

I-440 Improvement Project (STIP U-2719)

WBS No. 35869.1.2

Purpose and Need Statement

FINAL

September 2014

Prepared for:



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1. PURPOSE AND NEED STATEMENT

Note to Reader:

An environmental document is being prepared for the proposed project in accordance with the requirements set forth in the National Environmental Policy Act (NEPA) of 1969, as amended. The North Carolina Department of Transportation (NCDOT) and the Federal Highway Administration (FHWA) are joint lead agencies for the proposed action.

A summary of this Purpose and Need Statement will become Chapter 1 of the project's Environmental Assessment (EA). This statement describes the purpose of the project and why the proposed action is needed. The purpose and need will drive the development and evaluation of alternatives.

Supporting information includes a description of the existing roadway network and how it operates now and in the future; data on population and employment trends; discussion of other transportation modes; and review of area transportation and land use plans.

1.1. PROPOSED ACTION

The North Carolina Department of Transportation (NCDOT) proposes to widen I-440/US 1-64 in Wake County from south of Walnut Street (SR 1313) in the Town of Cary to north of Wade Avenue (SR 1728) in the City of Raleigh. The project also will include the modification and/or rehabilitation of interchanges and structures on I-440 within the project limits. A project location map is shown on **Figure 1**. The length of the proposed project is approximately five miles.

The project is included as Project U-2719 in NCDOT's adopted 2012-2020 *State Transportation Improvement Program (STIP)* (September 2013) with right of way programmed to begin in 2016 and construction programmed to begin in 2018.

1.2. NEED FOR PROJECT

The needs for the project are described below. These needs are supported by the existing and projected conditions in the study area, which are discussed in detail in **Section 1.5** through **Section 1.8**. A video tour of the project corridor that illustrates existing corridor deficiencies can be viewed at www.ncdot.gov/projects/i-440improvements.

- Capacity Deficiencies – The four-lane section of I-440 through the project study area forms a bottleneck between the six-lane sections to the north and south.

Currently, the approximately five-mile segment of I-440 in the project study area is a four-lane divided controlled access freeway, with auxiliary lanes between some interchanges and a southbound collector-distributor road near I-40. These four through lanes form a “bottleneck” between the six through lanes to the north and south.

Travelers on I-440/US 1-64 in the project study area regularly experience congestion, which is projected to worsen through 2035. Traffic volumes on I-440/US 1-64 within the project study area are projected to increase by 19 to 26 percent between 2012 and 2035. By 2035, levels of service along I-440/US 1-64 are projected to be almost all LOS E or F (the worst levels) during peak periods. Existing and future average travel speeds are well below the posted

speed limit during morning and evening peak hours northbound and in the evening peak hours southbound.

- Geometric Deficiencies – The roadway and interchanges in the project study area have substandard design elements.

Congestion experienced along I-440/US 1-64 in the project study area is a function of geometric deficiencies as well as capacity deficiencies. The roadway and interchanges in this section of I-440 have substandard design elements such as poor sight lines, narrow shoulders and medians, and short acceleration/deceleration lanes.

- Condition Deficiencies – Due to the age of the facility, pavement, structures, and interchanges along the project segment are in need of rehabilitation.

I-440 in the project study area was constructed in the early 1960's and is the oldest section of the Raleigh Beltline. Due to the age of the facility, the pavement, structures, and interchanges are in need of rehabilitation.

1.3. PROJECT PURPOSE

The purpose of the project is to improve traffic flow and operational efficiency and enhance mobility on this segment of I-440. The project will address the need to increase capacity and improve design and condition deficiencies along this segment of I-440.

The environmental resource and regulatory agencies (the NEPA/Section 404 Merger Team) for the project concurred with the purpose and need for the project (Concurrence Point #1) on August 22, 2012. A copy of the concurrence form is included in **Appendix A**.

Performance measures will be used to screen various alternative concepts to evaluate their ability to meet the project's purpose. These measures, which may include the following, may be refined during the alternatives development and screening phase:

- Average travel speeds through the corridor during peak periods
- Vehicle miles traveled through the corridor during peak periods (Generally, scenarios with higher VMT represent a benefit to mobility, as more vehicles are able to travel greater distances along the corridor during the peak periods)
- Average travel delay and levels of service at interchange ramp termini during peak periods
- Ability to improve and/or rehabilitate roadway and interchange geometry in conformance with current design standards

1.4. PROJECT SETTING AND HISTORY OF I-440 IMPROVEMENTS

1.4.1. Project Setting and Context

As shown on **Figure 1**, the project is located in an established mixed-use urban area approximately three miles west of downtown Raleigh in east central North Carolina. Raleigh is in the eastern portion of the Triangle region (Raleigh, Durham, Chapel Hill, and surroundings). The project study area is primarily within the City of Raleigh's

Project Setting

The project corridor is in an established mixed-use urban area approximately 3 miles west of downtown Raleigh.

planning and service area boundaries. However, a small portion of the project study area south of I-40 is within the jurisdiction of the Town of Cary.

The Triangle region is associated with Research Triangle Park (RTP), a large business/research park established in the late 1950s. RTP is approximately ten miles northwest of the project area along I-40. RTP is home to numerous high-tech companies and enterprises attracted by the research facilities and educated workforce provided by the region's three major universities (North Carolina State University, University of North Carolina at Chapel Hill, and Duke University).

The university community is an important influence in the project area. The main campus of North Carolina State University (NCSU) is located to the east of the project area and several University facilities are located within the project area. Meredith College is also located in the project area in the northeast quadrant of the I-440/Hillsborough Street interchange. There is a large student population living in apartment complexes and homes in the project area, which increases the demand for bicycle, pedestrian, and transit facilities in the area.

Several regional resources are located in and around the project corridor that generate high volumes of traffic either during the week or for special events, as described in **Section 1.7.2**. In addition, Lake Johnson Park is a prominent recreational resource located east of I-440 and north of Jones Franklin Road. Many people use I-440/US 1-64 to access these resources.

According to Raleigh's 2030 Comprehensive Plan, long-term goals for future growth in the project area include redevelopment along the Western Boulevard corridor west of I-440, and mixed-use development around a proposed transit station at Hillsborough Street and Blue Ridge Road also west of I-440. In addition, there is potential for growth along the Jones Franklin Road corridor, especially in the office parks adjacent to the east side of I-440 just south of Lake Johnson.

1.4.2. History of I-440 Improvements

The four-lane section of I-440 through the project study area from I-40 to Hillsborough Street is the oldest section of the Raleigh Beltline. It was opened to traffic in approximately 1959-1960. By 1963, the Beltline was extended around the north side of Raleigh to Capital Boulevard, then to New Bern Avenue approximately one year later. By 1984, the loop was complete with the construction of I-40 around the south side of Raleigh. The I-440 designation was assigned by FHWA in 1991. The road was originally named the Cliff Benson Beltline to honor a developer and highway commissioner who played a major role in getting the road built. Beginning in 1991, Beltline widening had begun, and widening to six lanes was completed by 1997, except for the U-2719 project section.

Corridor History

The four-lane section of I-440 through the project study area is the oldest section of the Raleigh Beltline.

A feasibility study to widen I-440 from Wade Avenue to I-40 in the project area was conducted in June 1994. There were plans to widen I-440 from Wade Avenue to I-40 in the 2000s, but the NCDOT's 2006-2012 STIP did not include funding for the upgrade. The updated 2012-2018 STIP programmed the widening of I-440 in the project area with right of way programmed to begin in 2016 and construction programmed to begin in 2018.

1.5. EXISTING TRANSPORTATION SYSTEM

1.5.1. Regional Network

I-440 is within the Triangle region of North Carolina (Raleigh, Durham, Chapel Hill and surroundings). This region is served by two interstates, I-40 and I-85, and two partial urban loops, I-440 and I-540. These interstate roadways, along with other major US routes (US 1, US 64, US 70, US 64, US 264, US 401, and US 15-501) provide connectivity within and through the region (see inset in **Figure 1**).

I-440 has statewide and regional importance. The facility forms a partial loop around the north of downtown Raleigh and is a critical link in the roadway network of the Triangle region. Because of its statewide and regional importance,

I-440 has been designated as a Strategic Highway Corridor (SHC) by NCDOT. It is also included on the Statewide Tier of the North Carolina Multimodal Investment Network (NCMIN). Facilities on the Statewide Tier “serve long-distance trips, connect regional centers, have the highest usage, and mostly provide a mobility function” (NCDOT NCMIN Website: www.ncdot.gov/download/performance/NCMIN_definitions.pdf).

Regional connections from I-440 within the project study area include an interchange with I-40 near the southern end of the project study area and another connection to I-40 via Wade Avenue near the northern end of the study area. I-440 terminates at its interchange with I-40 near the southern end of the project study area and continues southbound as US 1-64 to Cary and Apex. North of the project study area, I-440 continues north and then east to form a loop around northern Raleigh before reconnecting with I-40 in southeast Raleigh.

I-440 provides a route to several regional resources located in and around the project study area, including the North Carolina State Fairgrounds, Carter-Finley Stadium, PNC Arena, the North Carolina Museum of Art, Rex Hospital, North Carolina State University, Meredith College, and Crossroads Shopping Center. In addition, commuters use I-440 to access Research Triangle Park, which is a major employment center located approximately ten miles northwest of the project study area along I-40.

Regional Network

I-440 has statewide and regional importance. It has an interchange with I-40 and provides a route to several regional resources in and around the project study area, including the NC State Fairgrounds, Carter-Finley Stadium, PNC Arena, the NC Museum of Art, Rex Hospital, NC State University, Meredith College, and Crossroads Shopping Center.

1.5.2. Existing I-440/US 1-64 in Project Area

In general, I-440 within the project study area is a four-lane median divided freeway facility with auxiliary lanes between some interchanges and a southbound collector-distributor road near I-40. This section of four-lane freeway is a bottleneck between the six-lane section of US 1-64 south of the project area and the six-lane section of I-440 north of the project area. **Figure 2** presents the lane configurations along the project corridor.



I-440 looking north from Athens Drive bridge



I-440 looking south at start of collector-distributor road near I-40

I-440 is signed eastbound and westbound. However, in the project area, I-440 runs north/south, so I-440 eastbound vehicles are actually traveling north and I-440 westbound vehicles are traveling south. I-440/US 1-64 has the following interchanges in the project study area, listed from south to north:

- Walnut Street (SR 1313)
- Crossroads Boulevard (partial interchange)
- I-40
- Jones Franklin Road (SR 5039)
- Melbourne Road (SR 1445) (partial interchange)
- Western Boulevard (SR 2012)
- Hillsborough Street (NC 54)
- Wade Avenue (SR 1728)

There are three additional roadway crossings of I-440 that do not have interchanges. Athens Drive is on a bridge over I-440 just north of the Jones Franklin Road interchange; Ligon Street crosses through a one-lane tunnel under I-440 north of the Western Boulevard interchange; and Beryl Street crosses under I-440 just south of the CSX railroad tracks and Hillsborough Street.



Ligon Street one-lane tunnel under I-440

The posted speed limit along I-440 through the project study area is 55 miles per hour (mph), but increases to 65 mph along the six-lane section of US 1-64 located to the south of the project area, and 60 mph along the six-lane section of I-440 north of the project area.

1.5.3. Bicycle and Pedestrian Facilities

Pedestrians and bicycles are prohibited on I-440/US 1-64, but there are numerous pedestrian and bicycle facilities within the project study area crossing over or adjacent to I-440/US 1-64.

Sidewalks

Sidewalks are provided on many streets in the project study area, but only two roads have sidewalks crossing I-440 in the project area – Melbourne Road and Western Boulevard. As discussed in **Section 1.8.1**, the Town of Cary is studying providing a sidewalk along Walnut Street across US 1-64 (STIP Project EB-5516).



Reedy Creek Greenway pedestrian bridge across I-440 north of Wade Avenue

Greenways

A signature pedestrian bridge crosses I-440 just north of the Wade Avenue interchange. This bridge is part of the Reedy Creek Greenway of the Capital Area Greenway system. The Reedy Creek Greenway proceeds south adjacent to the east side of I-440 through the Meredith College campus, then turns eastward parallel to Hillsborough Street.

Two other Capital Area Greenway trails are in the project area; House Creek Greenway and Lake Johnson West Loop Greenway. The House Creek Greenway connects to the Reedy Creek Greenway near the bridge on the east side of I-440 and proceeds north, generally following I-440. The Lake Johnson West Loop Greenway is a loop trail around the western portion of Lake Johnson and comes near to I-440 in the northeast quadrant of the Jones Franklin Road interchange.

Local planners also noted the potential for an extension of the Walnut Creek Trail across I-440 through the Jones Franklin Road interchange, but this is not currently shown on the Capital Area Greenway System map.

Bicycle Routes

In addition to the greenways, signed City of Raleigh bicycle routes cross I-440 in the project study area on Beryl Road and Melbourne Road. There is also a separate bicycle path along the north side of Western Boulevard through the project area (City of Raleigh Bike Map, June 2013).

1.5.4. Other Transportation Modes

Public Transportation

Transit service in the project area is provided by Capital Area Transit (CAT), Cary Transit (C-Tran), Triangle Transit (TT), and NC State University (NCSU) Wolfline. These transit agencies have bus routes that cross I-440, but none use I-440 in the project area.

CAT provides fixed route transit service throughout Raleigh. Two CAT routes circulate in the project study area. Connector Route 11c (Buck Jones Connector) crosses I-440

Transportation Modes

Four transit agencies have bus routes that cross I-440, but none use I-440 as part of any of their existing routes.

The NC Railroad rail corridor, with two main tracks and a siding track, crosses under I-440 between Hillsborough Street and Beryl Road.

on Athens Drive and Melbourne Road. Route 12 (Method) is east of I-440 and uses Method Road and Hillsborough Street.

C-Tran provides fixed route transit service along six routes within the Town of Cary. Two of these routes, Route 1 and Route 2, traverse the southern portion of the project study area. Both routes cross the corridor on Walnut Street.

TT operates regional routes through the project study area. These routes cross I-440 on Jones Franklin Road (Route 305), Western Boulevard (Routes 301, 303, and 305), Hillsborough Street (Route 100), and Wade Avenue (Routes 105, DRX [Durham Raleigh Express], and CRX [Chapel Hill-Raleigh Express]).

NCSU Wolfline is tailored to student class schedules, but also serves the general public fare-free. Wolfline Route 4 – Westgrove crosses I-440 on Western Boulevard and Beryl Road. Full services are offered during the fall and spring semesters while reduced services are offered over the summer and during holiday breaks.

Rail Service

I-440 crosses over one rail corridor parallel to the south side of Hillsborough Street and the north side of Beryl Road (**Figure 1**). This corridor includes two main tracks and a siding track. It is owned by NC Railroad (NCR) and used by Norfolk Southern and CSX for freight transport. Three Amtrak passenger rail routes also use this corridor: the Piedmont, the Carolinian, and the Silver Star.

Triangle Transit is in the planning stages for a regional fixed-guideway system in the Durham-Wake County corridor. A commuter rail alternative for this fixed guideway system follows the existing rail line adjacent to Hillsborough Street (*Durham-Wake County Corridor Alternatives Analysis: Conceptual Alternatives Technical Report*, Triangle Transit, March 2011).

Airports

Raleigh Durham International Airport (RDU) is approximately 8 miles to the northwest of the project study area and can be accessed from I-40. In 2012, 9.2 million passengers traveled through RDU (RDU Website: www.rdu.com/authority/stats.html).

1.6. CONDITIONS AND OPERATIONS ALONG THE PROJECT CORRIDOR

1.6.1. Deficiencies in Roadway Geometry and Conditions

I-440 in the project study area was constructed over 50 years ago, and is the oldest section of the Raleigh Beltline. The roadway and interchanges in this section of I-440 have substandard design elements such as poor sight lines, narrow shoulders and medians, and short acceleration/deceleration lanes. In addition, due to the age of the facility, the pavement, structures, and interchanges are in need of rehabilitation.

Existing deficiencies are shown on **Figure 3**, with more details shown in the Existing Conditions Diagrams in **Appendix B**. The deficiency analysis methods and results

Roadway Deficiencies

This segment of I-440 has substandard design elements, such as poor sight lines, narrow shoulders and medians, and short acceleration/deceleration lanes. In addition, the pavement and bridges are in need of rehabilitation.

are documented in the *Existing Conditions and Deficiencies Report* (Atkins, July 2013).

In the analysis of physical conditions along the corridor, the report found that of the 15 bridges along and over the I-440 corridor in the project study area, six are functionally obsolete (built to standards that do not meet the minimum federal clearance requirements for a new bridge) and three are structurally deficient (need maintenance and repair and eventual rehabilitation or replacement to address deficiencies). In addition, multiple incidents of deep cracking and potholes were reported based on a visual inspection of the project corridor, leading to a classification of “poor” for pavement conditions along the entire length of the corridor.

The analysis of geometric features included an assessment of horizontal alignment, vertical alignment, horizontal clearance, stopping sight distance, decision sight distance, and exit and entrance ramp design throughout the project corridor. The assessment found deficiencies at numerous locations along the corridor regarding horizontal clearance (distance to roadside hazards such as wall, piers, mature trees, etc.), decision sight distance (distance that a motorist has to visually identify an exit ramp and then make a decision on what action to take while traveling at highway speed), and exit and entrance ramp design (length of acceleration and deceleration lanes).

Finally, the assessment of design operations found three areas where lane and route continuity are not up to current standards (i.e., drivers are not provided a continuous through route on which they are not required to change lanes), and multiple areas where the ramp sequencing is not up to current standards (i.e., a reasonable distance is not provided for weave sections between successive ramps).

1.6.2. Existing and Projected Traffic Volumes

Traffic Forecast Methodology

Traffic forecasts for 2012 and 2035 for the project were prepared using the Triangle Regional Travel Demand Model (Version TRM V4-2009), as described in the *Traffic Forecast for U-2719* (NCDOT, January 10, 2013). Travel demand models are computer models used for simulating current travel conditions and forecasting future travel patterns and conditions.

Traffic Volumes

Annual average daily traffic volumes (AADT) for 2012 and 2035 along the project corridor are shown in **Figure 4** and **Table 1**. Year 2012 volumes on I-440 range from 79,200 to 134,200 vehicles per day (vpd), with the highest traffic volumes along the segment just south of the I-40 interchange. By 2035, with no changes to the project corridor, traffic volumes are projected to increase 19-26 percent, to 96,400 to 169,600 vpd.

Traffic Volumes

Traffic volumes on I-440/US 1-64 are projected to increase 19-26 percent between 2012 and 2035.

TABLE 1. Existing and Projected No-Build Traffic Volumes

I-440/US 1-64 Segment		2012 AADT*	2035 AADT*	Percent Change (2012-2035)
From	To			
Cary Parkway	Walnut Street (SR 1313)	118,000	145,600	23%
Walnut Street (SR 1313)	Crossroads Boulevard (partial interchange)	118,500	149,200	26%
Crossroads Boulevard (partial interchange)	I-40	134,200	169,600	26%
I-40	Jones Franklin Road (SR 5039)	79,200	96,400	22%
Jones Franklin Road (SR 5039)	Melbourne Road (SR 1445) (partial interchange)	81,200	98,700	22%
Melbourne Road (SR 1445) (partial interchange)	Western Boulevard (SR 2012)	85,000	105,500	24%
Western Boulevard (SR 2012)	Hillsborough Street (NC 54)	88,200	105,100	19%
Hillsborough Street (NC 54)	Wade Avenue (SR 1728)	94,800	117,600	24%
Wade Avenue (SR 1728)	Lake Boone Trail (SR 1676)	109,200	138,000	26%

*AADT – Annual Average Daily Traffic Volumes (vehicles per day)

Source: *Traffic Forecast for U-2719*, NCDOT, January 10, 2013

1.6.3. Existing and Future No-Build Traffic Conditions

Analysis Methodologies and Definitions

The analyses of existing and future no-build traffic operations were conducted in accordance with the NCDOT Congestion Management's *Capacity Analysis Guidelines* (January 2012). The operations analysis is documented in the *Traffic Operations Technical Memorandum – I-440 Improvement Project (STIP U-2719)* (Atkins, June 2014).

As described below, the analysis of traffic operations was conducted two ways – modeling of individual corridor segments and model simulation of the entire corridor using VISSIM. VISSIM is a traffic flow simulation program useful in modeling complex transportation projects such as freeway networks.







Individual corridor segments were evaluated for level of service (LOS) during the morning and evening peak hours based on the segment volumes from the traffic forecast. The *Highway Capacity Software 2010* (HCS) (McTrans), which is based on the *Highway Capacity Manual* (Transportation Research Board, 2012), was used to conduct the analysis.

The level of service (LOS) is a qualitative measure describing traffic flow conditions within a traffic stream. The LOS is defined with letter designations from A to F that can be applied to both roadway segments and intersections. LOS A represents the best operating conditions and LOS F the worst. Although LOS A to LOS F can be used to describe best to worse operating conditions for both roadway and intersections, the specific descriptions of each LOS for roadway segments and intersection are not the same.

Table 2 describes the traffic conditions experienced under each LOS designation for roadway segments. In Raleigh, it's the City's policy to try to maintain an overall LOS E or better on all

roadways and intersections within the city, except where maintaining this LOS is infeasible or it conflicts with other goals (Raleigh 2030 Comprehensive Plan Policy T 2.10). LOS E occurs when traffic volumes are at or very near capacity.

TABLE 2. Definitions of Levels of Service for Roadway Segments

Level of Service	Representative Image	Description
A		Free flow. Individuals are unaffected by others in traffic stream. Freedom to select speed and maneuver is extremely high.
B		Free flow, but the presence of other vehicles begins to be noticeable. Slight decline in freedom to maneuver.
C		Stable flow, but the beginning of the range in which the influence of traffic density on operations becomes marked. Maneuvering requires substantial vigilance. Average travel speeds may begin to show some reduction.
D		High density flow in which ability to maneuver is severely restricted by increasing volumes. Only minor traffic disruptions can be absorbed without effect.
E		Flow at or near capacity. Unstable. Most traffic disruptions will cause queues to form and service to deteriorate.
F		Breakdown flow. Traffic exceeds capacity. Queues form behind such locations, which are characterized by extremely unstable stop-and-go waves.

Description Source: Highway Capacity Manual, Transportation Research Board, 2012.

Image Source: California DOT Website: www.dot.ca.gov/ser/forms.htm

In addition to evaluating the LOS for corridor segments, operations along the entire corridor (the corridor network) were simulated using the computer model VISSIM. Two-hour periods during the morning peak and evening peak were modeled. The VISSIM model provides peak period average travel speeds and vehicle miles traveled (VMT) along the corridor. Results for the 2-hour model periods and for 1-hour peak periods can be pulled from the model.

As a roadway corridor reaches and exceeds its capacity, average travel speeds decrease. The same effect applies to VMT. The peak hour corridor VMT is a measure of how many vehicles can travel through the corridor in the peak hour. As the roadway fills with vehicles, the VMT will continue to increase until the average travel speed begins to drop. As speed drops, the number of vehicles that can get through the corridor during the peak period decreases. Generally, scenarios with higher VMT represent a benefit to mobility as more vehicles are able to travel greater distances along the corridor during the peak periods.

Traffic Operations on I-440/US 1-64

Table 3 presents existing (2012) and future (2035) no-build morning and evening peak hour levels of service for segments along the corridor. Traffic flow is heaviest in the northbound direction in the mornings, switching to the southbound direction in the evenings.

Traffic Operations
 By 2035, I-440/US 1-64 is projected to operate at mostly LOS E-F during peak periods. Average speeds are estimated to be well below the speed limit by 2035.

Under existing conditions, the most congestion occurs on the corridor segments between Jones Franklin Road and Wade Avenue, and as shown in the table, congestion is expected to worsen by 2035.

TABLE 3. Existing and Future No-Build Levels of Service During Peak Hours

I-440/US 1-64 Segment	2012 (Existing)				2035 (Future No-Build)			
	Northbound ¹ Peak 1-Hour		Southbound ¹ Peak 1-Hour		Northbound ¹ Peak 1-Hour		Southbound ¹ Peak 1-Hour	
	AM	PM	AM	PM	AM	PM	AM	PM
Cary Pkwy to Walnut St	D	C	C	D	F	D	D	F
Walnut St to I-40	E	D	C	D	F	F	C	D
I-40 to Jones Franklin Rd	F	C	C	D	F	F	D	E
Jones Franklin Rd to Melbourne Rd	F	D	D	F	F	F	F	F
Melbourne Rd to Western Blvd	F	E	C	E	F	F	E	F
Western Blvd to Hillsborough St	F	E	E	F	F	F	F	F
Hillsborough St to Wade Ave	F	E	E	E	F	F	F	F
Wade Ave to Lake Boone Trail	D	D	F	F	F	E	F	F
Direction of Travel	↓ NB ends here		↑ SB starts here		↓ NB ends here		↑ SB starts here	

Source: *Traffic Operations Technical Memorandum for I-440 Improvements Project STIP Number U-2719*, Atkins, June 2014

1. Northbound and southbound are the actual directions vehicles are traveling. For I-440, northbound is signed as I-440 east and southbound is signed as I-440 west.

NOTE: Red shaded cells indicate segments operating at an unacceptable level of service (LOS E of F). Yellow shading indicates LOS D, and green shading indicates LOS C or better.

A review of the northbound direction shows this direction is more congested in the morning peak period than in the evening peak period. As vehicles pass the I-40 interchange, the movements on and off I-440/US 1-64 at the I-40 interchange combine with a through lane ending just north of the interchange, creating the delays at this bottleneck location.

A review of the southbound direction shows that there is congestion beginning north of Wade Avenue where the number of through lanes reduces from three lanes to two lanes, and congestion generally continues to the I-40 interchange. At the I-40 interchange, additional capacity is provided by the collector-distributor road that takes traffic to the interchanges at I-40, Crossroads Boulevard, and Walnut Street, which lessens the congestion.

Peak hour average travel speeds and VMT along the corridor are presented in **Table 4**. In the northbound direction, existing average travel speeds are well below the 55-65 miles per hour (mph) posted speed limit in both the morning and evening peak hour (41-47 mph), and are expected to slow further by 2035 (39-41 mph). In the southbound direction, existing average travel speeds are close to the posted speed limit in the mornings (not the main commuting direction), and well below the posted speed limit in the evenings (the main commuting direction). Again, by 2035, the speeds are expected to get slower.

Table 4 also presents vehicle miles traveled through the corridor limits during the morning and evening peak 1-hour periods. As shown in the table, the peak hour corridor VMTs are predicted to decrease (i.e., less traffic can get through the corridor during the peak period), except for the southbound direction in the morning peak period (not the main commuting direction) where VMTs increase slightly. This is because in 2012, there is still some extra room on the road for more vehicles in the southbound direction (see **Table 3**) and the VMT continues to increase slightly through 2035 as this capacity is used up, even as the speed is decreasing.

TABLE 4. Average Travel Speeds and Vehicle Miles Traveled Along I-440

I-440/US 1-64 Direction	Morning (AM) Peak 1-Hour Period				Evening (PM) Peak 1-Hour Period			
	Speed (mph)		Vehicle Miles Traveled ¹		Speed (mph)		Vehicle Miles Traveled ¹	
	2012	2035	2012	2035	2012	2035	2012	2035
Northbound	41	39	21,940	19,280	47	41	20,270	17,880
Southbound	58	53	21,170	22,140	43	39	24,370	24,030

Source: *Traffic Operations Technical Memorandum for I-440 Improvements Project STIP Number U-2719*, Atkins, June 2014

1. Vehicle Miles Traveled (VMT) are the vehicle miles travelled along the corridor in the study area during the peak one-hour period. Higher VMT means more mobility (i.e., more vehicles are moving through the corridor during the analysis period).

1.6.4. Existing Crash Data

In addition to high traffic volumes creating congestion, incidents such as vehicle breakdowns or accidents occurring on I-440/US 1-64 can also cause back-ups and congestion. As discussed below, the project corridor experiences above average rates of crashes.

A crash analysis was performed to compare crash rates within the study area to other urban interstates in North Carolina, as well as to identify the types of crashes and to determine crash hot spots (*Traffic Operations Technical Memorandum for I-440 Widening STIP Number U-2719*, Atkins, June 2014).

Data provided by the NCDOT Traffic Survey Unit (*Traffic Engineering Accident Analysis System’s Strip Analysis Report*)

Crash Data

The project corridor experiences above average rates of crashes. Rear-end crashes comprise more than half of the total crashes along the project corridor.

was used to evaluate the existing crash rates on the I-440/US 1-64 mainline between milepost 14.18 (Cary Parkway) and milepost 21.02 (Lake Boone Trail). Three years of crash history, from August, 2009 to July, 2012, were analyzed.

Table 5 presents a comparison of the crash rates on I-440/US 1-64 within the study area versus the average crash rate for all urban interstates in North Carolina, as well as the critical crash rate and the safety ratio (definitions are provided in the table footnotes).

TABLE 5. Comparison of Crash Rates

Crash Type	Study Area Actual Crash Rate ¹	NC Urban Interstate Crash Rate ¹	I-440 Study Area Critical Crash Rate ^{1,2}	Safety Ratio (Critical/Actual) ^{1,3}
Total	324.30	101.82	117.40	0.36
Fatal	0.80	0.43	1.83	2.29
Non-Fatal Injury	60.60	29.43	38.00	0.63
Night	66.80	26.07	34.16	0.51
Wet	100.70	26.34	34.47	0.34
Run-Off-Road	18.40	28.89	37.38	2.03

Source: NCDOT Traffic Survey Unit 2009-2012 Three Year Crash Rates

1. Crash Rate defined by crashes per 100 million miles traveled.
2. Critical crash rate – a statistically derived value based on statewide crash rates for a 95 percent confidence interval. The critical crash rate is compared against a calculated actual crash rate to see if the actual crash rate for a given segment is above an average far enough so that something besides chance must be the cause.
3. Safety ratio is the critical crash rate divided by the actual crash rate. A value less than 1 indicates an actual crash rate is above average far enough that there is a crash issue.

As shown in **Table 5**, I-440/US 1-64 through the project study area has a substantially higher rate of total crashes than the average rate for all urban interstates in North Carolina. For the project corridor, the total crash ratio is 0.36, which indicates a crash rate well above average. The crash ratio also is less than one for non-fatal injury crashes, night crashes, and wet crashes

For the period August 2009 through July 2012, there were 1,166 reported crashes along the project corridor. These incidents frequently affect travel on I-440/US 1-64 by causing traffic slowdowns, and sometimes lane closures and temporary detours onto the surrounding roadways. The three most common types of crashes are rear end, ran off road, and sideswipe, which together make up nearly 82 percent of the total crashes. Rear end crashes comprise more than half of the total crashes along the project corridor, and are typically caused by traffic slowing down due to congestion.

An analysis also was conducted to identify crash hot spots along I-440/US 1-64 for each direction of travel. Using the Sliding Window Method from the American Association of State Highway and Transportation Officials' (AASHTO) *Highway Safety Manual*, a 0.5-mile segment of the corridor was analyzed, moving at 0.1-mile increments along the length of the corridor. The safety ratio was calculated for each segment in the sliding window analysis. Poor segments were identified as having a safety ratio less than 1.0 (meaning the actual crash rate is higher than the critical crash rate for that segment).

The sliding window analysis safety ratios are shown on the Existing Conditions Diagrams in **Appendix B**. In general, safety ratios are better on the basic freeway segments between the interchanges and worse within the interchanges, where more lane changing maneuvers take place. Areas with poor safety ratios (less than 1.0) are listed below. Overall, the safety analysis identified more poor segments along the I-440 eastbound lanes.

Eastbound I-440/Northbound US 1-64 (vehicles traveling north in project area)

- Through the Walnut Street, Crossroads Boulevard, and I-40 interchanges
- Jones Franklin Road interchange area
- Western Boulevard interchange area
- Through Hillsborough Street and Wade Avenue interchanges

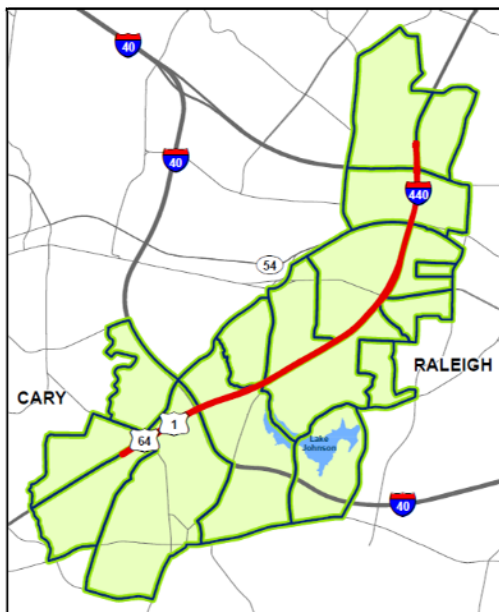
Westbound I-440/Southbound US 1-64 (vehicles traveling south in project area)

- Jones Franklin Road interchange area
- Between the Melbourne Road and Western Boulevard interchanges
- Through Hillsborough Street and Wade Avenue interchanges

1.7. Social and Economic Conditions

1.7.1. Population and Employment

A Demographic Study Area (DSA) was defined in the project's *Community Characteristics Report* (CCR) (Atkins, February 2013) to analyze population growth and other demographic characteristics in the project area. The DSA for this project includes 17 US Census block groups, all of which are located in Wake County.



Demographic Study Area Growth Trends

Population growth rates in the project area between 2000 and 2010 were approximately half the growth rates experienced by both the City of Raleigh and Wake County due to the developed nature of the area.

Population and Housing Trends

From 2000 to 2010, the overall population of the DSA increased 21.2 percent, from 24,612 to 29,824. Likewise, housing units increased from 10,812 in 2000 to 13,827 in 2010, a 27.9 percent increase. The population and housing growth rates for the DSA were approximately half the growth rates experienced by both the City of Raleigh and Wake County during the same time period (2010 US Census). The lower growth rates for the DSA are likely due to the fact that the DSA has established built out neighborhoods and limited vacant land.

Future population estimates for Wake County and the state were obtained from the North Carolina Office of State Budget and Management. Future population projections are not available at the Census block group level for the DSA. Wake County is projected to grow approximately 43 percent between 2010 and 2030, from a population of 900,993 to a population of 1,292,106. The state as a whole is projected to have a lower growth rate from 2010 to 2030 of approximately 22 percent, from 9,535,483 people to 11,631,865 people.

It is anticipated that future growth rates in the DSA will continue to be lower than those for Wake County and the state, mainly because neighborhoods are built out and there is limited amount of vacant land. However, areas along Western Boulevard just west of I-440 and areas around the future transit station on Hillsborough Street are targeted for redevelopment, which may lead to a spike in population growth in the DSA at some point in the future, although the timing is uncertain.

Economic Characteristics

Wake County's top three industries are state government, education, and healthcare (Wake County Economic Development Web site: www.raleigh-wake.org). Raleigh is the state capital, and therefore the center of state government. Numerous high-technology and medical corporations have been attracted to the Triangle Region because of the outstanding educational and research facilities at area universities.

Of the top ten employers in Wake County, the State of North Carolina (#1), NCSU (#4), and Rex Healthcare (#7) have facilities within and near the project study area (Wake County Economic Development Web site: www.raleigh-wake.org). There are numerous other employment centers within and near the project, including Meredith College, office parks, and retail shopping centers (see **Section 1.7.3**).

In 2012, Wake County's unemployment rate (7.5 percent) was lower than the state's as a whole (9.5 percent) (US Bureau of Labor Statistics Web site: www.bls.gov/lau). Likewise, Wake County's poverty rate has been lower than the state's. Based on the American Community Survey 5-Year Estimates (2006-2010), Wake County's poverty rate was an average of 9.7 percent for this period, while the state's was 15.5 percent. However, there is a higher rate of poverty in the DSA at 20.0 percent. Nine of the 17 block groups in the DSA, as well as the DSA as a whole, have percentages of the population living below poverty level that exceed the Wake County percentage by more than ten percentage points. This is most likely the result of the higher percentage of college students and recent graduates living in the project area.

1.7.2. Major Destinations Near Project Corridor

I-440/US 1-64 is an important link in the region's transportation network, and it provides access from the region to numerous major destinations near the project corridor that generate high volumes of traffic either daily or during special events. These major activity centers are shown on **Figure 5**, listed in **Table 6**, and described below from south to north.

Shopping Centers on Walnut Street

Cary Towne Center, South Hills, and Crossroads Plaza are all located on Walnut Street, with highway access from the US 1-64 interchange at Walnut Street and the US 1-64 partial interchange at Crossroads Boulevard (direct access to Crossroads Plaza). There are also other retail areas farther south along Walnut Street.

Cary Towne Center is an indoor mall with 914,252 square feet of retail shops. South Hills is an outdoor shopping center with 300,000 square feet of retail shops. Crossroads Plaza is an outdoor shopping center with 1.3 million square feet of retail shops.

WakeMed Soccer Park

The 150-acre WakeMed Soccer Park is owned by the State and operated and maintained by the Town of Cary. The park is home to the Carolina Railhawks, who are part of the North American Soccer League (NASL), a professional soccer league. The team plays fall and spring schedules and the stadium has a capacity of 10,000 seats. In addition, the park has numerous practice fields and also hosts youth soccer clubs, college and high school soccer tournaments, and other sports events. The park has 2,600 parking spaces. (Town of Cary Web site: www.townofcary.org).

TABLE 6. Major Destinations Near Project Corridor

Destination	General Location	Activity Type	Primary Type of Traffic Generated
Cary Towne Center Mall	West of US 1-64 on Walnut St	Retail	Weekday, Weekend, Holiday
South Hills Shopping Center	US 1-64/Walnut St interchange northwest quadrant	Retail	Weekday, Weekend, Holiday
Crossroads Plaza	US 1-64/Walnut St interchange northeast quadrant	Retail	Weekday, Weekend, Holiday
WakeMed Soccer Park	Hillsborough St just west of I-40	Sports Venue	Special Events (mainly weekends and evenings)
Office Parks off Jones Franklin Road	I-440/Jones Franklin Rd interchange northwest and southeast quadrants	Office Park	Weekday
NCSU	West and east of I-440, centered around Hillsborough St and Western Blvd	University	Weekday
NC State Fairgrounds	West of I-440 and north of Hillsborough St	Special Events Venue	Weekends and Special Events
PNC Arena/ Carter-Finley Stadium	West of I-440 and north of Hillsborough St	Sports/Entertainment Venues	Special Events (mainly weekends and evenings)
Meredith College	I-440/Wade Avenue interchange southeast quadrant	University	Weekday
Ridgewood Shopping Center	Wade Avenue east of I-440, just north of Meredith College	Retail	Weekday, Weekend, Holiday
NC Museum of Art	I-440/Wade Avenue interchange northwest quadrant	Museum	Weekends and Special Events
Rex Healthcare Hospital	West of I-440, north of the NC Museum of Art	Hospital	Weekdays and Weekends

Jones Franklin Road Office Parks

Several office parks are located in the northwest and southeast quadrants of the I-440/Jones Franklin Road interchange and off Jones Franklin Road south of I-40. According to local planners, notable traffic volumes enter and exit these office parks during the morning and evening rush hours, with many commuters using the Jones Franklin interchange to access I-440.

North Carolina State University

NCSU is a large public university with over 34,000 students and 8,000 faculty and staff (NCSU Web site: www.ncsu.edu). The sprawling campus extends from west of I-440 to downtown Raleigh, generally centered around Hillsborough Street and Western Boulevard.

In the northwest quadrant of the I-440 interchange with Hillsborough Street is the Centennial Biomedical Campus, which includes the School of Veterinary Medicine and the University Club (clubhouse, pool, tennis courts, and golf facilities).

South of Hillsborough Street and west of I-440 are research buildings primarily associated with the Horticulture Department and the JC Raulston Arboretum. The one-lane Ligon Street tunnel under I-440 connects these research buildings to the campus properties east of I-440. Directly east of I-440 are greenhouse buildings on the south side of Ligon Street. Farther east is the NCSU Method Road

soccer complex and ES King Village (graduate and married student housing). The main campus and Centennial Campus are east of these facilities.

In addition, there are concentrations of off-campus student housing located in and near the project, specifically in rental homes in the Kentwood neighborhood (east of I-440, south of Western Boulevard) and in Sumter Square Apartments just west of I-440 at the Jones Franklin Road interchange. Students living in Sumter Square use I-440 to access classes and other activities on the NCSU campus.

NC State Fairgrounds

The NC State Fairgrounds is owned and operated by the NC Department of Agriculture and Consumer Services and is located at the northwest corner of Hillsborough Street and Blue Ridge Road. The Fairgrounds consist of 344 acres of land and more than 400,000 total square feet of building space. (NC Department of Agriculture and Consumer Services Web site: www.ncstatefair.org). The Fairgrounds attract many visitors attending over 600 events held each year, with the largest event being the North Carolina State Fair. This annual 11-day event held in October draws millions of visitors from North Carolina and beyond.

PNC Arena and Carter-Finley Stadium

PNC Arena (formerly RBC Center) and Carter-Finley Stadium are located next to each other approximately one mile west of the I-440/Wade Avenue interchange. They are on the NCSU West Campus.

PNC Arena is a 770,000 square-foot multi-purpose entertainment and sports arena. Home to the Carolina Hurricanes of the NHL and the NCSU Wolfpack basketball team, the arena provides seating for nearly 20,000 basketball and hockey fans. On an annual basis, PNC Arena welcomes over 1.5 million guests and hosts more than 150 events, including major concert tours and family shows. The expansive surface parking lots have a capacity of 8,000 parking spaces in total. (PNC Arena Web site: www.pncarena.com).

Carter-Finley Stadium is home to the NCSU Wolfpack football team and occasionally hosts other events. The stadium has a capacity of 55,571 and shares the parking areas with PNC Arena.

The events at the arena and stadium often result in traffic congestion and backups on the portion I-440 in the project study area. Traffic issues in the area are multiplied when concurrent events are being held in these venues, the NC State Fairgrounds, and/or the NC Museum of Art.

Meredith College

The 225-acre Meredith College campus is located between Wade Avenue and Hillsborough Street along the east side of I-440. Meredith College is a private women's liberal arts college with approximately 2,000 students and 122 full-time faculty (Meredith College Web site: www.meredith.edu). The main entrance to the campus is on Hillsborough Street, but a secondary access is provided from Faircloth Street.

Ridgewood Shopping Center

Ridgewood Shopping Center is an approximately 97,000 square-foot strip shopping center in the northeast quadrant of Wade Avenue and Ridge Road, east of I-440 and just north of Meredith College.

NC Museum of Art

The NC Museum of Art (NCMA) is located in the northwest quadrant of the I-440/Wade Avenue interchange. The NCMA features more than 40 galleries in two buildings (over 300,000 square feet) and a 164-acre museum park. The park has walking trails and sculptures. There is also a 500-seat outdoor theatre with lawn seating for 2,000 that hosts movies and performances. The Reedy Creek Greenway pedestrian bridge over I-440 touches down on NCMA property and links to the museum's trails. (NCMA Web site: www.ncartmuseum.org)

Rex Hospital Complex

Rex Hospital is a 665-bed acute care hospital located at the corner of Blue Ridge Road and Lake Boone Trail. The Rex Hospital complex is on a 67-acre site, with an additional 30 acres nearby to accommodate a hospital expansion. Many staff, hospital patients, and visitors travel on I-440 to the Lake Boone Trail interchange (the next interchange north of the Wade Avenue interchange) to access Rex Health Care's services. During peak hours, the westbound off ramp at Lake Boone Trail sometimes backs up onto I-440.

1.8. Transportation Plans and Land Use Plans

1.8.1. Transportation Plans

There are several transportation plans that include the project or reference the importance of the project area, as listed below.

- *State Transportation Improvement Program (August 2013)*
- *Capital Area MPO Comprehensive Transportation Plan (October 2010)*
- *Capital Area MPO 2040 Long Range Transportation Plan (April 2013)*
- *Capital Area MPO Metropolitan Transportation Improvement Program 2012-2018 (September 2011)*
- *City of Raleigh Bicycle Transportation Plan (2009)*
- *Triangle Transit, Durham-Wake County Corridor Alternatives Analysis (June 2011)*

Recommendations applicable to the U-2719 project area from each of these transportation plans are provided in the following discussion.

State Transportation Improvement Program (STIP) (August 2013)

The project is included as Project U-2719 in NCDOT's adopted 2012-2020 *State Transportation Improvement Program (STIP)* with right of way programmed to begin in 2016 and construction programmed to begin in 2018. Other major STIP projects in the vicinity of the project study area are listed in **Table 7**.

TABLE 7: STIP Projects in Project Vicinity

STIP No.	Route	Description	Schedule
I-4744	I-40	From SR 1728 (Wade Ave, Mile Post 289) to I-440/US 1-64 (Mile Post 293). Add Lanes.	Under Construction – GARVEE Bond Funding. Payback FY 2019-2020
I-4709	I-40	From SR 1728 (Wade Ave) to east of I-440/US 64 (Mile Post 302). Pavement repair and resurfacing.	Project Complete - GARVEE bond funding. Payback FY 2007 - FY 2018
I-5338	I-40/US 64	West of SR 1319 (Jones Franklin Rd) to east of I-440/US 64 (Exit 301). Pavement rehabilitation, including widening for maintenance of traffic (no additional travel lanes), and its deployment on alternate routes for traffic management.	Under construction as a design-build project. Construction through FY 2016
I-5333	I-440	I-40 TO SR 1728 (Wade Ave). Pavement rehabilitation. <i>(Note: this project does not address all rehabilitation needs in the I-2719 project study area)</i>	Part under construction. Construction through FY 2014.
U-4437	NC 54 Hillsborough St	NC 54 (Hillsborough St) and SR 1664/SR3074 (Blue Ridge Rd) near CSX Railroad and Norfolk Southern Railroad and SR 3042 (Beryl Road) in Raleigh. Construct a grade separation.	Planning/design in progress. Right of way in 2015 and construction in FY 2018-2020.
FS-1005A	I-40, I-440, US 64	I-40 West of SR 1728 (Wade Ave) to near Cary to I-440/US 64 interchange (Exit 301) in Raleigh and I-440/US 64 to US 64-264 interchange in Raleigh. Upgrade corridor, including additional general purpose and/or managed lanes, pavement rehabilitation, interchange modifications, and other operational improvements.	Feasibility Study in Progress
B-4656	SR 1011 Hillsborough St	SR 1011 Hillsborough St – Remove Bridge No. 492 over SR 1012 (Western Blvd) and reconstruct intersections.	Right of way in progress. Construction in FY 2013.
B-5130	SR 1321 Avent Ferry Rd	SR 1321 (Avent Ferry Rd) – Replace Bridge No.318 over Lake Johnson in Raleigh	Construction in FY 2016.
EB-5516	SR 1313 Walnut St	From SR 1315 (Buck Jones Rd) to Meeting St. Construct sidewalk.	Construction in FY 2018.

Source: NCDOT Current STIP (September 2013). Accessed via NCDOT Website:
https://connect.ncdot.gov/projects/planning/Planning%20Document%20Library/LIVE_STIP.pdf

Capital Area MPO Comprehensive Transportation Plan (October 2010)

In 2001, the North Carolina legislature approved legislation mandating local and regional development of Comprehensive Transportation Plans (CTPs). The CTP identifies all modes of travel, including highways, public transportation, rail, and bicycle facilities, that are needed to serve anticipated travel demand. Projects listed in an area's LRTP are typically drawn from the area's CTP. The CTP is intended to strengthen connections between the area's transportation plan, adopted local land development plans, and community vision.

The Bicycle Map identifies Walnut Street, Jones Franklin Road, Western Boulevard, and Hillsborough Street across I-440/US 1-64 as needing improved bicycle facilities. On the *CAMPO 2040 CTP* Highway Map (October 2010), I-440 south of Wade Avenue is shown as a freeway that needs improvement. Other roadways within the project area identified for improvement include:

Freeways

- Wade Avenue west of I-440
- I-40, both east and west of I-440

Boulevards

- Western Boulevard west of I-440

Major Thoroughfares

- Jones Franklin Road, both east and west of I-440
- Walnut Street, both east and west of US 1-64

Grade Separation

- Blue Ridge Road and NCR Rail at Hillsborough Street. This project is currently in the planning stage (STIP Project U-4437).

Capital Area MPO 2040 Long Range Transportation Plan (April 2013)

The CAMPO 2040 LRTP is part of a joint document created with the Durham-Chapel Hill-Carrboro MPO titled, *Research Triangle Region - 2040 Metropolitan Transportation Plans* (CAMPO Web site: www.campo-nc.us).

Roadway projects within and near the project corridor listed in the CAMPO 2040 LRTP for Year 2020 include widening I-40 from Wade Avenue to Lake Wheeler Road (Projects F16 and F43 in the LRTP), the Blue Ridge Road grade separation with the NCR Rail at Hillsborough Street (Project A486), and widening Walnut Street from US 1-64 south to Macedonia Road (Project A561).

Year 2030 projects include the proposed project (listed as Project F10 in the LRTP). Year 2040 projects include widening Wade Avenue from I-440 to I-40 (Project A562) and widening Jones Franklin Road from Dillard Drive to Western Boulevard (Projects A560a and A560b).

Regarding transit, the LRTP (Section 7.3) states regional efforts for rail transit are ongoing and the current status of the efforts can be found at www.ourtransitfuture.com. A Wake-Durham commuter rail service is being considered on the NCR Rail corridor that crosses under I-440.

The LRTP recognizes that many local governments in the region have developed their own bicycle and pedestrian plans. Specific bicycle recommendations for the project area are discussed below under the City of Raleigh's *Bicycle Transportation Plan*.

Capital Area MPO Metropolitan Transportation Improvement Program 2012-2018 (September 2011)

The *Metropolitan Transportation Improvement Program* (MTIP) is a seven-year program adopted by the Capital Area Metropolitan Planning Organization (CAMPO). The MTIP schedules state and federal funding for transportation projects in the Raleigh urban area, as identified in the LRTP. The funds are used for roadway, bridge, safety, public transportation, passenger rail, bicycle, pedestrian, and enhancement projects. The CAMPO 2012-2018 MTIP includes the U-2719 project and the projects listed in **Table 7**.

City of Raleigh Bicycle Transportation Plan (April 2009)

The Bicycle Transportation Plan analyzed the Bicycle Level of Service (BLOS) for most major and collector roadways in the City of Raleigh. All major roadways analyzed in the project study area are BLOS "D" or worse, indicating poor conditions for bicycle use. The plan recommendations in the project study area include:

- Striping a bike lane on Athens Drive;
- New construction of bike lanes on Jones Franklin Road and Hillsborough Street; and
- Striping the wide outside lane on Western Boulevard.

Triangle Transit - Durham-Wake County Corridor Alternatives Analysis (June 2011)

Planning for a regional fixed-guideway system in the Durham-Wake County Corridor began over a decade ago. The Durham-Wake County Corridor Alternatives Analysis identifies a preliminary locally-preferred alternative. This alternative would operate commuter rail within the existing NCRR right of way from west Durham to Garner. The NCRR right-of-way includes the railroad tracks that pass under I-440 just south of Hillsborough Street.

1.8.2. Land Use Plans

The following plans are described below as they relate to the project or project study area.

- City of Raleigh and Town of Cary Existing Zoning
- *City of Raleigh 2030 Comprehensive Plan* (October 2009 and as amended)
- *Town of Cary Comprehensive Plan* (November 1996 and amended through August 2009)
- North Carolina State University *Physical Master Plan* (2007) and *Centennial Biomedical Campus Development and Design Guidelines* (July 2010)

Recommendations applicable to the U-2719 project area from each of these plans are provided in the following discussion.

City of Raleigh and Town of Cary Existing Zoning

Existing land uses in the study area are consistent with designated zoning, which include residential, office and institutional, industrial, and business districts. Property in the project study area south of I-40 is within the jurisdiction of the Town of Cary and is zoned for general commercial or office, research and development, with a mixed use overlay district.

North of I-40, the project study area is within the jurisdiction of the City of Raleigh. Between I-40 and Western Boulevard, most of the property in the project study area is zoned for low and medium-density residential uses, with the exception of Conservation Management (CM) zoning around Lake Johnson and office and institutional zoning between Jones Franklin Road and I-40.

North of Western Boulevard, the project study area includes office and institutional zoning districts associated with North Carolina State University and Meredith College, industrial zoning districts along Hillsborough Street and the railroad corridor, and scattered residential and business uses.

2030 Comprehensive Plan for the City of Raleigh (October 2009, as amended)

The City of Raleigh's *2030 Comprehensive Plan* is an extensive document with numerous elements developed to set policy and guide the city's future land use and infrastructure decision-making. The Comprehensive Plan is the basis for the city's Unified Development Ordinance (UDO), which went into effect September 1, 2013. The UDO includes a new approach to zoning regulations, and a new "zoning map" is currently being developed. The map will effectively "implement" the UDO.

The following sections highlight portions of the Comprehensive Plan with notable recommendations related to the project study area.

Transportation Element. Policies listed in this element of the Comprehensive Plan that are relevant to the proposed project include the following:

- Policy T 2.1 – Integration of Travel Modes – Promote and develop an integrated, multi-modal transportation system that offers safe and attractive choices among modes including pedestrian walkways, bikeways, public transportation, roadways, railways, and aviation.
- Policy T 2.8 – Access Management Strategies – Appropriate access management strategies (i.e. location and spacing of permitted driveways) should be applied based on a roadway’s functional characteristics, surrounding land uses, and the roadway’s users.
- Policy T 2.10 – Level of Service – Maintain level of service (LOS) “E” or better on all roadways and for overall intersection operation at all times, including peak travel times, unless maintaining this LOS would be infeasible and/or conflict with the achievement of other goals.
- Policy T 2.11 – Lane Additions – Consider adding lanes to increase roadway capacity only after the roadway exceeds 20 percent of full capacity and all other alternative approaches have been considered. This includes enhancing other transportation modes and roadway modifications such as restricting driveway access and adding turn lanes. Improvements to the roadway network should increase vehicle dispersion and circulation.
- Policy T 5.6 – Bridges, Underpasses, and Interchanges – Pedestrians and bicyclists shall be accommodated on roadway bridges, underpasses, and interchanges (except on roadways where they are prohibited by law). Bicycle lanes and wide sidewalks should be included on all new bridges and underpasses (requires NCDOT coordination on state-maintained roads).

Future Land Use Map (November 2009). The future land use designations in the project area generally reflect existing uses, with the exception of a Community Retail Mixed Use designation between Western Boulevard and Hillsborough Street around the future transit station to be located on Hillsborough Street at Blue Ridge Road. The Community Retail Mixed Use designation recommends incentives for vertical mixed use (e.g., ground floor retail under high density residential) where this designation adjoins future transit stations.

Growth Framework Map (October 2009). The Growth Framework Map represents a vision for accommodating projected growth through 2030 and seeks to redirect the majority of this growth into downtown and a series of growth centers, transit-oriented centers, and mixed-use community centers. Consistent with the Future Land Use Map, the Growth Framework Map identifies a future rail station and Transit Orient Development (TOD) area at the intersection of Blue Ridge Road and Hillsborough Street, and a mixed use community center on the west side of I-440 at Western Boulevard (currently a K-mart).

The City also identifies a city growth center west of I-440 between Wade Avenue and Western Boulevard that extends west to I-40. Mixed-use community centers are “targeted for infill development and improvements to urban design and connectivity intended to retrofit them over time as more integrated, walkable centers” and city growth centers “provide significant opportunities for new residential and economic development and redevelopment.” In addition, Hillsborough Street through the project area is designated as a multi-modal corridor targeted for a higher level of transit service such as enhanced bus, express bus, bus rapid transit, or streetcar.

Target Areas for Economic Development Map (October 2008). Target areas for economic development are areas that demonstrate a need for economic development intervention or present opportunities for economic development. The Target Areas for Economic Development map identifies two target areas that include portions of the project study area. The first is University

West (Target Area 17), which is located between I-440 and Gorman Street south of Hillsborough Street. The second is NC 54/ Jones Franklin Road (Target Area 18), which includes the area surrounding Jones Franklin Road west of I-440 to NC 54.

Avent West Small Area Plan. The purpose of this Plan was to communicate to the City of Raleigh the characteristics of the neighborhood in order to garner support for preserving, stabilizing, improving, and promoting this established area that is valued locally. The Plan intent is to serve as a guide for neighborhood initiatives that will take place outside of the authority of the City of Raleigh. The Avent West neighborhood is generally bounded on the north by Western Boulevard, on the east by Kent Road and properties adjacent to Brent Road, on the south by Avent Ferry Road and Athens Drive, and on the west by Powell Drive and Ravenwood Drive. The neighborhood includes property on both sides of I-440 in the central portion of the project study area.

The following policies and actions from the area plan are related to properties within the project study area:

- The Melbourne Road bridge should be retained in the future as changes, such as widening of the I-440 Beltline, occur.
- As part of future Beltline widening, NCDOT should be encouraged to repair or rebuild the Simmons Branch Dam per the Simmons Branch study. (The City of Raleigh has a current project to repair this dam and is coordinating with NCDOT regarding the design.)
- Consider reducing speed limits and/or implementing traffic calming on I-440 access streets such as Kaplan Drive, Melbourne Road, Pineview Drive, Swift Drive, and Deboy Streets.
- Request that NCDOT replace the median on Western Boulevard east of I-440 and west of Kent Road.

Town of Cary Comprehensive Plan (November 1996, amended through August 2009)

The *Land Use Plan* is Volume 2 of the Town of Cary's *Comprehensive Plan*. The *Land Use Plan* designates a regional activity center (RAC) on both sides of US 1-64 south of I-40, which includes the southern end of the project study area and Crossroads Plaza and South Hills shopping centers.

Southeast Area Plan. The *Southeast Area Plan*, adopted in September 2004, covers more than 2,000 acres in the southeast Cary south of US 1-64 and I-40. Land use recommendations are organized around four major mixed-use activity centers, two of which include the southern portion of the project study area. The Crossroads Plaza Regional Activity Center (RAC) surrounds the Crossroads Plaza Shopping Center east of US 1-64 and the South Hills Community Activity Center (CAC) centers on South Hills Mall located on the west side of US 1-64.

Bicycle and pedestrian recommendations in the *Southeast Area Plan* call for sidewalks and/or multi-use paths along all major roadways and collector roads. Within the U-2719 project study area, the *Southeast Area Plan* recommends the greenway system provide external connections to the Walnut Creek Greenway via Buck Jones Road, and an eventual connector bridge to Crossroads Plaza.

North Carolina State University *Physical Master Plan – A Campus of Neighborhoods and Paths* (2007, currently being updated) and *Centennial Biomedical Campus Development and Design Guidelines* (July 2010)

The NCSU physical master plan “lays out the future of physical development at NC State University...This plan includes guidelines and standards for individual projects and directions for fitting those projects into the overall campus fabric.” The master plan includes Ligon Street and the

tunnel under I-440 as a pedestrian connector path. The Ligon Street corridor under I-440 also has an existing fiber optic telecommunications distribution line.

In September 2007, the Raleigh City Council approved the master plan and Planned Development Conditional Use Overlay District for the CBC campus. The 218-acre NCSU Centennial Biomedical Campus (CBC) is bordered by Hillsborough Street, Blue Ridge Road, Wade Avenue and I-440 (**Figure 6**). The College of Veterinary Medicine is located on the western portion of the tract. The University Club and golf course are on the eastern portion of the site adjacent to I-440.

Most new development is proposed on the western side of the property. However, new residential areas are proposed between the University Club main building and Hillsborough Street. The master plan also calls for shared open space with a greenway/multi-purpose path adjacent to I-440 and a tree preserve area in the southwest quadrant of the I-440/Wade Avenue interchange.

2. REFERENCES AND SUPPORTING DOCUMENTATION

2.1 REFERENCES

American Association of State Highway and Transportation Officials (AASHTO)

Highway Safety Manual

North Carolina Department of Transportation (NCDOT)

NCDOT 2012-2020 State Transportation Improvement Program (STIP)

NCDOT Crash Data Reports (2009-2012)

NCDOT Policy to Projects (DRAFT, September 2012)

MPO Documents

Capital Area MPO 2012-2018 Metropolitan Transportation Improvement Program (MTIP)

Capital Area MPO 2035 Long Range Transportation Plan (LRTP) (May 2009)

Capital Area MPO Comprehensive Transportation Plan (CTP) (October 2010)

Local Plans and Documents (High Point, Greensboro, and Guilford County)

2030 Comprehensive Plan for the City of Raleigh (October 2009, as amended)

Blue Ridge Road District Study (August 2012)

Capital Area Transit Short Range Transit Plan (Draft, March 2012)

Capital Area Greenway System Map (2011)

City of Raleigh, Bicycle Transportation Plan (April 2009)

North Carolina State University, Physical Master Plan, A Campus of Neighborhoods and Paths – Centennial Biomedical Campus Development and Design Guidelines (July 2010)

Raleigh-Durham International Airport, www.rdu.com/newsroom/facts.com

Town of Cary, Comprehensive Transportation Plan (CTP) (amended December 2010)

Town of Cary, Community Investment Bonds website: www.carybonds.org

Town of Cary, Land Use Plan (November 1996)

Town of Cary, Southeast Area Plan (September 2004)

Triangle Transit, Durham-Wake County Corridor Alternatives Analysis: Conceptual Alternatives Technical Report (March 2011)

Socio-Economic Data Sources

American Community Survey (ACS) 5-Year Estimate (2006-2010)

NC Office of State Budget and Management

Wake County Economic Development

2.2 SUPPORTING DOCUMENTATION

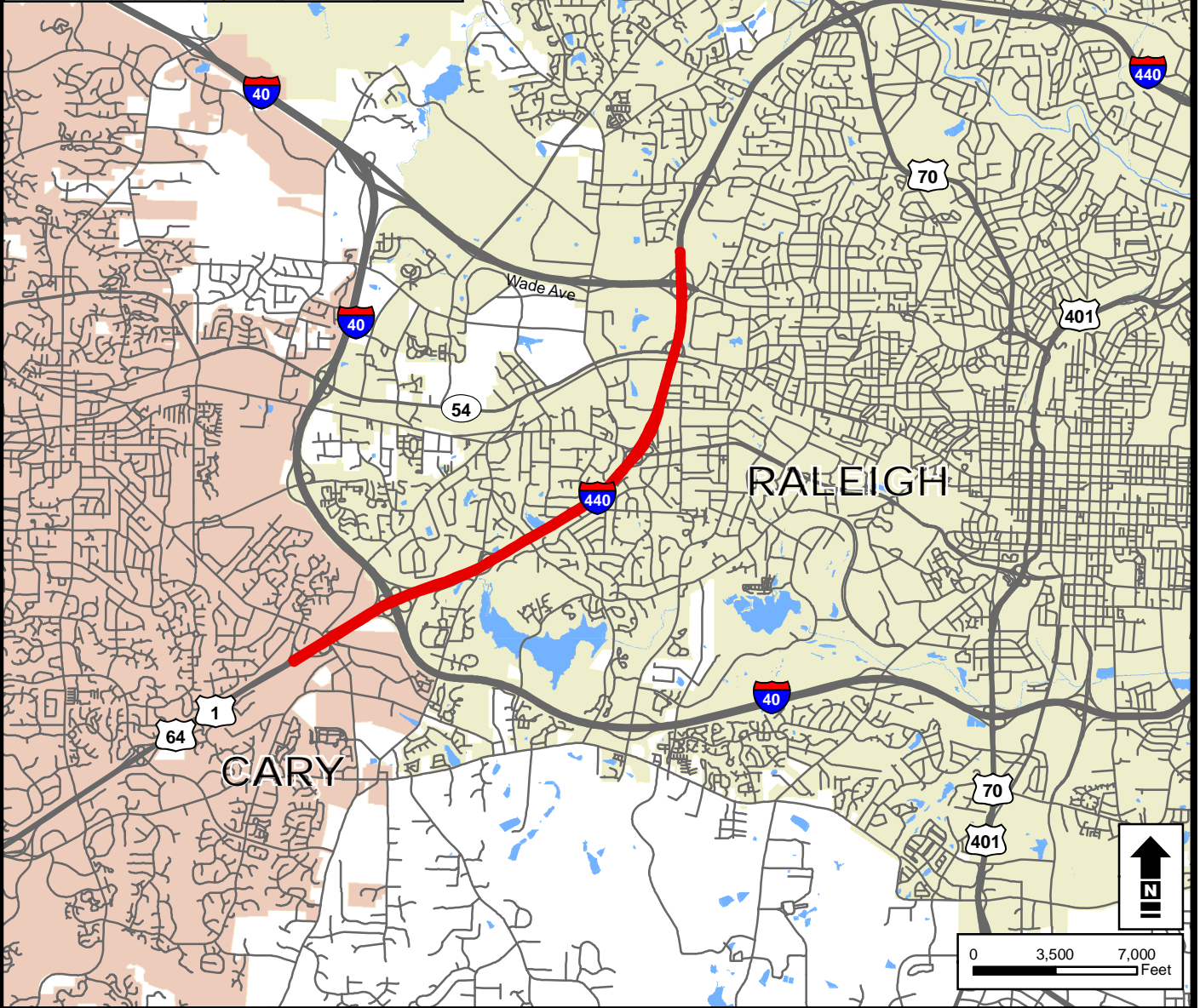
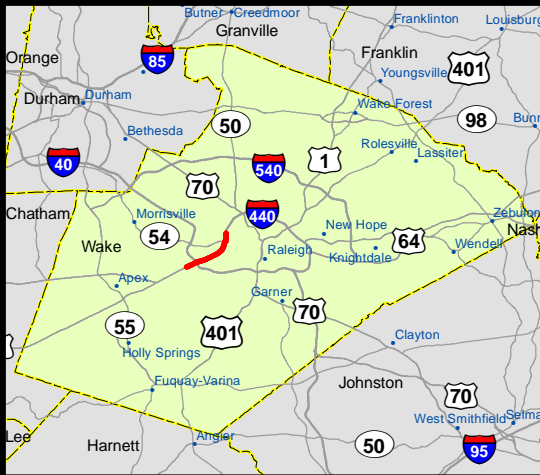
2013, January 10 Traffic Forecast for U-2719. Prepared by NCDOT.

2013, February U-2719 Community Characteristics Report. Prepared by Atkins

2013, July I-440 Widening Project Existing Conditions and Deficiencies Report. Prepared by Atkins

2014, June Traffic Operations Technical Memorandum for I-440 Improvements Project STIP Number U-2719. Prepared by Atkins

PROJECT LOCATION IN COUNTY



U-2719_P&N_Fig1_RegionalProjectLocation.mxd AKB 01.18.2013

I-440 IMPROVEMENTS
 STIP PROJECT NO. U-2719
 Wake County, North Carolina



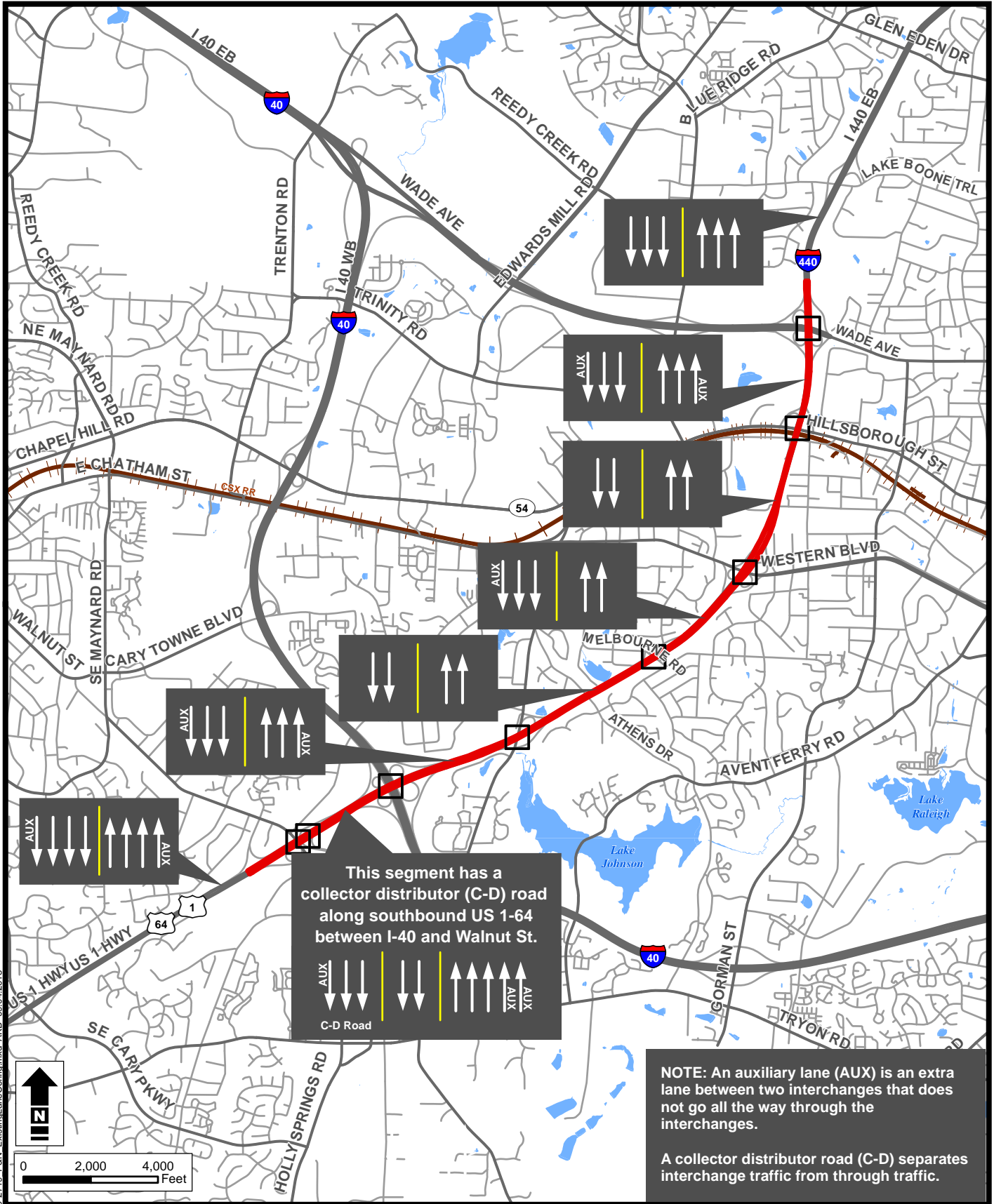
LEGEND

- U-2719 Project
- Interstate
- US Highway
- NC Highway
- Streets
- Lakes
- Cary Municipality
- Raleigh Municipality

Source: ESRI, NCDOT, Wake County, NCOneMap.

REGIONAL PROJECT LOCATION

FIGURE 1



U-2719_P&N_ExistingLaneConfig.mxd_AKB_09.04.2013

I-440 IMPROVEMENTS
 STIP PROJECT NO. U-2719
 Wake County, North Carolina



LEGEND

- U-2719 Project Area
- Lakes
- Interchanges
- Railroad
- Existing Lane Configuration

EXISTING LANE CONFIGURATION

FIGURE 2

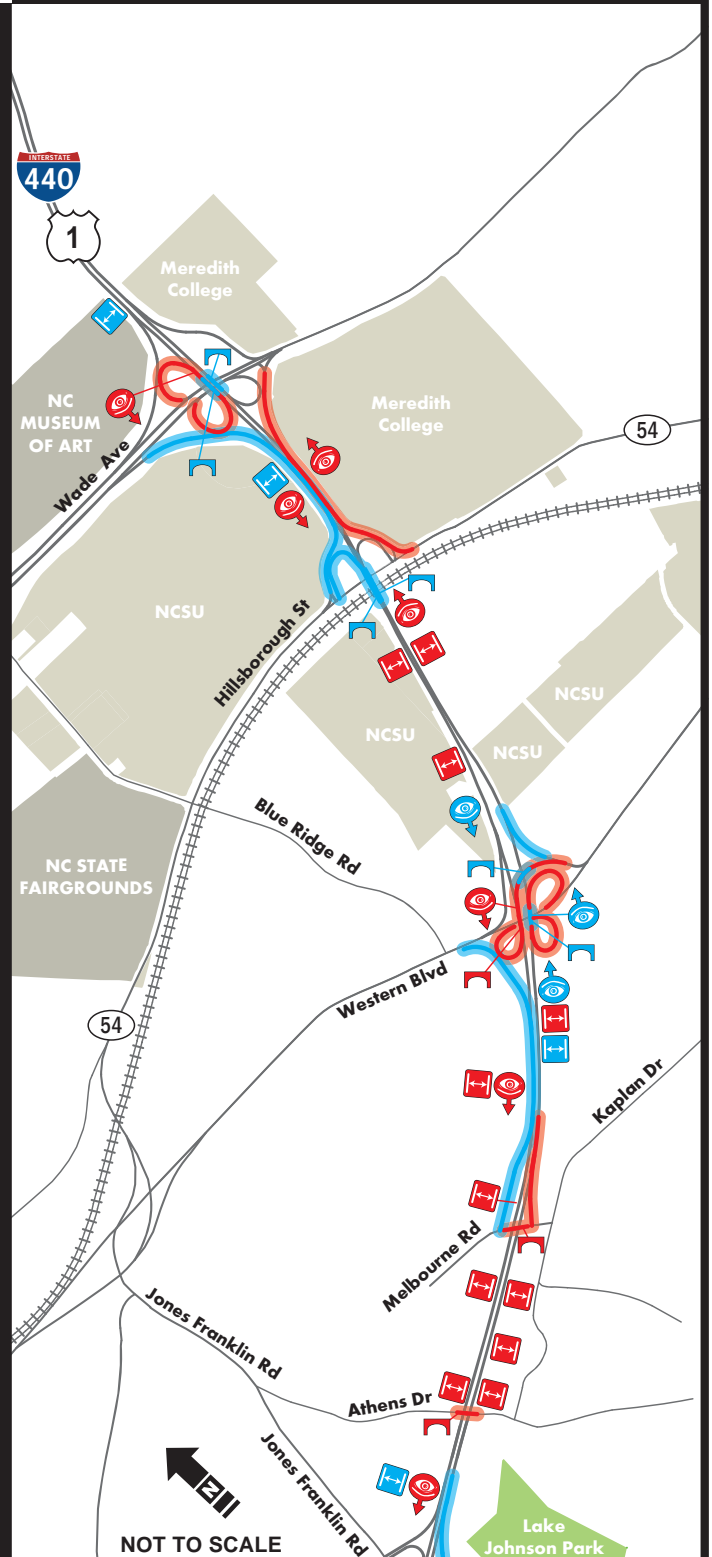
Source: NCDOT; Wake County; NCOneMap

SOUTHERN HALF



SOUTHERN HALF

NORTHERN HALF



NORTHERN HALF

U-2719_P&N_ExtRowyCond&Defic_8x11.ai AKB 09.03.2013

I-440 IMPROVEMENTS
 STIP PROJECT NO. U-2719
 Wake County, North Carolina



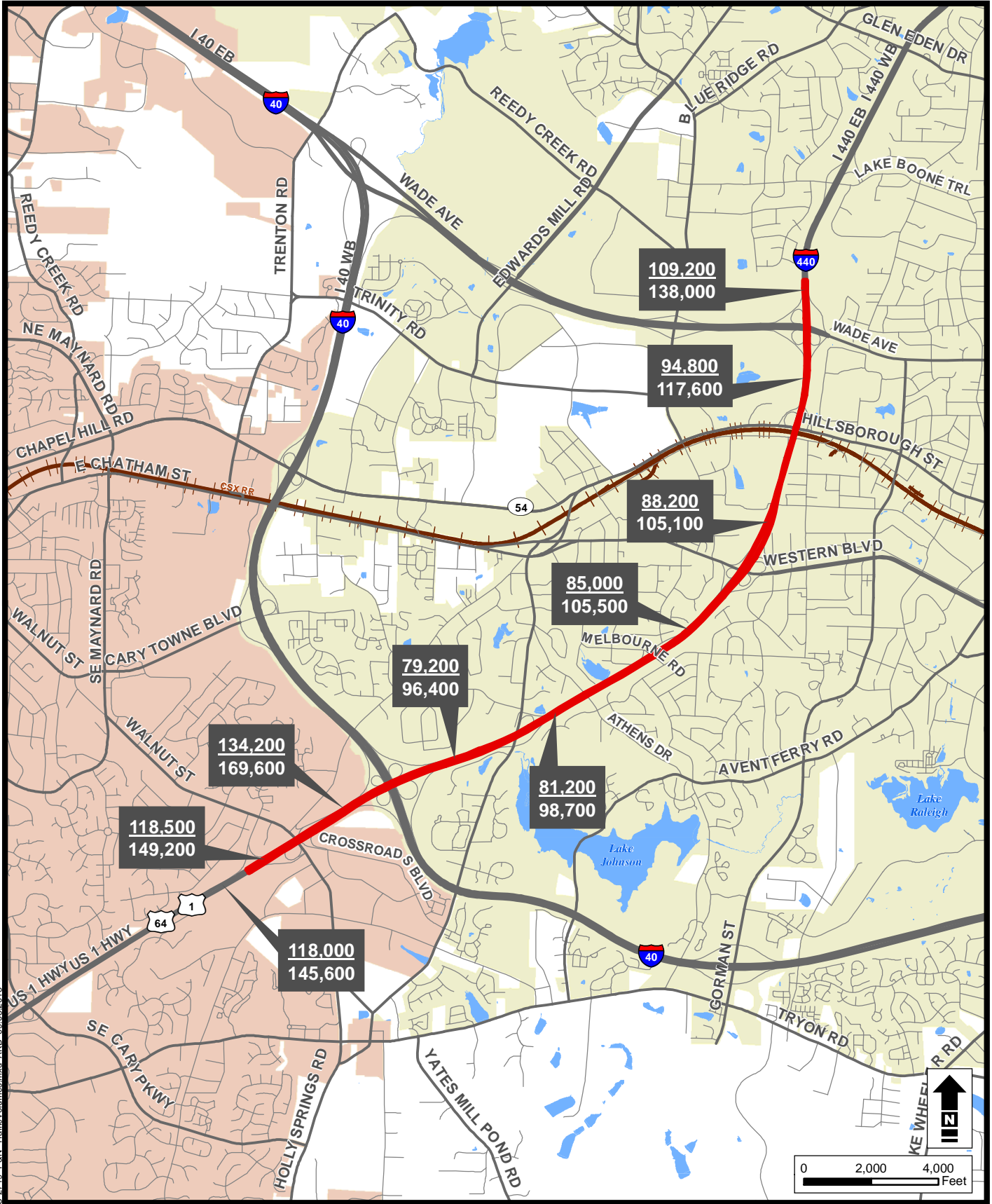
LEGEND

Bridges	Fair	Exit & Entrance Design	Fair	Interstate
	Poor		Poor	US Highway
Horizontal Clearance	Fair	Decision Sight Distance	Fair	Streets
	Poor		Poor	Rail

EXISTING ROADWAY CONDITIONS AND DEFICIENCIES

FIGURE 3

Source: NCDOT, Wake County



U-2719_P&N_TrafficVolumes.mxd_AKB_09.03.2013

I-440 IMPROVEMENTS
 STIP PROJECT NO. U-2719
 Wake County, North Carolina



LEGEND

- U-2719 Project Area
- Railroad
- Lakes
- Cary Municipality
- Raleigh Municipality
- X,XXX 2012 AADT
- X,XXX 2035 No Build AADT

Source: NCDOT; Wake County; NCOneMap; Traffic Forecast for U-2719, January 2013

TRAFFIC VOLUMES

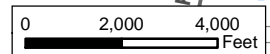
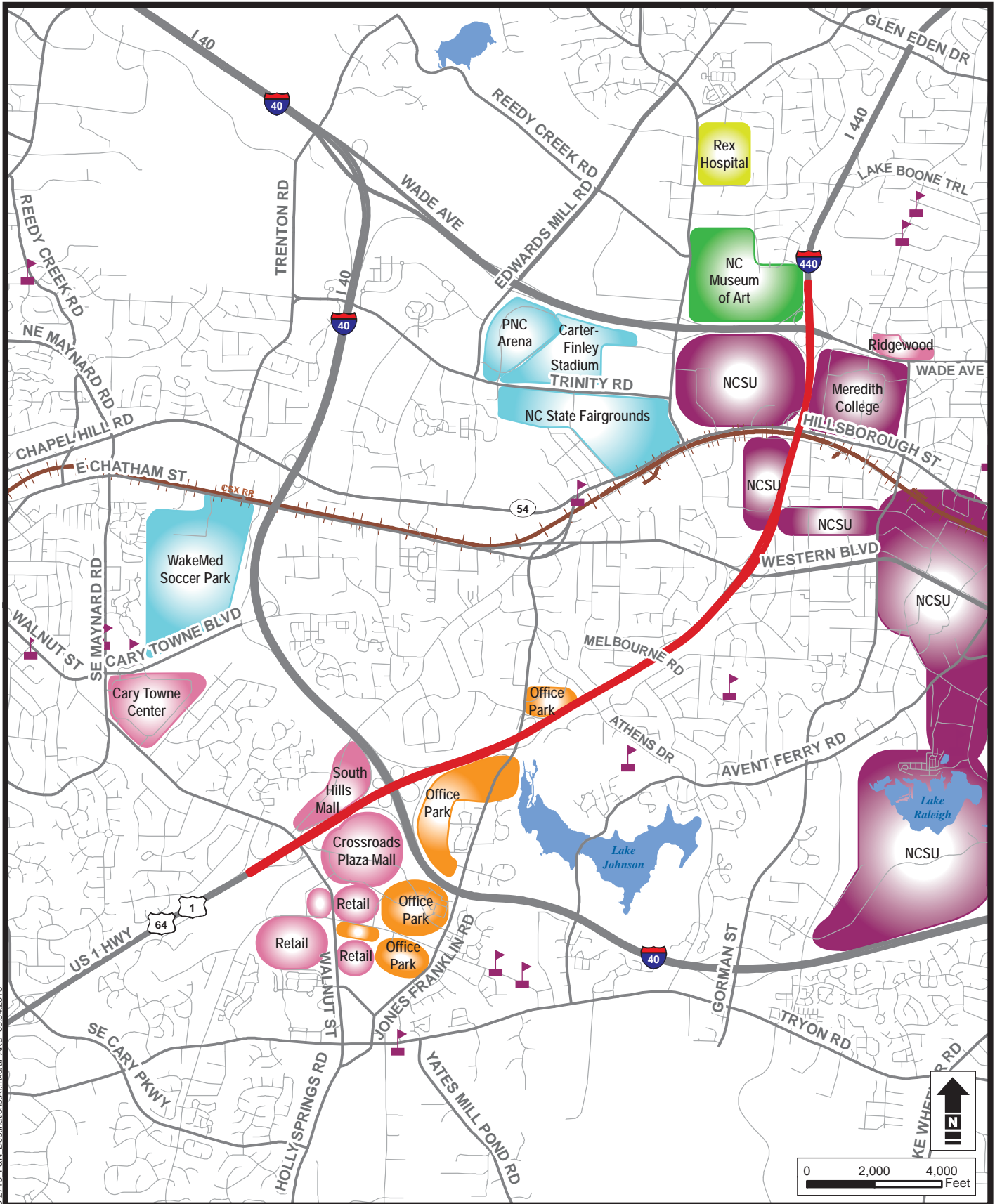


FIGURE 4



L12719_P&N_Destinations_A1rncd/ai_AKB_09.04.2013

I-440 IMPROVEMENTS
 STIP PROJECT NO. U-2719
 Wake County, North Carolina



LEGEND

- U-2719 Project Area
- Public Schools
- Hospital
- Museum
- Sports/Entertainment
- University
- Retail
- Office Park

Source: NCDOT; Wake County; NCOneMap

**MAJOR DESTINATIONS
 NEAR PROJECT
 CORRIDOR**

FIGURE 5



Appendix A

NEPA/Section 404 Merger Process – Concurrence Point #1 (Purpose and Need)

Section 404/NEPA Merger Project Team Meeting Agreement Concurrence Point No. 1 - Purpose and Need

Project No./TIP No./Name/Description:

Federal Project Number: IMSNHS-0440(10); WBS Number 35869.1.2

TIP Number: U-2719

Description: I-440 Improvements from US 4 south of Walnut Street (SR 1313) to north of Wade Avenue (SR 1728), Wake County

Purpose and Need of Proposed Project:

The purpose of the project is to improve traffic flow and operational efficiency and enhance mobility on this segment of I-440. The overall needs for the project are described below.

- The project section of I-440 consists of four through lanes, forming a "bottleneck," with six through lanes to the north and south. The four through lanes in the project section regularly experience congestion. Traffic volumes are forecasted to increase in the future.
- The roadway and interchanges in this section of I-440 have substandard design elements such as poor sight lines, narrow shoulders and medians, and short acceleration/deceleration lanes.
- Pavement, structures, and interchanges along the project segment are in need of rehabilitation.

The Project Team concurred on this date of 22 Aug 2012 with the purpose of and need for the proposed project as stated above.

USACE *Eric C. Allen*

NCDOT *Dezha Wing Munn*

USEPA *Don A. [Signature]*

USFWS *Gary Jordan*

NCDWQ *Robert [Signature]*

NCWRC *[Signature]*

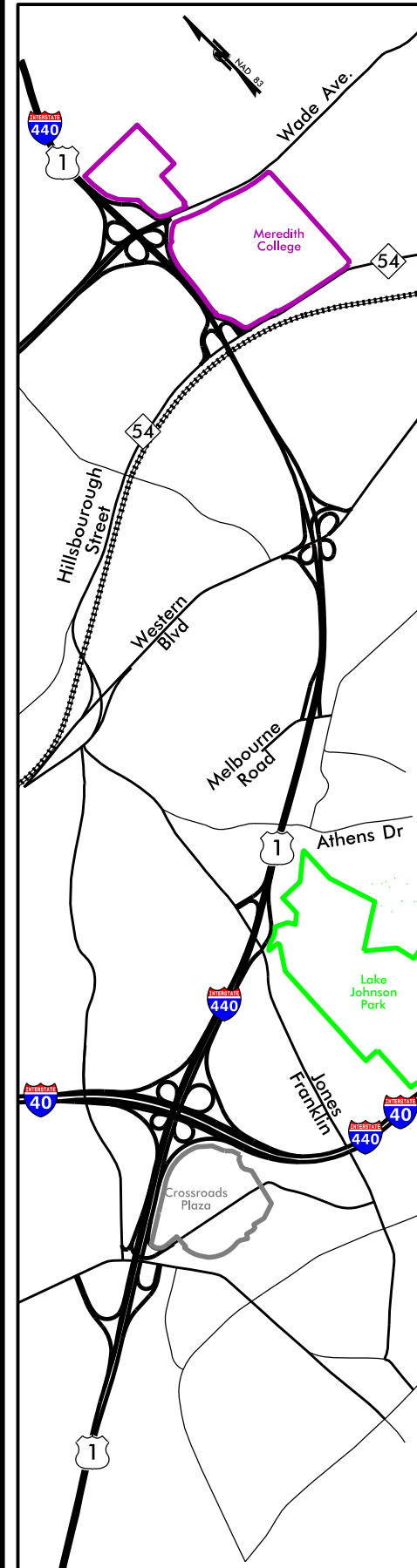
NCDCR *Renee Bledhill-Carley*

FHWA *Felix [Signature]*

CAMPO *[Signature]*

Appendix B

Existing Conditions Diagrams



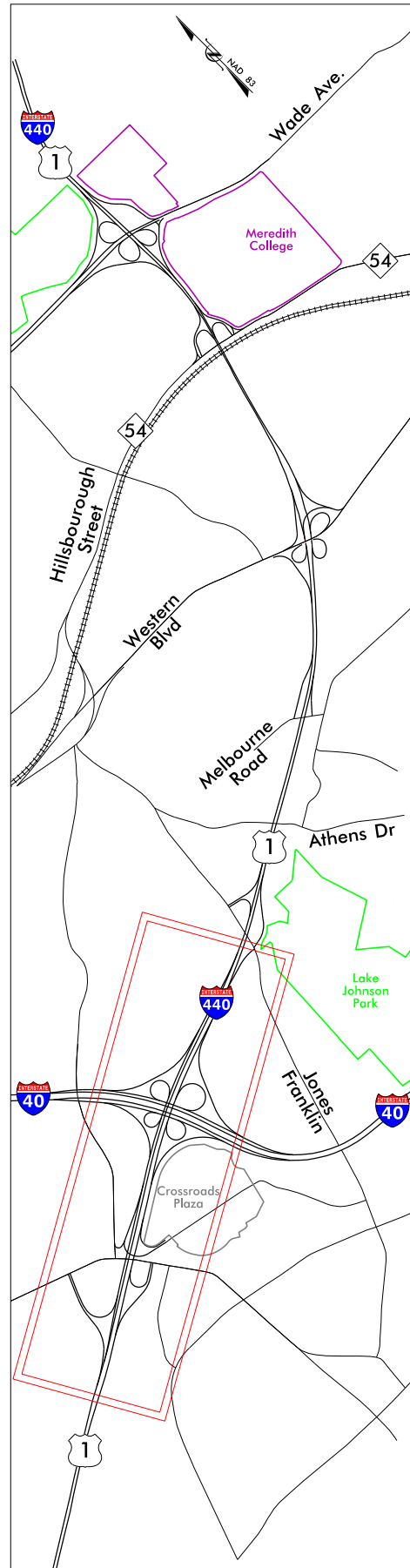
LEGEND

- P.....PHYSICAL CONDITION
- G.....GEOMETRIC FEATURES
- DO.....DESIGN OPERATIONS
- OP.....OPERATIONAL PERFORMANCE

(To provide an assessment of the conditions along the I-440 corridor:)

I-440	P	HIGHWAY STRUCTURES	General condition ratings provide an overall assessment of physical condition of bridge deck and superstructure. Ratings range from 0 (failed condition) to 9 (excellent). The present condition of each bridge is presented as colored lines based on the ratings; 7 to 9 is GOOD (green), 4 to 6 is FAIR (yellow), and 0 to 3 is POOR/CRITICAL (red).
		PAVEMENT	Pavement rating value assesses the overall condition of the pavement structure. Scores range from 0 to 100. Pavement sections with a rating of 75 or more will be considered to be in GOOD (green) condition, between 50 to 74 in FAIR (yellow) condition, and less than 50 in POOR (red) condition.
	G	HORIZONTAL ALIGNMENT	Minimum horizontal curvature for interstate roadways is 1,340 feet (radius) for 65 mph design speed. Curves that meet 65+ mph design speed are GOOD (green), that meet 60 – 65 mph design speed are FAIR (yellow), and that are below 60 mph design speed are POOR (red).
		VERTICAL ALIGNMENT	Maximum vertical grade for rural and urban freeway is 4% for rolling terrain at a design speed of 65 mph. A grade less than 4% is GOOD (green), between 4 – 4.5% is FAIR (yellow), and above 4.5% is POOR (red). Minimum vertical grade is 0.3%.
		STOPPING SIGHT DISTANCE	Stopping sight distance is defined as the minimum length of vertical curve (K value) to provide adequate stopping distance at a specific design speed before impacting a 2 foot object in its travel path and is related to the length of the vertical curve. A 65 mph or greater (K) value is GOOD (green), a 60 – 65 mph (K) value is FAIR (yellow), and a (K) value less than 60 mph is POOR (red).
		HORIZONTAL CLEARANCE	For interstate facilities, 30 to 34 feet is desired to be clear of roadside hazards. A horizontal clearance distance of 30 feet or greater is GOOD (green), between 24 – 30 feet is FAIR (yellow), and less than 24 feet is POOR (red).
		DECISION SIGHT DISTANCE	Decision sight distance is defined as the distance that a motorist has to visually identify an exit ramp and then make a decision on what action to take. Decision sight distances 2,000 feet or greater are GOOD (green), between 1,999 – 1,000 feet are FAIR (yellow), and less than 1,000 feet are POOR (red).
EXIT & ENTRANCE DESIGN		Ratings for parallel exit and entrance ramps are based whether or not they have an acceptable length for acceleration and deceleration. The acceleration lanes on ramp entrances are rated as follows: greater than 800 feet is GOOD (green), between 800-550 feet is FAIR (yellow), and less than 550 feet is POOR (red). The acceleration lanes on loop entrances are rated as: greater than 1,400 feet is GOOD (green), between 1,400 – 900 feet is FAIR (yellow), and less than 900 feet is POOR (red). The deceleration lanes on ramps exits are rated as follows: greater than or equal to 400 feet is GOOD (green), between 399-250 feet is FAIR (yellow), and less than 250 feet is POOR (red). The deceleration lanes on loop exits are rated as: greater than 550 feet is GOOD (green), between 550 – 350 feet is FAIR (yellow), and less than 350 feet is POOR (red). For weaving sections, greater than 1500' is GOOD (green), between 1500' and 1000' is FAIR (yellow), and below 1000' is POOR (red).	
DO	ROUTE CONTINUITY	Route continuity refers to the provision of a directional path along and throughout the length of I-440. The designation pertains to a route number or name of a major highway. The principle of route continuity simplifies the driving task by providing a continuous through route on which changing lanes is not necessary to continue on the through route.	
	LANE BALANCE	Proper lane balance follows basic principles that govern the number of lanes at entrance and exit ramps, and how lane reduction is achieved. Green lines indicate the principles have been met and Red lines indicate they have not.	
	RAMP SEQUENCE	To provide sufficient weaving length and adequate space for signing, ramp spacing should be 800 feet between successive entrance or exit ramps, 400 feet between successive exit/entrance ramps, 600 feet between turning roadways, and 1000 feet between weaving sections. Green lines indicate standard distances are met and Red lines indicate they are not.	
OP	MAINLINE LEVEL OF SERVICE	A standardized measure of the traffic flow on a highway is Level of Service (LOS). LOS A: Free flow/vehicles can move freely within the traffic stream. LOS B: Reasonably free flow operations; freedom to maneuver slightly restricted. LOS C: Flow with speeds at or near free flow; freedom to maneuver noticeably restricted. LOS D: Speeds decline, increasing traffic; freedom to maneuver noticeably limited. LOS E: Near capacity/little or no room to maneuver. LOS F: Breakdowns in traffic flow; capacity exceeded. For the mainline, LOS A, B and C are shown as GOOD (green). LOS D is shown as FAIR (yellow). LOS E and F are shown as POOR (red).	
	SAFETY RATIO	The safety ratio is the critical crash rate divided by the actual crash rate. The critical crash rate was calculated based on the statewide crash rate for a 95% confidence interval, and the actual crash rate is the number of crashes per 100 million vehicle miles travelled. A ratio above 1.5 is GOOD (green), between 1.0 and 1.5 is FAIR (yellow), and less than 1.0 is POOR (red).	

█ GOOD
 █ FAIR
 █ POOR



SOUTHBOUND I-440

P	HIGHWAY STRUCTURES	---		---		
	PAVEMENT	---		---		
G	HORIZONTAL ALIGNMENT	10,000'	10,000'	11,500'	15,000'	12,000'
	VERTICAL ALIGNMENT	+0.9%	+1.9%	-2.7%	-1.5%	+3.3%
	STOPPING SIGHT DISTANCE	K=500	K=320	K=410	K=230	
	HORIZONTAL CLEARANCE	---				
	DECISION SIGHT DISTANCE	1000'				
	EXIT & ENTRANCE DESIGN	800'				
DO	ROUTE CONTINUITY	---				
	LANE BALANCE	---				
	RAMP SEQUENCE	2500'+	COLLECTOR DISTRIBUTOR			---
OP	MAINLINE LEVEL OF SERVICE	D	C	D		
	SAFETY RATIO	4.65	1.45	1.97	1.39	1.86

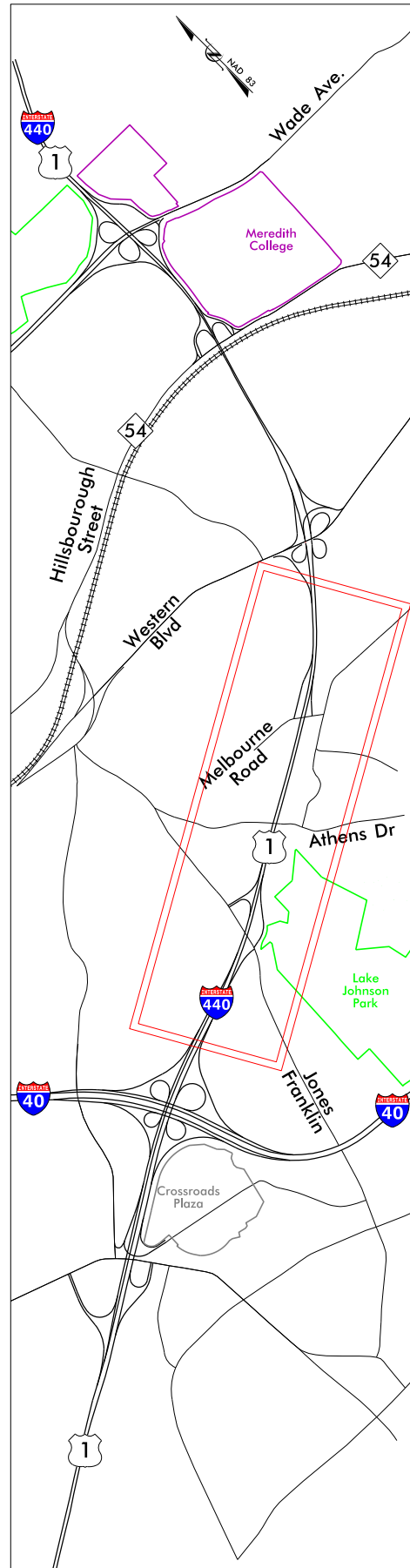
LEGEND (SEE COVER FOR DEFINITIONS)

- P.....PHYSICAL CONDITION
- G.....GEOMETRIC FEATURES
- DO.....DESIGN OPERATIONS
- OP.....OPERATIONAL PERFORMANCE
- █ GOOD
- █ FAIR
- █ POOR
- B MAINLINE LEVEL OF SERVICE (2012)
- 0.00 SAFETY RATIO - ALL CRASHES (2009 - 2012)



NORTHBOUND I-440

P	HIGHWAY STRUCTURES	---		---					
	PAVEMENT	---		---					
G	HORIZONTAL ALIGNMENT	10,000'		10,750'	10,500'				
	VERTICAL ALIGNMENT	+0.9%	+1.9%	-2.8%	-1.3%	+3.2%			
	STOPPING SIGHT DISTANCE	K=1,030	K=320	K=330	K=225				
	HORIZONTAL CLEARANCE	---							
	DECISION SIGHT DISTANCE	1050'							
	EXIT & ENTRANCE DESIGN	2,150'	1,250'	775'	1,850'	1,250'			
DO	ROUTE CONTINUITY	---							
	LANE BALANCE	---							
	RAMP SEQUENCE	2,500'+	1,150'	920'	1,250'	1,050'	770'	1,200'	1,250'
OP	MAINLINE LEVEL OF SERVICE	D	F	E	D	E	C	F	E
	SAFETY RATIO	1.80		0.60			1.23	1.56	0.74



SOUTHBOUND I-440

P	HIGHWAY STRUCTURES	[Color-coded bar]									
	PAVEMENT	[Color-coded bar]									
G	HORIZONTAL ALIGNMENT	15,000'	12,000'	5,500'		20,000'		5,750'			
	VERTICAL ALIGNMENT	-2.7%	-1.5%	+3.3%		-1.3%		+0.8%		-2.1%	
	STOPPING SIGHT DISTANCE	K=410	K=230		K=330		K=485		K=430		
	HORIZONTAL CLEARANCE	[Color-coded bar]									
	DECISION SIGHT DISTANCE		1,000'		850'				950'		
DO	ROUTE CONTINUITY	[Color-coded bar]									
	LANE BALANCE	[Color-coded bar]									
	RAMP SEQUENCE	COLLECTOR DISTRIBUTOR	1,550'	670'		2,500'+			1,350'		
OP	MAINLINE LEVEL OF SERVICE	D E F E F									
	SAFETY RATIO	1.86	1.05	0.87	1.11	1.99	1.30	1.91	0.60		

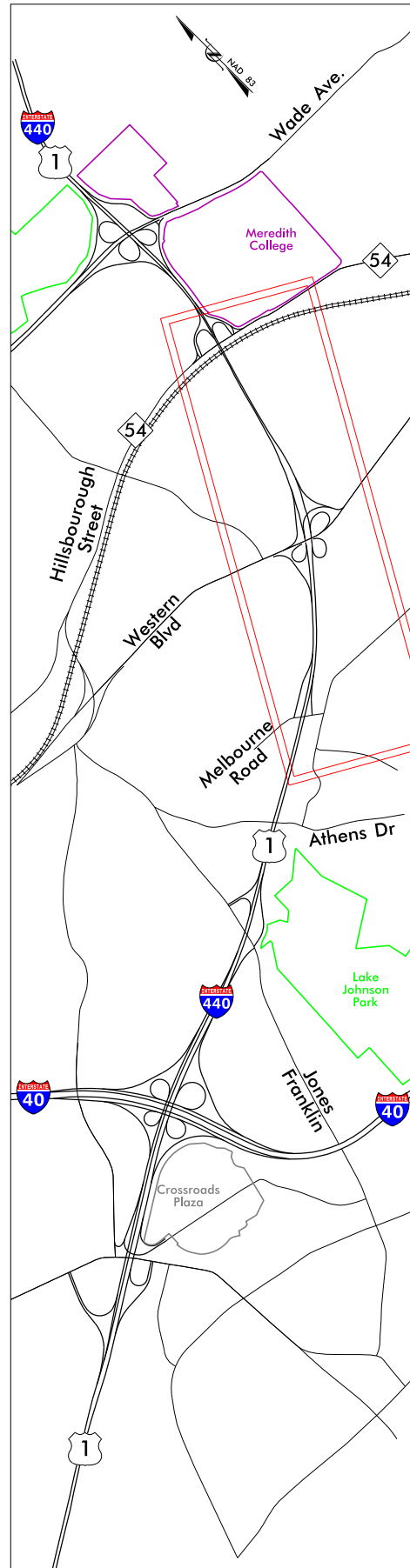
LEGEND (SEE COVER FOR DEFINITIONS)

- P.....PHYSICAL CONDITION
 - G.....GEOMETRIC FEATURES
 - DO.....DESIGN OPERATIONS
 - OP.....OPERATIONAL PERFORMANCE
- [Green Box] GOOD
 - [Yellow Box] FAIR
 - [Red Box] POOR
- B MAINLINE LEVEL OF SERVICE (2012)
 - 0.00 SAFETY RATIO - ALL CRASHES (2009 - 2012)



NORTHBOUND I-440

P	HIGHWAY STRUCTURES	[Color-coded bar]									
	PAVEMENT	[Color-coded bar]									
G	HORIZONTAL ALIGNMENT	10,500'		20,000'		20,000'		5,750'			
	VERTICAL ALIGNMENT	-2.8%	-1.3%	+3.2%		-1.4%		+1.0%	+0.3%	+1.6%	-1.9%
	STOPPING SIGHT DISTANCE	K=330	K=225		K=330		K=425		K=200		
	HORIZONTAL CLEARANCE	[Color-coded bar]									
	DECISION SIGHT DISTANCE	1,850'							1,100'		
DO	ROUTE CONTINUITY	[Color-coded bar]									
	LANE BALANCE	[Color-coded bar]									
	RAMP SEQUENCE	1,250'	2,300'		2,500'+			2,000'			
OP	MAINLINE LEVEL OF SERVICE	C F E F									
	SAFETY RATIO	1.23	1.56	0.74	1.35	1.85	1.43	1.98	1.05		



SOUTHBOUND I-440

P	HIGHWAY STRUCTURES	-	-	-	-	-	-	-	-	-	-	-	-	
	PAVEMENT	[Red line]												
G	HORIZONTAL ALIGNMENT	-20,000'	5,750'	8,000'	2,665'	5,700'								
	VERTICAL ALIGNMENT	-1.3%	+0.8%	-2.1%	-3.3%	+2.3%	+1.6%	+2.6%	+0.9%	+3.5%	-1.7%			
	STOPPING SIGHT DISTANCE	K=485	K=430	K=100	K=680	K=470	K=285	K=195	K=340					
	HORIZONTAL CLEARANCE	[Green line]												
	DECISION SIGHT DISTANCE		950'	400'	1,000'									
DO	EXIT & ENTRANCE DESIGN	1,350'	LEFT	0'	400'	900'								
	ROUTE CONTINUITY	[Green line]												
	LANE BALANCE	[Green line]												
OP	RAMP SEQUENCE	2,500'+	1,350'	850'	400'	750'	2,500'+	550'						
	MAINLINE LEVEL OF SERVICE	F	E	F										
	SAFETY RATIO	1.30	1.91	0.60	1.71	1.24	0.87							

LEGEND (SEE COVER FOR DEFINITIONS)

- P.....PHYSICAL CONDITION
- G.....GEOMETRIC FEATURES
- DO.....DESIGN OPERATIONS
- OP.....OPERATIONAL PERFORMANCE

█ GOOD
█ FAIR
█ POOR

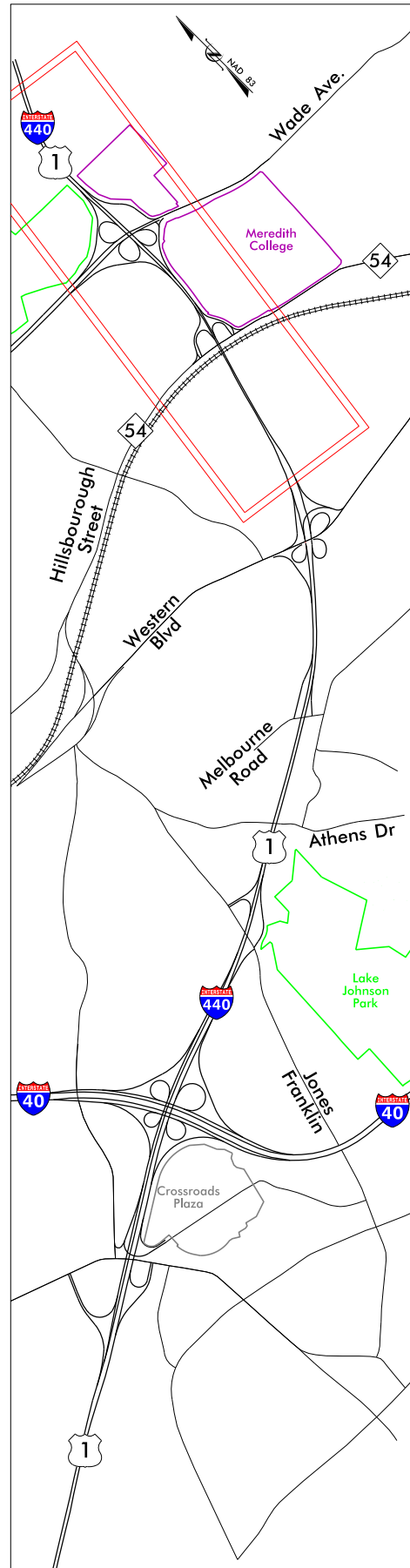
B MAINLINE LEVEL OF SERVICE (2012)

0.00 SAFETY RATIO - ALL CRASHES (2009 - 2012)



NORTHBOUND I-440

P	HIGHWAY STRUCTURES	-	-	-	-	-	-	-	-	-	-	-	-	
	PAVEMENT	[Red line]												
G	HORIZONTAL ALIGNMENT	-20,000'	5,750'	4,250'	4,250'	5,700'								
	VERTICAL ALIGNMENT	-1.4%	+1.0%	+0.3%	+1.6%	-1.9%	-1.2%	+4.0%	+1.2%	+3.4%	-1.7%			
	STOPPING SIGHT DISTANCE	K=425	K=200	K=710	K=160	K=200	K=340							
	HORIZONTAL CLEARANCE	[Green line]												
	DECISION SIGHT DISTANCE		450'	1,100'	1,000'	850'								
DO	EXIT & ENTRANCE DESIGN		450'	400'	450'	725'	900'							
	ROUTE CONTINUITY	[Green line]												
	LANE BALANCE	[Green line]												
OP	RAMP SEQUENCE	2,500'+	2,000'	800'	450'	1,050'	2,500'+	700'						
	MAINLINE LEVEL OF SERVICE	F	E	F										
	SAFETY RATIO	1.85	1.43	1.98	1.05	0.68	1.10	2.34	0.54					



SOUTHBOUND I-440

P	HIGHWAY STRUCTURES	[Diagram showing highway structures with yellow and red segments]									
	PAVEMENT	[Diagram showing pavement status with red and yellow segments]									
G	HORIZONTAL ALIGNMENT	8,000'	2,665'			5,700'			2,925'		
	VERTICAL ALIGNMENT	+2.6%	+0.9%	+3.5%		-1.7%		-3.6%		-1.0%	
	STOPPING SIGHT DISTANCE	K=285	K=195	K=340			K=410		K=250	K=505	
	HORIZONTAL CLEARANCE	[Diagram showing clearance with green and red segments]									
	DECISION SIGHT DISTANCE					800'		950'		1,100'	
DO	EXIT & ENTRANCE DESIGN		900'		1,050'		525'			1,050'	
	ROUTE CONTINUITY	[Diagram showing route continuity with green and red segments]									
	LANE BALANCE	[Diagram showing lane balance with green and red segments]									
OP	RAMP SEQUENCE	2,500'+ 550' 1,050' 925' 525' 900' 2,400' 1,800'									
	MAINLINE LEVEL OF SERVICE	F E F D E F E									
OP	SAFETY RATIO	1.71 1.24 0.87 1.16 0.75									

LEGEND (SEE COVER FOR DEFINITIONS)

- P.....PHYSICAL CONDITION
 - G.....GEOMETRIC FEATURES
 - DO.....DESIGN OPERATIONS
 - OP.....OPERATIONAL PERFORMANCE
- █ GOOD
 - █ FAIR
 - █ POOR
- B MAINLINE LEVEL OF SERVICE (2012)
 - 0.00 SAFETY RATIO - ALL CRASHES (2009 - 2012)



NORTHBOUND I-440

P	HIGHWAY STRUCTURES	[Diagram showing highway structures with yellow and red segments]									
	PAVEMENT	[Diagram showing pavement status with red and yellow segments]									
G	HORIZONTAL ALIGNMENT	4,250'	4,250'			5,700'			2,875'		
	VERTICAL ALIGNMENT	+4.0%	+1.2%	+3.4%		-1.7%		-3.6%		-1.0%	
	STOPPING SIGHT DISTANCE	K=200		K=340			K=525		K=190	K=505	
	HORIZONTAL CLEARANCE	[Diagram showing clearance with green and red segments]									
	DECISION SIGHT DISTANCE					850'		950'			1,050'
DO	EXIT & ENTRANCE DESIGN					900'		825'			
	ROUTE CONTINUITY	[Diagram showing route continuity with green and red segments]									
	LANE BALANCE	[Diagram showing lane balance with green and red segments]									
OP	RAMP SEQUENCE	2,500'+ 700' 850' 1,000' 1,450' 2,500'+									
	MAINLINE LEVEL OF SERVICE	F E D									
OP	SAFETY RATIO	2.34 0.54 1.44 4.48									