

cover alone whether or not violations of water quality standards will occur at specific downstream locations. As part of the application for a Section 401 Water Quality Certification for the proposed project, additional modeling of pollutant loadings will be conducted in accordance with NCDENR Division of Water Quality's policy document entitled *Cumulative Impacts and the 401 Water Quality Certification and Isolated Wetlands Program* (NCDWQ, 2004). To issue a Water Quality Certification, NCDWQ is required to determine that a project "does not result in cumulative impacts, based upon past or reasonably anticipated future impacts that cause or will cause a violation of downstream water quality standards." The water quality modeling will account for the effect of stormwater treatment practices and provide the basis for determining whether or not violations of water quality standards would occur. If violations are predicted, mitigation will be proposed to address the issue.

Table 9
Change in Impervious Surface Cover by Watershed
No Build Compared to Build

	Total Watershed Area (Acres)	2007 Impervious Cover (Acres)	2035 No Build Impervious Cover (Acres)	Build Direct Change in Impervious Cover (Acres)	Build Indirect Change in Impervious Cover (Acres)	Build Condition Total Impervious Cover (Acres)*	2007 Percent Impervious Cover	2035 No Build Percent Impervious Cover	2035 Build Percent Impervious Cover*
Beaverdam Creek	12,200	700	1,000	0	100	1,100	5.7%	8.2%	9.0%
Catawba Creek	20,700	3,700	4,800	100	300	5,200	17.9%	23.2%	25.1%
Duharts Creek-South Fork Catawba River	25,300	4,600	6,900	100	0	6,900	18.2%	27.3%	27.3%
Lake Wylie-Catawba River	10,500	2,200	3,600	100	-100	3,700	21.0%	34.3%	35.2%
Lower Crowders Creek	36,700	2,100	2,800	100	200	3,100	5.7%	7.6%	8.4%
Mill Creek-Lake Wylie	15,000	1,600	2,400	0	100	2,500	10.7%	16.0%	16.7%
Paw Creek-Lake Wylie	11,900	3,300	5,400	0	0	5,400	27.7%	45.4%	45.4%
Upper Crowders Creek	26,500	1,600	3,800	200	-200	3,700	6.0%	14.3%	14.0%
Fites Creek-Catawba River	11,000	2,000	3,400	0	-100	3,400	18.2%	30.9%	30.9%
Study Area Total	169,800	21,800	34,100	600	300	35,000	12.8%	20.1%	20.6%

*Cumulative effect of past actions (existing conditions), the impacts of reasonably foreseeable actions by others (future household and employment growth and other transportation projects), the indirect effects of the project and the direct increase in impervious surface cover resulting from the project.

Note: Results have been rounded to the nearest 100 acres. Build Condition Total Impervious Cover may not appear to match the sum of the No Build, Build Direct and Build Indirect because of rounding. Study area total calculated based on rounded values.

3.4 Wildlife Habitat

3.4.1 Impacts of Past and Present Actions

The quantity and quality of upland wildlife habitats in the study area have been impacted by past development. For the Catawba River basin as a whole, forest cover decreased by 104,000 acres or 10.1 percent between 1982 and 1997 (NCDWQ, 2004). Including urban trees, approximately 58.6% of the study area is covered by tree cover as of 2007 (See Table 12 and Figure 13). At a watershed level, the highest percentage of tree cover occurs in the Upper and Lower Crowders Creek subwatersheds (65.7 and 64.9 percent, respectively), while the lowest percentage occurs in the heavily developed Paw Creek-Lake Wylie subwatershed (37.8 percent).

Figure 13 illustrates the forest interior habitat patches, defined based on the 300-foot edge effect zone explained in Section 2.5.3. Table 10 shows that the majority of the forest interior habitat patches in the study area are small and that there are only 9 interior habitat patches greater than 500 acres in size. The largest habitat patches are located in and around Crowders Mountain State Park. Some of the large habitat patches in this area actually extend beyond the boundaries of the study area. As expected, there are no large interior habitat patches remaining in the most heavily developed portions of the study area, such as Gastonia.

Table 10
Study Area Forest Interior Habitat Patches

Total Acres	Forest Interior Habitat (Acres)	Percent Forest Interior Habitat	Count of Forest Interior Habitats by Patch Size (Acres)					Mean Interior Patch Size*
			Less than 20	20 to 100	101 to 200	201-500	Greater than 500	
169,763	28,248	16.6%	12,085	151	44	22	9	36.3

*Excluding interior patches of less than one acre.

3.4.2 Impacts from Other Actions (No Build Alternative)

Under the No Build Alternative 10,300 to 23,100 acres of tree cover could be lost as a result of the future development, reducing the total percent forest cover in the study area to 52.5 to 45.0 percent.[8] The loss of tree cover under the No Build Alternative would reduce the quality and quantity of upland wildlife habitat in the study area and increase habitat fragmentation, although the degree of fragmentation cannot be reasonably quantified (See Section 2.5.3). As discussed in Section 5.0, the planning strategies to minimize potential impacts to wildlife habitat include encouraging higher density development in appropriate locations and preserving contiguous habitat blocks that provide the highest quality habitat.

[8] For an explanation of how the "low" and "high" tree cover impact estimates were developed, refer to Section 2.5.3.

3.4.3 Direct Impacts from the Preferred Alternative

The Preferred Alternative would directly impact 1,000 acres of tree cover, 300 acres of which would occur in the Upper Crowders Creek subwatershed. The Preferred Alternative would directly impact 290 acres of forested interior habitat and result in indirect edge effects potentially reducing the quality of an additional 480 acres of forest interior habitat within 300 feet of the right-of-way. Table 11 and Figures 14 through 20 provide detailed information on the impacts of the Preferred Alternative on forest interior habitat patches of 20 or more acres in size. The figures illustrate the high degree of existing fragmentation in the Gaston East-West Connector corridor. The project would incrementally increase this fragmentation.

The habitat fragmentation impacts of the Preferred Alternative would inhibit the movement of some wildlife species across the roadway and potentially increase wildlife road mortality. As discussed in the FEIS, a wildlife passage structure will be studied at the crossing of Stream S156 (located between Forbes Road to the west and Robinson Road to the east) during final design of the Preferred Alternative.

Table 11
Forest Interior Habitat Patch Impact Analysis*

ID†	Existing Interior Habitat Block (acres)	Direct Impacts (acres)	New Conversions to Edge (acres)	Remaining Interior Habitat Block(s) (acres)
A	20.6	0	3.6	16.9
B	22.3	0.4	6.1	15.8
C	76.9	0	3.9	73
D	29.3	0.5	1.5	27.3
E	336.7	18.3	33.2	63.2 222
F	112.5	27.2	20.5	62.3 2.4
G	847.6	29.1	61.2	1 <1 <1 185.8 570.5
H	18.4	9.9	6.5	2.1
I	29.2	7	7.3	14.9
J	98.6	15.3	21.9	58.6 <1 2.4
K	25.3	4.4	9.1	11.8
L	370.5	18.5	27.1	274.3 50.6
M	150.7	18.8	26.2	<1 1.6 1.8 9.9 92.3

ID†	Existing Interior Habitat Block (acres)	Direct Impacts (acres)	New Conversions to Edge (acres)	Remaining Interior Habitat Block(s) (acres)
N	215.4	2.3	4.7	207.6 <1
O	62.0	9.5	15.8	30.4 <1 6.1
P	34.7	6.1	16.1	2.1 10.3
Q	112.2	18.7	19.1	72.2 <1 2.1
R	519.1	24.3	46.1	28.1 2.9 131.2 286.5
S	124.0	8.5	16.8	34.6 64.1
T	32.3	1.8	5.8	<1 <1 24.6
U	92.9	12.8	21.2	5.9 53
V	308.6	13.9	24.8	70.1 199.9
W	211.5	18.1	46.6	11.6 50.2 <1 85

*For interior habitat patches of approximately 20 acres in size or larger only. Impacts to smaller patches were calculated and included in the total edge effect statistics in the text.
† Refer to Figures 14 through 20.

3.4.4 Indirect Effects from the Preferred Alternative

Depending on the specific locations chosen for future development, the changes in the development patterns associated with the Preferred Alternative could increase tree cover loss by 100 to 1,300 acres. The greatest potential for indirect effects on forest cover is within the Catawba Creek subwatershed.

3.4.5 Potential for Cumulative Effects

Tables 12 and 13 show the cumulative effect of past actions (e.g. existing tree cover), other actions (the No Build condition) and the direct and indirect effects of the Preferred Alternative. The combination of these effects is predicted to be a total acreage of tree cover in the study area of 88,300 to 74,100 acres. This represents a cumulative loss of forest cover of 11,200 to 25,400 acres or a percent decrease of 11 to 26 percent. The actual impacts will depend on the specific location of each new development, although the actual number will likely be closer to the low estimate. The incremental effect of the Preferred Alternative accounts for 900 to 2,300 acres of the cumulative loss of forest

cover from existing conditions. As discussed in Section 5.0, the planning strategies to minimize potential impacts to wildlife habitat include encouraging higher density development in appropriate locations and preserving contiguous habitat blocks that provide the highest quality habitat.

Table 12
Change in Tree Cover by Watershed (Low Impact Estimate)
No Build Compared to Build

	Total Acres	2007 Forest Cover (Acre)	2035 No Build Forest Cover (Acres)	Build Direct Change in Forest Cover (Acres)	Build Indirect Change in Forest Cover (Acres)	Build Condition Total Forest Cover (Acres)	2007 Percent Forest Cover	2035 No Build Percent Forest Cover	2035 Build Percent Forest Cover
Beaverdam Creek	12,200	6,500	6,500	0	0	6,500	53.3%	53.3%	53.3%
Catawba Creek	20,700	12,100	11,500	-100	-300	11,000	58.5%	55.6%	53.1%
Duharts Creek-South Fork Catawba River	25,300	15,400	12,800	-100	0	12,700	60.9%	50.6%	50.2%
Lake Wylie-Catawba River	10,500	6,000	4,200	-200	100	4,100	57.1%	40.0%	39.0%
Lower Crowders Creek	36,700	23,800	23,700	-200	-100	23,400	64.9%	64.6%	63.8%
Mill Creek-Lake Wylie	15,000	8,800	8,000	-100	0	8,000	58.7%	53.3%	53.3%
Paw Creek-Lake Wylie	11,900	4,500	3,100	0	0	3,100	37.8%	26.1%	26.1%
Upper Crowders Creek	26,500	17,400	16,000	-300	300	16,000	65.7%	60.4%	60.4%
Fites Creek-Catawba River	11,000	5,000	3,400	0	100	3,500	45.5%	30.9%	31.8%
Study Area Total	169,800	99,500	89,200	-1,000	100	88,300	58.6%	52.5%	52.0%

Notes: Negative change indicates loss of forest cover, positive indicates gain.
Results have been rounded to the nearest 100 acres. Differences were calculated prior to rounding. Study area total calculated based on rounded values.
For an explanation of how the “low” and “high” tree cover impact estimates were developed, refer to Section 2.5.3.

Table 13
Change in Tree Cover by Watershed (High Impact Estimate)
No Build Compared to Build

	Total Acres	2007 Forest Cover (Acre)	2035 No Build Forest Cover (Acres)	Build Direct Change in Forest Cover (Acres)	Build Indirect Change in Forest Cover (Acres)	Build Condition Total Forest Cover (Acres)	2007 Percent Forest Cover	2035 No Build Percent Forest Cover	2035 Build Percent Forest Cover
Beaverdam Creek	12,200	6,500	5,900	0	-200	5,700	53.3%	48.4%	46.7%
Catawba Creek	20,700	12,100	9,300	-100	-700	8,500	58.5%	44.9%	41.1%
Duharts Creek-South Fork Catawba River	25,300	15,400	10,600	-100	0	10,400	60.9%	41.9%	41.1%
Lake Wylie-Catawba River	10,500	6,000	3,700	-200	0	3,500	57.1%	35.2%	33.3%
Lower Crowders Creek	36,700	23,800	22,000	-200	-400	21,400	64.9%	59.9%	58.3%
Mill Creek-Lake Wylie	15,000	8,800	6,900	-100	-200	6,700	58.7%	46.0%	44.7%
Paw Creek-Lake Wylie	11,900	4,500	2,200	0	0	2,200	37.8%	18.5%	18.5%
Upper Crowders Creek	26,500	17,400	13,300	-300	100	13,100	65.7%	50.2%	49.4%
Fites Creek-Catawba River	11,000	5,000	2,500	0	100	2,600	45.5%	22.7%	23.6%
Study Area Total	169,800	99,500	76,400	-1,000	-1,300	74,100	58.6%	45.0%	43.6%

Notes: Negative indicates loss of forest cover, positive indicates gain.
Note: Results have been rounded to the nearest 100 acres. Differences were calculated prior to rounding. Study area total calculated based on rounded values.
For an explanation of how the “low” and “high” tree cover impact estimates were developed, refer to Section 2.5.3.

4.0 Evaluate Analysis Results

The objective of Step 7 of the ICE assessment process is to consider the assumptions and associated uncertainty used in the analysis. This section discusses the uncertainty associated with the ICE assessment in general, as well as a discussion of the effect of removing the Bud Wilson Road interchange from the design of the Preferred Alternative.

As with any attempt to forecast 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 forecasts described in earlier sections. These land use forecasts were developed using recommended methods as described in the NCDOT ICE Guidance. Specifically, the land use forecasts rely on the planning organizations in the study area, and, therefore, the results are only as accurate as those forecasts. The quantities of projected development also rely on assumptions about development density, as explained in earlier sections of this report, and these assumptions are another limitation on the accuracy of the analysis. Thus, the process of developing the Build condition forecasts induces uncertainty. The exact level of uncertainty resulting from these forecasts is not possible to quantify.

In addition to assumptions about the quantities of future development, the analysis also requires assumptions about the distribution of future development to individual TAZs. The purpose of producing the quantified scenarios is to gain an understanding of the incremental effects of the proposed action (i.e., indirect effects) as well as the overall cumulative effects to the environment. Consequently, assumptions made about the distribution of land use follow a logical construct and provide a level of accuracy consistent with the gravity model estimating method. In other words, the analysis is a product of assumptions that allow reasonable estimates and comparisons to be made, but in so doing, the actual projected distribution of development is generalized according to those assumptions and does not replicate the unknown individual private land use decisions of the future.

4.1 Bud Wilson Road Interchange

An interchange at Bud Wilson Road (SR 2423) was included in the description of the Gaston East-West Connector at the time of the DEIS. The Bud Wilson Road interchange was also included in the travel demand modeling conducted for the project. As noted in Section 2.4.2, zone-to-zone travel time information from this modeling was the basis of the gravity model assessment of the potential for shifts in the location of households and employment. However, subsequent to the publication of the DEIS, refinements to the design of the Preferred Alternative led to a decision to eliminate the interchange proposed at Bud Wilson Road.

The Bud Wilson Road interchange would have been located in relatively close proximity to another interchange (Robinson Road 1.2 miles to the west), thus the effect on localized transportation access would be minimal. In addition, the ICE assessment results show on overall pattern of increased growth in southern Gaston County and northern York County with the project. The removal of the Bud Wilson Road interchange would not change this basic pattern of the growth forecasts because numerous other

interchanges remain part of the design of the Preferred Alternative. The land around Bud Wilson Road has the potential to become more attractive to development with the completion of the project, even without an interchange in this location because Bud Wilson Road can easily be accessed from other roads that do connect to the Gaston East-West Connector. The Bud Wilson Road area can be accessed via Union Road (NC 274), as well as Robinson Road (by taking Sparrow Dairy Road). Therefore, it can be concluded that the elimination of the Bud Wilson Road interchange does not have the potential to substantially alter the results of the ICE assessment.

5.0 Mitigation

The basic requirement to consider mitigation measures is established in the CEQ NEPA regulations (40 CFR 1502.16 (h)). Compensatory mitigation for the direct impacts of the Preferred Alternative to regulated resources (e.g. wetlands and streams) is discussed in the FEIS. With respect to mitigation for indirect and cumulative effects related to land use change, both the NCDOT ICE Guidance and FHWA *Interim Guidance* note that it is necessary to identify mitigation actions beyond the control of the transportation agencies. While such mitigation cannot be committed to be implemented as part of the project, the purpose of identifying the mitigation is to inform the affected local jurisdictions and other reviewers of the EIS. Mitigation for the indirect and cumulative effects on land use, water resources and tree cover identified by this study could be reduced in magnitude through implementation and enforcement of the following planning strategies. As noted in the text below, many of these strategies are already beginning to be implemented in the study area.

- **Zoning/Comprehensive Planning** to support higher density development in planned growth areas and to discourage growth in environmentally sensitive areas. Gaston County has adopted a Unified Development Ordinance that provides new flexibility for higher density development, including Traditional Neighborhood Development (TND) and a streamlined development process. York County is in the process of developing a Unified Development Ordinance. Open Space Planning is also an important part of protecting key wildlife habitat areas. York County completed an Open Space Plan in 2009.

- **Growth Management** through restrictions on the expansion of infrastructure. Water and sewer service should be strictly tied to areas designated for growth in local land use plans. There is some evidence of consideration of this type of policy in parts of Gaston County. For example, Gaston County's "Existing Initiatives Map" identifies areas where sewer service should not be extended, including a portion of the South Fork Crowders Creek watershed.

- **Riparian buffers**. Existing riparian buffer policies applicable to the study area are discussed in Section 3.3.1. These policies are a key aspect of water resources protection.

- **Stream Restoration**. Many urban streams have been straightened, channelized, piped and buried, and/or stripped of native vegetation. Stream restoration

policies would directly improve habitat and water quality by addressing erosion and sedimentation issues.

- **Land Acquisition/Conservation Easements**. Conservation easement programs, such as the Gaston Conservation District Land Preservation Program are another strategy for preserving high quality wildlife habitat that can be implemented by the private or public sector. The mapping of interior forest patches conducted for this study provides information that could be used to prioritize areas for conservation planning and land acquisition investments.

6.0 Conclusion

The land use forecasting conducted for this study shows that the potential for indirect land use effects is greatest in southern Gaston County and northern York County. These areas would experience the largest increase in accessibility with the project. The results are consistent with Gaston County's land use plan, but may be inconsistent with York County's plan for rural residential and agricultural uses in the northern portion of the county. Local land use regulations will be key in shaping the location and form of development in the study area.

In terms of environmental impacts, over 12,000 acres of impervious surface is expected to be added to the study area by 2035 without the proposed project. Between 10,300 and 23,100 acres of tree cover could be lost under the No Build condition. The proposed project would directly and indirectly affect the environment. The total incremental effect of the project on impervious surface cover (direct plus indirect) is an addition of 900 acres to the growth in impervious surface cover under the No Build condition. The total incremental effect of the project on tree cover is estimated to be a loss of 900 to 2,300 acres over the No Build condition. Numerous planning strategies are available to reduce the impacts of future growth on water resources and wildlife habitat, including zoning/comprehensive planning, growth management, riparian buffers, stream restoration and land acquisition.

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Appendix A

Interviews

MEMORANDUM

The Louis Berger Group, Inc., 199 Water Street, 23rd Floor, New York, NY 10038
Tel: (212) 612-7900 Fax: (212) 363-4341

Date: June 24, 2010

To: Project File

From: Leo Tidd

Re: Gaston East-West Connector Indirect and Cumulative Effects Study

Subject: Summary of the June 22, 2010 Teleconference with the Rock Hill - Fort Mill Area Transportation Study (RFATS) and the York County Department of Planning and Development

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Attendees:

- Steve Allen, Planning Services Manager, York County Department of Planning and Development
- David Hooper, Transportation Planner, RFATS
- Curtis Bridges, Long Range Planner, City of Rock Hill Planning Services Department
- Chuck Chorak, Senior Planner, City of Rock Hill Development Services Department (formerly with RFATS).
- Jill Gurak, PBS&J
- Leo Tidd, Louis Berger Group
- Larry Pesesky, Louis Berger Group

The objective of the teleconference was to confirm whether or not the 2035 Metrolina model TAZ-level forecasts should represent the No Build condition in York County and to provide a reasonableness check for the land use forecasting results based on the local area knowledge of the participants. Berger provided the participants with a description of the household and employment forecasting methodology and maps of the preliminary results in advance of the meeting.

In the discussion of the No Build condition, Mr. Chorak indicated that he participated in the original demographic forecasting for the York County portion of the 2025 Metrolina travel demand model. These original forecasts have been updated with the various updates to the model, including a reduction in the forecasts for the 2035 model based on current economic conditions. Mr. Chorak stated that Gaston East-West Connector (or Garden Parkway) was assumed to be completed in the allocation of future growth to specific zones in York County. Household and employment growth was added to areas in northern York County under the assumption that these areas would become more attractive for development as a result of the project. This means that the potential

indirect land use effect of the project is already embedded within the 2035 Metrolina model forecasts. As a result, Berger proposed that the 2035 Metrolina model forecasts be used as the Build condition for the indirect and cumulative effects assessment. A No Build scenario with slightly lower growth in northern York County would be estimated using the gravity model approach. All the participants concurred that it was appropriate to use the 2035 forecasts as the Build condition and that the indirect effect of the project was reflected in these forecasts.

The group discussed the growth-inducing potential of the Gaston East-West Connector project more generally and agreed that factors other than transportation access were more important in determining the location and magnitude of future development. Mr. Allen noted that the availability of utilities was very important in determining how much development could be accommodated in York County. It is uncertain whether the acquisition of some utility providers by York County will increase or decrease the expansion of water and sewer service areas in northern York County. It was noted that York County's comprehensive plan indicates a desire for northern York County to remain rural and agricultural in character.

Although the land use forecasting results were to be revised to account for the 2035 forecasts as the Build condition, the group reviewed and discussed the incremental effect of the project based on the preliminary results that assumed the 2035 forecasts represented the No Build condition. RFATS and York County representatives stated that the incremental effect projected with the gravity model approach appeared higher than they would expect. The two areas in particular where indirect growth effects appeared too high were around Clover (TAZ 3261) and adjacent to Lake Wylie (TAZ 3268).

York County commented that the 2035 Metrolina model household forecast for TAZ 3276 appeared too high given the rural residential pattern of development expected in that area. The group concluded that the 2035 Metrolina model household forecast for TAZ 3275 was lower than expected because a recent development proposal in that TAZ was not know at the time the updated forecasts were prepared. York County and RFATS also provided suggestions on improving the readability of the mapping .

MEMORANDUM

The Louis Berger Group, Inc., 199 Water Street, 23rd Floor, New York, NY 10038
Tel: (212) 612-7900 Fax: (212) 363-4341

Date: July 1, 2010

To: Project File

From: Leo Tidd

Re: Gaston East-West Connector Indirect and Cumulative Effects Study

Subject: Summary of the June 25, 2010 Teleconference with the Gaston Urban Area Metropolitan Planning Organization (GUAMPO) and the Gaston County Department of Planning and Development Services

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Attendees:

- Hank Graham, Principal Transportation Planner, GUAMPO
- Willie King Jr., Senior Planner, Gaston County
- David Williams, Planning Director, Gaston County
- Jeff Dayton, NCTA
- Jill Gurak, PBS&J
- Leo Tidd, Louis Berger Group
- Larry Pesesky, Louis Berger Group

The objective of the teleconference was to confirm whether or not the 2035 Metrolina model TAZ-level forecasts should represent the No Build condition in Gaston County and to provide a reasonableness check for the land use forecasting results based on the local area knowledge of the participants. Berger provided the participants with a description of the household and employment forecasting methodology and maps of the preliminary results in advance of the meeting.

The participants noted that transportation access was not considered the most important factor in future development patterns and that the majority of development is expected to occur regardless of whether or not the Gaston East-West Connector is constructed. However, the participants did agree that the 2035 Metrolina model forecasts should be used as the Build condition because the indirect effect of the project was reflected in the household and employment forecasts. The No Build condition would have somewhat less growth in southern Gaston County than the forecasts. Mr. Graham noted that a five percent difference in households in the study area between the No Build and Build conditions seemed reasonable.

Mr. Graham stated that GUAMPO has evaluated the reasonableness of the 2035 household and employment forecasts in light of the economic recession. They have

concluded that the forecasts remain reasonable for now, but may need to be reconsidered in a few years depending on economic trends.

Mr. Graham provided an overview of infrastructure projects in addition to the Gaston East-West connector that were specifically considered in making the TAZ-level household and employment forecasts. The forecasts for southern Gaston County assume that water and sewer service capacity will be expanded in the future, so the availability of utilities is not a constraint on growth in this area. The planning effort for a countywide water and sewer authority was discussed. Other projects considered in the land use forecasting conducted by GUAMPO include the proposed Gastonia Multimodal Center, passenger rail service between Gastonia and Charlotte, and the employment growth associated with the intermodal freight facility at the Charlotte Douglas International Airport.

MEMORANDUM

The Louis Berger Group, Inc., 199 Water Street, 23rd Floor, New York, NY 10038
Tel: (212) 612-7900 Fax: (212) 363-4341

Date: July 2, 2010

To: Project File

From: Leo Tidd

Re: Gaston East-West Connector Indirect and Cumulative Effects Study

Subject: Summary of the July 2, 2010 Teleconference with the Mecklenburg-Union Metropolitan Planning Organization (MUMPO) and the Charlotte-Mecklenburg Planning Department

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Attendees:

- Bob Cook, MUMPO
- Kent Main, Charlotte-Mecklenburg Planning Department
- Jeff Dayton, NCTA
- Leo Tidd, Louis Berger Group
- Larry Pesesky, Louis Berger Group

The objective of the teleconference was to confirm whether or not the 2035 Metrolina model TAZ-level forecasts should represent the No Build condition in Mecklenburg County and to provide a reasonableness check for the land use forecasting results based on the local area knowledge of the participants. Berger provided the participants with a description of the household and employment forecasting methodology and maps of the preliminary results in advance of the meeting.

Mr. Cook stated that the Gaston East-West connector and associated land use effects were considered by MUMPO in making the 2035 forecasts for the Metrolina model. The participants agreed that the 2035 Metrolina model forecasts should be used as the Build condition because the indirect effect of the project was reflected in the household and employment forecasts. Mr. Cook noted that the forecasting approach is consistent between the various MPOs in the study area.

The participants noted that the preliminary indirect effects analysis results for the Mecklenburg County portion of the study area show little change between the No Build and Build condition and the direction of the change is downward (e.g. lower household and employment levels in western Mecklenburg County in the Build condition compared to the No Build). Berger explained that the gravity model approach redistributes growth based on accessibility to employment centers. The gravity model results show southern Gaston County and northern York County receiving the largest increase in accessibility

from the project, and as a result the majority of the indirect land use effects are concentrated in these areas. Mecklenburg County has a well established transportation network and would not experience as large a change in accessibility. As a result, the gravity model approach shifts a small portion of the growth projected for Mecklenburg County and other areas in the Metrolina model to southern Gaston and northern York counties. The participants agreed the results appeared reasonable and consistent with their expectation that the Gaston East-West Connector would not substantially affect land use in Mecklenburg County.

Appendix B

Household and Employment Forecasts

This appendix provides the 2005 and 2035 (No Build and Build) household and employment estimates for the ICE study area. A key to the field names used in the data table is provided below. The household and employment results presented in the table are unrounded.

Field Name	Explanation
TAZ	Metrolina model Traffic Analysis Zone ID.
TAZ_Acres	Calculated acreage of the Metrolina model TAZ. The portion of the TAZ within the study area may be less than this total—see the Sub Zone Acres field.
State	37= North Carolina 45= South Carolina
County	45= Cleveland 71= Gaston 91= York 119= Mecklenburg
HUC12	Hydrologic Unit Code 12 watershed name
Sub Zone ID	See Section 2.1.5 of the report for the explanation of how the Metrolina model TAZs were split into smaller zones based on watershed boundaries.
Sub Zone_Acres	Calculated acreage of sub zone. Note that zones displayed as “zero” indicate zones with an area of less than 0.5 acres.
HH_2005	2005 Households
NB_HH_2035	2035 No Build Households
B_HH_2035	2035 Build Households
EMP_2005	2005 Employment
NB_EMP_2035	2035 No Build Employment
B_EMP_2035	2035 Build Employment

TAZ	TAZ_Acres	State	County	HUC12	Sub Zone ID	Sub Zone_Acres	HH_2005	NB_HH_2035	B_HH_2035	EMP_2005	NB_EMP_2035	B_EMP_2035
2001	149	37	71	Catawba Creek	251	16	37	50	47	22	24	24
2002	84	37	71	Catawba Creek	252	2	0	3	3	23	27	27
2003	99	37	71	Catawba Creek	250	99	82	90	89	632	781	781
2004	85	37	71	Catawba Creek	249	79	36	41	41	1,728	1,755	1,755
2006	254	37	71	Catawba Creek	253	3	2	2	2	4	4	4
2007	125	37	71	Catawba Creek	288	6	4	5	5	7	7	7
2008	35	37	71	Catawba Creek	287	35	9	10	10	188	220	220
2009	44	37	71	Catawba Creek	286	44	11	9	9	211	245	245
2010	489	37	71	Duharts Creek-South Fork Catawba River	244	14	16	16	16	36	39	39
2010	489	37	71	Catawba Creek	245	476	547	559	556	1,265	1,369	1,351
2011	148	37	71	Catawba Creek	248	148	294	318	315	266	278	277
2012	366	37	71	Catawba Creek	205	366	645	721	713	1,218	1,402	1,395
2013	434	37	71	Upper Crowders Creek	206	8	15	15	15	6	7	7
2013	434	37	71	Catawba Creek	207	426	826	831	831	347	375	375
2014	112	37	71	Catawba Creek	210	112	290	492	492	44	46	46
2015	149	37	71	Upper Crowders Creek	208	3	7	8	8	2	2	2
2015	149	37	71	Catawba Creek	209	146	349	376	375	95	99	99
2016	650	37	71	Upper Crowders Creek	158	636	1,048	1,281	1,287	356	445	452
2016	650	37	71	Catawba Creek	159	14	23	28	28	8	10	10
2017	67	37	71	Catawba Creek	211	60	74	92	90	242	288	287
2018	240	37	71	Upper Crowders Creek	212	1	3	3	3	1	1	1
2018	240	37	71	Catawba Creek	213	1	2	2	2	1	1	1
2019	130	37	71	Catawba Creek	215	31	59	74	71	44	46	46
2022	187	37	71	Upper Crowders Creek	214	12	17	22	21	13	13	13
2023	228	37	71	Upper Crowders Creek	164	176	213	258	250	211	226	224
2023	228	37	71	Catawba Creek	165	1	1	1	1	1	1	1
2024	566	37	71	Upper Crowders Creek	160	555	807	883	878	524	663	663
2024	566	37	71	Catawba Creek	161	11	16	18	18	11	13	13
2025	448	37	71	Upper Crowders Creek	162	448	553	751	731	437	852	839
2026	808	37	71	Upper Crowders Creek	106	808	263	576	575	332	561	574
2027	929	37	71	Upper Crowders Creek	105	929	806	1,130	1,228	150	154	155
2028	543	37	71	Upper Crowders Creek	156	507	605	915	961	581	618	625
2028	543	37	71	Lower Crowders Creek	157	35	42	64	67	41	43	44
2029	231	37	71	Upper Crowders Creek	202	5	7	8	8	10	11	11
2029	231	37	71	Lower Crowders Creek	203	1	2	2	2	3	3	3
2029	231	37	71	Catawba Creek	204	225	334	378	379	495	534	538
2030	319	37	71	Upper Crowders Creek	151	0	0	0	0	0	0	0
2030	319	37	71	Lower Crowders Creek	152	318	260	355	372	109	112	113
2030	319	37	71	Catawba Creek	153	0	0	1	1	0	0	0
2031	847	37	71	Lower Crowders Creek	149	23	22	31	32	8	10	10
2031	847	37	71	Catawba Creek	150	824	794	1,119	1,155	291	345	354
2032	121	37	71	Catawba Creek	200	121	293	310	310	256	266	267
2033	773	37	71	Catawba Creek	148	773	958	1,115	1,119	354	369	370
2034	641	37	71	Duharts Creek-South Fork Catawba River	198	4	6	7	7	0	0	0
2034	641	37	71	Catawba Creek	199	637	997	1,145	1,136	79	82	82
2035	520	37	71	Catawba Creek	195	520	348	1,162	1,187	99	179	187
2036	556	37	71	Duharts Creek-South Fork Catawba River	242	530	547	597	590	775	837	833
2036	556	37	71	Catawba Creek	243	26	26	28	28	37	40	40
2037	282	37	71	Duharts Creek-South Fork Catawba River	246	267	158	189	182	543	681	658
2037	282	37	71	Catawba Creek	247	15	9	10	10	31	39	38
2038	316	37	71	Duharts Creek-South Fork Catawba River	284	223	655	687	678	427	452	446
2038	316	37	71	Catawba Creek	285	90	264	277	273	172	182	180
2039	118	37	71	Duharts Creek-South Fork Catawba River	341	118	146	150	149	441	465	460
2040	448	37	71	Duharts Creek-South Fork Catawba River	340	439	67	259	251	4,779	5,217	5,226
2041	182	37	71	Duharts Creek-South Fork Catawba River	283	182	30	30	30	1,230	1,443	1,443

TAZ	TAZ_Acres	State	County	HUC12	Sub Zone ID	Sub Zone_Acres	HH_2005	NB_HH_2035	B_HH_2035	EMP_2005	NB_EMP_2035	B_EMP_2035
2042	81	37	71	Duharts Creek-South Fork Catawba River	282	81	0	0	0	1,015	1,045	1,045
2043	253	37	71	Duharts Creek-South Fork Catawba River	342	253	227	266	257	245	519	470
2044	332	37	71	Duharts Creek-South Fork Catawba River	338	332	119	139	133	2,342	2,475	2,444
2045	561	37	71	Duharts Creek-South Fork Catawba River	281	561	834	921	900	263	276	274
2046	985	37	71	Duharts Creek-South Fork Catawba River	193	12	15	19	19	2	8	8
2046	985	37	71	Catawba Creek	194	973	1,234	1,557	1,542	193	637	653
2047	880	37	71	Duharts Creek-South Fork Catawba River	240	880	876	1,163	1,099	64	68	67
2047	880	37	71	Catawba Creek	241	1	1	1	1	0	0	0
2048	570	37	71	Duharts Creek-South Fork Catawba River	280	570	510	778	719	344	414	404
2049	141	37	71	Duharts Creek-South Fork Catawba River	344	141	98	181	158	158	308	276
2050	614	37	71	Duharts Creek-South Fork Catawba River	293	614	308	409	395	396	522	513
2051	219	37	71	Duharts Creek-South Fork Catawba River	292	212	205	549	546	408	463	466
2052	512	37	71	Duharts Creek-South Fork Catawba River	291	10	11	14	14	7	11	11
2053	303	37	71	Duharts Creek-South Fork Catawba River	290	1	1	1	1	1	1	1
2054	582	37	71	Duharts Creek-South Fork Catawba River	289	11	14	16	15	10	10	10
2057	489	37	71	Duharts Creek-South Fork Catawba River	254	0	0	0	0	0	0	0
2058	236	37	71	Duharts Creek-South Fork Catawba River	255	164	10	15	15	0	0	0
2059	148	37	71	Duharts Creek-South Fork Catawba River	217	65	6	9	9	0	0	0
2060	1,630	37	71	Duharts Creek-South Fork Catawba River	218	1,616	170	280	291	12	12	12
2061	1,203	37	71	Duharts Creek-South Fork Catawba River	256	1,145	128	420	391	92	96	96
2062	676	37	71	Duharts Creek-South Fork Catawba River	257	666	222	465	475	8	39	43
2063	591	37	71	Duharts Creek-South Fork Catawba River	258	591	143	374	336	179	759	701
2064	527	37	71	Duharts Creek-South Fork Catawba River	294	527	447	514	492	237	558	471
2065	285	37	71	Duharts Creek-South Fork Catawba River	337	285	148	202	184	188	199	196
2066	378	37	71	Duharts Creek-South Fork Catawba River	279	378	245	414	375	3,532	3,814	3,765
2067	605	37	71	Duharts Creek-South Fork Catawba River	239	605	663	892	882	334	574	580
2068	579	37	71	Duharts Creek-South Fork Catawba River	188	569	190	351	371	97	135	142
2068	579	37	71	Catawba Creek	189	11	4	7	7	2	3	3
2069	696	37	71	Duharts Creek-South Fork Catawba River	191	673	370	1,096	1,051	411	676	678
2069	696	37	71	Catawba Creek	192	23	13	38	36	14	23	23
2070	453	37	71	Duharts Creek-South Fork Catawba River	142	7	3	10	10	2	4	4
2070	453	37	71	Catawba Creek	143	446	226	623	635	110	263	277
2071	867	37	71	Catawba Creek	141	867	798	1,169	1,182	47	49	49
2072	945	37	71	Lower Crowders Creek	144	22	16	23	25	6	6	6
2072	945	37	71	Catawba Creek	145	924	675	985	1,053	254	273	278
2073	1,233	37	71	Lower Crowders Creek	95	6	4	6	7	1	1	1
2073	1,233	37	71	Catawba Creek	96	1,227	812	1,324	1,474	218	258	270
2074	304	37	71	Lower Crowders Creek	146	17	1	1	1	1	1	1
2074	304	37	71	Catawba Creek	147	286	9	10	10	20	21	21
2075	1,295	37	71	Lower Crowders Creek	99	1,254	387	1,767	2,058	321	465	497
2075	1,295	37	71	Catawba Creek	100	41	13	57	67	11	15	16
2076	259	37	71	Upper Crowders Creek	103	1	1	1	1	0	0	0
2076	259	37	71	Lower Crowders Creek	104	258	168	239	263	32	33	33
2077	469	37	71	Upper Crowders Creek	154	445	460	632	692	179	185	187
2077	469	37	71	Lower Crowders Creek	155	24	25	35	38	10	10	10
2078	747	37	71	Upper Crowders Creek	101	530	288	443	520	117	121	122
2078	747	37	71	Lower Crowders Creek	102	218	118	182	213	48	49	50
2079	1,127	37	71	Upper Crowders Creek	71	1,127	220	326	350	14	14	14
2080	682	37	71	Upper Crowders Creek	72	682	100	164	165	62	65	65
2081	1,128	37	71	Upper Crowders Creek	73	1,128	402	823	769	93	97	97
2082	805	37	71	Upper Crowders Creek	74	805	187	323	301	61	64	64
2083	3,080	37	71	Upper Crowders Creek	40	2,809	492	736	691	44	46	46
2083	3,080	37	71	Lower Crowders Creek	41	271	47	71	67	4	4	4
2084	1,124	37	71	Upper Crowders Creek	70	1,124	693	842	884	123	139	143
2085	1,275	37	71	Upper Crowders Creek	65	710	129	171	198	818	956	1,052

TAZ	TAZ_Acres	State	County	HUC12	Sub Zone ID	Sub Zone_Acres	HH_2005	NB_HH_2035	B_HH_2035	EMP_2005	NB_EMP_2035	B_EMP_2035
2085	1,275	37	71	Lower Crowders Creek	66	565	103	135	157	651	760	836
2086	1,621	37	71	Lower Crowders Creek	67	1,621	792	1,086	1,249	6	111	166
2087	1,959	37	71	Lower Crowders Creek	97	1,916	772	933	1,048	131	135	137
2087	1,959	37	71	Catawba Creek	98	43	17	21	24	3	3	3
2088	2,471	37	71	Mill Creek-Lake Wylie	93	1	0	1	1	0	0	0
2088	2,471	37	71	Catawba Creek	94	2,470	365	1,683	2,285	254	435	511
2089	1,404	37	71	Duharts Creek-South Fork Catawba River	139	35	11	22	24	5	6	6
2089	1,404	37	71	Catawba Creek	140	1,369	419	875	959	212	230	234
2090	1,124	37	71	Duharts Creek-South Fork Catawba River	137	1,114	219	1,261	1,360	190	314	332
2090	1,124	37	71	Catawba Creek	138	10	2	12	13	2	3	3
2091	1,725	37	71	Duharts Creek-South Fork Catawba River	187	1,718	537	1,813	1,962	88	299	329
2092	455	37	71	Duharts Creek-South Fork Catawba River	190	455	135	270	268	101	105	105
2093	466	37	71	Duharts Creek-South Fork Catawba River	238	466	206	786	774	58	301	316
2094	1,175	37	71	Duharts Creek-South Fork Catawba River	185	3	1	3	3	0	1	1
2094	1,175	37	71	Lake Wylie-Catawba River	186	2	1	2	2	0	1	1
2095	409	37	71	Duharts Creek-South Fork Catawba River	236	7	9	10	10	7	10	10
2096	525	37	71	Duharts Creek-South Fork Catawba River	237	513	615	751	741	221	240	240
2097	360	37	71	Duharts Creek-South Fork Catawba River	277	323	367	494	465	277	291	288
2099	252	37	71	Duharts Creek-South Fork Catawba River	276	0	0	0	0	0	0	0
2100	899	37	71	Duharts Creek-South Fork Catawba River	278	891	498	1,460	1,166	711	949	892
2103	825	37	71	Duharts Creek-South Fork Catawba River	296	40	30	53	48	24	110	96
2104	588	37	71	Duharts Creek-South Fork Catawba River	295	408	191	260	248	622	906	873
2105	1,005	37	71	Duharts Creek-South Fork Catawba River	259	971	831	1,048	1,036	37	38	38
2107	775	37	71	Duharts Creek-South Fork Catawba River	220	14	12	14	14	1	1	1
2108	661	37	71	Duharts Creek-South Fork Catawba River	260	1	1	2	2	1	1	1
2112	1,843	37	71	Duharts Creek-South Fork Catawba River	168	4	2	5	5	0	1	1
2113	777	37	71	Duharts Creek-South Fork Catawba River	219	10	4	5	5	7	8	8
2128	1,197	37	71	Duharts Creek-South Fork Catawba River	216	0	0	0	0	0	0	0
2134	950	37	71	Upper Crowders Creek	110	9	1	1	1	21	26	25
2135	370	37	71	Upper Crowders Creek	166	4	2	2	2	7	8	8
2136	297	37	71	Upper Crowders Creek	163	279	331	473	441	425	497	485
2137	221	37	71	Upper Crowders Creek	75	221	77	178	157	84	356	317
2138	599	37	71	Upper Crowders Creek	108	561	76	96	91	543	781	738
2139	804	37	71	Upper Crowders Creek	77	804	168	396	344	97	1,434	1,199
2140	1,381	37	71	Upper Crowders Creek	109	23	7	14	13	6	11	10
2142	1,704	37	71	Upper Crowders Creek	111	38	25	37	35	26	33	32
2143	2,024	37	71	Upper Crowders Creek	112	0	0	0	0	0	0	0
2144	1,158	37	71	Upper Crowders Creek	113	13	1	3	3	0	0	0
2145	1,660	37	71	Upper Crowders Creek	78	1,627	307	516	481	41	219	200
2146	1,493	37	71	Upper Crowders Creek	76	1,493	573	969	880	356	3,502	2,963
2147	794	37	71	Upper Crowders Creek	44	794	202	284	267	137	521	467
2148	227	37	71	Catawba Creek	201	227	425	366	368	188	196	196
2149	789	37	71	Duharts Creek-South Fork Catawba River	196	17	39	36	36	17	18	18
2149	789	37	71	Catawba Creek	197	772	1,756	1,621	1,635	754	799	798
2150	314	37	71	Upper Crowders Creek	107	314	205	374	359	70	73	73
2151	574	37	71	Lower Crowders Creek	64	574	45	125	179	4	4	4
2152	1,133	37	71	Upper Crowders Creek	31	425	37	82	110	22	64	89
2152	1,133	37	71	Lower Crowders Creek	32	708	63	137	183	38	108	149
2153	625	37	71	Upper Crowders Creek	68	604	90	182	226	1	1	1
2153	625	37	71	Lower Crowders Creek	69	21	3	6	8	0	0	0
2154	1,419	37	71	Upper Crowders Creek	36	696	144	212	231	7	7	7
2154	1,419	37	71	Lower Crowders Creek	37	724	149	221	240	8	8	8
2155	1,826	37	71	Upper Crowders Creek	38	13	2	3	3	0	0	0
2155	1,826	37	71	Lower Crowders Creek	39	1,813	312	480	464	15	15	15
2156	243	37	71	Lower Crowders Creek	33	243	15	24	30	122	125	127

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2157	731	37	71	Upper Crowders Creek	42	722	79	1,790	1,790	0	0	0
2157	731	37	71	Lower Crowders Creek	43	9	1	24	24	0	0	0
2170	3,087	37	71	Duharts Creek-South Fork Catawba River	167	346	86	154	165	6	7	7
2175	3,367	37	71	Mill Creek-Lake Wylie	129	12	2	2	2	1	1	1
2175	3,367	37	71	Duharts Creek-South Fork Catawba River	130	1,134	162	306	432	67	155	230
2175	3,367	37	71	Lake Wylie-Catawba River	131	2,032	290	547	773	120	279	413
2176	1,506	37	71	Duharts Creek-South Fork Catawba River	135	1,492	362	714	911	78	387	557
2176	1,506	37	71	Lake Wylie-Catawba River	136	10	2	5	6	1	3	4
2177	1,775	37	71	Mill Creek-Lake Wylie	132	7	1	2	3	0	1	1
2177	1,775	37	71	Duharts Creek-South Fork Catawba River	133	1,750	360	627	818	35	210	325
2177	1,775	37	71	Catawba Creek	134	18	4	7	9	0	2	3
2178	2,318	37	71	Mill Creek-Lake Wylie	88	344	47	225	341	13	52	75
2178	2,318	37	71	Duharts Creek-South Fork Catawba River	89	253	34	166	203	9	38	45
2178	2,318	37	71	Catawba Creek	90	1,721	235	1,127	1,708	63	258	375
2179	1,785	37	71	Mill Creek-Lake Wylie	91	0	0	0	0	0	0	0
2179	1,785	37	71	Catawba Creek	92	1,785	285	526	585	25	26	26
2180	1,706	37	71	Mill Creek-Lake Wylie	59	57	9	19	25	1	11	16
2180	1,706	37	71	Catawba Creek	60	1,648	274	550	711	18	289	447
2181	2,372	37	71	Mill Creek-Lake Wylie	56	1,801	304	507	637	56	21	0
2181	2,372	37	71	Lower Crowders Creek	57	509	86	143	180	16	6	0
2181	2,372	37	71	Catawba Creek	58	62	10	18	22	2	1	0
2182	1,162	37	71	Mill Creek-Lake Wylie	61	7	1	2	0	0	0	0
2182	1,162	37	71	Lower Crowders Creek	62	1,154	155	278	340	19	19	19
2182	1,162	37	71	Catawba Creek	63	1	0	0	0	0	0	0
2183	1,010	37	71	Upper Crowders Creek	34	27	1	3	4	1	1	1
2183	1,010	37	71	Lower Crowders Creek	35	983	52	116	146	26	27	27
2184	160	37	71	Duharts Creek-South Fork Catawba River	339	160	119	146	141	202	486	458
2185	436	37	71	Duharts Creek-South Fork Catawba River	343	436	234	882	783	63	498	461
2186	1,424	37	71	Lower Crowders Creek	6	1,274	79	253	209	0	0	0
2187	730	37	71	Lower Crowders Creek	14	730	107	177	212	0	0	0
2188	2,880	37	71	Lower Crowders Creek	15	2,880	198	427	408	4	4	4
2190	1,842	37	71	Upper Crowders Creek	16	401	19	24	24	1	1	1
2190	1,842	37	71	Lower Crowders Creek	17	1,220	57	86	81	2	2	2
2191	1,982	37	71	Upper Crowders Creek	114	86	13	23	21	2	2	2
2236	1,566	37	71	Upper Crowders Creek	18	1,484	113	423	351	10	72	62
2238	217	37	71	Upper Crowders Creek	79	203	187	305	273	55	77	72
2239	448	37	71	Upper Crowders Creek	45	448	108	263	234	1	11	10
3257	5,612	45	91	Beaverdam Creek-Catawba River	3	1	0	0	0	0	0	0
3257	5,612	45	91	Lower Crowders Creek	4	5,465	326	488	503	144	219	231
3258	15,605	45	91	Lower Crowders Creek	1	27	0	1	1	0	0	0
3260	5,141	45	91	Lower Crowders Creek	5	15	1	2	2	0	0	0
3261	8,972	45	91	Beaverdam Creek-Catawba River	11	3,020	835	1,201	1,393	925	1,294	1,487
3262	2,880	45	91	Beaverdam Creek-Catawba River	12	650	134	194	226	9	26	35
3262	2,880	45	91	Lower Crowders Creek	13	2,217	456	661	770	29	90	119
3266	4,803	45	91	Beaverdam Creek-Catawba River	23	4,717	407	662	750	418	733	838
3266	4,803	45	91	Lower Crowders Creek	24	85	7	12	14	8	13	15
3267	8,052	45	91	Beaverdam Creek-Catawba River	21	18	2	4	4	1	2	2
3267	8,052	45	91	Lower Crowders Creek	22	416	51	79	87	29	42	45
3268	5,163	45	91	Mill Creek-Lake Wylie	52	4,702	1,026	1,477	1,764	1,031	1,227	1,345
3268	5,163	45	91	Duharts Creek-South Fork Catawba River	53	1	0	0	0	0	0	0
3268	5,163	45	91	Lower Crowders Creek	54	18	4	6	7	4	5	5
3268	5,163	45	91	Catawba Creek	55	442	97	139	166	97	116	127
3269	1,885	45	91	Mill Creek-Lake Wylie	50	953	696	1,088	1,174	233	433	483
3269	1,885	45	91	Lower Crowders Creek	51	932	681	1,064	1,148	228	423	472
3270	6,787	45	91	Mill Creek-Lake Wylie	48	5	1	1	1	0	0	0

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3270	6,787	45	91	Lower Crowders Creek	49	1,119	144	209	239	12	37	49
3275	5,915	45	91	Mill Creek-Lake Wylie	25	10	1	2	2	1	1	1
3275	5,915	45	91	Beaverdam Creek-Catawba River	26	3,717	375	619	682	334	457	490
3275	5,915	45	91	Lower Crowders Creek	27	2,048	206	341	376	184	252	270
3276	6,063	45	91	Mill Creek-Lake Wylie	28	1,161	148	220	249	4	9	11
3276	6,063	45	91	Beaverdam Creek-Catawba River	29	44	6	8	9	0	0	0
3276	6,063	45	91	Lower Crowders Creek	30	4,857	619	924	1,043	17	40	48
4106	339	37	45	Upper Crowders Creek	82	334	252	362	329	57	85	78
4107	180	37	45	Upper Crowders Creek	115	4	1	2	2	1	5	4
4108	183	37	45	Upper Crowders Creek	80	183	152	264	230	84	101	97
4109	157	37	45	Upper Crowders Creek	47	157	147	262	225	47	61	57
4110	122	37	45	Upper Crowders Creek	81	121	140	253	217	156	152	153
4111	291	37	45	Upper Crowders Creek	83	6	4	6	5	3	4	4
4115	320	37	45	Upper Crowders Creek	46	287	346	397	381	143	250	222
4116	311	37	45	Upper Crowders Creek	19	289	154	173	167	318	470	431
4117	591	37	45	Upper Crowders Creek	20	14	6	6	6	16	22	21
4123	1,801	37	45	Upper Crowders Creek	10	1	0	0	0	0	0	0
4135	1,810	37	45	Upper Crowders Creek	9	3	0	1	1	0	0	0
4136	1,665	37	45	Upper Crowders Creek	7	382	24	95	74	160	196	187
4136	1,665	37	45	Lower Crowders Creek	8	62	4	15	12	26	31	30
4137	3,317	37	45	Lower Crowders Creek	2	4	0	1	1	0	0	0
10577	430	37	119	Lake Wylie-Catawba River	263	0	0	0	0	0	0	0
10581	482	37	119	Lake Wylie-Catawba River	264	7	1	1	1	3	2	2
10584	649	37	119	Lake Wylie-Catawba River	174	0	0	0	0	0	0	0
10587	703	37	119	Lake Wylie-Catawba River	221	30	6	41	36	34	38	38
10588	766	37	119	Lake Wylie-Catawba River	173	634	371	1,032	1,001	1,462	1,905	1,902
10589	1,219	37	119	Lake Wylie-Catawba River	176	1,216	625	922	909	131	2,222	2,213
10590	207	37	119	Lake Wylie-Catawba River	223	207	7	51	49	14	2	2
10591	1,015	37	119	Lake Wylie-Catawba River	222	1,004	109	537	475	139	345	323
10592	686	37	119	Paw Creek-Lake Wylie	226	1	0	0	0	0	1	1
10592	686	37	119	Lake Wylie-Catawba River	227	662	63	74	71	178	2,012	1,517
10593	176	37	119	Paw Creek-Lake Wylie	224	3	0	1	1	0	0	0
10593	176	37	119	Lake Wylie-Catawba River	225	172	3	46	53	11	2	0
10599	261	37	119	Lake Wylie-Catawba River	265	1	0	0	0	2	2	2
10600	2,460	37	119	Paw Creek-Lake Wylie	266	110	0	0	0	612	907	882
10600	2,460	37	119	Lake Wylie-Catawba River	267	1	0	0	0	5	8	8
10601	947	37	119	Paw Creek-Lake Wylie	228	928	145	600	608	391	2,372	2,484
10601	947	37	119	Lake Wylie-Catawba River	229	16	2	8	8	7	32	33
10602	813	37	119	Paw Creek-Lake Wylie	231	813	218	439	444	311	757	785
10603	309	37	119	Paw Creek-Lake Wylie	268	298	18	18	18	174	126	124
10604	514	37	119	Paw Creek-Lake Wylie	180	9	0	13	15	1	0	0
10604	514	37	119	Lake Wylie-Catawba River	181	504	21	702	797	32	12	8
10605	279	37	119	Paw Creek-Lake Wylie	230	279	59	238	243	65	55	54
10606	746	37	119	Paw Creek-Lake Wylie	182	438	40	373	422	15	7	5
10606	746	37	119	Lake Wylie-Catawba River	183	302	28	257	291	11	5	4
10607	687	37	119	Paw Creek-Lake Wylie	184	446	25	746	742	31	173	178
10608	335	37	119	Paw Creek-Lake Wylie	234	4	1	7	6	0	2	2
10614	46	37	119	Paw Creek-Lake Wylie	316	4	1	1	1	7	6	6
10620	205	37	119	Paw Creek-Lake Wylie	269	205	0	63	61	39	544	547
10621	221	37	119	Paw Creek-Lake Wylie	233	221	18	37	34	37	305	274
10622	103	37	119	Paw Creek-Lake Wylie	271	103	3	12	11	623	674	675
10623	220	37	119	Paw Creek-Lake Wylie	303	220	11	14	14	69	50	51
10624	96	37	119	Paw Creek-Lake Wylie	317	90	0	2	2	122	84	87
10625	87	37	119	Paw Creek-Lake Wylie	304	87	6	19	18	43	13	15
10626	75	37	119	Paw Creek-Lake Wylie	302	75	0	4	4	101	75	76

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10628	130	37	119	Paw Creek-Lake Wylie	272	130	116	123	122	51	118	108
10629	192	37	119	Paw Creek-Lake Wylie	307	189	66	79	76	74	187	165
10630	225	37	119	Paw Creek-Lake Wylie	270	225	114	130	130	96	484	485
10631	251	37	119	Paw Creek-Lake Wylie	235	0	0	0	0	0	0	0
10632	233	37	119	Paw Creek-Lake Wylie	232	221	153	272	254	71	144	135
10633	229	37	119	Paw Creek-Lake Wylie	274	74	21	155	135	49	66	64
10634	455	37	119	Paw Creek-Lake Wylie	297	35	10	74	62	11	24	22
10636	730	37	119	Paw Creek-Lake Wylie	328	670	712	1,112	1,092	297	738	727
10637	103	37	119	Paw Creek-Lake Wylie	332	10	19	20	20	14	11	11
10638	376	37	119	Paw Creek-Lake Wylie	327	14	36	46	45	65	86	85
10639	512	37	119	Paw Creek-Lake Wylie	320	512	550	550	631	223	223	132
10640	194	37	119	Paw Creek-Lake Wylie	318	65	19	23	23	224	322	316
10641	348	37	119	Paw Creek-Lake Wylie	329	348	337	502	514	177	175	175
10642	338	37	119	Paw Creek-Lake Wylie	299	330	240	605	557	118	103	104
10643	347	37	119	Paw Creek-Lake Wylie	309	347	302	799	752	45	27	28
10644	289	37	119	Paw Creek-Lake Wylie	321	289	467	469	469	69	57	57
10645	513	37	119	Paw Creek-Lake Wylie	308	503	154	232	228	256	1,162	1,166
10646	475	37	119	Paw Creek-Lake Wylie	319	475	230	280	276	311	405	400
10647	224	37	119	Paw Creek-Lake Wylie	306	224	124	146	144	241	449	437
10648	309	37	119	Paw Creek-Lake Wylie	305	309	100	180	185	63	132	138
10649	232	37	119	Paw Creek-Lake Wylie	323	232	280	370	370	274	248	247
10650	104	37	119	Paw Creek-Lake Wylie	322	104	215	212	212	33	18	18
10651	218	37	119	Paw Creek-Lake Wylie	310	87	132	175	174	69	313	315
10652	198	37	119	Paw Creek-Lake Wylie	300	6	0	12	12	2	7	7
10654	2,071	37	119	Paw Creek-Lake Wylie	261	17	3	13	11	4	7	7
10656	465	37	119	Paw Creek-Lake Wylie	298	4	1	3	3	4	5	5
10658	592	37	119	Paw Creek-Lake Wylie	262	1	0	1	1	0	0	0
10661	348	37	119	Paw Creek-Lake Wylie	331	335	136	138	138	1,371	1,858	1,858
10662	244	37	119	Paw Creek-Lake Wylie	335	244	547	634	632	170	522	525
10663	142	37	119	Paw Creek-Lake Wylie	334	142	334	350	349	37	23	23
10665	135	37	119	Paw Creek-Lake Wylie	336	26	66	66	66	19	15	15
10666	151	37	119	Paw Creek-Lake Wylie	333	135	416	427	426	206	185	186
10670	167	37	119	Paw Creek-Lake Wylie	326	5	0	0	0	15	14	14
10671	383	37	119	Paw Creek-Lake Wylie	330	383	326	327	327	1,031	1,874	1,874
10672	342	37	119	Paw Creek-Lake Wylie	324	324	43	48	48	772	789	791
10673	336	37	119	Paw Creek-Lake Wylie	325	326	319	334	334	454	554	559
10675	406	37	119	Paw Creek-Lake Wylie	314	66	9	16	17	128	129	129
10676	302	37	119	Paw Creek-Lake Wylie	312	5	2	2	2	4	5	5
10677	313	37	119	Paw Creek-Lake Wylie	313	15	23	28	28	3	15	16
10680	308	37	119	Paw Creek-Lake Wylie	311	4	2	3	3	2	2	2
10702	248	37	119	Paw Creek-Lake Wylie	315	0	0	0	0	0	0	0
10943	752	37	119	Lake Wylie-Catawba River	171	2	3	4	4	2	5	5
10944	417	37	119	Lake Wylie-Catawba River	172	19	8	8	8	86	110	110
10952	478	37	119	Mill Creek-Lake Wylie	169	9	5	17	16	3	9	9
10953	471	37	119	Mill Creek-Lake Wylie	116	8	1	11	10	0	5	5
10954	1,250	37	119	Mill Creek-Lake Wylie	119	1,237	136	1,511	1,327	50	504	458
10955	1,224	37	119	Mill Creek-Lake Wylie	84	1,017	72	349	319	32	1,109	1,049
10956	716	37	119	Mill Creek-Lake Wylie	117	16	2	17	15	2	9	8
10957	899	37	119	Mill Creek-Lake Wylie	118	11	3	8	7	0	2	2
10960	1,049	37	119	Mill Creek-Lake Wylie	121	57	30	138	127	26	72	69
10960	1,049	37	119	Lake Wylie-Catawba River	122	5	3	12	11	2	6	6
10961	1,795	37	119	Mill Creek-Lake Wylie	123	16	7	9	9	11	14	14
10961	1,795	37	119	Lake Wylie-Catawba River	124	1,697	790	976	958	1,203	1,519	1,500
10962	264	37	119	Lake Wylie-Catawba River	170	1	1	1	1	1	1	1
10963	1,295	37	119	Mill Creek-Lake Wylie	85	1,232	168	296	298	90	309	320

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10963	1,295	37	119	Lake Wylie-Catawba River	86	6	1	1	1	0	2	2
10964	813	37	119	Mill Creek-Lake Wylie	120	807	185	231	226	87	170	165
10965	962	37	119	Mill Creek-Lake Wylie	127	44	2	15	15	1	0	0
10965	962	37	119	Lake Wylie-Catawba River	128	918	46	318	308	10	0	0
10966	290	37	119	Mill Creek-Lake Wylie	87	290	0	2	4	4	2	0
10967	1,241	37	119	Mill Creek-Lake Wylie	125	1,227	210	613	613	28	14	13
10967	1,241	37	119	Lake Wylie-Catawba River	126	14	2	7	7	0	0	0
10968	168	37	119	Lake Wylie-Catawba River	175	168	59	107	102	18	189	177
10969	109	37	119	Lake Wylie-Catawba River	177	109	137	164	161	9	1	2
10970	320	37	119	Lake Wylie-Catawba River	179	320	7	412	396	19	4	4
10971	449	37	119	Lake Wylie-Catawba River	178	449	56	316	307	42	24	24
11056	160	37	119	Paw Creek-Lake Wylie	301	81	46	111	109	139	345	348
11057	97	37	119	Paw Creek-Lake Wylie	273	97	35	127	125	264	387	390
11058	71	37	119	Paw Creek-Lake Wylie	275	0	0	0	0	0	0	0
2060	1,630	37	71	Fites Creek-Catawba River	345	6	1	1	1	0	0	0
2062	676	37	71	Fites Creek-Catawba River	346	10	3	7	7	0	1	1
2091	1,725	37	71	Fites Creek-Catawba River	347	7	2	7	7	0	1	1
2094	1,175	37	71	Fites Creek-Catawba River	348	1,170	508	913	963	60	267	300
2095	409	37	71	Fites Creek-Catawba River	349	401	493	558	546	379	560	537
2096	525	37	71	Fites Creek-Catawba River	350	12	14	18	17	5	6	6
2097	360	37	71	Fites Creek-Catawba River	351	38	43	57	54	32	34	34
2098	778	37	71	Fites Creek-Catawba River	352	778	625	632	631	1,078	1,132	1,125
2099	252	37	71	Fites Creek-Catawba River	353	252	182	268	263	1,192	1,497	1,503
2100	899	37	71	Fites Creek-Catawba River	354	8	4	9	9	6	8	8
2101	565	37	71	Fites Creek-Catawba River	355	565	416	380	383	942	1,480	1,477
2102	629	37	71	Fites Creek-Catawba River	356	629	293	984	963	185	753	778
2103	825	37	71	Fites Creek-Catawba River	357	784	592	840	827	457	1,396	1,411
2104	588	37	71	Fites Creek-Catawba River	358	180	85	115	110	274	400	385
2105	1,005	37	71	Fites Creek-Catawba River	359	34	29	37	36	1	1	1
2107	775	37	71	Fites Creek-Catawba River	360	745	645	778	777	71	73	73
2108	661	37	71	Fites Creek-Catawba River	361	660	344	909	854	323	597	591
2109	557	37	71	Fites Creek-Catawba River	362	557	670	777	760	88	208	196
2110	363	37	71	Fites Creek-Catawba River	363	360	317	279	283	203	405	396
2111	344	37	71	Fites Creek-Catawba River	364	237	301	195	200	139	83	83
2112	1,843	37	71	Fites Creek-Catawba River	365	62	28	67	69	4	8	8
2116	2,001	37	71	Fites Creek-Catawba River	366	0	0	0	0	0	0	0
2118	289	37	71	Fites Creek-Catawba River	367	116	134	153	153	204	291	292
2175	3,367	37	71	Fites Creek-Catawba River	368	189	27	51	72	11	26	38
2176	1,506	37	71	Fites Creek-Catawba River	369	4	1	2	2	0	1	1
10606	746	37	119	Fites Creek-Catawba River	370	6	1	1	1	0	0	0
10607	687	37	119	Fites Creek-Catawba River	371	241	13	434	419	16	100	100
10608	335	37	119	Fites Creek-Catawba River	372	331	50	529	471	19	148	137
10629	192	37	119	Fites Creek-Catawba River	373	4	1	2	2	1	4	3
10631	251	37	119	Fites Creek-Catawba River	374	251	34	153	141	18	35	34
10632	233	37	119	Fites Creek-Catawba River	375	12	8	15	14	4	8	7
10633	229	37	119	Fites Creek-Catawba River	376	156	43	280	279	102	133	135
10634	455	37	119	Fites Creek-Catawba River	377	420	117	910	761	140	285	263
10635	272	37	119	Fites Creek-Catawba River	378	272	64	228	211	92	94	94
10642	338	37	119	Fites Creek-Catawba River	379	2	2	4	4	1	1	1
10645	513	37	119	Fites Creek-Catawba River	380	10	3	5	5	5	28	28
10653	326	37	119	Fites Creek-Catawba River	381	213	0	0	0	13	0	0
10654	2,071	37	119	Fites Creek-Catawba River	382	663	127	524	457	161	310	292
10656	465	37	119	Fites Creek-Catawba River	383	452	145	396	346	446	546	531
10657	176	37	119	Fites Creek-Catawba River	384	4	0	0	0	0	10	10
10659	204	37	119	Fites Creek-Catawba River	385	37	6	15	14	5	5	5

TAZ	TAZ_Acres	State	County	HUC12	Sub Zone ID	Sub Zone_Acres	HH_2005	NB_HH_2035	B_HH_2035	EMP_2005	NB_EMP_2035	B_EMP_2035
10686	429	37	119	Fites Creek-Catawba River	386	13	4	7	7	1	2	2
11058	71	37	119	Fites Creek-Catawba River	387	71	15	129	127	20	76	78
					Total	169,763	66,646	114,169	117,444	65,105	102,533	102,170