EPHESUS CHURCH ROAD-FORDHAM BOULEVARD AREA

PLANNING DISTRICT

DRAFT TRANSPORTATION IMPACT ANALYSIS

TECHNICAL MEMORANDUM #1
EXISTING CONDITIONS ANALYSIS

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February 2017

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I. EXISTING CONDITIONS

A. Project Overview

The Town of Chapel Hill has contracted with HNTB North Carolina, PC to produce a multi-modal transportation impact analysis for the Ephesus Church Road-Fordham Boulevard Area/District (E-F District). This technical memorandum provides detailed information on existing conditions within the E-F District related to all modes of transportation and serves as a baseline for detailed studies of future development/redevelopment scenarios within the E-F District itself and broader E-F TIA study area. The analyses and methodologies provided in this document were performed in accordance with the Town's approved guidelines and after consultation with Town staff, as directed by the Town Council.

Per information from Town staff, the Ephesus-Fordham Area became a new zoning district in July 2014. The goal is to renew and transform an area characterized by strip malls, parking lots, confusing roadways and traffic congestion. The area includes some of Chapel Hill's older, suburban style shopping centers -- including Eastgate Shopping Center, built in 1958; Village Plaza, built in 1974; and Rams Plaza, built in 1982. The vision for the zoning district is to create a pleasant walking experience, and a mix of commercial uses, upper story residences and offices, bike paths and sidewalk cafes.

In 2011, a detailed Small Area Plan and Traffic Impact Analysis was completed for the E-F District. This analysis was limited to the area of proposed E-F District and included assumptions about future development. Since the preparation of the 2011 analysis assumptions about future land uses have been revised. In addition, the community has expressed an interest in a revised analysis that expands the study area and includes assessment of all modes of transportation. To address those needs, this technical memorandum provides an updated "snapshot" of 2016 conditions in a much broader study area context, and will serve as the basis for future evaluation of scenarios in a longer-term manner (using a 2030 future evaluation year).

The Ephesus-Fordham District and overall project study area are located on the east side of Chapel Hill, with the project study area encompassing almost 40 intersections along major transportation corridors within the Town. **Figure 1**, found in ***Appendix A***, shows the general location of the site and the project study area defined for this report and agreed-upon by Town of Chapel Hill staff, with public input at a project scoping meeting held in October 2016.

B. Site Location and Study Area

This technical memorandum defines and analyzes the existing transportation system in the Ephesus Church Road/Fordham Boulevard District project study area. The following 39 intersections are part of the project study area:

1) US 15-501 (Durham-Chapel Hill Boulevard) & Eastowne Drive/Lakeview Drive
2) US 15-501 (Durham-Chapel Hill Boulevard) & Eastowne Drive
3) US 15-501 (Durham-Chapel Hill Boulevard) & Sage Road/Old Durham Road
4) US 15-501 (Fordham Boulevard) & Erwin Road/Europa Drive (4 intersection superstreet)
5) US 15-501 (Fordham Boulevard) & Ephesus Church Road
6) US 15-501 (Fordham Boulevard) & Elliott Road

7) US 15-501 (Fordham Boulevard) & Willow Drive
8) US 15-501 (Fordham Boulevard) & Estes Drive
9) US 15-501 (Fordham Boulevard) & Cleland Road
10) US 15-501 (Fordham Boulevard) & Brandon Road
11) US 15-501 (Fordham Boulevard) & NC 54 Westbound Ramps
12) US 15-501 (Fordham Boulevard) & NC 54 Eastbound Ramps
13) US 15-501/NC 54 (Fordham Boulevard) & Old Mason Farm Road
14) US 15-501/NC 54 (Fordham Boulevard) & Manning Drive
15) Raleigh Road and US 15-501 (Fordham Boulevard) Southbound Ramps
16) NC 54 (Raleigh Road) & US 15-501 (Fordham Boulevard) Northbound Ramps
17) NC 54 (Raleigh Road) & Hamilton Road
18) NC 54 (Raleigh Road) & Environ Way
19) NC 54 (Raleigh Road) & Burning Tree Drive/Finley Golf Course Road
20) Estes Drive & Caswell Road
21) Estes Drive & Library Drive
22) Estes Drive & E. Franklin Street
23) Estes Drive & Willow Drive/Shepherd Lane
24) Elliott Road & Old Oxford Road/Velma Road
25) Elliott Road & E. Franklin Street
26) Eastgate Crossing & E. Franklin Street
27) Ephesus Church Road & Rams Plaza Access (RIRO) / University Inn Driveway
28) Ephesus Church Road & Legion Road
29) Ephesus Church Road & Pinehurst Drive
30) Legion Road & Clover Drive / Rams Plaza Access
31) Legion Road & Quality Inn Driveway
32) Legion Road & Europa Drive
33) US 15-501 Service Road & Quality Inn Driveway
34) Europa Drive & US 15-501 Service Road
35) Legion Road & Scarlett Drive
36) Weaver Dairy Road & Erwin Road
37) Sage Road & Erwin Road
38) Sage Road & Cosgrove Avenue/Lowes Entrance
39) Old Durham Road & Scarlett Drive

These intersections were selected for detailed study through input from Town staff, previous public involvement efforts and public input. Additional engineering judgement was used to assess the relative impact of the proposed future E-F study area growth patterns on the regional transportation system and to include intersections and transportation facilities in the broader project study area that might be impacted by future long-term growth in the E-F District and in other areas of future development in Town that might also contribute to trip-making activities to and from the E-F District.

The impacts of the proposed District at the study area intersections and transportation facilities will be primarily evaluated during the AM, noon, and PM peak hours of an average weekday, so all 2016 base year analyses include these three peak time periods, as well as a planning-level evaluation of daily traffic flows and capacities on study area roadway segments, and general quantitative and qualitative evaluations of transit, pedestrian and bicycle operations.

C. E-F Planning District Description

The Ephesus Church Road-Fordham Boulevard Area district has a high degree of current development, both residential and commercial. The District encompasses approximately 175 acres. It was defined as a special zoning district by the Town in 2014. The land parcels within the District are bordered by two primary thoroughfares for the Town – US 15-501 (Fordham Boulevard) and SR 1010 (E. Franklin Street), which have a free-flowing grade separated interchange within the District boundaries. The southern portion of the district is defined by properties with frontage along Elliott Road between the two major thoroughfares. To the east, the E-F District is bordered by Ephesus Church Road and Legion Road. It extends to the north past Europa Drive to the existing Chapel Hill Memorial Cemetery. Besides the primary transportation facilities mentioned above, the District also features connectivity to several other local streets, paralleling service roads off of US 15-501. **Figure 2** shows an aerial schematic of the E-F Planning District, existing roadway connections, existing major land uses, and locations of existing surface parking facilities and major signalized intersections.

D. Existing and Proposed Land Uses in the Vicinity of the District

The land uses and development in the broad project study area vary from higher density commercial, office and institutional development along the study area high volume thoroughfares (US 15-501, NC 54, E. Franklin Street) to lower density single-family residential neighborhoods and undeveloped wooded tracts and watersheds nearby or adjacent to the highly developed corridors. There are several parks and schools located within the project study area, as well.

The Existing Land Use Plan shown in the 2020 *Town of Chapel Hill Comprehensive Plan* indicates that the E-F District is currently primarily "commercial" with small areas of "office", "institutional" and "high-density residential – 8-15 units/acre". The 2020 Land Use Plan, also a part of the Town Comprehensive Plan adopted in 2012, indicates that the District was envisioned to be part of a "Future Focus Discussion Area" and a "Development Opportunity Area" utilizing a small area plan. 2020 land use designations within the District were listed as primarily "Town/Village Center", with some areas of "office", "parks/open space", and "institutional". The District currently has several zoning designations – "WX-7", "WX-5", "WR-7" and "WR-3". These designations refer to the "walkable-mixed use" and "walkable-residential" categories, with heights of seven, five, and three stories, respectively.

E. Existing and Committed Surface Transportation Network

i.) Roadways

The E-F District project study area features several major arterial roadways serving areas throughout the Town of Chapel Hill and points beyond, as well as a number of collector and local access streets. **Table 1** summarizes pertinent information on the study area roadway facilities. Categorical information was compiled from field and/or aerial mapping review of each roadway facility.

Annual Average Daily Traffic (AADT) data was taken from 2015 AADT GIS shapefiles produced by the NCDOT Traffic Survey Unit and updated for most areas in the project study area from traffic data collection completed for this analysis. **Figures 3A through 3C** show the existing lane configuration, traffic control, and speed limits for these study area roadways.

Intersections

Table 2 summarizes all 39 existing study area intersections, traffic control features, and pedestrian amenities at each. Laneage details and intersection turn bay lengths are also detailed on **Figure 2A through 3B**.

The project study area features a mixture of signalized and unsignalized intersections. Several arterial corridors feature coordinated signal operation for weekday peak hours in separate control zones. Control zones include the US 15-501 corridor from I-40 through Estes Drive, the E. Franklin Street area, NC 54 (Raleigh Road), and the US 15-501 corridor in the vicinity of Manning Drive. Several study area signalized intersections currently operate in "free-run" uncoordinated operation where the signal's cycle length and timings vary throughout the day. Most intersections in urbanized areas feature crosswalks and pedestrian signal heads, which are features listed in the table.

Table 1. Existing Study Area Roadways

Road Name	Functional Classification*	Study Area Cross-Section	Recent AADT	Speed Limit	Sidewalk	On-Street Parking	Bicycle Facilities	Bus Stops
US 15-501 (Durham-Chapel Hill Boulevard)	Other Freeway	4-lane median divided	47,000-53,000	45	N	N	N	N
US 15-501 (Fordham Boulevard)	Other Freeway	4-lane median divided	28,000-41,000	45	S	N	N	N
US 15-501/NC 54 Bypass (Fordham Boulevard)	Other Freeway	4-lane median divided	42,000-55,000	45	S	N	N	Y
NC 54 (Raleigh Road)	Other Principal Arterial	6-lane median divided	44,000-46,000	35	Y	N	Y	Y
E. Franklin Street (SR 1010)	Other Principal Arterial	5-lane undivided with TWLTL & 4-lane undivided	18,000-28,000	35	Y	N	N	Y
Manning Drive (SR 1902)	Other Principal Arterial	4-lane undivided	16,300	25	Y	N	N	Y
Old Durham Road (SR 1838)	Minor Arterial	3-lane undivided with TWLTL	6,600	35	S	N	S	Y
Sage Road (SR 1741)	Minor Arterial	3-lane undivided with TWLTL	8,400-14,500	35	Y	N	Y	Y
Estes Drive (SR 1750)	Minor Arterial	2-lane undivided & 3-lane undivided with TWLTL	12,000-16,000	35	Y	N	N	Y
Raleigh Road (SR 2048)	Minor Arterial	4-lane undivided and median divided	24,000	35	Y	N	N	Y
Erwin Road (SR 1734)	Minor Arterial / Major Collector	2-lane undivided & 3-lane undivided with TWLTL	5,200-7,500	35	S	N	S	Y
Weaver Dairy Road (SR 1733)	Major Collector	2-lane undivided	10,000	35	N	N	N	N
Ephesus Church Road (SR 1742)	Major Collector	3-lane undivided with TWLTL/2-lane undivided	6,800-10,000	35	S	N	N	Y
Eastowne Drive	Local	2-lane undivided	5,000	25	Y	Y	N	Y
Lakeview Drive	Local	2-lane undivided	3,000	35	N	Y	N	Y
Cosgrove Road	Local	2-lane undivided	N/A	25	Y	N	N	N
Scarlett Drive	Local	2-lane undivided	2,500	35	S	Y	N	Y

S – Some Sidewalk/On-Street Parking/Bicycle Facilities Present Along Certain Sections
TWLTL – Two-Way Left-turn Lane
* - Functional Classification taken from NCDOT State-wide Functional Classification GIS information

Table 1. Existing Study Area Roadways (Continued)

Road Name	Functional Classification*	Study Area Cross-Section	Recent AADT	Speed Limit	Sidewalk	On-Street Parking	Bicycle Facilities	Bus Stops
Legion Road	Local	2-lane undivided	4,300-5,900	35	S	N	S	Y
Europa Drive	Local	2-lane undivided	2,500	25	Y	N	N	Y
US 15-501 Service Road	Local	2-lane undivided	N/A	25	S	N	N	Y
Clover Drive	Local	2-lane undivided	N/A	25	Y	Y	N	N
Pinehurst Drive / Sharon Road	Local	2-lane undivided	N/A	25	Y	S	N	N
Elliott Road	Local	3-lane undivided with TWLTL/2-lane undivided	4,900-9,300	25	Y	S	N	Y
Eastgate Drive	Local	2-lane undivided	4,300-7,000	25	Y	N	N	N
Old Oxford Road/Velma Drive	Local	2-lane undivided	N/A	25	S	Y	N	N
Caswell Road	Local	2-lane undivided	N/A	25	S	Y	N	Y
Willow Drive	Local	2-lane undivided	2,300-5,700	25	Y	S	N	Y
Cleland Road	Local	2-lane undivided	2,200	25	N	N	N	N
Brandon Road	Local	2-lane undivided	1,500	25	Y	Y	N	Y
Carmichael Drive	Local	2-lane undivided	1,600	25	S	Y	N	N
Hamilton Road	Local	2-lane undivided	2,600-4,900	25	Y	Y	N	Y
Rogerson Road	Local	2-lane undivided	100	25	N	Y	N	N
Finley Golf Course Rd / Old Mason Farm Rd (SR 1900)	Local	2-lane undivided	2,400	35	S	N	N	Y
Burning Tree Drive	Local	2-lane undivided	1,700	25	S	N	N	N

S – Some Sidewalk/On-Street Parking/Bicycle Facilities Present Along Certain Sections
TWLTL – Two-Way Left-turn Lane
* - Functional Classification taken from NCDOT State-wide Functional Classification GIS information

Table 2. Existing Study Area Intersection Details

ID #	Intersection	Traffic Control	Signal Inv #	Signal Phases	Signal Operation	Crosswalk	Ped Signal
1	US 15-501 (Durham-Chapel Hill Boulevard) & Eastowne Drive/Lakeview Drive	Signal	07-1011	5	Coordinated	No	No
2	US 15-501 (Durham-Chapel Hill Boulevard) & Eastowne Drive/US 15-501 Service Road	Signal	07-0211	5	Coordinated	Yes (1)	Yes (1)
3	US 15-501 (Durham-Chapel Hill Boulevard) & Sage Road/Old Durham Road	Signal	07-0370	8	Coordinated	No	No
4	US 15-501 (Fordham Boulevard) & Erwin Road/Europa Drive (4 intersection superstreet)	Signal	07-0382,2065, 2066,2067	2-3	Coordinated	Yes (1)	Yes (1)
5	US 15-501 (Fordham Boulevard) & Ephesus Church Road	Signal	07-0530	6	Coordinated	Yes (1)	Yes (1)
6	US 15-501 (Fordham Boulevard) & Elliott Road	Signal	07-0547	5	Coordinated	No	No
7	US 15-501 (Fordham Boulevard) & Willow Drive	Signal	07-0506	5	Coordinated	Yes (2)	Yes (2)
8	US 15-501 (Fordham Boulevard) & Estes Drive	Signal	07-0529	6	Coordinated	Yes (1)	Yes (1)
9	US 15-501 (Fordham Boulevard) & Cleland Road	Two-Way Stop	N/A	N/A	No	No	N/A
10	US 15-501 (Fordham Boulevard) & Brandon Road	Two-Way Stop	N/A	N/A	No	No	N/A
11	US 15-501 (Fordham Boulevard) & NC 54 Westbound Ramps	Signal/Yield	07-1696	2	Free-Run	No	N/A
12	US 15-501 (Fordham Boulevard) & NC 54 Eastbound Ramps	Two-Way Stop	N/A	N/A	No	No	N/A
13	US 15-501/NC 54 (Fordham Boulevard) & Old Mason Farm Road/Carmichael Drive/Fern Lane	Signal – 5 Leg	07-1709	7	Coordinated	Yes (5)	Yes (4)
14	US 15-501/NC 54 (Fordham Boulevard) & Manning Drive	Signal	07-0505	6	Coordinated	Yes (2)	Yes (2)
15	Raleigh Road and US 15-501 (Fordham Boulevard) Southbound Ramps	Two-Way Stop	N/A	N/A	No	No	N/A
16	NC 54 (Raleigh Road) & US 15-501 (Fordham Boulevard) Northbound Ramps	Two-Way Stop	N/A	N/A	No	No	N/A
17	NC 54 (Raleigh Road) & Hamilton Road	Signal	07-0521	5	Coordinated	Yes (4)	Yes (4)
18	NC 54 (Raleigh Road) & Environ Way	Signal	07-2136	3	Coordinated	Yes (3)	Yes (3)
19	NC 54 (Raleigh Road) & Burning Tree Drive/Finley Golf Course Road	Signal	07-1238	5	Coordinated	Yes (4)	Yes (4)
20	Estes Drive & Caswell Road	Signal	07-0219	3	Free-Run	Yes (3)	Yes (3)
21	Estes Drive & Library Drive	Signal	07-2208	2	Free-Run	Yes (2)	Yes (2)
22	Estes Drive & E. Franklin Street	Signal	07-0527	8	Coordinated	Yes (4)	Yes (4)
23	Estes Drive & Willow Drive/Shepherd Lane	Signal	07-0556	3	Coordinated	Yes (2)	Yes (2)
24	Elliott Road & Old Oxford Road/Velma Road	Two-Way Stop	N/A	N/A	No	No	N/A
25	Elliott Road & E. Franklin Street	Signal	07-0531	8	Coordinated	Yes (4)	Yes (4)
26	Eastgate Crossing & E. Franklin Street	Signal	07-0590	2	Coordinated	Yes (2)	Yes (2)
27	Ephesus Church Road & Rams Plaza Access (RIRO) / University Inn Driveway	Two-Way Stop	N/A	N/A	N/A	No	N/A
28	Ephesus Church Road & Legion Road	Signal	07-1883	3	Free-Run	Yes (1)	No
29	Ephesus Church Road & Pinehurst Drive/Sharon Road	Two-Way Stop	N/A	N/A	N/A	Yes (2)	N/A
30	Legion Road & Clover Drive / Rams Plaza Access	Two-Way Stop	N/A	N/A	N/A	No	N/A
31	Legion Road & Quality Inn Driveway	Two-Way Stop	N/A	N/A	N/A	No	N/A
32	Legion Road & Europa Drive	Two-Way Stop	N/A	N/A	N/A	Yes (1)	N/A
33	US 15-501 Service Road & Quality Inn Driveway	Two-Way Stop	N/A	N/A	N/A	No	N/A
34	Europa Drive & US 15-501 Service Road	Two-Way Stop	N/A	N/A	N/A	No	N/A
35	Legion Road & Scarlett Drive	Two-Way Stop	N/A	N/A	N/A	No	N/A
36	Weaver Dairy Road & Erwin Road	Signal	07-1657	3	Free-Run	No	No
37	Sage Road & Erwin Road	Signal	07-2099	8	Free-Run	Yes (4)	Yes (4)
38	Sage Road & Lowes Entrance/Cosgrove Drive	Signal	CH 1501	2	Coordinated	Yes (4)	Yes (4)
39	Old Durham Road & Scarlett Drive	Two-Way Stop	N/A	N/A	No	No	N/A

Crosswalk/Ped Signal (X) = Number of Quadrants with Crosswalk and Pedestrian Signal

ii.) Bicycle Routes and Sidewalks

Specific bicycle facilities are present in the broad E-F project study area, with striped bicycle lanes in both directions along Sage Road and Old Sterling Drive in the northern study area section. Additionally, paved greenways extend along Booker Creek just north/west of the E-F District and along Bolin Creek and Battle Branch in the southern portion of the study area, Additional paved off-road greenway exists along NC 54 east of Hamilton Road. Off road paths also connect to the Chapel Hill Library off nearby adjacent streets. The Fordham Boulevard corridor also has widened paved shoulders (to four feet from edge of travel) that potentially permit bicycling. No other existing facilities specifically prohibit bicycling, but none of these facilities have specific bicycle amenities, other than some roadway curb-and-gutter cross-sections may have some existing lane widths slightly greater than the standard 12 foot wide travel lanes.

Pedestrian sidewalk is found throughout the broader E-F study area with some connectivity to and within the E-F District itself. There is a lack of connectivity and facilities directly along the US 15-501 corridor throughout the entire study area, but some of the paralleling surface streets have some crosswalk and pedestrian signal crossings, particularly just to the south of the E-F District. **Figures 4A and 4B** display schematics of existing pedestrian and bicycle facilities in the project study area.

iii.) Transit Routes

Current Chapel Hill Transit (CHT) Routes CL, D, F, G, HU, S and V serve various corridors in the project study area with weekday local bus service. CHT weekday Express Bus Service is provided on Routes DX and FCX in the study area. Numerous bus stops, with a range of amenities (shelters, benches), are also present in the overall study area, with 23 designated stops currently within the E-F District. **Table 3** details the nine current CHT routes serving the study area, along with four GoTriangle regional bus routes. Several CHT and GoTriangle routes also provide limited weekend service. Three CHT routes (CL, D, and F) provide direct service to the E-F District, with the G Route serving areas proximate to the E-F District. The remaining routes primarily serve the NC 54 corridor in the southern portion of the broader E-F study area. GoTriangle Routes 400 and 405 serve the E-F District along E. Franklin Street with regional service to Durham and downtown Chapel Hill.

Figures 5A and 5B displays transit routes that currently exist in the project study area, along with park-and-ride facilities that are in the project study area. There are no park-and-ride facilities currently proximate to the Ephesus Church-Fordham District. Information shown on the figures were taken from the CHT 2016 Fall Ride Guide.

Table 3. Current Study Area Weekday Transit Service

Route	Headways (minutes)			E-F Study Area Stops	E-F District Stops	Destinations
	AM Peak	PM Peak	Off Peak			
CHT Fixed-Route Local Service*						
CL	60	70	N/A	• E. Franklin Street • Old Oxford Road • Sage Road • Old Durham Road	• Eastgate Shopping Center • Village Plaza • Legion Road	• Colony Lake • Downtown Chapel Hill • UNC Main Campus/Hospitals
D	20	20	40-50	• E. Franklin Street • Eastowne • Foxcroft • Pinegate	• Eastgate Shopping Center • Village Plaza • Rams Plaza • Legion Road	• Culbreth Road • Downtown Chapel Hill • UNC Main Campus/Hospitals
F	25-30	30	50	• University Place • E. Franklin Street • Colony Woods	• Ephesus Church Road • Rams Plaza • Village Plaza	• Downtown Chapel Hill • Carrboro
G	35-45	45-50	50-60	• Raleigh Road • Glen Lennox • University Place	• N/A	• Booker Creek Apts / MLK Jr. Blvd • Downtown Chapel Hill • UNC Main Campus/Hospitals
HU	10-15	10-15	40	• Old Mason Farm Road • Finley Golf Course Road	• N/A	• Friday Center Park and Ride • UNC Hospitals
S	10	10	35	• Old Mason Farm Road • NC 54 (Raleigh Road)	• N/A	• UNC Main Campus • NC 54 Park and Ride • Southern Village
V	35	35	50-80	• NC 54 (Raleigh Road)	• N/A	• Southern Village • Downtown Chapel Hill Meadowmont
CHT Express Service*						
DX	45	50	N/A	• Eastowne • Sage Road • Old Durham Road	• Foxcroft	• UNC Main Campus/Hospitals
FCX	5	10	15-30	• N/A	• N/A	• Friday Center Park & Ride UNC Main Campus
GoTriangle Service*						
400/405	30	30	30	• E. Franklin Street	• Eastgate Shopping Center • Village Plaza	• Durham
800/805	15-30	30	60	• NC 54 (Raleigh Road)	• N/A	• Raleigh/RTP

* - Sources: Chapel Hill Transit 2016 Fall Ride Guide, TT System Map (April 2016)

iv.) Surface Transportation Improvement Projects Under Construction in Fall 2016

There were no NCDOT Transportation Improvement Program (STIP) projects in the study area that were under construction in the fall of 2016 when the existing conditions analysis was conducted. NCDOT had one storm water improvement project in the study area vicinity that had traffic flow impacts due to a road closure and detours. The Town of Chapel Hill had several on-going road capacity and connectivity improvement projects that affected traffic flow in the project study area. No notable private development roadway network improvement projects were observed in the project study area in fall 2016, other than roadway improvements/changes directly tied to the Town roadway projects. **Table 4** summarizes these projects.

Table 4. Fall 2016 Project Study Area Road Construction Projects

Project Location	Description	Project ID	Completion Date
US 15-501 South U-Turn & US 15-501 Northbound Traffic Signal	• Connect US 15-501 Southern U-Turn Outside Lane to Service Road Southbound • No signal operation/phasing changes	Town Project	2/17
Ephesus Church Road and US 15-501	• Widen westbound approach for dual left-turn lanes • Restrict full access connections on westbound approach • Realign intersection geometrics for improved vehicular and pedestrian safety	Town Project	2/17
Eastgate Drive & US 15-501 Southbound Service Road	• Local access improvements to close south leg of Service Road intersection with Eastgate Shopping Center Driveway	Town Project	2/17
US 15-501 Northbound Service Road and Rams Plaza	• Revise existing access to Service Road / Rams Plaza area from US 15-501 northbound lanes to separate inbound and exiting Rams Plaza traffic flows • Provide pedestrian facility improvements.	Town Project	2/17
Sage Road Corridor	• Restriping project to reduce cross-section to three lanes and provide buffered bicycle lanes	Town Project	12/16
Ephesus Church Road and Longleaf Road	• NCDOT culvert replacement project involving complete road closure and detour around immediate Ephesus Church Road area	NCDOT Maintenance Project	12/16

Figure 6 displays a schematic of the location of the current roadway improvement projects identified in the table above.

II. DATA COLLECTION

A. Traffic Count Data Compilation

Traffic volume data for this study was collected from a variety of sources all within the one-year calendar time frame of October 2015 – November 2016. The counts used to determine these volumes for study area intersections were collected for a continuous 13 hours on a "typical" weekday from 6:00 AM to 7:00 PM or for the weekday periods 7:00 - 9:00 AM, 11:30 AM – 1:30 PM, and 4:00 – 6:00 PM. Recent counts were taken from the following sources:

- *Wegmans Traffic Impact Study* (April 2016, 3 intersections)
- *Oxford Reserve Traffic Impact Study* (April 2016, 1 intersection)
- NCDOT on-line traffic count data (October 2015 and May 2016, 8 intersections) https://connect.ncdot.gov/resources/safety/Pages/Volume-Class.aspx?d=07&c=Orange&p=TM
- Town of Chapel Hill – Sage Road Pavement Marking Plan Update (September 2016, 2 intersections)
- Town of Chapel Hill – *Legion Road Traffic Capacity Study* (April 2016, 4 intersections)

To augment this existing information, additional 13 hour and weekday peak period turning movement counts were collected at all remaining study area intersections, with 13 hour counts completed at higher volume signalized intersections. Counts were collected in late October/early November 2016 and all counts included intersection pedestrian, bicycle and truck percentage information. 13 Hour count data were extrapolated (using NCDOT Transportation Planning Branch and Traffic Survey Unit standards) at those high volume intersections to estimate Average Annual Daily Traffic (AADT) for roadway segments connecting to each intersection. The Town of Chapel Hill also requested 12 hour (6:00 AM-6:00 PM) pedestrian and bicycle count data be collected in and around the project study area at 25+ locations that included greenways, mid-block areas and at several key intersections. These counts were also conducted in early November 2016.

In addition to turning movement count and pedestrian/bicycle count data, HNTB collected 48-hour vehicle classification and volume (tube count) data at seven locations along several major study area thoroughfares. This information was used to compare to and update NCDOT AADT data for the project study area for use in making comparisons of planning level daily traffic demand/capacity in the study area and for baseline comparisons to travel demand model network development. This data, along with all turning movement count output is found in ***Appendix B***. The tube count information was collected in October/November 2016 and was adjusted by daily and seasonal factors, per information from NCDOT Transportation Planning Branch (TPB), in estimating roadway segment AADTs. **Tables 5, 6 and 7** provide a detailed listing of each count type, peak hour, and count date. Count data is summarized schematically on study area mapping for the following:

- **Figures 7A through 7C** show the existing 2016 balanced AM peak hour traffic volumes for the study area intersections.
- **Figures 8A through 8C** show the existing 2016 balanced noon peak hour traffic volumes for the study area intersections.
- **Figures 9A through 9C** show the existing 2016 balanced PM peak hour traffic volumes for the study area intersections.
- **Figures 10A and 10B** show the existing 2016 estimated 24 hour AADT estimates for study area roadway links, as developed through the procedure described previously.
- **Figures 11A and 11B** show the existing 2016 12 Hour Pedestrian and Bicycle Count locations and results in the project study area.

Table 5. Traffic Count Information – Intersection Turning Movements

ID #	Traffic Count Location	Count Type	Peak Hour Starts			Count Date
			AM	Noon	PM	
1	US 15-501 & Eastowne Drive/Lakeview Drive	6 HR TMC	7:30	11:45	4:30	4/27/16
2	US 15-501 & Eastowne Drive/Service Road	6 HR TMC	7:30	12:00	4:30	4/27/16
3	US 15-501 & Sage Road/Old Durham Road	6 HR TMC	7:45	12:00	5:00	4/27/16
4	US 15-501 & Erwin Road/Europa Drive	6 HR TMC	7:45	12:00	4:15	4/14/16
5	US 15-501 & Ephesus Church Road	13 HR TMC	7:45	12:30	4:15	10/25/16
6	US 15-501 (Fordham Boulevard) & Elliott Road	13 HR TMC	7:45	12:00	4:45	10/27/16
7	US 15-501 (Fordham Boulevard) & Willow Drive	6 HR TMC	7:45	12:00	4:45	10/27/16
8	US 15-501 (Fordham Boulevard) & Estes Drive	13 HR TMC	8:15	12:30	4:45	10/27/16
9	US 15-501 (Fordham Boulevard) & Cleland Road	13 HR TMC	8:00	11:15	4:15	4/28/16
10	US 15-501 (Fordham Boulevard) & Brandon Road	13 HR TMC	7:45	12:30	4:30	5/24/16
11	US 15-501 & NC 54 Westbound Ramps	N/A	Count Data Taken From Adjacent Count Locations			
12	US 15-501 & NC 54 Eastbound Ramps	N/A				
13	US 15-501/NC 54 & Old Mason Farm Road/Carmichael Drive/Fern Lane	13 HR TMC	7:30	12:00	4:30	5/26/16
14	US 15-501/NC 54 (Fordham Blvd) & Manning Drive	13 HR TMC	8:00	12:00	4:00	11/2/16
15	Raleigh Road & US 15-501 Southbound Ramps	13 HR TMC	7:30	12:15	4:30	5/24/16
16	NC 54 (Raleigh Rd) & US 15-501 Northbound Ramps	13 HR TMC	7:30	12:00	4:30	5/26/16
17	NC 54 (Raleigh Road) & Hamilton Road	13 HR TMC	7:30	12:00	5:00	10/6/15
18	NC 54 (Raleigh Road) & Environ Way	13 HR TMC	7:30	12:15	5:00	10/6/15
19	NC 54 (Raleigh Rd) & Burning Tree Dr/Finley G.C. Rd	13 HR TMC	7:30	12:00	5:00	10/6/15
20	Estes Drive & Caswell Road	6 HR TMC	7:30	11:45	5:00	11/2/16
21	Estes Drive & Library Drive	6 HR TMC	8:00	12:00	4:45	11/2/16
22	Estes Drive & E. Franklin Street	13 HR TMC	7:45	12:15	5:00	10/25/16
23	Estes Drive & Willow Drive/Shepherd Lane	6 HR TMC	8:00	12:00	5:00	11/2/16
24	Elliott Road & Old Oxford Road/Velma Road	6 HR TMC	7:30	12:00	5:00	11/2/16
25	Elliott Road & E. Franklin Street	13 HR TMC	7:45	12:15	5:00	10/25/16
26	Eastgate Crossing & E. Franklin Street	13 HR TMC	7:45	12:15	5:00	10/25/16
27	Ephesus Church Rd & Rams Plaza RIRO / Motel Dr	6 HR TMC	7:30	11:30	5:00	11/2/16
28	Ephesus Church Road & Legion Road	6 HR TMC	7:30	11:30	5:00	4/27/16
29	Ephesus Church Road & Pinehurst Dr/Sharon Road	6 HR TMC	7:30	11:30	4:45	10/25/16
30	Legion Road & Clover Drive / Rams Plaza Access	6 HR TMC	7:30	12:00	4:45	10/25/16
31	Legion Road & Quality Inn Driveway	6 HR TMC	7:30	12:00	5:00	10/27/16
32	Legion Road & Europa Drive	6 HR TMC	7:45	12:00	4:45	4/27/16
33	US 15-501 Service Road & Quality Inn Driveway	6 HR TMC	7:45	12:00	4:00	11/2/16
34	Europa Drive & US 15-501 Service Road	6 HR TMC	7:30	11:45	4:30	11/2/16
35	Legion Road & Scarlett Drive	6 HR TMC	8:00	12:00	5:00	4/27/16
36	Weaver Dairy Road & Erwin Road	6 HR TMC	8:00	12:00	5:00	11/2/16
37	Sage Road & Erwin Road	6 HR TMC	7:45	12:15	5:00	9/7/16
38	Sage Road & Lowes Entrance/Cosgrove Drive	6 HR TMC	8:00	12:30	5:00	9/7/16
39	Old Durham Road & Scarlett Drive	6 HR TMC	7:30	12:00	4:45	4/27/16

Table 6. Traffic Count Information – 48 Hour Volume/Speed/Classification Counts

ID #	Traffic Count Location	Count Data	24 Hour AADT*	Peak Hour Starts**			Count Date
				AM	Noon	PM	
1	Estes Drive west of E. Franklin Street	15,822	15,800	8:00	12:00	5:00	11/2-11/3/16
2	E. Franklin Street north of Estes Drive	22,658	22,700	8:00	1:00	5:00	11/2-11/3/16
3	US 15-501 north of Estes Drive	31,992	30,700	8:00	12:00	4:00	11/2-11/3/16
4	E. Franklin Street north of Eastgate Crossing	23,733	23,700	8:00	12:00	5:00	11/2-11/3/16
5	Elliott Road east of E. Franklin Street	10,844	10,800	9:00	12:00	5:00	11/2-11/3/16
6	Ephesus Church Road east of Frances Drive	8,919	8,700	7:00	12:00	5:00	10/25-10/26/16
7	US 15-501 west of Sage Road	54,846	52,700	7:00	11:00	5:00	11/2-11/3/16

* - NCDOT Seasonal and Daily Factor Applied to Averaged 24 Hour Raw Data ** - Data Collected in One Hour Bins

Table 7. 12 Hour Bicycle/Pedestrian Count Information

ID #	Traffic Count Location	Bicycle 12 Hour Volume	Pedestrian 12 Hour Volume	Count Date
1	Sage Road north of Erwin Road	16	69	11/10/16
2	Old Sterling Drive east of Sage Road	8	175	11/10/16
3	Sage Road south of Erwin Road	9	57	11/10/16
4	Erwin Road south of McGregor Drive	6	45	11/10/16
5	Old Durham Road west of Bluefield Drive	6	3	11/10/16
6	Scarlett Drive north of Legion Road	7	55	11/10/16
7	Dobbins Drive west of Erwin Road	17	50	11/10/16
8	Europa Drive north of Legion Road	0	49	11/10/16
9	Legion Road south of Europa Drive	8	105	11/10/16
10	Ephesus Church Road east of Eden Drive	20	76	11/10/16
11	Elliott Road east of Allard Street	7	60	11/10/16
12	Elliott Road midblock near Galleria Shops	9	49	11/10/16
13	US 15-501 south of Elliott Road	13	69	11/10/16
14	Willow Drive midblock north of University Mall	4	119	11/10/16
15	Estes Drive east of Halifax Street	17	67	11/10/16
16	Bolin Creek Trail – near Estes Drive	33	476	11/10/16
17	E. Franklin Street south of Plant Road	37	83	11/10/16
18	Cleland Drive and Hamilton Road (Intersection)#	11	43	11/10/16
19	Pinehurst Drive north of Sheffield Drive	21	115	11/10/16
20	Raleigh Road west of US 15-501/NC 54 interchange	24	41	11/10/16
21	NC 54 (Raleigh Rd) at Burning Tree Dr/Finley G.C. Rd (including Greenways along NC 54)#	37	207	11/10/16
22	Barbee Chapel Road and Greenway Crossing	30	423	11/10/16
23	E. Franklin St & Eastgate Drive (Intersection)#	22	448	10/25/16
24	E. Franklin St & Elliott Road (Intersection)#	32	384	10/25/16
25	US 15-501 & Ephesus Church Road (Intersection)#	23	427	10/25/16
26	US 15-501 & Elliott Road (Intersection)#	17	16	10/27/16

- Location Includes Total Bike and Ped Volumes for All Quadrants

Traffic count information shows traffic flows on the major study area arterials (US 15-501, NC 54, and E. Franklin Street, Estes Drive) were heavy during the AM and PM peak count periods, with southbound flows from US 15-501/E. Franklin Street to downtown Chapel Hill/UNC Campus areas heaviest in the AM peak and northbound return flows heaviest in the PM peak. Similarly, westbound traffic on NC 54 inbound to UNC Main Campus was heaviest in the AM Peak and eastbound return traffic was prominent in the PM peak. Noon peak flows were primarily evenly balanced along most corridors. Traffic on other minor arterials such as Estes Drive, Ephesus Church Road, Sage Road, and Manning Drive was moderate to heavy during the peak periods, with directional variation depending on whether these facilities were radial (like the major arterials) or circumferential (distributing traffic in an east-west pattern). Traffic flows were light to moderate on the remaining study area roadways that function as collector or local access streets.

Volume Balancing

For the intersection capacity analyses and microsimulation model development, volume balancing was done for through movements along major arterial facilities and some turning movements at high volume intersections, due to variability in turning movement counts at several locations as well as variability due to midblock local streets and private development driveways throughout the study area network. Additional variability also resulted from traffic count data being taken at different time periods over the last year and because the peak hour (in 15 minute increments) varied between individual intersections. Flows were generally balanced to within 100 vehicles upstream/downstream for each intersection, with acknowledgement of variability due to driveways and local midblock streets.

Construction Project Impacts

The field data collection process to obtain new turning movement and 48 hour tube counts began in late October 2016, when several on-going construction projects immediately in the Ephesus-Fordham District were on-going but did not result in detours/lane closures that significantly affected local travel patterns. NCDOT closed Ephesus Church Road east of the E-F District in early November 2016. All local counts in the E-F area at major study area intersections were completed prior to this closure. Several additional counts at intersections further away from this closure and detour area were conducted after the closure and data was reviewed to note any abnormalities in traffic flow patterns between count data collected prior to and after the closure.

B. Field Data Collection/Observation

Field reviews of existing conditions in the project study area, including review of existing traffic signal operations, verification of study area transportation network and facilities, and field observation of existing transportation system operations and areas of traffic congestion/safety concerns were conducted in October and November of 2016. Information from the field observations were added/modified to inputs to the microsimulation models developed for the project, as relevant, to verify results regarding intersection operations, general traffic flow and travel speeds and areas of peak hour congestion in the study area transportation network.

C. Triangle Regional Model

HNTB staff coordinated with the Town of Chapel Hill, Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO), and Triangle Regional Model Bureau to obtain the most current approved version of the Triangle Region Travel Demand Model (TRM) from the for use in sub-area modeling efforts. Based on these discussions, Model Version 5.1 was provided by the MPO for use in the study.

D. Current Transportation Studies and Data Sources

The latest versions of all appropriate and applicable Town-related planning documentation in the project study area, along with any private development plans and plans/studies previously completed or on-going by NCDOT, the Durham-Chapel Hill-Carrboro MPO or any other public agency were requested and compiled for use in the current existing operations analysis or for future use in the 2030 design year analyses. **Table 8** shows a list of the planning documentation.

Table 8. Current Transportation Plans, Studies and Information

Document/Information	Mode	Year	Agency	Status
Town of Chapel Hill Bicycle Plan	Bicycle	2014	Town of Chapel Hill - Planning	To be used in 2030 Design Year Analysis
Town of Chapel Hill Pedestrian Plan	Pedestrian	2004	Town of Chapel Hill - Planning	New Plan in Progress
CHT Routes/Schedules/ Ride Guide	Transit	2016 Fall	CHT	Used in 2016 Existing Conditions Analysis
CHT Ridership Data	Transit	2016 Fall	CHT	Used in 2016 Existing Conditions Analysis
Long Range Transit Plan	Transit	2010	CHT/Town of Chapel Hill Planning	To be used in 2030 Design Year Analysis
Chapel Hill Transit Trip Generation Report	Transit	2013	Town of Chapel Hill – Planning	
Durham-Orange Light Rail Project DEIS/FEIS	Transit	2015	GoTriangle	
GoTriangle Routes/Schedules	Transit	2016	GoTriangle	Used in 2016 Existing Conditions Analysis
GoTriangle Transit (Bus) Plan	Transit	2012	GoTriangle	Will be reviewed and used, as applicable, in 2030 Analysis
2040 Metropolitan Transportation Plan	All	2012	DCHC MPO	
Triangle Regional Travel Demand Model	Vehicle/ Transit	2040	DCHC MPO	Will be used in 2016 and 2030 Analyses
NCDOT 2016-2025 STIP	All	2016	NCDOT	Will be reviewed and used, as applicable, in 2030 Analysis
US 15-501 Corridor Study (STIP U-5304)	Vehicle	Current	NCDOT/ Town of Chapel Hill	
E-F Small Area Plan & Traffic Study	Vehicle	2011	Town of Chapel Hill	
Chapel Hill Mobility and Connectivity Plan	All	2017	Town of Chapel Hill	
Signal Plans	Vehicle	Current	NCDOT/Town	Used in 2016 Existing Conditions Analysis
Synchro Models – latest signal timing information	Vehicle	Current	Town of Chapel Hill	
Individual Development/Site Plans	N/A	Current	Town of Chapel Hill	To be used in 2030 Design Year Analysis (See **Table 9**)

E. Current Background Development Information

In addition to public agency planning efforts, individual site plans and current development plan status was compiled for the project study area. This information will be utilized in the development of background traffic growth inputs in the 2030 No-Build and 2030 Build scenario modeling processes for the project. A current schematic of locations of private development projects (whether approved or under construction as of Fall 2016) is shown in **Figure 12** and highlighted in **Table 9**.

Table 9. Background Development Plans

Development Name	Status	Include in 2030 No-Build Sub-Area Model Explicitly?	Include as External Node Traffic Into Sub-Area Model?	Include as Ambient Background Traffic Growth in Sub-Area Model?
Glen Lennox	Completed TIA 2014 – No current development	Yes – assume nearly built-out	No	No
Obey Creek	Completed TIA 2015 – No current development	No	Yes	No
Carolina North	2009 TIA and Devlpmt Agreement – No major current activities	No	Yes	No
American Legion	Concept Plan	Yes – will review assumptions	No	No
Wegmans	Active TIA	Yes - assume built-out	No	No
Crown Honda Redevelopment	Concept Plan	Yes – assume built-out	No	No
Village Plaza Apartments	Under construction – nearing completion	Yes – assume built-out	No	No
Gateway Station LRT Area	Conceptual Development Pattern from Station Area Planning Document	Yes – assume built-out	No	No
SECU Data Center	Potential Redevelopment Planning Underway	Yes – will review assumptions	No	No
Greenfield Place	Starting construction	Yes – assume built-out	No	No
Eastgate Building D	Under Construction	Yes – assume built-out	No	No
CVS/Rams Plaza Outparcel	Under Construction	Yes – assume built-out	No	Yes
SECU Family House	These developments, whether planned or under construction or currently on hold, will be considered to be background traffic generators captured under growth rates between 2016 Base Year Model and 2030 Future Year model.	No	No	Yes
The Station at East 54		No	No	Yes
Murray Hill Condos		No	No	Yes
Paul Rizzo Conf Ctr Phase3		No	No	Yes
Stancil Dr Car Wash		No	No	Yes
The Station at Barbee Chapel		No	No	Yes
Siena Hotel Expnsion		No	No	Yes
Taylor Family Restaurant		No	No	Yes
Oxford Reserve		No	No	Yes
Signature Health Care Expansion		No	No	Yes
Chapel Hill Retirement Residence		No	No	Yes
The Sawmill		No	No	Yes
Grace New Testament Church Expansion		No	No	Yes
UNC Development Plan – Main Campus	Previous Plans Nearly Complete	No	Possibly	Possibly

III. 2016 EXISTING CONDITIONS ANALYSIS

A. Sub-Area Model Development

A sub-area travel demand macroscopic model using the TransCAD software and latest version of the TRM obtained from the DCHC MPO was developed as part of the existing conditions analysis in this study. Information from on-going NCDOT US 15-501 corridor studies in the project study area that can be applied to the sub-area model will be reviewed and included, as appropriate, as the E-F TIA process moves forward. The following sub-sections provide details related to the sub-area model development for existing conditions. **Figure 13** shows a schematic of the sub-area model extents, including network roadway links and traffic analysis zones (TAZs) that are necessary for the sub-area model development.

i.) Methodology

In the Ephesus Church Road - Fordham Boulevard Area TIA, the TransModeler simulation software is being used in detailed operational analysis of traffic impacts due to future development in the Ephesus-Fordham District and surrounding area. The TransModeler model uses inputs from various software packages like Synchro, HCS and the TRM Travel Demand Model. The TDM, and corresponding E-F sub-area model, is used to provide highway, transit and land use information as a basis for TransModeler microsimulation model evaluation of peak hour traffic operations.

The TRM is the most current and official regional travel demand model that was developed by the Triangle Regional Model Service Bureau at ITRE, in partnership with Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO), Capital Area MPO (CAMPO), the Triangle Transit Authority (TTA) and the North Carolina Department of Transportation (NCDOT). This model is run on Caliper Corporation's TransCAD software platform, with which TransModeler integrates very well, since it is a companion software product from Caliper. This provides the required data exchange capabilities through various utilities in both software packages. The current version of TRM is version 5 and is calibrated to the base year model of 2010. It can provide traffic volumes for weekday AM peak period (4 hours), PM peak (4 hours) and off-peak period (rest of the day). In addition, the peak period assignments can be further broken in 3 periods in each AM and PM peak periods. These 3 periods include peak hour and two shoulder periods of 1.5 hours each.

The TRM model setup included the base year model of 2010 and future year model of 2040. For the E-F TIA and sub-area model development, daily traffic counts were collected at various locations within the region in the year 2016. Since the base year TRM model is 2010, it was necessary to develop the 2016 model and compare the modeled volumes with the 2016 traffic counts at those locations. The 2016 model inputs were developed using 2010 and 2040 models. The socioeconomic data in 2010 and 2040 was linearly interpolated to estimate that 2016 trip generation details. The external trips were also estimated for 2016 using liner interpolation of external trips between 2010 and 2040. The 2016 highway network was developed by starting with 2010 network adjusting the network for any capacity projects between 2010 and 2016 were incorporated in the base year network. Once the 2016 inputs were prepared, the model was run and daily modeled volume was compared with the traffic counts collected. The results are presented in **Table 10**.

Table 10. 2016 Sub-Area Model Daily Assignment Versus Existing AADT

Roadway Facility	Segment ID	Segment Limit		2016 AADT (vpd)	Modeled Volume	% Difference
		From	To			
US 15-501 (Fordham Boulevard – Durham / Chapel Hill Boulevard)	1	I-40	Eastowne/Lakeview Drive	52,700	62,054	18%
	2	Lakeview Drive	Eastowne/Service Road	46,800	54,703	17%
	3	Eastowne/Service Road	Sage Road/Old Durham Road	46,900	49,321	5%
	4	Sage Road/Old Durham Road	Erwin Road/Europa Drive	52,700	53,672	2%
	5	Erwin Road/Europa Drive	Ephesus Church Road	52,600	59,668	13%
	6	Ephesus Church Road	Elliott Road	35,400	44,554	26%
	7	Elliott Road	Willow Drive	37,000	41,761	13%
	8	Willow Drive	Estes Drive	33,500	35,372	6%
	9	Estes Drive	Cleland Road	40,500	43,869	8%
	10	Cleland Road	Brandon Road	38,600	43,614	13%
	11	Brandon Road	NC 54 (Raleigh Road)	37,700	41,446	10%
	12	NC 54 (Raleigh Road)	Old Mason Farm Rd/Carmichael Dr	53,400	59,037	11%
	13	Old Mason Farm Rd/Carmichael Dr	Manning Drive	52,600	60,091	14%
	14	Manning Drive	Mason Farm Road	41,800	41,675	0%
Eastowne Drive (East)	15	Providence Drive	US 15-501 (Fordham Boulevard)	5,200	3,812	-27%
Lakeview Drive	16	US 15-501 (Fordham Boulevard)	Old Durham Road	3,100	5,326	**72%**
Eastowne Drive (West)	17	US 15-501 (Fordham Boulevard)	Pinegate Road	4,000	5,464	37%
Sage Road/Old Durham Road	19	Weaver Dairy Road	Erwin Road	8,400	8,183	-3%
	20	Erwin Road	Old Sterling Drive	9,900	8,795	-11%
	21	Old Sterling Drive	US 15-501 (Durham CH Blvd)	14,500	11,760	-19%
	22	US 15-501 (Durham-CH Blvd)	Scarlett Drive	8,300	17,341	**109%**
Scarlett Drive	23	Old Durham Road	Legion Road	2,300	8,275	**260%**
Erwin Road	24	Covington Drive	Sage Road	7,700	11,436	49%
	25	Sage Road	Weaver Dairy Road	5,200	9,995	**92%**
	26	Weaver Dairy Road	US 15-501 (Fordham Boulevard)	7,500	12,919	**72%**
Europa Drive	27	US 15-501 (Fordham Boulevard)	Legion Road	2,500	1,009	**-60%**
Legion Road	28	Scarlett Drive	Europa Drive	4,300	7,475	**74%**
	29	Europa Drive	Ephesus Church Road	5,800	7,101	22%
Ephesus Church Road / Eastgate	30	E. Franklin Street	US 15-501 (Fordham Boulevard)	7,000	2,396	**-66%**
	31	US 15-501 (Fordham Boulevard)	Legion Road	8,300	11,839	43%
	32	Legion Road	Eden Drive	6,700	8,068	20%
Elliott Road	33	Old Oxford Road/Velma Drive	E. Franklin Street	4,900	9,770	**99%**
	34	E. Franklin Street	US 15-501 (Fordham Boulevard)	9,300	9,613	3%

Roadway Facility	Segment ID	Segment Limit		2016 AADT (vpd)	Modeled Volume	% Difference
		From	To			
Willow Drive	35	Estes Drive	US 15-501 (Fordham Boulevard)	5,700	6,608	16%
	36	US 15-501 (Fordham Boulevard)	Spruce Drive	2,300	224	**-90%**
Estes Drive	37	West of Caswell Drive	Caswell Drive	16,000	18,750	17%
	38	Caswell Drive	E. Franklin Street	15,800	13,393	-15%
	39	E. Franklin Street	Willow Drive	16,300	11,622	-29%
	40	Willow Drive	US 15-501 (Fordham Boulevard)	12,100	9,008	-26%
E. Franklin Street	41	US 15-501 (Fordham Blvd) Split	Eastgate Crossing	24,400	28,153	15%
	42	Eastgate Crossing	Elliott Road	27,500	26,352	-4%
	43	Elliott Road	Estes Drive	25,800	26,451	3%
	44	Estes Drive	Meadowbrook Drive	17,700	25,397	43%
Cleland Drive	45	US 15-501 (Fordham Boulevard)	Hamilton Road	2,200	872	**-60%**
Brandon Road	46	US 15-501 (Fordham Boulevard)	Flemington Road	1,500	2,801	**87%**
NC 54 (Raleigh Road)	47	Greenwood Drive	US 15-501 (Fordham Boulevard)	21,000	33,323	**59%**
	48	US 15-501 (Fordham Boulevard)	Hamilton Road	46,000	65,552	43%
	49	Hamilton Road	Rogerson Road/Environ Way	46,000	65,930	43%
	50	Rogerson Road/Environ Way	Burning Tree Ln/Finley GC Road	43,800	65,553	50%
	51	Burning Tree Ln/Finley GC Road	E. Barbee Chapel Road	45,600	65,610	44%
Hamilton Road	52	Maxwell Lane	NC 54 (Raleigh Road)	2,600	2,702	4%
	53	NC 54 (Raleigh Road)	Prestwick Drive	4,900	2,649	-46%
Burning Tree Lane	54	Oak Tree Court	NC 54 (Raleigh Road)	1,600	543	**-66%**
Old Mason Farm Road/Carmichael Drive	55	NC 54 (Raleigh Road)	Prestwick Drive	4,000	189	**-95%**
	56	US 15-501 (Fordham Boulevard)	Highland Woods Road	3,800	1,382	**-64%**
	57	US 15-501 (Fordham Boulevard)	Fern Lane	1,600	2,089	31%
Manning Drive	58	US 15-501 (Fordham Boulevard)	Skipper Bowles Drive	16,300	21,742	33%

Red = Model/AADT differences greater than 50% Orange = Model/AADT differences between 30 and 50%

ii.) Model Calibration/Validation

Existing calibration/validation documentation and model set-up and run procedures from the TRM documentation were reviewed for the development of the E-F TIA sub-area model. A quality control check was performed on the existing base year sub-area model network links and centroids, as well as the TRM transit network in the proposed sub-area. The original TRM network was adjusted to include additional local street links, where necessary, to provide a consistent basis with the TransModeler traffic microsimulation model.

The comparison of the 2016 modeled daily assignment traffic volumes against the daily traffic volumes in **Table 10** shows that the 2016 model requires calibration and validation. However, as most the travel demand models do, TRM lacks several local roads that makes it difficult to validate for a small region like the current study area. In addition, the proposed development/redevelopments within the E-F District would require splitting TAZs and adjusting the socioeconomic forecasts in future year scenarios. The splitting of zones is not recommended in TRM guidelines, due to the limitation of the software itself. Therefore, it was decided that the validation of existing traffic flows during peak periods would be done in the TransModeler itself. The TransCAD TRM model would be used to provide the necessary inputs to develop the preliminary models in TransModeler for 2016 and future year scenarios. In addition, it will provide the socioeconomic growth for development of future year trip tables.

Another important result to be gained from comparison of 2016 modeled trips to 2016 AADTs is that, in general, daily model assignments are higher than field collected/estimated AADT values. In general, historical AADT data in the E-F study area between 2010 and 2016 indicates limited traffic volume growth, whereas the interpolation of 2016 model TAZ data and resulting assignments using the 2010 and 2040 data sets may be over-predicting short-term growth versus actual conditions.

The detailed approach to modify the base year sub-area model for use in future scenario development and testing is discussed in the steps below:

- A sub-area corresponding to the E-F TIA is defined in 2016 TRM model. Using TransCAD's subarea assignment procedure, the 2016 sub-area network and the corresponding trip tables will be generated. This will be done for AM peak, PM peak and off-peak periods. The new network consists of internal zones that were the zones in the original network, and the external zones that are newly generated and connect to the links that cross the sub-area boundary. The 2016 subarea network and the trip tables will be used in TransModeler, either directly or as a comparison to existing turning movement count data for peak hour analysis.
- As per TransModeler requirements for microsimulation analysis, more details will be added to the subarea network. TransModeler will use the refined subarea network and the traffic counts collected and run the Origin-destination matrix estimation (ODME) to generate a new set of 2016 trip tables.
- A difference matrix (called Delta matrix) will be estimated between the trip table generated using ODME and the one obtained from TransCAD for the subarea. This will be utilized in the 2030 future scenario analysis development.
- 2030 future year TRM model will be prepared by incorporating future developments in the network and socioeconomic data. As in 2016, a subarea network and corresponding trip tables will be extracted for future years to be used in TransModeler.
- Again, the network will be refined with the details needed by TransModeler to make the most accurate estimate of future year trip tables, Delta matrix obtained from 2016 will be applied to the future year trip tables obtained from TransCAD.

- Once the future year network and trip tables are prepared, TransModeler will be used for detailed operational analysis.

B. 2016 Existing Peak Hour Traffic Operations Analysis

i.) TransModeler Model Development Methodology

Evaluation of traffic operations on suburban arterials is most effective through the determination of level of service (LOS) criteria. The concept of level of service correlates qualitative aspects of traffic flow to quantitative terms. This enables transportation professionals to take the qualitative issues, such as congestion and substandard geometrics, and translate them into measurable quantities, such as operating speeds and vehicular delays. The 2010 *Highway Capacity Manual (HCM 2010)* characterizes level of service by letter designations A through F. Level of service A represents ideal low-volume traffic operations, and level of service F represents over-saturated high-volume traffic operations. Level of service is measured differently for various roadway facilities, but in general, level of service letter designations are described by the following in **Table 11**. TransModeler MOE data produced in this study will be used to develop an equivalent LOS for study area intersections from simulation model results.

Table 11. Level of Service (LOS) Characteristics

Level of Service Description	Per Vehicle Delay at Signal	Per Vehicle Delay at Stop Sign
LOS A ➢ Free flow ➢ Freedom to select desired speed and to maneuver is extremely high ➢ General level of comfort and convenience for motorists is excellent	**< 10.0 sec**	**< 10.0 sec**
LOS B ➢ Stable flow ➢ Other vehicles in the traffic stream become noticeable ➢ Reduction in freedom to maneuver from LOS A	**10.0 – 20.0 sec**	**10.0 – 15.0 sec**
LOS C ➢ Stable flow ➢ Maneuverability/operating speed significantly affected by other vehicles ➢ General level of comfort and convenience declines noticeably	**20.0 – 35.0 sec**	**15.0 – 25.0 sec**
LOS D ➢ High density but stable flow ➢ Speed/freedom to maneuver are very restricted ➢ General level of comfort / convenience is poor ➢ Small increases in traffic will generally cause operational problems	**35.0 – 55.0 sec**	**25.0 – 35.0 sec**
LOS E ➢ Unstable flow ➢ Speed reduced to lower but relatively uniform value ➢ Volumes at or near capacity level ➢ Comfort and convenience are extremely poor ➢ Small flow increases or minor traffic stream disturbances will cause breakdowns	**55.0 – 80.0 sec**	**35.0 – 50.0 sec**
LOS F ➢ Forced or breakdown flow ➢ Volumes exceed roadway capacity ➢ Formation of unstable queues ➢ Stoppages for long periods of time because of traffic congestion	**> 80.0 sec**	**> 50.0 sec**

The minimum acceptable peak hour intersection level of service established for this project is LOS D for signalized intersections or LOS E for critical movements at unsignalized intersections, or no increase in delay for signalized intersections operating below LOS D or unsignalized intersection critical movements operating below LOS E without the inclusion of E-F District "build" scenario traffic. These conditions and thresholds will be further analyzed and mitigation recommendations made for future scenarios that account for No-Build and Build development scenarios for the E-F District area.

TransModeler Version 4.0 Build 6170 (current approved NCDOT version) was utilized for peak hour traffic operations microsimulation. Base model network information for a majority of the overall E-F TIA study area was imported from existing Synchro files either developed previously by HNTB for Town traffic impact analyses and/or augmented with information from the Town of Chapel Hill. Network information included the following:

- Link and intersection geometrics
- Traffic signal control information and coordinated signal timings
- Traffic volume data (updated for balanced 2016 peak hour data collected for this study)

Additional modification within the TransModeler network was necessary for the following microsimulation model parameters:

- Roadway characteristics (NCDOT default road classes and speed distributions)
- Vehicle mix (truck percentage information taken from 2016 traffic count data)
- Development of O-D matrices and ODME trip tables (comparison of sub-area model data and usage of TransModeler ODME methodologies based on intersection turning movement count data)
- Set run control for 10 runs and 15 minute model seeding period.
- Set volume distributions (per NCDOT guidelines) to distribute peak hour volume in 15 minute increments to emulate a 0.90 peak hour factor for traffic flow variation within the peak hour
- Pedestrian crossing locations and signal group assignments
- Pedestrian volumes

The methodology of evaluating the 2016 Existing Conditions and 2030 future year scenarios for signalized intersections is to use current Town of Chapel Hill data for the cycle length and splits of individual signalized intersections and report LOS and delay values from TransModeler run results. There are several traffic signals in the project study area that operate as "free-run" signals at all times. These were analyzed as such in all scenarios

Appendix C contains the raw TransModeler output for the three peak hours analyzed for all signalized and unsignalized intersections in the project study area.

ii.) TransModeler Measures-of-Effectiveness Results

After coding/updating the TransModeler 2016 Existing Conditions network with AM, noon, and PM peak hour data, measures-of-effectiveness (MOE) statistics were produced for the study area network "system", US 15-501 corridor, and all intersections in the project study area. 10 runs of each model scenario were conducted and results averaged for the following MOEs:

Project Study Area System MOEs

Project study area system-wide MOEs were collected from the Trip Statistics output in TransModeler. MOEs were collected for each peak hour to include the following, for the entire model network:

- Vehicle Miles Traveled (VMT)
- Vehicle Hours Traveled (VHT)
- Mean System Speed
- Total System Delay/Delay Per Vehicle

In addition to these output statistics, the simulation runs also tallied system-wide trips completed and trips queued as measures of system total throughput and an indicator of system congestion (if the number of trips queued outside the network unable to get in is high relative to the trips completed).

Table 12 shows the network MOE results. The highest numbers of trips completed and queued were in the PM peak hour, which also had correspondingly the highest VMT and VHT. Network speed, delay and delay per vehicle shows that all three peak hours have fairly similar results. The value of the 2016 existing year network MOE statistics will be found in comparison made during the No-Build and Build future scenario tests to compare the amount of degradation additional growth and traffic demands place on the E-F study area transportation network.

Table 12. System-wide MOE Results

MOE	AM Peak Hour	Noon Peak Hour	PM Peak Hour
Trips Completed	14,463	13,001	16,871
Trips Queued	115	37	130
Vehicle Miles Traveled (VMT)	25,533	23,121	28,481
Vehicle Hours Traveled (VHT)	1,134	977	1,420
Network Speed (mph)	22.5	23.7	20.1
Network Delay (Hours)	605	497	821
Delay Per Vehicle (Seconds)	151	138	175

Corridor-Level MOEs

Corridor-Level MOEs were compiled through the use of sensors placed in the study area TransModeler networks that record vehicular travel times and speeds between pairs of sensors over specified durations. MOE data was collected from TransModeler output matrices for each existing 2016 peak hour simulation to include the following:

- Average Travel Time/Speed between selected points on US 15-501 (Fordham Boulevard)
- Number of vehicles making a complete trip between the two points for each segment

The choice of segmentation for US 15-501 into three areas allows existing and future scenario comparisons for the southern portion of the E-F study area, the portion of the corridor through the E-F District itself, and the northern portion of the study area. The three segment boundaries are:

- Manning Drive to Estes Drive (2.0 miles)
- Estes Drive to Sage Road (1.7 miles) – through the E-F District
- Sage Road to I-40 Eastbound Ramps (0.8 miles)

Aggregated corridor MOE data is shown in **Table 13** for all three existing 2016 peak hour simulation runs. Speed and travel time results are fairly consistent between the two directions. Northbound speeds through the middle corridor segment and southbound speeds on the northern end of the corridor are, overall, the lowest of the three sections. No time period experiences marked differences in overall end-

to-end corridor speeds. Without true origin-destination information available, the ODME created in TransModeler assigns in the neighborhood to 200 northbound and southbound "through" trips that begin on one end of the network and end on the other end of the network. These results may be different from the O-D trip table produced by the sub-area model, or by a field verified O-D survey.

Table 13. US 15-501 Corridor MOE Results

Travel Direction	Segment	MOE								
		Through Trips Completed			Travel Time (min)			Speed (mph)		
		AM Peak	Noon Peak	PM Peak	AM Peak	Noon Peak	PM Peak	AM Peak	Noon Peak	PM Peak
Fordham Boulevard Northbound	Manning Dr to Estes Dr	774	681	751	4.30	3.69	4.07	28.3	33.0	29.9
	Estes Dr to Sage Rd	668	478	663	3.46	4.55	4.08	28.8	21.9	24.4
	Sage Rd to I-40 Ramps	1,325	1,294	1,562	1.52	1.36	1.58	32.3	36.1	31.2
	Manning Dr to I-40	**256**	**178**	**225**	**9.07**	**9.24**	**9.55**	**29.8**	**29.3**	**28.3**
Fordham Boulevard Southbound	I-40 Ramps to Sage Rd	1,504	1,122	1,358	2.16	1.70	2.21	22.7	28.9	22.3
	Sage Rd to Estes Dr	603	444	482	3.79	3.41	3.65	26.9	29.9	28.0
	Estes Dr to Manning Dr	664	710	773	4.13	3.55	4.46	29.4	34.1	27.2
	I-40 to Manning Dr	**234**	**183**	**201**	**9.97**	**8.77**	**10.38**	**27.3**	**31.1**	**26.2**

Intersection MOEs

Intersection MOEs were collected through the use of delay and queue reports produced by the TransModeler software. The Delay-by-Lane and Spillback Queue reports were utilized to produce the following MOE data.

- Average Queue Length for each intersection movement/approach
- Maximum Queue Length for each intersection movement/approach
- Average vehicular delay and Level-of-Service (LOS) for each intersection

Table 14 presents the averaged per vehicle delay results for the existing year peak hour traffic conditions as compiled from the 10 simulation runs for each peak period. The table lists overall intersection delay as an average for all movements and approaches at each signalized intersection. It also lists data for the worst-case individual movements encountering delay at the stop-controlled intersections, per similar methodologies that would be employed by empirical HCM calculations. **Figures 14A through 14C** present a summary intersection LOS for each peak period.

AM Peak Hour Analysis

Of the 39 intersection locations analyzed, only five currently experience deficient overall peak hour LOS in the AM peak period, based on averaged 10 run TransModeler simulation results. The specific intersections and issues that contribute to the deficient LOS E or LOS F operation include the following:

- **US 15-501 (Durham-Chapel Hill Boulevard) and Sage Road/Old Durham Road**
  Overall LOS E results reported are caused by high traffic volume demand on US 15-501 coupled with moderate demand on both minor street approaches and an eight-phase traffic signal operation. This intersection is also near capacity in the PM peak hour.

- **US 15-501 (Fordham Boulevard) Northbound & Northbound U-Turn**
  Overall LOS E results from the AM peak intersection capacity analysis at this location may be due to the two single-lane traffic flows entering just upstream of the traffic circle and queuing/turbulence present at the intersection.

- **US 15-501/NC 54 Bypass (Fordham Blvd) & Old Mason Farm Road**
  Overall LOS E results are caused by a complex five-legged intersection with pedestrian crossings and complex signal phasing. Very high traffic volumes in both directions in this area on US 15-501.

- **US 15-501/NC 54 Bypass (Fordham Blvd) & Manning Drive**
  Overall LOS E results are caused by high traffic demands on US 15-501 at the major entry point to the UNC Main Campus, coupled with moderate demand on the Manning Drive leg outbound from the campus area.

- **Old Durham Road & Scarlett Drive**
  Overall LOS F results for the AM peak hour (and subsequent Noon and PM peak hours) are caused by the location of this intersection being too close to the major US 15-501/Sage Road/Old Durham Road signalized intersection. Queues on Old Durham Road prevent gaps for Scarlett Drive traffic to enter this intersection.

All other remaining signalized and unsignalized intersections in the project study area feature acceptable LOS, as determined by Town of Chapel Hill thresholds (LOS D overall for signalized intersections or LOS E for critical movements for unsignalized intersections).

Noon Peak Hour Analysis

Of the 39 intersection locations analyzed, only one signalized intersection (E. Franklin Street & Elliott Road) currently experiences a deficient peak hour LOS in the noon peak period, based on averaged simulation run results. This intersection has high noon peak traffic volumes on E. Franklin Street and Elliott Road northbound, coupled with pedestrian activity and lack of storage capacity on Elliott Road. Two unsignalized intersection critical movements experience operational LOS issues. Noon peak traffic flows in the project study area are generally lower and more directionally balanced than AM and PM peak flows.

Table 14. Capacity Analysis Results for Study Area Intersections - 2016 Existing Traffic

ID	Intersection Name	Average Control Delay (sec/veh)			Equivalent LOS		
		AM	Noon	PM	AM	Noon	PM
1	US 15-501 (Durham-Chapel Hill Boulevard) & Eastowne Drive/Lakeview Drive	22.7	18.2	45.0	C	B	D
2	US 15-501 (Durham-Chapel Hill Boulevard) & Eastowne Drive / US 15-501 Service Road	10.6	8.5	11.3	B	A	B
3	US 15-501 (Durham-Chapel Hill Boulevard) & Sage Road/Old Durham Road	***63.2***	38.4	50.3	***E***	D	D
401	US 15-501 Southbound & Southbound U-Turn	17.2	38.6	41.4	B	D	D
402	Erwin Road & US 15-501 Southbound	16.6	14.2	17.3	B	B	B
403	US 15-501 Northbound & Europa Drive	16.1	20.9	15.7	B	C	B
404	Northbound U-Turn – Service Road Connector & US 15-501 Northbound	***58.3***	41.1	33.1	***E***	D	C
5	US 15-501 (Fordham Boulevard) & Ephesus Church Road	37.9	42.4	46.7	D	D	D
6	US 15-501 (Fordham Boulevard) & Elliott Road	11.4	22.2	16.2	B	C	B
7	US 15-501 (Fordham Boulevard) & Willow Drive	21.5	18.1	22.4	C	B	C
8	US 15-501 (Fordham Boulevard) & Estes Drive	25.3	28.6	35.7	C	C	D
9	US 15-501 (Fordham Boulevard) & Cleland Road	34.1	***56.8***	***99.9***	D	***F***	***F***
10	US 15-501 (Fordham Boulevard) & Brandon Road	36.5	43.9	***96.1***	E	E	***F***
11	US 15-501 (Fordham Boulevard) & NC 54 Westbound Ramps	20.4	12.0	18.3	C	B	B
12	US 15-501 (Fordham Boulevard) & NC 54 Eastbound Ramps	14.8	12.0	23.5	B	B	C
13	US 15-501/NC 54 (Fordham Boulevard) & Old Mason Farm Road / Carmichael Drive/Fern Lane	***57.0***	16.9	47.8	***E***	B	D
14	US 15-501/NC 54 (Fordham Boulevard) & Manning Drive	***63.0***	20.5	53.5	***E***	C	D
15	Raleigh Road and US 15-501 (Fordham Boulevard) Southbound Ramps	11.8	9.1	10.3	B	A	B
16	NC 54 (Raleigh Road) & US 15-501 (Fordham Boulevard) Northbound Ramps	36.0	22.3	45.7	E	C	E
17	NC 54 (Raleigh Road) & Hamilton Road	16.0	17.8	20.2	B	B	C
18	NC 54 (Raleigh Road) & Environ Way	0.8	2.9	3.2	A	A	A
19	NC 54 (Raleigh Road) & Burning Tree Drive/Finley Golf Course Road	12.2	11.4	15.7	B	B	B
20	Estes Drive & Caswell Road	12.5	7.9	14.5	B	A	B

BOLD/ITALIC – Movement or Overall Intersection is over capacity per Town of Chapel Hill TIS Guidelines

Table 14 (Continued). Capacity Analysis Results for Study Area Intersections - 2016 Existing Traffic

ID	Intersection Name	Average Control Delay (sec/veh)			Equivalent LOS		
		AM	Noon	PM	AM	Noon	PM
21	Estes Drive & Library Drive	4.0	8.5	7.8	A	A	A
22	Estes Drive & E. Franklin Street	41.6	47.3	***56.0***	D	D	***E***
23	Estes Drive & Willow Drive/Shepherd Lane	10.1	11.7	16.8	B	B	B
24	Elliott Road & Old Oxford Road/Velma Road	6.8	7.1	8.1	A	A	A
25	Elliott Road & E. Franklin Street	19.2	***61.8***	***62.1***	B	***E***	***E***
26	Eastgate Crossing & E. Franklin Street	6.1	7.6	8.9	A	A	A
27	Ephesus Church Road & Rams Plaza Access (RIRO) / University Inn Driveway	22.1	12.0	45.7	C	B	E
28	Ephesus Church Road & Legion Road	24.3	17.0	54.3	C	B	D
29	Ephesus Church Road & Pinehurst Drive/Sharon Road	9.9	8.6	10.3	A	A	B
30	Legion Road & Clover Drive / Rams Plaza Access	7.7	8.4	***90.1***	A	A	***F***
31	Legion Road & Quality Inn Driveway	5.8	6.2	12.3	A	A	B
32	Legion Road & Europa Drive	7.8	7.4	11.5	A	A	B
33	US 15-501 Service Road & Quality Inn Driveway	5.2	5.3	5.1	A	A	A
34	Europa Drive & US 15-501 Service Road	14.2	15.2	18.5	B	C	C
35	Legion Road & Scarlett Drive	8.8	14.3	***103.3***	B	B	***F***
36	Weaver Dairy Road & Erwin Road	16.1	12.3	13.5	B	B	B
37	Sage Road & Erwin Road	25.5	21.7	28.0	C	C	C
38	Sage Road & Lowes Entrance/Cosgrove Drive	24.3	11.1	10.8	C	B	B
39	Old Durham Road & Scarlett Drive	***154.1***	***160.1***	***450.9***	***F***	***F***	***F***

BOLD/ITALIC – Movement or Overall Intersection is over capacity per Town of Chapel Hill TIS Guidelines

PM Peak Hour Analysis

Of the 39 intersection locations analyzed, two signalized intersections currently experience deficient overall peak hour LOS in the PM peak period, based on traffic simulation results.

- **E. Franklin Street and Estes Drive**
  PM peak hour LOS E results are caused by high traffic volumes on E. Franklin Street and Estes Drive and existing geometrics that feature shared through-right turn lanes on all approaches coupled with high turning movement (left and right-turns) at several approaches.

- **Franklin Street & Elliott Road**
  The same issues described previously that reduce traffic capacity in the Noon Peak hour also continue in the PM peak hour at this intersection.

Several unsignalized intersections have critical stop-controlled movements that operate at LOS E or F in the PM peak hour due to their location relative to traffic signals where queues on minor street approaches block these intersections during the simulation run or the intersections are located along high volume arterials that have limited gaps for stop-controlled traffic.

Peak Hour Queue Results Discussion

Using the TransModeler lane and spillback queue reports, an evaluation of existing peak hour maximum queue information was made for all study area intersections. Evaluation of the queue report data was made by identifying intersection links where spillback rate (percentage) was greater than zero and assessing maximum queue lengths reported for the 10 simulation runs compared to existing link lengths and separation between existing intersections.

Figure 15 shows a graphical schematic of the queue analysis results, identifying both links upstream of study area intersections where there is queue spillback potential and the approximate distance of the maximum queue in these areas for at least one peak hour.

The figure highlights the following queue spillback areas:

- **US 15-501/Manning Drive/Old Mason Farm Road** – model results for multiple peak hours indicate significant queue issues in this area along the US 15-501 corridor, due to congestion at the two major signalized intersections.

- **East Franklin Street/Estes Drive** – in the PM peak hour, significant queuing is reported on all four approaches due to congestion issues at the intersection.

- **Elliott Road** – in multiple peak hours, significant maximum queues are reported from the model run results at both the E. Franklin Street and US 15-501 intersections from Elliott Road.

- **US 15-501/Ephesus Church Road area** – model results indicate that significant queuing on Ephesus Church Road is impairing this approach and spilling back past Legion Road, which also causes significant queuing up Legion Road.

- **US 15-501/Sage Road/Old Durham Road** – model results indicate some significant queuing in multiple peak hours for the Sage Road and Old Durham Road/Scarlett Drive approaches that extend past upstream intersections away from the major US 15-501 intersection.

C. Generalized Daily Arterial Volume/Capacity (v/c) Analysis

A generalized daily arterial capacity analysis was conducted for existing planning-level conditions. Data for this analysis was taken from the latest version of the TRM used in the sub-area model development for this study and current or recent Annual Average Daily Traffic (AADT) data on selected study area network roadway segments. Daily volume/capacity link analyses are more applicable to long range future conditions, but were used as a baseline in this report to compare to future projected traffic growth in subsequent analyses for the E-F District. Study area traffic operations are usually better explained by peak hour intersection LOS methodologies, in most cases, when current and short range data are available.

The TRM/sub-area model data includes estimated peak hour link capacities for roadway facilities in the study area. These capacities account for existing roadway characteristics (number of lanes, operating speeds, access control, presence of traffic signals) and were extrapolated to a daily capacity estimation by applying a factor of 10 to the link capacity estimate, which is general assumption used in traffic forecasting activities accounting for the likelihood that 10 percent of daily traffic/capacity is found within the highest weekday peak hour.

As shown in **Table 15** on the following page, three roadway segments currently exhibit daily traffic volumes that exceed estimated daily capacities (v/c ratio > 1.0) with the input AADT values and six segments are approaching daily capacity thresholds (v/c ratio 0.90 or greater), meaning they are approaching their daily capacity limit and likely experience periods of congested traffic conditions. The locations of the congested segments are as follows:

- **US 15-501 from I-40 to Ephesus Church Road** – this corridor is near or above daily capacity for five segments, as overall daily AADT values are near or above existing roadway characteristics used to calculate the capacity values. This area currently experiences peak hour congested conditions.

- **US 15-501 from NC 54 (Raleigh Road) to Manning Drive** – this corridor has current daily traffic demands exceeding daily capacity and experiences the highest daily traffic volumes for the 15-501 corridor throughout the project study area. The area experiences existing peak hour traffic congestion stemming from the two intersections at Manning Drive and Old Mason Farm Road.

- **Estes Drive west of Caswell Drive to E. Franklin Street** – this corridor has two segments that are near daily capacity, as high traffic volumes on Estes Drive are constrained to a two-three lane roadway cross-section.

Table 15. 2016 Daily Volume/Capacity Analysis for Selected Study Area Road Segments

Roadway Facility	Segment ID	Segment Limit		2015 NCDOT AADT (vpd)	2016 Field AADT (vpd)	2016 Capacity (vpd)	V/C Ratio*
		From	To				
US 15-501 (Fordham Boulevard - Durham/Chapel Hill Boulevard)	1	I-40	Eastowne/Lakeview Drive	42,000	52,700	55,200	0.95
	2	Lakeview Drive	Eastowne/Service Road	--	46,800	55,200	0.85
	3	Eastowne/Service Road	Sage Road/Old Durham Road	--	46,900	55,200	0.85
	4	Sage Road/Old Durham Road	Erwin Road/Europa Drive	43,000	52,700	55,200	0.95
	5	Erwin Road/Europa Drive	Ephesus Church Road	48,000	52,600	43,200	***1.22***
	6	Ephesus Church Road	Elliott Road	--	35,400	51,800	0.68
	7	Elliott Road	Willow Drive	--	37,000	51,800	0.71
	8	Willow Drive	Estes Drive	30,000	33,500	51,800	0.65
	9	Estes Drive	Cleland Road	37,000	40,500	51,800	0.78
	10	Cleland Road	Brandon Road	--	38,600	51,800	0.75
	11	Brandon Road	NC 54 (Raleigh Road)	--	37,700	51,800	0.73
	12	NC 54 (Raleigh Road)	Old Mason Farm Rd/Carmichael Dr	54,000	53,400	51,800	***1.03***
	13	Old Mason Farm Rd/Carmichael Dr	Manning Drive	--	52,600	51,800	***1.02***
	14	Manning Drive	Mason Farm Road	--	41,800	51,800	0.81
Eastowne Drive (East)	15	Providence Drive	US 15-501 (Fordham Boulevard)	--	5,200	14,500	0.36
Lakeview Drive	16	US 15-501 (Fordham Boulevard)	Old Durham Road	--	3,100	17,300	0.18
Eastowne Drive (West)	17	US 15-501 (Fordham Boulevard)	Pinegate Road	--	4,000	14,500	0.28
Service Road	18	US 15-501 (Fordham Boulevard)	Performance Motors	--	1,500	13,000	0.12
Sage Road/Old Durham Road	19	Weaver Dairy Road	Erwin Road	--	8,400	21,400	0.39
	20	Erwin Road	Old Sterling Drive	9,900	14,500	21,400	0.68
	21	Old Sterling Drive	US 15-501 (Durham CH Blvd)	--	14,500	21,400	0.68
	22	US 15-501 (Durham-CH Blvd)	Scarlett Drive	--	8,300	21,400	0.39
Scarlett Drive	23	Old Durham Road	Legion Road	--	2,300	10,900	0.21
Erwin Road	24	Covington Drive	Sage Road	--	7,700	17,300	0.45
	25	Sage Road	Weaver Dairy Road	--	5,200	17,300	0.30
	26	Weaver Dairy Road	US 15-501 (Fordham Boulevard)	7,500	N/A	21,400	0.35
Europa Drive	27	US 15-501 (Fordham Boulevard)	Legion Road	--	2,500	13,000	0.19
Legion Road	28	Scarlett Drive	Europa Drive	--	4,300	13,000	0.33
	29	Europa Drive	Ephesus Church Road	5,900	5,800	13,000	0.45
Ephesus Church Road/Eastgate	30	E. Franklin Street	US 15-501 (Fordham Boulevard)	--	7,000	14,000	0.50
	31	US 15-501 (Fordham Boulevard)	Legion Road	9,800	8,300	17,300	0.48
	32	Legion Road	Eden Drive	6,800	6,700	17,300	0.39
Elliott Road	33	Old Oxford Road/Velma Drive	E. Franklin Street	4,300	4,900	14,700	0.33
	34	E. Franklin Street	US 15-501 (Fordham Boulevard)	7,100	9,300	14,700	0.63

vpd = vehicles per day
Data Sources: 2015 AADT Counts from NCDOT Traffic Survey Group and 2016 Field Data, Daily capacity data from the TRM Version 5.0 (Hourly Capacity Divided by Assumed DHV = 0.10)
*- V/C Ratio for Highest Demand Between 2015 NCDOT and 2016 Field-Collected Data

Table 15 (Continued). 2016 Daily Volume/Capacity Analysis for Selected Study Area Road Segments

Roadway Facility	Segment ID	Segment Limit		2015 NCDOT AADT (vpd)	2016 Field AADT (vpd)	2016 Capacity (vpd)	V/C Ratio*
		From	To				
Willow Drive	35	Estes Drive	US 15-501 (Fordham Boulevard)	5,700	N/A	17,300	0.33
	36	US 15-501 (Fordham Boulevard)	Spruce Drive	2,300	N/A	13,000	0.18
Estes Drive	37	West of Caswell Drive	Caswell Drive	16,000	N/A	17,300	0.92
	38	Caswell Drive	E. Franklin Street	16,000	15,800	17,300	0.91
	39	E. Franklin Street	Willow Drive	16,000	16,300	34,700	0.47
	40	Willow Drive	US 15-501 (Fordham Boulevard)	13,000	12,100	34,700	0.35
E. Franklin Street	41	US 15-501 (Fordham Boulevard) Split	Eastgate Crossing	21,000	24,400	42,800	0.57
	42	Eastgate Crossing	Elliott Road	--	27,500	42,800	0.64
	43	Elliott Road	Estes Drive	23,000	25,800	42,800	0.60
	44	Estes Drive	Meadowbrook Drive	17,000	17,700	42,800	0.41
Cleland Drive	45	US 15-501 (Fordham Boulevard)	Hamilton Road	2,200	2,200	13,000	0.17
Brandon Road	46	US 15-501 (Fordham Boulevard)	Flemington Road	--	1,500	14,500	0.10
NC 54 (Raleigh Road)	47	Greenwood Drive	US 15-501 (Fordham Boulevard)	21,000	N/A	42,800	0.49
	48	US 15-501 (Fordham Boulevard)	Hamilton Road	50,000	46,000	64,300	0.72
	49	Hamilton Road	Rogerson Road/Environ Way	--	46,000	64,300	0.72
	50	Rogerson Road/Environ Way	Burning Tree Ln/Finley GC Road	--	43,800	64,300	0.68
	51	Burning Tree Ln/Finley GC Road	E. Barbee Chapel Road	50,000	45,600	77,800	0.59
Hamilton Road	52	Maxwell Lane	NC 54 (Raleigh Road)	--	2,600	13,000	0.20
	53	NC 54 (Raleigh Road)	Prestwick Drive	--	4,900	13,000	0.38
Burning Tree Lane	54	Oak Tree Court	NC 54 (Raleigh Road)	1,700	1,600	13,000	0.12
Old Mason Farm Road/Carmichael Drive	55	NC 54 (Raleigh Road)	Prestwick Drive	2,900	4,000	14,700	0.27
	56	US 15-501 (Fordham Boulevard)	Highland Woods Road	3,000	3,800	14,700	0.26
	57	US 15-501 (Fordham Boulevard)	Fern Lane	--	1,600	14,700	0.11
Manning Drive	58	US 15-501 (Fordham Boulevard)	Skipper Bowles Drive	18,000	16,300	34,700	0.47

vpd = vehicles per day
Data Sources: 2015 AADT Counts from NCDOT Traffic Survey Group and 2016 Field Data, Daily capacity data from the TRM Version 5.0 (Hourly Capacity Divided by Assumed DHV = 0.10)
*- V/C Ratio for Highest Demand Between 2015 NCDOT and 2016 Field-Collected Data

D. Existing Transit Analysis

An existing analysis of all current CHT and GoTriangle fixed routes in the project study area (directly serving stops within the E-F SAP boundaries or periphery) was conducted based on existing weekday ridership demand data (boardings and alightings) and service capacity, based on bus sizes/seats and existing headways (latest fall 2016 data provided by CHT and GoTriangle). A summary of each existing route serving the E-F District and the peak hour capacity analysis results are shown below.

Calculations of route demand are given by average load at each bus stop taken from ridership samples collected by CHT and GoTriangle. Estimations of bus capacity were made by the following:

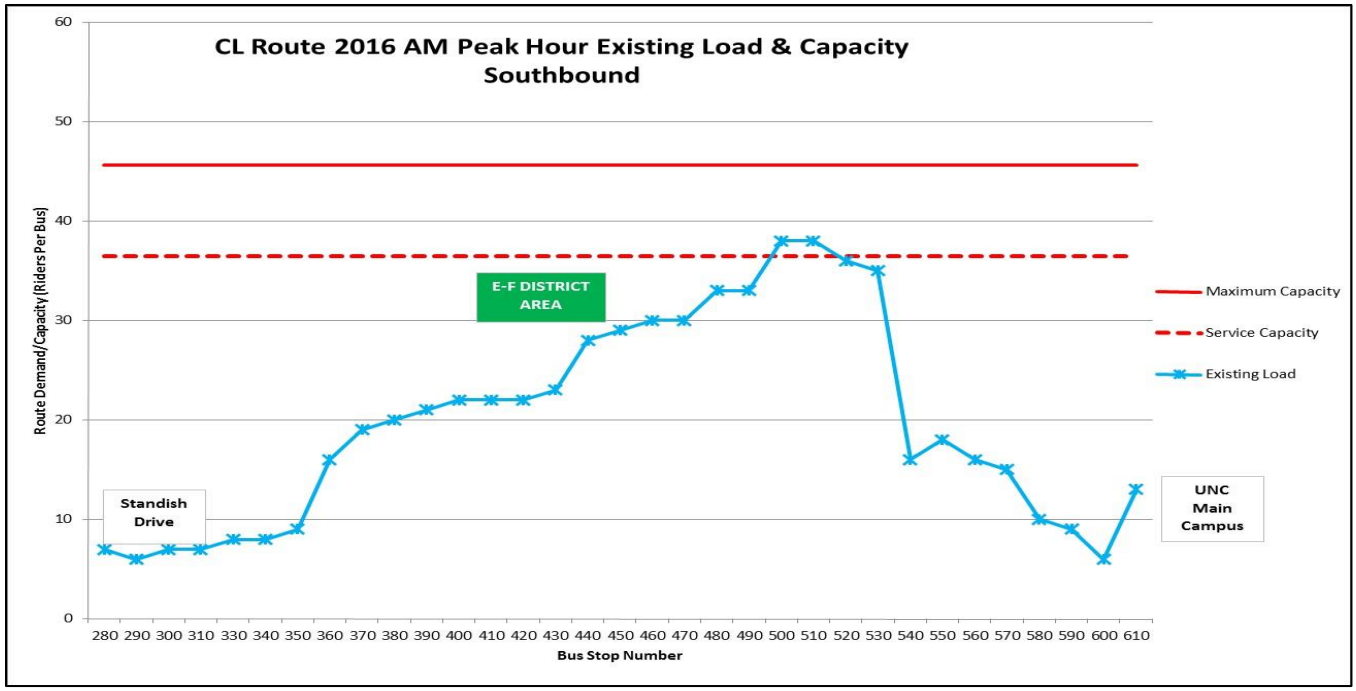
- Maximum bus capacity for a 40 foot standard bus = 38 seats X 1.5 maximum capacity factor = 57 passengers
- Maximum threshold capacity assumed to = 57 passengers X 0.80 factor = 45.6 passengers = analyzed "maximum capacity" of a bus
- Service capacity = 45.6 passengers X 0.80 factor = 36.48 passengers/bus

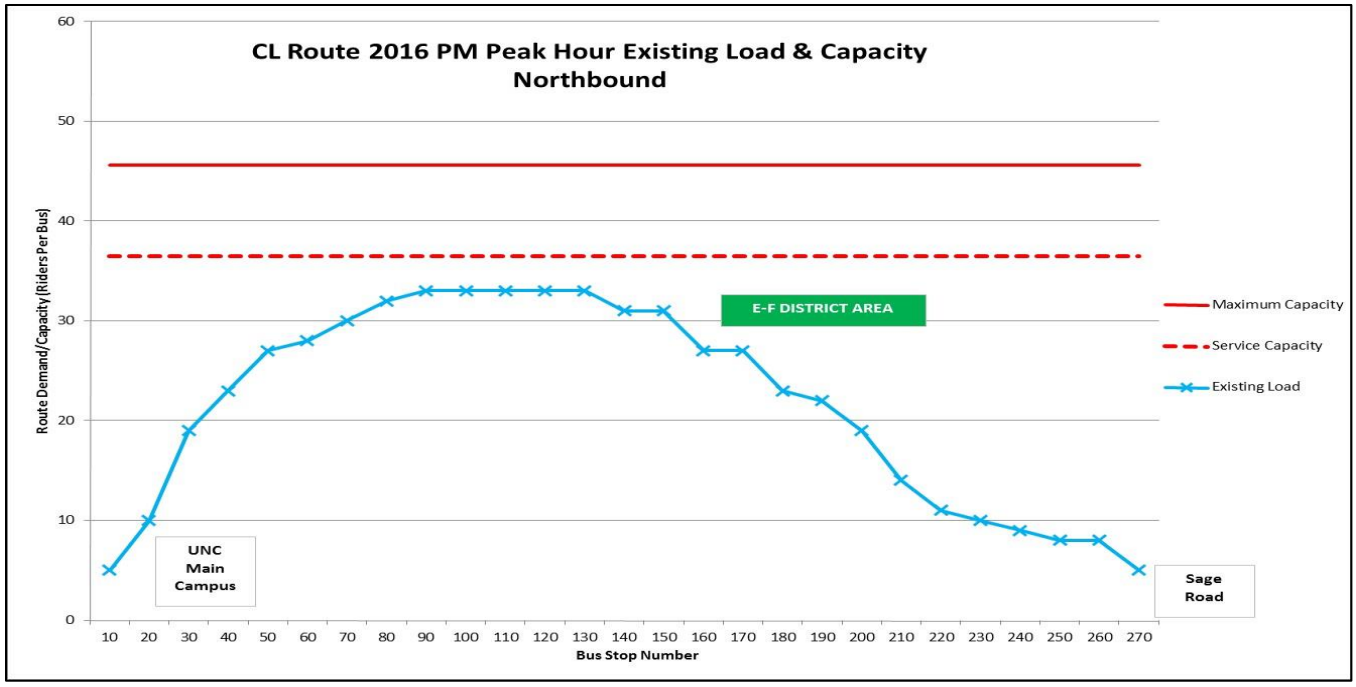
These values were developed based on input by CHT staff on previous bus operational capacity studies for other traffic impact analyses for major developments in Chapel Hill. Average loads were further computed by accounting for by multiple buses traveling through the E-F District during weekday peak hours based on vehicular traffic and not necessarily directly correlated to peak hours for transit loads, though the two often correlate well. This assumption will be necessary in making estimates for future transit ridership increases due to development changes in future scenarios where methodologies for trip generation and resulting mode split estimations will be done for the vehicular peak hours analyzed in this study. ***Appendix D*** contains load/capacity graphical results for CHT and GoTriangle routes in the project study area.

CL Route Demand/Capacity Results

CL Route information provided by CHT indicates that one bus traverses the E-F study area in the AM and PM peak hours, with no noon peak bus service for this route. Load and capacity graphs are shown on the following page for the peak hour highest ridership/load levels – inbound (southbound) in the AM peak hour and outbound (northbound) in the PM peak hour. Several stops on the CL route are within the E-F District along E. Franklin Street and Legion Road. The two graphs shown below highlight loads along the route. In the AM peak, passenger loads to the south of the E-F District are exceeding current service capacity for an individual bus, and PM peak hour loads are nearing service capacity for a large portion of the route.

Passenger loads in the opposite direction are much lower during these peak time periods, with average demand less than 10 riders on a bus for every stop along the route.



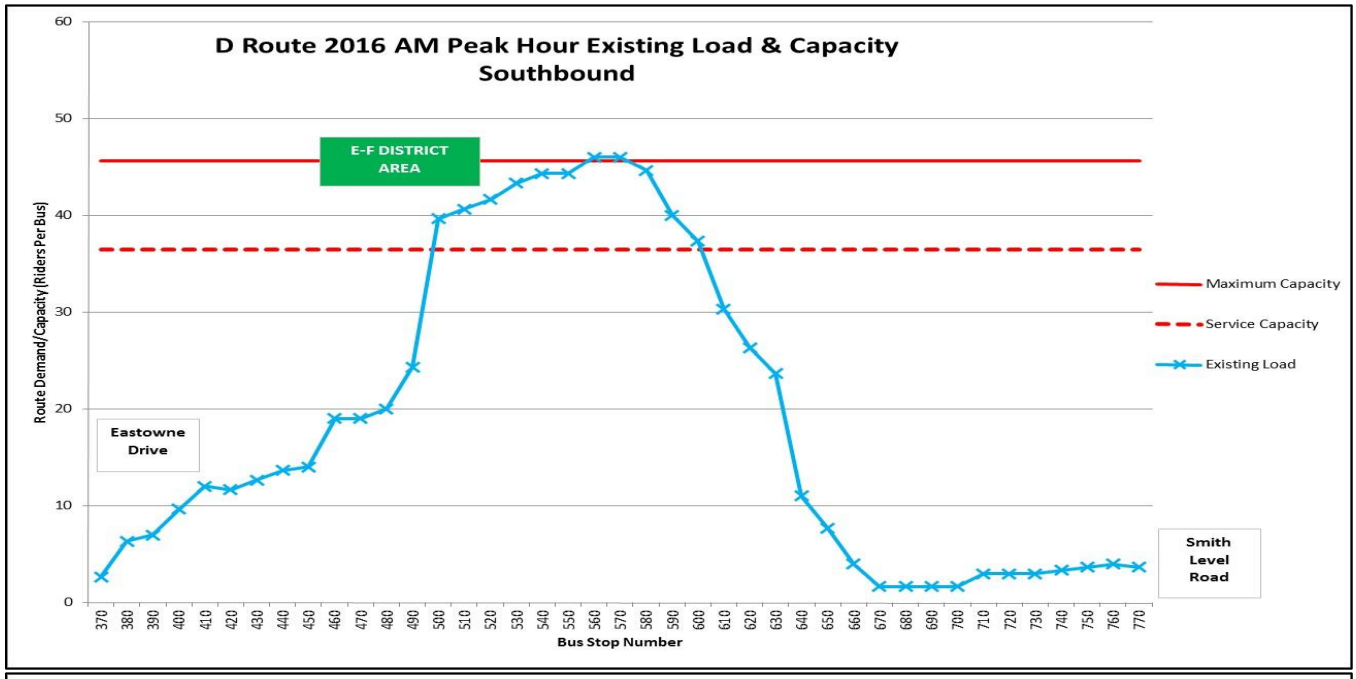


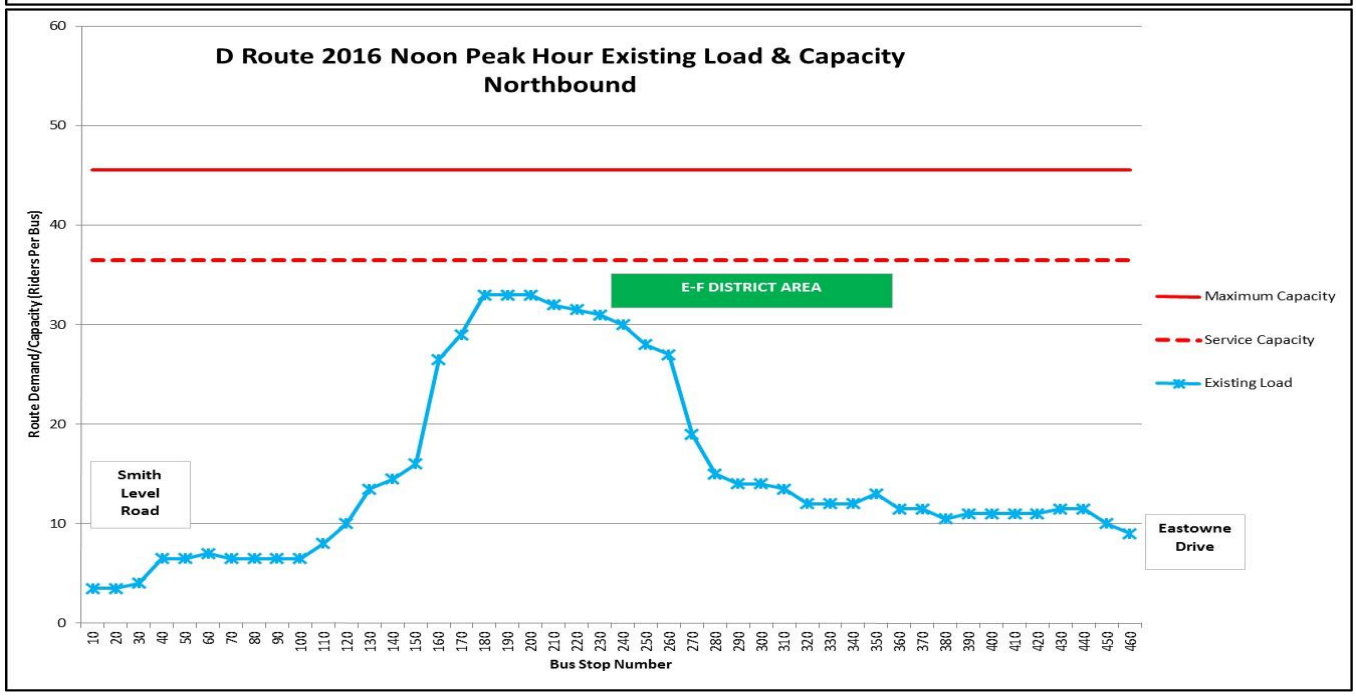
D Route Demand/Capacity Results

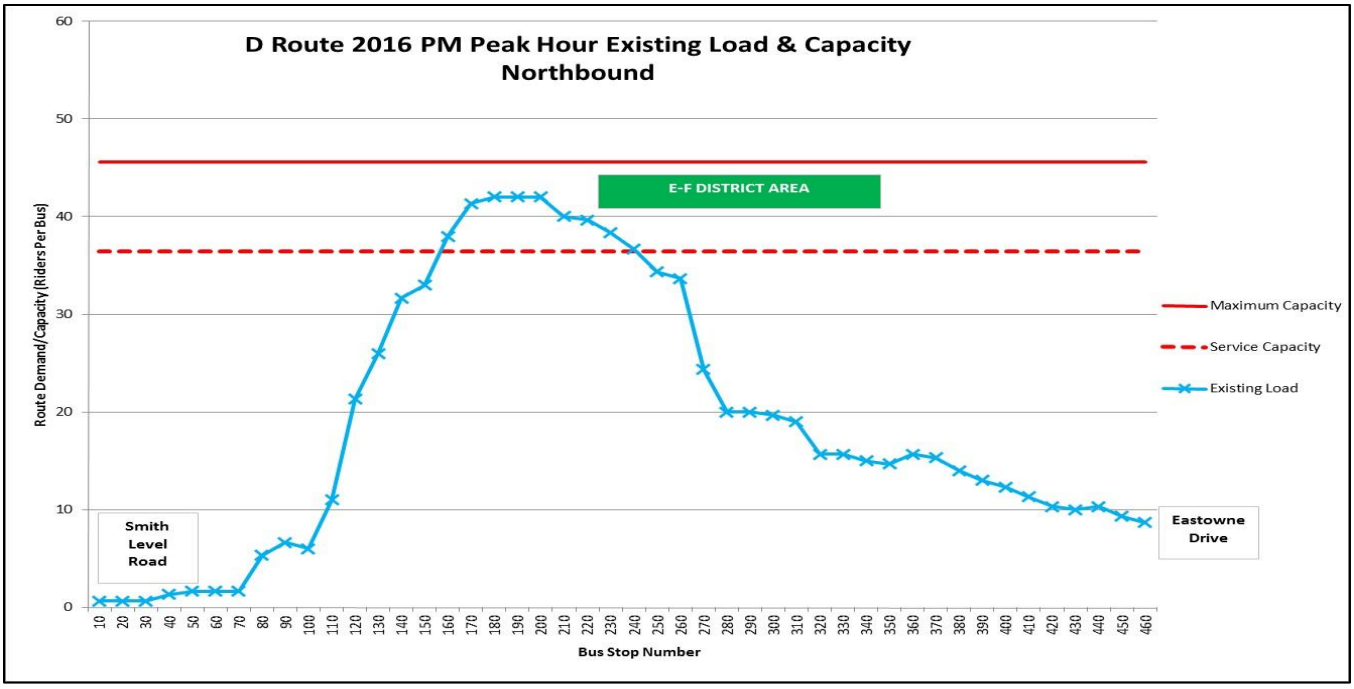
D Route information provided by CHT indicates that three buses traverse the E-F study area in the AM and PM peak hours, with two noon peak buses in service in the area for this route. Load and capacity graphs are shown below for the highest ridership/load levels – inbound (southbound) in the AM peak hour and outbound (northbound) in the PM peak hour, along with outbound in the noon peak hour. Several stops on the D route are within the E-F District along E. Franklin Street and the US 15-501 Service Road (outbound) and Dobbins Drive (inbound). The three graphs shown below highlight loads along the route. In the AM peak, passenger loads within and to the south of the E-F District are exceeding current service and maximum capacity for an individual bus, and PM peak hour loads are exceeding

service capacity for a small portion of the route prior to the E-F District area, where a sizable number of riders alight.

Passenger loads in the opposite direction are much lower during these peak time periods, with average demand less than 20 riders on a bus for every stop along the route.







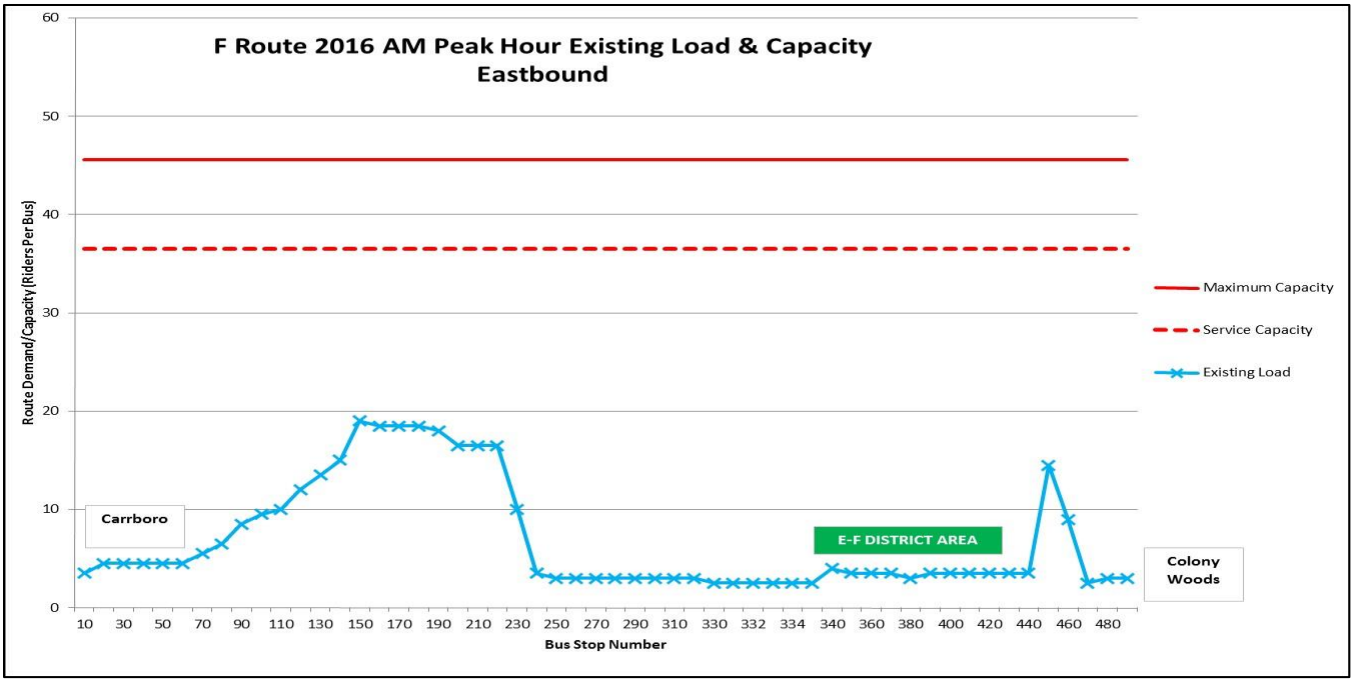
DX Route Demand/Capacity Results

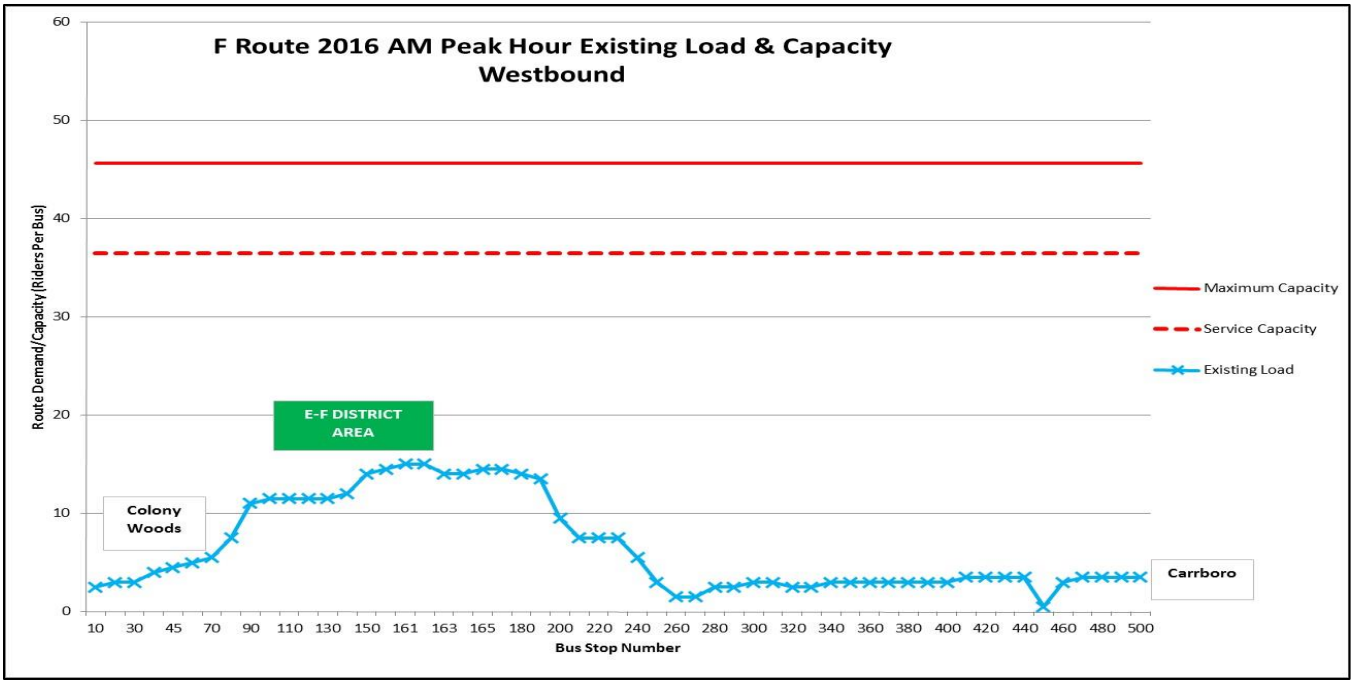
DX Route information provided by CHT indicates that a single DX bus traverses the E-F study area in the AM and PM peak hours, with no noon peak buses in service in the area for this route. Load and capacity graphs indicate that no load levels exceed 20 passengers currently at any DX stop. No stops on the DX route are within the E-F District currently and stop information was only provided for inbound (southbound) AM peak and outbound (northbound) PM peak trips.

F Route Demand/Capacity Results

F Route information provided by CHT indicates that two buses traverse the E-F study area in the AM and PM peak hours, with one noon peak buses in service in the area for this route. Load and capacity graphs are shown on the following for the highest ridership/load levels – eastbound (from Carrboro to east side of Chapel Hill) in the AM peak hour and westbound in the PM peak hour. Multiple stops on the F route are within the E-F District along E. Franklin Street, Elliott Road and Ephesus Church Road. The F Route provides service to the most stops of any existing transit route within the E-F District.

The two graphs shown on the following page highlight heaviest peak hour loads along the route. In both peaks, passenger loads along the F Route are light, averaging less than 20 passengers at any given bus stop along the route.

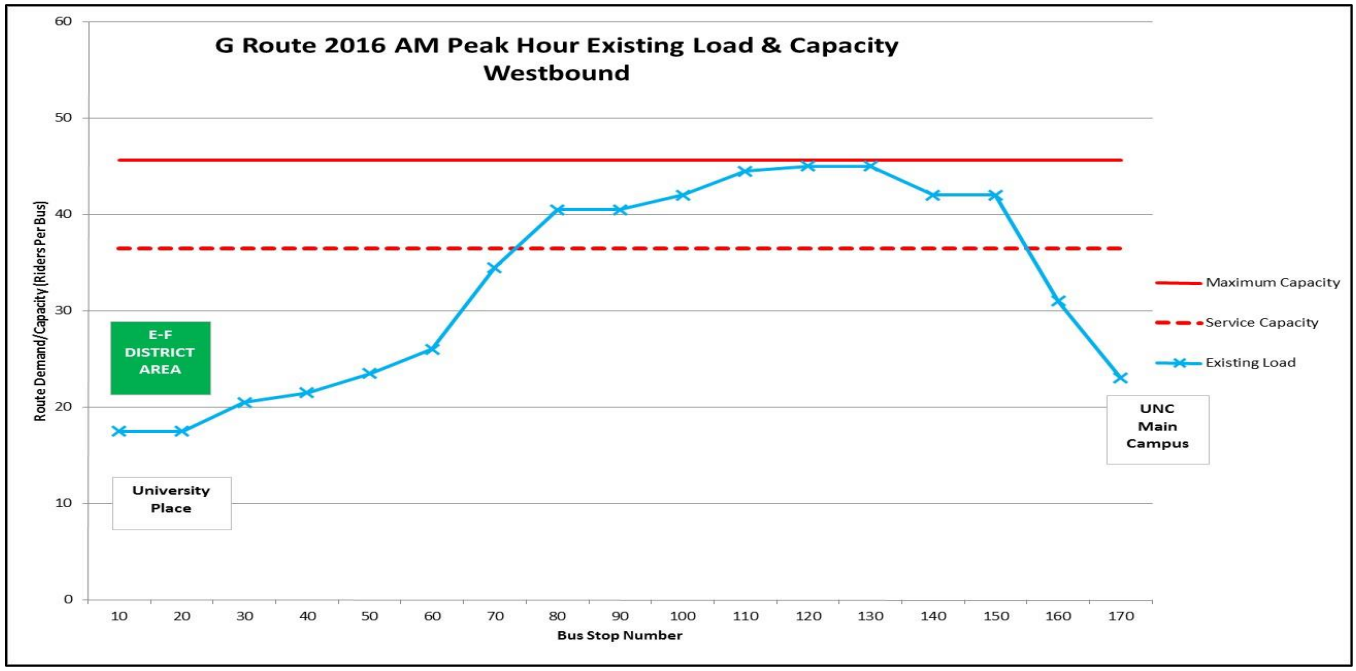


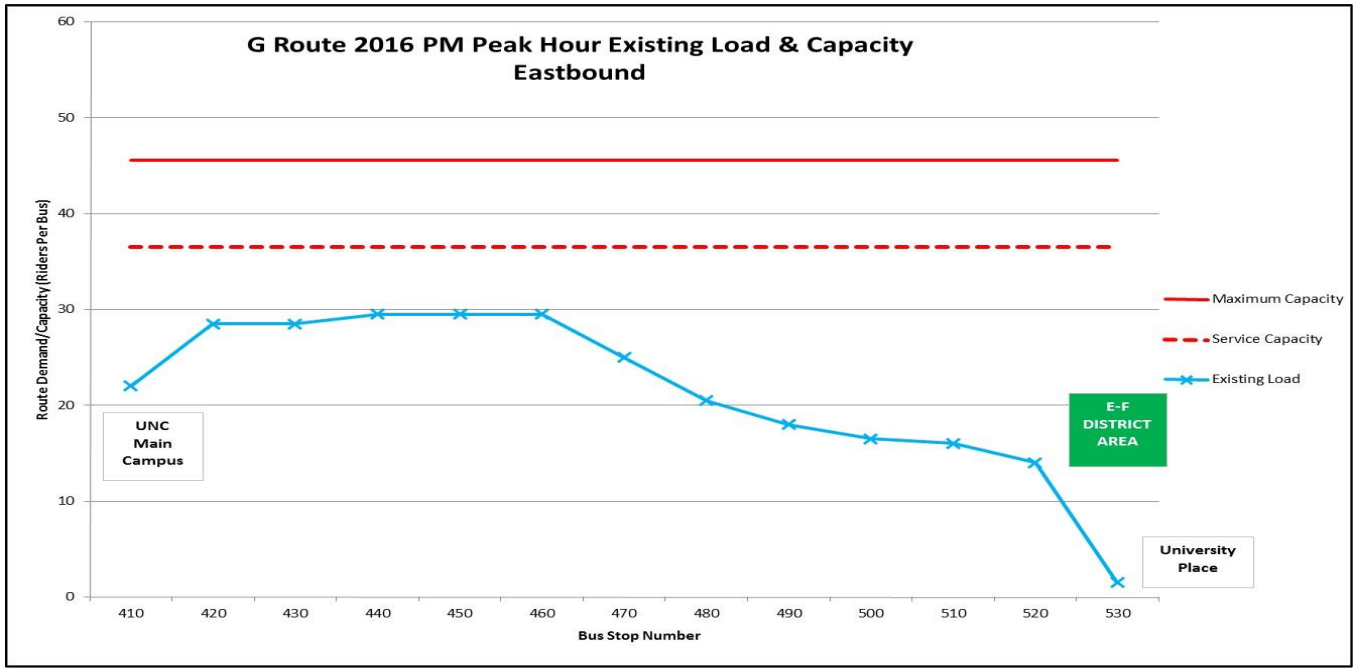


G Route Demand/Capacity Results

G Route information provided by CHT indicates that two buses traverse the E-F study area in the AM, noon, and PM peak hours. Load and capacity graphs are shown following page for the highest ridership/load levels for the portion of the G Route that traverses the E-F project study area, from University Place to/from UNC Main Campus/downtown area. The other portion of the G Route serves areas to the north and west of the E-F TIA study area and was not considered in this analysis. For the G Route, demand is highest inbound (westbound) in the AM peak hour and outbound (eastbound) in the PM peak hour. There are no stops specifically within the E-F District, although G Route stops are within University Place, which is a short walk from E-F District destinations.

Passenger loads in the AM peak exceed service capacity along this portion of the G Route, approaching maximum capacity inbound toward UNC Campus area. PM peak loads are below service capacity for the eastbound G Route service. Passenger loads in the opposite direction, are much lower during these peak time periods, and for the noon peak hour as well, with average demand less than 10 riders on a bus for every stop along the route.





In the sub-area model development process, an assessment of existing TRM transit networks was made to compile model boarding and alighting local/express daily assignment data. This information was compared with a summation of total daily boardings for CHT routes in this study taken from fall 2016 raw information. **Table 16** shows that the TRM, in most cases, is over predicting the levels of transit boarding compared to existing field collected information. Additional review of both existing data sources and model data will be made to verify results and determine applicability of direct usage of transit route information from future scenario sub-area models developed for this study.

Table 16. Comparison of TRM Transit Boardings to CHT Data

CHT Route	Model	Actual	Ratio
CL	697	158	4.41
D	48	76	0.63
DX	4,797	1,698	2.83
F	1,565	417	3.75
G	1,403	857	1.64

Transit operations were also evaluated as part of multi-modal analyses of pedestrian and bicycle facilities within the E-F District in the next sections of this report. **Table 17** highlights LOS results for transit facilities and operations along four E-F District transportation corridors. These results are not as detailed as the operational load/capacity evaluations and pertain to the availability and condition of bus stops, bus shelters and raw number of buses running during peak time periods along each side of a roadway. The LOS results are demonstrative of several issues – lack of stops and buses directly equates to a poor LOS score, and even with buses and facilities present along a road segment, if load factors are excessive, the resulting LOS will degrade rapidly.

E. Existing Pedestrian Analysis

From a qualitative perspective, the E-F TIA study area, and E-F District specifically, have areas of adequate pedestrian accessibility and connectivity, but lack an overall "complete" pedestrian network, with sidewalk on both sides of major roadways, and easily accessible pedestrian crossing on multiple sides of major intersections. A review of **Figures 4A and 4B** highlight these issues. A review of the 12 hour pedestrian count information collected for this study indicates that certain areas in the network have considerable pedestrian activity in those areas where pedestrian facilities allow.

A corridor-level pedestrian LOS assessment of four (4) existing corridors within the specific E-F District area was conducted using the Highway Capacity Software (HCS) ARTPLAN multi-model analysis tool to provide a more robust analysis of pedestrian facilities. The four corridors involved in the analysis are:

- US 15-501 (Fordham Boulevard) from Estes Drive to Erwin Road/Europa Drive
- Ephesus Church Road/Eastgate Crossing from E. Franklin Street to Frances Street
- Elliott Road from Old Oxford Road/Velma Street to US 15-501 (Fordham Boulevard)
- E. Franklin Street from Estes Drive to US 15-501 (Fordham Boulevard) interchange

The ARTPLAN multi-modal evaluation tool relies on geometric, traffic flow, and traffic control information entered for each corridor in a peak direction. Thus, two analyses of each corridor were done to correspond to AM and PM peak hour directions, based on highest traffic flows for each of the four facilities. After this data was input, multi-modal data for each link segment and each direction was entered. This data included the following:

- Outside Lane Width (narrow, typical, wide)
- Pavement Condition (desirable, typical, undesirable)
- Paved Shoulder/Bicycle Lane (yes/no)
- Side Path (yes/no and if yes, distance from roadway)
- Sidewalk (yes/no)
- Sidewalk/Roadway Protective Barrier (yes/no – refers to tree lawn or other physical barrier)
- Bus Frequency (buses per direction on segment per hour)
- Passenger Load Factor (demand versus hourly bus capacity)
- Amenities (bus shelters?)
- Bus Stop (Typical, major or none)

These data sets included quantitative information available from field review or aerial/Google Earth inspection of existing facilities along each corridor, by direction. If sidewalk characteristics varied with a roadway link segment, pedestrian sub-links were added to address changes to that particular segment. Results for pedestrian LOS, bicycle LOS, and transit LOS were extracted from the ARTPLAN models and are shown in **Table 17**. LOS values are determined by composite "scores" of the existing multi-modal features entered into the evaluation tool and pre-set thresholds developed through research done for the Highway Capacity Manual. They do not correspond to the same methodology for LOS for vehicular operations. LOS thresholds for pedestrians, bicycle and transit link segments are shown in **Table 18**, for reference. ***Appendix E*** contain the raw output sheets from the ARTPLAN program.

For the E-F District pedestrian facilities, **Table 17** indicates that LOS scores range between LOS B and LOS F, depending on the existing sidewalk characteristics. The US 15-501 corridor, which lacks pedestrian facilities and connectivity in most of the District, has a corresponding LOS F. Some sections of the other three facilities have a better LOS result for certain segments.

Table 17. Multi-modal HCS Bike/Ped/Transit Analysis Results

E. Franklin St Corridor	Bicycle Street		Pedestrian		Bus	
Link #	Score	LOS	Score	LOS	Adj. Buses	LOS
Southbound (AM Peak)						
1 (to Eastgate Driveway)	4.39	E	4.81	E	3.57	C
2 (to Elliott Road)	4.41	E	3.67	D	3.99	C
3 (to Estes Drive)	4.42	E	3.59	D	5.7	B
Overall Corridor	**4.41**	**E**	**4.25**	**D**	**4.45**	**B**
Northbound (PM Peak)						
1 (to Estes Drive)	4.13	D	3.18	C	7.51	A
2 (to Elliott Road)	4.41	E	3.74	D	5.13	B
3 (to Eastgate Driveway)	4.41	E	3.57	D	1.16	E
4 (to Europa Dr)	4.39	E	5.07	F	0.76	F
Overall Corridor	**4.37**	**E**	**4.31**	**E**	**3.14**	**C**

Table 17 (Continued). Multi-modal HCS Bike/Ped/Transit Analysis Results

Elliott Road Corridor	Bicycle Street		Pedestrian		Bus	
Link #	Score	LOS	Score	LOS	Adj. Buses	LOS
Eastbound (AM Peak)						
1 (to E. Franklin Street)	3.24	C	3.54	D	0	F
2 (to US 15-501 (Fordham))	3.97	D	2.9	C	5.66	B
Overall Corridor	**3.81**	**D**	**3.09**	**C**	**4.15**	**B**
Westbound (PM Peak						
1 (to E. Franklin Street)	3.97	D	2.93	C	2.51	D
2 (to Old Oxford)	3.24	C	2.32	B	0	F
Overall Corridor	**3.81**	**D**	**2.8**	**C**	**1.84**	**E**

Ephesus Church Road Corridor	Bicycle Street		Pedestrian		Bus	
Link #	Score	LOS	Score	LOS	Adj. Buses	LOS
Westbound (AM Peak)						
1 (to Legion Road)	3.95	D	2.98	C	1.8	E
2 (to US 15-501 (Fordham))	4	D	2.88	C	2	E
3 (to E. Franklin)	3.72	D	2.59	B	0	F
Overall Corridor	**3.9**	**D**	**2.85**	**C**	**1.29**	**E**
Eastbound (PM Peak)						
1 (to US 15-501 (Fordham))	3.72	D	4.19	D	0	F
2 (to Legion Road)	4	D	4.47	E	1.02	E
3 (to Frances St)	3.95	D	4.43	E	1.53	E
Overall Corridor	**3.9**	**D**	**4.37**	**E**	**0.94**	**F**

US 15-501 Corridor	Bicycle Street		Bicycle Sidepath		Pedestrian		Bus	
Link #	Score	LOS	Score	LOS	Score	LOS	Adj. Buses	LOS
Southbound (AM Peak)								
1 (to Ephesus Church Rd)	4.58	E	N/A	N/A	5.59	F	0	F
2 (to Elliott Road)	4.66	E	N/A	N/A	5.67	F	1.04	E
3 (to Willow Drive)	4.63	E	N/A	N/A	4.27	E	0	F
4 (to Estes Drive)	4.65	E	N/A	N/A	5.61	F	0	F
Overall Corridor	**4.62**	**E**			**5.49**	**F**	**0.21**	**F**
Northbound (PM Peak)								
1 (to Estes Drive)	4.73	E	1.46	A	6.26	F	0	F
2 (to Willow Drive)	4.65	E	N/A	N/A	5.87	F	0	F
3 (to Elliott Road)	4.63	E	N/A	N/A	5.91	F	0	F
4 (to Ephesus Church Rd)	4.66	E	N/A	N/A	5.94	F	1.16	E
5 (to Europa Drive)	4.58	E	N/A	N/A	5.59	F	0	F
Overall Corridor	**4.64**	**E**			**5.88**	**F**	**0.19**	**F**

Table 18. Multi-Modal Level-of-Service (LOS) Threshold Values

Level-of-Service	Mode		
	Pedestrian and Bicycle	Transit	Bicycle Side Path
	Link Score	Link Score	Link Score
A	≤ 2.00	> 6	≤ 1.50
B	≥ 2.00 – 2.75	> 4 and ≤ 6	≥ 1.50 – 2.50
C	≥ 2.75 – 3.50	≥ 3 and ≤ 4	≥ 2.50 – 3.50
D	≥ 3.50 – 4.25	≥ 2 and < 3	≥ 3.50 – 4.50
E	≥ 4.25 – 5.00	≥ 1 and < 2	≥ 4.50 – 5.50
F	> 5.00	< 1	> 5.50

It is important to note that, in addition to the characteristics directly related to bicycle, pedestrian, and transit environments along a corridor, roadway characteristics such as traffic volumes and speeds have direct correlation in affecting the multi-modal LOS results.

F. Existing Bicycle Analysis

Similar to the pedestrian analysis completed in the previous section, a qualitative review of existing bicycling facilities and conditions was conducted. In general, there is less organized bicycle connectivity and safe bicycling routes in the study area corridor compared to existing pedestrian facilities. There are a number of highly utilized greenway off-road facilities for bicyclists in the broad study area, but little connectivity to and through the E-F District itself. Recent bike lane improvements and upcoming planned improvements for facilities in the northern portion of the study area will allow better opportunities for cyclists in that area, but additional connectivity will be needed to link those areas with the E-F District.

Looking at Bicycle LOS results from **Table 17** within the E-F District primary roadways, the Elliott Road and Ephesus Church Road corridors score LOS C and D, respectively, indicating conditions where bicycling is possible, but not ideal. Higher traffic volumes and lack of dedicated facilities impair bicycle LOS performance along all segments on E. Franklin Street and US 15-501. The paralleling northbound side path along US 15-501 prior to Estes Drive is evaluating by ARTPLAN as LOS A.

G. Existing Crash Analysis

A strip crash analysis of five corridors within the E-F SAP area was conducted using the NCDOT TEAAS software for the most current five (5) year study range at the initiation of the existing conditions study. Strip crash analysis data and crash rates for the five corridors is summarized in **Table 19**. The primary focus of tabular results is the comparison of summary statistics for crashes along each corridor in the District to comparable 2013-2015 data from the NCDOT Traffic Safety Unit for similar facilities state-wide. ***Appendix F*** presents raw crash data taken from the most recent information compiled from the TEAAS software platform for each corridor.

Results in **Table 19** are summarized for each corridor below:

US 15-501 (Fordham Boulevard) – crash rate data for this corridor within the E-F District are consistently higher than state-wide averages for all categories with the exception of fatalities. Existing traffic congestion throughout the day is likely a major contributing factor in the resulting crash rates.

E. Franklin Street – crash rate data for E. Franklin Street in the area of the E-F District indicates that rates are lower than state-wide averages for similar 5-lane undivided facilities, with the exception of night time crashes.

Ephesus Church Road – crash rate data comparisons indicate that, while overall crash rates are higher than similar facilities state-wide, other crash categories are generally lower along Ephesus Church Road than similar facilities.

Elliott Road – crash rate data for the short segment of Elliott Road within the E-F District indicates higher crash rates for this segment compared to state-wide similar facilities, with the exception of fatalities. Existing congestion at each end of Elliott Road (E. Franklin Street and US 15-501), coupled with high turning volumes from driveways along the facility, and potentially the amount of horizontal curvature and sight distance along the roadway could be contributing factors in the high crash rates.

Legion Road – crash rate data for the segment of Legion Road within the E-F District indicates much lower crash rates for this segment compared to state-wide similar facilities for all crash categories listed. Very few crashes were identified along this corridor compared to the other corridors in the District, though traffic volumes along Legion Road are comparable to the other minor arterial/collector facilities like Elliott Road.

Eastgate Shopping Center Driveway – crash rate data for this short segment within the Eastgate Shopping Center indicates a higher than average rate for total crashes, but lower rates for all other categories. The high driveway aisle density along the roadway could be contributing to the high overall crash rate, while low operating speeds may be contributing to the lower than average categories.

In addition to the crash rate analysis, a breakout of crash types for each corridor was completed and results are shown in **Table 20**. For all corridors, rear-end crashes are the predominate crash type, again pointing to the fact that existing congestion patterns can lead to high proportions of this crash type. A high number of turning crashes (both left-turn and right-turn) are evident for several corridors – particularly Elliott Road within the E-F District.

Table 19. Five Year Study Area Crash Rate Comparison

Corridor	Facility Type	Crashes Per 100 Million Vehicle Miles				
		Total Crash Rate	Fatal Crash Rate	Non-Fatal (Injury) Crash Rate	Night Crash Rate	Wet Crash Rate
US 15-501	Urban US Route 4-Lane Divided – No Access Control	410.78	0.85	144.58	108.01	75.69
NC Average		305.77	0.99	89.52	67.54	55.88
E. Franklin Street	Urban Secondary Road 4+ Lane Undivided with Center Left-Turn Lane	379.64	0.00	103.95	92.65	70.05
NC Average		430.62	1.03	131.54	87.62	82.11
Ephesus Church Road	Urban 2-Lane Secondary Road	368.75	0.00	66.19	37.82	47.28
NC Average		247.39	1.18	76.16	65.51	46.04
Elliott Road	Urban 2-Lane Secondary Road with Center Left-Turn Lane	595.33	0.00	225.26	128.72	64.36
NC Average		324.59	1.66	99.33	74.81	60.40
Legion Road	Urban 2-Lane Secondary Road	92.42	0.00	11.55	11.55	11.55
NC Average		247.39	1.18	76.16	65.51	46.04
Eastgate Shopping Center Drive	Urban 2-Lane Secondary Road	338.91	0.00	56.49	56.49	0.00
NC Average		247.39	1.18	76.16	65.51	46.04

RED = Facility Rate is Worse than State-wide Averages, GREEN = Facility Rate is Better than State-wide Averages

Table 20. Five Year Study Area Crash Type Summary

Corridor	Number of Crashes						
	Total	Angle	Left-Turn	Rear-End	Right-Turn	Sideswipe	Ped/Bike
US 15-501	483	34	23	326	13	32	7
E. Franklin Street	168	15	19	99	2	13	2
Ephesus Church Road	39	9	4	13	2	4	0
Elliott Road	37	10	18	5	1	1	0
Legion Road	8	1	2	3	0	0	0
Eastgate Shopping Center Drive	6	1	0	2	0	2	1

IV. CONCLUSIONS/SUMMARY OF EXISTING CONDITIONS

In summary, this technical memorandum's purpose to is establish baseline conditions for traffic operations and safety for all travel modes within the broad E-F TIA study area, with a particular focus on the network within the E-F District. A comprehensive effort into collecting all pertinent field data was undertaken in October and November 2016 that included traffic counts, pedestrian and bicycle counts, compilation of transit ridership and bus route capacities, and collection of crash data for the last five years. Detailed field observations and collection of all applicable planning documents, traffic control data, and models was also done at this time.

Related to each travel mode, the existing conditions analyses provided in **Section III** can be summarized for each mode:

Vehicular operations – Peak hour analyses of the weekday AM, noon, and PM peak hours in the E-F TIA study area indicate several areas of peak traffic congestion in the project study area where individual intersection LOS falls below Town/NCDOT threshold for acceptable operation. Queue analyses verified similar areas where congestion currently exists, impairing traffic flow.

Transit operations – Peak hour load/capacity evaluations for all routes directly serving the E-F District was completed with assistance from CHT and GoTriangle sources. Peak hour load demands exceed available individual bus capacity on several routes, depending on route direction and time of day. AM inbound routes through the E-F District and corresponding PM outbound routes face the highest demands.

Pedestrian operations – The primary focus of pedestrian analyses for this study is the provision of adequate pedestrian facilities and crossings at intersections to provide connectivity within the E-F District and areas serving the District. Existing analysis results, both LOS estimates and general qualitative inspection of the existing pedestrian network indicate gaps in connectivity throughout the overall TIA study area and areas within the District, though several areas of high pedestrian activity exist.

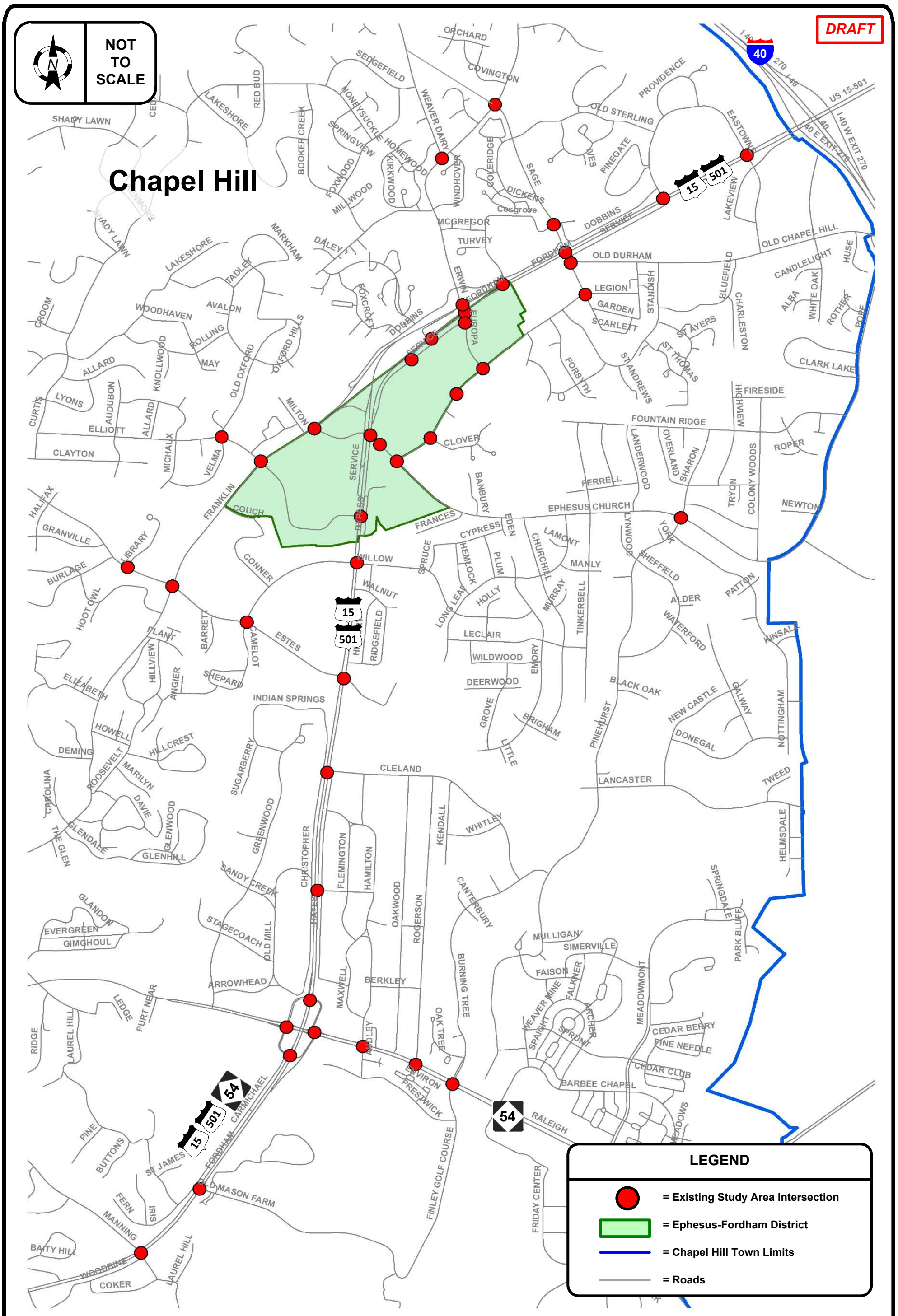
Bicycle operations – Similar to the pedestrian evaluations, bicycle analyses in this study focus on provision of safe and accessible bicycle routes within and outside the District. Comparatively, pedestrian accessibility is better than bicycle accessibility within and outside the District. There are locations throughout the larger study area where bicycling activity is present, but is more limited to off-road paved paths and greenways.

Crash analysis – Data from the NCDOT crash analysis software indicates that crash rates on major facilities serving the E-F District vary considerably in comparison to state-wide averages. Depending on the amount of congestion on the facility and its geometrics and amount of existing access points, corresponding rates were higher (US 15-501, Elliott Road) or lower (E. Franklin Street, Ephesus Church Road, Legion Road) than comparable state-wide averages. Primarily crashes in and near the E-F District were rear-end type collisions, with certain facilities exhibiting high numbers of turning crashes at intersections or driveways.

As part of the existing conditions analysis process, a sub-area travel demand model was created, based on the existing Triangle Regional Model. Information from this sub-area model was used in comparison with existing peak hour data to aid the development of the peak hour traffic microsimulation model used in this study. The sub-area model will be used to evaluate travel growth for 2030 future year scenarios developed in the next phase of the E-F TIA.

Appendix A –

Figures



TOWN OF CHAPEL HILL / HNTB	**Ephesus Church Road - Fordham Boulevard District Transportation Impact Analysis**	**DATE:** February 2017
	PROJECT STUDY AREA	**FIGURE 1**

Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

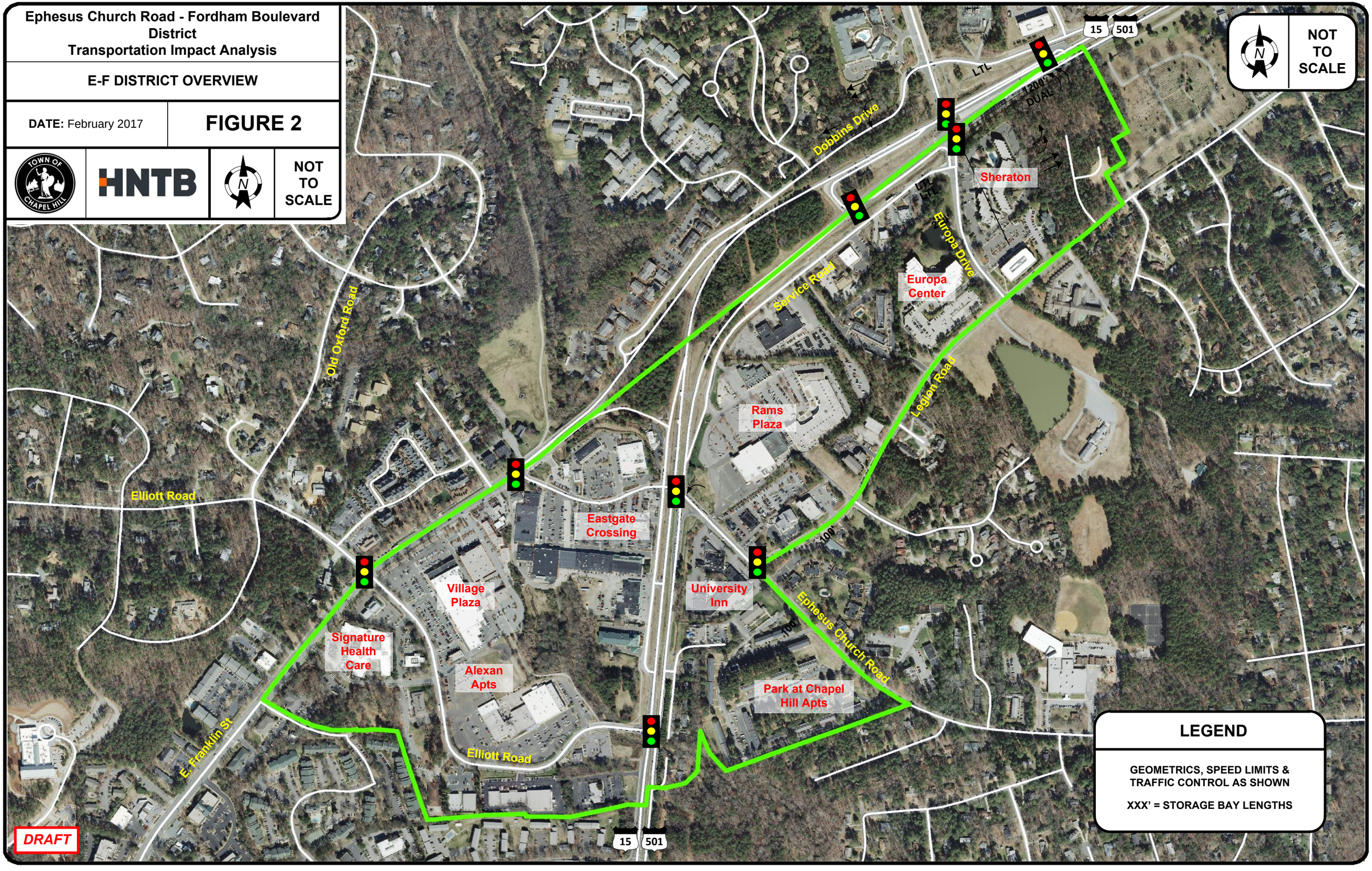
E-F DISTRICT OVERVIEW

DATE: February 2017

FIGURE 2

HNTB

NOT TO SCALE



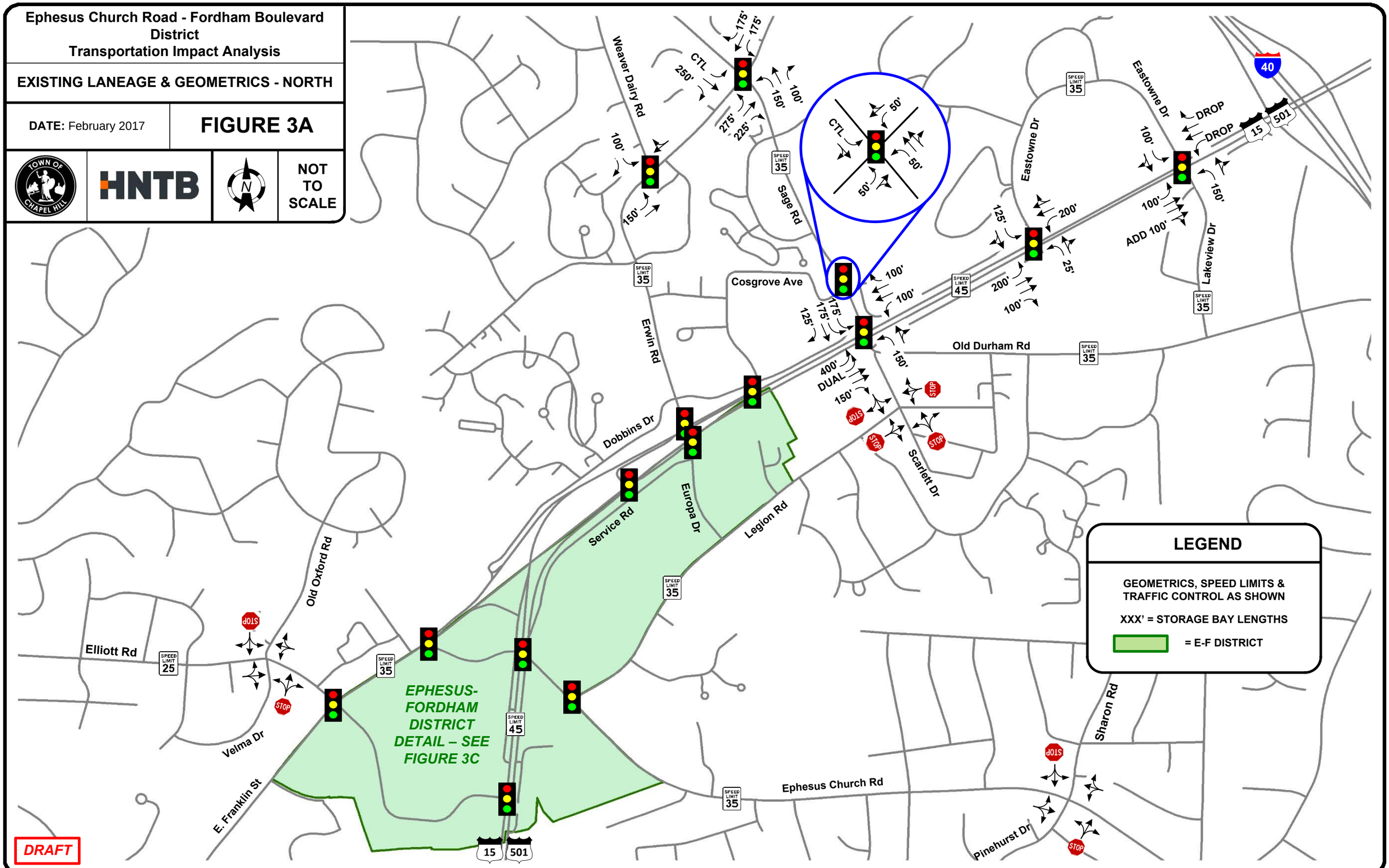
Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

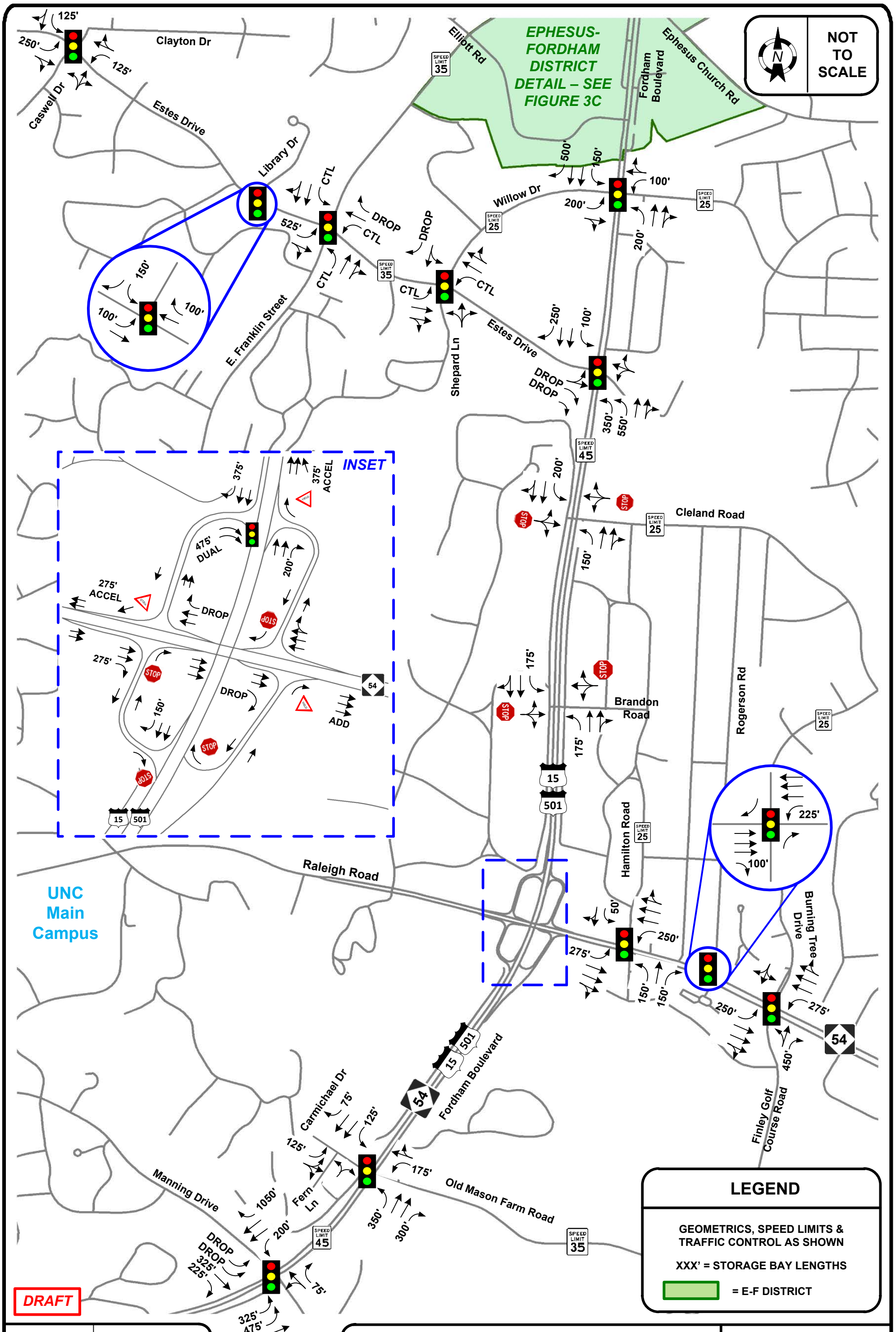
EXISTING LANEAGE & GEOMETRICS - NORTH

DATE: February 2017

FIGURE 3A

TOWN OF CHAPEL HILL | HNTB | N | NOT TO SCALE





TOWN OF CHAPEL HILL

HNTB

Ephesus Church Road - Fordham Boulevard District Transportation Impact Analysis

EXISTING LANEAGE & GEOMETRICS - SOUTH

DATE: February 2017

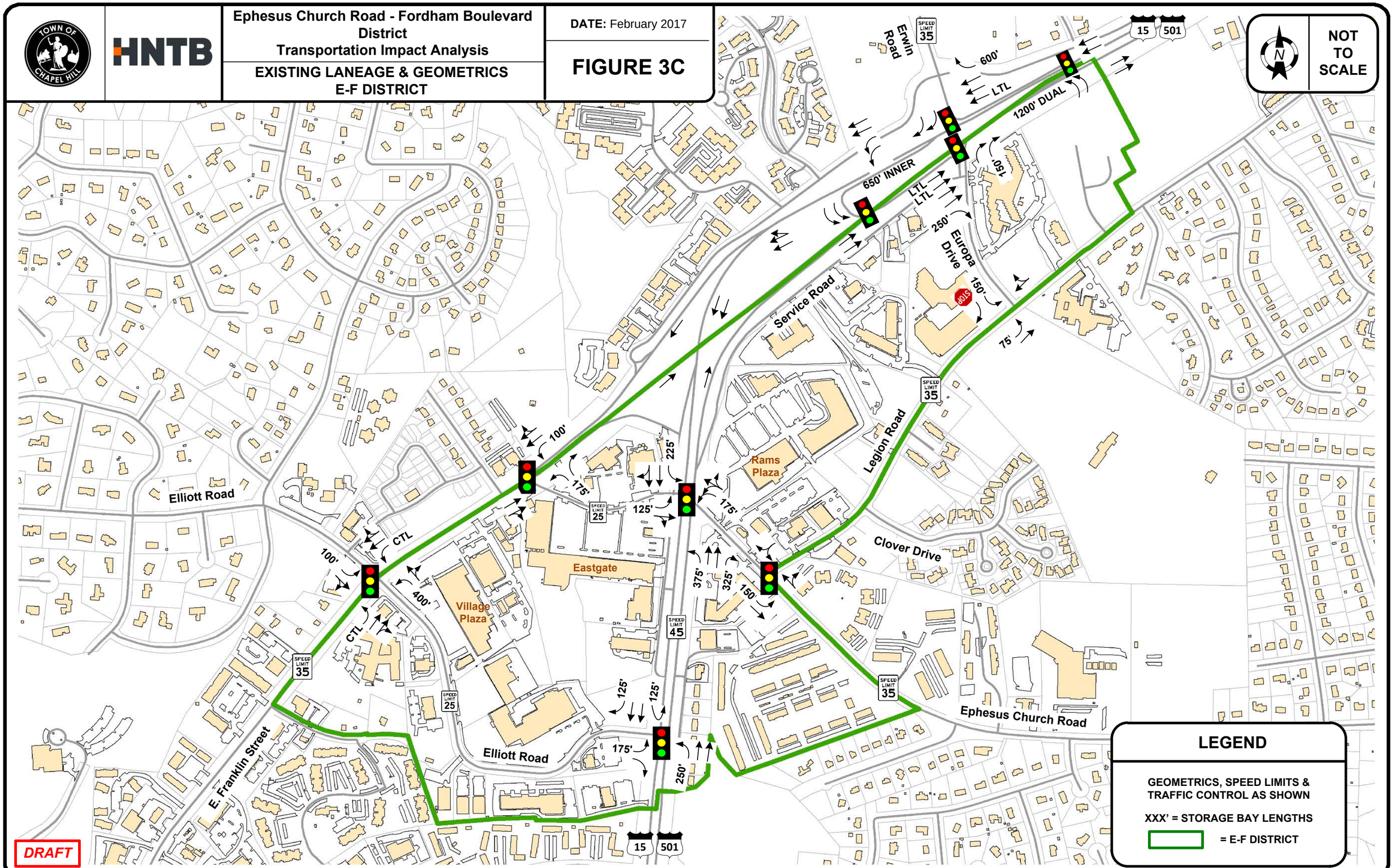
FIGURE 3B

Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

EXISTING LANEAGE & GEOMETRICS
E-F DISTRICT

DATE: February 2017

FIGURE 3C



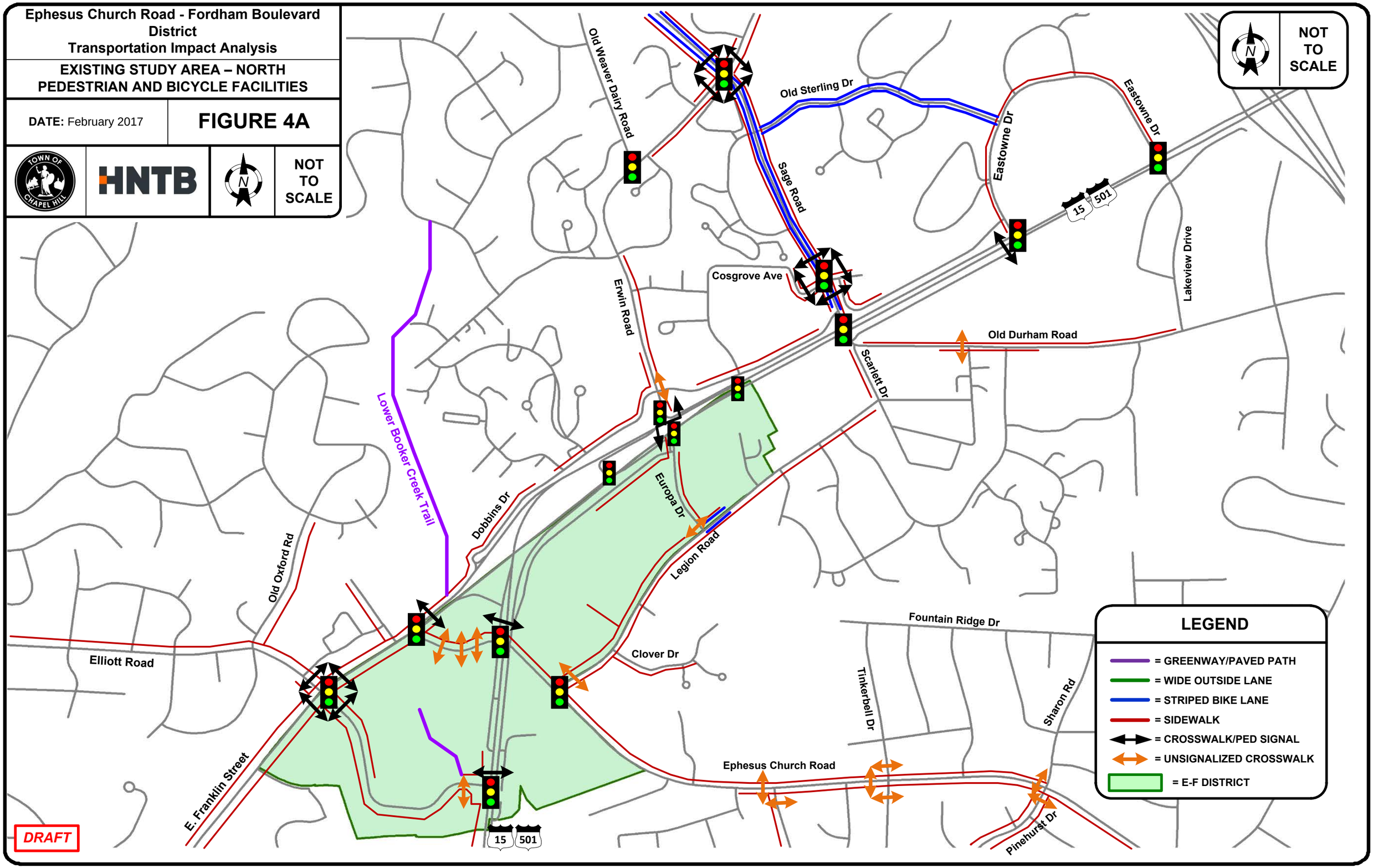
Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

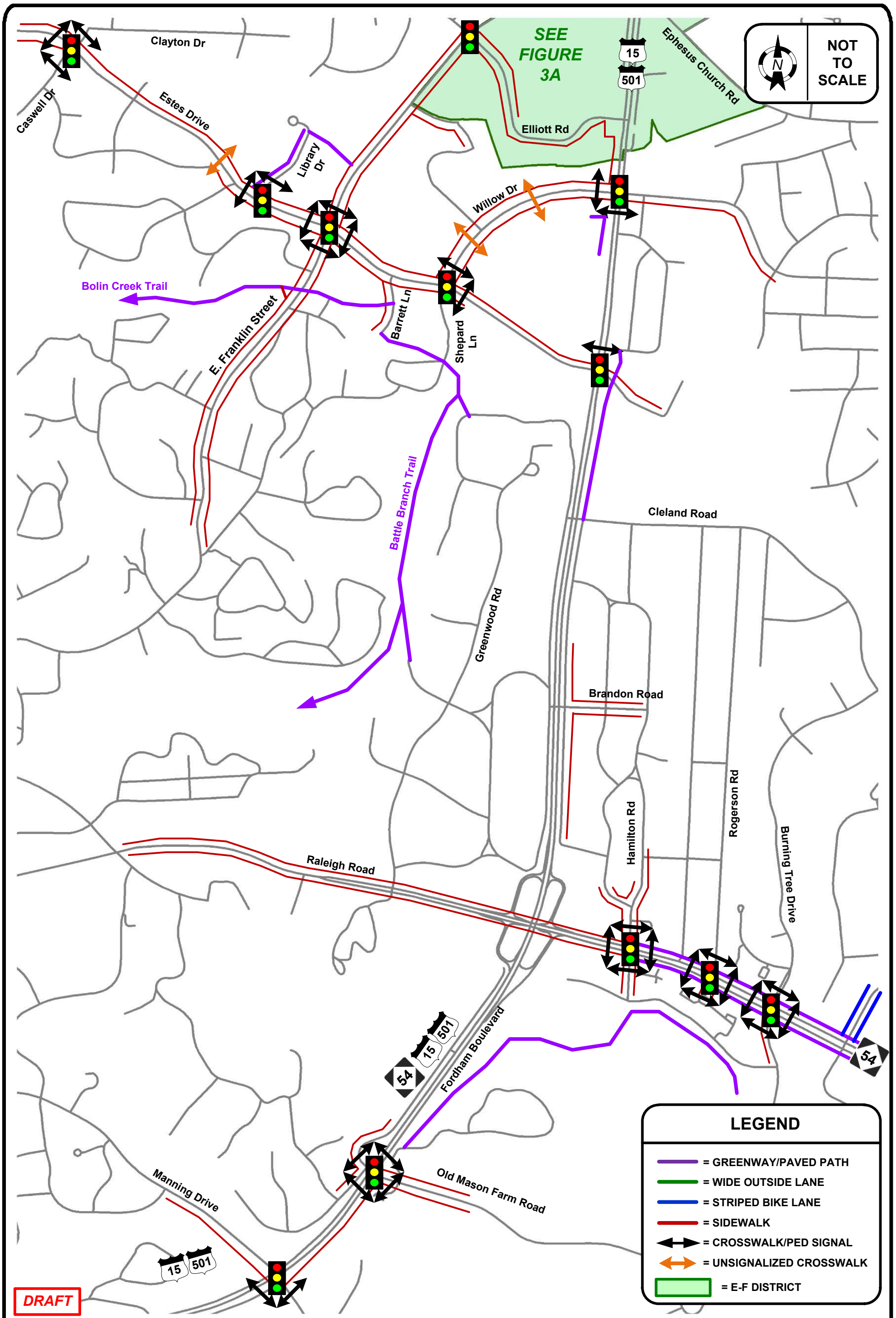
EXISTING STUDY AREA – NORTH
PEDESTRIAN AND BICYCLE FACILITIES

DATE: February 2017

FIGURE 4A

NOT TO SCALE





TOWN OF CHAPEL HILL

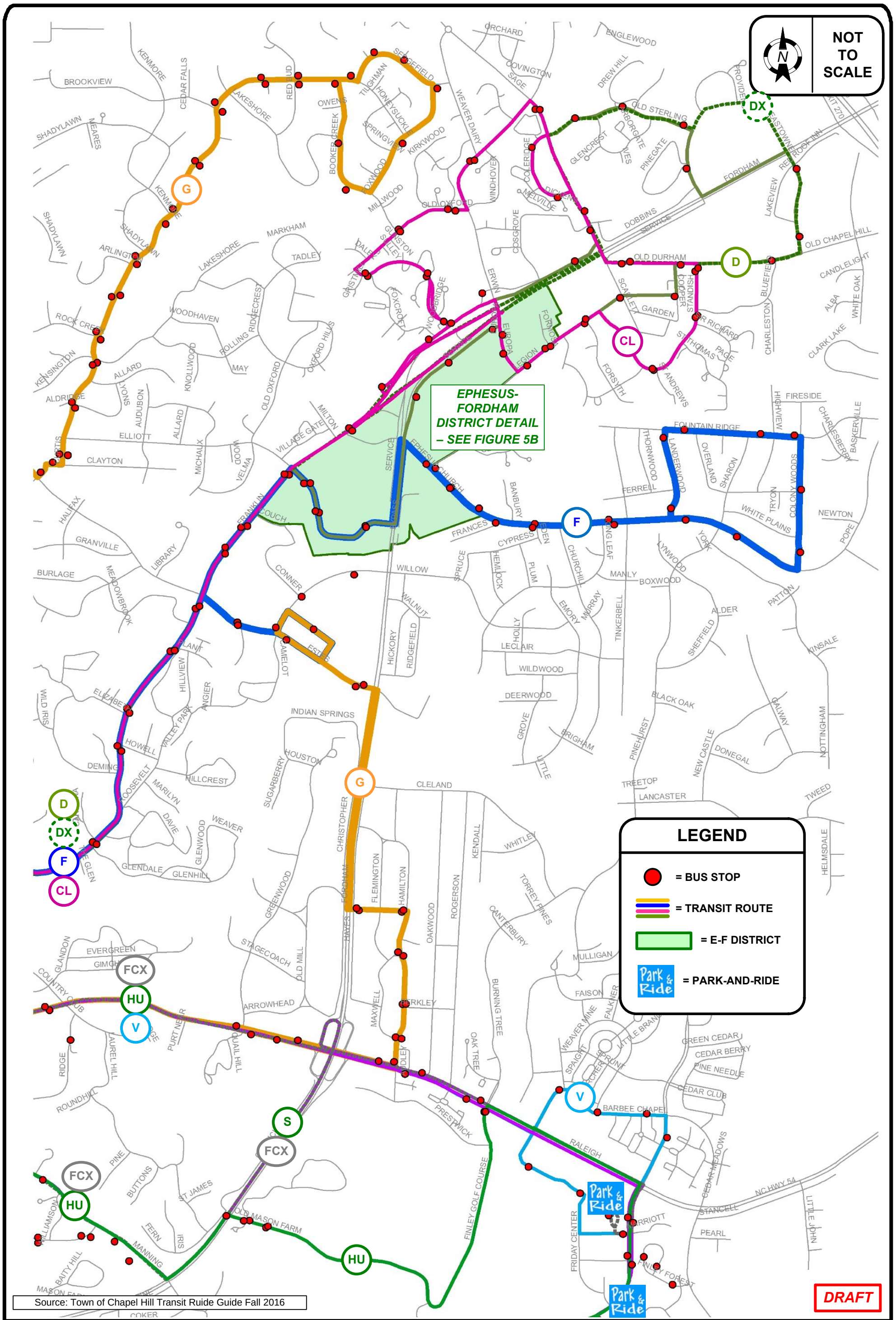
HNTB

Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

EXISTING STUDY AREA - SOUTH
PEDESTRIAN AND BICYCLE FACILITIES

DATE: February 2017

FIGURE 4B



Source: Town of Chapel Hill Transit Ruide Guide Fall 2016

TOWN OF CHAPEL HILL

HNTB

Ephesus Church Road - Fordham Boulevard District Transportation Impact Analysis

EXISTING CHT TRANSIT ROUTES/STOPS

DATE: February 2017

FIGURE 5A

TOWN OF CHAPEL HILL

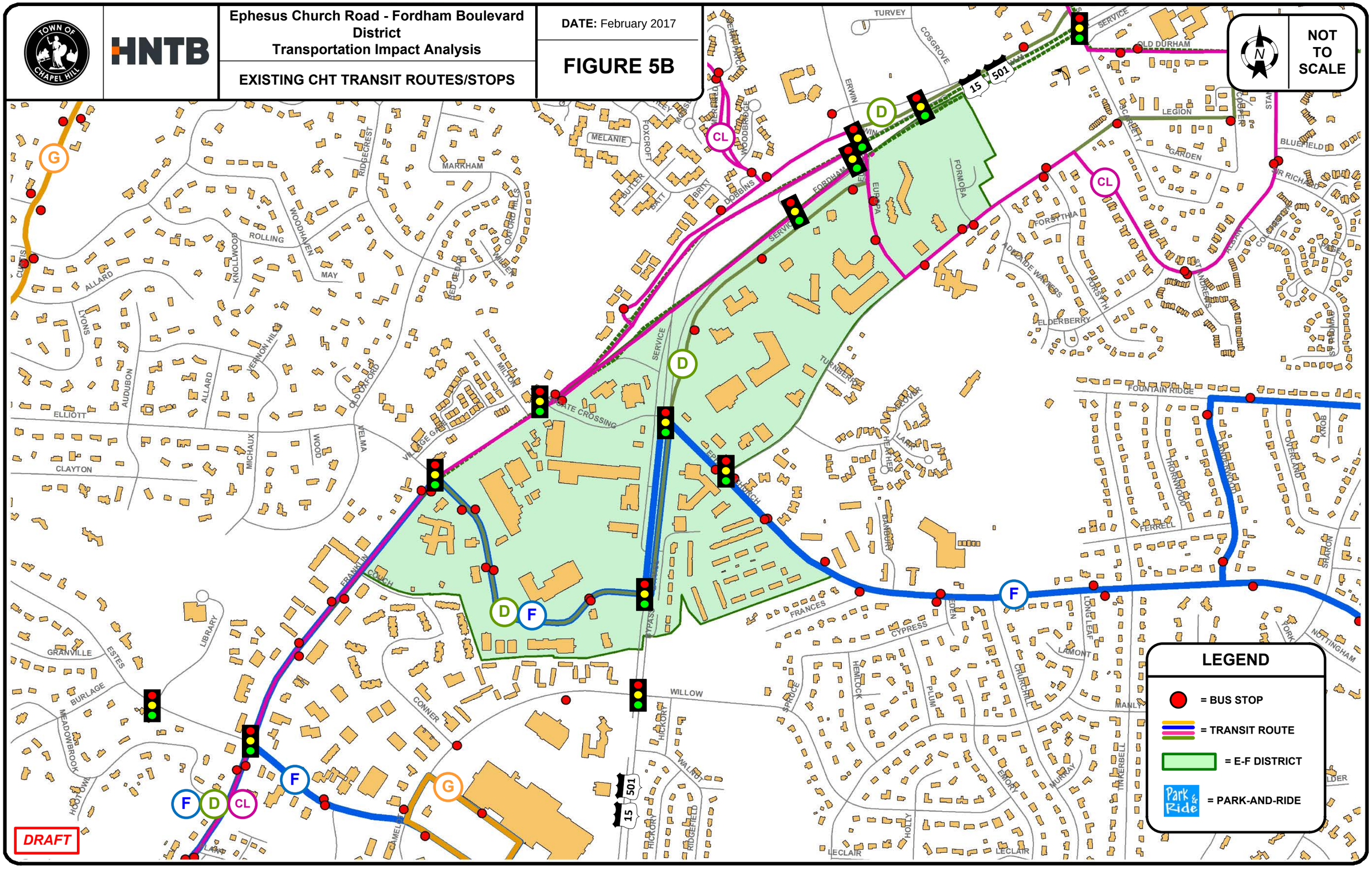
HNTB

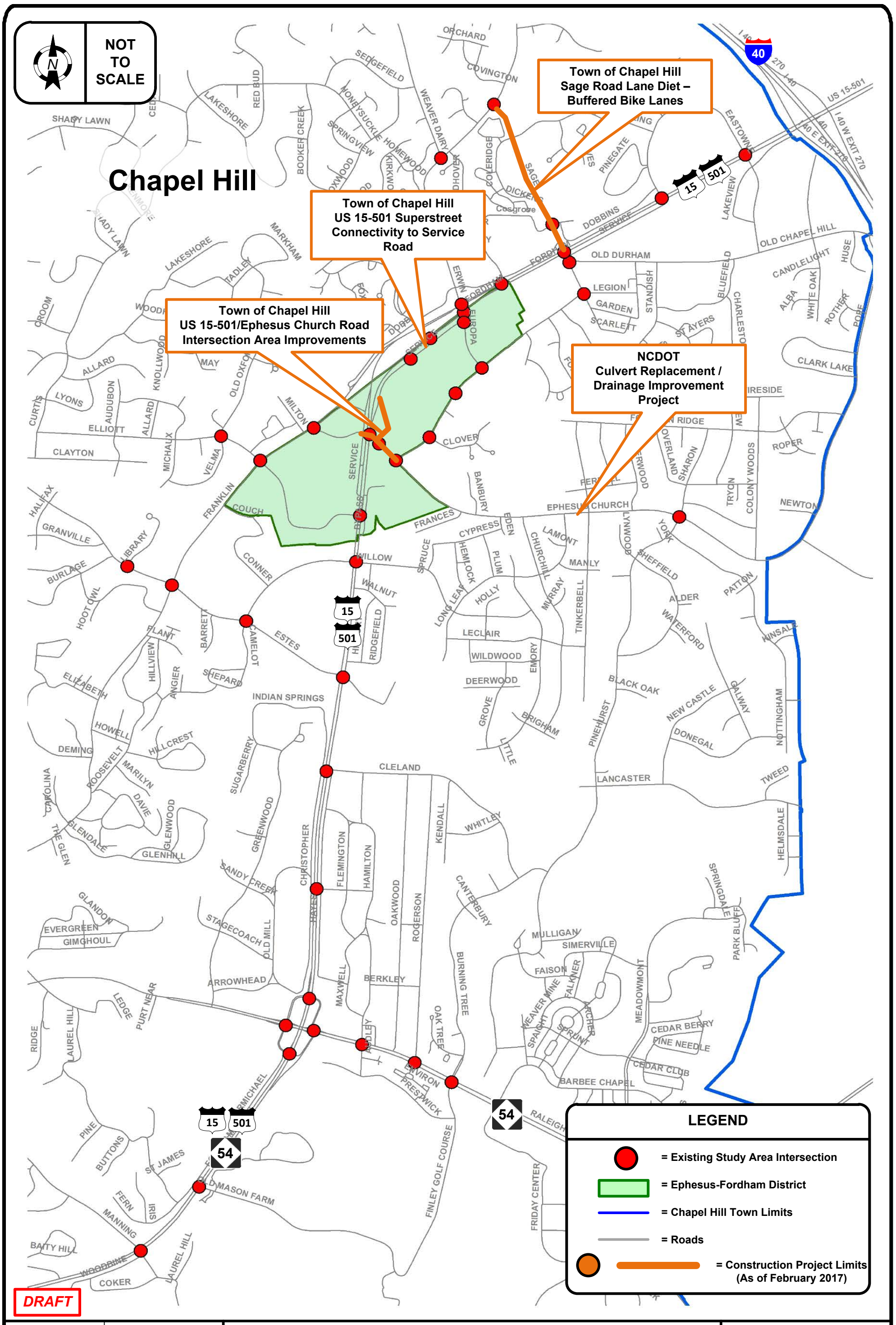
Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

EXISTING CHT TRANSIT ROUTES/STOPS

DATE: February 2017

FIGURE 5B





Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

FALL 2016 CONSTRUCTION PROJECTS

DATE: February 2017

FIGURE 6

Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

2016 EXISTING PEAK HOUR TRAFFIC VOLUMES

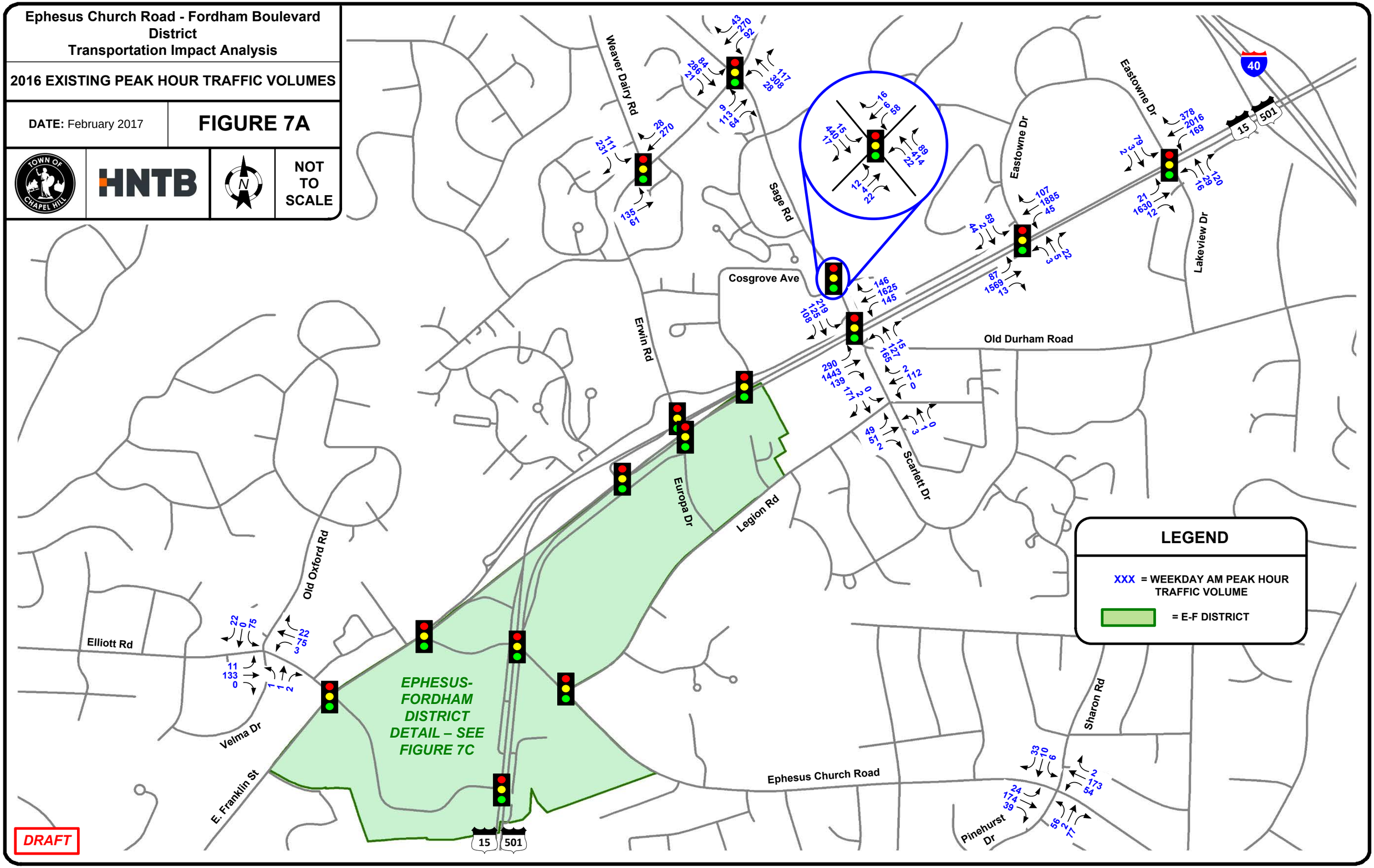
DATE: February 2017

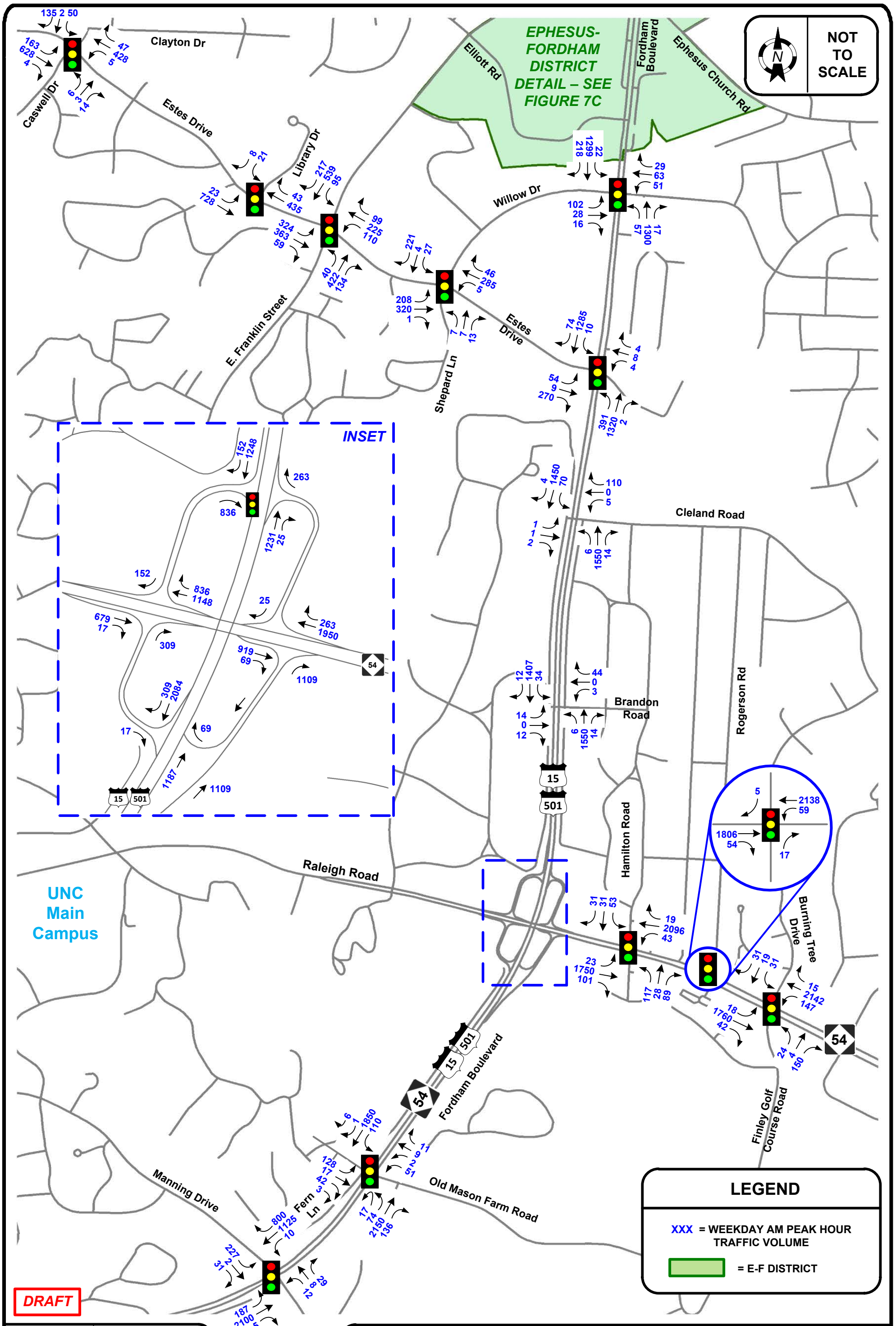
FIGURE 7A

TOWN OF CHAPEL HILL

HNTB

NOT TO SCALE





TOWN OF CHAPEL HILL

HNTB

Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

2016 EXISTING PEAK HOUR TRAFFIC VOLUMES

DATE: February 2017

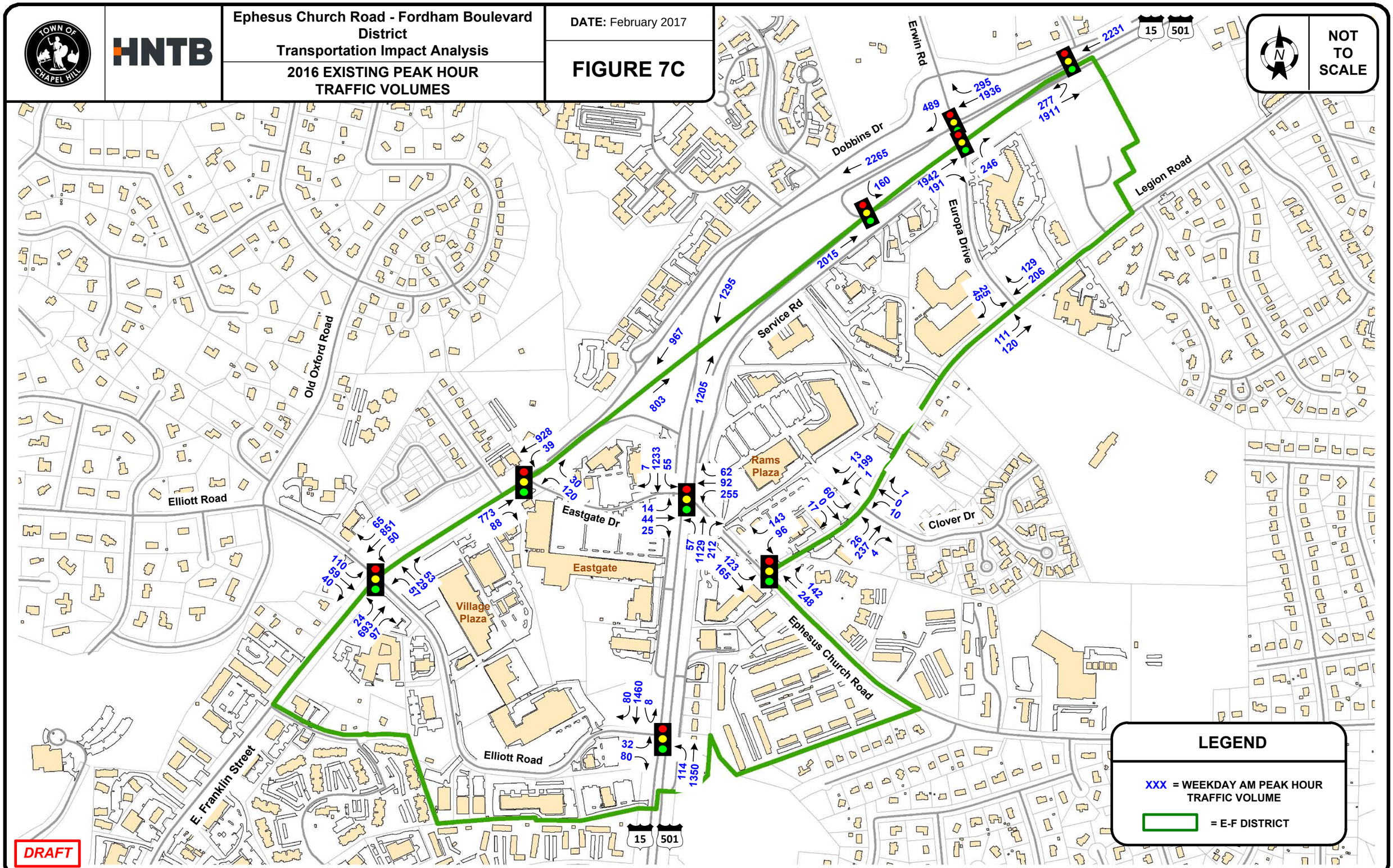
FIGURE 7B

Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

DATE: February 2017

FIGURE 7C

2016 EXISTING PEAK HOUR TRAFFIC VOLUMES



Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

2016 EXISTING PEAK HOUR TRAFFIC VOLUMES

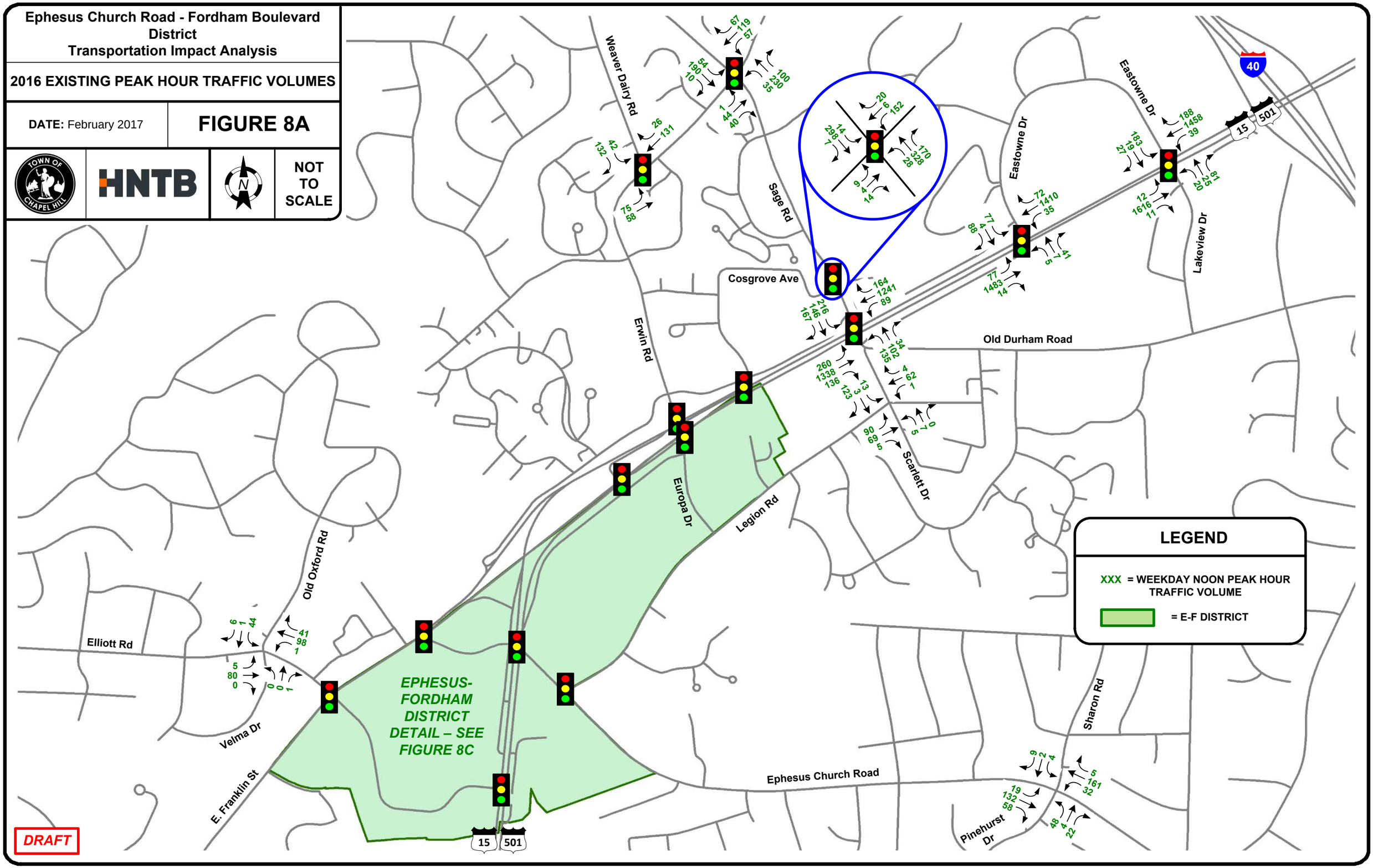
DATE: February 2017

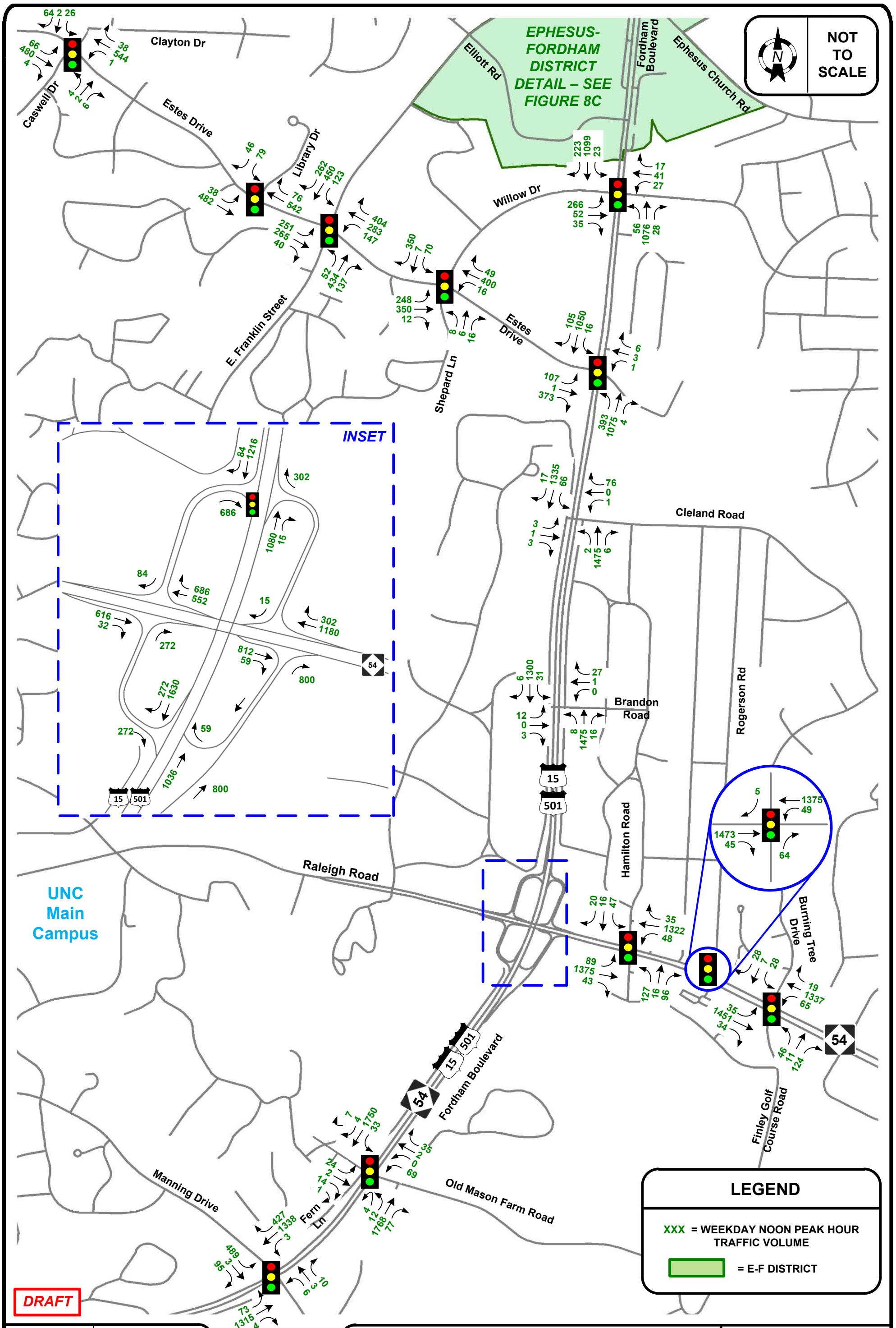
FIGURE 8A

TOWN OF CHAPEL HILL

HNTB

NOT TO SCALE





TOWN OF CHAPEL HILL

HNTB

Ephesus Church Road - Fordham Boulevard District Transportation Impact Analysis

2016 EXISTING PEAK HOUR TRAFFIC VOLUMES

DATE: February 2017

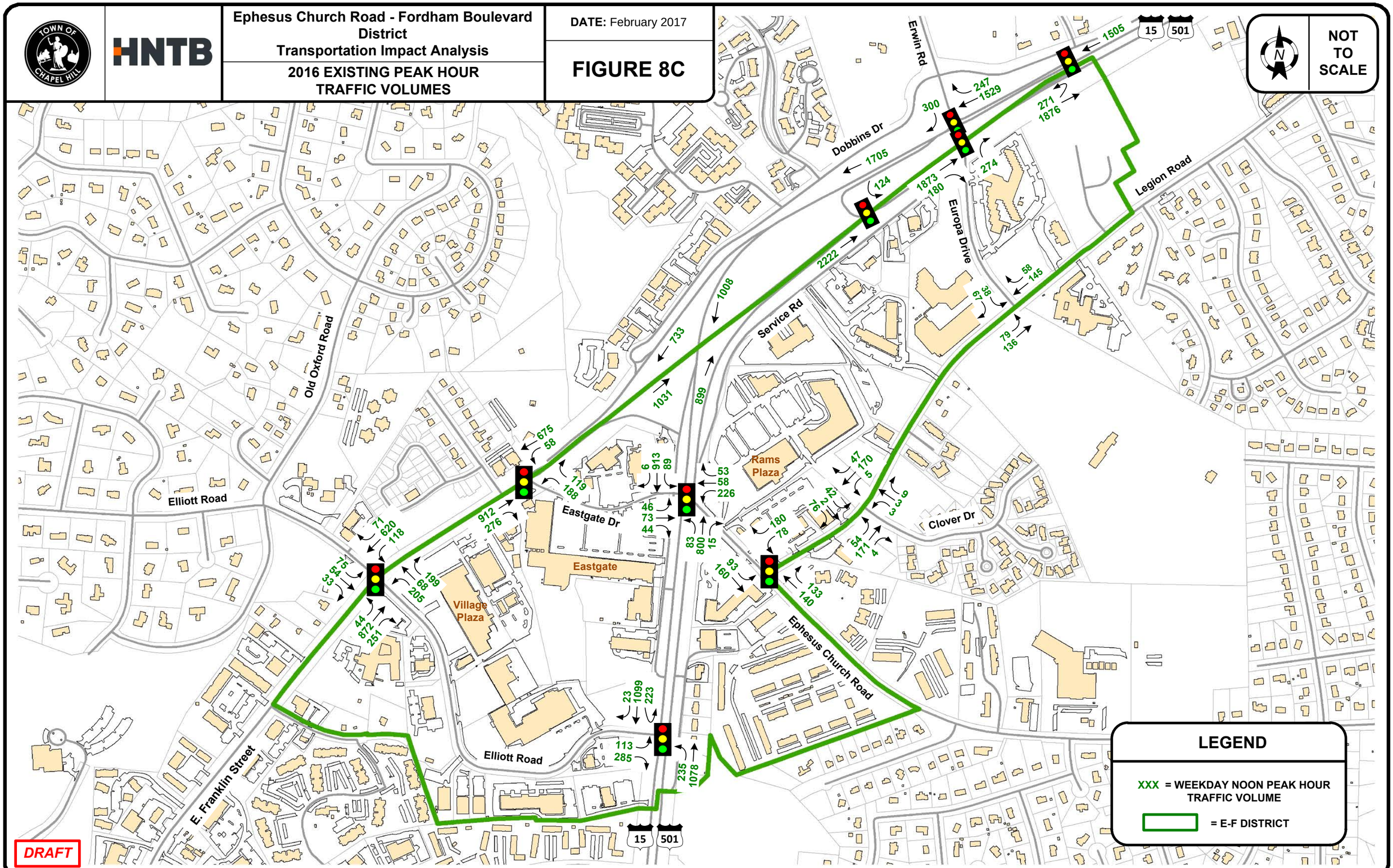
FIGURE 8B

Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

DATE: February 2017

FIGURE 8C

2016 EXISTING PEAK HOUR TRAFFIC VOLUMES



Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

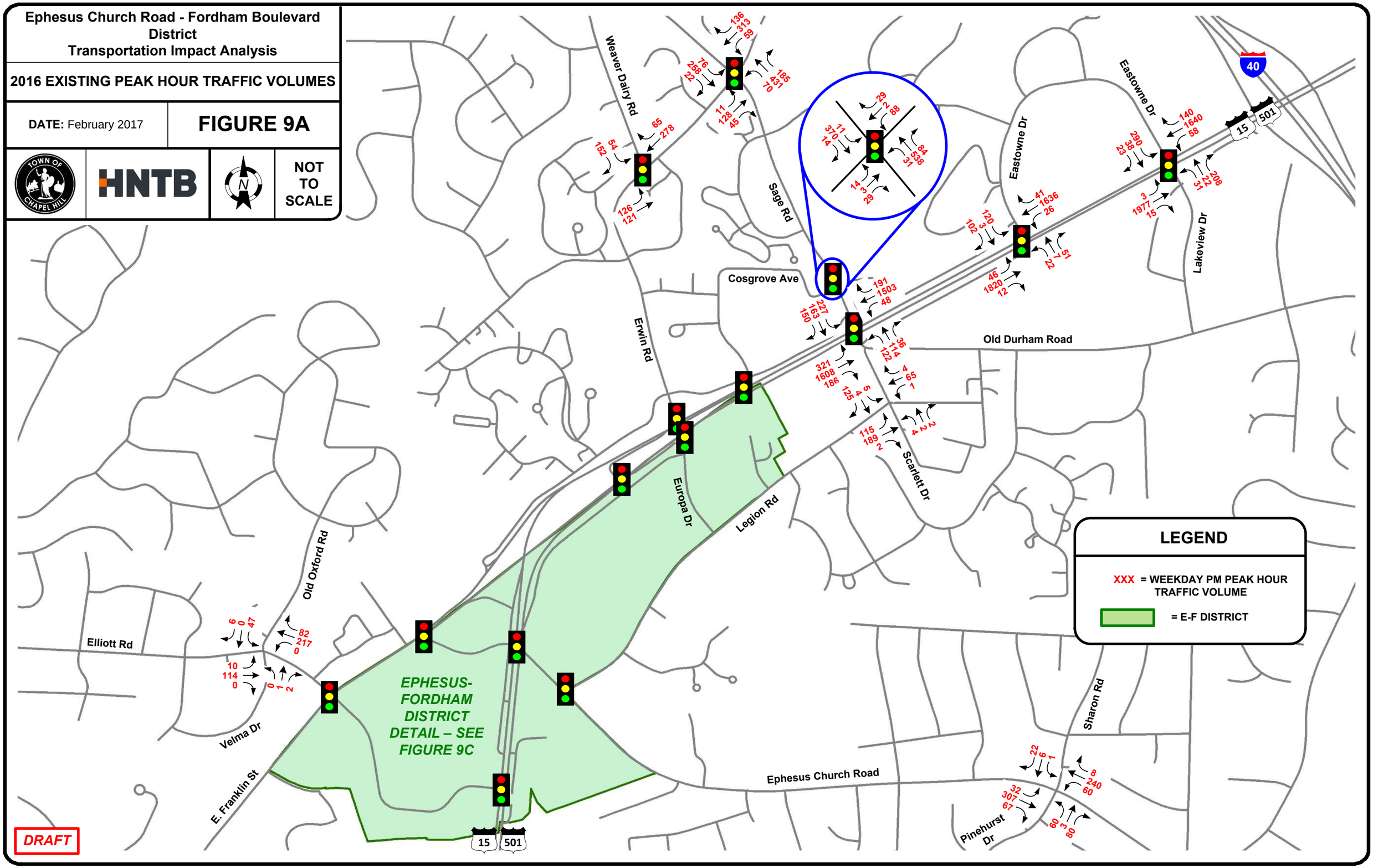
2016 EXISTING PEAK HOUR TRAFFIC VOLUMES

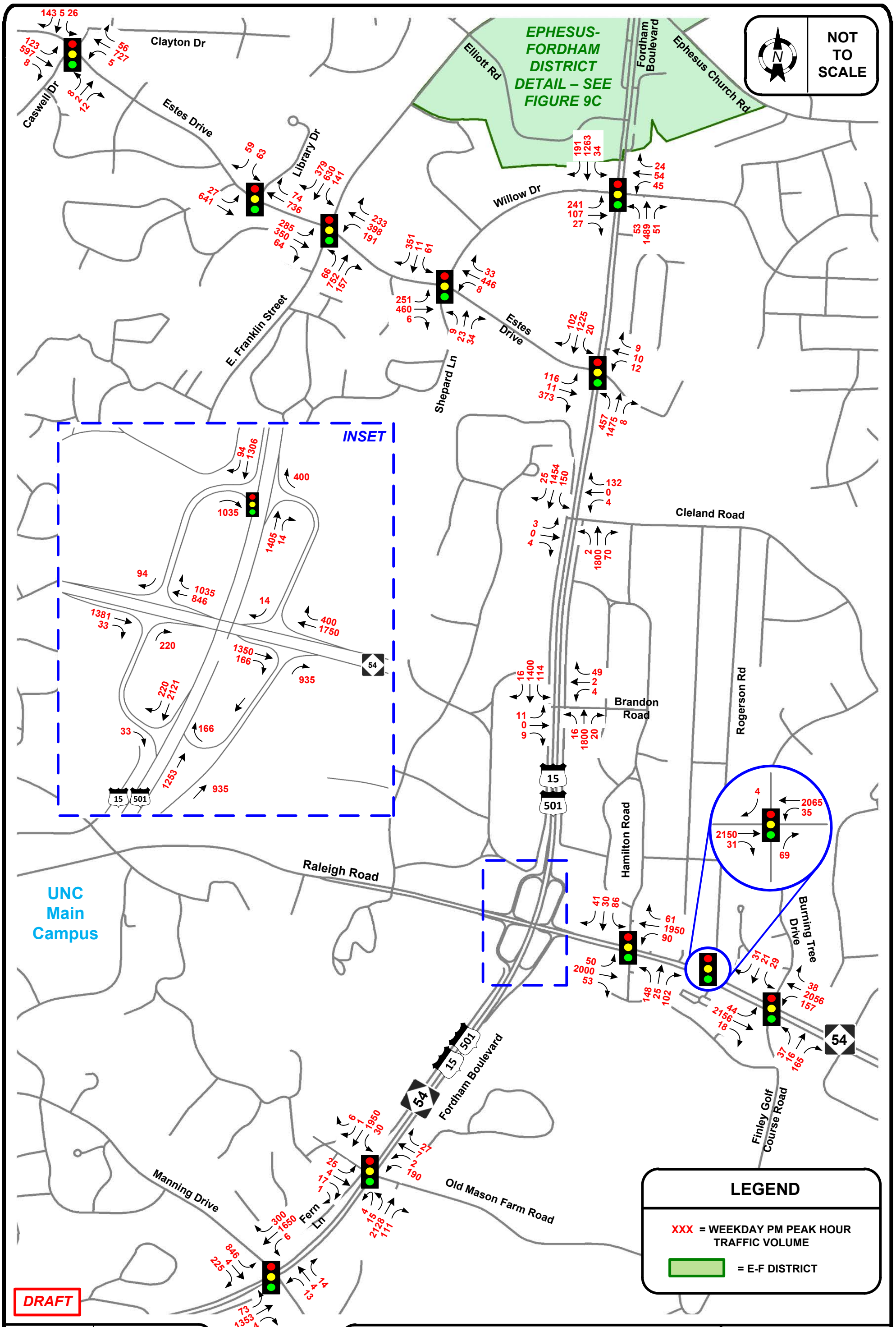
DATE: February 2017

FIGURE 9A

HNTB

NOT TO SCALE





TOWN OF CHAPEL HILL

HNTB

Ephesus Church Road - Fordham Boulevard District Transportation Impact Analysis

2016 EXISTING PEAK HOUR TRAFFIC VOLUMES

DATE: February 2017

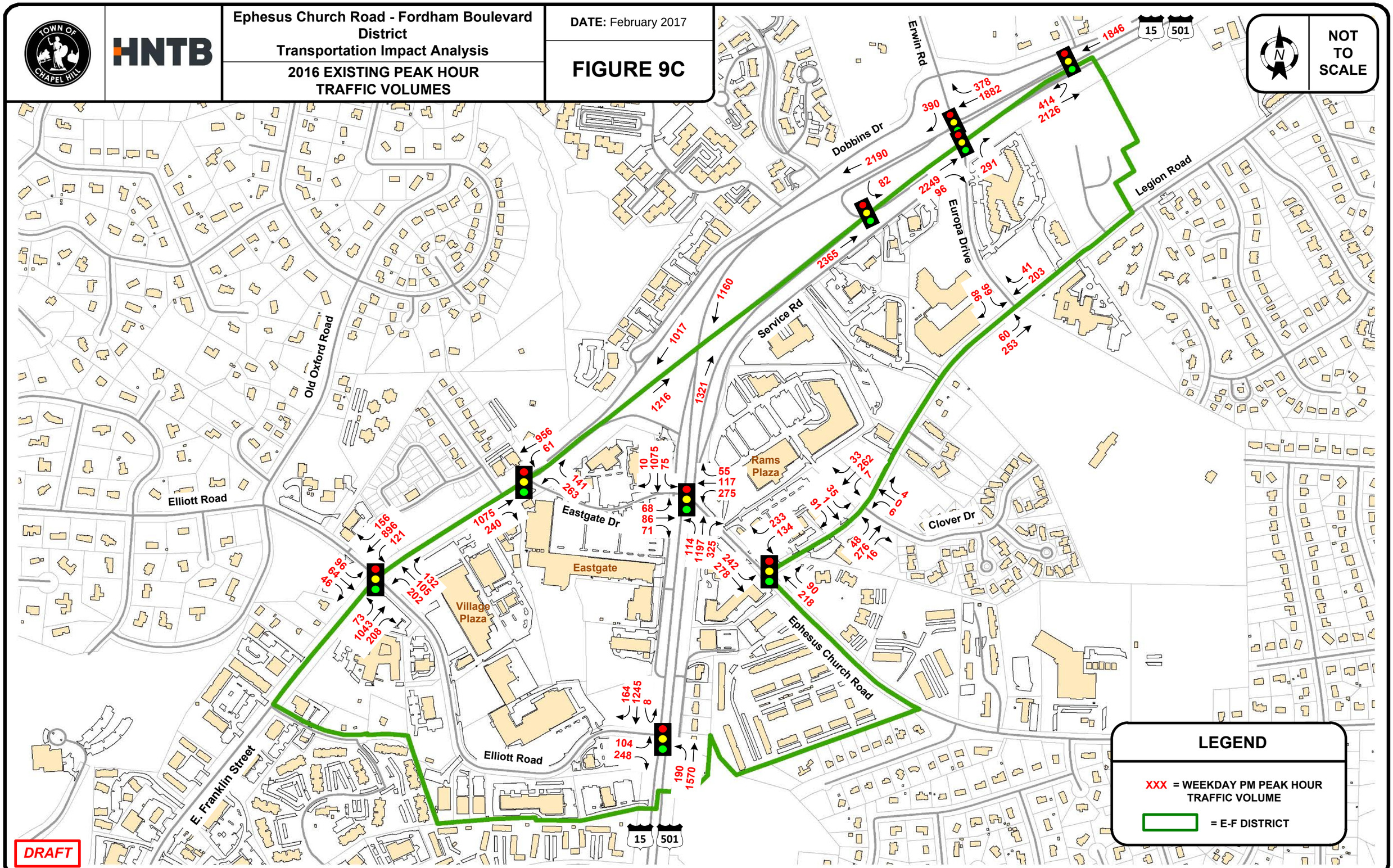
FIGURE 9B

Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

DATE: February 2017

FIGURE 9C

2016 EXISTING PEAK HOUR TRAFFIC VOLUMES



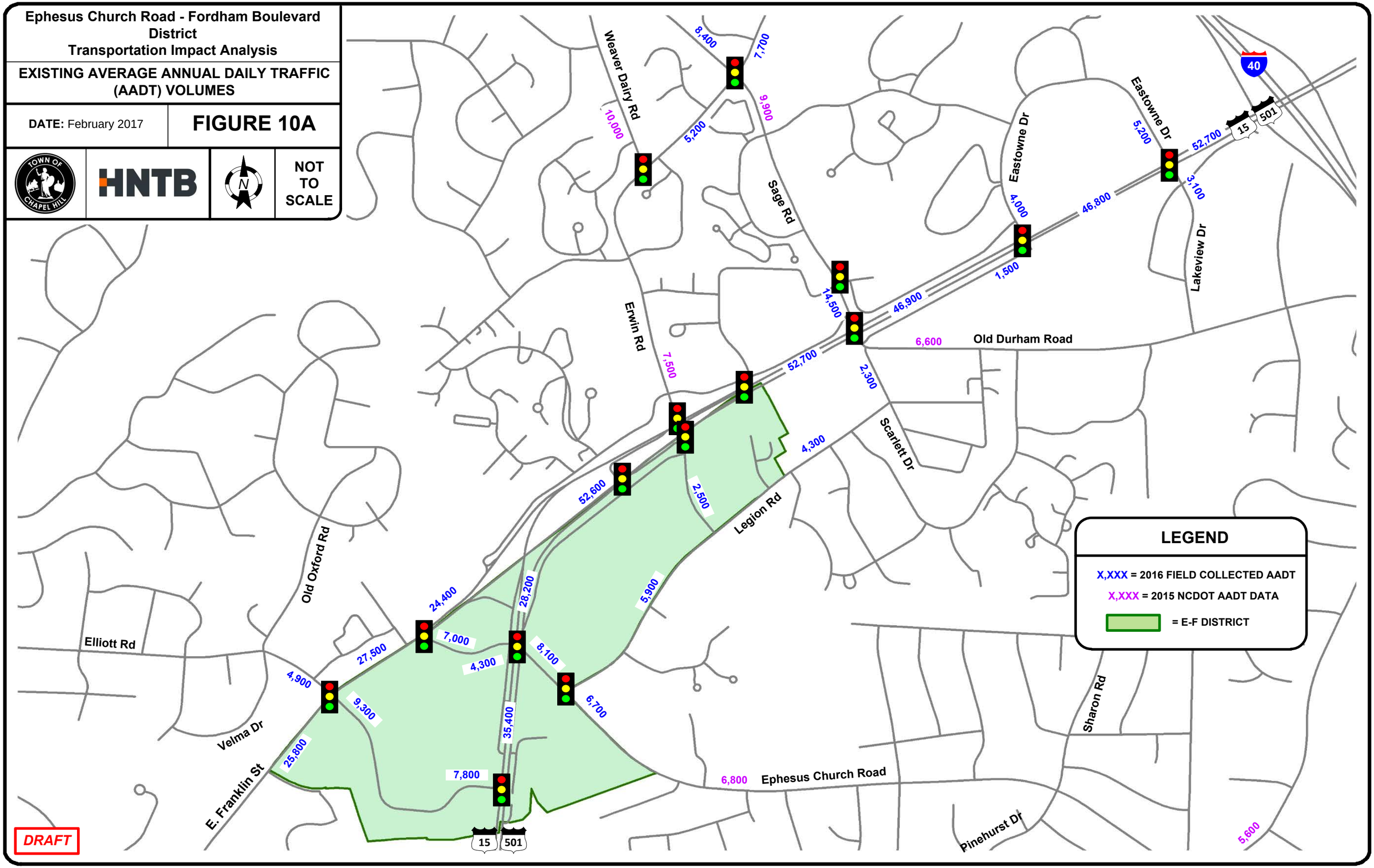
Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

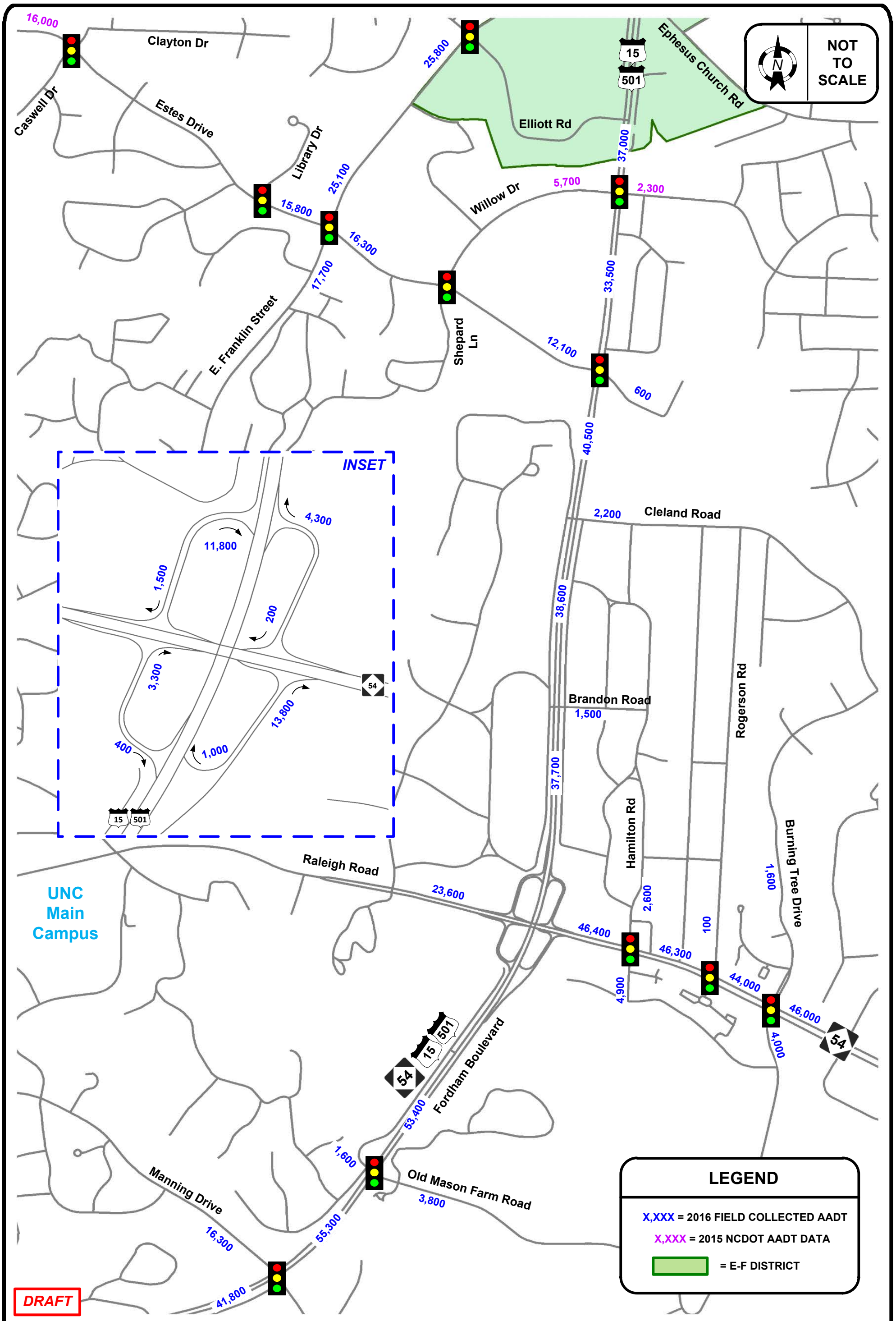
EXISTING AVERAGE ANNUAL DAILY TRAFFIC (AADT) VOLUMES

DATE: February 2017

FIGURE 10A

NOT TO SCALE





TOWN OF CHAPEL HILL

HNTB

Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

DATE: February 2017

EXISTING AVERAGE ANNUAL DAILY TRAFFIC (AADT) VOLUMES

FIGURE 10B

Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

12 HOUR PEDESTRIAN AND BICYCLE VOLUMES

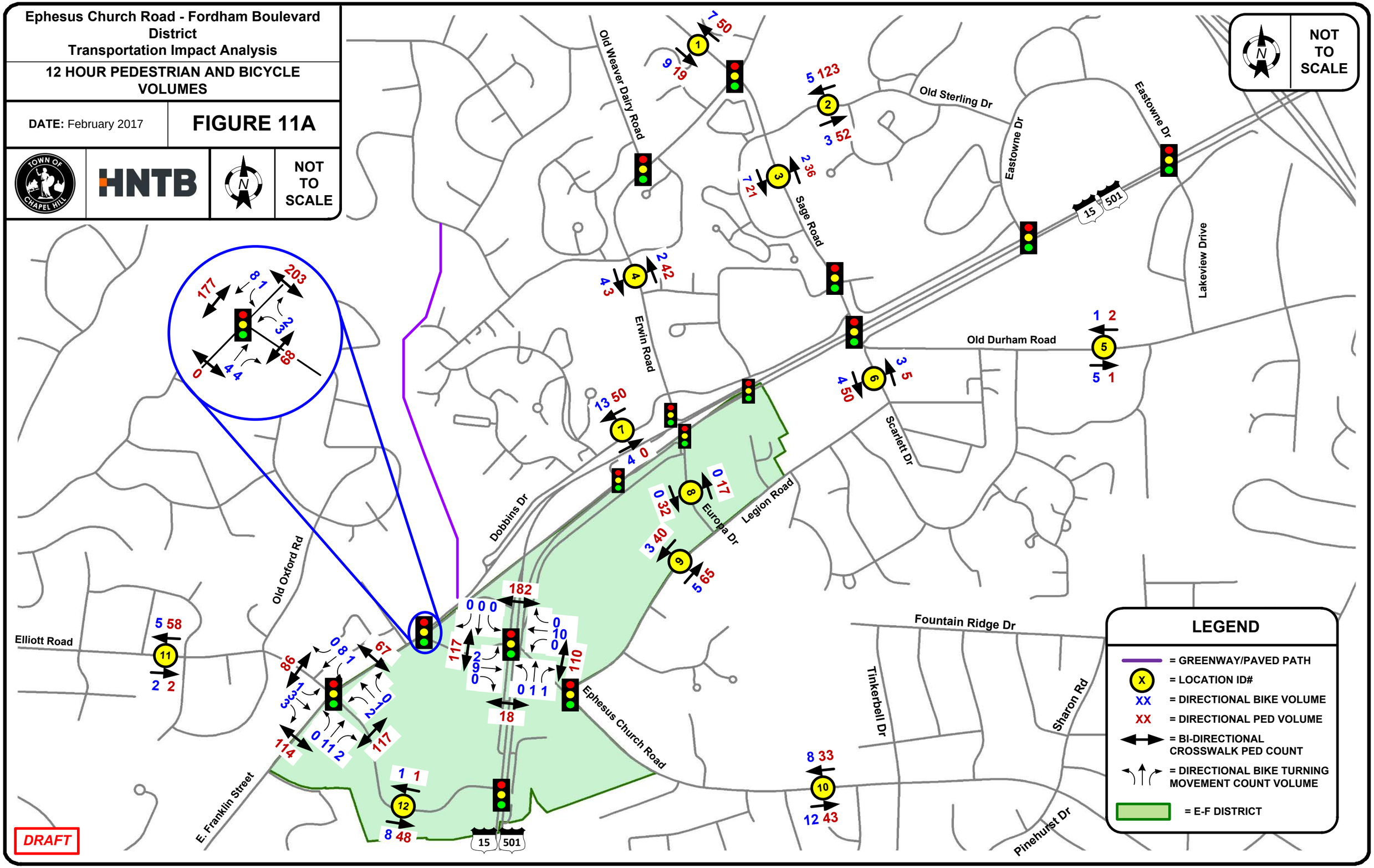
DATE: February 2017

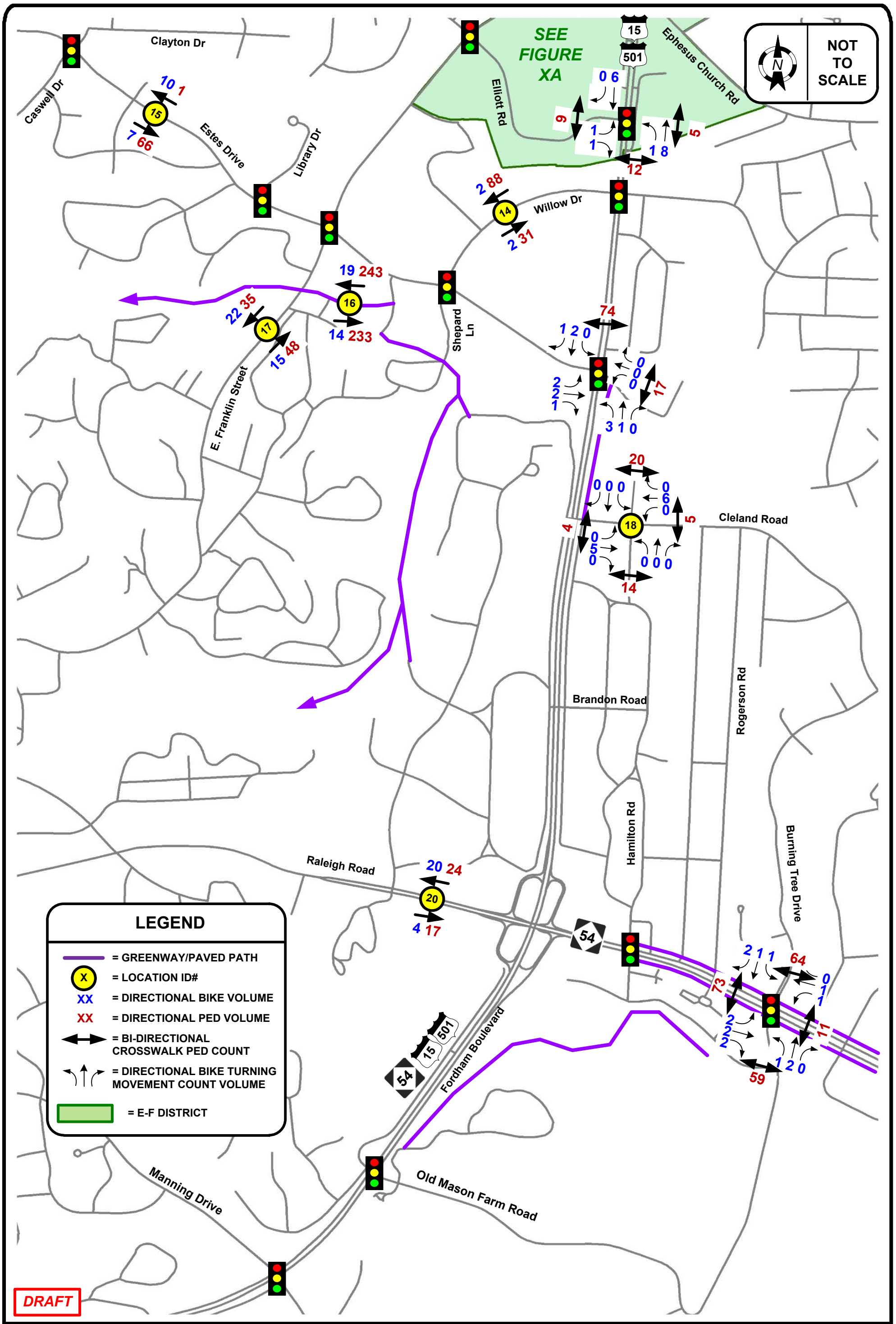
FIGURE 11A

TOWN OF CHAPEL HILL

HNTB

NOT TO SCALE



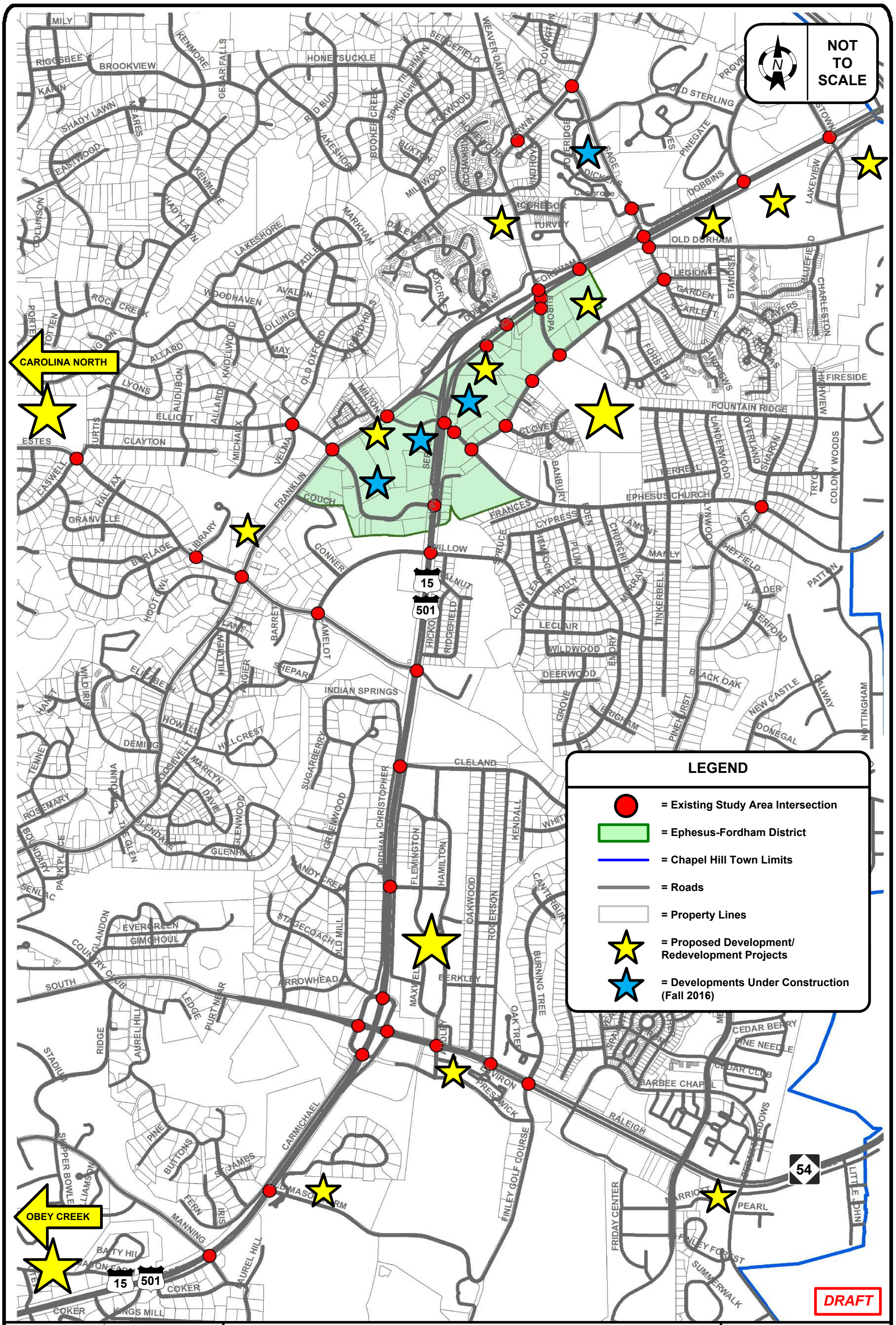


Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

12 HOURS PEDESTRIAN & BICYCLE VOLUMES

DATE: February 2017

FIGURE 11B



TOWN OF CHAPEL HILL

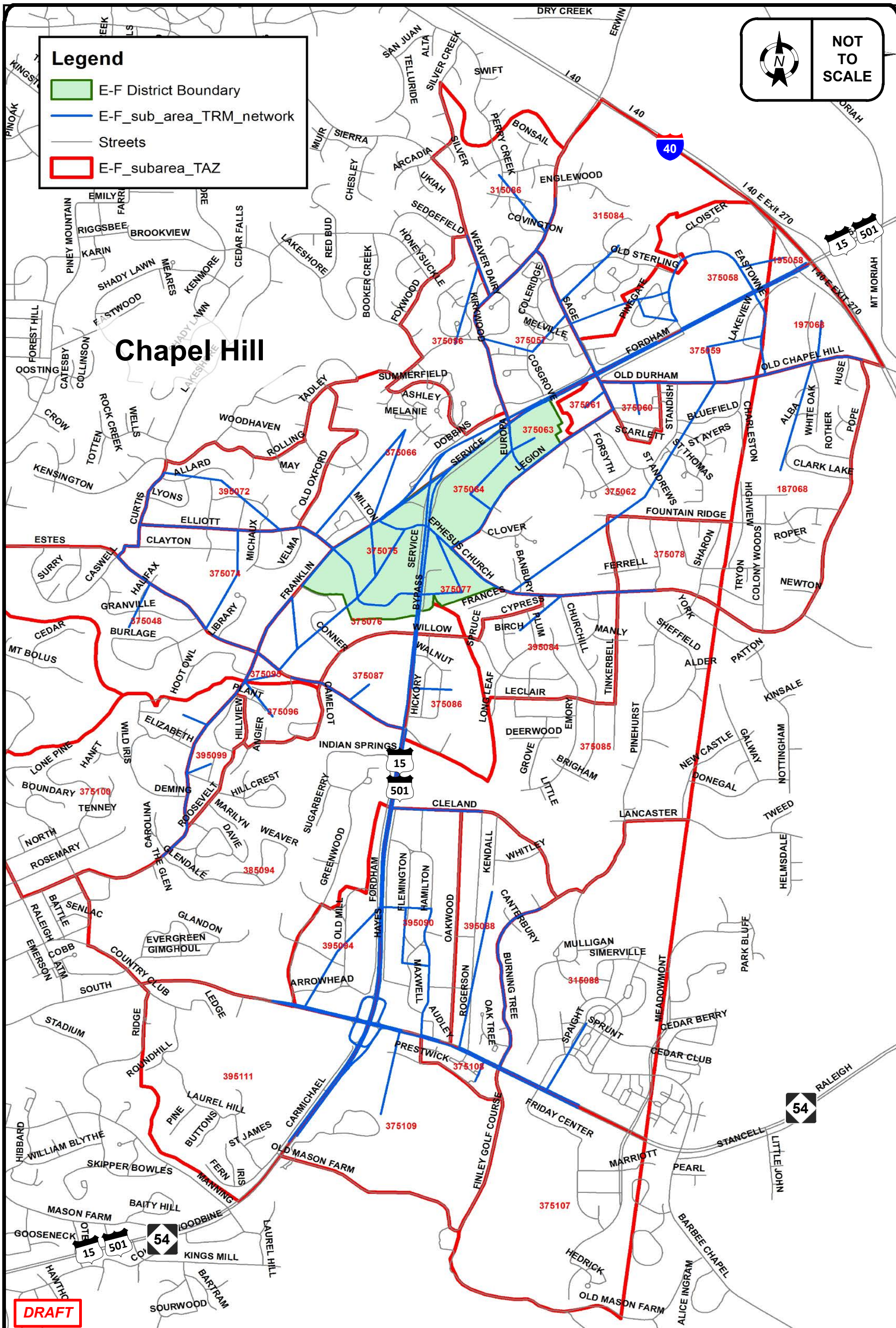
HNTB

Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

DATE: February 2017

CURRENT/FUTURE BACKGROUND DEVELOPMENT PROJECTS

FIGURE 12



Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

TRM SUB-AREA MODEL SCHEMATIC

DATE: February 2017

FIGURE 13

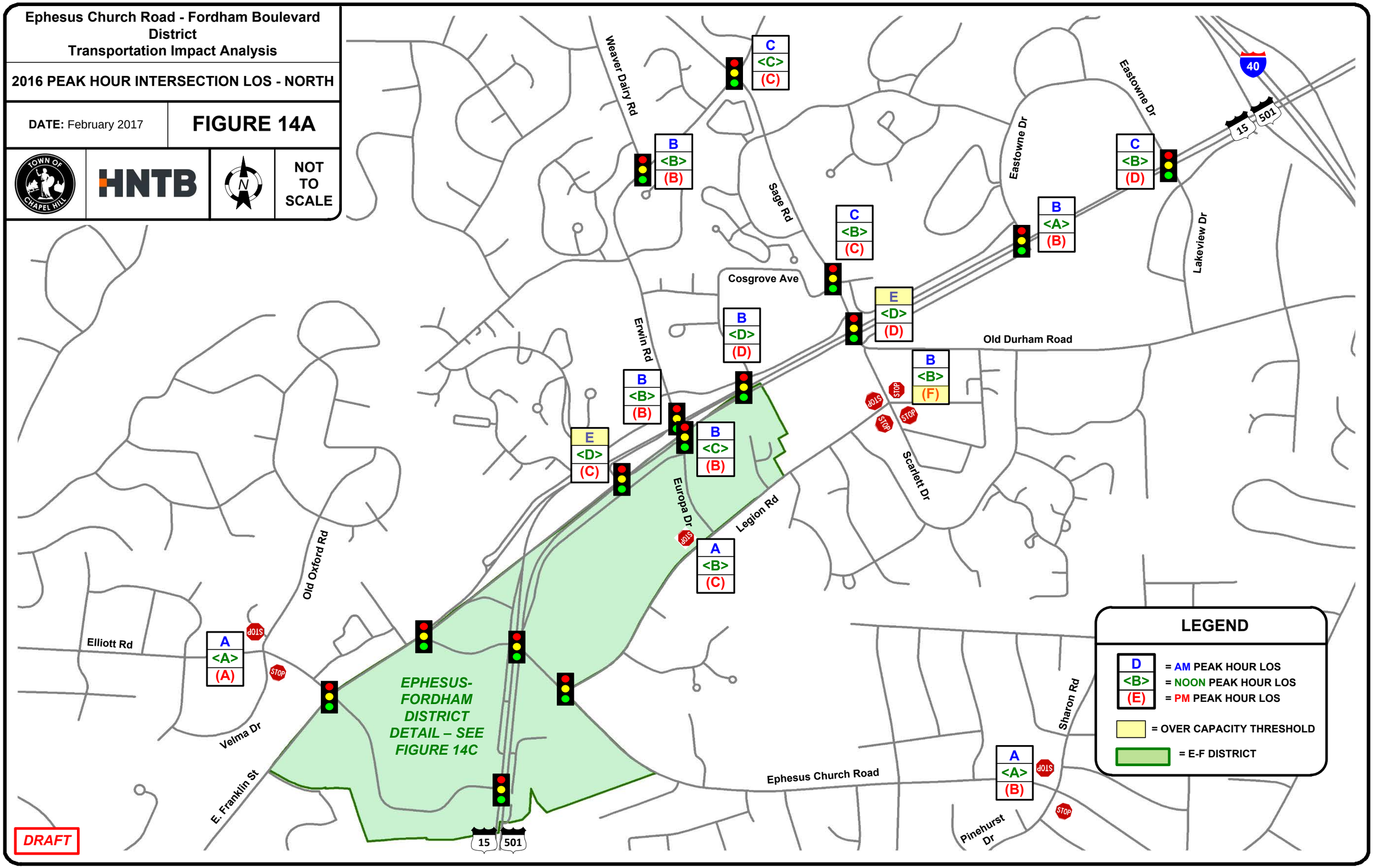
Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

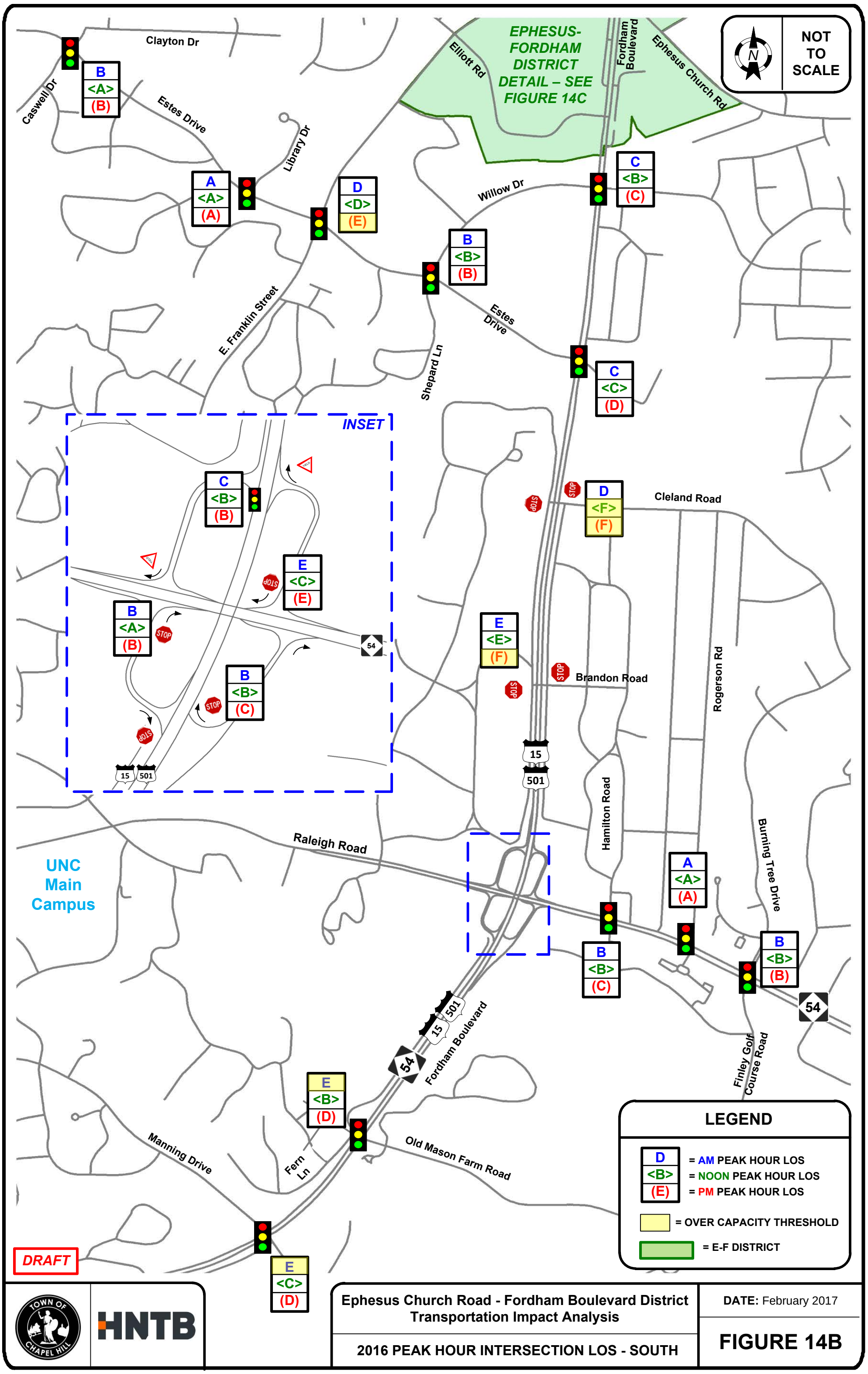
2016 PEAK HOUR INTERSECTION LOS - NORTH

DATE: February 2017

FIGURE 14A

NOT TO SCALE





Ephesus Church Road - Fordham Boulevard District Transportation Impact Analysis

2016 PEAK HOUR INTERSECTION LOS - SOUTH

DATE: February 2017

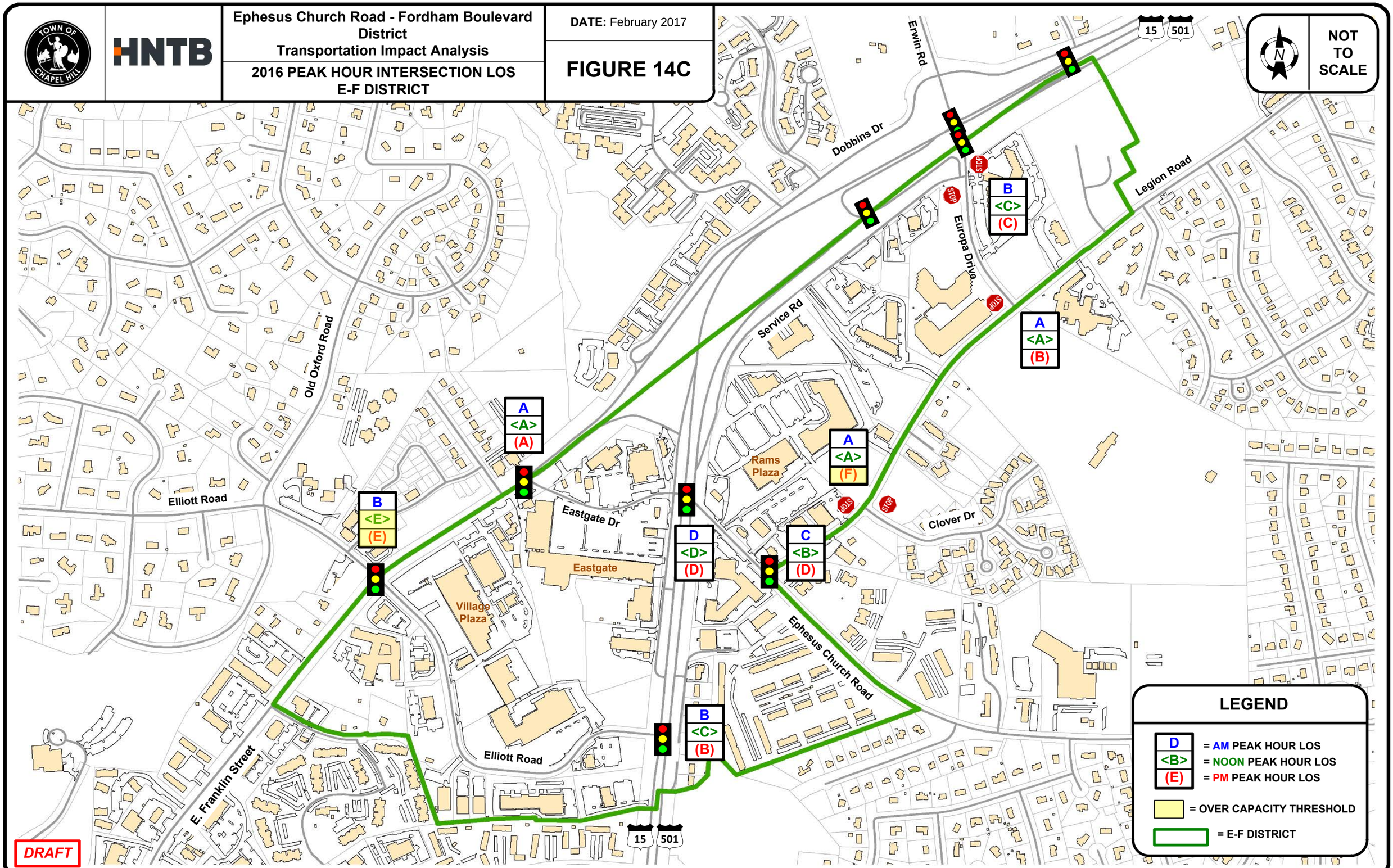
FIGURE 14B

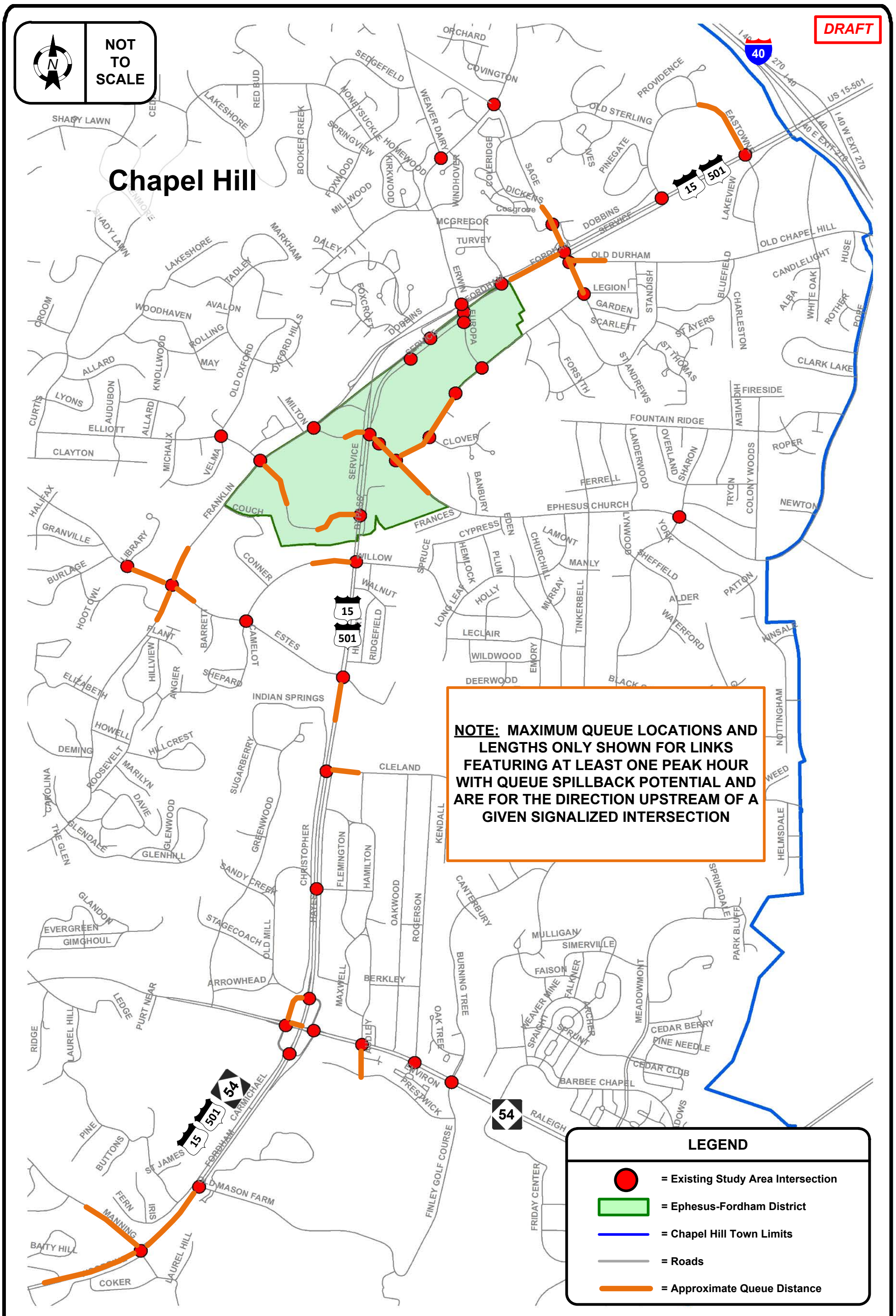
Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

DATE: February 2017

FIGURE 14C

2016 PEAK HOUR INTERSECTION LOS E-F DISTRICT





Ephesus Church Road - Fordham Boulevard District
Transportation Impact Analysis

QUEUE SPILLBACK ANALYSIS

DATE: February 2017

FIGURE 15