Appendix C-1: Proposed Refinements Travel Demand Methodology and Results Report

Durham-Orange Light Rail Transit Project

GO Triangle

October 2018

Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

Acronym/Abbreviation	Definition
CHT	Chapel Hill Transit
DEIS	Draft Environmental Impact Statement
D-O	Durham-Orange
D-O LRT	Durham-Orange Light Rail Transit
EA	Environmental Assessment
FEIS	Final Environmental Impact Statement
FTA	Federal Transit Administration
LRT	light rail transit
mphps	miles per hour per second
NCCU	North Carolina Central University
NEPA	National Environmental Policy Act
ROD	Record of Decision
TOB	transit on-board
TRM	Triangle Regional Model
UNC	University of North Carolina

1. Introduction

In compliance with the National Environmental Policy Act (NEPA), GoTriangle, together with the Federal Transit Administration (FTA), prepared a Draft Environmental Impact Statement (DEIS) for the Durham-Orange Light Rail Transit (D-O LRT) Project in August 2015 to evaluate a potential high-capacity transit improvement within the Durham-Orange (D-O) Corridor, between Chapel Hill and Durham. FTA issued a Combined Final Environmental Impact Statement (FEIS)/Record of Decision (ROD) for the D-O LRT Project in February 2016 in response to comments made on the DEIS Following the FEIS/ROD, FTA and GoTriangle conducted a Supplemental Environmental Assessment (EA) to evaluate changes in the D-O LRT Project associated with extending the alignment to a station near North Carolina Central University (NCCU), herein referred to as the "NCCU Station Refinement". The FTA approved the D-O LRT Project to advance into the Engineering phase of the Federal Capital Investment Grant Program, on July 28, 2017. During the Engineering phase, further refinements have been made addressing stations and park-and-ride lots, among other elements, leading to an additional Supplemental EA effort. The D-O LRT Project addressed in the previous NEPA documentation is identified as the Previous Design. The changes to the Previous Design being evaluated in this report are known as the Proposed Refinements.

This document provides an update to and supplements the Travel Demand Methodology and Results Report, Appendix B.1 of the *Durham-Orange Light Rail Transit Project NCCU Station Refinement Supplemental Environmental Assessment*, published in November 2016. Since that publication, changes have been made to the travel demand forecasting methodology and assumptions for the D-O LRT Project as part of the New Starts Application submission to the FTA. Section 2 of this report presents an overview of the changes to the Triangle regional travel demand forecasting model. Section 3 discusses the ridership forecast results for the D-O LRT Project with Proposed Refinements from University of North Carolina (UNC) hospitals to NCCU.

2. Model Refinements, Calibration, and Validation

The Triangle Regional Model (TRM) Version 5, which was used to develop travel demand forecasts for the NEPA documentation for the Previous Design, was reviewed and refined using the new 2014 Transit on-Board (TOB) Survey as discussed in Section 2 of the November 2016 Travel Demand Methodology and Results Report.

2.1 Further Model Testing and Validation based on the 2014 Transit On-Board Survey

Model testing and validation based on the 2014 TOB survey is the same as described in Section 2.1 of the November 2016 Travel Demand Methodology and Results Report.

2.2 Weighted Average Fare

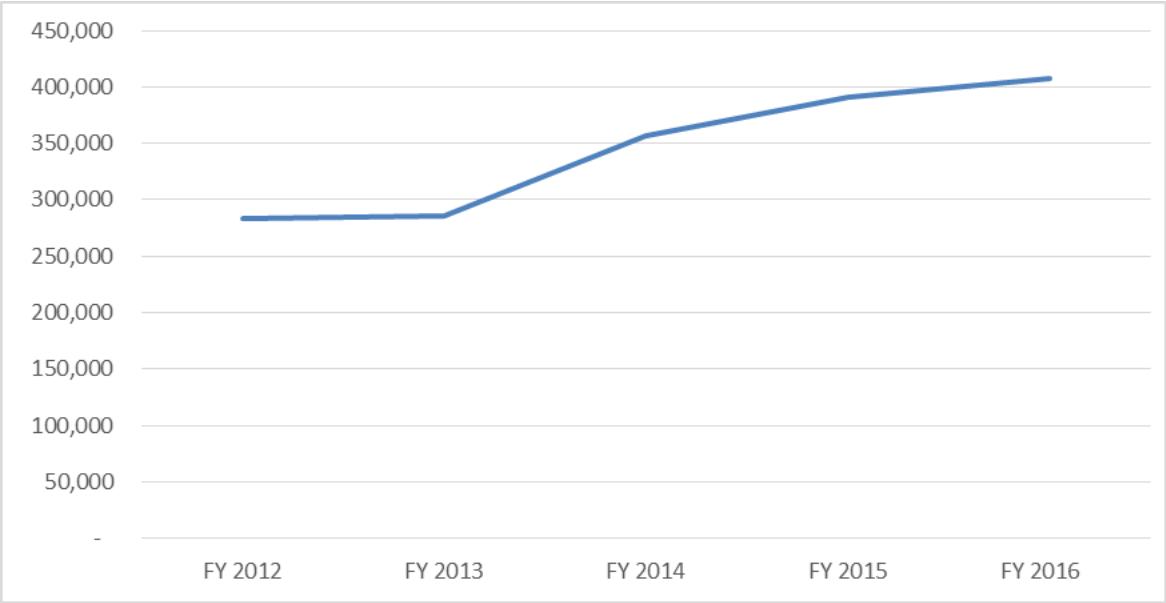
A weighted fare, used in the modeling, accounts for the current mix of free pass-wielding, discount fare-wielding, and walkup fare payers in the project environs. As a conservative assumption, this mix is not changed for modeling the future years even though there are trends showing increasing levels of free pass-wielding patrons. This treatment of discounted fares – arriving at a weighted average fare – is typical in other regional modeling constructs.

With this approach in the modeling, D-O LRT fares collected will be a hybrid of cash fares and pass usages, with an average fare expected to be heavily influenced by employer-based pass programs and incentives to use day passes over cash fare, as is the case today.

Since the early 2000s, GoTriangle has worked steadily to expand transit markets in the region through its signature employer-based transit pass program, the GoPass. UNC-Chapel Hill was the first major employer to adopt a GoPass back in 2003. Duke University became a GoPass employer in 2011, and other major employers in the D-O LRT Corridor have since followed suit, including NCCU.

UNC employees receive the GoPass for free; Duke employees receive the GoPass for $25 per year. Students at the three universities in the D-O Corridor (UNC-Chapel Hill, Duke, and NCCU) receive a free GoPass. These types of programs make transit available in the two counties at zero marginal cost to employees at these major employers. **Figure 2-1** shows the growth of UNC-based GoPass usage on GoTriangle services over the past few fiscal years.

Figure 2-1: Annual UNC Go Pass Trips on GoTriangle Services – FY12 to FY16



Use of the Duke GoPass on GoTriangle services in FY16 was approximately 182,000 boardings through the first 11 months of FY 2016, with another 257,000 on GoDurham services.

In a 2013 customer service survey, at the system level for GoTriangle, 28 percent of riders paid the cash fare while 72 percent used another fare type, with GoPass being the largest fare category at 43 percent.

For GoDurham, a 2015 survey found that only 15 percent of GoDurham passengers paid the GoDurham cash fare, while 47 percent used a Day Pass. GoPass usage on the GoDurham system rose from 3 percent of fares paid in 2011 to 13 percent of fares paid in 2015.

While the UNC and Duke GoPass programs dominate GoPass usage in the corridor, GoTriangle has recently expanded to several other area employers, including NCCU, Durham Tech Community College (Durham Tech), and the American Tobacco Campus, which is GoTriangle's first GoPass relationship with a property management company that provides GoPass administrative support to dozens of small companies onsite. Significant growth has occurred since the earliest adoption of these three pass programs to the most recent quarterly report data. NCCU GoPass holders contributed to approximately 5,100 boardings in December 2015, American Tobacco GoPass holders had about 4,600 boardings in March 2016, while Durham Tech GoPass holders had roughly 30,300 boardings in March 2016.

The latest GoTriangle data and analyses showed not only significant increases in usage of GoPass in GoTriangle and GoDurham services over the past few years but also high spatial variations of GoPass usage at the route level. GoPass usage in the GoDurham system is strongly associated with the high-density employment destinations that have GoPass programs, and which are proposed to be served by the D-O LRT. Routes that serve the major employers, who provide their employees with GoPass programs, including Duke, American Tobacco Campus, and NCCU, show much higher rates of GoPass usage than routes that serve destinations without GoPass programs. For example, GoDurham Routes 6 and 6B and Route 11 serve the Duke main campus and hospital; more than 37 percent of riders on Routes 6 and 6B used GoPass according to the 2014 TOB survey. The GoDurham routes in the study area that were surveyed in the 2014 TOB survey had an average GoPass usage rate of 25.1 percent in 2016, a significant increase over the GoPass usage rate of 17.3 percent in 2014, according to farebox data. Conversely, routes away from these GoPass employment centers have lower GoPass usage, although their GoPass usage rates have increased as well. For those GoDurham routes outside the study area corridor, 10.7 percent of riders used GoPass in 2016, compared with 6.9 percent in 2014. Given the high spatial variations of GoPass usage rates, system-wide average fare is inappropriate to use as a reference fare for the D-O LRT Project because it does not account for the spatial variations of the market penetration of employer-provided, prepaid GoPass programs.

The findings from the new 2014 TOB survey provide further evidence of widespread use of discounted fares on the system (a phenomenon that was previously noted during the modeling efforts for the Previous Design). The 2014 TOB survey provides the market share of different prepaid and discount transit programs, and has been used to calculate the weighted average fare for each surveyed service provider. The results are summarized in **Table 2-1**.

Table 2-1: Weighted Average Boarding Fare

Transit Operator	Routes	Weighted Average Fare
GoTriangle	Local Routes	$0.79
	Express Routes	$1.52
CHT	All Routes	$0.00
GoDurham	Robertson Scholar Express (RSX)	$0.25
	Bull City Connector (BCC)	$0.00
	Other Routes	$0.73

Table 2-1 shows that the prepaid and discount transit programs significantly lower the weighted average fare. For example, the full cash fare for GoTriangle local routes is $2.25 and the weighted average fare is $0.79.

There are five existing routes that run in/nearby the D-O Corridor. They are the BCC route from GoDurham, the 400 and 405 routes from GoTriangle, and the FCX, S, and HU routes from Chapel Hill Transit (CHT). The average fare on these five routes provides a reference for the average fare of the D-O LRT.

The average fare is calculated by summing up the market shares of each fare type times the corresponding cost per ride for each fare type. The market shares are summarized from the 2014 TOB survey. The cost per ride is either obtained from the fare schedule of each transit agency, or if transit passes are used, it is calculated as the cost of a transit pass divided by the average swipes per card. The average swipes per card is calculated based on transit passes used in September and October 2014.

The analysis also indicates that, on existing bus routes within the D-O Corridor (FCX, S, HU, 400, 405 and BCC), the weighted average fare is $0.12, but a portion of the riders who are riding currently fare-free buses would pay a fare with the light rail service. Approximately 15 percent of these riders are not full-time employees or full-time or part-time college/university students, based on the survey. If these trips are treated as non-free-fare trips, a new average fare is estimated to be $0.23 in 2014 dollars ($0.20 in 2006 dollars), under the following assumptions:

- All of these riders are riders without a GoPass (a conservative assumption)
- For FCX, S, and HU, which are all CHT routes, riders without GoPass have to pay $1.00 in 2014 dollars if CHT was to charge a fare like the cash fare for GoDurham or GoRaleigh
- For BCC, which is a GoDurham route, riders without GoPass have to pay the same fare to ride BCC as for riding any other GoDurham route without Go Pass, which is $0.79 (in 2014 dollars).

2.3 Assignment of the Observed Transit Trip Table

Model preparation and trip assignment, as well as validation testing, are the same as described in Section 2.1 of the November 2016 Travel Demand Methodology and Results Report, but incorporate the revised weighted average fares developed in Section 2.2.

The weighted average fares shown in Section 2.2 are in 2014 dollars. They were converted to 2006 dollars by reducing 14.8 percent since the TRM Version 5 base year model used fares in 2006 dollars.

2.4 TRM 2014 Model Validation

Validation of the 2014 TRM model is the same as described in Section 2.1 of the November 2016 Travel Demand Methodology and Results Report.

3. Model Applications and Ridership Forecasting

The TRM Version 5 model was tested for two base year model sets (2014 No-Build and 2014 with D-O LRT), two 2035 model sets (2035 No-Build and 2035 with D-O LRT), and two 2040 model sets (2040 No-Build and 2040 with D-O LRT) in the previous DEIS and EA. The current evaluation focuses on the 2040 ridership forecasting for the D-O LRT Project with Proposed Refinements. The ridership forecasts made use of the latest planning assumptions, including the socioeconomic data that were recently developed to support the 2045 Metropolitan Transportation Plan process. The 2040 socioeconomic input files were derived by interpolating the 2035 and 2045 data under the TRM Version 6 structure that were used in the 2045 Metropolitan Transportation Plan. The socioeconomic data were converted to the TRM Version 5 TAZ structure, which has been used for the D-O ridership forecasting, based on the equivalency between the Version 5 and Version 6 TAZ structures.

The D-O LRT Project with Proposed Refinements consists of light rail service from UNC Hospitals in Chapel Hill to NCCU in Durham, with 19 stations along the corridor. The Transit Operating Plan has detailed descriptions of the alignment by segment, station locations, estimated light rail travel times, the proposed service plan, estimated operating requirements, and changes between the Previous Design and the Proposed Refinements.

- The proposed service frequencies are every 10 minutes for peak and every 20 minutes for off-peak on a weekday.
- Station-to-station travel times were developed and coded for the D-O LRT Alternative.

- To account for the pre-paid transit pass program, a weighted average fare input was developed for each service provider using available survey data on average fare paid, as discussed in Section 2.2.
- To integrate with the light rail system, bus systems were modified for GoTriangle, GoDurham, and CHT routes in the corridor, including elimination of competing bus services, modifications to the background bus network to work with the LRT, and introduction of new feeder bus routes.

Travel times were calculated for the D-O LRT Project with Proposed Refinements based on operational and alignment characteristics such as horizontal curves, vertical grades, and operating environment (i.e., exclusive right-of-way versus mixed traffic). The calculations assume a 20-second dwell time for each station stop and a 3.0 mile per hour per second (mphps) acceleration and deceleration rate. Potential delays when crossing at-grade intersections were estimated with the assistance of project engineers, considering intersections likely to have full priority given to light rail trains (i.e., gated crossings or full signal preemption) and those assumed to have partial signal preemption.

For the D-O LRT Project with Proposed Refinements, drive access to transit stations has the following assumptions:

- Drive access link coding was modified to reflect changes in parking capacity at certain stations as part of the Proposed Refinements while keeping others the same (**Figure 3-1**).
  - **Table 3-1** summarizes the park-and-ride lot locations with different maximum drive time in the tested scenarios. It shows that only the Leigh Village Station park-and-ride lot has the maximum drive time of 45 minutes with the Proposed Refinements, while two other locations (Dillard and Alston stations) no longer keep the same assumption as in the Previous Design. The other park-and-ride lots assume the same maximum 30-minute drive time as before, with some having slight shifts in locations.
  - Leigh Village station will be designed with a park-and-ride lot, which will serve the UNC community in a manner similar to an intercept park-and-ride lot currently operating around the campus. For UNC-bound commuters coming from Southeast Durham, Morrisville, Cary, and Raleigh, Leigh Village station effectively acts as a terminus station for that travel market, even though the station is in the middle of the line. This type of park-and-ride lots tends to attract users from far away, as evidenced from the 2014 TOB Survey.
  - Based on the Proposed Refinements, Alston Avenue station is expected to have a capacity constraint for their parking lots, thus assuming a 15-minute maximum drive time for potential riders.
  - In the Proposed Refinements, parking is not being provided for transit customers at the Dillard Street Station. Thus, park-and-ride access was turned off in the model for the Dillard Street Station.

Figure 3-1: Park-and-Ride Lot Locations for the 2040 Build Scenario

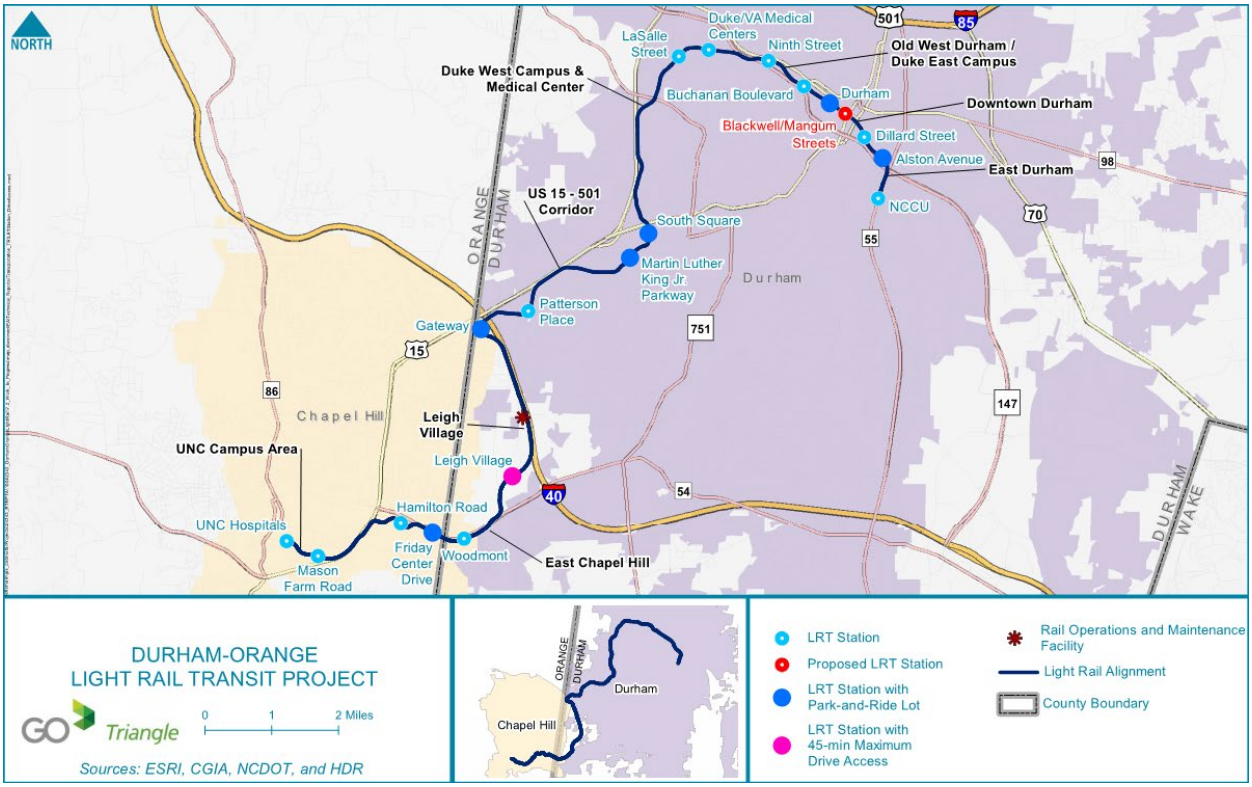


Table 3-1: Summary of Park-and-Ride Lots with Different Maximum Drive Time

Drive Shed	Previous Design	Proposed Refinements
Park-and-ride lots with 45-minute maximum drive time	Alston Avenue, Dillard Street, and Leigh Village	Leigh Village
Park-and-ride lots with 15-minute maximum drive time		Alston

Note: all other park-and-ride lots keep the same maximum drive time of 30 minutes.

3.1 2040 Ridership Forecasts

Table 3-2 shows the shares of light rail ridership forecasts by trip purposes and transit-dependent population. Station-level activities for boardings and deboardings by directions are displayed in **Table 3-3**.

Some of the major findings are:

- Boarding forecasts are estimated at approximately 23,940 boardings for an average weekday in 2040.
- Work-related trips (home-based work and work-based non-home trips) were estimated to account for 48 percent of the total estimated LRT ridership, and home-based university student trips were forecast to share 19 percent of total daily ridership.

- Zero-vehicle households were estimated to take 41 percent of the total daily ridership, while low-income households with any vehicle will share 29 percent of the total daily ridership.
- Major attraction stations include UNC Hospitals, NCCU, and Fulton/Duke/VA Medical Centers stations, with the largest numbers of deboardings in the morning peak period.
- Major production stations include the Leigh Village, Friday Center, Durham and Alston Avenue stations, with the largest numbers of boardings in the morning peak period.
- On a daily basis, walk and bicycle access to the project was forecast to account for well over half of the total project ridership (60 percent), with the remaining project access split between drive access (19 percent), drop-off/pick-up (2 percent), and bus transfers (20 percent).

Table 3-2: 2040 Daily Ridership Forecasts by Trip Purposes and Transit-dependent Populations

Trip Purposes	Share (%)
Work (Home-Based Work)	34
Shopping (Home-Based Shopping)	10
School (Home-Based School)	2
Other (Home-Based Other)	11
Work-Based Non-Home Trips	12
Non-Home-Based Non-Work Trips	12
College (Home-Based University)	19
Transit-dependent Populations	**Percentage (%)**
Zero Vehicle Households	41
Low-Income Households with any Car	29

Table 3-3: 2040 Daily Ridership Forecasts by Stations for the D-O LRT Project with Proposed Refinements

Station	UNC-NCCU Boardings	UNC-NCCU Deboardings	NCCU-UNC Boardings	NCCU-UNC Deboardings
UNC Hospitals	2,780	0	0	2,780
Mason Farm Road	820	50	50	820
Hamilton Road	190	80	80	190
Friday Center Drive	600	950	950	600
Woodmont	280	310	310	280
Leigh Village	750	1,460	1,460	750
Gateway	630	640	640	630
Patterson Place	490	470	470	490
Martin Luther King Jr. Parkway	440	580	580	440
South Square	1,210	290	290	1,210
LaSalle Street	340	700	700	340
Duke/VA Medical Centers	1,630	820	820	1,630
Ninth Street	440	410	410	440

Table 3-3 (Cont'd): 2040 Daily Ridership Forecasts by Stations for the D-O LRT Project with Proposed Refinements

Station	UNC-NCCU Boardings	UNC-NCCU Deboardings	NCCU-UNC Boardings	NCCU-UNC Deboardings
Buchanan Boulevard	230	310	310	230
Durham	390	1,320	1,320	390
Blackwell/Mangum	280	920	920	280
Dillard Street	100	340	340	100
Alston Avenue	370	680	680	370
NCCU	0	1,640	1,640	0
TOTAL	11,970	11,970	11,970	11,970

* Average weekday ridership estimates. Rounding was used and may lead to discrepancy in totals. Parking lots at Durham and Alston Avenue stations are subject to capacity constraints and use 15-minute catchment areas.