Transportation Feasibility & Impact Analyses FY 2013

I-85 Future Interchange Location Analysis

Final Technical Memorandum

June 28, 2013

Table of Contents

Tables

Figures

Executive Summary

This Hot Spot analysis is the evaluation of a potential interchange on I-85 in Granville County. The 2008 Granville County CTP and the MPO's 2040 MTP identify a potential need for an additional interchange between Exit 191 (NC 56) and Exit 202 (US 15). The goal of this hot spot study is to evaluate the impacts of potential interchange locations, and identify their potential benefits and challenges. The study is a technical analysis of current and future traffic conditions in the study area, potential improvements and their impacts on network connectivity, traffic, and the community.

This study focuses on the identification and comparative evaluation of three potential I-85 interchange locations and the resulting performance of the overall transportation network performance, with due consideration given to emergency response, economic development, and land use.

Baseline Conditions

The study area is rural in nature with most of the population and employment in the towns of Creedmoor, Butner, Stem, and Oxford. However the area is growing. Granville County's population increased 24 percent from 2000 to 2010, with much of that growth in south Granville. Economic development growth, as measured by new non-farm businesses, saw more modest growth of 6 percent.

TABLE 1 GRANVILLE COUNTY POPULATION 2000-2010

Town	2000 Population	2010 Population	% change
Butner	5,792	7,591	31.1%
Creedmoor	2,232	4,124	84.7%
Oxford	8,338	8,461	1.5%
Stem	229	463	102.2%

Travel conditions were estimated for the study area using the Triangle Regional Model's outputs showing existing conditions are within acceptable levels when looking at regional mobility. No roadways within the study area currently experience high levels of congestion.

The results of the capacity analysis for the 2012 existing conditions indicate that the intersections in the study area operate within acceptable levels-of-service of C or better for both the morning and afternoon peak-hours, with a few movements operating at a service level of D for AM and PM peak-hours. These intersections are very close to LOS C and small operational changes may reduce delay in the short-term.

Future Baseline Roadway Conditions

The Triangle Regional Model was used for the regional analysis, and shows acceptable Volume to Capacity ratios and travel speeds in the future to 2040. Volumes are expected to increase steadily over the time period with minor changes in the study area, and no mainline capacity issues.

Intersection-level analysis shows a significant change, however, at Exit 202 for the vehicle movement from Northbound I-85 to Northbound US 15. This LOS may warrant signalization of the interchange in the future. The future condition for Exit 191 includes a widening of NC56 from two lanes to four lanes. With this improvement, the intersections are expected to operate well. Although not tested as part of this analysis, the absence of this project would likely result in poor conditions in the future year.

Interchange Justification Requirements

When proposing a new interchange on the Interstate System, justification for this new connection must be provided for review and approval by the Federal Highway Administration (FHWA) even if no federal funds are being used for the improvement. This report summarizes the guidance set forth in order to complete the Interchange Justification Report, sometimes referred to as an Interstate System Access Change Request.

The FHWA focuses on mobility, safety, and congestion as major components of interchange justification. The Administration places a premium on looking at utilizing existing infrastructure through operational improvements over the development of a new interchange to relieve congestion. However, other impacts such as economic development are acknowledged within the interchange guidance. The Guide states, "*The impact of access changes on the operations of the Interstate System are important; also of equal importance is the impact the changes will have on the system as a whole, the environment, potential economic development, the local street system, and safety, both on and off of the Interstate System.*"[1]

Interchange Location Alternatives Analyses

The analysis of alternatives focuses on congestion, but as described above, other considerations such as economic development, impacts to street systems, safety, and the environment are included, though each should be explored in future in-depth studies.

Criteria used for the selection of the alternatives include:

- Location between I-85 Exits 191 and 202
- Connection to an existing roadway
- Provision of emergency access to I-85
- Impact to nearby wetlands, buildings and/or facilities
- Greater support for economic development

Five possible interchange locations were identified:

- Brogden Road (SR 1127)
- Sanders Road (SR 1132)

[1] FHWA Interstate System Access Information Guide, August 2010, p1

- Smith Road (SR 1135)
- Bryan Hills Road
- Thollie Green Road

Of these, the first three were advanced for more detailed study. The rest areas at mile marker 199 make access from Bryan Hills Road untenable, while the small right-of-way and residential nature of Thollie Green Road removed this option from further consideration. The evaluation of the three alternatives is summarized in the table below.

TABLE 2 ALTERNATIVES EVALUATION

	Brogden Road (SR 1127)	*Sanders Road (SR 1132)*	*Smith Road (SR 1135)*
Mobility Impacts			
Improved 2040 V/C ratio	●	●	●
Improved 2040 LOS	◒	◒	◒
Need for 2040 regional mobility	○	○	○
Environmental Impacts (high score = low impacts)			
Water quality	●	◒	◒
Wetlands / Flood hazards	◒	●	●
Air quality	●	●	●
Energy usage	n/a	n/a	n/a
Community Impacts			
Improve mobility	●	●	●
School access	◒	●	◒
Minimize existing land use changes	○	◒	◒
Bike/Ped access improvements	○	○	○
Emergency Management Impacts			
Access to midpoint	○	◒	●
Access to high crash areas	●	◒	○
Economic Development Impacts			
Proximity to growth	●	◒	○
Distance to existing/planned water & sewer	●	○	○
Undeveloped / underdeveloped land	●	◒	◒
Large parcels	●	◒	○

Key: ● = High rating ◒ = Medium Rating ○ = Low Rating

Brogden Road Summary

Brogden Road is located 2 miles north of I-85 Exit 191 at MM 193. It is the most direct route connecting the Towns of Creedmoor and Stem. It is a two lane rural road, has a speed limit of 55 mph and passes over I-85 at its intersection. The interchange is included in the Regional Comprehensive Transportation Plan and the Triangle Regional Model in the year 2030.

TRM results show the corridor as mostly unconstrained through 2040, limiting the mobility improvements of this interchange. Mainline congestion remains low with a new Brogden Interchange with a relative increases in volumes expected on the I-85 mainline NC 56 at W. Lyon Station Road, US 15 North of Creedmoor and at Hester Road, and on Brogen and its link with W. Lyons Station Road. These changes in travel patterns point toward shifts in traffic from Creedmoor, Butner, Oxford, and Stem to use the new interchange.

Brogden Road provides the most economic benefit of the three options, as it is closest to existing and projected growth centers, has parcels of a size that could be appealing to developers, and is closest to existing water and sewer service. It is also mostly undeveloped, meaning that new business could locate here, but at the cost of noticeable changes to the existing character. The presence of wetlands near Brogden Road could limit some development opportunities and impact the design of the intersection, but these issues would need to be examined more closely in future studies.

From a safety standpoint, crashes on I-85 have disproportionally occurred on the southern end of the Exit 191 to Exit 202 section of I-85, and this interchange would provide the best access to those high-crash areas.

Sanders Road Summary

Sanders Road is located 5.75 miles north of I-85 Exit 191 near MM 197. It is a two lane rural road, has a speed limit of 55 mph and passes under I-85 at its intersection. Sanders connects US 15 to the east and Belltown Road to the west and provides access to Granville Central High School, whose Assistant Superintendent has expressed support for an interchange at this location.

TRM results show the corridor as mostly unconstrained through 2040, limiting the mobility improvements of this interchange. However, significant increases in mainline volumes on Sanders Road would be expected in this alternative.

This location would greatly increase access to Granville High School, which has clear benefits to users of the school, but safety concerns related to increased traffic may dampen that benefit. Additionally, Sanders Road would have less economic development potential than other alternatives based on existing development patterns, limited numbers of large parcels, and lack of access to water and sewer service.

Smith Road Summary

Smith Road is located approximately 5 miles south of I-85 Exit 202 near MM 198 and 6 miles north of I-85 Exit 191. It is a two lane rural road, has a speed limit of 55 mph and passes over I-85 at its intersection. Like Sanders, Smith Road connects US 15 to the east and Belltown Road to the west.

TRM results show the corridor as mostly unconstrained through 2040, limiting the mobility improvements of this interchange. Regional model results do show significant increases in mainline volumes on Smith Road, with reductions in volumes on US 15 south of Smith Road and Belltown Road. The changes in travel patterns point to an interchange at this location being utilized primarily by commuters north of the interchange in the Oxford area. There is also a reduction in vehicles utilizing Exit 202, US 15.

Smith Road's central location would be highly desired by emergency management personnel, though highway crashes have occurred more frequently on the southern end of the corridor. However, its economic development potential is the lowest of the alternatives.

Recommendations

A new interchange would have limited benefits because it is not forecasted to relieve congestion on study area roadways or adjacent interchanges to a measurable extent. Therefore, from a mobility standpoint the interchange will not need to be constructed prior to the year 2040. If an interchange is deemed desirable and necessary for the economic development and emergency management goals of the region it is recommended that it be located at Brogden Road.

Additional improvements are recommended within the study area and include:

- Pedestrian signals, crosswalks, and sidewalks at Exit 191 (if plans move forward with regional bicycle/pedestrian connectivity plans)
- Traffic signals at Exit 202 to reduce the number of crashes (following MUTCD criteria Warrant 7 of more than 5 correctable crashes per year)
- Pedestrian signals, crosswalks, and sidewalks at Exit 202 (if plans move forward with regional bicycle/pedestrian connectivity plans)
- Pedestrian signals, crosswalks, and striping at New Brogden Interchange (if plans move forward with regional bicycle/pedestrian connectivity plans)

Cost Estimate and Implementation

The costs for interchange improvements can vary widely depending upon the level of construction, environmental issues encountered, materials costs, etc. As such, the cost estimates provided are order of magnitude estimates, and should be used as a ballpark figure only.

TABLE 3 COST ESTIMATES FOR RECOMMENDATIONS

Improvement	Cost
New Brogden Interchange	$14M--$17M
Pedestrian signals, crosswalks, and sidewalks at Exit 191 (if plans move forward with regional bicycle/pedestrian connectivity plans)	$185,000--$250,000
Traffic signals at Exit 202 to reduce the number of crashes (following MUTCD criteria Warrant 7 of more than 5 crashes per year)	$125,000--$250,000
Pedestrian signals, crosswalks, and sidewalks at Exit 202 (if plans move forward with regional bicycle/pedestrian connectivity plans)	$270,000--$365,000
Pedestrian signals, crosswalks, and striping at New Brogden Interchange (if plans move forward with regional bicycle/pedestrian connectivity plans)	$310,000--$500,000

Introduction

The Capital Area Metropolitan Planning Organization (CAMPO) has developed a program to look at areas of concern within their region that were previously identified as in need of further study. This analysis is part of that program referred to as "Hot Spots" where an objective look at these areas aims to provide information about improvement decisions moving forward.

This Hot Spot analysis is the evaluation of a potential interchange on I-85 in Granville County. The 2008 Granville County CTP and the MPO's 2040 MTP identify a potential need for an additional interchange between Exit 191 (NC 56) and Exit 202 (US 15) where safety concerns exist due to lack of access to the Interstate for emergency vehicles within this 11 mile stretch. In addition, there is no alternate routing available for vehicles in the event of an incident or emergency. There may be additional operational benefits to the adjacent interchanges and economic development within the study area from having an additional freeway access point. The goal of this hot spot study is to evaluate the impacts of potential interchange locations, and identify their potential benefits and challenges. The study is a technical analysis of current and future traffic conditions in the study area, potential improvements and their impacts on network connectivity, traffic, and the community.

Study Purpose

This study focuses on the identification of three potential I-85 interchange locations and the resulting performance of the overall transportation network performance, with due consideration given to EMS response, economic development, and land use. The purpose of this analysis is to recommend a location for a new interchange that would meet the federal interchange access justification criteria, one that would improve mobility and emergency management on I-85 while maintaining the existing character of the study area (Figure 1) and providing economic development opportunities. NC 56 at exit 191 and US 15 at exit 202 are central spines for Butner, Creedmoor, and Oxford downtowns, and the absence of additional exits between these towns has no doubt influenced the development character of these communities. Balancing mobility, development, and incident management can be accomplished through coordination and consideration of various alternatives.

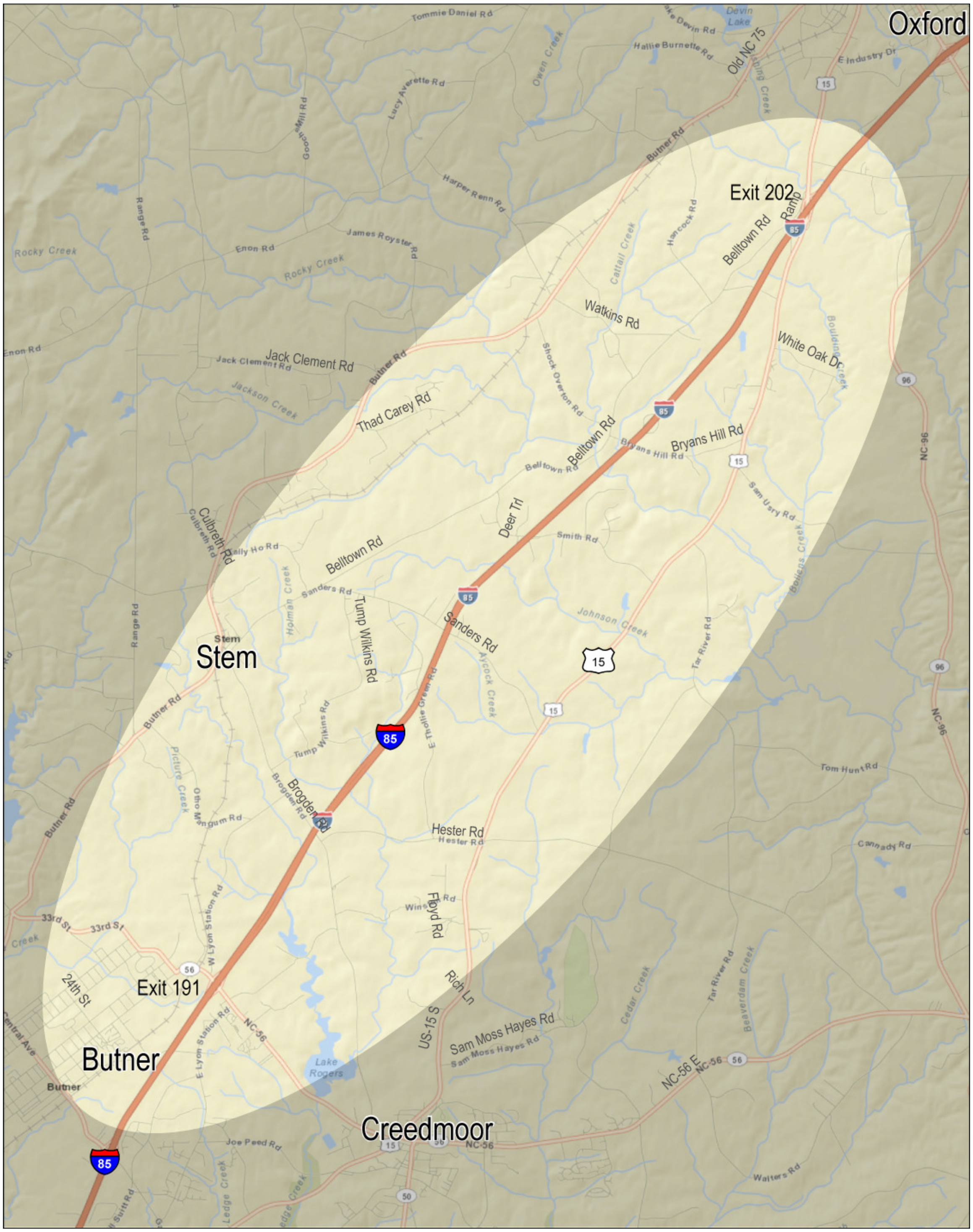

FIGURE 1 STUDY AREA MAP

Approach

An approach was developed to provide the most objective evaluation of a new interchange and its potential impacts. It has been completed in the following steps.

Analysis of Existing Conditions and Trends
Objective: Collect, review, and analyze transportation and socio-economic data and identify current and future trends for the study area(s).

Identification and Evaluation of Transportation Improvements
Objective: Identify potential network, operational and safety transportation improvements and assess the suitability of those improvements analyzed.

Evaluation of Feasibility and Impacts
Objective: Evaluate the feasibility of a federally-approved future interchange and evaluate the local direct and indirect transportation impacts of different interchange locations.

Conclusions
Objective: Develop a preferred interchange location, and costs for potential relevant short- and long-term transportation improvements.

Baseline Conditions

Baseline conditions and trends includes a review of previous studies and plans and their relevance, existing population, employment, and land use, interchange traffic conditions, emergency management operations, and economic development for the current and baseline future year of 2040.

Review of Existing Plans

The following relevant regional studies were reviewed:

2040 Metropolitan Transportation Plan

Description
The 2040 Metropolitan Transportation Plan (MTP) was developed jointly by CAMPO and DCHC and lays out the vision for the region, alternatives to achieving that vision, and the policies, projects and costs to help assist in reaching regional goals.

The transportation Vision for the region is "*a seamless integration of transportation services that offer a range of travel choices and are compatible with the character and development of our communities, sensitive to the environment, improve quality of life and are safe and accessible for all*." This vision is to be achieved through objectives centered on the goal of development of a regional transportation network that is Sustainable; Efficient, Safe & Reliable; and, Affordable & Accessible.

Relevance

This Plan not only requires that projects identified as part of this analysis should meet the goals and objectives of the Plan, but it identifies long range projects to assist in achieving its vision. There are two relevant projects within the I-85 Future Interchange Analysis:

- Widening of NC56 from I-85 (Exit 191) to US 15 from two lanes to four in 2040
- New interchange at I-85 and Brogden Road in the year 2030

Both of these projects are reflected in the Triangle Regional Model.

CAMPO Transportation Improvement Program

Description

The Transportation Improvement Program (TIP) is the region's 5 year fiscally constrained work program of transportation improvements. The TIP includes projects for all modes, funding amounts and sources, years of development, and project phasing.

Relevance

In addition to regular maintenance, bridge replacement/repair, enhancements, and preservation projects, the following projects and initiatives may be within the study area of the I-85 Future Interchange Analysis and include:

TABLE 4 RELEVANT TIP PROJECTS

ID	Project/Initiative	Total Project Cost	Completion Year
C-5114	Feasibility Study for "Greenway – Spur of 'Hike and Bike' Project" (Granville County, location unknown)	$596,000	2012
C-5144	Cross-Town pedestrian-Bicycle Sidewalk and Trail. Construct a multiuse Trail (Granville County, location known)	$477,000	2012
C-5166	NC 56 Greenway Project constructing bike-ped trail system	$2,091,000	2015

Granville County CTP

Description

The Comprehensive Transportation Plan (CTP) was developed to ensure that the transportation system is developed to meet the needs of the county. It serves as an official guide to providing a well-coordinated, efficient, and economical transportation system of all modes. The purpose of the CTP is to examine present and future transportation needs of the county and develop a plan to meet those needs. The plan recommends improvements deemed necessary to provide an efficient transportation system within the 2005-2035 planning period.

The CTP includes a Vision to:

1) Enhance connectivity throughout the county by developing a transportation network that promotes and adequately supports economic development and is compatible with the environment and land use patterns.
2) Provide convenient, safe, reliable and affordable transportation choices and education to the public on those choices.
3) Develop a regional transportation network that improves quality of life while protecting and enhancing the environment.

Relevance

The CTP identifies several initiatives and proposed improvements that are relevant within the I-85 Future Interchange Analysis area including:

- The Granville County CTP identifies two possible locations for a new interchange: Sanders Road (SR 1132) and Hester Road (SR 1129)
- Roadway improvement needs on US 56 at Exit 191
- Roadway improvement on US 15 from Creedmoor to Oxford including at Exit 202
- Need for bicycle improvements on US 15 at Exit 202 and on NC 56 at Exit 191
- Bus Route improvements on I-85 between Exits 191 and 202
- NC 56 is recommended as part of a future bus circulator corridor to provide service from Butner to Creedmoor
- Granville County Greenway Corridor along US15 and US 56 at Exit 191
- Widening on I-85 to 6 lanes through the county

NCDOT 2040 Plan

Description

The NCDOT 2040 Plan includes four documents that define the strategies and investments required to maintain, improve, and expand the State's multi-modal transportation network to meet the State's mobility needs, ensure safety and promote economic growth. The four documents include:

Challenges and Opportunities—Documents the preparation of the NCDOT 2040 Plan and defines baseline conditions in terms of both transportation systems and the social and economic forecasts that must drive transportation program delivery. It identifies a series of transportation challenges that the plan must address and the opportunities available for addressing those challenges.

System Inventory and Modal Needs— The purposes of this report are to 1) provide a profile of existing modal conditions and performance as a frame of reference for the preparation of a 30-year plan for the delivery of transportation infrastructure and services in the state, and 2) present an estimate of the future modal needs, for both capital and operating costs, to the year 2040 to serve as a foundation for subsequently examining priorities for investing in transportation infrastructure and operational services.

Financial Plan and Investment Strategies—The ability to implement the vision that the 2040 Plan defines is contingent upon having in place funding sources that generate adequate and sustainable revenues over the long term to meet transportation needs. This technical report provides the results of the financial planning analysis conducted to support the Plan's recommendations.

Strategic Policies, Processes and Programs—This report addresses three primary objectives: 1) Identifies the principle planning policies, processes and programs in place throughout the State at all levels; 2) Assesses how they may be better coordinated; and, 3) Recommends how they may be better integrated into the 2040 Plan initiatives.

Relevance

In order for projects to be funded through NCDOT they must support the goals and objectives of the Department. The Plan provides relevant policies, processes and programs of the Plan including (in no particular order):

TABLE 5 NCDOT 2040 PLAN POLICIES

Policies, Processes and Programs	Relevance
Focus Investment on Multimodal Facilities of Statewide Importance	Including multimodal considerations into improvements may provide better state funding opportunities
Work with Regional Planning Partners to Increase Flexibility and Responsiveness	Better coordination with NCDOT
Reward Entities that Better Integrate Land Use and Transportation Planning	Developing land use policies that make land use and transportation more efficient may provide better state funding opportunities
Expedite Project Development and Delivery Through Improved Efficiency and Flexibility	Better coordination with NCDOT

Policies, Processes and Programs	Relevance
Strengthen Planning Processes to Recognize North Carolina's Diversity	On-going community, historic, and cultural inclusion to ensure transportation decisions are inclusive.
Maximize Economic Opportunity and Job Creation via Improved Freight Initiatives	Include freight community in on-going phases of interchange development to support economic growth
Establish New Sources of Revenue for Transportation Investments	Monitor state revenue changes to ensure funding is available for improvements
Increase Funding Flexibility to Recognize Regional, Urban and Rural Differences	Monitor state revenue changes to ensure funding is available for improvements
Embrace and Capitalize on Technological Advances	Monitor technological advances and incorporate in future transportation designs as necessary.

CAMPO Congestion Management Process (CMP)

Description

The CAMPO CMP looks at the contributors to congestion and attempts to address them through mitigation objectives and strategies aimed at addressing current and heading off future congestion. It is multimodal in nature and takes both quantitative and qualitative approaches to assessing and addressing regional and localized congestion.

Relevance

The process notes that alternative modes, transportation demand management, transportation system management, etc. all play an important role in maintaining the system and reducing overall congestion. Therefore, alternatives should be considered when conducting regional planning for congestion.

CAMPO Intelligent Transportation Systems Strategic Deployment Plan Update

Description

This plan provides the Vision, Goals, Objectives, and Strategies to implement ITS systems to allow vehicles to navigate regional roadways efficiently, effectively, and safely. It lays out the regional ITS architecture, which is a blueprint for ITS integration and implementation over a 25 year time horizon.

Relevance

The I-85 corridor in Granville County is recommended for Incident Management Assistance Patrols (IMAP) Expansion.

Butner 2020 Comprehensive Land Use Plan

Description

The purpose of this plan is to establish a set of clear policy goals and objectives that promote the desired vision for the Town's future, as established through consultation with the plan Advisory Committee and the citizens of the Town of Butner. To achieve this, the plan sets forth the goals in both a graphic format, geographically illustrating the desired future location and extent of different land use types, as well as through written policy guidelines that articulate the desired vision.

Relevance

The Plan provides as a few of its goals:

- Provide a pattern of commercial development which best serves community needs through maximum efficiency and accessibility along NC 56 and the I-85 corridor
- Provide a pattern of clustered industrial development which best serves community needs through maximum efficiency and accessibility along the Southern Railroad and I-85

It also includes several roadway projects that may impact the study area including widening NC 56 to 5 lanes from 33rd Street through the Lyon Station District.

Oxford Comprehensive Plan

Description

Oxford's Plan provides a clear community vision to:

- Retain its rural atmosphere where friendly citizens foster a positive community spirit
- Be a regional destination for tourists and visitors attracted by the city's heritage and historic character
- Provide recreation opportunities for all citizens
- Have a historic and vibrant downtown with unique shops, restaurants, housing, and community activities
- Be a walkable and safe community with tree-lined streets and attractive buildings
- Have well-designed neighborhoods and commercial areas offering a variety of shopping, dining, entertainment, and housing options for all residents
- Plan for future growth while protecting its environmental resources and maintaining quality public services at an affordable cost

Relevance

The Plan focuses development efforts on its downtown, encouraging retail development and residential users to locate in downtown Oxford. It also provides objectives for improving non-motorized transportation through enhancements to its bicycle/pedestrian infrastructure. In addition, the town also looks to promote industrial sites and recommends the US 15 corridor from Exit 202 be developed as a retail and service use corridor.

Creedmoor City Plan 2030

Description
The Plan provides information about the town's historic and future growth, zoning and land use, commuting patterns, natural and cultural resources, and infrastructure.

Relevance
The City of Creedmoor's Zoning Ordinance will be replaced with a unified development ordinance. The new ordinance contains numerous policy changes. Those that impact the regional transportation system include maintaining the adequate volume of commercial and industrial zoning to sustainable levels, reduction in the number of residential districts, reducing the density in agricultural areas to discourage sprawling subdivisions, and increasing provision of sidewalks. Although not directly within the study area, Creedmoor is located between exit 191 and Raleigh, and land use and transportation policies will contribute to the impact of a new interchange.

NC50 Corridor Study

Description
The study covers the 15-mile segment of the NC 50 corridor from I-540 in Wake County to NC 56 in downtown Creedmoor, and evaluates the efficiency and effectiveness of the existing NC 50 roadway. In the study the corridor is divided into four context zones. The Main Street zone begins at Creedmoor city limits and proceeds through downtown, terminating at NC 56. This segment of NC 50 is Creedmoor's Main Street.

Relevance
Though not directly in the study area, improved access to Creedmoor could assist in its growth and its contribution to traffic within the study area. There is a widening project of NC 50 planned from the Granville/Wake border to Creedmoor. This project is listed in the 2040 MTP as being completed by 2040.

Existing Population, Employment, and Land Use

The study area is rural in nature with most of the population and employment within the towns of Creedmoor, Butner, and Oxford. However the area is growing. According to the US Census, Granville County had a total population of 59,916 in April of 2010 and 60,436 in June of 2012. This is up 24 percent from the 48,824 residents in 2000. This growth has been based in south Granville primarily, as exemplified by the four towns' growth: Butner, Creedmoor, and Stem have seen 31 percent, 85 percent and 102% population growth, respectively, while Oxford has seen just over 1 percent growth.

Town	2000 Population	2010 Population	% change
Butner[2]	5,792	7,591	31.1%
Creedmoor	2,232	4,124	84.7%
Oxford	8,338	8,461	1.5%
Stem	229	463	102.2%

Economic development growth has not been as robust. In 2010 there were a total of 835 non-farm businesses in the county, employing nearly 13,200 people. This is up only 6 percent from 785 establishments in 2000.

[2] Butner was classified as a CDP in the 2000 Census, but as a town in the 2010 Census

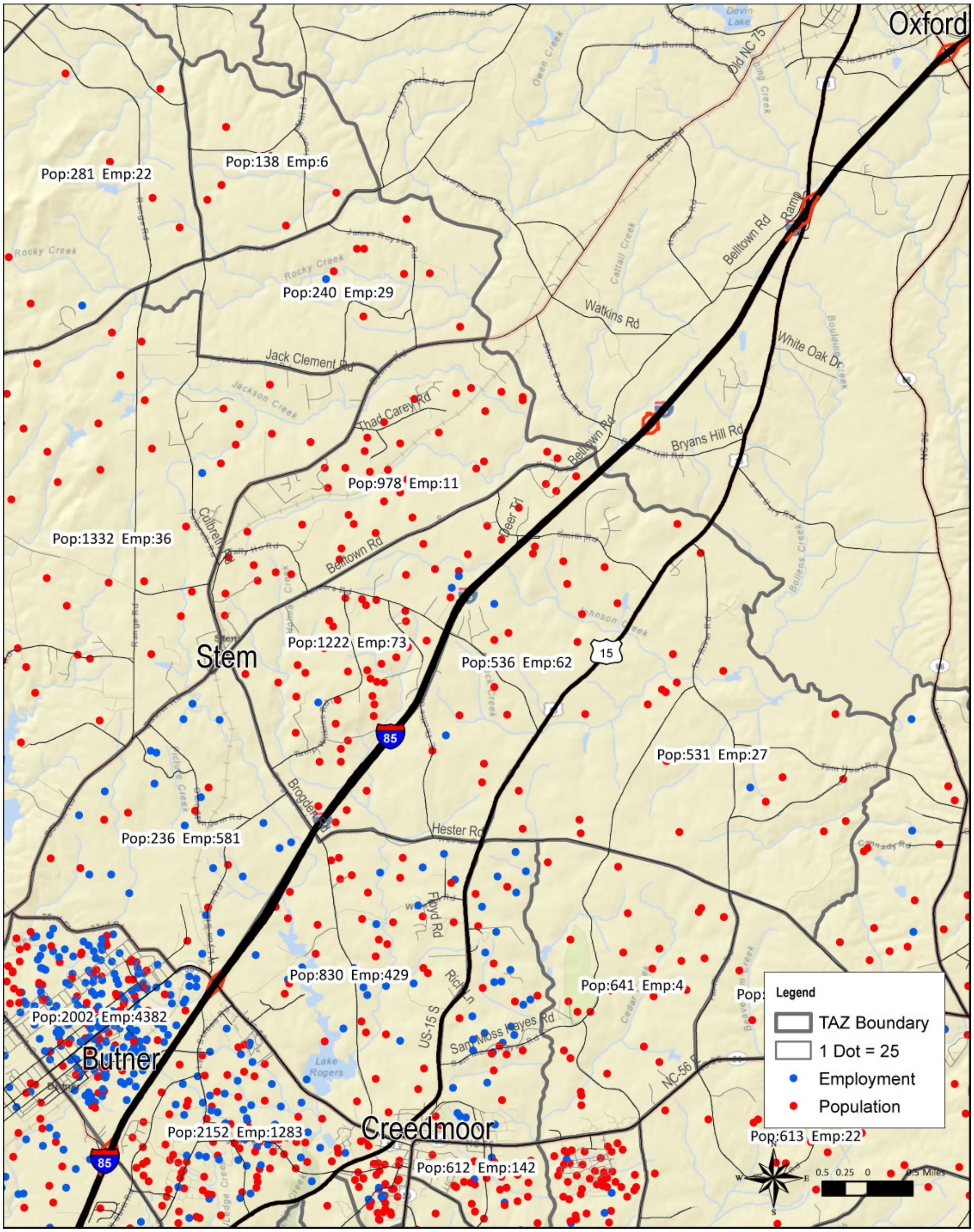

FIGURE 2 2012 POPULATION AND EMPLOYMENT

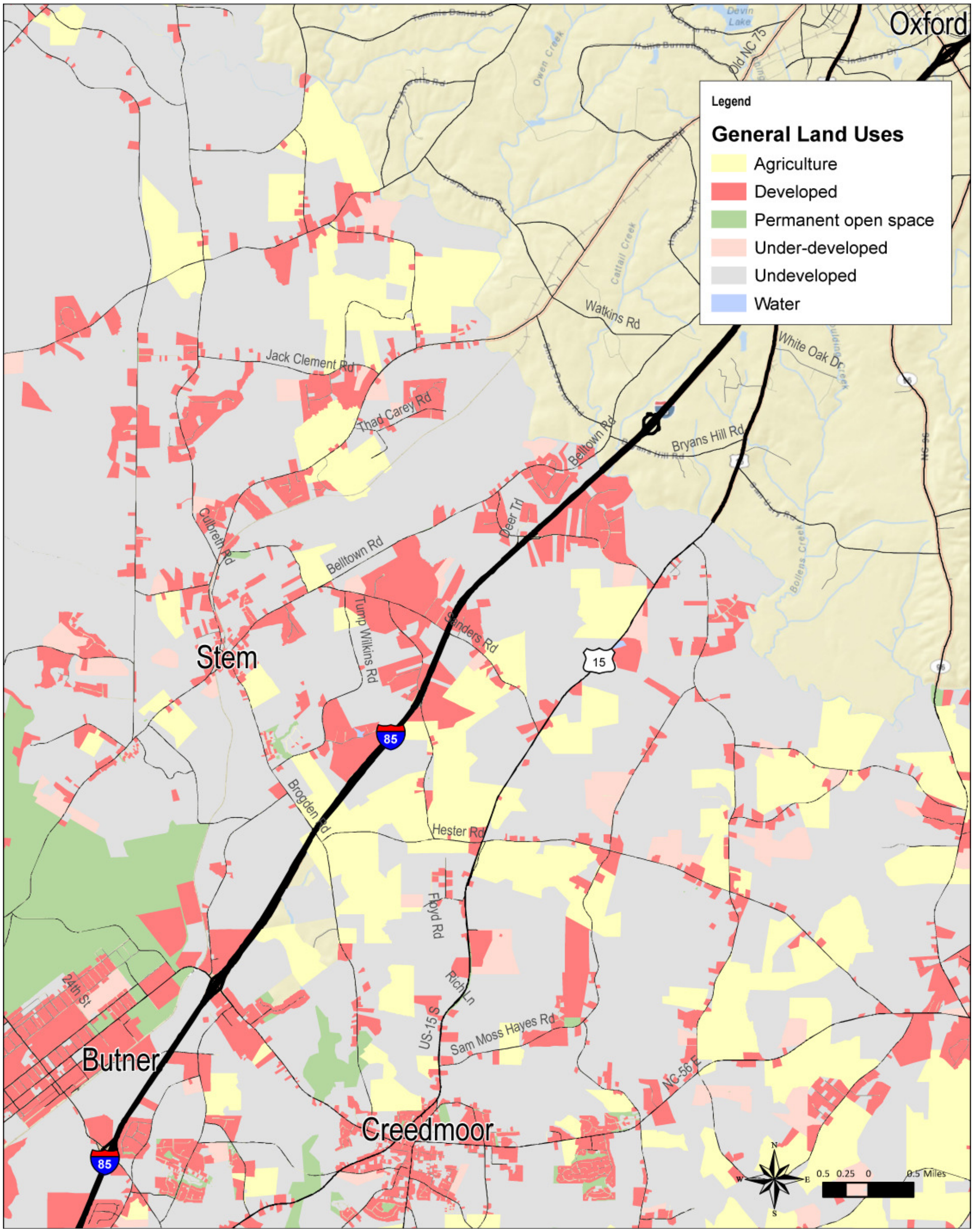

FIGURE 3 LAND USE MAP

Existing Roadway Conditions

With limited transit service in the area, auto traffic accounts for most travel mode choices. Below is a review of existing regional roadway conditions, as well as intersection-level conditions for I-85 Exits 191 and 202. The purpose of documenting these conditions is to measure to what extent tested improvements impact the transportation system.

Study Area Travel Conditions

Travel conditions were estimated for the study area using the Triangle Regional Model's outputs for 2010. Existing conditions are within acceptable levels when looking at regional mobility. No roadways within the study area currently experience high levels of congestion.

TABLE 6 2010 TRAVEL SPEED AND V/C RATIO

	2010	
Roadway	Travel Speed (mph)	V/C
I-85 btwn Exits 191 and 202	72	0.28
US 56 West of I-85 Interchange	44	0.38
US 56 East of I-85 Interchange	33	0.51
Brogden Road at I-85	42	0.15
E. Thollie Green Road at I-85	46	0.01
Sanders Road at I-85	38	0.01
Smith Road at I-85	46	0.02
Belltown Road at Sanders Rd	49	0.07
Belltown Road at Brogden Rd	49	0.08
W. Lyons Station Rd. at Brogden	43	0.24
US 15 N of Creedmoor	53	0.14
US 15 at Hester Rd.	53	0.11
US 15 at Sanders Rd.	53	0.11
US 15 at Smith Rd.	53	0.09

Traffic Conditions

Traffic conditions are different from regional conditions in that they account for geometry, signal timing, turning movements, and traffic volumes at a smaller level of detail. The existing traffic conditions for I-85 Exits 202 and 191 are described below.

Turning movement counts were conducted at the following locations and times.

TABLE 7 TURNING MOVEMENT COUNT LOCATIONS AND TIMES

	Location	Date Collected	Time Period	Peak Hour
1	I-85 Exit 191 Ramp SB	5/13/2013	6:00 AM to 9:00 AM	7:15 AM to 8:15 AM
2	I-85 Exit 191 Ramp SB	5/13/2013	3:00 PM to 6:00 PM	4:15 PM to 5:15 PM
3	I-85 Exit 191 Ramp NB	5/14/2013	6:00 AM to 9:00 AM	7:15 AM to 8:15 AM
4	I-85 Exit 191 Ramp NB	5/14/2013	3:00 PM to 6:00 PM	4:15 PM to 5:15 PM
5	I-85 Exit 202 Ramp SB	5/29/2013	6:00 AM to 9:00 AM	6:45 AM to 7:45 AM
6	I-85 Exit 202 Ramp SB	5/29/2013	3:00 PM to 6:00 PM	3:45 AM to 4:45 AM
7	I-85 Exit 202 Ramp NB	5/23/2013	6:00 AM to 9:00 AM	7:30 AM to 8:30 AM
8	I-85 Exit 202 Ramp NB	5/23/2013	3:00 PM to 6:00 PM	5:00 PM to 6:00 PM
9	US 56 @ W. Lyon Station Rd.	6/7/2013	6:00 AM to 9:00 AM	7:15 AM to 8:15 AM
10	US 56 @ W. Lyon Station Rd.	6/6/2013	3:00 PM to 6:00 PM	4:15 PM to 5:15 PM

The peak-hour turning movement counts are presented in the appendix. Baseline analyses were performed for existing (2012 due to availability of NCDOT AADT data) conditions and an assumed build year of 2040. Intersection traffic operations were modeled and analyzed in accordance with the Transportation Research Board's Highway Capacity Manual[3] (HCM). Level-of–Service (LOS) is defined as a "qualitative measure describing operation conditions within a traffic stream, based on service measures such as speed and travel time, freedom to maneuver, traffic interruptions, comfort, and convenience… Delay is a complex measure and depends on a number of variables including the quality of progression, the cycle length, the green ratio [ratio of effective green time], and the v/c ratio for the lane group. The critical v/c ratio is an approximate indicator of the overall sufficiency of the intersection. The critical v/c ratio depends on the conflicting critical lane flow rates and the signal phasing." The LOS for intersections is measured in seconds of delay. The HCM also defines six levels-of-service for intersections with LOS A representing the best operating condition and LOS F the worst. The tables below give the criteria for LOS at signalized and two-way stop-controlled (TWSC) intersections.

TABLE 8 LOS CRITERIA

LOS Criteria for Signalized Intersections		LOS Criteria for TWSC Intersections	
LOS	**Control Delay Per Vehicle (sec)**	**LOS**	**Control Delay Per Vehicle (sec)**
A	≤ 10	A	0 - 10
B	> 10 - 20	B	>10 - 15
C	> 20 - 35	C	>15 - 25
D	> 35 - 55	D	>25 - 35

[3] National Research Council. Transportation Research Board. Highway Capacity Manual, Special Report 209. 4th Edition, Washington, DC. 2000.

LOS Criteria for Signalized Intersections		LOS Criteria for TWSC Intersections	
LOS	**Control Delay Per Vehicle (sec)**	**LOS**	**Control Delay Per Vehicle (sec)**
E	> 55 - 80	E	>35 - 50
F	>80	F	>50

The Definition of Quality and Levels of Service

Quality of service requires quantitative measures to characterize operational conditions within a traffic stream. Level of service (LOS) is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience.

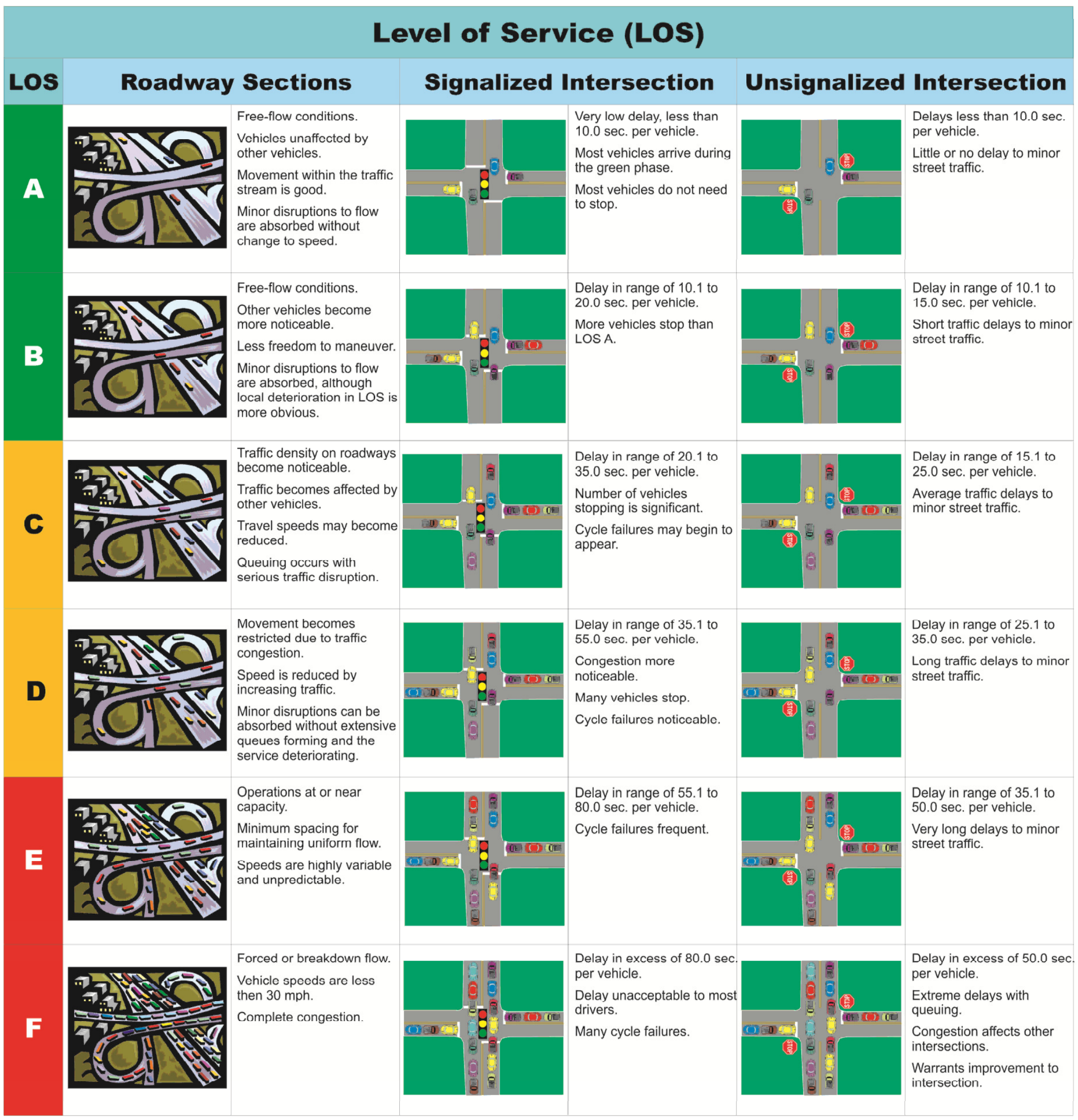

FIGURE 4 LEVEL OF SERVICE EXAMPLE

A model of the study area was developed in Synchro 8.0. NCDOT 2012 AADT Volumes and field data was entered into the model including turning movements, speed limits, lane geometry, and signal phasing. AADT volumes were factored up in the model utilizing the growth projections for the respective roadways from the Triangle Regional Model for the 2040 baseline condition. The signal phasing was obtained from the signal upgrade plan dated May 2013 from the NCDOT. Existing operational conditions were further imputed into the model including the allowance of Right-Turns on Red (RTOR).

The results of the capacity analysis for the 2012 existing conditions, presented below, indicate that the intersections in the study area operate within acceptable levels-of-service of C or better for both the morning and afternoon peak-hours, with a few movements operating at a service level of D for both AM and PM peak-hours. These intersections are very close to LOS C and small operational changes may provide less delay in the short-term.

Existing conditions are shown in the tables below for the 2012. The baseline year of 2012 was used because of AADT volume availability from NCDOT.

TABLE 9 EXISTING TRAFFIC SUMMARY

2012 Existing Traffic														
Level-of-Service, Capacity, and Delay Summary														
	MOE	**Overall**	**Eastbound**			**Westbound**			**Northbound**			**Southbound**		
			L	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**	**L**	**T**	**R**
AM Peak Hour														
1. NC 56 (E-W) & I-85 NB Ramps (N-S)	***LOS***	A	A	A			B		D		C			
	Capacity (v/c)	0.55	0.13	0.34			0.57		0.53		0.07			
	Delay	11.1	4.2	3.6			10.1		35.0		32.0			
2. NC 56 (E-W) & I-85 SB Ramps (N-S)	***LOS***	B	B			A	A					D		D
	Capacity (v/c)	0.49	0.49			0.29	0.32					0.49		0.12
	Delay	13.1	10.4			4.5	3.7					41.5		38.2
3. NC 56 (E-W) & W. Lyon Station Rd (N-S)	***LOS***	B	D	A			C	B				C		B
	Capacity (v/c)	0.66	0.20	0.25			0.72	0.10				0.65		0.06
	Delay	19.8	35.5	8.2			22.6	12.4				27.8		17.3
4. US 15 (N-S) & I-85 NB Ramps (E-W)	***LOS***		B									A		
	Capacity (v/c)		0.22									0.05		
	Delay		15.0									7.8		
5. US 15 (N-S) & I-85 SB Ramps (E-W)	***LOS***					B			A					
	Capacity (v/c)					0.20			0.02					
	Delay					12.4			7.8					
PM Peak Hour														
1. NC 56 (E-W) & I-85 NB Ramps (N-S)	***LOS***	B	A	A			B		D		C			
	Capacity (v/c)	0.69	0.55	0.50			0.72		0.61		0.14			
	Delay	14.5	9.3	5.1			15.8		36.9		31.5			
2. NC 56 (E-W) & I-85 SB Ramps (N-S)	***LOS***	B	B			B	A					D		D
	Capacity (v/c)	0.72	0.78			0.36	0.41					0.50		0.05
	Delay	14.8	17.2			11.5	4.3					41.5		37.6
3. NC 56 (E-W) & W. Lyon Station Rd (N-S)	***LOS***	B	D	A			B	A				C		C
	Capacity (v/c)	0.62	0.45	0.57			0.30	0.19				0.61		0.03
	Delay	12.8	36.1	7.5			10.3	9.3				33.7		22.3
4. US 15 (N-S) & I-85 NB Ramps (E-W)	***LOS***		D									A		
	Capacity (v/c)		0.65									0.07		
	Delay		30.5									8.0		
5. US 15 (N-S) & I-85 SB Ramps (E-W)	***LOS***					B			A					
	Capacity (v/c)					0.30			0.01					
	Delay					14.9			0.2					

Crash History

Historical crash data was collected for the study area for the five (5) years between 2007 and 2011. These data provide information on the locations of crashes in order to inform this analysis on areas for potential roadway safety improvements, as well as for EMS response when considering a potential new interchange.

There were a total of 230 crashes on I-85 between Exits 191 and 202 during the 5-year time period. Two thirds of these occurred between Sanders Road and Exit 191. There were 21 crashes at Exit 191 and 54 crashes at Exit 202. These crash data are shown in Figure 4.

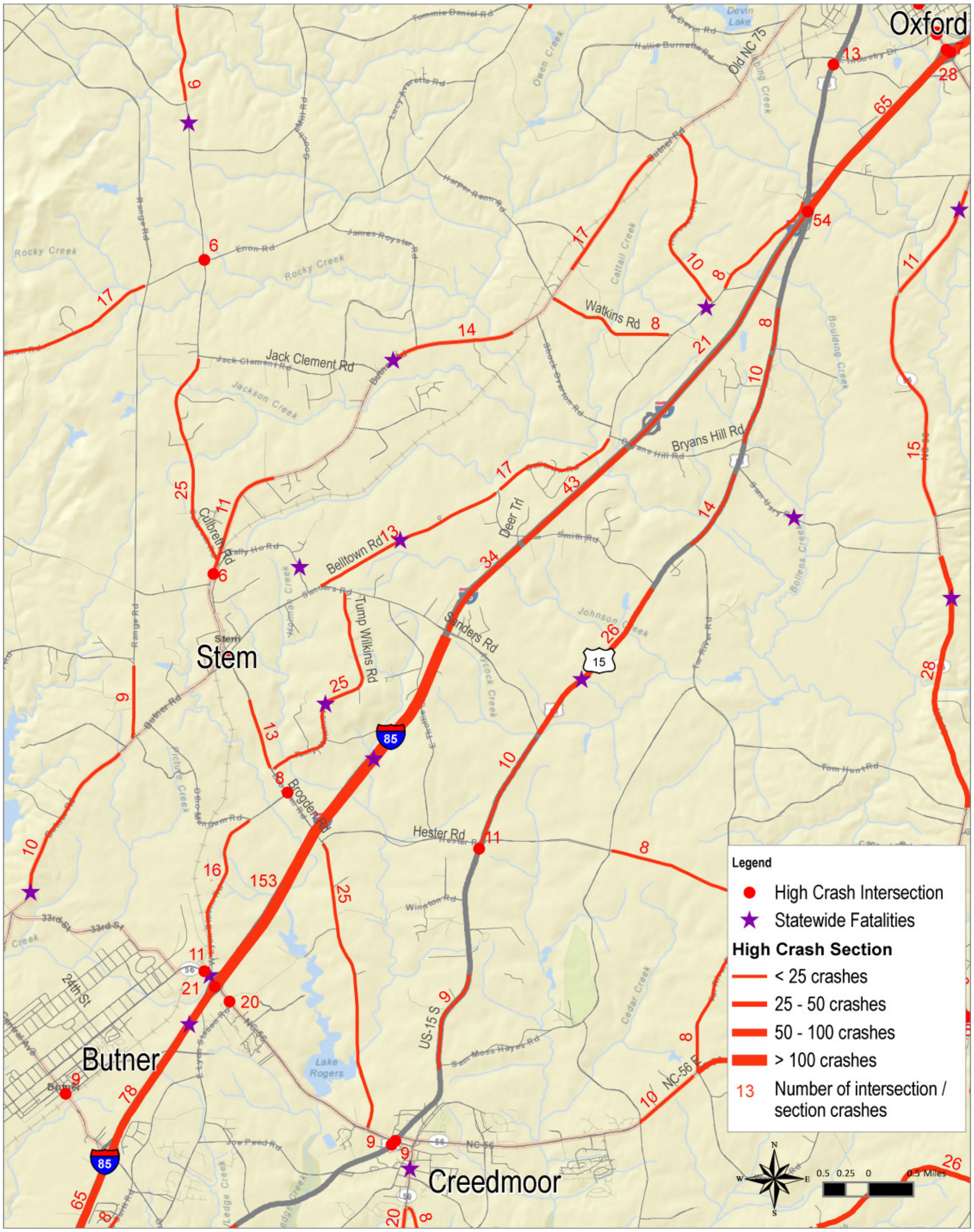

FIGURE 5 2007-2011 CRASH MAP

Future Baseline Roadway Conditions

Future Baseline Roadway Conditions include the existing infrastructure and planned projects within the fiscally constrained regional Transportation Improvement Program (TIP) or Long Range Transportation Plan (LRTP). The horizon year for this analysis is 2040 and traffic volumes were estimated using the Triangle Regional Model. Modeled highway volumes were then used to factor interchange volumes from existing AADTs to estimate future interchange LOS.

Planned Projects

There are two significant projects planned in the study area. The first is a widening of NC 56, from two lanes to four lanes, between the interchange and W. Lyon Station Road. This project is planned for implementation by the year 2040. The second is a new interchange at I-85 and Brogden Road by the year 2030. Since this analysis is aimed at assessing a new interchange and its impacts within the study area, and a future baseline condition was necessary for the assessment, the Brogden Interchange was removed to be tested as an alternative. The NC56 widening project was left in the baseline condition as well as each alternative. The analysis of the alternatives, especially at the detailed Exit 191 intersection level, would be much different if this project were removed.

Travel Demand Model Results

All links within the modeled study area show acceptable Volume to Capacity ratios and travel speeds. Volumes are expected to increase steadily over the time period with minor changes in the study area. For example, volumes at NC 56 and I-85 (Exit 191) are expected to increase as a result of planned capacity improvements. These volumes are diversions from Brogden Road, which is expected to see a decrease in volumes from 2030 to 2040 as a result of the project. V/C ratios also improve as a result of these capacity improvements. The change in AADT, travel speeds and V/C ratios are shown in the table below for roadways within the study area.

TABLE 10 2040 FUTURE BASELINE ROADWAY SUMMARY

	2020			2030			2040		
Roadway	10 Year % Change in AADT	Travel Speed (mph)	V/C	10 Year % Change in AADT	Travel Speed (mph)	V/C	10 Year % Change in AADT	Travel Speed (mph)	V/C
I-85 btwn Exits 191 and 202	0.1%	72	0.29	1.3%	72	0.29	1.4%	72	0.29
US 56 West of I-85 Interchange	41.0%	41	0.53	13.8%	41	0.61	76.4%	44	0.37
US 56 East of I-85 Interchange	-7.0%	34	0.50	17.4%	33	0.58	55.6%	44	0.35
Brogden Road at I-85	42.0%	41	0.22	25.5%	41	0.28	-6.9%	41	0.24
E. Thollie Green Road at I-85	59.1%	46	0.01	0.0%	46	0.01	14.3%	46	0.01

Roadway	2020			2030			2040		
	10 Year % Change in AADT	Travel Speed (mph)	V/C	10 Year % Change in AADT	Travel Speed (mph)	V/C	10 Year % Change in AADT	Travel Speed (mph)	V/C
Sanders Road at I-85	0.0%	38	0.01	4.3%	38	0.01	25.0%	38	0.01
Smith Road at I-85	6.1%	46	0.02	11.4%	46	0.02	15.4%	46	0.02
Belltown Road at Sanders Rd	13.6%	49	0.08	13.7%	49	0.08	14.3%	48	0.10
Belltown Road at Brogden Rd	12.5%	49	0.08	16.2%	49	0.10	14.7%	48	0.11
W. Lyons Station Rd. at Brogden	25.9%	42	0.29	20.2%	42	0.35	-5.7%	42	0.34
US 15 N of Creedmoor	24.6%	52	0.19	34.4%	52	0.23	8.6%	52	0.24
US 15 at Hester Rd.	-0.6%	53	0.13	8.4%	53	0.13	-5.7%	53	0.11
US 15 at Sanders Rd.	20.6%	52	0.13	12.9%	52	0.15	10.0%	52	0.16
US 15 at Smith Rd.	15.5%	53	0.11	10.3%	53	0.12	9.3%	53	0.13

Intersection Level Traffic Estimates

Baseline intersection LOS is not expected to significantly worsen over time, with a few exceptions. The Northbound I-85 to Eastbound NC 56 (Exit 191) is expected to experience a minor increase in delay, from an LOS C to and LOS D. This is also true with Southbound W. Lyon Station Road and Westbound NC 56. A significant change, however, is expected at Exit 202 and the vehicle movement from Northbound I-85 to Westbound US 15. This LOS may warrant signalization of the interchange in the future. Detailed LOS for the 2040 Baseline intersections are shown in the table below.

TABLE 11 2040 FUTURE BASELINE TRAFFIC SUMMARY

2040 Future Traffic (No New Interchange)														
Level-of-Service, Capacity, and Delay Summary														
	MOE	Overall	Eastbound			Westbound			Northbound			Southbound		
			L	T	R	L	T	R	L	T	R	L	T	R
AM Peak Hour														
1. NC 56 (E-W) & I-85 NB Ramps (N-S)	*LOS*	C	C	A			C		D		D			
	Capacity (v/c)	0.87	0.83	0.44			0.83		0.67		0.85			
	Delay	22.7	33.3	5.4			24.4		35.6		53.9			
2. NC 56 (E-W) & I-85 SB Ramps (N-S)	*LOS*	B	B			A	A					D		D
	Capacity (v/c)	0.60	0.51			0.57	0.28					0.62		0.43
	Delay	15.8	14.8			8.8	4.4					42.1		37.7
3. NC 56 (E-W) & W. Lyon Station Rd (N-S)	*LOS*	B	D	B			B	B				C		B
	Capacity (v/c)	0.63	0.58	0.59			0.40	0.34				0.54		0.05
	Delay	17.2	37.4	12.3			18.9	18.9				24.2		14.0
4. US 15 (N-S) & I-85 NB Ramps (E-W)	*LOS*		F									A		
	Capacity (v/c)		0.84									0.08		
	Delay		53.9									8.1		
5. US 15 (N-S) & I-85 SB Ramps (E-W)	*LOS*					C			A					
	Capacity (v/c)					0.35			0.01					
	Delay					16.4			8.0					
PM Peak Hour														
1. NC 56 (E-W) & I-85 NB Ramps (N-S)	*LOS*	B	A	A			A		D		C			
	Capacity (v/c)	0.49	0.23	0.27			0.46		0.68		0.12			
	Delay	11.4	4.2	3.7			9.2		38.5		30.0			
2. NC 56 (E-W) & I-85 SB Ramps (N-S)	*LOS*	B	B			B	A					D		D
	Capacity (v/c)	0.69	0.71			0.61	0.36					0.63		0.07
	Delay	14.3	15.7			19.3	4.1					44.5		36.5
3. NC 56 (E-W) & W. Lyon Station Rd (N-S)	*LOS*	C	C	A			C	B				D		B
	Capacity (v/c)	0.68	0.25	0.24			0.63	0.14				0.85		0.12
	Delay	22.0	34.1	9.9			22.9	17.0				35.8		14.0
4. US 15 (N-S) & I-85 NB Ramps (E-W)	*LOS*		C									A		
	Capacity (v/c)		0.24									0.05		
	Delay		15.7									7.8		
5. US 15 (N-S) & I-85 SB Ramps (E-W)	*LOS*					B			A					
	Capacity (v/c)					0.22			0.02					
	Delay					12.5			7.8					

Emergency Management

The Stem, Providence, and Butner Fire Departments divide responsibility of this corridor, as shown in Figure 5. Emergency management responders receive approximately 100-120 incident reports per year along I-85 between exits 191 and 202. There are three emergency vehicle turnaround points on this stretch, at locations just north and south of the Granville County Rest Area at milepost 199, and an additional turnaround approximately 0.5 miles north of exit 191.

Currently, responders are often forced to park on the opposite side of the interstate, increasing responder safety concerns. Incident management personnel estimate that the minimum response time from Providence Station to the midpoint between exits 191 and 202 is 15 minutes. Based on an analysis of a sample response data set from Granville County Emergency Management, average response times are a little over 8 min, with a median response time of 7 minutes and 30 seconds.

The National Fire Protection Association (NFPA) has developed standards for all aspects of response. Standard NFPA 1720 is the *Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations and Special Operations to the Public by Volunteer Fire Departments.* The table below shows the population/distance threshold, minimum staff, and response time standards from NFPA. Currently, the average and median response times are within these standards.

TABLE 12 NFPA 1720 STANDARDS

Population Protected	Minimum Staff	Response Time (min)
>1,000 people/sq. mi.	15	9
500-1,000 people/sq. mi.	10	10
<500 people/sq. mi.	6	14
Travel distance ≥ 8 mi.	4	14

In the event of a road closure along the interstate, police and fire departments are equipped to coordinate detour routes, though no formal alternative route exists. NCDOT is available to assist on rerouting when low-weight bridges require additional detours for trucks.

There is no Intelligent Transportation Systems (ITS) equipment currently in use by the county within the project study area, though NCDOT does have cameras. Granville County has expressed interest in obtaining access to these cameras, though that has yet to occur and is not included in the CAMPO ITS Deployment Plan.

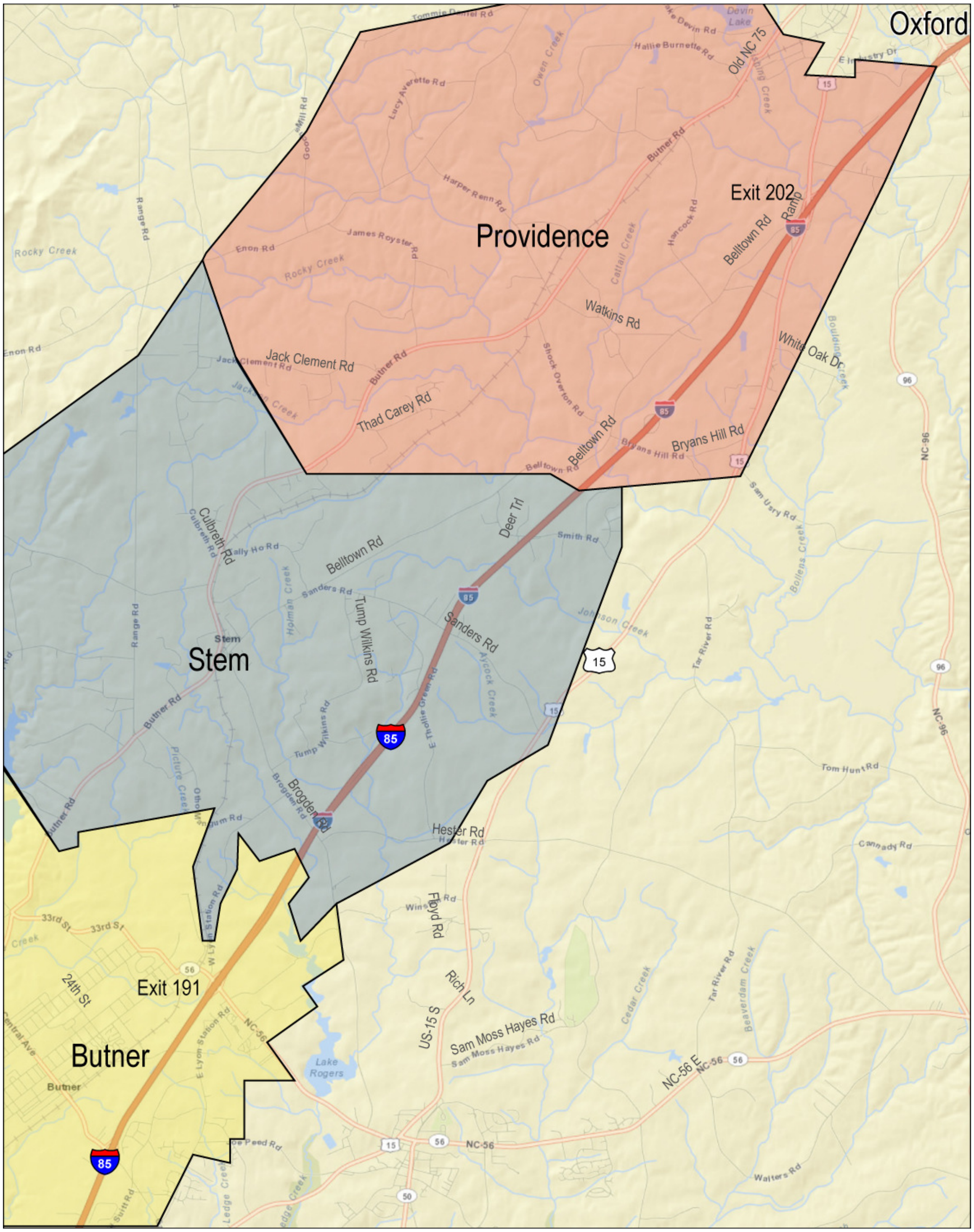

FIGURE 6 STUDY AREA FIRE DISTRICTS

Economic Development

One of the purposes of a new interchange is the economic development potential it may bring for the study area and region. As discussed earlier in this report, economic development growth has not been robust. The vast majority of the area north of exit 191 is either being used for agricultural purposes, or is unused or underused. (See Figure 3 above.)

Exit 191 is currently characterized as retail strip type development, accommodating restaurants, fuel stations, etc. Heavy industrial, light industrial, and general commercial uses are scattered on the towns' peripheries. To the immediate south of the corridor, there is interest by the Town of Butner to develop land between Exits 189 and 191 adjacent to I-85 SB between the interstate and Railroad tracks. Currently the land has no access road, and the town is currently planning to add one. The land is zoned for light and heavy industrial use, and would remain as such if an access road were built.

Much of the land in the study area is composed of large parcels which, were there mutual interest by landowner and developer, would be one criteria of suitability for industrial and commercial development. Figure 6 shows the location of these large parcels. While many of the parcels immediately adjacent to the interstate are smaller, there are many large parcels along Brogden Road, particularly south towards Creedmoor, as well as a few large parcels along Sanders Road. Note again, however, that this map does not indicate that these parcels are available for purchase or redevelopment, merely that industrial and commercial developers are more likely to be interested in larger parcels and the prevalence of such land suggests the possibility of future redevelopment interest associated with a new interchange.

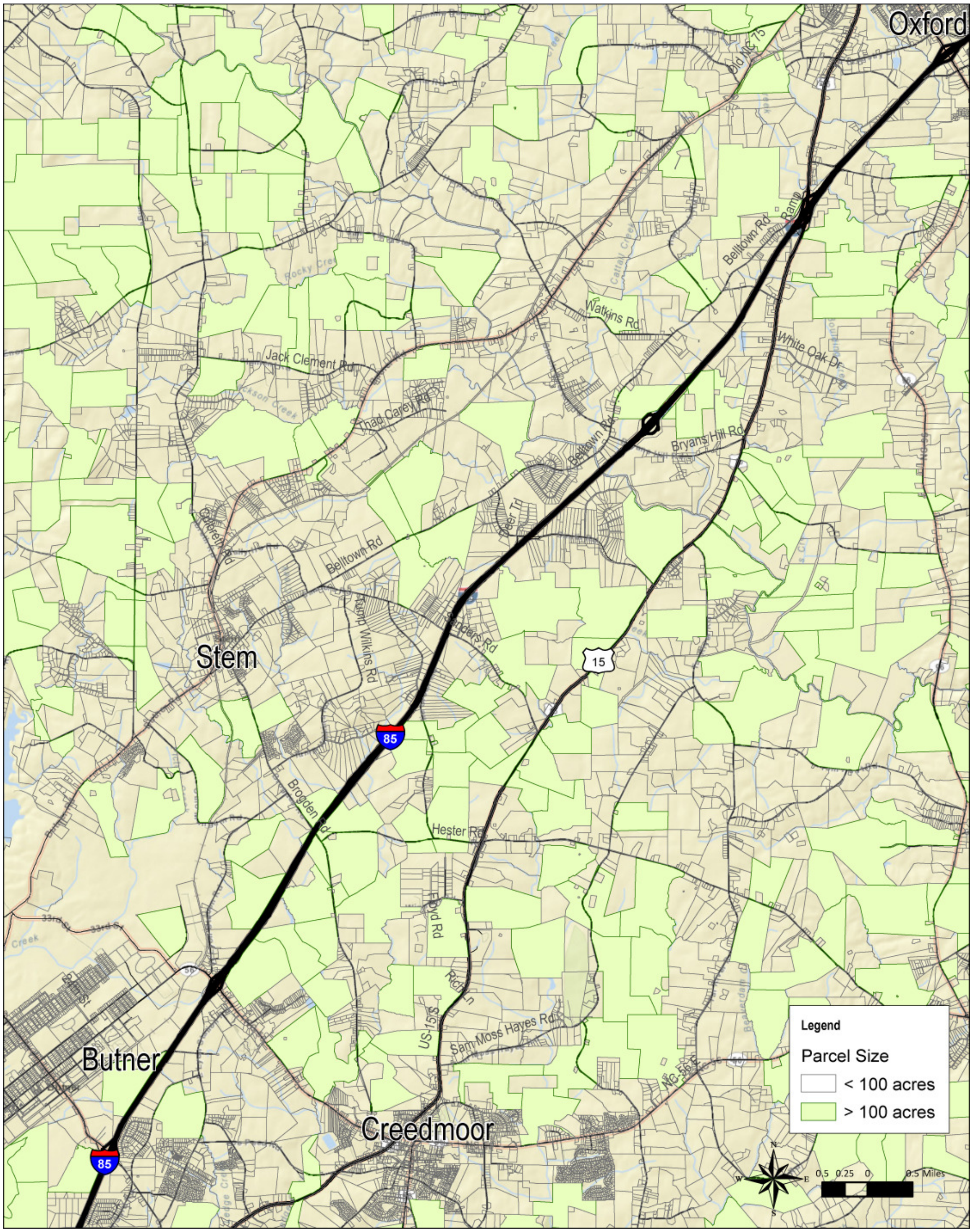

FIGURE 7 LARGE STUDY AREA PARCELS

Interchange Justification Requirements

When proposing a new interchange on the Interstate System, justification for this new connection must be provided for review and approval by the Federal Highway Administration (FHWA). The Policy states that it "*is applicable to new or revised access points to the existing Interstate System regardless of the source of funding of the original construction or source of funding for the proposed access points. This includes routes incorporated into the Interstate System under the provisions of 23 U.S.C. 103(c)(4)(A) or other legislation.*"[4] The *Interstate System Access Information Guide* (August 2010) developed by the FHWA provides the "*guidance on how and what should be addressed in requests for new or modified access to the Interstate System*."[5] The following provides the guidance set forth in order to complete the Interchange Justification Report, sometimes referred to as an Interstate System Access Change Request.

Area of Influence

The area of influence is based on safety and operations concerns. The area of influence must include adjacent interchanges on either side of the proposed access change. Since this analysis considers an interchange between I-85 Exits 191 and 202, these interchanges must be included in the analysis. The analysis should also include intersections near the interchange that may impact (or be impacted) by a proposed change. The figure below illustrates a sample area of influence for a request of a new interchange. The FHWA states that the "*area of influence should be extended beyond these limits based on the impact of the proposed change in access. If the safety or operational performance of segments beyond the adjacent interchanges may be affected, or a coordinated signal system is involved with the local roadway network, then the area of influence should be expanded to support making an informed decision based on the consequences of the project.*"[6]

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[4] FHWA Interstate System Access Information Guide, August 2010, p4
[5] FHWA Interstate System Access Information Guide, August 2010, p1
[6] FHWA Interstate System Access Information Guide, August 2010, p15

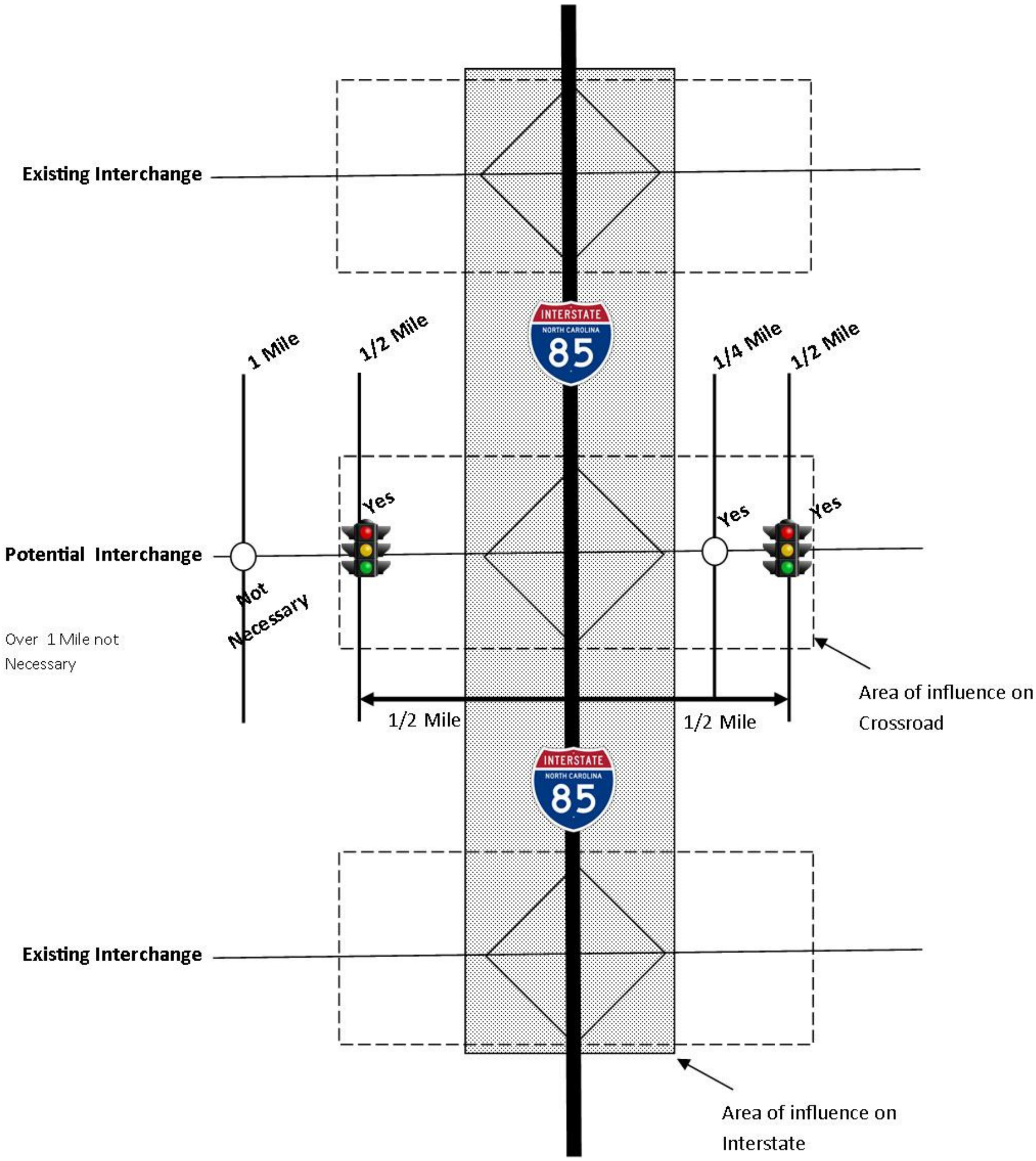


FIGURE 8 INTERCHANGE JUSTIFICATION AREA OF INFLUENCE DIAGRAM

Safety and Operational Performance

The current and anticipated safety and operational performance associated with the proposed change in access in the design year is strongly related to the following:

- Traffic volume (average daily and peak periods)
- Mix of traffic volumes (percent trucks, transit, and special use (HOV/HOT))
- Location (rural, urban, suburban)
- Terrain (mountainous, rolling, level)
- Interchange and access (ramp) spacing along the mainline and their effect on weaving distances, the number of lane changes required, and the speed differential of mixing vehicles
- Roadway segments (mid-block or typical section; intersection, including type of intersection traffic control) along the local roadway network
- Surrounding land use (number of driveways, commercial versus residential; associated pedestrian activity) and the anticipated changes in land use and resulting travel patterns
- Limits of the project if part of a system of improvements
- Influence of operations at adjacent interchanges along the Interstate facility or intersections along the intersecting roadways within the transportation network
- Alternatives / modes that are being considered to address the problem
- Hours of congestion (as defined by the problem statement) present today and in the future
- Crash data

Alternatives

For any Interstate System Access Change Request, the FHWA requests that the following alternatives be analyzed. The need for any change in access should be supported by a qualitative and quantitative comparison of these minimum alternatives.

No Build or No Action Alternative
This alternative describes the conditions that will exist if the proposed new or modified access is not completed. The alternative should be analyzed in the existing condition and the design period to establish a baseline for the analysis of the potential benefits and impacts of the proposed new or modified access.

Transportation System Management Alternative
This alternative should clearly show that there are no other alternatives which could meet the need addressed by the proposed new or modified alternative. This alternative will demonstrate that the need being addressed by the request cannot be satisfied adequately by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets; improving traffic control; modifying ramp terminals and intersection; or adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands.

Alternative Transportation Modes
In the operational analysis of this alternative, the consideration of any modal shift of traffic to public transit or special use lanes should be consistent with the planning data presented in other plans or studies and derived from the regional travel demand forecasting model provided by the State DOT or MPO.

Build Alternative (Alternative[s] that Provide for New or Modified Access)
Only after the TSM and Alternative Transportation Modes have been analyzed to demonstrate that they cannot meet the needs being addressed in the request should new or modified access be considered. The analysis of these alternatives should provide an analysis that considers the safety, operational, design, and environmental consequences of the proposed action as compared to the No Build Alternative.

Build Alternative which Incorporate TSM and Alternative Modes (Alternative[s] that Provide for New or Modified Access)
This is a hybrid alternative which reflects a combination of the previously discussed alternatives. Combining these alternatives may provide a greater value than the two other alternatives independent of each other.

Performance Objectives, Measures, and Technical Analysis Requirements

The purpose, need, goal, and objective of the interchange should be discussed during the coordination process. This purpose and need identify or define the performance criteria or deficiency that the project is looking to address or overcome, and provides an objective and measurable baseline in which the proposed and recommended alternative is to address. A set of quantitative performance measures should be established to support this analysis.

The documentation requirements include the following sections at a minimum:

- Summary
- Introduction—Background Purpose and Location
- Methodology
- Existing Conditions
- Need
- Alternatives
- Future Year Traffic
- Alternatives Analysis
- Funding Plan
- Recommendations
- Appendices

Interchange Justification Policy Requirements

The FHWA requires that eight policy requirements be addressed as part of the Justification document. A detailed list of the policy requirements are provided in the appendix. In summary, the policy requirements are:

- Demand and capacity of the current interchange system and its adequacy to handle current and future traffic in its current configuration and/or with improvements
- Transportation System Management (TSM), geometric design, and alternative improvement to the Interstate to accommodate current and future traffic
- No adverse impact on the safety and operations of the interstate facility
- Will connect to a public road and will provide for traffic movements in all directions
- Coordination and consistency with local and regional plans
- Consider a comprehensive corridor approach if plans include multiple access improvements
- Coordination and consistency between planned future land use and development, and transportation improvements
- Inclusion of environmental considerations

The FHWA focuses on mobility, safety, and congestion as a major component of interchange justification. The Administration places a premium on looking at utilizing existing infrastructure through operational improvements over the development of a new interchange to relieve congestion. However, other impacts such as economic development are acknowledged within the interstate guidance. The Guide states, "*The impact of access changes on the operations of the Interstate System are important; also of equal importance is the impact the changes will have on the system as a whole, the environment, potential economic development, the local street system, and safety, both on and off of the Interstate System.*"[7]

Interchange Location Alternatives Analyses

The analysis of alternatives as part of this effort focuses on congestion, but as described above, other considerations such as economic development, impacts to street systems, safety, and the environment are included, though each should be explored in future in-depth studies.

[7] FHWA Interstate System Access Information Guide, August 2010, p1

Selection Criteria

This analysis was to consider a maximum of three alternative locations for a new interchange between I-85 Exit 191 and 202. Criteria used for the selection of the alternatives include:

- Location between I-85 Exits 191 and 202
- Connection to an existing roadway
- Provision of emergency access to I-85
- Impact to nearby wetlands, buildings and/or facilities
- Greater support for economic development

Interchange Configuration Options

There are many different types of interchange configurations. The American Association of State Highway and Transportation Officials (AASHTO) publishes "The Green Book" which includes the standards of geometric designs for the nation's highways and streets. The figure below shows the basic interchange configuration types. The current Exits 191 and 202 are diamond interchanges.

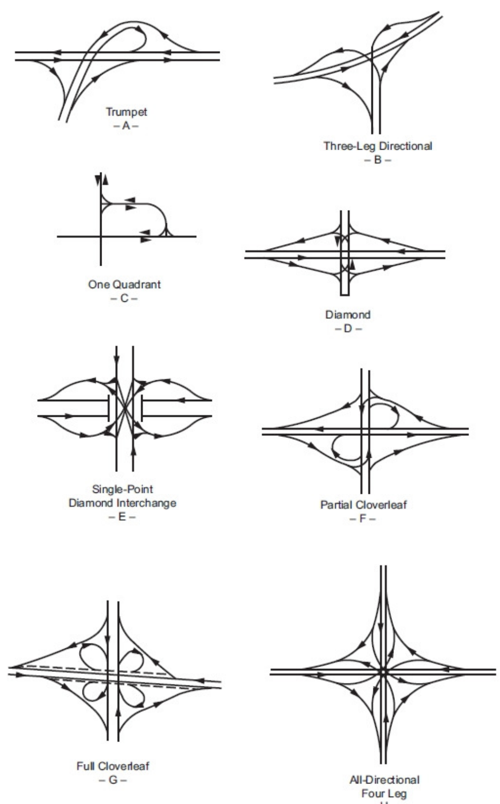


FIGURE 9 AASHTO INTERCHANGE CONFIGURATION TYPES
Source: AASHTO Green Book

The Brogden interchange as coded in the Triangle Regional Model is a modified diamond in order to avoid potentially sensitive environmental areas on the Northeast quadrant of the interchange. An image of the interchange is shown below.

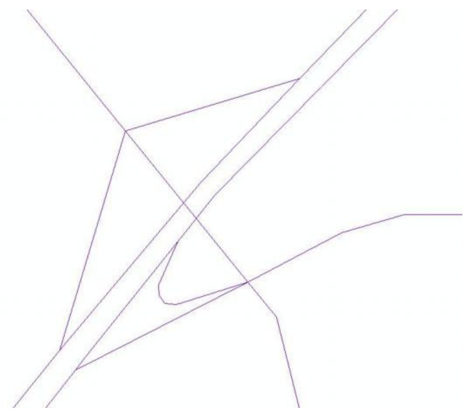


FIGURE 10 BROGDEN INTERCHANGE FROM TRM

Brogden Rd. and I-85 Interchange Configuration as Coded in the Triangle Regional Model for 2030

Based on the anticipated traffic volumes, environmental considerations, and the rural character of the study area diamond interchanges provide the most straightforward configuration. Diamond interchanges can be signalized (as Exit 191) or unsignalized (as Exit 202). It provides for movements in all directions and requires less use of land than free flowing clover leaf-style interchanges. It does, however, appear logical to include a modified diamond in the case of Brogden Road in order to tie in to nearby Hester Road.

In addition all the alternatives include the widening of NC 56 from two lanes to four at Exit 191 for the year 2040 as included in the 2040 MTP and Triangle Regional Model. Maintaining this interchange in its current configuration as a two lane road in 2040 could have significant impacts on the LOS at this Exit.

Interchange Location Alternatives

Based on the criteria described above, five interchange locations were preliminarily evaluated. Three interchange locations were selected which include those at the following locations:

- Brogden Road (SR 1127)
- Sanders Road (SR 1132)
- Smith Road (SR 1135)
- Bryan Hills Road
- Thollie Green Road

Bryan Hills Road was not considered a viable alternative because of its close proximity to the Northbound and Southbound rest areas on I-85 within the study area. Ramp configurations, changes to rest area access, and a possible relocation of Bryan Hills Road to provide enough spacing for merging cars and rest area access were all considerations. Thollie Green Road is not considered a viable alternative because it is a residential street that approaches I-85 at a skewed angle, and dead ends at the interstate. There are no other existing roadways that cross I-85 within the study area. As such, only Brogden Road, Sanders Road, and Smith Road were fully evaluated as options in this study.

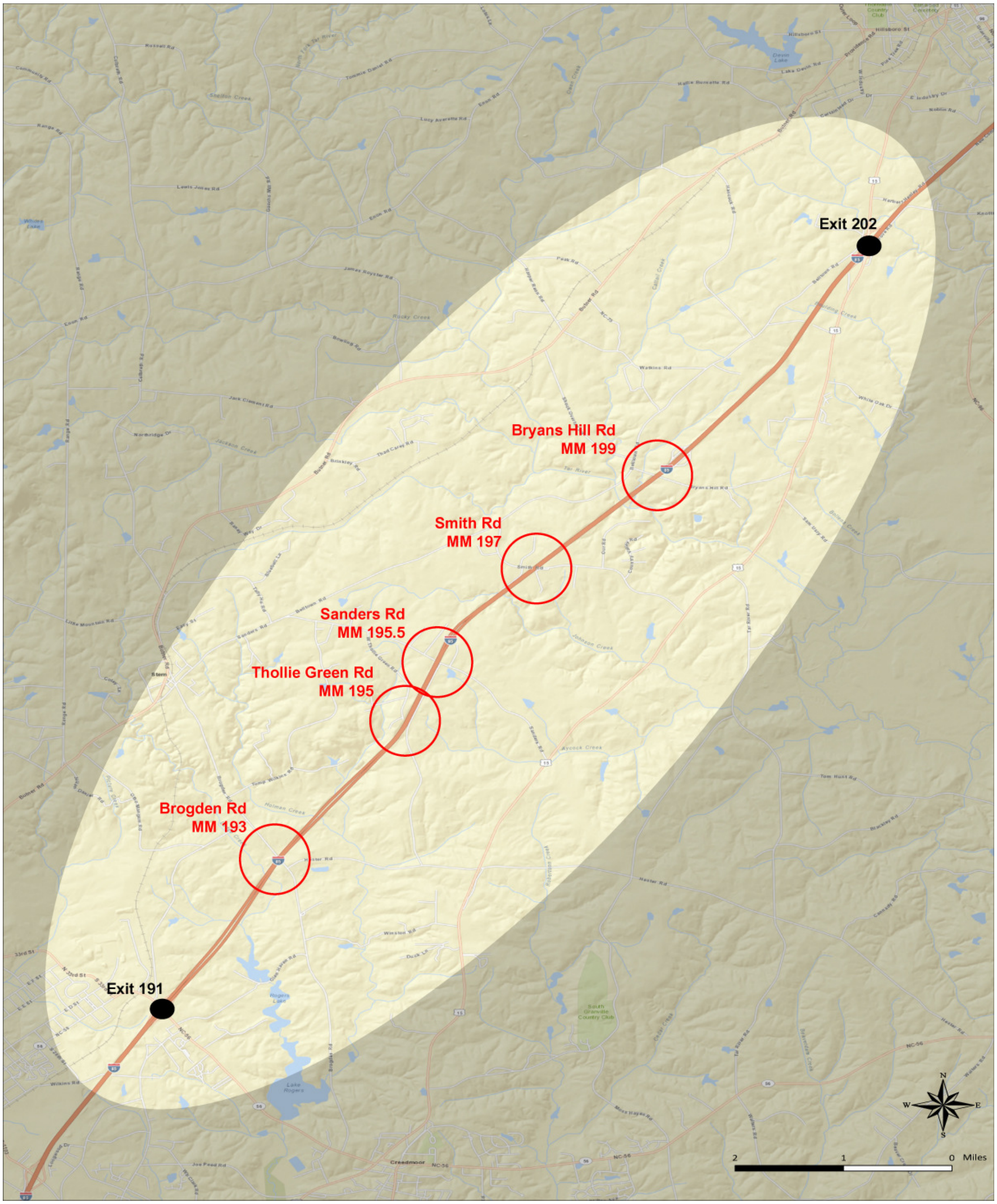


FIGURE 11 LOCATIONS OF INTERCHANGE ALTERNATIVES

Interchange Alternatives Functional Analyses

Brogden Road (SR 1127)

Brogden Road is located 2 miles north of I-85 Exit 191 at MM 193. It is the most direct route connecting the Towns of Creedmoor and Stem. It is a two lane rural road, has a speed limit of 55 mph and passes over I-85 at its intersection. The interchange is included in the Regional Comprehensive Transportation Plan and the Triangle Regional Model in the year 2030.

From a traffic standpoint as determined by the baseline Triangle Regional Model and interchange LOS results described previously, there is little need to advance an interchange for regional mobility or localized congestion mitigation. Therefore, this and all alternatives tested are for the year 2040. Modeled performance of the study area roadways are summarized below for this alternative and the baseline alternative for the build year.

TABLE 13 2040 BROGDEN ROAD INTERCHANGE OPTION ROADWAY SUMMARY

	2040 Brogden Interchange*			2040 Baseline		
Roadway	% Change in AADT from 2030	Travel Speed (mph)	V/C	% Change in AADT from 2030	Travel Speed (mph)	V/C
I-85 btwn Exits 191 and 202	15.8%	70	0.45	1.4%	72	0.29
US 56 West of I-85 Interchange	102.3%	45	0.27	76.4%	44	0.37
US 56 East of I-85 Interchange	44.0%	46	0.28	55.6%	44	0.35
Brogden Road at I-85	12.8%	39	0.40	-6.9%	41	0.24
E. Thollie Green Road at I-85	0.0%	46	0.01	14.3%	46	0.01
Sanders Road at I-85	30.0%	38	0.01	25.0%	38	0.01
Smith Road at I-85	17.2%	49	0.02	15.4%	46	0.02
Belltown Road at Sanders Rd	13.6%	48	0.10	14.3%	48	0.10
Belltown Road at Brogden Rd	13.2%	49	0.11	14.7%	48	0.11
W. Lyons Station Rd. at Brogden	24.0%	45	0.09	-5.7%	42	0.34
US 15 N of Creedmoor	21.3%	52	0.20	8.6%	52	0.24
US 15 at Hester Rd.	13.6%	53	0.08	-5.7%	53	0.11
US 15 at Sanders Rd.	10.2%	52	0.17	10.0%	52	0.16
US 15 at Smith Rd.	8.6%	52	0.13	9.3%	53	0.13

V/C increase over 2040 Base in **Red; V/C decrease over 2040 Base in **Green***

Mainline congestion remains low with a new Brogden Interchange with a relative increase in volumes expected on the I-85 mainline NC 56 at W. Lyon Station Road, US 15 North of Creedmoor and at Hester Road, and on Brogen and its link with W. Lyon Station Road. These changes in travel patterns point toward shifts in traffic from Creedmoor, Butner, Oxford, and Stem to use the new interchange. The performance of the interchange itself is shown in the LOS table below.

TABLE 14 2040 BROGDEN ROAD INTERCHANGE OPTION TRAFFIC SUMMARY

2040 Future Traffic (Brogden Interchange)

Level-of-Service, Capacity, and Delay Summary

	MOE	Overall	Eastbound			Westbound			Northbound			Southbound		
			L	T	R	L	T	R	L	T	R	L	T	R
AM Peak Hour														
1. NC 56 (E-W) & I-85 NB Ramps (N-S)	LOS	B	A	A			A		D		C			
	Capacity (v/c)	0.48	0.23	0.26			0.44		0.72		0.12			
	Delay	12.6	6.2	4.9			8.7		45.7		34.1			
2. NC 56 (E-W) & I-85 SB Ramps (N-S)	LOS	B	B			B	A					D		D
	Capacity (v/c)	0.62	0.54			0.59	0.29					0.61		0.48
	Delay	15.8	15.1			14.1	3.2					39.3		36.0
3. NC 56 (E-W) & W. Lyon Station Rd (N-S)	LOS	C	D	B			C	C				D		B
	Capacity (v/c)	0.67	0.28	0.24			0.59	0.14				0.86		0.20
	Delay	24.3	39.2	10.4			22.4	25.5				40.9		16.9
4. US 15 (N-S) & I-85 NB Ramps (E-W)	LOS		C									A		
	Capacity (v/c)		0.43									0.07		
	Delay		23.3									8.0		
5. US 15 (N-S) & I-85 SB Ramps (E-W)	LOS					C			A					
	Capacity (v/c)					0.37			0.03					
	Delay					16.0			8.0					
6. Brogden Rd (N-S) & I-85 NB Ramps (E-W)	LOS	B	C		C				A	A			B	B
	Capacity (v/c)	0.42	0.43		0.06				0.18	0.42			0.41	0.06
	Delay	10.4	25.7		23.3				4.3	5.4			11.0	15.3
7. Brogden Rd (N-S) & I-85 SB Ramps (E-W)	LOS	A				C		C	A	A			B	A
	Capacity (v/c)	0.55				0.47		0.06	0.18	0.41			0.54	0.06
	Delay	9.5				26.9		24.2	2.4	2.9			12.2	7.6
PM Peak Hour														
1. NC 56 (E-W) & I-85 NB Ramps (N-S)	LOS	C	D	A			C		D		E			
	Capacity (v/c)	0.87	0.84	0.45			0.86		0.61		0.85			
	Delay	25.8	42.5	6.0			28.7		36.2		55.4			
2. NC 56 (E-W) & I-85 SB Ramps (N-S)	LOS	B	B			D	A					D		C
	Capacity (v/c)	0.71	0.75			0.67	0.37					0.59		0.07
	Delay	15.8	17.1			35.0	4.2					39.7		33.7
3. NC 56 (E-W) & W. Lyon Station Rd (N-S)	LOS	C	D	A			A	B				D		B
	Capacity (v/c)	0.62	0.54	0.52			0.33	0.34				0.75		0.05
	Delay	21.0	39.1	8.4			18.3	37.9				40.3		19.6
4. US 15 (N-S) & I-85 NB Ramps (E-W)	LOS		F									A		
	Capacity (v/c)		1.64									0.12		
	Delay		347.2									8.4		
5. US 15 (N-S) & I-85 SB Ramps (E-W)	LOS					D			A					
	Capacity (v/c)					0.67			0.02					
	Delay					30.3			8.3					
6. Brogden Rd (N-S) & I-85 NB Ramps (E-W)	LOS	B	C		C				B	B			B	B
	Capacity (v/c)	0.70	0.62		0.10				0.61	0.72			0.69	0.09
	Delay	13.7	28.6		22.5				14.8	10.4			12.3	14.9
7. Brogden Rd (N-S) & I-85 SB Ramps (E-W)	LOS	B				D		C	B	A			C	A
	Capacity (v/c)	0.92				0.73		0.10	0.54	0.69			0.93	0.11
	Delay	19.2				37.7		23.9	19.3	6.3			30.7	8.6

LOS Poorer than 2040 Base and LOS D or worse

LOS Better than 2040 Base at LOS C or better

The interchange was modeled as a signalized modified diamond interchange. As shown in the Brogden Interchange LOS table above, the new interchange functions well during the AM Peak hour with one movement (I-85 SB Ramp to SB Brogden) functioning at LOS D in the PM Peak period, if just barely so. Other notable changes include more congestion at the intersection of NC 56 and W. Lyon Station Road, and the SB I-85 to SB US 15 movement at Exit 202 due to more vehicles using the interstate for their commutes, adding to the current congestion at W. Lyon Station Road. Other movements are expected to function at or better than the baseline case.

Sanders Road (SR 1132)

Sanders Road is located 5.75 miles north of I-85 Exit 191 near MM 197. It is a two lane rural road, has a speed limit of 55 mph and passes under I-85 at its intersection. Sanders connects US 15 to the east and Belltown Road to the west and provides access to Granville Central High School, whose Assistant Superintendent has expressed support for an interchange at this location (see Appendix). Modeled performance of the study area roadways are summarized below for this alternative and the baseline alternative for the build year.

TABLE 15 2040 SANDERS ROAD INTERCHANGE OPTION ROADWAY SUMMARY

	2040 Sanders Interchange			2040 Baseline		
Roadway	% Change in AADT from 2030	Travel Speed (mph)	V/C	% Change in AADT from 2030	Travel Speed (mph)	V/C
I-85 btwn Exits 191 and 202	0.5%	72	0.29	1.4%	72	0.29
US 56 West of I-85 Interchange	53.8%	45	0.32	76.4%	44	0.37
US 56 East of I-85 Interchange	40.2%	45	0.32	55.6%	44	0.35
Brogden Road at I-85	-25.8%	41	0.20	-6.9%	41	0.24
E. Thollie Green Road at I-85	1528.6%	46	0.04	14.3%	46	0.01
Sanders Road at I-85	2741.7%	37	0.23	25.0%	38	0.01
Smith Road at I-85	-12.8%	46	0.02	15.4%	46	0.02
Belltown Road at Sanders Rd	-21.8%	49	0.08	14.3%	48	0.10
Belltown Road at Brogden Rd	-22.8%	49	0.08	14.7%	48	0.11
W. Lyons Station Rd. at Brogden	-25.2%	43	0.28	-5.7%	42	0.34
US 15 N of Creedmoor	18.0%	52	0.22	8.6%	52	0.24
US 15 at Hester Rd.	-20.2%	53	0.09	-5.7%	53	0.11
US 15 at Sanders Rd.	11.4%	52	0.16	10.0%	52	0.16
US 15 at Smith Rd.	13.1%	52	0.14	9.3%	53	0.13

V/C increase over 2040 Base in **Red; V/C decrease over 2040 Base in **Green***

TRM results show significant increases in mainline volumes on E. Thollie Green Road and Sanders Road. E. Thollie Green Road increases are misleading in that there is very little volume and although a significant increase in terms of percentage, it results in a relatively minor increase in overall volumes as shown by the still very low V/C ratio. Other notable changes include decreased volumes on Belltown Road and Smith Road. The performance of the interchange itself is shown in the LOS table below.

TABLE 16 2040 SANDERS ROAD INTERCHANGE OPTION TRAFFIC SUMMARY

2040 Future Traffic (Sanders Interchange)

Level-of-Service, Capacity, and Delay Summary

	MOE	Overall	Eastbound			Westbound			Northbound			Southbound		
			L	T	R	L	T	R	L	T	R	L	T	R
AM Peak Hour														
1. NC 56 (E-W) & I-85 NB Ramps (N-S)	LOS	B	B	A			B		D		C			
	Capacity (v/c)	0.57	0.34	0.32			0.54		0.76		0.20			
	Delay	14.7	11.7	8.0			10.5		46.6		33.3			
2. NC 56 (E-W) & I-85 SB Ramps (N-S)	LOS	C	C			D	A					D		D
	Capacity (v/c)	0.83	0.73			0.80	0.36					0.59		0.79
	Delay	22.8	23.0			35.4	4.2					35.8		47.7
3. NC 56 (E-W) & W. Lyon Station Rd (N-S)	LOS	C	D	B			C	C				D		B
	Capacity (v/c)	0.80	0.33	0.30			0.77	0.17				0.92		0.24
	Delay	28.1	39.5	12.5			28.1	25.9				46.6		15.4
4. US 15 (N-S) & I-85 NB Ramps (E-W)	LOS		C									A		
	Capacity (v/c)		0.43									0.07		
	Delay		23.3									8.0		
5. US 15 (N-S) & I-85 SB Ramps (E-W)	LOS					C			A					
	Capacity (v/c)					0.38			0.03					
	Delay					16.2			8.0					
8. Sanders Rd (E-W) & I-85 NB Ramps (N-S)	LOS	A	A	A			C		C		C			
	Capacity (v/c)	0.29	0.06	0.18			0.28		0.32		0.02			
	Delay	7.5	2.0	2.1			7.1		27.5		25.6			
9. Sanders Rd (E-W) & I-85 SB Ramps (N-S)	LOS	A		A		A	A					C		C
	Capacity (v/c)	0.27		0.26		0.06	0.19					0.29		0.03
	Delay	7.3		6.9		2.1	2.3					27.3		25.7
PM Peak Hour														
1. NC 56 (E-W) & I-85 NB Ramps (N-S)	LOS	D	F	A			C		C		E			
	Capacity (v/c)	1.38	1.46	0.57			0.94		0.60		0.97			
	Delay	54.0	254.5	9.2			33.3		32.9		72.9			
2. NC 56 (E-W) & I-85 SB Ramps (N-S)	LOS	C	C			D	A					D		C
	Capacity (v/c)	0.85	0.94			0.75	0.45					0.63		0.21
	Delay	21.4	26.3			39.9	5.9					40.0		33.6
3. NC 56 (E-W) & W. Lyon Station Rd (N-S)	LOS	C	D	B			B	D				D		B
	Capacity (v/c)	0.73	0.59	0.64			0.43	0.40				0.79		0.09
	Delay	22.5	39.9	11.3			18.9	38.8				40.3		17.6
4. US 15 (N-S) & I-85 NB Ramps (E-W)	LOS		F									A		
	Capacity (v/c)		1.67									0.12		
	Delay		360.8									8.4		
5. US 15 (N-S) & I-85 SB Ramps (E-W)	LOS					D			A					
	Capacity (v/c)					0.69			0.02					
	Delay					31.2			8.3					
8. Sanders Rd (E-W) & I-85 NB Ramps (N-S)	LOS	A	A	A			B		C		C			
	Capacity (v/c)	0.40	0.09	0.25			0.41		0.31		0.04			
	Delay	8.9	2.6	2.70			10.1		25.5		23.9			
9. Sanders Rd (E-W) & I-85 SB Ramps (N-S)	LOS	A		A		A	A					C		C
	Capacity (v/c)	0.38		0.39		0.10	0.25					0.30		0.04
	Delay	9.0		9.8		3.3	3.4					25.6		24.1

LOS Poorer than 2040 Base and LOS D or worse

LOS Better than 2040 Base at LOS C or better

The interchange at Sanders Road would be expected to function within acceptable LOS. LOS changes to the existing interchanges remain relatively unchanged except for the intersection of NB I-85 and NC 56 which functions poorly, and functions more poorly than under the Brodgen Road alternative presumably because travelers are looking to access populations further south (Creedmoor, Butner, Stem) than Sanders Road. (For example, travel delay for PM northbound right turns is 17.5 seconds higher in the Sanders Road alternative).

Smith Road (SR 1135)

Smith Road is located approximately 5 miles south of I-85 Exit 202 near MM 198 and 6 miles north of I-85 Exit 191. It is a two lane rural road, has a speed limit of 55 mph and passes over I-85 at its intersection. Like Sanders, Smith Road connects US 15 to the east and Belltown Road to the west. Modeled performance of the study area roadways are summarized below for this alternative and the baseline alternative for the build year.

TABLE 17 2040 SMITH ROAD INTERCHANGE OPTION ROADWAY SUMMARY

	2040 Smith Interchange			2040 Baseline		
Roadway	% Change in AADT from 2030	Travel Speed (mph)	V/C	% Change in AADT from 2030	Travel Speed (mph)	V/C
I-85 btwn Exits 191 and 202	7.2%	72	0.30	1.4%	72	0.29
US 56 West of I-85 Interchange	53.0%	45	0.33	76.4%	44	0.37
US 56 East of I-85 Interchange	40.4%	45	0.32	55.6%	44	0.35
Brogden Road at I-85	-27.8%	42	0.19	-6.9%	41	0.24
E. Thollie Green Road at I-85	14.3%	46	0.01	14.3%	46	0.01
Sanders Road at I-85	16.7%	38	0.01	25.0%	38	0.01
Smith Road at I-85	243.6%	46	0.09	15.4%	46	0.02
Belltown Road at Sanders Rd	-37.6%	49	0.06	14.3%	48	0.10
Belltown Road at Brogden Rd	-37.5%	49	0.06	14.7%	48	0.11
W. Lyons Station Rd. at Brogden	-28.1%	43	0.27	-5.7%	42	0.34
US 15 N of Creedmoor	-3.8%	52	0.21	8.6%	52	0.24
US 15 at Hester Rd.	-31.6%	53	0.07	-5.7%	53	0.11
US 15 at Sanders Rd.	-38.4%	52	0.09	10.0%	52	0.16
US 15 at Smith Rd.	-34.1%	53	0.07	9.3%	53	0.13

V/C increase over 2040 Base in *Red*; V/C decrease over 2040 Base in *Green

Regional model results show significant increases in mainline volumes on Smith Road, with reductions in volumes on US 15 south of Smith Road and Belltown Road. Inclusion of this interchange still results in very low V/C ratios throughout the regional system. The changes in travel patterns points to an interchange at this location being utilized primarily by commuters north of the interchange in the Oxford area. There is also a reduction in vehicles utilizing Exit 202, US 15. The performance of the Smith Road interchange and Exits 191 and 202 are shown in the LOS table below.

TABLE 18 2040 SMITH ROAD INTERCHANGE OPTION TRAFFIC SUMMARY

2040 Future Traffic (Smith Interchange)

Level-of-Service, Capacity, and Delay Summary

	MOE	Overall	Eastbound			Westbound			Northbound			Southbound		
			L	T	R	L	T	R	L	T	R	L	T	R
AM Peak Hour														
1. NC 56 (E-W) & I-85 NB Ramps (N-S)	LOS	B	A	A			A		D		C			
	Capacity (v/c)	0.49	0.24	0.27			0.46		0.73		0.12			
	Delay	12.8	6.5	5.2			8.9		46.4		34.0			
2. NC 56 (E-W) & I-85 SB Ramps (N-S)	LOS	B	B			B	A					D		D
	Capacity (v/c)	0.64	0.56			0.62	0.30					0.61		0.55
	Delay	16.6	16.4			16.1	3.2					38.7		37.6
3. NC 56 (E-W) & W. Lyon Station Rd (N-S)	LOS	C	D	B			C	C				D		B
	Capacity (v/c)	0.69	0.29	0.25			0.61	0.15				0.87		0.21
	Delay	24.5	39.3	10.6			22.7	24.5				41.8		16.8
4. US 15 (N-S) & I-85 NB Ramps (E-W)	LOS		B									A		
	Capacity (v/c)		0.15									0.04		
	Delay		12.8									7.7		
5. US 15 (N-S) & I-85 SB Ramps (E-W)	LOS					B			A					
	Capacity (v/c)					0.14			0.02					
	Delay					11.0			7.7					
10. Smith Rd (E-W) & I-85 NB Ramps (N-S)	LOS	A	A	A			A		C		C			
	Capacity (v/c)	0.11	0.02	0.07			0.10		0.20		0.01			
	Delay	6.3	1.8	1.6			4.5		28.6		27.2			
11. Smith Rd (E-W) & I-85 SB Ramps (N-S)	LOS	A		A		A	A					C		C
	Capacity (v/c)	0.10		0.09		0.02	0.07					0.21		0.01
	Delay	6.3		4.5		1.7	1.6					28.8		27.3
PM Peak Hour														
1. NC 56 (E-W) & I-85 NB Ramps (N-S)	LOS	C	D	A			C		D		E			
	Capacity (v/c)	0.92	0.90	0.46			0.86		0.62		0.87			
	Delay	27.1	50.7	6.2			28.6		36.4		58.6			
2. NC 56 (E-W) & I-85 SB Ramps (N-S)	LOS	B	B			D	A					D		C
	Capacity (v/c)	0.73	0.77			0.70	0.38					0.59		0.07
	Delay	16.4	18.0			37.0	4.4					39.8		33.5
3. NC 56 (E-W) & W. Lyon Station Rd (N-S)	LOS	C	D	A			B	D				D		B
	Capacity (v/c)	0.63	0.54	0.53			0.34	0.35				0.76		0.06
	Delay	21.4	39.1	8.7			18.8	39.0				40.6		19.3
4. US 15 (N-S) & I-85 NB Ramps (E-W)	LOS		C									A		
	Capacity (v/c)		0.48									0.06		
	Delay		21.0									7.8		
5. US 15 (N-S) & I-85 SB Ramps (E-W)	LOS					B			A					
	Capacity (v/c)					0.21			0.01					
	Delay					12.8			7.8					
10. Smith Rd (E-W) & I-85 NB Ramps (N-S)	LOS	A	A	A			A		C		C			
	Capacity (v/c)	0.19	0.04	0.12			0.18		0.22		0.02			
	Delay	6.9	2.0	2.0			6.0		27.0		25.9			
11. Smith Rd (E-W) & I-85 SB Ramps (N-S)	LOS	A		A		A	A					C		C
	Capacity (v/c)	0.18		0.17		0.04	0.12					0.23		0.02
	Delay	7.0		6.1		2.0	2.0					27.3		26.0

LOS Poorer than 2040 Base and LOS D or worse

LOS Better than 2040 Base at LOS C or better

A new interchange at Smith Road would be expected to function at acceptable levels of service. The most pronounced improvement over the baseline 2040 forecasts is the functionality of Exit 202. During the AM peak period, the northbound exit ramp movement to US 15 WB is shown to operate at LOS F in the baseline and LOS B with a Smith Road interchange. Functionality at Exit 191 worsens, however, particularly in the PM Peak period.

Additional Impacts/Considerations

In addition to the impact on congestion resulting from the addition of a new interchange, the FHWA requires a comprehensive look at the secondary impacts as well. These include environmental and community impacts, multimodal (bicycle/pedestrian) impacts, and economic well-being. Summarized below are items to consider when conducting further analysis on a future interchange.

Environmental Impacts

Environmental impact considerations are critical to any decision to implement large transportation projects such as a new interstate interchange. Detailed environmental documents are required as the planning process moves forward, however environmental consideration should be taken into account early in the process to ensure potential issues are identified as soon as possible. The general environmental issues and their considerations are discussed below.

Water quality

Run off from an interchange construction site, and the resulting facility, may impact the quality of ground water. This is especially true in rural areas where wells provide drinking water to residents. Obviously, all improvements would have some additional impact to the ground water quality. Therefore it would be most beneficial if operational improvements were made to existing interchanges if the project is attempting to address capacity, air quality issues, emergency management access, etc. As part of this analysis, water quality would benefit from exploring if operational improvements at Exits 191 and 202 would assist in meeting the regions goals.

Wetlands and Wildlife

Impacts to wetlands and wildlife are often present when a project is close to a wetland, is near an upstream water source, or within a wildlife migration path or habitat. Wetlands and flood hazards are documented in the immediate vicinity of the Brogden Road interchange, though much of the identified wetlands are several hundred feet or more from the roadway, particularly south of the interstate. The impact of this interchange will need to be investigated within subsequent studies, in addition to impacts to wildlife habitat.

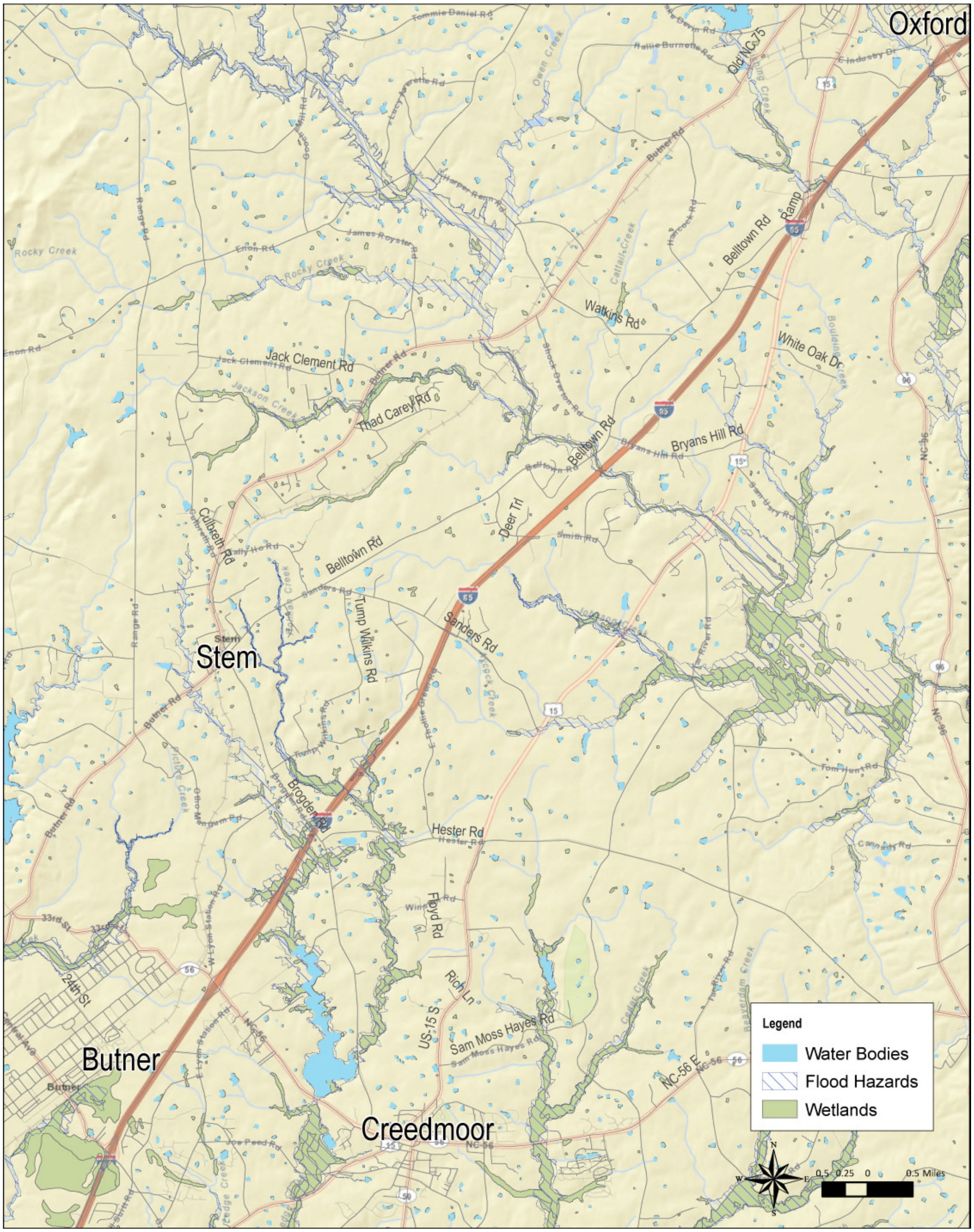


FIGURE 12 WETLANDS AND FLOOD HAZARDS

Air quality

Air quality in a non-attainment area requires that transportation projects conform to not contribute, and ideally reduce, impacts to air quality. Granville County is a non-attainment county for 8-hour ozone readings (as of March 12, 2009). A Clean Air Act requires states to submit to EPA its recommendations for nonattainment designations within 1-year of promulgation of a new or revised National Ambient Air Quality Standard (NAAQS). The 8-Hour Ozone NAAQS was revised to 0.075 parts per million (ppm) on March 12, 2008.

Auto congestion contributes to poor air quality, so implementing projects that reduce congestion generally benefit air quality. Based on this analysis, air quality modeling should be conducted to determine the impacts of the new interchange alternatives. Because the Brogden interchange is included as part of the adopted regional CTP and the Triangle Regional Model, it is assumed that this location has no adverse impacts to the region.

Energy usage

Energy usage is becoming a larger part of planning for transportation improvements. In general, more efficient movement of vehicles contributes to a reduction in the amount of energy required. A well designed new interchange would increase the number of access points which would theoretically reduce energy regionally, but may produce localized congestion off-setting the benefits. This would have to be studied in further detail.

Community Impacts

Community impacts of large-scale transportation improvements such as this are wide-ranging. As the interchange development moves forward, public involvement will be required to gauge what the community impacts will be. However, there are some considerations that can be assessed independently, including following.

Mobility

Communities are impacted in large part by how well people are able to travel to work, groceries, entertainment, home, family, etc. Increasing access to the extent possible to allow residents, goods, and materials to flow more freely generally benefits a community. An interstate interchange would reduce travel times for residents who travel to/from the middle of the study area, to/from Oxford and points north or to/from Butner and points south.

The Sanders Road interchange would impact Granville Central High School by increasing traffic by the school. The school however is supportive of a new interchange at this location for increased mobility. Sixty-two full time employees and 8 part time employees commute to the school, and of the current number of students 30 percent do not ride the bus. There is a large cluster of students residences in the Butner area with others scattered throughout the district.

Land use

Land use policies impact communities in direct and profound ways, and define the character of an area. Land uses at interchanges, particularly in rural areas, are predominantly service based and cater to highway traveler needs as well as the local towns. This is evident particularly at I-85 Exit 191. The land use at Exit 202 is rural in character, with low density and limited services. One of the aims of providing a new interchange is to spur economic development in the study area. The future provision of water and sewer services along Brogden Road would make this interchange location more attractive for development and the land use policy changes necessary to change the area from low density to another use of higher density should be considered carefully.

Medical/emergency management response

One of the reasons a new interchange is being studied is because of a local desire to allow emergency personnel better access to the interstate in case of an incident. Currently there are no access points along the 11 mile stretch between Exits 191 and 202. Ideally an interchange in the middle of the segment would provide the best access. This would make the Smith Road location the most attractive for EMS responders. However, the majority of crashes on I-85 occur between Sanders Road and Exit 191, pointing toward potential emergency response benefits in having an interchange further south. In addition, the Stem Fire Department would have more direct access with a Brogden interchange.

Due to generally better access to I-85, any of the scenarios would shorten response times for certain stretches of the Interstate particularly for the Stem Fire Department because it is located in the middle of the inaccessible stretch of the interstate. For example, response times could reasonably be reduced by as much as half, from around eight minutes to four minutes, if responding to an incident between Brogden and Sanders and an interchange at Brogden were in place. The Providence and Butner Departments would realize fewer benefits since they have relatively close interstate access.

Bicycle/Pedestrian

The area of study is an interstate corridor and not conducive to bicycle or pedestrian travel, and therefore these modes are not the focus of this study. However, design of bicycle and pedestrian facilities at interchanges and intersections within the area as part of the Interchange Justification Criteria should be considered. Both NC 56 and US 15 have been identified in regional plans as potential future bicycle routes and, in the case of NC 56, a planned multi-use corridor (bicycle and pedestrian). Therefore, consideration should be given to providing sidewalks, bicycle lanes, wide shoulders, or a combination of each in addition to pedestrian signals and crosswalks.

In general, pedestrian signals improve multi-modal access and safety, and can be considered an upgrade to intersection operation. Capacity is relatively unaffected.

According to MUTCD Section 4E.03 Application of Pedestrian Signal Heads Standard, pedestrian signal heads shall be used in conjunction with vehicular traffic control signals under any of the following conditions:

- If a traffic control signal is justified by an engineering study and meets either Warrant 4, Pedestrian or Volume or Warrant 5, School Crossing;
- If an exclusive signal phase is provided or made available for pedestrian movements in one or more directions, with all conflicting vehicular movements being stopped;
- At an established school crossing at any signalized location; or
- Where engineering judgment determines that multi-phase signal indications (as with split-phase timing) would tend to confuse or cause conflicts with pedestrians using a crosswalk guided only by vehicular signal indications.

Economic Development Impacts

All things being equal, economic development is maximized when it is targeted in areas where raw materials, work force, housing, utilities and efficient transportation are available. Therefore, economic development closer to population centers and roadway access would yield greater results than in rural undeveloped areas.

In this study area the population is primarily clustered at the southern end in Butner, Creedmoor, and Stem, with a rural mid-section and Oxford to the north. From an economic development perspective the placement of an interchange closer to the south would yield the most benefit. Water and sewer extensions are planned along Brogden Road and the interchange alternative is on a direct connection between Creedmoor and Stem. From an economic perspective, a new interchange would be best suited in this location over Sanders or Smith Roads.

New and infill development planning and economic efforts should be conducted in accordance with good land use planning practices, meaning land near existing interchanges should be utilized to the fullest potential to maximize transportation efficiency and minimize adverse impacts.

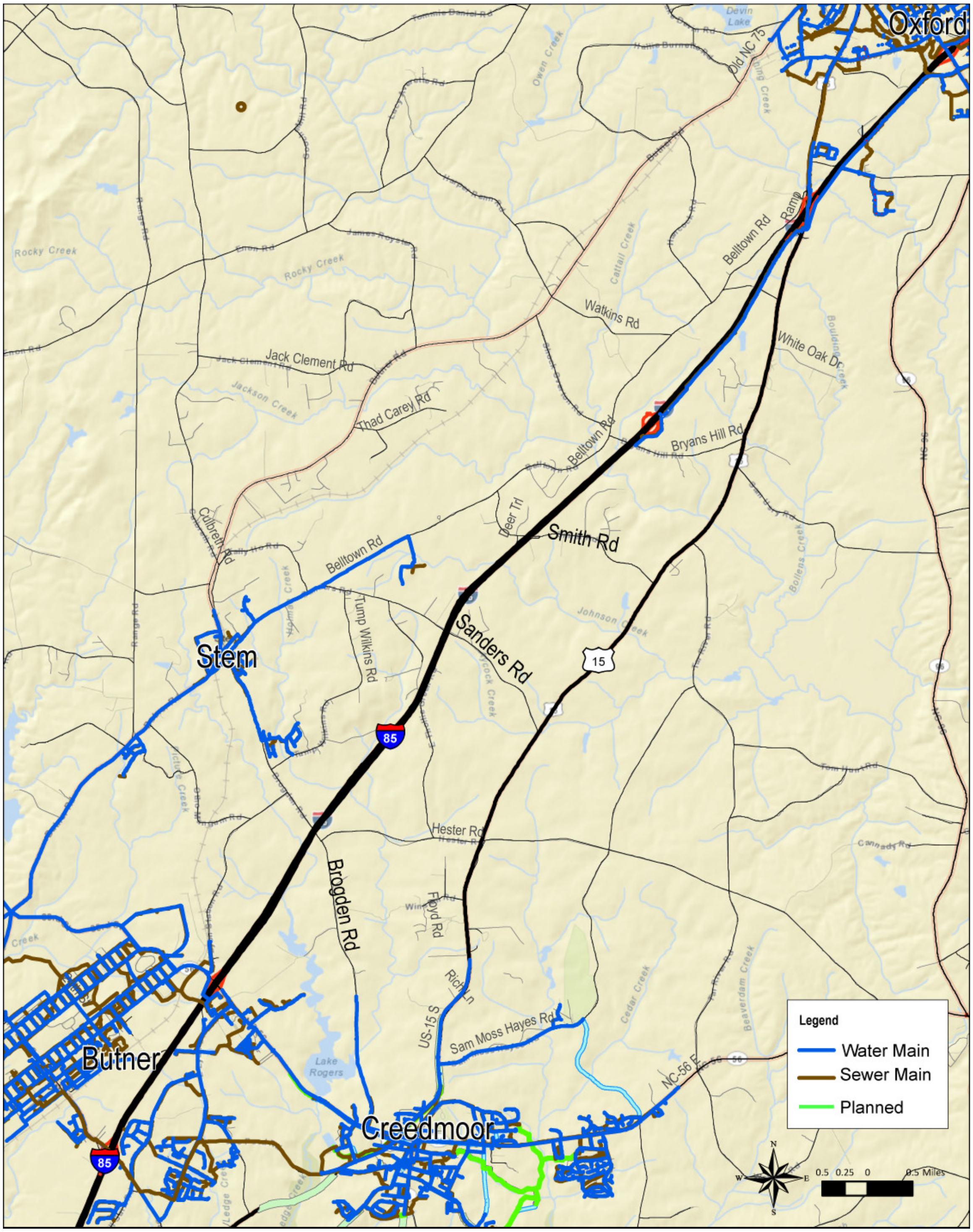


FIGURE 13 WATER AND SEWER PROVISION

How the interchange locations tested compare against these criteria is summarized in the table below.

TABLE 19 ALTERNATIVES EVALUATION

	Brogden Road (SR 1127)	*Sanders Road (SR 1132)*	*Smith Road (SR 1135)*
Mobility Impacts			
Improved 2040 V/C ratio	●	●	●
Improved 2040 LOS	◒	◒	◒
Need for 2040 regional mobility	○	○	○
Environmental Impacts (high score = low impacts)			
Water quality	●	◒	◒
Wetlands / Flood hazards	◒	●	●
Air quality	●	●	●
Energy usage	n/a	n/a	n/a
Community Impacts			
Improve mobility	●	●	●
School access	◒	●	◒
Minimize existing land use changes	○	◒	◒
Bike/Ped access improvements	○	○	○
Emergency Management Impacts			
Access to midpoint	○	◒	●
Access to high crash areas	●	◒	○
Economic Development Impacts			
Proximity to growth	●	◒	○
Distance to existing/planned water & sewer	●	○	○
Undeveloped / underdeveloped land	●	◒	◒
Large parcels	●	◒	○

Key: ● = High rating ◒ = Medium Rating ○ = Low Rating

Recommendations

Interchange Justification

As stated previously, this analysis satisfies some but not all interchange justification criteria required by the FHWA. Therefore, if the process is to move forward, additional study will be necessary to provide a comprehensive interchange justification report.

The criteria satisfied by this report include:

- No Build or No Action Alternative
- Build Alternative (Alternative[s] that provide for New or Modified Access)
- I-85 and adjacent roadway current and expected future volumes
- Estimate of LOS of interstate and connecting streets
- Estimate of LOS of existing interchanges
- Alternative locations for a new interchange
- Estimate of LOS on interstate and connecting streets after new interchange is established
- Estimate of LOS of alternative interchange locations
- Estimate of LOS at adjacent interchanges after new interchange is established
- Preliminary regional coordination
- Crash/Safety data incorporation
- Coordination and consistency with existing regional plans

The additional information required for the FHWA Interchange Access Justification Report includes:

- Transportation System Management Alternative testing (including signal provision at Exit 202 to help reduce the number of crashes and assist in increasing LOS in the future year)
- Alternative Transportation Modes testing
- Build Alternative which Incorporates TSM and Alternative Models (Alternative[s] that Provide for New or Modified Access)
- Analysis of Hester Road at Brogden as part of a Brogden interchange analysis
- Analysis of E. Thollie Green Road at Sanders as part of the Sanders interchange analysis
- Coordination and consistency between planned future land use and development, and transportation improvements
- Inclusion of environmental considerations (air quality analysis on alternatives, wetlands impacts, etc.)

Interchange Location

This analysis focuses on the impacts of a potential interchange in three locations on the LOS of the study area roadways, and the new and adjacent interchanges. From this standpoint, a new interchange would have limited benefits because it is not forecasted to relieve congestion on study area roadways or adjacent interchanges to a measurable extent. From a mobility standpoint the interchange will not need to be constructed prior to the year 2040. If an interchange is deemed desirable and necessary for the economic development and emergency management goals of the region it is recommended that it be located at Brogden Road.

Brogden Road is well positioned to provide interstate access in a more direct manner to Stem and Creedmoor. The roadway intersects the segment of I-85 that historically has the most number of crashes and a new interchange would provide emergency personnel better access to this segment and reduced response times. In addition, the current grade of Brogden and I-85 allows for Brogden to pass over I-85, which would provide better sight distance than an underpass, providing a more safe intersection.

As discussed earlier, economic development initiatives are most effective when there is access to workforce, housing, schools, etc. Since most of the study area population is on the southern end, access at Brogden Road would be better located to take advantage of the current and proposed growth in the region. The prevalence of large, possibly developable parcels (many of which are either undeveloped currently used for agricultural purposes) adds to the added economic development impacts relative to the Sanders and Smith Road alternatives.

Additional Improvements

Additional improvements are recommended within the study area and include:

- Pedestrian signals, crosswalks, and sidewalks at Exit 191 (if plans move forward with regional bicycle/pedestrian connectivity plans)
- Traffic signals at Exit 202 to reduce the number of crashes (following MUTCD criteria Warrant 7 of more than 5 correctable crashes per year)
- Pedestrian signals, crosswalks, and sidewalks at Exit 202 (if plans move forward with regional bicycle/pedestrian connectivity plans)
- Pedestrian signals, crosswalks, and striping at New Brogden Interchange (if plans move forward with regional bicycle/pedestrian connectivity plans)

Note: the addition of pedestrian signals would impact the intersection LOS calculations.

Cost Estimate and Implementation

The costs for interchange improvements can vary widely depending upon the level of construction, environmental issues encountered, materials costs, etc. As such, the cost estimates provided for the Brogden Interchange Location are gross estimates, and should be used as a ballpark figure only.

TABLE 20 IMPROVEMENT COSTS

Improvement	Cost
New Brogden Interchange	$14M--$17M
Pedestrian signals, crosswalks, and sidewalks at Exit 191 (if plans move forward with regional bicycle/pedestrian connectivity plans)	$185,000--$250,000
Traffic signals at Exit 202 to reduce the number of crashes (following MUTCD criteria Warrant 7 of more than 5 crashes per year)	$125,000--$250,000
Pedestrian signals, crosswalks, and sidewalks at Exit 202 (if plans move forward with regional bicycle/pedestrian connectivity plans)	$270,000--$365,000
Pedestrian signals, crosswalks, and striping at New Brogden Interchange (if plans move forward with regional bicycle/pedestrian connectivity plans)	$310,000--$500,000

At this study phase, it is important to begin to think about how the recommendations will be implemented. NCDOT is required to be the organization to submit the Interchange Access Justification Report, and would thus take the lead on developing it. However, implementation will rest on stakeholders, including municipal and county planners, CAMPO, Kerr-Tar RPO, NCDOT and FHWA, who will need to coordinate on developing the necessary documentation.

Some improvements may be able to be implemented in the short term, however, such as bicycle and pedestrian improvements. These improvements should be done in conjunction with other regional plans to expand the greenway and bicycle networks in the study area. The recommendations should also be considered in terms of available resources and priorities.

The following next steps are recommended to move to implementation.

1. Discuss the findings of the report
2. Establish a dialogue among NCDOT, CAMPO, and municipal and county stakeholders to agree on those recommendations critical for advancement
3. Develop an action plan to further the projects, and resume the planning and implementation process

Appendices

Peak Hour Turning Movement Counts

Turning Movement Counts				Taken	6/6/13 and 6/7/13						
US 56 @ W. Lyon Station Rd.											
	EB US 56			WB US 56			SB W. Lyon Station Rd.				
	R	T	L	R	T	L	R	T	L	Totals	
6:00-6:15 AM		28	4	10	79		6		41	168	
6:15-6:30 AM		20	4	19	138		23		47	251	
6:30-6:45 AM		34	3	24	108		20		66	255	
6:45-7:00 AM		88	5	15	116		20		60	304	
7:00-7:15 AM		39	3	10	83		9		60	204	
7:15-7:30 AM		51	5	20	92		16		68	252	Peak Hour
7:30-7:45 AM		47	5	30	98		16		70	266	
7:45-8:00 AM		53	8	42	135		32		70	340	
8:00-8:15 AM		49	6	28	74		16		57	230	
8:15-8:30 AM		48	8	27	56		15		53	207	
8:30-8:45 AM		43	9	31	50		10		46	189	
8:45-9:00 AM		38	4	15	52		9		45	163	
Totals		538	64	271	1081		192		683	2829	
Total Peak Hour		200	24	120	399		80		265	1088	
% of Total Traffic		19%	2%	10%	38%		7%		24%		
3:00-3:15 PM		121	22	44	61		9		43	300	
3:15-3:30 PM		109	9	52	62		10		35	277	
3:30-3:45 PM		169	23	66	72		11		36	377	Peak Hour
3:45-4:00 PM		137	15	57	56		10		39	314	
4:00-4:15 PM		150	18	58	56		12		35	329	
4:15-4:30 PM		116	18	69	56		8		27	294	
4:30-4:45 PM		134	22	74	61		12		43	346	
4:45-5:00 PM		87	10	75	67		14		40	293	
5:00-5:15 PM		137	16	70	73		12		44	352	
5:15-5:30 PM		92	16	73	59		5		35	280	
5:30-5:45 PM		80	15	82	71		14		40	302	
5:45-6:00 PM		55	14	84	70		9		48	280	
Totals		1387	198	804	764		126		465	3744	
Total Peak Hour		624	84	346	313		58		189	1614	
% of Total Traffic		37%	5%	21%	20%		3%		12%		

Turning Movement Counts		Taken:	5/13/2013								
I-85 SB Ramp at Exit 191											
	SB I-85 Exit Ramp			EB NC 56			WB NC 56				
	R	T	L	R	T	L	R	T	L	Totals	
6:00-6:15 AM	34	0	8	32	36			46	21	177	
6:15-6:30 AM	109	0	16	38	48			69	22	302	
6:30-6:45 AM	48	0	28	40	53			79	25	273	
6:45-7:00 AM	52	0	22	39	90			89	21	313	
7:00-7:15 AM	39	0	25	39	67			71	39	280	
7:15-7:30 AM	50	0	22	54	84			100	46	356	Peak Hour
7:30-7:45 AM	46	1	25	54	85			84	35	330	
7:45-8:00 AM	44	0	22	35	80			127	32	340	
8:00-8:15 AM	34	1	22	38	86			89	35	305	
8:15-8:30 AM	29	0	27	42	66			69	25	258	
8:30-8:45 AM	21	0	20	26	78			62	35	242	
8:45-9:00 AM	8	1	13	16	78			77	37	230	
Totals	514	3	250	453	851			962	373	3406	
Total Peak Hour	174	2	91	181	335			400	148	1331	
% of Total Traffic	15%	0%	7%	13%	25%			28%	11%		
3:00-3:15 PM	7	0	21	20	172			88	30	338	
3:15-3:30 PM	22	1	16	17	111			96	24	287	
3:30-3:45 PM	19	0	19	19	162			154	27	400	
3:45-4:00 PM	33	0	16	12	129			111	31	332	
4:00-4:15 PM	16	0	16	22	172			135	31	392	
4:15-4:30 PM	17	1	13	13	218			117	21	400	Peak Hour
4:30-4:45 PM	5	0	20	15	176			125	23	364	
4:45-5:00 PM	19	0	21	28	152			147	33	400	
5:00-5:15 PM	20	1	24	23	180			134	28	410	
5:15-5:30 PM	16	0	10	18	121			132	26	323	
5:30-5:45 PM	12	0	19	13	111			135	29	319	
5:45-6:00 PM	20	0	19	10	107			139	28	323	
Totals	206	3	214	210	1811			1513	331	4288	
Total Peak Hour	61	2	78	79	726			523	105	1574	
% of Total Traffic	5%	0%	5%	5%	42%			35%	8%		

Turning Movement Counts		Taken:	5/14/2013								
I-85 NB Ramp at Exit 191											
	EB US 56			**WB NC 56**			**NB I-85 Ramp**				
	R	T	L	R	T	L	R	T	L	Totals	
6:00-6:15 AM		51	9	8	86		5		6	165	
6:15-6:30 AM		50	10	6	89		12		15	182	
6:30-6:45 AM		59	17	18	95		19		11	219	
6:45-7:00 AM		91	33	19	102		23		8	276	
7:00-7:15 AM		67	23	22	95		13		8	228	
7:15-7:30 AM		84	14	13	123		28		14	276	Peak Hour
7:30-7:45 AM		117	19	25	128		20		29	338	
7:45-8:00 AM		114	5	26	158		31		23	357	
8:00-8:15 AM		61	12	13	94		23		27	230	
8:15-8:30 AM		87	16	19	98		26		16	262	
8:30-8:45 AM		85	21	12	87		12		14	231	
8:45-9:00 AM		88	5	16	80		18		11	218	
Totals		954	184	197	1235		230		182	2982	
Total Peak Hour		376	50	77	503		102		93	1201	
% of Total Traffic		32%	6%	7%	41%		8%		6%		
3:00-3:15 PM		130	77	28	80		33		18	366	
3:15-3:30 PM		124	40	38	100		37		19	358	
3:30-3:45 PM		162	75	28	80		33		18	396	
3:45-4:00 PM		111	31	48	147		64		29	430	
4:00-4:15 PM		136	41	32	140		37		30	416	
4:15-4:30 PM		180	80	52	101		35		27	475	Peak Hour
4:30-4:45 PM		181	52	47	140		42		22	484	
4:45-5:00 PM		154	54	55	138		57		32	490	
5:00-5:15 PM		151	39	48	140		46		25	449	
5:15-5:30 PM		141	27	34	135		51		35	423	
5:30-5:45 PM		136	11	35	134		63		28	407	
5:45-6:00 PM		119	31	34	102		37		19	342	
Totals		1725	558	479	1437		535		302	5036	
Total Peak Hour		802	266	234	659		217		136	2314	
% of Total Traffic		34%	11%	10%	29%		11%		6%		

Turning Movement Counts				Taken	5/23/2013						
I-85 NB Ramp at Exit 202											
	EB US 15			WB US 15			NB I-85 Ramp				
	R	T	L	R	T	L	R	T	L	Totals	
6:00-6:15 AM		28	5	12	14		1		11	71	
6:15-6:30 AM		35	6	14	24		3		18	100	
6:30-6:45 AM		53	8	10	30		6		23	130	
6:45-7:00 AM		62	9	15	51		9		32	178	
7:00-7:15 AM		62	15	12	40		3		16	148	
7:15-7:30 AM		57	9	20	37		2		16	141	
7:30-7:45 AM		62	17	25	34		4		20	162	Peak Hour
7:45-8:00 AM		59	21	26	45		5		22	178	
8:00-8:15 AM		40	10	19	40		1		25	135	
8:15-8:30 AM		52	16	16	46		1		25	156	
8:30-8:45 AM		47	18	18	30		1		27	141	
8:45-9:00 AM		28	14	15	38		5		21	121	
Totals		585	148	202	429		41		256	1661	
Total Peak Hour		218	57	90	156		12		83	616	
% of Total Traffic		35%	9%	12%	26%		2%		15%		
3:00-3:15 PM		28	10	10	40		1		18	107	
3:15-3:30 PM		52	10	16	44		1		31	154	
3:30-3:45 PM		71	14	22	43		1		35	186	
3:45-4:00 PM		64	13	22	42		7		59	207	
4:00-4:15 PM		61	22	27	68		2		42	222	
4:15-4:30 PM		59	13	18	46		7		45	188	
4:30-4:45 PM		65	11	17	50		6		43	192	
4:45-5:00 PM		68	12	15	45		8		58	206	
5:00-5:15 PM		61	25	21	59		1		49	216	Peak Hour
5:15-5:30 PM		79	15	24	46		6		49	219	
5:30-5:45 PM		80	20	23	42		6		55	226	
5:45-6:00 PM		73	26	20	54		2		55	230	
Totals		761	191	235	579		48		539	2353	
Total Peak Hour		314	83	98	268		24		237	1024	
% of Total Traffic		32%	8%	10%	25%		2%		23%		

Turning Movement Counts		**Taken:**	**5/29/2013**								
I-85 SB Ramp at Exit 202											
	SB I-85 Exit Ramp			**EB US 15**			**WB US 15**				
	R	T	L	R	T	L	R	T	L	Totals	
6:00-6:15 AM	6		6	48	25			21	7	113	
6:15-6:30 AM	12		10	59	36			25	6	148	
6:30-6:45 AM	8		19	53	39			48	10	177	
6:45-7:00 AM	15		22	34	51			76	11	209	Peak Hour
7:00-7:15 AM	15		21	52	52			48	11	199	
7:15-7:30 AM	17		24	53	59			51	5	209	
7:30-7:45 AM	16		19	65	61			50	7	218	
7:45-8:00 AM	19		20	39	47			71	8	204	
8:00-8:15 AM	15		23	32	44			66	3	183	
8:15-8:30 AM	10		18	35	48			55	4	170	
8:30-8:45 AM	10		11	30	41			45	5	142	
8:45-9:00 AM	17		5	21	53			67	5	168	
Totals	160		198	521	556			623	82	2140	
Total Peak Hour	67		86	189	211			238	23	814	
% of Total Traffic	7%		9%	24%	26%			29%	4%		
3:00-3:15 PM	18		16	22	35			75	2	168	
3:15-3:30 PM	28		12	19	50			79	8	196	
3:30-3:45 PM	19		22	30	62			110	5	248	
3:45-4:00 PM	26		18	23	85			117	2	271	Peak Hour
4:00-4:15 PM	22		19	29	51			101	8	230	
4:15-4:30 PM	20		22	28	76			93	3	242	
4:30-4:45 PM	21		27	26	73			112	5	264	
4:45-5:00 PM	20		30	24	58			98	4	234	
5:00-5:15 PM	26		19	31	67			103	3	249	
5:15-5:30 PM	26		28	29	58			104	3	248	
5:30-5:45 PM	26		17	26	87			103	4	263	
5:45-6:00 PM	26		27	17	47			118	1	236	
Totals	278		257	304	749			1213	48	2849	
Total Peak Hour	87		98	109	274			406	15	989	
% of Total Traffic	10%		9%	11%	26%			43%	2%		

FHWA Interchange Justification Policy Requirements

Interchange Policy Requirements
Source: FHWA Interstate System Access Informational Guide, August 2010

#	Requirement	Description
1	*The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands (23 CFR 625.2(a)).*	The intent of this requirement is to demonstrate that an access point is needed for regional traffic needs and not to solve the needs associated with local traffic. While the Interstate facility should not be allowed to become part of the local circulation system, it should be maintained as the main regional facility. Improvements to parallel facilities should be considered in lieu of new access wherever feasible.
2	*The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate without the proposed change(s) in access (23 CFR 625.2(a)).*	Improvements within an existing interchange should be considered prior to new access. This point does not mean that only ramp metering, mass transit, and HOV facilities are the only TSM alternatives that should be considered. Analysis needs to be provided that addresses the design, safety, and operational considerations of these alternatives. The proposed change in access also needs to document the consistency of any proposed change with regional, corridor, or system-wide assumptions of special use lanes, transit, or other alternatives to ensure the change in access does not preclude implementation of these TSM alternatives in the future.

Interchange Policy Requirements

Source: FHWA Interstate System Access Informational Guide, August 2010

#	Requirement	Description
3	*An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).*	The operational and safety analysis performed needs to include all elements of the Interstate System, including collector-distributor roads, and provide a comparison of the no-build and build conditions that are anticipated to occur through the design year of the project. The analysis may be extended beyond the minimum requirements outlined above to establish the potential extent and scope of the impacts. Extending the limits of the analysis in urbanized areas where there are closely spaced interchanges may be required. The analysis should demonstrate the engineering and operational acceptability of the proposed change in access. When considering the impacts of various alternatives, priority needs to be given to the performance of the Interstate System within the context of the local planning, environmental, design, safety, and operational conditions.

Interchange Policy Requirements

Source: FHWA Interstate System Access Informational Guide, August 2010

#	Requirement	Description
4	*The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)).*	All interchanges need to provide for each of the eight basic movements (or four basic movements in the case of a three-legged interchange), except in the most extreme circumstances. Partial interchanges usually have undesirable operational characteristics. If circumstances exist where a partial interchange is considered appropriate as an interim improvement, then commitments need to be included in the request to accommodate the ultimate design. These commitments may include purchasing the right-of-way required during the interim improvements. Access to special use lanes, transit stations, or park and ride lots that are part of the Interstate System are special cases, and the movements requiring access should be determined on a case-by-case basis.
5	*The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93.*	The Interstate System Access Change Request needs to include a discussion as to how the proposal is consistent with the transportation planning activities for the area. If the project will be added to the planning process in the future, a discussion needs to be provided that indicates how the project will affect the current plan. Although FHWA may review a proposed change in access prior to its inclusion in the transportation plans, final approval cannot be given until the project is adopted in the MPO's long-range transportation plan or MPO's TIP within metropolitan areas and the STIP in rural areas. This would include funding from any sponsor, including a State, local agency, or private developer. Additionally, if approval of the access hinges upon improvements to the local street network, those local improvements must also be included in the TIP and STIP.

Interchange Policy Requirements

Source: FHWA Interstate System Access Informational Guide, August 2010

#	Requirement	Description
6	*In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan (23 U.S.C. 109(d), 23 CFR 625.2(a), 655.603(d), and 771.111).*	Sufficient review and coordination needs to be performed to avoid conflicts with other proposed changes in access or corridor improvements. If two or more changes in access are being considered in the same vicinity, then these changes should be analyzed together. The combined effect of the proposed change in access is especially important when several new interchanges are proposed. The intent of this requirement is to avoid isolated, piecemeal analysis for access change decisions. Where multiple access changes are anticipated in the vicinity, analysis must consider the possible, cumulative effects if all were to be implemented.
7	*When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvements (23 CFR 625.2(a) and 655.603(d)). The request must describe the commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point (23 CFR 625.2(a) and 655.603(d)).*	Highways should be developed in an orderly and coordinated manner to serve the public. When new development is the driving force behind the need for access, it is expected that the appropriate coordination and analysis is performed to achieve mutual benefits with minimal adverse impact on Interstate travelers. As a condition of approval, certain parts of the local circulation system may be required to be constructed or improved before the new or change in access is opened to traffic. Coordination and cooperation is essential to ensure that when several projects are linked to the approval of a change in access that they are constructed according to an appropriate phasing plan. A commitment of funding or inclusion of projects as part of the planning process prior to final approval of the change in access may be required.

Interchange Policy Requirements
Source: FHWA Interstate System Access Informational Guide, August 2010

#	Requirement	Description
8	*The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of the environmental processing (23 CFR 771.111).*	The Policy allows for a two-step approval process. The first step is the determination of engineering and operational acceptability. The final approval can be granted only after the National Environmental Policy Act (NEPA) process is completed. The NEPA process must be followed regardless of the source of funding (including private funding) for the project, since approval of the proposed change in access constitutes a Federal Action. The development of final plans, specifications and engineering, and right-of-way acquisition and construction may be performed only after this final approval is granted.

Granville County Schools Letter and Map

GRANVILLE
COUNTY SCHOOLS

Post Office Box 927 - Oxford, NC 27565 - 919 693 4613 - www.gcs.k12.nc.us

May 1, 2013

Mr. Justin Jorgensen
Granville County Transportation Planner
P. O. Box 877
Oxford, N. C. 27565

Mr. Jorgensen:

We are delighted to hear about the possibility of an interchange being added to Interstate 85, particularly at Saunders Road. I have provided the information below and on the enclosed sheet which you requested.

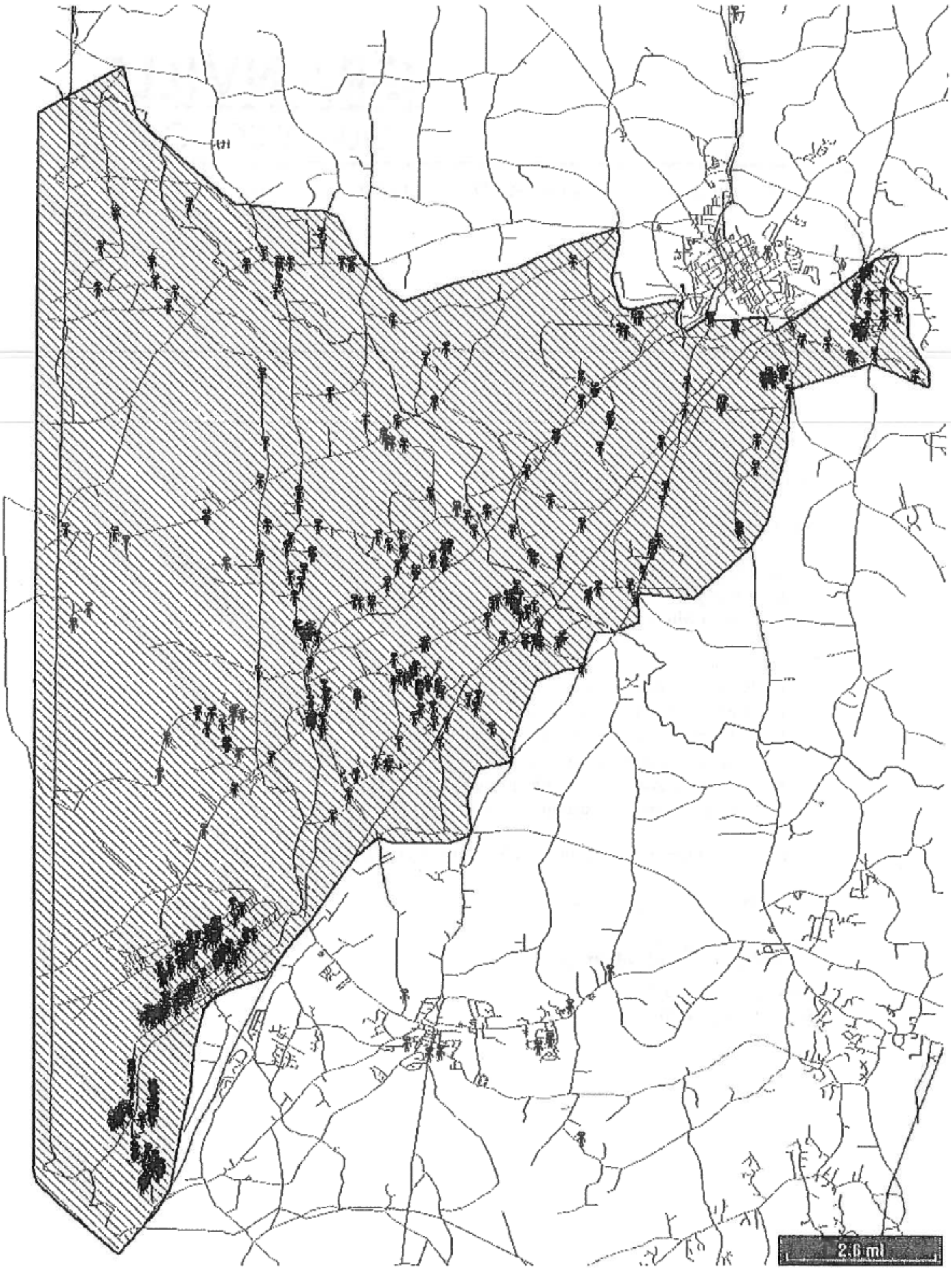
- Number of full-time employees at Granville Central – **62**
- Number of part-time employees at Granville Central – **8**
- Total number of students at Granville Central – **611**
- Current school attendance boundaries – **See the enclosed map.**
- Number of students who ride the bus – **426**
- Student household locations – **See the enclosed map.**

Feel free to contact us for additional information that might be helpful to you.

Sincerely,

Dorwin L. Howard, Sr.

Dorwin L. Howard, Sr.
Assistant Superintendent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