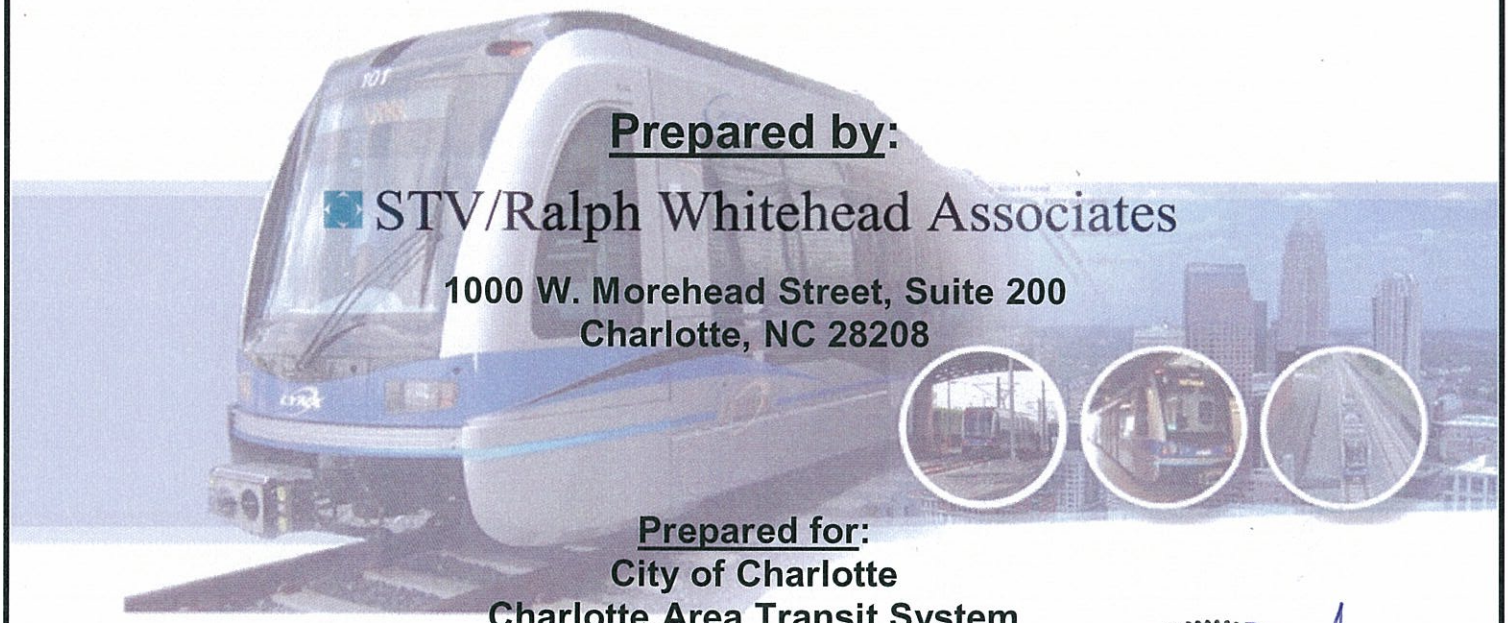
LYNX Blue Line Extension
(Northeast Corridor)
Light Rail Project
Contract #: 08-477
WBS #: 6.10

Traffic Analysis Report



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1.0 INTRODUCTION

1.1 Purpose of Report

This technical report presents the results of the traffic analysis for the proposed Charlotte Area Transit System (CATS) LYNX Blue Line Extension (BLE) light rail project in Charlotte. The following traffic modeling software was used to determine several measures of effectiveness for the traffic operations within the study area:

- SYNCHRO was used to determine intersection level of service (LOS), intersection volume to capacity ratio (v/c), intersection delay and intersection LOS.
- VISSIM was used to simulate the highway and rail interactions and to supplement the Synchro analysis, including LOS and intersection delay.
- Bicycle and Pedestrian (Bike/Ped) LOS were determined for the signalized intersections.

Traffic congestion is, and will continue to be, an issue in the Tyron Street/US-29 corridor. The LYNX BLE is a transit project and the scope of the project does not include "solving" the existing and projected traffic congestion issues in the corridor. However, the transit capacity provided by the LYNX BLE will enhance the North Tryon Street/US-29 corridor by both increasing the overall capacity of the corridor and by providing a transit option for trips in the corridor.

The analysis contained in this report seeks to identify areas where the projected no-build traffic conditions may be adversely affected by the proposed LYNX BLE project. Recommendations are provided to mitigate, to the extent practical, any impacts due to the Light Rail Alternative.

The information and/or findings contained in this document may be updated, refined or superseded as further studies are completed.

1.2 Review of LYNX BLE Corridor

The CATS LYNX BLE extends approximately 11 miles from Center City Charlotte to the northeast to I-485 near the Mecklenburg and Cabarrus County line as shown in **Figure 1: Northeast Corridor Base Map**. The corridor consists of mostly urban and suburban development within the corporate limits and land use jurisdiction of the City of Charlotte.

The alignment is an extension of the existing LYNX Blue Line (South Corridor) and runs through the following areas: Center City Charlotte, North Charlotte Historic District, Carolina's Medical Center - University (CMC – University), University of North Carolina at Charlotte (UNC Charlotte) campus and a park-and-ride lot just south of the I-485/US-29 (North Tryon Street) interchange.

1.3 Corridor Objectives

Light Rail Transit is a core component of the 2030 Transit Corridor System Plan for the region, which was developed to create alternate route and mode choices, improve connectivity and develop and enhance pedestrian facilities. The LYNX BLE is a transit project; not a roadway project intended to add capacity or ameliorate existing traffic congestion. The proposed project enhances the corridor through transit by providing additional transportation capacity and options.

The existing road network has three main arteries in the corridor; North Tryon Street/US-29, W.T. Harris Boulevard and University City Boulevard. Long term goals for the corridor couple the proposed light rail project with improved capacity and connectivity to abate the dependence on the existing major thoroughfares. The improvement of pedestrian facilities also plays a critical role in the long term goals of the corridor by promoting walking and cycling, rather than vehicular travel.

An important design element of a pedestrian-friendly transit facility is the reduction of intersection footprints at median station locations. Minimizing the number of turn lanes at these intersections reduces the crossing distance for pedestrians. The attainment of pedestrian-friendly environments is consistent with the urban vision for the corridor, stimulates transit oriented developments (TODs) and facilitates the master plan for the area. These types of communities allow for a high quality of life and mobility, while simultaneously helping to reduce pollution and vehicle miles traveled.

North Tryon Street/US-29 currently has 20 median openings from Old Concord Road to UNCC Research Drive, and eight of these are signalized. Two additional signals will be installed by the Weave Project at the I-85 Connector and University City Boulevard. Two intersections are anticipated to be signalized by 2030; Orr Road and Arrowhead Drive. The proposed Light Rail Alternative would signalize four additional intersections; Owen Boulevard, Orchard Trace Lane, University City Station Access and US-29 Service Road, totaling 15 signalized intersections between Orr Road and UNCC Research Drive. With light rail transit running in the median, safety requires traffic signals at all median openings. Preserving median openings and adding additional traffic signals restores some of the access that would be lost if the existing unsignalized median openings were closed or restricted. Preserving median openings also reduces U-turn movements that would otherwise be redistributed to the existing signalized intersections under the proposed Light Rail Alternative. This is particularly important in reducing the footprint at those intersections where light rail stations are located.

1.4 2030 Transit Corridor System Plan Criteria

When developing the 2030 Transit Corridor System Plan, the Charlotte Area Transit System (CATS), used the following criteria as a baseline of services that fit each corridor.

Land Use – The key to a successful transit corridor lies in the integration of transit and land development. The plan developed by CATS actively encourages transit use by fostering development along transit lines, TODs. One example of this type of development can be found in the University City Area Plan.

Environment – Public transportation helps minimize air and noise pollution by lowering the number of vehicles on the road and fostering development patterns that produce fewer and shorter trips. The introduction of public transportation in areas with severe congestion would reduce the source of environmental contaminants as well as the negative effect of pollution on local communities, natural areas and cultural resources.

System Integration – Each corridor is part of a larger system, making it vital to ensure that each new transit corridor solution has the ability to operate within the entire system. The system should consider passenger distribution, service between regional corridors and balanced use of system capacity.

Mobility – Several components constitute mobility, with ridership being an integral element. Ridership includes the number of passengers utilizing public transportation and the quantity of new transit trips exchanged for automobiles. Improving accessibility is another component, which is essential for serving a variety of travel markets. Increased mobility will ultimately produce savings in travel times and enhance reliability.

Financial – The level of investment to build, operate and maintain a transit system must be balanced with ridership demand. With appropriations being limited and federal and state revenue sources existing as grants, consideration should be given to improvements that attract those particular grants.

2.0 FUTURE ROADWAY PROJECTS

The following four projects have been identified to be planned and/or constructed within the limits of this project. It is assumed that these projects would be completed prior to the future analysis year of 2030. All impacts associated with these projects would be realized prior to the opening of the LYNX Blue Line Extension.

2.1 "Weave Area"

The "Weave Area" includes the roadway segment along North Tryon Street/US-29 Street from the I-85 Connector to University City Boulevard/NC-49. Currently, northbound North Tryon Street/US-29 Street and the I-85 Connector have two lanes approaching this area. Both approaches narrow to a single lane prior to merging together. From this merge point there is a relatively short weave segment (approximately 0.3 miles) for drivers to choose to travel north on North Tryon Street/US-29 or east to University City Boulevard/NC-49. Similarly, southbound vehicles merge from two lanes on North Tryon Street/US-29 and form a single lane on University City Boulevard/NC-49. Within this "Weave Area" drivers must decide whether to continue south on North Tryon Street/US-29 or exit to I-85 via the I-85 Connector. Due to the demand of traffic travelling from I-85 to and from the University Area, a highly intense weave area is created within this segment.

In 1998, the City of Charlotte (City) allocated funding from its Capital Investment Plan to plan, design and construct an interchange between US-29 and NC-49, in an effort to improve safety and capacity within the "Weave Area." Ongoing transportation and land use planning influenced CDOT to reevaluate the scope of the interchange project. As a result, a Transportation Analysis Report was performed by Charlotte Department of Transportation (CDOT) in February 2006 to substantiate the interchange project in lieu of area development and plans to integrate rapid transit in the corridor. The results of the Transportation Analysis Report recommended the construction of two at-grade intersections at the I-85 Connector and University City Boulevard/NC-49 along North Tryon Street/US-29. The report also recommended the construction of a four lane divided cross section for North Tryon Street/US-29; wide enough to accommodate additional travel lanes and/or future light rail transit. Specific geometric changes would include realigning the I-85 Connector to intersect North Tryon Street/US-29 at the Sandy Avenue intersection. Left and right turn movements would replace the merging to or from the I-85 Connector. North Tryon Street/US-29 would posses dual turn lanes to and from the I-85 Connector. Additionally, a second intersection would be created by realigning University City Boulevard/NC-49 with North Tryon Street/US-29. The fourth leg of this intersection would form the extension of the existing University City Boulevard/NC-49 interchange with I-85. This intersection would also have a four-lane section with turn lanes on both North Tryon Street/US-29 and University City Boulevard/NC-49. The segment of University City Boulevard/NC-49 between I-85 and North Tryon Street/US-29 would also serve the proposed mixed-use development (Belgate), which includes a new Ikea store (opened February 2009) and Wal-Mart. The "Weave Area" project would be complete prior to the construction of the proposed Light Rail Alternative.

2.2 Shopping Center Drive

A signalized intersection has been created at the prior unsignalized Shopping Center Drive location. A fourth leg has been constructed that serves the mixed-use development west of the intersection, which includes a Wal-mart. Additional plans for Shopping Center Drive include an extension westward across I-85 to IBM Drive.

2.3 JW Clay Boulevard

JW Clay Boulevard is currently a three-leg signalized intersection. Due to the growth of the UNC Charlotte Research Institute a fourth leg would be added to the JW Clay Boulevard intersection. It was assumed that the fourth leg would be constructed prior to the opening of the proposed BLE project.

2.4 Sugar Creek Road Grade Separation Project

North Carolina Railroad (NCRR) recently initiated an engineering study to investigate the ability to depress Sugar Creek Road below the existing and proposed freight tracks. This project is also included in the North Carolina State Transportation Improvement Plan (STIP) as U-5008. This project is planned to be constructed prior to or concurrently with the construction of the proposed BLE project and would result in the light rail being grade-separated over Sugar Creek Road.

3.0 BUILD ALTERNATIVE

3.1 Light Rail Alternative

The Light Rail Alternative (**Figure 1: Northeast Corridor Base Map**) begins at the southern terminus of the CATS LYNX Blue Line Light Rail at 7th Street in Center City Charlotte and would follow the former NCRR right-of-way (ROW) north through Center City, refer to Figure 1: Northeast Corridor Base Map. This ROW is owned by the City of Charlotte up to 12th Street and was purchased for transit use in 1998. The light rail would travel at the existing street level, and light rail crossings with gates would be used at 7th Street, 8th Street, 9th Street, the proposed 10th Street Connector and 12th Street.

North of 12th Street, the alignment would be grade-separated over the CSX Transportation (CSXT) rail line and would return to ground level just before 16th Street. The proposed Light Rail Alternative would cross 16th Street at the existing street level with a gated light rail crossing, followed by a shift south that would run between the southern edge of the Norfolk Southern Intermodal Facility and the northern side of North Brevard Street. Changes to North Brevard Street are not proposed. The alignment would continue along the northern edge of North Brevard Street and cross over Little Sugar Creek on a small bridge and continue under the 30th Street bridge.

East of 30th, while the proposed Light Rail Alternative is within the NCRR corridor, the four grade separations occur with existing roadways. After crossing 36th Street via grade separation, the proposed alignment would be grade separated over Craighead Road on an S-curve to position the proposed Light Rail tracks on the east side of the existing freight tracks. The proposed alignment would continue on the east side of the existing freight tracks and would have grade separations with Sugar Creek Road and Eastway Drive. The NCRR plans to depress Sugar Creek Road under the existing freight tracks that are at street level due to safety concerns. CATS has worked with NCRR to develop plans that would also allow the light rail tracks to pass alongside the freight tracks on an adjacent bridge over Sugar Creek Road. The alignment would continue along the northwest side of the existing NS tracks within the NCRR ROW. At Eastway Drive, the proposed alignment would go under the bridge that carries vehicular traffic as the existing freight tracks do today. The Eastway Drive bridge would be lengthened to accommodate the proposed light rail tracks. Just east of the Northpark Shopping Center, the proposed Light Rail Alternative would exit the NCRR corridor and would shift north towards Old Concord Road.

The Light Rail Alternative grade separates the proposed alignment over Old Concord Road and the northbound travel lanes of North Tryon Street/US-29. The grade-separated design would align the proposed light rail into the median of North Tryon Street/US-29. The proposed light rail would return to street level approximately 300 feet south of the North Tryon Street/US-29 and Orr Road intersection and would continue in the median just north of JW Clay Boulevard and the entrance to the UNC Charlotte Research Institute. The Light Rail Alternative – Sugar Creek Design Option (SCDO) positions the proposed light rail alignment in the median of North Tryon Street/US-29 north of Dorton Street via grade separation.

The SCDO would enter the median of North Tryon Street/US-29 just north of Dorton Street via grade separation, cross Eastway by grade separation and return to ground level to cross the Old Concord Road intersection at-grade. The Light Rail Alternative and the Light Rail Alternative

– Sugar Creek Design Option would be the same from north of Old Concord Road to the northern end of the Project.

At the confluence of North Tryon Street/US-29 and University City Boulevard/NC-49, NCDOT is upgrading the existing "Weave Area." CDOT has designed safety improvements that include the construction of two at-grade signalized intersections. For the purposes of this study, it is assumed that the construction of the two intersections would begin in 2009. In order to pass through the reconfigured intersections, the light rail would be grade separated over the realigned I-85 Connector Road-North Tryon Street/US-29 intersection. The proposed Light Rail Alternative would return to street level south of the proposed University City Park-and-Ride Entrance. The intersection with the University City Park-and-Ride Entrance would be an at-grade light rail crossing. The North Tryon Street/US-29 and Stetson Drive intersection would be restricted to right-in/right-out with the light rail running through the median. Beyond Stetson Drive, the light rail would again be grade-separated over the realigned University City Boulevard/NC-49 and North Tryon Street/US-29 intersection. The alignment would return to street level north of Brookside Lane.

The proposed alignment would continue at street level in the median of North Tryon Street/US-29, past McCullough Drive. Just north of Ken Hoffman Drive, the alignment would transition to an aerial structure, crossing over W.T. Harris Boulevard and return to street level south of JM Keynes Drive/Hospital Drive. After an at-grade crossing with JM Keynes Drive, the proposed alignment would continue north and cross JW Clay Boulevard at-grade. Just north of the at-grade crossing with UNCC Research Drive, the proposed Light Rail Alternative would begin a negative grade and cross under the northbound North Tryon Street/US-29 travel lanes to enter the University of North Carolina at Charlotte (UNCC) campus. The traverse under the travel lanes would restrict Grove Lake Drive to a right-in right-out operation.

Following the entrance onto the UNCC campus; the proposed alignment would travel south towards the northeastern edge of the existing UNC Charlotte buildings. A bridge would carry the light rail over Toby Creek and the proposed Toby Creek Greenway, and continue along the northern side of Cameron Boulevard, across from Squires Hall Dormitory. Upon leaving the campus, the alignment would cross an unnamed tributary and head northeast towards Mallard Creek Church Road. The light rail would cross Mallard Creek Church Road at-grade, and travel north after passing the Mallard Creek Church Road Station. A bridge crossing over Mallard Creek, followed by a northeast turn, would position the alignment parallel to North Tryon Street/US-29. The proposed light rail would continue along the eastern side of the roadway, cross US-29 Service Road via grade separation and reach the terminal station, which would be located approximately 3,600 feet south of I-485. US-29 Service Road would serve as the main entrance for I-485 Station, with the second being the I-485 Station Access Road. Traffic exiting the station through the Access Road is restricted to right turns only.

3.2 Light Rail Alternative Stations

9th Street Station

The 9th Street Station would be located directly north of 9th Street and directly south of the proposed 10th Street Connector, along the former NCRR ROW. The station would be designed as an urban station with walk-up access and eight bicycle parking spaces. Sidewalks, like those placed next to the LYNX Blue Line light rail tracks within Center City Charlotte, would extend between 9th and 12th Streets. No trip generation was performed for this station since no permanent parking spaces are proposed.

Parkwood Station

This station would be located at the intersection of Parkwood Avenue and North Brevard Street. Parkwood Station would be designed as a neighborhood walk-up station with eight kiss-and-ride spaces and 16 bicycle parking spaces. A small landscaped esplanade would be located in front of the station. No trip generation was performed for this station since no permanent parking spaces are proposed. The Parkwood Station has the potential to be relocated to 16th Street due to changes in the track alignment. The station characteristics would remain the same.

27th Street Station

The 27th Street Station would be located along the northwest side of Brevard Street, northeast of Little Sugar Creek. The station would be a neighborhood walk-up station with 16 bicycle parking spaces. No trip generation was performed for this station since no permanent parking spaces are proposed.

36th Street Station

Located along the south side of the NCRR ROW, the 36th Street Station would be designed as a neighborhood walkup station, with 16 bicycle parking spaces. The station platform would be positioned on a bridge structure and 36th Street would be depressed under the existing Norfolk Southern freight tracks and the proposed light rail tracks. The bridge structure would be at the same elevation as the existing freight tracks. 36th Street would be lower than the existing elevation.

Pedestrian access would be available via a sidewalk along the east side of 36th Street that connects to a ramp with platform access. No trip generation was performed for this station since no permanent parking spaces are proposed.

Sugar Creek Station

The Sugar Creek Station would be located along the north side of the NCRR. The station platform would be located on a bridge structure with Sugar Creek Road being depressed under the existing NS freight tracks and the proposed light rail tracks. This bridge structure would be at the same elevation as the freight tracks.

The station would be designed as a regional station and would include three park-and-ride lots with approximately 924 spaces, three bus transfer bays, four kiss-and-ride spaces and 26 bicycle parking spaces. Vehicular access to the park-and-ride lot would be available from Raleigh Street and Sugar Creek Road. Pedestrian walkways would be provided along both sides of Sugar Creek Road. The station would include stairs and elevators for pedestrian access.

Old Concord Road Station

This station would be located between the NCRR ROW and Old Concord Road, in the area the alignment would depart the NCRR ROW. Old Concord Road Station would function as a community station and would include a surface park-and-ride lot with 505 spaces, three bus transfer bays, three kiss-and-ride spaces and 20 bicycle parking spaces. Access to the park-and-ride lot would be from Old Concord Road and North Tryon Street/US-29.

Tom Hunter Station

The Tom Hunter Station platform would be located directly south of the realigned Tom Hunter Road, in the median of North Tryon Street/US-29. The station would operate as a community station, containing a surface park-and-ride lot with approximately 117 spaces, two bus transfer bays and 16 bicycle parking spaces. Access would be available from North Tryon Street/US-29.

University City Blvd. Station

The University City Boulevard Station is proposed in the median of North Tryon Street/US-29 within the "weave area"; between the future intersections of US-29 Connector Road, North Tryon Street/US-29 and University City Boulevard/NC-49. This station was proposed as part of the US-29/NC-49 planning charette in 2006. This station is proposed as a regional station, accommodating a surface park-and-ride lot with 591 spaces on the west side of North Tryon Street/US-29, four bus transfer bays and 22 bicycle parking spaces.

McCullough Station

This station would be located directly north of McCullough Drive within the median of North Tryon Street/US-29, and would be designed as a community station. The McCullough Station would include a surface park-and-ride lot with 225 spaces, two bus transfer bays and 18 bicycle parking spaces. The park-and-ride lot would be located on the west side of North Tryon Street/US-29 at McCullough Drive. Access to the park-and-ride lot would be available from McCullough Drive.

JW Clay Blvd. Station

The JW Clay Blvd. Station would be located south of JW Clay Boulevard in the median of North Tryon Street/US-29. The station would be designed as a neighborhood station with walk-up access, 16 bicycle parking spaces, two bus transfer bays and three kiss-and-ride spaces. No trip generation was performed for this station since no permanent parking spaces are proposed.

UNC Charlotte Station

This station would be located on the UNC Charlotte campus, opposite Squires Hall Dormitory. The station would be designed with walk-up access, two bus transfer bays, 32 bicycle parking spaces and connections with the campus shuttle service. No trip generation was performed for this station since no permanent parking spaces are proposed.

Mallard Creek Church Station

The Mallard Creek Church Station would be located north of Mallard Creek Church Road, east of Mallard Creek. The station would provide 12 bicycle parking spaces and a surface park-and-ride lot with 150 spaces. Vehicle access would be available from Stone Quarry Road.

I-485/North Tryon Station

The I-485/North Tryon Station would be a regional station with a five-story parking garage located to the east of North Tryon Street/US-29, just south of the I-485 ramps and Morningstar Drive. It is the only station planned to include a parking garage. Additionally, the station would contain a surface parking lot, a future building pad, four bus transfer bays, four kiss-and-ride spaces and 24 bicycle parking spaces. Approximately 2,134 spaces would be provided.

3.3 Sugar Creek Design Option

Under the Light Rail Alternative – Sugar Creek Design Option, the alignment was analyzed to enter the median of North Tryon Street/US-29 just north of Dorton Street. The light rail would cross northbound North Tryon Street/US-29 grade-separated and enter the median. The SCDO would be grade-separated at the intersection of North Tryon Street/US-29 and Eastway Drive and then return to at-grade to pass through the North Tryon Street/US-29 and Old Concord Road intersection. The Light Rail Alternative and the SCDO are the same from north of Old Concord Road to the end of the Project at I-485.

3.3.1 SCDO Stations

Sugar Creek Station - SCDO

The Sugar Creek Station would be located along the east side of Dorton Street, just north of Raleigh Street. The station would include a surface park-and-ride lot with 893 spaces, three bus transfer bays, four kiss-and-ride spaces and 26 bicycle parking spaces. Access to the park-and-ride lot would be available from Dorton Street and Raleigh Street.

Old Concord Road Station - SCDO

This station would be located in the median of North Tryon Street/US-29, directly west of the Old Concord Road intersection. The Old Concord Road Station would include a surface park-and-ride lot with 458 spaces, three bus transfer bays and 20 bicycle parking spaces. Access to the park-and-ride lot would be available from North Tryon Street/US-29 and Old Concord Road. The park-and-ride lot, under the SCDO, is positioned just west of the park-and-ride lot for the Light Rail Alternative Old Concord Road Station.

4.0 METHODOLOGY

4.1 Traffic Counts

Daily traffic volumes for all significant roadway segments within the proposed LYNX BLE area of influence were obtained from CDOT and collected by the STV Team. CDOT provided intersection counts for all signalized intersections, while the STV Team conducted intersection counts for all un-signalized intersections. The raw turning movement traffic count data can be found in **Appendix A**.

Turning movement counts were conducted between March 23, 2008 and May 9, 2008 during the AM and PM peak travel periods (6:30 – 9:30 AM, 4:00 – 7:00 PM). Additional counts were conducted on January 8, 2009 and January 15, 2009. A review of the traffic counts revealed that the morning peak hour was 7:30 to 8:30 AM and the afternoon peak hour was 4:45 to 5:45 PM for the study area. The peak hours (four consecutive fifteen minute intervals) were determined by the peak hour volumes of the intersections within the study area.

4.2 Scenarios and Segments

Several scenarios were analyzed as part of this technical report. The 2008 Existing and the 2030 No-Build Alternative scenarios were developed to determine the expected traffic operations without the construction of the LYNX BLE. The 2030 Light Rail Alternative and the 2030 Sugar Creek Design Option (SCDO) scenarios were developed to determine the expected traffic operations if the proposed project is constructed.

All scenarios were divided into three segments due to the length of the corridor, changes in growth rates and changes in surrounding land uses. A map illustrating the location of each segment can be found in **Figure 1: Northeast Corridor Base Map**. Segment 1 includes the intersections from Center City Charlotte north to Owen Boulevard along North Tryon Street/US-29. This segment also includes all intersections analyzed on Sugar Creek Road and Eastway Drive. Segment 2 begins with Tom Hunter Road and runs along North Tryon Street/US-29 through Barton Creek Drive. Segment 3 includes Mallard Creek Church Road up to the I-485 Ramps along North Tryon Street/US-29.

The 2008 Existing Scenario included all roadway characteristics that were present in the year 2008 (See **Figures 2.1** through **2.12: Measures of Effectiveness – 2008 Existing Conditions**). These roadway characteristics included lane configurations, speed limits, peak hour traffic volumes, traffic signal timing and truck percentages. Data for the lane configurations, speed limits and peak hour traffic volumes were taken from field observations and aerial mapping. The peak hour traffic volumes were balanced between intersections. Most adjacent intersections were not balanced completely because of midblock driveways. Traffic volumes were not balanced between segments. CDOT approved the resulting 2008 Existing Scenario traffic volumes, and provided traffic signal timing. Additionally, CDOT approved the use of a two percent truck percentage and a peak hour factor of 1.00 for all segments and scenarios.

The 2030 No-Build Alternative was subsequently developed (See **Figures 3.1** through **3.12: Measures of Effectiveness – 2030 No-Build Alternative**). Growth factors were developed and applied to the 2008 base year traffic volumes to estimate year 2030 traffic. These growth factors, shown in **Appendix B**, were derived from the 2030 Metrolina Travel Demand model maintained by CDOT. The growth factors were applied to the peak hour traffic volumes that

were created for the 2008 Existing Scenario. **Table 4.1: Growth Factors** show the growth factors for each segment.

Table 4.1
Growth Factors

Corridor Segment	Growth Factor
Segment 1	1.30
Segment 2	1.25
Segment 3	1.55

Source: Charlotte Department of Transportation

Several other changes were applied to the 2030 No-Build Scenario, which included roadway improvement projects that were expected to be complete by 2030. Modifications to the "weave area", Shopping Center Drive and JW Clay Boulevard were included as discussed in Section 2 of this technical report. Pedestrian phases were added to each signalized intersection. A walk speed of 3.5 feet per second was used to determine the required pedestrian phase timing. The existing signal phase splits and offsets were adjusted to account for changes in the peak hour traffic volumes.

The 2030 Light Rail Alternative and 2030 SCDO Build Scenarios were developed next (See **Figures 4.1** through **4.12: Measures of Effectiveness – 2030 Light Rail Alternative** and **Figures 5.1** through **5.6: Measures of Effectiveness – 2030 Light Rail Alternative – Sugar Creek Design Option**). Lane configurations for the 2030 Light Rail Alternative and SCDO scenarios began with existing conditions and incorporated future roadway projects, such as the "Weave Area." It should be noted that the recommendations for the side street turn lane configurations will be refined throughout the design process. The peak hour traffic volumes were adjusted based on the turn restrictions included in the civil plans. The SCDO included additional changes to the lane configurations and peak hour traffic volumes. Peak hour traffic volumes were added to the network due to the trips generated by the proposed park and ride stations. Pedestrian phases were adjusted based on the changes to existing lane configurations. A walk speed of 3.5 feet per second was used to determine the necessary pedestrian phase timing. Lead/Lag phasing was used for all protected left turn movements along North Tryon Street/US-29, in order to reduce the footprint of the signalized intersections. The existing signal phase splits and offsets were adjusted to account for the changes in the peak hour traffic volumes.

4.3 Synchro

Synchro 7.0 was used to analyze intersection operations in the study area. The Synchro results give several measures of effectiveness (MOE) which are used to evaluate the operations for each intersection. It should be noted that the measure of effectiveness results from Synchro do not reflect the operational impacts of light rail running at-grade. Instead, the Synchro results reflect the impacts that physical changes to the streets, caused by the proposed project, are expected to have on intersections. Synchro results are reported for intersections outside the North Tryon Street/US-29 corridor.

Level of service (LOS) and delay are quality MOEs describing conditions within a traffic stream, generally in terms of service measures such as speed and travel time. The LOS is an important measure of roadway congestion. The LOS ranges from A (no congestion) to F (severe congestion). The LOS criteria for signalized and unsignalized intersections are shown in **Table 4.2: Intersection Level of Service**.

Table 4.2
Intersection Level of Service

Signalized Intersections		Unsignalized Intersections	
LOS	**Delay per Vehicle (seconds)**	**LOS**	**Delay per Vehicle (seconds)**
A	≤10	A	≤10
B	>10 and ≤20	B	>10 and ≤15
C	>20 and ≤35	C	>15 and ≤25
D	>35 and ≤55	D	>25 and ≤35
E	>55 and ≤80	E	>35 and ≤50
F	>80	F	>50

Source: Highway Capacity Manual

4.4 VISSIM

VISSIM 5.10 was used to analyze the interaction between the light rail system and vehicular traffic, which Synchro is unable to do. This interaction is important to determine which intersections would benefit from grade-separated roadways in order to maintain acceptable levels of service for traffic. The VISSIM analysis was performed for each segment to determine the speed and travel time for each scenario to compare the at-grade and grade-separated options to the no-build condition. VISSIM results are reported for intersections inside the North Tryon Street/US-29 corridor, between Sugar Creek Road and the I-485 Ramp.
Several assumptions were considered when modeling the light rail system, namely:

1. The light rail system would operate with 6 minute headways for two car trains and 10 minute headways with three car trains
2. Two and three car trains would be used with a total train length of 180 and 270 feet, respectively
3. Dwell times at each station were derived from the BLE Running Times Calculation Report dated May 1, 2009
4. Trains would accelerate at a rate of 1.5 miles per hour per second (mphps) and decelerate at a rate of 1.5 mphps (including civil braking distances), as referenced in the BLE Running Times Calculation Report dated May 1, 2009
5. Maximum light rail operating speed used would be 55 miles per hour (mph)
6. Maximum light rail operating speed within North Tryon Street/US-29 would be 45 mph
7. Traffic signal preemption would be utilized

Signalized intersections were analyzed with the unsignalized intersection nodes removed from the model to include any queue build up adjacent to the signalized intersection. During the course of the analysis, large delays were observed at unsignalized intersections adjacent to signalized intersections. This was mainly due to queues building up at signalized intersections and extending through the adjacent unsignalized intersections. Due to VISSIM software parameters, the signalized intersection queue extending through the adjacent unsignalized intersections was solely reported under the unsignalized intersections, when in fact the queue had developed from the signalized intersection. In an effort to capture the entire queue for the signalized intersection analysis, the unsignalized intersection nodes were removed to include any queue built prior to the signalized intersection. Intersection nodes are consistent between the No-Build and Build scenarios to account for unsignalized intersections that become signalized in the Build scenario.

Intersection delays and levels of service were analyzed using the Vissim node evaluation. To report these values, nodes were placed at each intersection to encompass the entire intersection storage lane lengths. Signalized and unsignalized intersections were analyzed separately to report the delays associated with the specific intersection type. The purpose of this was to capture the delays created by signalized intersections that queue through adjacent unsignalized intersections. The signalized intersection delay reported is the average intersection delay for all movements. Unsignalized intersection delays were reported based on the worst movement of the minor street. For both node evaluations, a 2,500 foot "start of delay segment" parameter was used to capture the total delay due to extensive queues in certain locations. Intersection nodes are consistent between the No-Build and Build scenarios to account for unsignalized intersections that become signalized in the Build scenario. This ensures the same intersection areas are analyzed for all scenarios.

4.5 Duration of Congestion

Analysis was performed using 15 minute intervals for three hours surrounding the a.m. and p.m. peak hours of the 2030 Light Rail Alternative and 2030 SCDO scenarios. The purpose of the 15 minute analysis was to estimate the duration of congestion beyond the peak one hour. The trigger for performing this analysis was when a peak hour volume to capacity (v/c) was greater than 0.95. The v/c ratio, also referred to as degree of saturation, represents the sufficiency of an intersection to accommodate the vehicular demand. This provides an additional MOE to evaluate intersections.

Counts, provided by CDOT, were used to calculate the 15 minute interval volumes for each corresponding segment. Each 15 minute interval, contained in the peak hour, was converted to a percentage of the peak hour. For intervals outside the peak hour the 15 minute tube count volume was converted to a percentage of the peak hour volume. These percentages were then used to calculate the 15 minute interval volumes for each intersection using the balanced peak hour volumes.

The 15 minute interval volumes, derived from the peak hour volumes, were projected to hourly conditions by applying a peak hour factor (PHF) of 0.25. The existing tube count data along the corridor was used to calculate each 15 minute interval as a percentage of the peak hour volume. These percentages were then used to calculate the 15 minute interval volumes from the peak hour volumes. The 15 minute v/c ratios were inserted into worksheets, provided by CDOT, to calculate the incremental capacity of the intersections which had v/c ratios of 0.95 or greater. These worksheets illustrate the projected demand and capacity utilization at the intersection. Projected demand is defined as the v/c ratio, for a particular intersection, as a percentage of each 15 minute interval. The projected capacity utilization is the capacity of the intersection, with a maximum value of 100 percent. For intervals where the v/c ratio is greater than 100 percent (volume exceeds capacity), the overflow capacity is carried over to the next interval. The carry over continues until an interval is reached with a v/c percentage less than 100 percent. In cases where the v/c ratio could not be calculated, a value of 999 percent was used to represent the error value produced by the Synchro calculation. The results of the v/c analysis can be found in **Appendices D.3**, **E.3** and **F.3** for Segments 1, 2 and 3, respectively.

4.6 Bicycle/Pedestrian Levels of Service

Levels of service were calculated for the bicycle and pedestrian facilities using the Bicycle/Pedestrian Levels of Service worksheets developed by CDOT. These worksheets evaluate the intersection geometry and signalization characteristics according to the comfort

and safety of bicyclists and pedestrians at signalized intersections. The Pedestrian Level of Service worksheet specifically evaluates the crossing distance, left turn conflicts, right turn conflicts, pedestrian phasing, corner radius, right turns on red, crosswalk treatment and adjustments for one-way streets. These eight individual scores are evaluated for the crossing of each approach. The total for each approach is averaged to calculate the level of service of the intersection as a whole. The Bicycle Level of Service evaluates left turn conflicts, stop bar location, bicycle travel through the intersection, right turn conflicts, right turn on red conflicts and the intersection crossing distance. Similar to the Pedestrian level of service, the sum of the six individual scores are averaged to calculate the level of service.

4.7 Signal Timing

The existing signal timing along North Tryon Street/US-29 is not conducive for optimal transit and traffic operations with pre-emption. The analysis revealed that significant delays would be produced at traffic signals that operate with the existing cycle lengths. In order to improve the level of service and delay under the No-Build and Build scenarios, cycle lengths were increased to 150 seconds at intersections along and adjacent to North Tryon Street/US-29. Signal pre-emption, associated with the Build scenario, also required that left turn phases on North Tryon Street become protected in order to maintain safe left turn movements across the light rail alignment. Additionally, lead/lag phasing was employed for these left turn movements to optimize turning efficiency. Lastly, green time adjustments were made throughout the network to maximize the number of processed vehicles through an intersection.

4.8 Park-and-Ride Traffic

4.8.1 Station Trip Generation

Trip generation was performed for light rail stations that have proposed park-and-ride lots. To calculate the trip generation for these stations it was assumed 50 percent of the capacity of the park-and-ride lot would be entering/exiting during the a.m./p.m. peak hour. The station trip generation and distribution exhibits are included in **Appendix C**.

4.8.2 Station Trip Distribution

Trips were distributed for each park-and-ride lot based on the projected trip production scatter-plots provided by CATS. From these scatter plots it was assumed that the majority of the generated trips would move in the peak direction and that less than 1/3 of the trips would back-track to access these stations.

5.0 Capacity Analysis Results

5.1 Segment 1

Segment 1 includes the intersections from Center City Charlotte north to Owen Boulevard along North Tryon Street/US-29. This segment also includes all intersections analyzed on Sugar Creek Road & Eastway Drive. The analysis for this segment includes both the Light Rail Alternative and SCDO alignments. The Light Rail Alternative alignment would enter the North Tryon Street/US-29 median at Old Concord Road. The SCDO alignment would enter the North Tryon Street/US-29 median just north of Dorton Street. The analysis results for this segment are included in **Appendix D**.

5.1.1 At-Grade versus Grade Separated Analysis

The proposed Light Rail Alternative leaves the NCRR/NS ROW and enters the median of North Tryon Street/US-29 at Old Concord Road. In order to determine whether the light rail should cross this intersection and enter North Tryon Street/US-29 at-grade or be grade separated, traffic simulations were developed using VISSIM. The resulting measures of effectiveness for the two crossing alternatives are shown in **Tables 5.1**, **5.2** and **5.3**. **Table 5.1** presents a comparison of LOS and delay for the nearby signalized intersections of Old Concord Road, Eastway Drive and Sugar Creek Road. Results of the p.m. peak hour analysis, assuming two car train operations, show significant reductions in delay at Eastway Drive and Old Concord Road with the grade separation alternative. The a.m. peak hour results show a significant delay reduction at Old Concord Road and a slight reduction at Eastway Drive. The a.m. and p.m. peak hour delay at Sugar Creek increases slightly with the grade separation at Old Concord Road. This increase can be attributed to the greater number of vehicles processed at the upstream intersections of Old Concord Road and Eastway Drive, which sends more traffic to Sugar Creek during the peak hour than if Old Concord Road is preempted by light rail. The three car train analysis produces a similar trend with delay; however, only slight decreases in delay occur at Eastway Drive during the p.m. peak hour, grade separated scenario. Furthermore, the a.m. peak hour results show slight decreases in delay at all three intersections with the grade separation of the light rail at Old Concord Road. A significant increase in delay occurs at Sugar Creek Road during the p.m. peak hour of the grade separated scenario, with the three car train option. The two car train option, under the grade separated scenario, produces similar delay results as the at-grade scenario.

Table 5.1
Segment 1 At-Grade versus Grade Separated Analysis

2 Car Train Analysis with 6 Minute Headways (Light Rail Alternative)								
	2030 Build At-Grade				2030 Build Grade Separated			
	Delay (sec.)		LOS		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Sugar Creek Road	82.6	136.2	F	F	93.1	138.6	F	F
Eastway Drive	32.2	140.4	C	F	25.7	116.5	C	F
Old Concord Road	105.9	169.9	F	F	64.2	45.1	E	D
3 Car Train Analysis with 10 Minute Headways (Light Rail Alternative)								
Sugar Creek Road	94.6	101.5	F	F	91.0	170.5	F	F
Eastway Drive	26.0	119.0	C	F	25.7	112.4	C	F
Old Concord Road	68.7	72.7	E	E	64.2	41.3	E	D
2 Car Train Analysis with 6 Minute Headways (SCDO)								
Sugar Creek Road	130.1	108.5	F	F	129.3	102.5	F	F
Eastway Drive	33.7	168.9	C	F	31.1	91.6	C	F
Old Concord Road	75.5	166.0	E	F	76.8	65.9	E	E
3 Car Train Analysis with 10 Minute Headways (SCDO)								
Sugar Creek Road	126.7	82.9	F	F	126.6	82.8	F	F
Eastway Drive	33.4	152.6	C	F	30.6	98.9	C	F
Old Concord Road	63.8	167.2	E	F	87.7	66.0	F	E

Tables 5.2 and **5.3** present a comparison of travel times and speeds along North Tryon Street/US-29 from approximately Eastway Drive to Tom Hunter Road. As shown in these tables, the grade separation alternative provides better overall travel times and speeds for traffic traveling North Tryon Street/US-29 than the at-grade alternative; with the exception of the southbound movement during the a.m. peak hour. Due to the preemption with the at-grade alternative, the signal cycle length at the North Tryon Street/US-29 & Old Concord Road intersection is constantly interrupted and the resulting cycles (i.e. green, red phases) are much shorter. Over the peak hour, southbound North Tryon Street/US-29 receives 240 seconds more green time with the at-grade alternative, compared to the grade separated alternative. This additional green time, in conjunction with the free flow characteristics of the southbound movement at North Tryon Street/US-29 & Eastway Drive, causes the southbound North Tryon Street/US-29 travel speeds to be higher with the at-grade alternative than with the grade separated alternative.

Table 5.2
Segment 1 Grade Separated Travel Speeds and Travel Times

	Travel Speeds				Travel Times			
	a.m. peak period		p.m. peak period		a.m. peak period		p.m. peak period	
	NB (mph)	SB (mph)	NB (mph)	SB (mph)	NB (min)	SB (min)	NB (min)	SB (min)
2008 Existing	39	36	35	41	2.0	2.2	2.2	1.9
2030 No-Build	30	23	33	28	2.6	3.4	2.4	2.7
2030 Light Rail Alternative (2 car trains)	24	18	24	15	3.2	4.4	3.2	5.0
2030 Light Rail Alternative (3 car trains)	28	17	29	16	2.8	4.5	2.7	4.7
2030 SCDO (2 car trains)*	28	27	14	18	5.9	6.2	11.8	9.2
2030 SCDO (3 car trains)*	28	27	14	18	6.0	6.1	11.6	9.1

***Note: Travel speeds and times are measured from Sugar Creek Road to Tom Hunter Road due to where the SCDO enters the median of North Tryon Street/US-29**

Table 5.3
Segment 1 At-Grade Travel Speeds and Travel Times

	Travel Speeds				Travel Times			
	a.m. peak period		p.m. peak period		a.m. peak period		p.m. peak period	
	NB (mph)	SB (mph)	NB (mph)	SB (mph)	NB (min)	SB (min)	NB (min)	SB (min)
2030 Light Rail Alternative (2 car trains)	17	24	20	10	4.6	3.2	3.8	7.7
2030 Light Rail Alternative (3 car trains)	23	25	22	15	3.4	3.1	3.5	5.1
2030 SCDO (2 car trains)*	28	27	16	12	5.9	6.2	12.5	16.7
2030 SCDO (3 car trains)*	28	28	14	12	5.9	6.0	12.2	14.0

***Note: Travel speeds and times are measured from Sugar Creek Road to Tom Hunter Road due to where the SCDO enters the median of North Tryon Street/US-29**

5.1.2 Unsignalized Intersections Measures of Effectiveness

The unsignalized intersections were analyzed using Synchro and VISSIM. Synchro provided v/c ratio information and LOS/delay results for intersections outside the North Tryon Street/US-29 corridor. For intersections along North Tryon Street/US-29, VISSIM results are provided to account for light rail interactions. The delay at unsignalized intersections will be focused on the minor roadway due to the stop control. The major roadway will be free flowing with little or no delay. The MOEs for the Segment 1 unsignalized intersections can be found in Tables **5.4**, **5.5**, **5.6**, **5.7**, **5.8** and **5.9**.

The 2008 Existing Scenario shows that most unsignalized intersections in this segment operate at LOS C, or better, during both the a.m. and p.m. peak period. Background traffic growth affects the majority of the unsignalized intersections from the Existing Scenario to the No-Build Scenario. The increase in traffic would cause most intersections to operate at LOS D, or better, during the a.m. peak hour. Conversely, delays during the p.m. peak hour continue to increase, causing most intersections to operate at LOS D, or worse. For the purposes of this study, two unsignalized intersections along North Tryon Street/US-29, Orr Road and Arrowhead Drive, are assumed to be signalized by the year 2030. Analysis results for these two intersections are discussed in Section 5.1.3.

Construction of the proposed project would improve the MOEs for a few unsignalized intersections along North Tryon Street/US-29 such as Austin Drive and Heathway Drive. The improvements in LOS and delay for these two intersections can be attributed to geometry restrictions (i.e. right-in/right-out access) resulting from the light rail running within the median of North Tryon Street/US-29. The level of service would remain the same as the 2030 No-Build for most other unsignalized intersections. The proposed project also realigns the two offset intersections of Raleigh Street at Sugar Creek Road to form a single four-leg intersection. This intersection, along with two new driveways on Sugar Creek Road, will provide vehicular access to the Sugar Creek Station Park-and-Ride. Based on analysis, high delays are expected at the realigned Raleigh Street intersection, and a traffic signal was considered to mitigate the high delays. A preliminary Signal Warrant Analysis indicated that Warrant 3, Peak Hour was satisfied during the p.m. peak period, but no other signal warrants were met. Due to the preliminary Signal Warrant Analysis and the close proximity to the Sugar Creek Road & Greensboro Street and Sugar Creek Road & North Davidson intersections, a traffic signal is not being considered.

Traffic queues have the potential of extending over the light rail tracks given the proposed alignment south of Sugar Creek Road, particularly at 16th Street & Parkwood Avenue. Based on the 95th queue analysis provided by Synchro, traffic queues should not extend over the proposed light rail tracks.

Table 5.4
Segment 1 Existing Unsignalized Intersections

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
16th Street & Parkwood	0.40*	0.38*	23.5*	17.2*	C*	C*
Brevard Street & Parkwood Ave	0.43*	0.31*	15.6*	11.1*	C*	B*
28th Street & Brevard Street	0.07*	0.11*	10.4*	9.8*	B*	A*
Craighead Road & Raleigh Street	0.19*	0.21*	12.3*	11.7*	B*	B*
Craighead Road & North Davidson Street	0.35*	0.35*	14.0*	17.0*	B*	C*
Sugar Creek Road & North Davidson Street	0.32*	1.25*	22.9**	188.9**	C**	F**
Sugar Creek Road & Raleigh Street (southern intersection)	0.31*	0.43*	17.7*	18.4*	C*	C*
Sugar Creek Road & Raleigh Street (northern intersection)	0.31*	0.43*	15.0*	17.8*	B*	C*
North Tryon Street/US-29 & Beechway Circle	0.41*	0.36*	5.5**	9.3**	A**	A**
North Tryon Street/US-29 & Wellingford Street	0.40*	0.40*	31.9**	7.6**	D**	A**
North Tryon Street/US-29 & Dorton Street	0.40*	0.52*	13.3**	18.1**	B**	C**
North Tryon Street/US-29 & Mellow Drive	0.40*	0.71*	11.7**	7.0**	B**	A**
North Tryon Street/US-29 & Bennett Street	0.53*	0.76*	17.6**	16.1**	C**	C**
North Tryon Street/US-29 & Bingham Drive	0.41*	0.78*	13.7**	30.7**	B**	D**
North Tryon Street/US-29 & Lambeth Drive	0.69*	0.77*	17.0**	17.1**	C**	C**
Eastway Drive & Curtiswood Drive	0.37*	0.46*	12.2*	15.8*	B*	C*
Eastway Drive & Northpark Mall Driveway #1	0.27*	0.34*	10.6*	10.4*	B*	B*
North Tryon Street/US-29 & Northchase Drive	0.52*	0.53*	9.0**	9.2**	A**	A**
North Tryon Street/US-29 & Orr Road	0.57*	1.22*	84.1**	46.7**	F**	E**
North Tryon Street/US-29 & Austin Drive	0.63*	Error*	21.3**	27.4**	C**	D**
North Tryon Street/US-29 & Arrowhead Drive	1.07*	Error*	20.2**	49.5**	C**	E**
North Tryon Street/US-29 & Heathway Drive	0.57*	4.63*	13.7**	23.9**	B**	C**
North Tryon Street/US-29 & Owen Boulevard	0.40*	4.57*	7.3**	10.3**	A**	B**

* Note: Synchro results
** Note: VISSIM results

Table 5.5
Segment 1 No-Build Unsignalized Intersections

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
16th Street & Parkwood Avenue	0.52*	0.50*	41.9*	25.9*	E*	D*
Brevard Street & Parkwood Avenue	0.68*	0.41*	26.6*	13.4*	D*	B*
28th Street & Brevard Street	0.11*	0.15*	10.9*	10.3*	B*	B*
Craighead Road & Raleigh Street	0.25*	0.27*	14.5*	13.5*	B*	B*
Craighead Road & North Davidson Street	0.55*	0.61*	20.5*	30.1*	C*	D*
Sugar Creek Road & North Davidson Street	0.79*	3.40*	85.6**	Error**	F**	F**
Sugar Creek Road & Raleigh Street (southern intersection)	0.40*	0.56*	26.2*	37.3*	D*	E*
Sugar Creek Road & Raleigh Street (northern intersection)	0.40*	0.56*	20.4*	32.1*	C*	D*
North Tryon Street/US-29 & Beechway Circle	0.53*	0.47*	7.0**	110.2**	A**	F**
North Tryon Street/US-29 & Wellingford Street	0.53*	0.52*	21.5**	37.5**	C**	E**
North Tryon Street/US-29 & Dorton Street	0.52*	0.68*	15.2**	62.8**	C**	F**
North Tryon Street/US-29 & Mellow Drive	0.52*	0.92*	16.9**	55.5**	C**	F**
North Tryon Street/US-29 & Bennett Street	1.41*	0.99*	182.5**	63.4**	F**	F**
North Tryon Street/US-29 & Bingham Drive	0.53*	1.01*	32.5**	80.8**	D**	F**
North Tryon Street/US-29 & Lambeth Drive	0.90*	1.00*	30.8**	67.8**	D**	F**
Eastway Drive & Curtiswood Drive	0.48*	0.60*	15.0*	27.1*	B*	D*
Eastway Drive & Northpark Mall Driveway #1	0.36*	0.44*	11.3*	10.7*	B*	B*
North Tryon Street/US-29 & Northchase Drive	0.67*	0.69*	23.8**	14.2**	C**	B**
North Tryon Street/US-29 & Austin Drive	0.72*	0.91*	65.3**	64.0**	F**	F**
North Tryon Street/US-29 & Heathway Drive	1.33*	Error*	22.3**	41.5**	C**	E**
North Tryon Street/US-29 & Owen Boulevard	0.82*	167.29*	10.0**	38.0**	B**	E**

* Note: Synchro results
** Note: VISSIM results

Table 5.6
Segment 1 Build (Light Rail Alternative) Unsignalized Intersections
(2 car trains with 6 minute headways)

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
16th Street & Parkwood Avenue	0.52*	0.50*	41.9*	25.9*	E*	D*
Brevard Street & Parkwood Avenue	0.68*	0.41*	26.6*	13.4*	D*	B*
28th Street & Brevard Street	0.11*	0.15*	10.9*	10.3*	B*	B*
Craighead Road & Raleigh Street	0.25*	0.27*	14.5*	13.5*	B*	B*
Craighead Road & North Davidson Street	0.56*	0.70*	21.1*	37.2*	C*	E*
Sugar Creek Road & Raleigh Street	0.44*	0.74*	69.1*	116.9*	E*	F*
Sugar Creek Road & Sugar Creek Station Access	0.35*	0.78*	1.0*	91.1*	A*	F*
North Tryon Street/US-29 & Beechway Circle	0.53*	0.47*	6.1**	117.8**	A**	F**
North Tryon Street/US-29 & Wellingford Street	0.53*	0.53*	19.2**	192.7**	C**	F**
North Tryon Street/US-29 & Dorton Street	0.53*	0.68*	18.4**	40.6**	C**	E**
North Tryon Street/US-29 & Mellow Drive	0.52*	0.93*	14.4**	43.8**	B**	E**
North Tryon Street/US-29 & Bennett Street	1.45*	1.00*	35.1**	48.9**	E**	E**
North Tryon Street/US-29 & Bingham Drive	0.54*	1.02*	20.5**	155.1**	C**	F**
North Tryon Street/US-29 & Lambeth Drive	0.90*	1.16*	35.8**	151.5**	E**	F**
Eastway Drive & Curtiswood Drive	0.48*	0.60*	15.2*	28.8*	C*	D*
Eastway Drive & Northpark Mall Driveway #1	0.36*	0.44*	11.7*	11.2*	B*	B*
North Tryon Street/US-29 & Northchase Drive	0.67*	0.69*	14.5**	58.0**	B**	F**
North Tryon Street/US-29 & Old Concord Road Station Access	0.58*	0.71*	0.0**	10.8**	A**	B**
Old Concord Road & Old Concord Road Station Access	0.54*	0.59*	9.2*	41.6*	A*	E*
North Tryon Street/US-29 & Austin Drive	0.74*	0.93*	26.2**	34.3**	D**	D**
North Tryon Street/US-29 & Heathway Drive	0.75*	0.88*	9.4**	48.7**	A**	E**

* Note: Synchro results
** Note: VISSIM results; with gates, grade separated rail option

Table 5.7
Segment 1 Build (Light Rail Alternative) Unsignalized Intersections
(3 car trains with 10 minute headways)

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
16th Street & Parkwood Avenue	0.52*	0.50*	41.9*	25.9*	E*	D*
Brevard Street & Parkwood Avenue	0.68*	0.41*	26.6*	13.4*	D*	B*
28th Street & Brevard Street	0.11*	0.15*	10.9*	10.3*	B*	B*
Craighead Road & Raleigh Street	0.25*	0.27*	14.5*	13.5*	B*	B*
Craighead Road & North Davidson Street	0.56*	0.70*	21.1*	37.2*	C*	E*
Sugar Creek Road & Raleigh Street	0.44*	0.74*	69.1*	116.9*	E*	F*
Sugar Creek Road & Sugar Creek Station Access	0.35*	0.78*	1.0*	91.1*	A*	F*
North Tryon Street/US-29 & Beechway Circle	0.53*	0.47*	6.0**	121.3**	A**	F**
North Tryon Street/US-29 & Wellingford Street	0.53*	0.53*	13.4**	187.9**	B**	F**
North Tryon Street/US-29 & Dorton Street	0.53*	0.68*	13.0**	36.2**	B**	E**
North Tryon Street/US-29 & Mellow Drive	0.52*	0.93*	12.4**	29.7**	B**	D**
North Tryon Street/US-29 & Bennett Street	1.45*	1.00*	27.0**	62.6**	D**	F**
North Tryon Street/US-29 & Bingham Drive	0.54*	1.02*	21.7**	155.5**	C**	F**
North Tryon Street/US-29 & Lambeth Drive	0.90*	1.16*	35.5**	301.6**	E**	F**
Eastway Drive & Curtiswood Drive	0.48*	0.60*	15.2*	28.8*	C*	D*
Eastway Drive & Northpark Mall Driveway #1	0.36*	0.44*	11.7*	11.2*	B*	B*
North Tryon Street/US-29 & Northchase Drive	0.67*	0.69*	15.5**	59.1**	C**	F**
North Tryon Street/US-29 & Old Concord Road Station Access	0.58*	0.71*	0.0**	11.6**	A**	B**
Old Concord Road & Old Concord Road Station Access	0.54*	0.59*	9.2*	41.6*	A*	E*
North Tryon Street/US-29 & Austin Drive	0.74*	0.93*	38.1**	20.4**	E**	C**
North Tryon Street/US-29 & Heathway Drive	0.75*	0.88*	9.3**	29.1**	A**	D**

* Note: Synchro results
** Note: VISSIM results; with gates, grade separated rail option

Table 5.8
Segment 1 Build (SCDO) Unsignalized Intersections
(2 car trains with 6 minute headways)

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
16th Street & Parkwood Avenue	0.52*	0.50*	41.9*	25.9*	E*	D*
Brevard Street & Parkwood Avenue	0.68*	0.41*	26.6*	13.4*	D*	B*
28th Street & Brevard Street	0.11*	0.15*	10.9*	10.3*	B*	B*
Craighead Road & Raleigh Street	0.25*	0.27*	14.5*	13.5*	B*	B*
Craighead Road & North Davidson Street	0.56*	0.71*	21.0*	37.9*	C*	E*
Sugar Creek Road & Raleigh Street(southern intersection)	0.50*	0.66*	25.8*	25.5*	D*	D*
Sugar Creek Road & Raleigh Street(northern intersection)	0.40*	1.54*	22.0*	304.2*	C*	F*
North Tryon Street/US-29 & Beechway Circle	0.53*	0.47*	6.9**	106.5**	A**	F**
North Tryon Street/US-29 & Wellingford Street	0.52*	0.53*	15.3**	44.5**	C**	E**
North Tryon Street/US-29 & Mellow Drive	0.54*	0.98*	9.5**	8.3**	A**	A**
North Tryon Street/US-29 & Bennett Street	0.53*	1.06*	10.2**	8.7**	B**	A**
North Tryon Street/US-29 & Bingham Drive	0.56*	1.05*	10.6**	22.7**	B**	C**
Eastway Drive & Curtiswood Drive	0.48*	0.60*	15.0*	28.4*	B*	D*
Eastway Drive & Northpark Mall Driveway #1	0.36*	0.44*	11.5*	11.1*	B*	B*
North Tryon Street/US-29 & Northchase Drive	0.69*	0.70*	15.6**	557.5**	C**	F**
North Tryon Street/US-29 & Old Concord Road Station Access	0.59*	0.72*	See Note 1	13.0**	A**	B**
Old Concord Road & Old Concord Road Station Access	0.54*	0.59*	9.2*	40.9*	A*	E*
North Tryon Street/US-29 & Austin Drive	0.74*	0.93*	69.8**	32.9**	F**	D**
North Tryon Street/US-29 & Heathway Drive	0.75*	0.88*	9.9**	8.3**	A**	A**

* Note: Synchro results
** Note: VISSIM results; with gates, 2 car trains, 6 minute headways, grade separated rail option
Note 1: Nominal traffic on the side street approach produce negligible delays

Table 5.9
Segment 1 Build (SCDO) Unsignalized Intersections
(3 car trains with 10 minute headways)

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
16th Street & Parkwood Avenue	0.52*	0.50*	41.9*	25.9*	E*	D*
Brevard Street & Parkwood Avenue	0.68*	0.41*	26.6*	13.4*	D*	B*
28th Street & Brevard Street	0.11*	0.15*	10.9*	10.3*	B*	B*
Craighead Road & Raleigh Street	0.25*	0.27*	14.5*	13.5*	B*	B*
Craighead Road & North Davidson Street	0.56*	0.71*	21.0*	37.9*	C*	E*
Sugar Creek Road & Raleigh Street(southern intersection)	0.50*	0.66*	25.8*	25.5*	D*	D*
Sugar Creek Road & Raleigh Street(northern intersection)	0.40*	1.54*	22.0*	304.2*	C*	F*
North Tryon Street/US-29 & Beechway Circle	0.53*	0.47*	6.9**	75.7**	A**	F**
North Tryon Street/US-29 & Wellingford Street	0.52*	0.53*	9.3**	44.1**	A**	E**
North Tryon Street/US-29 & Mellow Drive	0.54*	0.98*	9.8**	8.2**	A**	A**
North Tryon Street/US-29 & Bennett Street	0.53*	1.06*	12.8**	8.6**	B**	A**
North Tryon Street/US-29 & Bingham Drive	0.56*	1.05*	7.6**	22.1**	A**	C**
Eastway Drive & Curtiswood Drive	0.48*	0.60*	15.0*	28.4*	B*	D*
Eastway Drive & Northpark Mall Driveway #1	0.36*	0.44*	11.5*	11.1*	B*	B*
North Tryon Street/US-29 & Northchase Drive	0.69*	0.70*	12.8**	1021.1**	B**	F**
North Tryon Street/US-29 & Old Concord Road Station Access	0.59*	0.72*	See Note 1	16.0**	A**	C**
Old Concord Road & Old Concord Road Station Access	0.54*	0.59*	9.2*	40.9*	A*	E*
North Tryon Street/US-29 & Austin Drive	0.74*	0.93*	70.1**	25.5**	F**	D**
North Tryon Street/US-29 & Heathway Drive	0.75*	0.88*	8.9**	8.1**	A**	A**

* Note: Synchro results
** Note: VISSIM results; with gates, 2 car trains, 6 minute headways, grade separated rail option
Note 1: Nominal traffic on the side street approach produce negligible delays

5.1.3 Signalized Intersections Measures of Effectiveness

In order to assess the effects of the proposed Light Rail Alternative and SCDO on individual intersections within the corridor, Synchro analysis and VISSIM simulation was performed. VISSIM was used to evaluate the interaction between light rail and roadway traffic where light rail is proposed to run within or in proximity to North Tryon Street/US-29. Where light rail runs within the NCRR/NS ROW, Synchro was used to measure traffic effects. While VISSIM delay and LOS results are reported only for the North Tryon Street/US-29 intersections, Synchro estimates of intersection capacity (reported as volume to capacity ratios) are provided for all intersections within the assessment area. The 2030 No-Build conditions show that most signalized intersections in this segment operate above LOS F with the exception of North Tryon Street/US-29 & Sugar Creek Road and North Tryon Street/US-29 & Eastway Drive, with both producing LOS F during the p.m. peak period. The 2030 Build Scenario produces similar results to the 2030 No-Build Scenario. The majority of the signalized intersections operate above LOS F, with the exception of North Tryon Street/US-29 & Sugar Creek Road and North Tryon Street/US-29 & Eastway Drive. The level of service at North Tryon Street/US-29 & Sugar Creek Road degrades to LOS F during the a.m. peak period.

12th Street & College Street

This signalized intersection currently operates at LOS B. The 2030 No-Build Scenario shows an increase to LOS A for the a.m. peak hour due to signal timing adjustments (cycle length changes) despite an increase in traffic volumes due to background growth. Timing adjustments were made to account for changes in demand volumes. The Light Rail Alternative and the SCDO scenarios during the 2030 Build Scenario would be the same at this intersection. No additional trips would be added to this intersection due to the construction of the proposed project; therefore the LOS would not change for either 2030 Build Scenarios. There would be no change in the pedestrian and bicycle LOS. The probability of queues extending from this intersection to the proposed tracks is a potential impact that could result from the construction of the proposed project. Based on the 95th queue analysis results, queuing should not extend back to the light rail tracks. The Synchro MOEs are shown in **Tables 5.10** and **5.11**. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

Table 5.10
12th Street & College Street a.m. Peak Results

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	0.09	0.12	0.13	0.13
LOS	B	A	A	A
Delay (sec.)	12.1	9.7	9.8	9.8

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

Table 5.11
12th Street & College Street p.m. Peak Results

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	0.18	0.22	0.22	0.23
LOS	B	B	B	B
Delay (sec.)	14.7	14.7	14.7	14.7

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

36th Street & North Davidson Street

This signalized intersection currently operates at LOS A for both period peaks. The background growth would decrease the p.m. peak hour in the 2030 No-Build Scenario to LOS B. There is a potential impact to this intersection due to trips generated by the Sugar Creek Station in the 2030 Build Scenario; however, the volume of trips generated is not significant enough to decrease the level of service. The number of generated trips varies between the Light Rail Alternative and SCDO, due to the location and size of the park-and-ride facilities between the two scenarios. Changes would not be made at this intersection that would affect the pedestrian and bicycle levels of service. **Tables 5.12** and **5.13** illustrate the Synchro MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

Table 5.12
36th Street & North Davidson Street a.m. Peak Results

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	0.37	0.50	0.52	0.51
LOS	A	A	A	A
Delay (sec.)	8.4	8.8	9.0	8.9

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

Table 5.13
36th Street & North Davidson Street p.m. Peak Results

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	0.45	0.57	0.57	0.59
LOS	A	B	B	B
Delay (sec.)	8.4	11.1	11.0	11.3

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

Sugar Creek Road & North Davidson Street

This unsignalized intersection currently operates at LOS C during the a.m. peak hour and LOS F during the p.m. peak hour. The background traffic growth associated with the 2030 No-Build Scenario would increase the delay at this intersection during both the a.m. and p.m. peak hours. This intersection would be signalized as part of the 2030 Build Scenario due to the long delays expected on North Davidson Street. The resulting signal would operate at LOS B and LOS C during the a.m. and p.m. peak period, respectively. The number of generated trips varies between the Light Rail Alternative and SCDO; however, the LOS remains the same. The station generated trips vary due to the size and location of the park-and-ride facilities between the two scenarios. The Sugar Creek Station would have 924 parking spaces under the Light Rail Alternative and 893 parking spaces under the SCDO. Further information related to the Sugar Creek Station can be found in **Appendix C.1** and **C.2**. This intersection would have a significant impact due to trips generated by the Sugar Creek Station in both the Light Rail Alternative and SCDO. **Tables 5.14** and **5.15** illustrate the Synchro MOEs at this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

Table 5.14
Sugar Creek Road & North Davidson Street a.m. Peak Results

	2008 Existing*	2030 No-Build*	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	0.32	0.79	0.82	0.83
LOS	C	F	B	B
Delay (sec.)	22.9	85.6	11.9	13.1

Note: v/c ratio and delay are based on the worst approach for unsignalized intersections.
*Note: Intersection unsignalized

Table 5.15
Sugar Creek Road & North Davidson Street p.m. Peak Results

	2008 Existing*	2030 No-Build*	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	1.25	3.40	0.94	0.97
LOS	F	F	C	C
Delay (sec.)	188.9	Error	23.4	27.4

Note: v/c ratio and delay are based on the worst approach for unsignalized intersections.
*Note: Intersection unsignalized

Sugar Creek Road & Greensboro Street

This signalized intersection currently operates at LOS A. The background growth would not affect the level of service at this intersection. Signal timing adjustments (cycle length changes) in the 2030 No-Build Scenario would improve delay during the a.m. peak hour. Timing adjustments were made to account for changes in demand volumes. The p.m. peak hour delay would increase slightly during the 2030 Build Scenario as a result of trips generated by the Sugar Creek Station. The number of station generated trips varies between the Light Rail Alternative and SCDO due to the size and location of the park-and-ride facilities between the two scenarios. The Sugar Creek Station would have 924 parking spaces under the Light Rail

Alternative and 893 parking spaces under the SCDO. Further information related to the Sugar Creek Station can be found in **Appendix C.1** and **C.2**. The volume of station generated trips is not significant enough to decrease the level of service. Changes would not be made at this intersection that would affect the pedestrian and bicycle levels of service. **Tables 5.16** and **5.17** present the Synchro MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

Table 5.16
Sugar Creek Road & Greensboro Street a.m. Peak Results

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	0.27	0.35	0.36	0.36
LOS	A	A	A	A
Delay (sec.)	3.7	7.9	3.4	3.2

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

Table 5.17
Sugar Creek Road & Greensboro Street p.m. Peak Results

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	0.43	0.56	0.62	0.58
LOS	A	A	B	B
Delay (sec.)	7.9	9.5	13.9	10.6

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

North Tryon Street/US-29 & Sugar Creek Road

This signalized intersection currently operates at LOS F during the a.m. peak hour and LOS D during the p.m. peak hour. The background traffic growth would increase the a.m. peak hour to LOS E and decrease the p.m. peak hour to LOS F during the 2030 No-Build Scenario. The level of service improves in the 2030 No-Build Scenario during the a.m. peak hour because of an increased cycle length from the 2008 Existing scenario. The increased cycle length provides more green time to the southbound North Tryon Street/US-29 approach, which lowers the overall intersection delay. Trips generated by the Sugar Creek Station in the 2030 Build Scenario would cause a potential impact to this intersection for both the Light Rail Alternative and SCDO. The number of station generated trips varies between the Light Rail Alternative and SCDO due to the size and location of the park-and-ride facilities between the two scenarios. The Sugar Creek Station would have 924 parking spaces under the Light Rail Alternative and 893 parking spaces under the SCDO. Further information related to the Sugar Creek Station can be found in **Appendix C.1** and **C.2**. The proposed project would decrease the level of service during the a.m. peak hour to LOS F for both two and three car train options. The p.m. peak hour level of service would remain LOS F from the No-Build Scenario for both two and three car train options. The VISSIM level of service and delay results can be found in **Tables 5.18** and **5.19**. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. The intersection would operate over capacity for 0.75 hours during the a.m. peak period and for 0.25 hours during the p.m. peak period of the 2030 No-Build Scenario. Furthermore, the intersection would take approximately 0.50 hours and 0.25 hours to recover during the a.m. and p.m. peak periods, respectively. During the 2030 Build Scenario of the Light Rail Alternative, the intersection would operate over capacity for 1.0 hours during the a.m. and p.m. peak periods. The recovery time for the a.m. and p.m. peak periods would be approximately 0.50 hours. Similar results would be expected for the 2030 Build SCDO scenario. The Synchro v/c analysis results are illustrated in **Table 5.20**. The remaining Synchro analysis is located in **Appendix D.2**.

Table 5.18
North Tryon Street/US-29 & Sugar Creek Road VISSIM Delay Results
(Light Rail Alternative)

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	93.8	42.9	78.0	122.6	93.1	138.6	91.0	170.5
Equivalent LOS	F	D	E	F	F	F	F	F

Note: VISSIM results reflect the grade separated rail configuration

Table 5.19
North Tryon Street/US-29 & Sugar Creek Road VISSIM Delay Results
(SCDO)

	2008 Existing		2030 No-Build		2030 Build SCDO			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	93.8	42.9	78.0	122.6	129.3	102.5	126.6	82.8
Equivalent LOS	F	D	E	F	F	F	F	F

Note: VISSIM results reflect the grade separated rail configuration

Table 5.20
North Tryon Street/US-29 & Sugar Creek Road Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
a.m. v/c ratio	0.80	1.00	1.03	1.08
p.m. v/c ratio	0.77	0.93	1.01	0.98

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

North Tryon Street/US-29 & Dorton Street

This intersection is signalized as part of the SCDO in the 2030 Build Scenario. The two and three car train options produce similar results, LOS A and LOSF during the a.m. and p.m. peak hours, respectively. The VISSIM LOS and delay results are shown in **Table 5.21**. The Synchro v/c analysis can be found in **Table 5.22**. The remaining Synchro analysis is located in **Appendix D.2**. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

Table 5.21
North Tryon Street/US-29 & Dorton Street VISSIM Delay Results

	2030 Build SCDO			
	2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	5.1	85.5	5.3	80.7
Equivalent LOS	A	F	A	F

Note: VISSIM results reflect the grade separated rail configuration

Table 5.22
North Tryon Street/US-29 & Dorton Street Synchro V/C Ratio

	2030 Build SCDO
a.m. v/c ratio	0.49
p.m. v/c ratio	0.96

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

North Tryon Street/US-29 & Lambeth Drive

This intersection is signalized as part of the SCDO in the 2030 Build Scenario. The two car train option operates at LOS B and LOS E during the a.m. and p.m. peak hours, respectively. The three car train option functions with a similar a.m. peak hour, LOS B; however, the p.m. peak hour operates at LOS F. The VISSIM LOS and delay results are shown in **Table 5.23**. The Synchro v/c analysis can be found in Table **5.24**. The remaining Synchro analysis is located in **Appendix D.2**. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

Table 5.23
North Tryon Street/US-29 & Lambeth Drive VISSIM Delay Results

	2030 Build SCDO			
	2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	16.7	79.9	14.6	98.9
Equivalent LOS	B	E	B	F

Note: VISSIM results reflect the grade separated rail configuration

Table 5.24
North Tryon Street/US-29 & Lambeth Drive Synchro V/C Ratio

	2030 Build SCDO
a.m. v/c ratio	0.89
p.m. v/c ratio	0.93

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

Eastway Drive & Northpark Mall Driveway #2

This signalized intersection currently operates at LOS A during both peak hours. The background traffic growth associated with the 2030 No-Build Scenario would not have an effect on the level of service at this intersection. The proposed project, during the 2030 Build Scenario, would remain LOS A during both peak periods. Trips generated by the Old Concord Road Station would have a slight impact on delay during the 2030 Build Scenario. The existing signal does not include pedestrian phases. It was assumed that pedestrian phases would be installed at this intersection by 2030. The pedestrian phases would improve the pedestrian level of service for the 2030 No-Build Scenario. **Tables 5.25** and **5.26** show the MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

Table 5.25
Eastway Drive & Northpark Mall Driveway #2 a.m. Peak Results

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	0.32	0.42	0.42	0.42
LOS	A	A	A	A
Delay (sec.)	2.4	3.3	2.8	3.0

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

Table 5.26
Eastway Drive & Northpark Mall Driveway #2 p.m. Peak Results

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	0.38	0.50	0.50	0.51
LOS	A	A	A	A
Delay (sec.)	5.3	7.4	7.6	7.8

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

North Tryon Street/US-29 & Eastway Drive

This signalized intersection currently operates at LOS B during the a.m. peak hour and LOS C during the p.m. peak hour. The additional background traffic growth during the 2030 No-Build Scenario would degrade the level of service to LOS D and LOS F during the a.m. and p.m. peak hours, respectively. Trips generated by the Old Concord Road Station would slightly increase the volume demand during the 2030 Build Scenario; however, due to traffic metering from the North Tryon Street/US-29 & Sugar Creek Road intersection, the level of service improves to LOS C during the a.m. peak hour. Traffic metering also takes place in the 2030 No-Build Scenario, but not as severely as in the 2030 Build Scenario. The p.m. peak hour would remain LOS F. The level of service is the same for both two and three car train options. The congestion in the northbound direction limits the amount of traffic that can pass through the intersection and therefore processes less volume than the demand dictates. This causes an improvement in the level of service during the a.m. peak period despite increased traffic from the Old Concord Road Station. The number of station generated trips varies between the Light Rail Alternative and SCDO due to the size of the park-and-ride facilities between the two scenarios. The location of park-and-ride facilities is the same between the two scenarios. The Old Concord Road Station would have 505 parking spaces under the Light Rail Alternative and 458 parking spaces under the SCDO. Further information related to the Old Concord Road Station can be found in **Appendix C.3** and **C.4**. The existing pedestrian and bicycle level of service is LOS F. The pedestrian level of service improves in the 2030 No-Build and Build Scenarios due to the addition of pedestrian signals at the intersection. The SCDO includes pedestrian refuges and bike lanes. This improves both the pedestrian and bicycle levels of service. **Tables 5.27** and **5.28** show the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. During the 2030 No-Build Scenario, the intersection would operate under capacity during the a.m. peak hours and would operate over capacity for the entire three hour period of the 2030 No-Build p.m. peak scenario. The p.m. peak period recovery time is uncertain due to the timeframe of the analysis. The 2030 Build Scenario would operate over capacity for 0.25 hours during the a.m. peak period and for the entire three hour period during the p.m. peak period. The a.m. peak would take approximately 0.25 hours to recover; however, the p.m. period recovery time is unknown due to the timeframe of the analysis. Similar results would be expected for the 2030 Build SCDO scenario. The Synchro v/c analysis can be found in **Table 5.29**. The remaining Synchro analysis is located in **Appendix D.2**.

Table 5.27
North Tryon Street/US-29 & Eastway Drive VISSIM Delay Results
(Light Rail Alternative)

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	19.8	26.1	37.7	95.7	25.7	116.5	25.7	112.4
Equivalent LOS	B	C	D	F	C	F	C	F

Note: VISSIM results reflect the grade separated rail configuration

Table 5.28
North Tryon Street/US-29 & Eastway Drive VISSIM Delay Results (SCDO)

	2008 Existing		2030 No-Build		2030 Build SCDO			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	19.8	26.1	37.7	95.7	31.1	91.6	30.6	98.9
Equivalent LOS	B	C	D	F	C	F	C	F

Note: VISSIM results reflect the grade separated rail configuration

Table 5.29
North Tryon Street/US-29 & Eastway Drive Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
a.m. v/c ratio	0.74	0.90	0.93	0.95
p.m. v/c ratio	0.94	1.19	1.19	1.26

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

North Tryon Street/US-29 & Old Concord Road

This signalized intersection currently operates at LOS E during the a.m. peak hour and LOS C during the p.m. peak hour. Traffic growth associated with the 2030 No-Build Scenario would have little effect on the delay; however, the a.m. peak hour improves to LOS D, while the p.m. peak hour remains LOS C. These results are mainly due to signal timing adjustments (cycle length changes). Old Concord Road would be realigned in the 2030 Build Scenario; removing the free flowing northbound North Tryon Street/US-29 right turn lane and providing dual westbound left turn lanes on Old Concord Road with 350 feet of storage on each lane. The Light Rail Alternative would be grade-separated over northbound North Tryon Street/US-29 as it enters the median just north of the intersection. Analysis of the at-grade and grade separated configurations revealed that the grade separated configuration would improve travel speeds and traffic operations, when compared with the at-grade scenario. The at-grade configuration indicated that queuing problems would develop causing traffic to extend over the proposed light rail tracks. The SCDO would already be within the North Tryon Street/US-29 median and would cross the intersection at-grade.

Impacts to the level of service would occur at this intersection due to the proposed project. The a.m. peak hour would decrease to LOS E and the p.m. peak hour would decrease to LOS D for both two and three car train options. The decrease in the levels of service would be due to the redistributed traffic from the North Tryon Street/US-29 & Orr Road intersection and additional traffic volume from the Old Concord Road Station. Traffic was redistributed due to the signal at North Tryon Street/US-29 & Orr Road, which will attract motorists that do not use this route today. Signal timing adjustments were made to the intersection, which include cycle length changes and modifications to the northbound and southbound North Tryon Street/US-29 left turn phases (permitted phasing to protected phasing). This would add phases to the signal timing; therefore, reducing the amount of green time to the other phases since the cycle length would remain the same. Additional volume would also be added to this intersection due to the trips generated by the Old Concord Road Station. The number of station generated trips varies

between the Light Rail Alternative and SCDO due to the size of the park-and-ride facilities between the two scenarios. The location of park-and-ride facilities is the same between the two scenarios. The Old Concord Road Station would have 505 parking spaces under the Light Rail Alternative and 458 parking spaces under the SCDO. Further information related to the Old Concord Road Station can be found in **Appendix C.3** and **C.4**. The pedestrian and bicycle levels of service improve in the 2030 Build Scenarios due to the addition of protected left turn phases and bike lanes. **Tables 5.30** and **5.31** illustrate the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. The intersection would operate over capacity for 0.75 hours during the a.m. peak period, but would not exceed capacity during the p.m. peak period of the 2030 No-Build Scenario. The recovery time for the a.m. peak period would be approximately 0.50 hours. During the 2030 Build Scenario, the intersection would operate over capacity for 0.25 hours during the a.m. and p.m. peak periods. The a.m. peak timeframe is shorter in the Build than in the No-Build Scenario due to changes in traffic distribution from the No-Build Scenario to the Build Scenario. Both the a.m. and p.m. peaks would take approximately 0.25 hours to recover. Similar results would be expected for the 2030 Build SCDO scenario. The Synchro v/c analysis is shown in **Table 5.32**. The remaining Synchro analysis is located in **Appendix D.2**.

Table 5.30
North Tryon Street/US-29 & Old Concord Road VISSIM Delay Results
(Light Rail Alternative)

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	57.5	22.2	54.4	22.8	64.2	45.1	64.2	41.3
Equivalent LOS	E	C	D	C	E	D	E	D

Note: VISSIM results reflect the grade separated rail configuration

Table 5.31
North Tryon Street/US-29 & Old Concord Road VISSIM Delay Results
(SCDO)

	2008 Existing		2030 No-Build		2030 Build SCDO			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	57.5	22.2	54.4	22.8	76.8	65.9	87.7	66.0
Equivalent LOS	E	C	D	C	E	E	F	E

Note: VISSIM results reflect the grade separated rail configuration

Table 5.32
North Tryon Street/US-29 & Old Concord Road Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
a.m. v/c ratio	0.79	1.01	0.96	1.04
p.m. v/c ratio	0.67	0.86	0.96	0.99

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

Old Concord Road & Orr Road

This signalized intersection currently operates at LOS C during the a.m. peak hour and LOS D during the p.m. peak hour. The 2030 No-Build traffic growth would decrease the a.m. peak hour level of service to LOS E, but would remain LOS D during the p.m. peak hour. Timing adjustments (cycle length changes) would be made to account for changes in demand volumes. The 2030 Build Scenario improves the level of service during the a.m. and p.m. peak hours to LOS D and LOS C, respectively. Additional volume would also be added to this intersection due to the trips generated by the Old Concord Road Station. The number of station generated trips varies between the Light Rail Alternative and SCDO due to the size of the park-and-ride facilities between the two scenarios. The location of park-and-ride facilities is the same between the two scenarios. The Old Concord Road Station would have 505 parking spaces under the Light Rail Alternative and 458 parking spaces under the SCDO. Further information related to the Old Concord Road Station can be found in **Appendix C.3** and **C.4**. The 2030 Build Scenario slightly decreases the delay over the 2030 No-Build Scenario due to the redistribution of the westbound through traffic to North Tryon Steet/US-29 & Orr. Traffic was redistributed due to the new signal at North Tryon Street/US-29 & Orr Road. **Tables 5.29** and **5.30** illustrate the Synchro MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

Table 5.33
Old Concord Road & Orr Road a.m. Peak Results

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	0.66	0.90	0.93	0.93
LOS	C	E	D	D
Delay (sec.)	30.4	62.0	50.0	54.5

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

Table 5.34
Old Concord Road & Orr Road p.m. Peak Results

	2008 Existing	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
v/c ratio	0.46	0.65	0.74	0.76
LOS	D	D	C	C
Delay (sec.)	37.1	37.5	30.7	32.9

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.

North Tryon Street/US-29 & Orr Road

This unsignalized intersection currently operates at LOS F during the a.m. peak hour and LOS E during the p.m. peak hour. Orr Road is particularly important to the corridor's limited street network and was assumed to be signalized at some point in the future with or without the proposed light rail project. As a result, the 2030 No-Build Scenario analyzes the intersection with a signal, which provides LOS E during the a.m. peak hour and LOS C during the p.m. peak hour. The 2030 Build Scenario would add traffic to this intersection as a result of trips generated by the Old Concord Road Station. The number of station generated trips varies between the Light Rail Alternative and SCDO due to the size of the park-and-ride facilities between the two scenarios. The location of park-and-ride facilities is the same between the two scenarios. A fourth leg would be added to the intersection under the 2030 Build Scenario. The additional eastbound Orr Road approach intends to restore connectivity for residents on the west side of North Tryon Street/US-29 that will be lost due to the proposed turning restrictions at Austin Drive. The proposed project would remain LOS E during the a.m. peak period, but would decrease the p.m. peak period to LOS D for the two car train option. The three car train option would remain LOS E and LOS C during the a.m. and p.m. peak periods, respectively. Redistributed traffic from the Old Concord Road & Orr Road intersection, along with the additional traffic generated by the Old Concord Road Station are the likely causes for the changes in the levels of service. This full movement intersection would allow U-turns for the adjacent unsignalized intersections and driveways that would be restricted to right-in/right-out due to the construction of the proposed project in the median of North Tryon Street/US-29. **Tables 5.35** and **5.36** depict the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

The proposed traffic signal would be approximately 1,540 feet north of the existing traffic signal at North Tryon Street/US-29 & Old Concord Road. The North Tryon Street/US-29 & Arrowhead Drive traffic signal is approximately 1,840 feet north of Orr Road along North Tryon Street/US-29. Left turn movements at this intersection would have protected phases to provide protection for crossing the rail line.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. The intersection would operate under capacity during the a.m. peak period of the 2030 No-Build Scenario, but would operate over capacity for 0.25 hours during the p.m. peak period. The recovery time for the p.m. peak period would be approximately 0.25 hours. The 2030 Build Scenario would operate over capacity for 0.25 hours for both the a.m. and p.m. peak periods. The recovery time for both the a.m. and p.m. peak periods would be approximately 0.25 hours. Similar results would be expected for the 2030 Build SCDO scenario. The Synchro v/c analysis is shown in **Table 5.37**. The remaining Synchro analysis is located in **Appendix D.2**.

Table 5.35
North Tryon Street/US-29 & Orr Road VISSIM Delay Results

	2008 Existing*		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	84.1	46.7	57.5	27.2	75.1	41.1	64.6	25.4
Equivalent LOS	F	E	E	C	E	D	E	C

Note: VISSIM results reflect the grade separated rail configuration
*Note: Intersection unsignalized

Table 5.36
North Tryon Street/US-29 & Orr Road VISSIM Delay Results (SCDO)

	2008 Existing*		2030 No-Build		2030 Build SCDO			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	84.1	46.7	57.5	27.2	50.5	45.6	55.1	34.3
Equivalent LOS	F	E	E	C	D	E	E	C

Note: VISSIM results reflect the grade separated rail configuration
*Note: Intersection unsignalized

Table 5.37
North Tryon Street/US-29 & Orr Road Synchro V/C Ratio

	2008 Existing*	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
a.m. v/c ratio	0.57	0.68	0.93	1.02
p.m. v/c ratio	1.22	0.97	0.97	2.91

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.
*Note: Intersection unsignalized

North Tryon Street/US-29 & Arrowhead Drive

Currently this unsignalized intersection operates at LOS C during the a.m. peak hour and LOS E during the p.m. peak hour. Based on the accident history at this intersection, connections to a residential development and business park and the likely extension to Old Concord Road, this intersection was assumed to be signalized for the 2030 No-Build and Build Scenarios. The 2030 No-Build Scenario provides LOS C during the a.m. peak hour and LOS B during the p.m. peak hour. The proposed configuration includes exclusive left turn lanes. The 2030 Build Scenario would add traffic to this intersection due to trips generated by the Old Concord Road Station. The proposed project would decrease the a.m. peak hour to LOS D and the p.m. peak hour to LOS C, under the two car train option. The three car train option remains LOS C during the p.m. peak hour, and improves the a.m. peak hour to LOS C. Similar to North Tryon Street/US-29 & Orr Road; this full movement intersection would allow U-turns for the adjacent unsignalized intersections and driveways that would be restricted to right-in/right-out due to the construction of the proposed project. **Tables 5.38 and 5.39** depict the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

The proposed traffic signal would be approximately 1,840 feet north of the proposed traffic signal at North Tryon Street/US-29 & Orr Road. The North Tryon Street/US-29 & Owen Boulevard traffic signal is approximately 1,450 feet north of Arrowhead Road along North Tryon Street/US-29. Left turn movements at this intersection would have protected phases to provide protection for crossing the rail line.

The duration of congestion analysis shows that both the No-Build and Build Scenarios operate under capacity during the a.m. and p.m. peak periods. The Synchro v/c analysis is shown in **Table 5.40**. The remaining Synchro analysis is located in **Appendix D.2**.

Table 5.38
North Tryon Street/US-29 & Arrowhead Drive VISSIM Delay Results

	2008 Existing*		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	20.2	49.5	27.1	17.3	40.0	32.6	34.7	25.3
Equivalent LOS	C	E	C	B	D	C	C	C

Note: VISSIM results reflect the grade separated rail configuration
*Note: Intersection unsignalized

Table 5.39
North Tryon Street/US-29 & Arrowhead Drive VISSIM Delay Results (SCDO)

	2008 Existing*		2030 No-Build		2030 Build SCDO			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	20.2	49.5	27.1	17.3	20.1	33.3	16.5	27.5
Equivalent LOS	C	E	C	B	C	C	B	C

Note: VISSIM results reflect the grade separated rail configuration
*Note: Intersection unsignalized

Table 5.40
North Tryon Street/US-29 & Arrowhead Drive Synchro V/C Ratio

	2008 Existing*	2030 No-Build	2030 Build	
			Light Rail Alternative	SCDO
a.m. v/c ratio	1.07	0.65	0.69	0.67
p.m. v/c ratio	Error	0.77	0.82	0.84

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.
*Note: Intersection unsignalized

North Tryon Street/US-29 & Owen Boulevard

Currently this unsignalized intersection operates at LOS A during the a.m. peak hour and LOS B during the p.m. peak hour. Background traffic growth associated with the 2030 No-Build Scenario decreases the a.m. peak hour to LOS B and decreases the p.m. peak hour to LOS E. The 2030 Build Scenario proposes a traffic signal at this intersection. The purpose of the proposed traffic signal is to provide more access points between signalized intersections and to help reduce some of the traffic demand at those intersections. Furthermore, this signalized intersection is intended to maintain pedestrian connectivity across North Tryon Street/US-29. This full movement intersection would allow U-turns for the adjacent unsignalized intersections and driveways that would be restricted to right-in/right-out due to the construction of the proposed project in the median of North Tryon Street/US-29. Under the two and three car train options, the a.m. level of service provides LOS C, while the p.m. level of service provides LOS B. **Tables 5.41** and **5.42** depict the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.44** and **5.45** at the end of this section.

The proposed traffic signal would be approximately 1,450 feet north of the proposed traffic signal at North Tryon Street/US-29 & Arrowhead Drive. The North Tryon Street/US-29 & Tom Hunter Road traffic signal is approximately 1,250 feet north of Owen Boulevard along North Tryon Street/US-29. Left turn movements at this intersection would have protected phases to provide protection for crossing the rail line.

The duration of congestion analysis shows that the Build Scenario operates under capacity during the a.m. and p.m. peak periods. The Synchro v/c analysis is shown in **Table 5.43**. The remaining Synchro analysis is located in **Appendix D.2**.

Table 5.41
North Tryon Street/US-29 & Owen Boulevard VISSIM Delay Results

	2008 Existing*		2030 No-Build*		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	7.3	10.3	10.0	38.0	20.7	17.6	24.2	11.4
Equivalent LOS	A	B	B	E	C	B	C	B

Note: VISSIM results reflect the grade separated rail configuration
*Note: Intersection unsignalized

Table 5.42
North Tryon Street/US-29 & Owen Boulevard VISSIM Delay Results (SCDO)

	2008 Existing*		2030 No-Build*		2030 Build SCDO			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	7.3	10.3	10.0	38.0	16.7	18.3	14.3	12.8
Equivalent LOS	A	B	B	E	B	B	B	B

Note: VISSIM results reflect the grade separated rail configuration
*Note: Intersection unsignalized

Table 5.43
North Tryon Street/US-29 & Owen Boulevard Synchro V/C Ratio

	2008 Existing*	2030 No-Build*	2030 Build	
			Light Rail Alternative	SCDO
a.m. v/c ratio	0.40	0.82	0.66	0.66
p.m. v/c ratio	4.57	167.29	0.81	0.83

Note: v/c ratio and delay are based on the entire intersection for signalized intersections.
*Note: Intersection unsignalized

5.1.4 Pedestrian and Bicycle Measures of Effectiveness

Levels of service were calculated for the bicycle and pedestrian facilities using the Bicycle/Pedestrian Levels of Service worksheets developed by CDOT. These worksheets evaluate the intersection geometry and signalization characteristics according to the comfort and safety of bicyclists and pedestrians at signalized intersections. **Tables 5.44** and **5.45** illustrate the pedestrian and bicycle levels of service for the signalized intersections in Segment 1.

Table 5.44
Segment 1 Pedestrian Level of Service

Intersection	2008 Existing	2030 No-Build	2030 Build (Light Rail Alternative)	2030 Build (SCDO)
12th Street & College Street	B+	B+	B+	B+
36th Street & North Davidson	B	B	B	B
Sugar Creek Road & North Davidson Street	-	-	C-	C-
Sugar Creek Road & Greensboro Street	C	C	C	C
North Tryon Street/US-29 & Sugar Creek Road	E+	E+	E+	E+
North Tryon Street/US-29 & Dorton Street	-	-	-	B
North Tryon Street/US-29 & Lambeth	-	-	-	B+
Eastway Drive & Northpark Mall Driveway #2	D	C	C	C
North Tryon Street/US-29 & Eastway Drive	F	F	E	C
North Tryon Street/US-29 & Old Concord Road	E	E	B-	B-
Old Concord Road & Orr Road	C	B-	B-	B-
North Tryon Street/US-29 & Orr Road	-	C	B+	B+
North Tryon Street/US-29 & Arrowhead Road	-	C	C+	C+
North Tryon Street/US-29 & Owen Boulevard	-	-	B	B

Table 5.45
Segment 1 Bicycle Level of Service

Intersection	2008 Existing	2030 No-Build	2030 Build (Light Rail Alternative)	2030 Build (SCDO)
12th Street & College Street	D	D	D	D
36th Street & North Davidson	C	C	C	C
Sugar Creek Road & North Davidson Street	-	-	E	E
Sugar Creek Road & Greensboro Street	D-	D-	D-	D-
North Tryon Street/US-29 & Sugar Creek Road	F	F	E	E
North Tryon Street/US-29 & Dorton Street	-	-	-	C-
North Tryon Street/US-29 & Lambeth	-	-	-	C-
Eastway Drive & Northpark Mall Driveway #2	F	F	F	F
North Tryon Street/US-29 & Eastway Drive	F	F	E	C
North Tryon Street/US-29 & Old Concord Road	F	F	D	D
Old Concord Road & Orr Road	E	E	E	E
North Tryon Street/US-29 & Orr Road	-	C	C	C
North Tryon Street/US-29 & Arrowhead Road	-	C	C+	C+
North Tryon Street/US-29 & Owen Boulevard	-	-	C-	C-

5.2 Segment 2

Segment 2 begins with Tom Hunter Road and runs along North Tryon Street/US-29 through Barton Creek Drive. The Light Rail Alternative and SCDO alignments are the same for this segment. The analysis results for this segment are included in **Appendix E**.

5.2.1 At-Grade versus Grade Separated Analysis

VISSIM analysis was performed on this segment to determine the effects of vehicular interactions with the Light Rail Alternative. The alignments for both the Light Rail Alternative and the SCDO are on the same location for this segment; therefore, the analysis results for either alignment would be the same. In Segment 2, four grade separations are proposed with the Light Rail Alternative: I-85 Connector, University City Boulevard, W.T. Harris Boulevard and the northbound travel lanes of North Tryon Street/US-29 directly south of Grove Lake Drive. **Table 5.46** presents the comparison of LOS and delay between the two design scenarios for the two and three car train options. In general, the results from both the two and three car train options indicate that the grade separated design operates with less delay than the at-grade design scenario.

Table 5.46
Segment 2 At-Grade versus Grade Separated Analysis

2 Car Train Analysis with 6 Minute Headways								
	2030 Build At-Grade				2030 Build Grade Separated			
	Delay (sec.)		LOS		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
I-85 Connector	134.6	197.5	F	F	58.5	216.3	E	F
University City Boulevard	166.5	228.1	F	F	119.9	160.4	F	F
W.T. Harris Boulevard	110.1	235.2	F	F	66.1	148.0	E	F
3 Car Train Analysis with 10 Minute Headways								
I-85 Connector	111.5	239.3	F	F	50.7	228.5	D	F
University City Boulevard	141.9	184.0	F	F	115.6	171.6	F	F
W.T. Harris Boulevard	90.3	204.2	F	F	63.2	179.1	E	F

The travel speeds and travel times for this segment for both design scenarios are shown in **Tables 5.47** and **5.48**. The travel times and speeds represent vehicles traveling on North Tryon Street/US-29 from Tom Hunter Road to Barton Creek Drive. The complete analysis results are included in **Appendix E.1**.

Table 5.47
Segment 2 Grade Separated Travel Speeds & Travel Times

	Travel Speeds				Travel Times			
	a.m. peak period		p.m. peak period		a.m. peak period		p.m. peak period	
	NB (mph)	SB (mph)	NB (mph)	SB (mph)	NB (min)	SB (min)	NB (min)	SB (min)
2008 Existing	31	26	22	29	6.6	7.8	9.2	7.0
2030 No-Build	25	25	13	15	7.9	7.9	14.7	13.1
2030 Build (2 car trains)	22	17	11	15	9.1	11.9	18.6	14.0
2030 Build (3 car trains)	24	18	11	15	8.1	11.2	18.7	13.7

Table 5.48
Segment 2 At-Grade Travel Speeds & Travel Times

	Travel Speeds				Travel Times			
	a.m. peak period		p.m. peak period		a.m. peak period		p.m. peak period	
	NB (mph)	SB (mph)	NB (mph)	SB (mph)	NB (min)	SB (min)	NB (min)	SB (min)
2030 Build (2 car trains)	18	25	16	12	10.9	7.9	12.5	16.7
2030 Build (3 car trains)	16	24	11	13	12.6	8.3	17.6	16.1

5.2.2 Unsignalized Intersections Measures of Effectiveness

The unsignalized intersections were analyzed using Synchro and VISSIM. Synchro provided v/c ratio information and VISSIM provided LOS/delay results. The delay at unsignalized intersections will focus on the minor roadway due to the stop control. The major roadway will be free flowing with little or no delay, except where traffic is slowed due to downstream congestion. The MOEs for the Segment 2 unsignalized intersections can be found in **Tables 5.49**, **5.50**, **5.51** and **5.52**.

The majority of the unsignalized intersections in Segment 2 operate at LOS C or above during the 2008 Existing Scenario with the exception of Reagan Road, Stetson Drive and Kemp Street. The intersection at Reagan Road is located in the “Weave Area” and will be removed once the “Weave Area” project is constructed. The Stetson Drive and Kemp Street intersections are also located in the “Weave Area” and will be retained.

Background traffic growth associated with the 2030 No-Build Scenario will affect the majority of the unsignalized intersections in Segment 2. Despite decreases in the level of service at most of the unsignalized intersections, half of the intersections will still operate at LOS C or above.

Intersections that will experience significant reductions in level of service include, Gloryland Avenue, Kemp Street, Brookside Lane, Clark Boulevard and Barton Creek Drive. Construction of the "Weave Area" project will reconfigure a large number of the unsignalized intersections from a design and operational standpoint.

Construction of the proposed Light Rail Alternative produces mixed results for the unsignalized intersections in Segment 2. Some intersections improve in level of service, while others experience reductions in level of service. Gloryland Avenue, Kemp Street, Brookside Lane and Clark Boulevard encounter significant reductions in level of service. These intersections are adjacent to congested signalized intersections that produce long queues during the 2030 Build Scenario. Despite the right-in/right-out configuration of the unsignalized intersections, the long queues generated by the signalized intersections do not provide sufficient gaps for the side street traffic to enter North Tryon Street/US-29. The delay at the remaining unsignalized intersections improves from the No-Build to the Build Scenario.

Table 5.49
Segment 2 Existing Unsignalized Intersections

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
North Tryon Street/US-29 & Gloryland Avenue	0.45*	0.61*	See Note 1	10.6**	A**	B**
North Tryon Street/US-29 & Orchard Trace Lane	0.60*	0.98*	15.2**	19.8**	C**	C**
North Tryon Street/US-29 & Reagan Road	1.11*	1.01*	69.0**	70.1**	F**	F**
North Tryon Street/US-29 & Kemp Street	0.29*	1.03*	10.0**	27.7**	A**	D**
North Tryon Street/US-29 & Sandy Avenue	0.32*	0.61*	10.0**	49.0**	B**	E**
North Tryon Street/US-29 & I-85 Service Road	0.62*	1.04*	2.0**	13.0**	A**	B**
North Tryon Street/US-29 & Stetson Drive	5.33*	5.14*	47.5**	24.7**	E**	C**
North Tryon Street/US-29 & Rocky River Road	0.63*	0.98*	17.0**	10.4**	C**	B**
North Tryon Street/US-29 & University City Boulevard/NC-49	0.27*	0.38*	130.6**	11.1**	F**	B**
North Tryon Street/US-29 & Brookside Lane	0.50*	0.55*	5.3**	3.7**	A**	A**
North Tryon Street/US-29 & Shopping Center Drive	0.37*	18.12*	0.6**	1.8**	A**	A**
North Tryon Street/US-29 & Clark Boulevard	0.51*	0.83*	9.9**	12.9**	A**	B**
North Tryon Street/US-29 & Hampton Church Road	0.39*	0.53*	10.6**	11.9**	B**	B**
North Tryon Street/US-29 & Grove Lake Drive	0.53*	0.59*	8.1**	9.3**	A**	A**
North Tryon Street/US-29 & Barton Creek Drive	0.51*	0.63*	10.6**	8.9**	B**	A**

* Note: Synchro results
** Note: VISSIM results
Note 1: Nominal traffic on the side street approach produce negligible delays

Table 5.50
Segment 2 No-Build Unsignalized Intersections

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
North Tryon Street/US-29 & Gloryland Avenue	0.57*	0.76*	See Note 1	238.2**	A**	F**
North Tryon Street/US-29 & Orchard Trace Lane	6.36*	Error*	25.4**	134.7**	D**	F**
North Tryon Street/US-29 & Kemp Street	0.58*	0.76*	31.7**	46.0**	D**	E**
North Tryon Street/US-29 & I-85 Service Road	0.68*	0.96*	See Note 1	19.3**	A**	C**
North Tryon Street/US-29 & Stetson Drive	1.49*	2.43*	47.8**	20.0**	E**	C**
North Tryon Street/US-29 & Rocky River Road	0.71*	0.96*	16.1**	16.8**	C**	C**
North Tryon Street/US-29 & Brookside Lane	0.49*	0.79*	47.3**	59.7**	E**	F**
North Tryon Street/US-29 & Clark Boulevard	0.66*	1.06*	22.5**	19.3**	C**	C**
North Tryon Street/US-29 & Hampton Church Road	0.51*	0.80*	11.9**	16.8**	B**	C**
North Tryon Street/US-29 & Grove Lake Drive	0.69*	0.79*	9.0**	12.0**	A**	B**
North Tryon Street/US-29 & Barton Creek Drive	1.89*	3.25*	28.8**	8.9**	D**	A**

* Note: Synchro results
** Note: VISSIM results
Note 1: Nominal traffic on the side street approach produce negligible delays

Table 5.51
Segment 2 Build (Light Rail Alternative) Unsignalized Intersections
(2 car trains with 6 minute headways)

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
North Tryon Street/US-29 & Gloryland Avenue	0.76*	0.76*	See Note 1	560.5**	A**	F**
North Tryon Street/US-29 & Kemp Street	0.59	0.52*	25.8**	1295.7**	D**	F**
North Tryon Street/US-29 & I-85 Service Road	0.91*	0.96*	See Note 1	9.4**	A**	A**
North Tryon Street/US-29 & Stetson Drive	0.98*	1.05*	8.2**	4.1**	A**	A**
North Tryon Street/US-29 & Rocky River Road	0.74*	1.03*	11.7**	11.4**	B**	B**
North Tryon Street/US-29 & Brookside Lane	0.50*	0.81*	34.8**	314.6**	D**	F**
North Tryon Street/US-29 & Clark Boulevard	0.70*	0.75*	68.3**	34.4**	F**	D**
North Tryon Street/US-29 & Hampton Church Road	0.53*	0.75*	7.9**	8.8**	A**	A**
North Tryon Street/US-29 & Grove Lake Drive	0.69*	0.80*	7.0**	10.5**	A**	B**
North Tryon Street/US-29 & Barton Creek Drive	1.90*	3.46*	9.8**	8.3**	A**	A**

* Note: Synchro results
** Note: VISSIM results; with gates, grade separated rail option
Note 1: Nominal traffic on the side street approach produce negligible delays

Table 5.52
Segment 2 Build (Light Rail Alternative) Unsignalized Intersections
(3 car trains with 10 minute headways)

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
North Tryon Street/US-29 & Gloryland Avenue	0.76*	0.76*	See Note 1	589.8**	A**	F**
North Tryon Street/US-29 & Kemp Street	0.59	0.52*	26.7**	1241.1**	D**	F**
North Tryon Street/US-29 & I-85 Service Road	0.91*	0.96*	See Note 1	8.4**	A**	A**
North Tryon Street/US-29 & Stetson Drive	0.98*	1.05*	8.4**	4.6**	A**	A**
North Tryon Street/US-29 & Rocky River Road	0.74*	1.03*	12.2**	10.8**	B**	B**
North Tryon Street/US-29 & Brookside Lane	0.50*	0.81*	39.5**	266.6**	E**	F**
North Tryon Street/US-29 & Clark Boulevard	0.70*	0.75*	43.3**	35.8**	E**	E**
North Tryon Street/US-29 & Hampton Church Road	0.53*	0.75*	8.3**	9.9**	A**	A**
North Tryon Street/US-29 & Grove Lake Drive	0.69*	0.80*	6.7**	9.3**	A**	A**
North Tryon Street/US-29 & Barton Creek Drive	1.90*	3.46*	6.0**	7.7**	A**	A**

* Note: Synchro results
** Note: VISSIM results; with gates, grade separated rail option
Note 1: Nominal traffic on the side street approach produce negligible delays

5.2.3 Signalized Intersections Measures of Effectiveness

VISSIM analysis was performed to analyze the effects of the vehicular interaction with the proposed light rail for intersections in the North Tryon Street/US-29 corridor. Data extracted from VISSIM contains an analysis for both two and three car trains with six and ten minute headways, respectively. All intersections in Segment 2 were analyzed with VISSIM, with respect to level of service and delay; while the Synchro analysis provided v/c ratio data for the intersections.

The 2009 Existing Scenario indicates that all of the signalized intersections function at or above LOS D. W.T. Harris Boulevard produces the worst level of service, LOS D in both the a.m. and p.m. peak periods. Two other intersections produce LOS D during the p.m. peak hour; North Tryon Street/US-29 & JW Clay Boulevard and North Tryon Street/US-29 & UNCC Research Drive.

Two intersections become signalized in the 2030 No-Build Scenario in Segment 2 as part of the "Weave Area" project; I-85 Connector and University City Boulevard. The 2030 No-Build conditions show that most signalized intersections in this segment operate at LOS D or above, with the exception of Tom Hunter Road, I-85 Connector, University City Boulevard and W.T. Harris Boulevard. These four intersections operate below LOS D in the p.m. peak hour; however, University City Boulevard operates at LOS F during both peak periods in the 2030 No-Build Scenario.

Construction of the proposed Light Rail Alternative would signalize two additional intersections in Segment 2; Orchard Trace Lane and the University City Blvd. Station Access. Overall, the proposed project would not dramatically affect the level of service at the signalized intersections in Segment 2. The delay does increase at most of these intersections; however, only slight decreases in level of service occur, with the exception of Shopping Center Drive. Traffic associated with vehicles accessing the park-and-ride stations is one of the main components for increases in delay between the No-Build and Build Scenarios. Project related access changes along North Tryon Street/US-29 are another component to the increases in delay. As stated earlier, cycle lengths were increased at the signalized intersections to help mitigate the effects of the increased traffic volumes. The 2030 Build Scenario provides level of service and delay results for two and three car train options.

<u>North Tryon Street/US-29 & Tom Hunter Road</u>

Currently this signalized intersection operates at LOS B during the a.m. peak hour and LOS C during the p.m. peak hour. The background traffic growth associated with the 2030 No-Build Scenario would increase delay at this intersection, degrading the p.m. peak hour to LOS F. However, the a.m. peak hour would remain LOS B. This intersection would be potentially impacted due to the trips generated at the Tom Hunter Station. The 2030 No-Build Scenario would improve the pedestrian level of service because it would assume that pedestrian phases would be added to the existing signal by 2030. The 2030 Build Scenario would degrade the a.m. peak hour level of service to LOS C, under the two car train option. The p.m. peak hour would remain LOS F. The three car train option produces a similar level of service during the p.m. peak hour; however, despite a difference of eight seconds in delay from the two car train option, the a.m. peak hour decreases to LOS D. The 2030 Build scenario adds station generated trips to this intersection. The Tom Hunter Station would have 117 parking spaces under the Light Rail Alternative. Further information related to the Tom Hunter Station can be found in **Appendix C.5**. An improvement in pedestrian and bicycle levels of service results from the addition of

pedestrian refuges in the median of North Tryon Street/US-29 and bike lanes. **Table 5.53** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. The intersection would operate under capacity in the 2030 No-Build Scenario during the a.m. and p.m. peak periods. During the 2030 Build Scenario, the intersection would operate under capacity during the a.m. peak period and over capacity for 0.25 hours during the a.m. and p.m. peak periods. The pm. peak period would take approximately 0.25 hours to recover. The Synchro v/c analysis is shown in **Table 5.54**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.53
North Tryon Street/US-29 & Tom Hunter Road VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	16.6	30.6	18.6	128.0	33.6	140.9	41.6	133.3
Equivalent LOS	B	C	B	F	C	F	D	F

Note: VISSIM results reflect the grade separated rail configuration

Table 5.54
North Tryon Street/US-29 & Tom Hunter Road Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build
a.m. v/c ratio	0.67	0.82	0.85
p.m. v/c ratio	0.76	0.94	0.96

North Tryon Street/US-29 & Orchard Trace Lane

Currently this unsignalized intersection operates at LOS C during both peak hours. The a.m. and p.m. peak hour levels of service would decrease in the 2030 No-Build Scenario to LOS D and LOS F, respectively. The construction of the Light Rail Alternative proposes a traffic signal at this intersection. The signalized intersection would produce LOS B during the a.m. peak hour and LOS F during the p.m. peak hour, for both two and three car train options. The poor level of service during the p.m. peak hour is due to backups from the North Tryon Street/US-29 & I-85 Connector intersection. The full access intersection at Orchard Trace Lane would allow U-turns for the adjacent unsignalized intersections and driveways that would be restricted to right-in/right-outs due to the construction of the proposed project in the median of North Tryon Street/US-29. Signalization of this intersection will also reconnect Reagan Road to North Tryon Street/US-29, which will be severed when the “Weave Area” project is constructed. The pedestrian and bicycle levels of service are shown for the 2030 Build Scenarios. The intersection is unsignalized in the other scenarios and therefore no pedestrian or bicycle levels of service could be determined. **Table 5.55** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section. The Synchro v/c analysis is shown in **Table 5.56**. The remaining Synchro analysis is located in **Appendix E.2**.

The proposed traffic signal would be approximately 920 feet north of the traffic signal at the North Tryon Street/US-29 & Tom Hunter Road intersection. The North Tryon Street/US-29 and I-85 Connector traffic signal is approximately 1,350 feet north of Orchard Trace Lane along North Tryon Street/US-29. Left turn movements at this intersection would have protected phases to provide protection for crossing the rail line.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. In the 2030 No-Build Scenario, the intersection would operate over capacity for 2.25 hours in the a.m. peak period and over capacity for the entire three hour period in the p.m. peak period. It is unclear when the intersection would recover during the a.m. and p.m. peak periods due to the timeframe of the analysis. The 2030 Build Scenario shows improved results, with both peak periods operating under capacity for the entire three hour period. This is due to the signalization of the intersection. The Synchro v/c analysis is shown in **Table 5.43**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.55
North Tryon Street/US-29 & Orchard Trace Lane VISSIM Delay Results

	2008 Existing*		2030 No-Build*		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	15.2	19.8	25.4	134.7	14.7	95.4	12.9	87.7
Equivalent LOS	C	C	D	F	B	F	B	F

Note: VISSIM results reflect the grade separated rail configuration
*Note: Intersection unsignalized

Table 5.56
North Tryon Street/US-29 & Orchard Trace Lane Synchro V/C Ratio

	2008 Existing*	2030 No-Build*	2030 Build
a.m. v/c ratio	0.60	6.36	0.74
p.m. v/c ratio	0.98	Error	0.73

*Note: Intersection unsignalized

North Tryon Street/US-29 & I-85 Connector/Sandy Avenue

Currently this unsignalized intersection of North Tryon Street/US-29 & Sandy Avenue operates at LOS B during the a.m. peak hour and LOS E during the p.m. peak hour. The "Weave Area" project would reconfigure this intersection to become a four-way signalized intersection with I-85 Connector from the west and Sandy Avenue from the east. This new intersection would operate at LOS D for the a.m. peak period and LOS F for the p.m. peak period in the 2030 No-Build Scenario. The 2030 Build Scenario shows increases in delay during the a.m. and p.m. peak periods for both the two and three car train options. The additional traffic volumes generated by the University City Blvd. park-and-ride facility contributes to the increase in delay from the No-Build to the Build Scenario during the p.m. peak hour. In addition, the bicycle and pedestrian levels of service remain the same during the 2030 Build Scenario. It was assumed that pedestrians would cross the full distance of an approach in the 2030 No-Build Scenario but

would only cross to the median in the 2030 Build Scenario since the proposed project would increase the median width. The bicycle level of service remains the same, despite a reduction in the speed limit as part of the proposed project. **Table 5.57** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. During the 2030 No-Build Scenario, the intersection would operate over capacity for 0.25 hours in the a.m. peak period and over capacity for the entire three hour period in the p.m. peak period. The a.m. peak period would take approximately 0.25 hours to recover. It is unclear when the p.m. peak period would recover due to the timeframe of the analysis. The 2030 Build Scenario would operate over capacity for 0.25 hours in the a.m. peak period and over capacity for the entire three hour period in the p.m. peak period. The a.m. peak hours would take approximately 0.25 hours to recover, while it is unclear when the p.m. peak periods would recover due to the timeframe of the analysis. The Synchro v/c analysis is shown in **Table 5.58**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.57
North Tryon Street/US-29 & I-85 Connector VISSIM Delay Results

	2008 Existing*		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	10.0	49.0	40.8	189.1	58.5	216.3	50.7	221.5
Equivalent LOS	B	E	D	F	E	F	D	F

Note: VISSIM results reflect the grade separated rail configuration
*Note: Intersection unsignalized

Table 5.58
North Tryon Street/US-29 & I-85 Connector Synchro V/C Ratio

	2008 Existing*	2030 No-Build	2030 Build
a.m. v/c ratio	0.32	0.92	0.95
p.m. v/c ratio	0.61	1.21	1.17

*Note: Intersection unsignalized

North Tryon Street/US-29 & University City Blvd. Station Access Road

This intersection does not currently exist but would be constructed to access the This intersection does not currently exist but would be constructed to access the University City Blvd. Station from North Tryon Street/US-29. This would be a full movement signalized "T" intersection with a northbound left turn lane and southbound left and right turn lanes on North Tryon Street/US-29. The southbound left turn lane is proposed to accommodate the future 4th leg of the intersection and to allow U-turn movements from Stetson Drive and driveway entrances north of this intersection. This new intersection would operate at LOS C and LOS D during both the a.m. and p.m. peak hours, respectively. The results are the same between the two and three car train options. **Table 5.59** illustrates the VISSIM MOEs for this intersection. The 2030 Build scenario adds station generated trips to the surrounding street network. The

University City Blvd Station would have 591 parking spaces under the Light Rail Alternative. Further information related to the University City Blvd. Station can be found in **Appendix C.6**. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section.

The proposed traffic signal would be located approximately 1,200 feet north of the North Tryon Street/US-29 & I-85 Connector intersection and 2,000 feet south of the University City Boulevard intersection. Left turn movements at this intersection would have protected phases to provide protection for crossing the rail line.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours and is based solely on projected traffic demand; it does not consider the effects of metering from nearby intersections. The intersection would operate under capacity during the a.m. peak period and would operate over capacity for the entire three p.m. peak period of the 2030 Build Scenario. It is unclear when the p.m. peak period would recover due to the timeframe of the analysis. The Synchro v/c analysis is shown in **Table 5.60**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.59
North Tryon Street/US-29 & University City Blvd. Station Access VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	-	-	-	-	24.3	39.1	21.9	40.4
Equivalent LOS	-	-	-	-	C	D	C	D

Note: VISSIM results reflect the grade separated rail configuration

Table 5.60
North Tryon Street/US-29 & University City Blvd. Station Access Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build
a.m. v/c ratio	-	-	0.81
p.m. v/c ratio	-	-	1.21

North Tryon Street/US-29 & University City Boulevard/NC-49

This intersection currently exists as a merge area between North Tryon Street/US-29 and University City Boulevard/NC-49 with a connector segment that allows right turn movements from westbound University City Boulevard/NC-49 to travel northbound on North Tryon Street/US-29. This stop-controlled connector segment operates at LOS F for the a.m. peak hour and LOS B for the p.m. peak hour. As part of the "Weave Area" construction project, this minor roadway segment will be replaced by a full movement signalized intersection that connects University City Boulevard from the east with City Boulevard from the west. When complete, this new intersection configuration will provide direct connectivity from University City Boulevard/NC-49 to I-85. Analysis of the 2030 No-Build Scenario indicates this intersection would operate at LOS F in both the a.m. and p.m. peak hours. Similar levels of service and delays are projected with the Light Rail Alignment for both two and three car operations. The pedestrian level of

service remains the same in the 2030 Build Scenario. The bicycle level of service remains the same in the 2030 Build Scenario. **Table 5.61** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. During the 2030 No-Build Scenario the intersection would operate over capacity for 1.75 hours during the a.m. and p.m. peak periods. The a.m. peak period would take approximately 1.0 hours to recover, while It is unclear when the p.m. peak period would recover due to the timeframe of the analysis. The 2030 Build Scenario produces similar results, with the a.m. peak period operating over capacity for 1.75 hours, while the p.m. peak period would operate over capacity for the entire three hours. It is unclear when either peak period would recover due to the timeframe of the analysis. The Synchro v/c analysis is shown in **Table 5.62**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.61
North Tryon Street/US-29 & University City Boulevard VISSIM Delay Results

	2008 Existing*		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	130.6	11.1	125.3	160.4	119.9	160.4	115.6	165.9
Equivalent LOS	F	B	F	F	F	F	F	F

Note: VISSIM results reflect the grade separated rail configuration
*Note: Intersection unsignalized

Table 5.62
North Tryon Street/US-29 & University City Boulevard Synchro V/C Ratio

	2008 Existing*	2030 No-Build	2030 Build
a.m. v/c ratio	0.27	1.05	1.16
p.m. v/c ratio	0.38	1.12	1.32

*Note: Intersection unsignalized

North Tryon Street/US-29 & Shopping Center Drive

This intersection currently exists as a signalized intersection. However, during the time the traffic counts were conducted in the 2008 base year the intersection was unsignalized. As such, the Shopping Center Drive approach was restricted to right-in/right-out access and a fourth leg was being added to the intersection. This fourth leg was being built as part of new development on the west side of North Tryon Street/US-29 and was operating with right-in/right-out access. Eventually, the City plans to extend this segment of Shopping Center Drive across I-85 to connect with IBM Drive. For the purposes of this analysis, it was assumed that the extension of Shopping Center Drive would be complete by 2030. This intersection operated at LOS A during the a.m. and p.m. peak hours in the Existing Scenario. The 2030 No-Build Scenario, which includes signalization, would operate at LOS D.

Delay at this intersection increases with construction of the proposed project. The two car train option produces LOS F during the a.m. and p.m. peak hours. The three car train option produces LOS E during the a.m. and p.m. peak hours. Some of the northbound left turns from the McCullough Drive intersection were redistributed to this intersection during the 2030 Build Scenario because the increased connectivity generated by the Light Rail Alternative would create alternative route choices. The redistributed traffic contributes to the increase in delay from the 2030 No-Build Scenario. The pedestrian and bicycle levels of service improve in the 2030 Build Scenario. It was assumed that pedestrians would cross the full distance of an approach in the 2030 No-Build Scenario but would only cross to the median in the 2030 Build Scenario since the proposed project would increase the median width. The bicycle level of service improves due to the addition of bike lanes and a reduction in the speed limit as part of the proposed project. **Table 5.63** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section.

The duration of congestion analysis shows that both the No-Build and Build Scenarios operate under capacity during the a.m. and p.m. peak periods. The Synchro v/c analysis is shown in **Table 5.64**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.63
North Tryon Street/US-29 & Shopping Center Drive VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	0.6	1.8	39.0	53.0	87.0	84.1	69.8	73.8
Equivalent LOS	A	A	D	D	F	F	E	E

Note: VISSIM results reflect the grade separated rail configuration

Table 5.64
North Tryon Street/US-29 & Shopping Center Drive Synchro V/C Ratio

	2008 Existing*	2030 No-Build	2030 Build
a.m. v/c ratio	0.37	0.60	0.72
p.m. v/c ratio	18.12	0.67	0.78

North Tryon Street/US-29 & McCullough Drive

Currently this signalized intersection operates at LOS B during both peak hours. With the background traffic growth associated with the 2030 No-Build Scenario, the level of service would remain the same during the a.m. peak hour and degrade to LOS D for the p.m. peak hour. This intersection would be potentially impacted due to the trips generated by the McCullough Station park-and-ride facility. The McCullough Station would have 225 parking spaces under the Light Rail Alternative. Further information related to the McCullough Station can be found in **Appendix C.7**. The 2030 Build Scenario would improve the p.m. peak hour level of service to LOS C under the two car train option. The a.m. peak hour level of service decreases to LOS C. The three car train option produces similar results during the a.m. peak hour, but the p.m. peak hour LOS drops from C to D due to a four second increase in delay. Some of the northbound left turns from this intersection were redistributed to the Shopping Center Drive intersection during the 2030 Build Scenario because the increased connectivity

generated by the Light Rail Alternative would create alternative route choices. The redistributed traffic contributes to the improved p.m. peak hour level of service from the 2030 No-Build Scenario. The pedestrian level of service improves in the 2030 No-Build Scenario due to the addition of pedestrian phases. The 2030 Build Scenario improves the pedestrian and bicycle levels of service. It was assumed that pedestrians would cross the full distance of an approach in the 2030 No-Build Scenario but would only cross to the median in the 2030 Build Scenario since the proposed project would increase the median width. The bicycle level of service improves due to the addition of bike lanes and a reduction in the speed limit as part of the proposed project. **Table 5.65** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section.

The duration of congestion analysis shows that both the No-Build and Build Scenarios operate under capacity during the a.m. and p.m. peak periods. The Synchro v/c analysis is shown in **Table 5.66**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.65
North Tryon Street/US-29 & McCullough Drive VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	17.2	17.8	17.3	37.0	24.9	34.8	28.0	41.4
Equivalent LOS	B	B	B	D	C	C	C	D

Note: VISSIM results reflect the grade separated rail configuration

Table 5.66
North Tryon Street/US-29 & McCullough Drive Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build
a.m. v/c ratio	0.45	0.63	0.67
p.m. v/c ratio	0.38	0.64	0.67

North Tryon Street/US-29 & Ken Hoffman Drive

This signalized intersection currently operates at LOS C during the a.m. peak hour and LOS B during the p.m. peak hour. With the background traffic growth associated with the 2030 No-Build Scenario, the level of service would increase to LOS B during the a.m. peak hour and would remain LOS B during the p.m. peak hour due to adjustments to the signal timing (cycle length changes). The Light Rail Alternative would operate at LOS C during the a.m. and p.m. peak hours under the two car train option. The three car train option shows an increase in level of service during the a.m. peak period, LOS B, but a similar level of service during the p.m. peak hour. The pedestrian level of service improves in the 2030 No-Build Scenario due to the addition of pedestrian phases. The 2030 Build Scenario improves the pedestrian and bicycle levels of service. It was assumed that pedestrians would cross the full distance of an approach in the 2030 No-Build Scenario but would only cross to the median in the 2030 Build Scenario since the proposed project would increase the median width. The bicycle level of service improves due to the addition of bike lanes and a reduction in the speed limit as part of the proposed project. **Table 5.67** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section.

The duration of congestion analysis shows that both the No-Build and Build Scenarios operate under capacity during the a.m. and p.m. peak periods. The Synchro v/c analysis is shown in **Table 5.68**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.67
North Tryon Street/US-29 & Ken Hoffman Drive VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	29.4	17.2	16.4	12.3	20.9	22.3	19.1	22.3
Equivalent LOS	C	B	B	B	C	C	B	C

Note: VISSIM results reflect the grade separated rail configuration

Table 5.68
North Tryon Street/US-29 & Ken Hoffman Drive Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build
a.m. v/c ratio	0.45	0.55	0.60
p.m. v/c ratio	0.38	0.51	0.53

North Tryon Street/US-29 & W.T. Harris Boulevard

Currently this signalized intersection operates at LOS D during the a.m. and p.m. peak hours. With the background traffic growth associated with 2030 No-Build scenario, the intersection would remain LOS D during the a.m. peak hour and decrease to LOS F during the p.m. peak hour. The 2030 Build Scenario shows the level of service would remain the same during the p.m. peak hour; however, the a.m. peak hour would degrade to LOS E. The level of service is the same for both two and three car train options. The 2030 No-Build pedestrian level of service improves due to the addition of pedestrian phases. The 2030 Build Scenario improves the pedestrian and bicycle levels of service. It was assumed that pedestrians would cross the full distance of an approach in the 2030 No-Build Scenario but would only cross to the median in the 2030 Build Scenario since the proposed project would increase the median width. The bicycle level of service improves due to the addition of bike lanes and a reduction in the speed limit as part of the proposed project. **Table 5.69** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. During the 2030 No-Build Scenario, the intersection would operate under capacity during the a.m. peak period, while the p.m. peak period would operate over capacity for 1.75 hours. It is unclear how long the p.m. peak period would take to recover due to the timeframe of the analysis. The 2030 Build Scenario would operate under capacity during the a.m. peak period and over capacity for 1.75 hours during the p.m. peak period. It is unclear how long the p.m. peak period would take to recover due to the timeframe of the analysis. The Synchro v/c analysis is shown in **Table 5.70**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.69
North Tryon Street/US-29 & W.T. Harris Boulevard VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	45.8	52.5	51.9	136.2	66.1	148.0	63.2	146.0
Equivalent LOS	D	D	D	F	E	F	E	F

Note: VISSIM results reflect the grade separated rail configuration

Table 5.70
North Tryon Street/US-29 & W.T. Harris Boulevard Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build
a.m. v/c ratio	0.68	0.82	0.89
p.m. v/c ratio	0.92	1.12	1.12

North Tryon Street/US-29 & JM Keynes Boulevard

This signalized intersection currently operates at LOS B during the a.m. and p.m. peak hours. With the background traffic growth associated with the 2030 No-Build Scenario, the intersection would remain LOS B during the a.m. peak hour and degrade to LOS D during the p.m. peak hour. The 2030 Build Scenario would provide LOS C during the a.m. peak hour and LOS D during the p.m. peak hour under the two car train option. The three car train option operates with slightly less delay, but with similar results for level of service. The pedestrian level of service improves slightly due to changes in the crossing distance. It was assumed that pedestrians would cross the full distance of an approach in the 2030 No-Build Scenario but would only cross to the median in the 2030 Build Scenario since the proposed project would increase the median width. The bicycle level of service improves due to the addition of bike lanes and a reduction in the speed limit as part of the proposed project. **Table 5.71** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section.

The duration of congestion analysis shows that both the No-Build and Build Scenarios operate under capacity during the a.m. and p.m. peak periods. The Synchro v/c analysis is shown in **Table 5.72**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.71
North Tryon Street/US-29 & JM Keynes Drive VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	19.2	13.8	12.5	39.7	28.3	52.5	23.1	51.2
Equivalent LOS	B	B	B	D	C	D	C	D

Note: VISSIM results reflect the grade separated rail configuration

Table 5.72
North Tryon Street/US-29 & JM Keynes Boulevard Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build
a.m. v/c ratio	0.47	0.58	0.59
p.m. v/c ratio	0.56	0.76	0.76

North Tryon Street/US-29 & JW Clay Boulevard

This signalized intersection currently operates at LOS B during the a.m. peak hour and LOS D during the p.m. peak hour. With the background traffic growth associated with the 2030 No-Build Scenario, and adjustments to the signal timing (cycle length changes) the intersection would remain LOS B and LOS D during the a.m. and p.m. peak hours, respectively. A fourth westbound leg would be added to this intersection to provide an entrance to the UNC Charlotte Research Institute. This fourth leg was included in both the 2030 No-Build and Build Scenarios. The 2030 Build Scenario degrades to LOS C during the a.m. peak hour and LOS E during the p.m. peak hour under the two car train option. The three car train option produces similar results for level of service. The removal of a northbound left turn lane contributes to the increase in delay from the 2030 No-Build Scenario. The left turn lane was removed to reduce the crossing distance for pedestrians accessing light rail stations. The pedestrian level of service improves in the 2030 No-Build Scenario due to the addition of pedestrian phases. The 2030 Build Scenario improves the pedestrian and bicycle levels of service. It was assumed that pedestrians would cross the full distance of an approach in the 2030 No-Build Scenario but would only cross to the median in the 2030 Build Scenario since the proposed project would increase the median width. The bicycle level of service improves due to the addition of bike lanes and a reduction in the speed limit as part of the proposed project. **Table 5.73** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. During the 2030 No-Build Scenario, the intersection would operate under capacity during the a.m. peak period and over capacity for 1.0 hours during the p.m. peak period. The p.m. peak period would take approximately 0.50 hours to recover. The 2030 Build Scenario indicates that the intersection would operate under capacity for the a.m. peak period and over capacity for 1.0 hours during the p.m. peak period. The p.m. peak period would take approximately 0.50 hours to recover. The Synchro v/c analysis is shown in **Table 5.74**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.73
North Tryon Street/US-29 & JW Clay Boulevard VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	15.3	38.6	16.8	52.1	23.0	79.7	25.5	75.2
Equivalent LOS	B	D	B	D	C	E	C	E

Note: VISSIM results reflect the grade separated rail configuration

Table 5.74
North Tryon Street/US-29 & JW Clay Boulevard Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build
a.m. v/c ratio	0.50	0.67	0.70
p.m. v/c ratio	0.64	1.01	1.01

North Tryon Street/US-29 & UNCC Research Drive

Currently this signalized intersection operates at LOS C during the a.m. peak hour and LOS D during the p.m. peak hour. The 2030 No-build Scenario adds background traffic to the intersection; however, adjustments to the signal timings (cycle length changes) improve the a.m. and p.m. peak hours to LOS B and LOS C, respectively. The 2030 Build Scenario remains LOS C during the p.m. peak hour, but decreases the a.m. peak hour to LOS C under the two car train option. Similarly, the three car train option operates with LOS C during the a.m. and p.m. peak hours. The pedestrian level of service would improve in the 2030 Build Scenario with the addition of pedestrian refuges in the median of North Tryon Street/US-29. It was assumed that only the distance to the median would be crossed at one time since the proposed project would increase the median width. The bicycle level of service would improve due to the addition of bike lanes and a reduction in the speed limit as part of the proposed project. **Table 5.75** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.77** and **5.78** at the end of this section.

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours and is based solely on projected traffic demand; it does not consider the effects of metering from nearby intersections. The 2030 No-Build Scenario operates under capacity during the a.m. peak period and over capacity for 1.75 hours during the p.m. peak period. The p.m. peak period would take approximately 0.25 hours to recover. The 2030 Build Scenario operates under capacity during the a.m. peak period and over capacity for 1.25 hours in the p.m. peak period. The p.m. peak period would take approximately 0.50 hours to recover. The improvement in v/c ratio from the p.m. 2030 Build Scenario compared with the 2030 No-Build Scenario is the result of project related access changes, which shift northbound North Tryon Street/US-29 left turn traffic from Grove Lake Drive to UNCC Research Drive. This change, combined with lead/lag left turn phasing, produces and improved v/c ratio for the intersection. The Synchro v/c analysis is shown in **Table 5.76**. The remaining Synchro analysis is located in **Appendix E.2**.

Table 5.75
North Tryon Street/US-29 & UNCC Research Drive VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	30.8	40.4	14.4	26.5	24.3	33.0	21.9	30.9
Equivalent LOS	C	D	B	C	C	C	C	C

Note: VISSIM results reflect the grade separated rail configuration

Table 5.76
North Tryon Street/US-29 & UNCC Research Drive Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build
a.m. v/c ratio	0.48	0.55	0.63
p.m. v/c ratio	0.81	1.09	1.03

5.2.4 Pedestrian and Bicycle Measures of Effectiveness

Levels of service were calculated for the bicycle and pedestrian facilities using the Bicycle/Pedestrian Levels of Service worksheets developed by CDOT. These worksheets evaluate the intersection geometry and signalization characteristics according to the comfort and safety of bicyclists and pedestrians at signalized intersections. **Tables 5.77** and **5.78** illustrate the pedestrian and bicycle levels of service for the signalized intersections in Segment 2.

Table 5.77
Segment 2 Pedestrian Level of Service

Intersection	2008 Existing	2030 No-Build	2030 Build (Light Rail Alternative)
North Tryon Street/US-29 & Tom Hunter Road	D	C	B
North Tryon Street/US-29 & Orchard Trace Lane	-	-	B+
North Tryon Street/US-29 & I-85 Connector	-	B	B
North Tryon Street/US-29 & University City Blvd. Station Access	-	-	A
North Tryon Street/US-29 & University City Boulevard	-	C	C
North Tryon Street/US-29 & Shopping Center Drive	-	D	C
North Tryon Street/US-29 & McCullough Drive	D-	D	B
North Tryon Street/US-29 & Ken Hoffman Drive	D-	C	B
North Tryon Street/US-29 & W.T. Harris Boulevard	F	E-	D-
North Tryon Street/US-29 & JM Keynes Boulevard	C-	C-	C+
North Tryon Street/US-29 & JW Clay Boulevard	E	D	C+
North Tryon Street/US-29 & UNCC Research Drive	D	D	C

Table 5.78
Segment 2 Bicycle Level of Service

Intersection	2008 Existing	2030 No-Build	2030 Build (Light Rail Alternative)
North Tryon Street/US-29 & Tom Hunter Road	E+	E+	C-
North Tryon Street/US-29 & Orchard Trace Lane	-	-	D+
North Tryon Street/US-29 & I-85 Connector	-	D	D
North Tryon Street/US-29 & University City Blvd. Station Access	-	-	B
North Tryon Street/US-29 & University City Boulevard	-	D	D
North Tryon Street/US-29 & Shopping Center Drive	-	F	D
North Tryon Street/US-29 & McCullough Drive	E	E	D+
North Tryon Street/US-29 & Ken Hoffman Drive	E+	E+	C+
North Tryon Street/US-29 & W.T. Harris Boulevard	F	F	D
North Tryon Street/US-29 & JM Keynes Boulevard	F	F	D+
North Tryon Street/US-29 & JW Clay Boulevard	E	F	D
North Tryon Street/US-29 & UNCC Research Drive	E	E	C

5.3 Segment 3

Segment 3 runs along North Tryon Street/US-29 from Barton Creek Drive to I-485. Included within the limits of this segment is a portion of Mallard Creek Church Road. As with Segment 2, the Light Rail Alternative and SCDO alignments are on the same location; therefore, only the Light Rail Alternative results are shown. The analysis results for this segment are included in **Appendix F**.

5.3.1 At-Grade versus Grade Separated Analysis

As the Light Rail Alternative leaves the UNCC campus and travels northward towards its terminus at I-485, it crosses Mallard Creek Church Road. Mallard Creek Church Road is a four lane thoroughfare carrying approximately 14,400 vehicles per day. By the year 2030, this roadway is projected to carry around 22,300 vehicles per day. To help determine whether light rail should cross this roadway at-grade or grade separated, both a planning level evaluation and a detailed VISSIM analysis were performed.

The planning level analysis was based on the guidelines as described in ITE's Light Rail Transit Grade Separation Guidelines (prepared by ITE Technical Committee 6A-42). According to the initial screening parameters in this report, projected traffic volumes on Mallard Creek Church Road and proposed light rail operating headways (6 minute and 10 minute) fall within the feasible range for at-grade operations. To confirm that this crossing can operate at-grade with no significant traffic impacts, VISSIM was used to examine traffic queuing and spillback to nearby intersections from the light rail crossing. The results of this analysis, presented in **Table 5.79**, do not suggest that traffic spillback will be a problem. Based on these considerations, plus the fact that light rail speeds will be low in this area due to the proximity of a light rail station, an at-grade crossing of Mallard Creek Church Road is proposed.

Table 5.79
Mallard Creek Church Road At-Grade Crossing Queue Length Summary

	Traffic Approaching At-Grade Crossing							
	Eastbound Traffic				**Westbound Traffic**			
	2 car trains		**3 car trains**		**2 car trains**		**3 car trains**	
	a.m.	**p.m.**	**a.m.**	**p.m.**	**a.m.**	**p.m.**	**a.m.**	**p.m.**
Maximum Queue (ft.)	398	582	468	563	213	295	274	239
	1,200' to North Tryon Street/US 29				300' to Stone Quarry Road			
	Traffic Approaching North Tryon Street/US-29							
Maximum Queue (ft.)	n/a	n/a	n/a	n/a	489	523	378	309
	n/a				1,200' to At-Grade Crossing			

5.3.2 Unsignalized Measures of Effectiveness

The unsignalized intersections were analyzed using Synchro and VISSIM. Synchro provided v/c ratio information and VISSIM provided LOS/delay results. The delay at unsignalized intersections will be focused on the minor roadway due to the stop control. The major roadway will be free flowing with little or no delay. The MOEs for the Segment 3 unsignalized intersections can be found in **Tables 5.80**, **5.81**, **5.82** and **5.83**.

The 2008 Existing Scenario indicates that the North Tryon Street/US-29 & US-29 Access operates at LOS C during the a.m. peak hour and LOS B during the p.m. peak hour. Mallard Creek Church Road & Stone Quarry Road operates at LOS A during the a.m. and p.m. peak hours. North Tryon Street/US-29 & Morningstar Place Drive produces LOS B and LOS C during the a.m. and p.m. peak hours, respectively.

The 2030 No-Build scenario would affect the North Tryon Street/US-29 & US-29 Access intersection due to background traffic growth. The a.m. peak hour degrades from LOS C to LOS E and the p.m. peak hour degrades from LOS B to LOS C. The level of service at the North Tryon Street/US-29 & Morningstar Place Drive intersection would also decrease due to background traffic growth during the a.m. and p.m. peak hours to LOS C and LOS D, respectively. Mallard Creek Church Road & Stone Quarry would remain at LOS A during both peak periods.

The 2030 two car Build scenario would decrease the p.m. peak hour to LOS D and the a.m. peak hour would remain LOS E at the North Tryon Street/US-29 & US-29 Access Road. The a.m. and p.m. peak hours, with the three car train option, remain LOS E and LOS C, respectively. The decrease in the level of service can be attributed to trips generated by the I-485 Station. The Light Rail Alternative would utilize Mallard Creek Church Road & Stone Quarry Road as access to the Mallard Creek Church Station. The park-and-ride facility at this station services 150 parking spaces. Station generated trips were added to this intersection; however, the increase in traffic would not affect the level of service during either peak period.

Construction of the proposed project would signalize the North Tryon Street/US-29 & Morningstar Place Drive intersection and add an unsignalized intersection approximately 500 feet north of the Morningstar Place Drive intersection. This new intersection would serve as a second entrance for the I-485 Station and would be configured for right-in/right-out side street access and would permit left turn access from southbound North Tryon Street/US-29. This intersection would produce LOS A during the a.m. peak hour and LOS C during the p.m. peak hour for both two and three car train options.

Table 5.80
Segment 3 Existing Unsignalized Intersections

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
North Tryon Street/US-29 & US-29 Access Road	0.68*	0.53*	16.4**	13.4**	C**	B**
North Tryon Street/US-29 & Morningstar Place Drive	0.50*	0.62*	12.2**	19.5**	B**	C**
Mallard Creek Church Road & Stone Quarry Road	0.18*	0.25*	See Note 1	See Note 1	A*	A*

* Note: Synchro results
** Note: VISSIM results
Note 1: Nominal traffic volume on the side street approach produces negligible delays

Table 5.81
Segment 3 No-Build Unsignalized Intersections

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
North Tryon Street/US-29 & US-29 Access Road	1.05*	0.82*	42.7**	16.8**	E**	C**
North Tryon Street/US-29 & Morningstar Place Drive	0.89*	6.97*	21.0**	26.9**	C**	D**
Mallard Creek Church Road & Stone Quarry Road	0.29*	0.41*	See Note 1	See Note 1	A*	A*

* Note: Synchro results
** Note: VISSIM results
Note 1: Nominal traffic volume on the side street approach produces negligible delays

Table 5.82
Segment 3 Build Unsignalized Intersections
(2 car trains with 6 minute headways)

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
North Tryon Street/US-29 & US-29 Access Road	1.05*	0.82*	38.1**	25.6**	E**	D**
North Tryon Street/US-29 & I-485 Secondary Station Access (right-in/right-out)	0.92*	1.40*	See Note 1	16.8**	A**	C**
Mallard Creek Church Road & Stone Quarry Road	0.29*	0.41*	See Note 1	See Note 1	A*	A*

* Note: Synchro results
**Note: VISSIM results, reflect a grade separated rail configuration
Note 1: Nominal traffic volume on the side street approach produces negligible delays

Table 5.83
Segment 3 Build Unsignalized Intersections
(3 car trains with 10 minute headways)

Intersection	V/C Ratio		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
North Tryon Street/US-29 & US-29 Access Road	1.05*	0.82*	38.4**	24.9**	E**	C**
North Tryon Street/US-29 & I-485 Secondary Station Access (right-in/right-out)	0.92*	1.40*	See Note 1	16.6**	A**	C**
Mallard Creek Church Road & Stone Quarry Road	0.29*	0.41*	See Note 1	See Note 1	A*	A*

* Note: Synchro results
**Note: VISSIM results, reflect a grade separated rail configuration
Note 1: Nominal traffic volume on the side street approach produces negligible delays

5.3.3 Signalized Intersections Measures of Effectiveness

North Tryon Street/US-29 & Mallard Creek Church Road

This signalized intersection currently operates at LOS C during the a.m. peak hour and LOS E during the p.m. peak hour. The 2030 No-Build Scenario would decrease the a.m. and p.m. peak hours to LOS F. Background traffic growth can be attributed to the decrease in the level of service. The construction of the Light Rail Alternative would improve the a.m. peak hour, for both two and three car train options in the a.m. peak hour to LOS D. The p.m. peak hour level of service would remain LOS F. The improved level of service can be attributed to an additional left turn lane added to the westbound approach. Dual westbound left turn lanes prevent traffic queues from extending over the proposed highway rail crossing on Mallard Creek Church Road, east of North Tryon Street/US-29. **Table 5.84** illustrates the VISSIM MOEs for this intersection. Pedestrian and bicycle levels of service can be found in **Tables 5.93** and **5.94** at the end of this section.

Table 5.84
North Tryon Street/US-29 & Mallard Creek Church Road VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	34.0	55.2	89.9	136.1	52.4	140.0	52.9	137.5
Equivalent LOS	C	E	F	F	D	F	D	F

Note: VISSIM results reflect the grade separated rail configuration along North Tryon Street/US-29 and the at-grade crossing of Mallard Creek Church Road

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. During the 2030 No-Build scenario, the intersection would operate over capacity for 0.50 hours in the a.m. peak period and 1.50 hours during the p.m. peak period. The a.m. peak period would take approximately 0.25 hours to recover, while the p.m. peak period would take approximately 0.50 hours to recover. During the 2030 Build scenario, the a.m. peak period would operate over

capacity for 0.25 hours in the a.m. peak period and for 1.75 hours in the p.m. peak period. The a.m. peak period would take approximately 0.25 hours to recover, while the p.m. peak period would take approximately 0.50 hours to recover. The Synchro v/c analysis is shown in **Table 5.85**. The remaining Synchro analysis is located in **Appendix F.2**.

Table 5.85
North Tryon Street/US-29 & Mallard Creek Church Road Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build
a.m. v/c ratio	0.60	0.99	0.96
p.m. v/c ratio	0.75	1.10	1.14

North Tryon Street/US-29 & Morningstar Place Drive (I-485 Station Entrance)

Currently this unsignalized intersection operates at LOS B during the a.m. peak hour and LOS C during the p.m. peak hour. The addition of background traffic, associated with the 2030 No-Build scenario, would decrease the a.m. and p.m. peak hour levels of service. The intersection would operate at LOS C during the a.m. peak hour and LOS D during the p.m. peak hour. The 2030 Build scenario would signalize this intersection and utilize the side street as the main entrance to the I-485 Station. The proposed light rail alignment would be parallel to, and run on the east side, of North Tryon Street/US-29 as it approaches Morningstar Place Drive. The light rail tracks would be grade separated over the eastern leg of Morningstar Place Drive before entering the I-485 Station. The light rail tracks are grade separated in this area because of the close proximity to North Tryon Street/US-29. The station platform would be elevated and would provide direct access to the parking garage. This five level parking garage, in conjunction with a surface parking lot, would provide approximately 2,134 parking spaces. The light rail project positioned one of two access points for the I-485 Station entrance at the relocated North Tryon Street/US-29 & Morningstar Place Drive signalized intersection. The other access point routed traffic to a proposed unsignalized intersection approximately 500 feet north that would operate as a right-in/right-out with left turn access from southbound North Tryon Street/US-29.

The signalized intersection would operate at LOS B during the a.m. peak hour and LOS E for the p.m. peak hour for both the two and three car train options. **Table 5.86** illustrates the VISSIM MOEs for this intersection. The pedestrian and bicycle levels of service are not shown for the Existing and No-Build scenarios since this intersection is unsignalized for these scenarios. Pedestrian and bicycle levels of service can be found in **Tables 5.93** and **5.94** at the end of this section.

Table 5.86
North Tryon Street/US-29 & Morningstar Place Drive (I-485 Station Entrance)
VISSIM Delay Results

	2008 Existing*		2030 No-Build*		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	12.2	19.5	21.0	26.9	11.6	70.1	11.3	71.7
Equivalent LOS	B	C	C	D	B	E	B	E

Note: VISSIM results reflect the grade separated rail configuration
*Note: Intersection unsignalized

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours. The unsignalized intersection in the 2030 No-Build scenario would operate under capacity during the a.m. peak period and over capacity for the entire three hour period in the p.m. peak period. The a.m. peak period would take approximately 0.25 hours to recover. The recovery time for the p.m. peak period is uncertain due to the timeframe of the analysis. The signalized intersection in the 2030 Build scenario would operate under capacity during the a.m. peak period and over capacity for 1.50 hours in the p.m. peak period. The p.m. peak period would take approximately 0.50 hours to recover. The Synchro v/c analysis is shown in **Table 5.87**. The remaining Synchro analysis is located in **Appendix F.2**.

Table 5.87
North Tryon Street/US-29 & Morningstar Place Drive (I-485 Station Entrance)
Synchro V/C Ratio

	2008 Existing*	2030 No-Build*	2030 Build
a.m. v/c ratio	0.50	0.89	0.86
p.m. v/c ratio	0.62	6.97	1.08

*Note: Intersection unsignalized

North Tryon Street/US-29 & I-485 Inner Ramp

This signalized intersection currently operates at LOS A during the a.m. peak hour and LOS B during the p.m. peak hour. With the background traffic growth in the 2030 No-Build scenario, the level of service at the intersection would decrease to LOS B during the a.m. peak hour and would remain LOS B during p.m. peak hour. The 2030 Build Scenario would add a significant number of station generated trips to this intersection, particularly to the I-485 off-ramp. With this additional traffic, VISSIM simulation shows long queues developing on the off-ramp with the present intersection configuration, which consists of a single right turn lane that merges onto North Tryon Street/US-29. As a means of mitigating this potential impact, dual right turn lanes are proposed on the ramp under signal control and the acceleration lane on North Tryon Street/US-29 would be removed. This proposed change would improve intersection safety by eliminating the weave area between the free flowing right turn lane and the southbound North Tryon Street/US-29 through movement. The dual right turn lanes would also improve safety by reducing the number of lanes a vehicle must traverse to access the I-485 Station.

Table 5.88 presents the queue length summary in the 2030 Build Scenario, with and without the additional right turn lane. As mentioned, significant reductions in queue lengths on the I-485 off-ramp occur with the installation of dual right turn lanes. The intersection operates at LOS C during the a.m. peak hour and LOS F during the p.m. peak hour with the dual right turn lanes.

Table 5.88
I-485 Queue Length Summary

	Eastbound Right				Southbound Through			
	2 car trains		3 car trains		2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Single I-485 Right Turn Lane (Free Flow)								
Maximum Queue (ft.)	992	0	1,143	0	1,678	814	1,678	911
Dual I-485 Right Turn Lanes (Signal Control)								
Maximum Queue (ft.)	506	80	464	91	1,678	873	1,678	834

Table 5.89 illustrates the VISSIM MOEs for this intersection. The Pedestrian and Bicycle levels of service would not be affected by the construction of the proposed project. Pedestrian and bicycle levels of service can be found in **Tables 5.93** and **5.94** at the end of this section.

Table 5.89
North Tryon Street/US-29 & I-485 Inner Ramp VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	6.0	16.5	16.9	17.4	31.6	85.3	31.1	82.7
Equivalent LOS	A	B	B	B	C	F	C	F

Note: VISSIM results reflect the grade separated rail configuration

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours and is based solely on projected traffic demand; it does not consider the effects of metering from nearby intersections. The 2030 No-Build scenario indicates the intersection would operate under capacity for both the a.m. and p.m. peak periods. The 2030 Build scenario shows that the intersection would operate over capacity for 1.0 hours in the a.m. peak period and for 0.50 hours in the p.m. peak period. The a.m. and p.m. peak periods would take approximately 0.25 hours to recover. The Synchro v/c analysis is shown in **Table 5.90**. The remaining Synchro analysis is located in **Appendix F.2**.

Table 5.90
North Tryon Street/US-29 & I-485 Inner Ramp Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build
a.m. v/c ratio	0.52	0.84	1.09
p.m. v/c ratio	0.55	0.83	1.12

North Tryon Street/US-29 & I-485 Outer Ramp

This signalized intersection currently operates at LOS B during the a.m. peak hour and LOS A during the p.m. peak hour. With the background traffic growth in the 2030 No-Build scenario, the level of service at the intersection would decrease to LOS D during the a.m. peak hour and LOS B during the p.m. peak hour. The 2030 Build Scenario would add a significant number of station generated trips to this intersection. The VISSIM simulation shows long queues developing on the off-ramp due to the station generated trips turning left at the intersection. The current intersection configuration consists of a single left turn lane. As a means of mitigating the increased number of left turn vehicles, dual left turn lanes are proposed on the off-ramp. With the additional left turn lane, the intersection would operate at LOS F during the a.m. peak hour and LOS C during the p.m. peak hour for both the two and three car train option. **Table 5.91** illustrates the VISSIM MOEs for this intersection. The Pedestrian and Bicycle levels of service would not be affected by the construction of the proposed project. Pedestrian and bicycle levels of service can be found in **Tables 5.93** and **5.94** at the end of this section.

Table 5.91
North Tryon Street/US-29 & I-485 Outer Ramp VISSIM Delay Results

	2008 Existing		2030 No-Build		2030 Build Light Rail Alternative			
					2 car trains		3 car trains	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Peak Hour Delay (sec.)	10.2	8.5	50.7	14.2	123.1	23.6	124.1	23.3
Equivalent LOS	B	A	D	B	F	C	F	C

Note: VISSIM results reflect the grade separated rail configuration

The analysis also examined the duration of congestion for this intersection due to the v/c ratios exceeding 0.95. This analysis spanned a three hour period surrounding the peak hours and is based solely on projected traffic demand; it does not consider the effects of metering from nearby intersections. The 2030 No-Build scenario indicates the intersection would operate under capacity for the a.m. peak period but over capacity for 0.25 hours in the p.m. peak period. The p.m. peak period would take approximately 0.25 hours to recover. The 2030 Build scenario shows that the intersection would operate under capacity in the a.m. peak period and over capacity for 0.25 hours in the p.m. peak period. The p.m. peak period would take approximately 0.25 hours to recover. The Synchro v/c analysis is shown in **Table 5.92**. The remaining Synchro analysis is located in **Appendix F.2**.

Table 5.92
North Tryon Street/US-29 & I-485 Outer Ramp Synchro V/C Ratio

	2008 Existing	2030 No-Build	2030 Build
a.m. v/c ratio	0.66	0.94	0.86
p.m. v/c ratio	0.70	1.06	1.03

5.3.3 Pedestrian and Bicycle Measures of Effectiveness

Levels of service were calculated for the bicycle and pedestrian facilities using the Bicycle/Pedestrian Levels of Service worksheets developed by CDOT. These worksheets evaluate the intersection geometry and signalization characteristics according to the comfort and safety of bicyclists and pedestrians at signalized intersections. **Tables 5.93** and **5.94** illustrate the pedestrian and bicycle levels of service for the signalized intersections in Segment 3.

Table 5.93
Segment 3 Pedestrian Level of Service

Intersection	2008 Existing	2030 No-Build	2030 Build (Light Rail Alternative)
North Tryon Street/US-29 & Mallard Creek Church Road	D-	D-	E+
North Tryon Street/US-29 & US-29 Service	-	-	B
North Tryon Street/US-29 & I-485 Inner Ramp	C	C	C
North Tryon Street/US-29 & I-485 Outer Ramp	F	F	F

Table 5.94
Segment 3 Bicycle Level of Service

Intersection	2008 Existing	2030 No-Build	2030 Build (Light Rail Alternative)
North Tryon Street/US-29 & Mallard Creek Church Road	F	F	F
North Tryon Street/US-29 & US-29 Service	-	-	E
North Tryon Street/US-29 & I-485 Inner Ramp	F	F	F
North Tryon Street/US-29 & I-485 Outer Ramp	E	E	E

6.0 SUMMARY OF RESULTS

This technical report analyzes the traffic operations associated with the Light Rail Alternative and SCDO. The Light Rail Alternative is an extension of the existing LYNX Blue Line (South Corridor) and extends approximately 11 miles from Center City Charlotte to the northeast to I-485 near the Mecklenburg and Cabarrus County line. The proposed alignment enters the median of North Tryon Street/US-29, via grade separation, just north of Old Concord Road. While in the median of North Tryon Street/US-29, the proposed alignment would be grade separated with I-85 Connector, University City Boulevard and W.T. Harris Boulevard. The remaining street crossings would be at-grade. The proposed alignment would exit the median of North Tryon Street/US-29 just north of UNCC Research Drive, via grade separation, as it enters the UNCC campus. Upon exiting the UNCC campus, the Light Rail Alternative crosses Mallard Creek Church Road, at-grade, and continues along the eastern side of North Tryon Street/US-29. The proposed alignment would cross Morningstar Place Drive via grade separation and reach the terminal station, which would be located approximately 3,600 feet south of I-485. All unsignalized intersections north of Old Concord Road were restricted to right-in/right-out access to prevent vehicles from crossing the proposed alignment without protection from a traffic signal. U-turns were allowed at the signalized intersections due to restricted access at unsignalized intersections.

The transit capacity provided by the LYNX BLE will enhance the North Tryon Street/US-29 corridor by both increasing the overall person carrying capacity of the corridor and by providing a transit option for north/south trips in the corridor. Long term goals for the corridor couple the proposed light rail project with additional street connectivity to lessen the dependence on the existing major thoroughfares. The improvement of pedestrian facilities also plays a critical role in the long term goals of the corridor by promoting walking and cycling, rather than vehicular travel. An important design element of a pedestrian-friendly transit facility is the reduction of intersection crossing distances at median station locations. Minimizing the number of turn lanes at these intersections reduces the crossing distance for pedestrians.

The “Weave Area” Project will install two signals; the I-85 Connector and University City Boulevard. Two additional intersections are anticipated to be signalized by 2030; Orr Road and Arrowhead Drive. If these intersections are not signalized prior to construction, this project will install these traffic signals. The proposed Light Rail Alternative would signalize four additional intersections; Owen Boulevard, Orchard Trace Lane, University City Station Access and Morningstar Place Drive. With light rail transit running in the median, safety requires traffic signals at all median openings. Preserving median openings and adding additional traffic signals restores some of the access that would be lost if the existing unsignalized median openings were closed or restricted. Preserving median openings also reduces U-turn movements that would otherwise be redistributed to the existing signalized intersections under the proposed Light Rail Alternative. This is particularly important in reducing the footprint at those intersections where light rail stations are located.

Unlike the Light Rail Alternative, the SCDO enters the median of North Tryon Street/US-29 just north of Dorton Street. Additional unsignalized intersections would be restricted to right-in/right-out access due to where the location of the SCDO enters the median of North Tyron Street/US-29. Unsignalized intersections between Dorton Street and Old Concord Road would be restricted as part of the SCDO. Traffic signals would be installed at the intersections of North Tryon Street/US-29 and Dorton Street and at North Tryon Street/US-29 and Lambeth Drive in the SCDO. These signalized intersections would provide additional locations for vehicles to make U-turns.

6.1 At-Grade versus Grade-Separated Rail Crossings

VISSIM analysis was performed to determine the effects of the vehicular and light rail interaction with both the Light Rail Alternative and the SCDO, where light rail is proposed to operate within North Tryon Stree/US-29. Grade-separated and at-grade crossing alternatives were analyzed for major street crossings. Based on results of this analysis, crossings of the Light Rail Alternative would be at-grade except for the following locations where grade-separation is recommended:

- Old Concord Road just east of North Tryon Street/US-29 and northbound North Tryon Street/US-29 just north of Old Concord Road
- The intersection of North Tryon Street/US-29 & I-85 Connector
- The intersection of North Tryon Street/US-29 & University City Boulevard
- The intersection of North Tryon Street/US-29 & W.T. Harris Boulevard
- Northbound North Tryon Street/US-29, east of UNCC Research Drive
- Morningstar Place Drive just east of North Tryon Street/US-29 (I-485 Station Entrance)

The SCDO would be at-grade at the intersection of North Tryon Street/US-29 and Old Concord Road. The following locations were recommended to be grade-separated for the SCDO:

- Northbound North Tryon Street/US-29 just north of Dorton Street
- The intersection of North Tryon Street/US-29 and Eastway Drive
- The intersection of North Tryon Street/US-29 & I-85 Connector
- The intersection of North Tryon Street/US-29 & University City Boulevard
- The intersection of North Tryon Street/US-29 & W.T. Harris Boulevard
- Northbound North Tryon Street/US-29, east of UNCC Research Drive
- Morningstar Place Drive just east of North Tryon Street/US-29 (I-485 Station Entrance)

6.2 Traffic Signal Measures of Effectiveness

Traffic signals were proposed to retain access along North Tryon Street/US-29 and to lessen impacts to existing signals that encounter U-turns as a result of the project. The turning restrictions generated by the location of the proposed Light Rail Alternative in the median of North Tryon Street/US-29 created heavy U-turn traffic at some of the signalized intersections. Several of the unsignalized intersections were identified as potential candidates for signalization in order to provide more access points between signalized intersections and to help reduce some of the traffic demand at those intersections. A summary of the VISSIM MOEs for the intersections along North Tryon Street/US-29 are presented in **Table 6.1**, while a summary of the Synchro v/c analysis results for these intersections are listed in **Table 6.2**.

Table 6.1
North Tryon Street/US-29 Signalized Intersections VISSIM Measures of Effectiveness

Cross Street	2008 Existing				2030 No-Build				2030 Light Rail Alternative*			
	Delay (sec.)		LOS		Delay (sec.)		LOS		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Sugar Creek Road	93.8	42.9	F	D	78.0	122.6	E	F	91.0	170.5	F	F
Eastway Drive	19.8	26.1	B	C	37.7	95.7	D	F	25.7	112.4	C	F
Old Concord Road	57.5	22.2	E	C	54.4	22.8	D	C	64.2	41.3	E	D
Orr Road[1]	84.1	46.7	F	E	57.5	27.2	E	C	64.6	25.4	E	C
Arrowhead Drive[1]	20.2	49.5	C	E	27.1	17.3	C	B	34.7	25.3	C	C
Owen Boulevard[2]	7.3	10.3	A	B	10.0	38.0	B	E	24.2	11.4	C	B
Tom Hunter Road	16.6	30.6	B	C	18.6	128.0	B	F	41.6	133.3	D	F
Orchard Trace Lane[2]	15.2	19.8	C	C	25.4	134.7	D	F	12.9	87.7	B	F
I-85 Connector[1]	10.0	49.0	B	E	40.8	189.1	D	F	50.7	221.5	D	F
University City Blvd Station Access[2]	-	-	-	-	-	-	-	-	21.9	40.4	C	D

*Note: LOS and delay results reflect 3 car trains with 10 minute headways and a grade separated rail configuration as listed in Section 6.1

[1]Note: Signalized in the 2030 No-Build Scenario

[2]Note: Signalized in the 2030 Build Scenario

Table 6.1 (continued)
North Tryon Street/US-29 Signalized Intersections VISSIM Measures of Effectiveness

Cross Street	2008 Existing				2030 No-Build				2030 Light Rail Alternative*			
	Delay (sec.)		LOS		Delay (sec.)		LOS		Delay (sec.)		LOS	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
University City Boulevard[1]	130.6	11.1	F	B	125.3	160.4	F	F	115.6	165.9	F	F
Shopping Center Drive[1]	0.6	1.8	A	A	39.0	53.0	D	D	69.8	73.8	E	E
McCullough Drive	17.2	17.8	B	B	17.3	37.0	B	D	28.0	41.4	C	D
Ken Hoffman Drive	29.4	17.2	C	B	16.4	12.3	B	B	19.1	22.3	B	C
W.T. Harris Boulevard	45.8	52.5	D	D	51.9	136.2	D	F	63.2	146.0	E	F
JM Keynes Drive	19.2	13.8	B	B	12.5	39.7	B	D	23.1	51.2	C	D
JW Clay Boulevard	15.3	38.6	B	D	16.8	52.1	B	D	25.5	75.2	C	E
UNCC Research Drive	30.8	40.4	C	D	14.4	26.5	B	C	21.9	30.9	C	C
Mallard Creek Church Road	34.0	55.2	C	E	89.9	136.1	F	F	52.9	137.5	D	F
Morningstar Place Drive[2]	12.2	19.5	B	C	21.0	26.9	C	D	11.3	71.7	B	E
I-485 Inner Ramp	6.0	16.5	A	B	16.9	17.4	B	B	31.1	82.7	C	F
I-485 Outer Ramp	10.2	8.5	B	A	50.7	14.2	D	B	124.1	23.3	F	C

*Note: LOS and delay results reflect 3 car trains with 10 minute headways and a grade separated rail configuration as listed in Section 6.1

[1]Note: Signalized in the 2030 No-Build Scenario

[2]Note: Signalized in the 2030 Build Scenario

Table 6.2
North Tryon Street/US-29 Signalized Intersections V/c Ratio Summary

	2008 Existing		2030 No-Build		2030 Light Rail Alternative*	
	V/c Ratio		V/c Ratio		V/c Ratio	
	a.m.	p.m.	a.m.	p.m.	a.m.	p.m.
Sugar Creek Road	0.80	0.77	1.00	0.93	1.03	1.01
Eastway Drive	0.74	0.94	0.90	1.19	0.93	1.19
Old Concord Road	0.79	0.67	1.01	0.86	0.96	0.96
Orr Road[1]	0.57	1.22	0.68	0.97	0.93	0.97
Arrowhead Drive[1]	1.07	Error	0.65	0.77	0.69	0.82
Owen Boulevard[2]	0.40	4.57	0.82	167.29	0.66	0.81
Tom Hunter Road	0.67	0.76	0.82	0.94	0.85	0.96
Orchard Trace Lane[2]	0.60	0.98	6.36	Error	0.74	0.73
I-85 Connector[1]	0.32	0.61	0.92	1.21	0.95	1.17
University City Blvd Station Access[2]	-	-	-	-	0.80	1.14
University City Boulevard[1]	0.27	0.38	1.05	1.12	1.16	1.32
Shopping Center Drive[1]	0.37	18.12	0.60	0.67	0.72	0.78
McCullough Drive	0.45	0.38	0.55	0.51	0.59	0.76
Ken Hoffman Drive	0.45	0.38	0.58	0.52	0.61	0.68
W.T. Harris Boulevard	0.68	0.92	0.82	1.12	0.89	1.12
JM Keynes Drive	0.47	0.56	0.58	0.76	0.59	0.78
JW Clay Boulevard	0.50	0.64	0.67	1.01	0.70	1.01
UNCC Research Drive	0.48	0.81	0.55	1.09	0.63	1.03
Mallard Creek Church Road	0.60	0.75	0.99	1.10	0.96	1.14
Morningstar Place Drive[2]	0.50	0.62	0.89	6.97	0.86	1.08
I-485 Inner Ramp	0.52	0.55	0.84	0.83	1.09	1.12
I-485 Outer Ramp	0.66	0.70	0.94	1.06	0.86	1.03

*Note: LOS and delay results reflect 3 car trains with 10 minute headways and a grade separated rail configuration as listed in Section 6.1

[1]Note: Signalized in the 2030 No-Build Scenario

[2]Note: Signalized in the 2030 Build Scenario

6.3 Project Related Changes and Mitigation

Access and operational improvements are recommended at intersections where impacts have been identified. Mitigation of impacts is considered for the Light Rail Alternative and the SCDO. The recommendations include installation of traffic signals and turn lanes along North Tryon Street/US-29 as well as a reduction in the posted speed limit from 45 mph to 35 mph. It should be noted that the recommendations for the side street turn lane configurations provided in this report will be refined throughout the design process. Storage length recommendations are presented in **Section 6.4**. The following recommendations apply to the Light Rail Alternative:

- *Sugar Creek Road & North Davidson Street* - Install a traffic signal at this intersection.
- *North Tryon Street/US-29 & Old Concord Road* - Provide exclusive dual left turn lanes and a separate right lane for the westbound Old Concord Road approach.
- *North Tryon Street/US-29 & Orr Road* – Provide a second approach lane for Orr Road. This lane can either serve as a through-right lane or as a separate right turn lane. Its use will be determined as the design proceeds. This intersection will be signalized by the project if not installed prior to construction.
- *North Tryon Street/US-29 & Arrowhead Drive* - Remove the existing northbound and southbound right turn lanes on North Tryon Street/US-29. The right turn volume at this intersection is minimal and the removal of these turn lanes do not adversely affect the level of service at this location. This intersection will be signalized by the project if not installed prior to construction.
- *North Tryon Street/US-29 & Owen Boulevard* - Install a traffic signal at this intersection and remove the northbound and southbound right turn lanes on North Tryon Street/US-29. Removal of these two lanes does not adversely affect the level of service at this location based on existing and projected volumes.
- *North Tryon Street/US-29 & Orchard Trace Lane* - Install a traffic signal at this intersection. A second approach lane on Orchard Trace Lane is also recommended. This lane can either serve as a through-right lane or as a separate right turn lane, depending on whether a fourth leg is eventually added to the intersection. Its use will be determined as the design process proceeds.
- *North Tryon Street/US-29 & University City Blvd. Station Access* - Install a traffic signal at this intersection. Provide a northbound left turn lane to access the park-and-ride facility and a southbound left turn lane to permit U-turns. Provide a southbound right turn lane for vehicles accessing the University City Blvd. Station from North Tryon Street/US-29.
- *North Tryon Street/US-29 & Shopping Center Drive* - Provide dual left turn lanes for the southbound approach of North Tryon Street/US-29.
- *North Tryon Street/US-29 & McCullough Drive* – Remove one of the dual left turn lanes on the southbound approach of North Tryon Street/US-29. The removal of this turn lane will not negatively impact the level of service for traffic and will in turn provide a shorter crossing distance for transit patrons accessing the station platform. The Light Rail Alternative would also remove the northbound right turn lane on North Tryon Street/US-29. The right turn volume at this intersection is minimal and the removal of this lane does not adversely affect the level of service at this location.
- *North Tryon Street/US-29 & JW Clay Boulevard* - Remove one of the dual left turn lanes on the northbound approach of North Tryon Street/US-29. The removal of this lane will not significantly impact the level of service for traffic and will in turn improve pedestrian access to the station platform by providing a shorter crossing of the street.

- *North Tryon Street/US-29 & Mallard Creek Church Road* - Provide a second westbound left turn lane from Mallard Creek Church Road to prevent traffic queues from extending over the proposed light rail tracks.
- *North Tryon Street/US-29 & Morningstar Place Drive (I-485 Station Entrance)* - Install a traffic signal at this intersection. Keep the existing northbound North Tryon Street/US-29 right turn lane.
- *North Tryon Street/US-29 & I-485 Inner Ramp* – Provide a second right turn lane on the eastbound I-485 off-ramp and place the right turn movement under signal control. The additional right turn lane is needed to mitigate long queues on the ramp.
- *North Tryon Street/US-29 & I-485 Outer Ramp* – Provide a second left turn lane on the westbound I-485 off-ramp. The additional left turn lane is needed to mitigate long queues on the ramp.

The following recommendations were made for the SCDO:

- *North Tryon Street/US-29 & Dorton Street* – Install a traffic signal at this intersection.
- *North Tryon Street/US-29 & Lambeth Drive* – Install a traffic signal at this intersection.
- The SCDO included all of the mitigation recommendations for the Light Rail Alternative.

6.4 Turn Lane Recommendations Along North Tryon Street/US-29

6.4.1 Left Turn Lanes

Synchro provides storage length recommendations based on the 95th queue percentile; however, the analysis does not consider light rail operations. Accordingly, VISSIM was used to make recommendations on storage lengths. The VISSIM simulation was examined over several time periods to identify the actual useable storage. In other words, the total length vehicles were observed occupying the turn lanes. In general, left turn movements along North Tryon Street/US-29 are restricted to single lanes where the proposed Light Rail Alignment crosses intersections at-grade. Single left turn lanes minimize the intersection footprint and reduce the crossing distance pedestrians must cross, particularly in areas where light rail stations occupy the median of North Tryon Street/US-29. However, this is not the case with the intersections of Shopping Center Drive and McCullough Drive. Turning volumes were particularly high at Shopping Center Drive and dual left turn lanes were required to help minimize the intersection delay. High turn volumes were also present at McCullough Drive on the northbound approach and dual left turn lanes provided the most beneficial option; not only for reducing intersection delay at McCullough Drive, but also minimizing metering that takes place at downstream intersections. The pedestrian crossing distance to the station would not be affected by the northbound dual left turn lanes because the park-and-ride facility is located on the opposite side of the intersection. **Table 6.3** displays the results of the left turn analysis. The left turn storage lengths are also illustrated in **Figures 4.13**, **4.14** and **4.15**.

Table 6.3
North Tryon Street/US-29 Left Turn Lane Recommendations

Cross Street	Movement	2008 Conditions		2030 Build		2030 Build Volumes AM (PM)
		Lanes	Existing Storage (ft)	Lanes	Recommended Storage (ft)	
Old Concord Road	NB Left	1	150	1	150	20 (43)
	SB Left	1	225	1	300	142 (137)
	WB Left	1	100	2	350	901 (478)
Orr Road	NB Left	1	150	1	200	75 (162)
	SB Left	1	200	1	400	258 (291)
	WB Left	0	Shared Lane	1	300	359 (20)
Arrowhead Drive	NB Left	1	150	1	400	91 (239)
	SB Left	1	200	1	200	97 (94)
Owen Boulevard	NB Left	1	150	1	200	58 (63)
	SB Left	1	150	1	150	27 (65)
Tom Hunter Road	NB Left	1	200	1	400	257 (279)
	SB Left	1	125	1	150	21 (31)
Orchard Trace Lane	NB Left	1	100	1	150	38 (109)
	SB Left	1	150	1	150	0 (0)
	EB Left	0	Shared Lane	1	150	81 (116)
I-85 Connector	NB Left	1	250*	1	250	78 (141)
	SB Left	1	400*	1	400	18 (44)
	EB Left	2	Drop Lanes#*	2	Drop Lanes#	841 (1391)
	WB Left	1	175*	1	175	50 (20)
University City Blvd. Park-and-Ride Entrance	NB Left	N/A	N/A	1	250	50 (19)
	SB Left	N/A	N/A	1	250	33 (64)
	EB Left	N/A	N/A	1	Drop Lane#	32 (225)
University City Boulevard/NC-49	NB Left	1	300*	1	300	167 (214)
	SB Left	1	225*	1	225	79 (215)
	EB Left	2	275*	2	275	311 (532)
	WB Left	2	425*	2	425	1235 (900)
Shopping Center Drive	NB Left	2	300	2	375	430 (665)
	SB Left	1	300	2	300	92 (257)
	EB Left	2	325	2	325	250 (435)
	WB Left	1	150	1	150	60 (95)
McCullough Drive	NB Left	2	275	2	275	209 (295)
	SB Left	2	250	1	250	10 (30)
	EB Left	1	225	1	225	34 (180)
	WB Left	1	150	1	150	10 (28)

#Note: A drop lane is a continuous turn lane from the preceding intersection ending at this intersection.

*Note: These storage lengths will be provided when the "Weave Area" project is constructed.

Table 6.3 (continued)
North Tryon Street/US-29 Left Turn Lane Recommendations

Cross Street	Movement	2008 Conditions		2030 Build		Projected Volumes AM (PM)
		Lanes	Existing Storage (ft)	Lanes	Recommended Storage (ft)	
Ken Hoffman Drive	NB Left	1	125	1	150	25 (30)
	SB Left	1	150	1	150	163 (98)
W.T. Harris Boulevard	NB Left	2	250	2	250	241 (568)
	SB Left	2	325	2	325	295 (499)
	EB Left	2	450	2	450	301 (455)
	WB Left	2	225	2	225	174 (299)
JM Keynes Boulevard	NB Left	1	275	1	275	81 (168)
	SB Left	1	300	1	350	141 (40)
	EB Left	1	Drop Lane[#]	1	Drop Lane[#]	28 (74)
JW Clay Boulevard	NB Left	2	350	1	500	84 (205)
	SB Left	1	150	1	300	116 (88)
	EB Left	1	350	1	450	154 (858)
	WB Left	1	100	1	100	11 (109)
UNCC Research Drive	NB Left	1	200	1	350	78 (361)
	SB Left	1	200	1	200	114 (92)
	EB Left	1	Drop Lane[#]	1	Drop Lane[#]	65 (166)
	WB Left	1	Drop Lane[#]	1	Drop Lane[#]	11 (109)
Mallard Creek Church Road	NB Left	2	225	2	225	183 (584)
	SB Left	1	250	1	250	201 (161)
	EB Left	2	350	2	350	245 (787)
	WB Left	1	225	2	225	246 (239)
Morningstar Place Drive (I-485 Main Station Entrance)	SB Left	1	300	1	200	480 (9)
	WB Left	1	175	1	175	51 (90)
I-485 Secondary Park-and-Ride Entrance	SB Left	N/A	N/A	1	300	542 (0)
I-485 Outer Ramp	WB Left	1	Drop Lane[#]	2	400/Drop Lane[#]	1109 (291)
	NB Left	2	250	2	250	53 (626)

[#]Note: A drop lane is a continuous turn lane from the preceding intersection ending at this intersection.

6.4.2 Right Turn Lanes

Right turn lanes have been recommended at several intersections throughout the network; either to provide separation between a high volume right turn movement and through traffic or to match the existing geometry of the intersection. The presence of right turn lanes, particularly those at stations, can affect pedestrian comfort and safety because of the extra crossing distance pedestrians must travel. Intersections were evaluated to determine the necessity of right turn lanes and turning volumes were the basis for either retaining or removing existing right turn lanes. In general, existing right turn lanes were retained if the turning volume exceeded 100 vehicles per hour (vph) during either the a.m. or p.m. peak hour. Subsequent to examining peak hour right turn volumes, intersections with fewer than 100 vph were modeled in VISSIM; with and without the right turn lane to verify that the absent right turn lane did not adversely affect the intersection level of service. In some instances, the right turn volumes were excessively high and dual right turn lanes were warranted. **Table 6.4** presents the results of the right turn lane analysis. The right turn storage lengths are also illustrated in **Figures 4.13**, **4.14** and **4.15**.

Table 6.4
North Tryon Street/US-29 Right Turn Lane Recommendations

Cross Street	Movement	2008 Conditions		2030 Build		Projected Volumes AM (PM)
		Lanes	Existing Storage (ft)	Lanes	Recommended Storage (ft)	
Old Concord Road	NB Right	1	Drop Lane#	1	Drop Lane#	424 (865)
Arrowhead Drive	NB Right	1	Drop Lane#	0	Through/Right	31 (23)
	SB Right	1	Drop Lane#	0	Through/Right	53 (72)
Heathway Drive	SB Right	1	Drop Lane#	0	Through/Right	0 (3)
Owen Boulevard	NB Right	1	325	0	Through/Right	8 (38)
	SB Right	1	Drop Lane#	0	Through/Right	0 (0)
Tom Hunter Road	SB Right	1	200	1	200	133 (159)
	EB Right	1	300	1	300	230 (280)
I-85 Connector	SB Right	2	350*	2	350	541 (641)
	EB Right	1	200*	1	200	198 (88)
I-85 Service Road	SB Right	1	150	0	Through/Right	40 (11)
University City Boulevard Park-and-Ride Entrance	SB Right	0	N/A	1	150	129 (28)
	EB Right	N/A	N/A	1	Drop Lane#	7 (51)
Rocky River Road	NB Right	1	425	1	425	131 (255)
University City Boulevard/NC-49	NB Right	2	250*	2	250	913 (1982)
	SB Right	1	200*	1	200	512 (302)
	EB Right	1	100*	1	100	168 (263)
	WB Right	1	200*	1	200	28 (200)
Shopping Center Drive	NB Right	1	200	1	200	38 (146)
	SB Right	1	175	1	175	340 (300)
	EB Right	1	Drop Lane#	1	Drop Lane#	230 (375)

#Note: A drop lane is a continuous turn lane from the preceding intersection ending at this intersection.

*Note: These storage lengths will be provided when the "Weave Area" project is constructed.

Table 6.4 (continued)
North Tryon Street/US-29 Right Turn Lane Recommendations

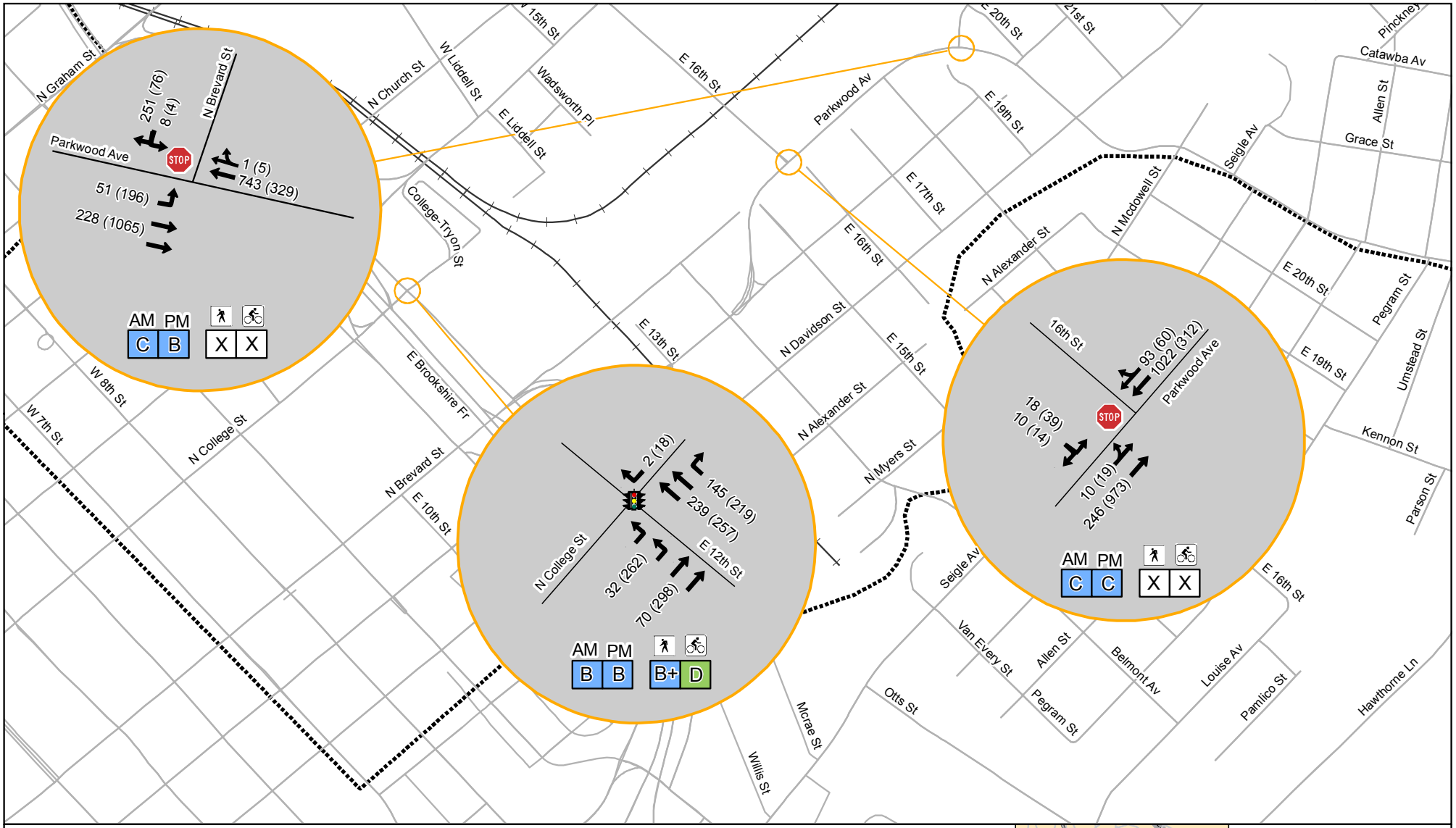
Cross Street	Movement	2008 Conditions		2030 Build		Projected Volumes AM (PM)
		Lanes	Existing Storage (ft)	Lanes	Recommended Storage (ft)	
McCullough Drive	NB Right	1	500	0	Through/Right	19 (39)
	SB Right	1	Drop Lane#	1	900**	231 (68)
	EB Right	1	225	1	225	343 (340)
	WB Right	1	150	1	150	19 (35)
Ken Hoffman Drive	NB Right	0	Through/Right	1	100	19 (58)
	EB Right	1	50	1	50	40 (23)
	WB Right	1	200	1	200	25 (53)
W.T. Harris Boulevard	NB Right	1	Drop Lane#	1	Drop Lane#	136 (280)
	SB Right	1	500	1	500	169 (247)
JM Keynes Drive	NB Right	1	150	1	150	131 (59)
	SB Right	1	Drop Lane#	1	800**	120 (73)
	WB Right	1	325	1	325	31 (234)
JW Clay Boulevard	SB Right	1	Drop Lane#	1	850**	450 (483)
	EB Right	1	Drop Lane#	1	Drop Lane#	65 (148)
UNCC Research Drive	NB Right	1	300	1	300	85 (80)
Grove Lake Drive	SB Right	1	Drop Lane#	1	Drop Lane#	34 (103)
Barton Creek Drive	SB Right	1	Drop Lane#	1	Drop Lane#	8 (44)
Mallard Creek Church Road	NB Right	1	175	1	175	63 (239)
	SB Right	1	700	1	700	791 (309)
	EB Right	1	175	1	175	380 (273)
	WB Right	1	225	1	225	40 (173)
Morningstar Place Drive (I-485 Station Entrance)	NB Right	1	425	1	425	53 (10)
	WB Right	1	Drop Lane#	2	Drop Lane#	0 (534)
I-485 Park-and-Ride Entrance	NB Right	N/A	N/A	1	Drop Lane#	29 (38)
	WB Right	N/A	N/A	1	Drop Lane#	12 (499)
I-485 Inner Ramp	NB Right	1	Drop Lane#	1	Drop Lane#	166 (1260)
	EB Right	1	750	2	750	620 (150)
I-485 Outer Ramp	WB Right	1	Drop Lane#	1	Drop Lane#	1034 (636)
	SB Right	1	500	1	500	3051 (1088)

#Note: A drop lane is a continuous turn lane from the preceding intersection ending at this intersection.
**Note: Storage lengths were maximized by extending the turn lane to the upstream intersection. The turn lane would begin after a 50 foot tangent section and a 100 foot taper following the curb return at the upstream intersection.

LYNX Blue Line Extension

Figure 2.1

Measures of Effectiveness - 2008 Existing Conditions



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes
- AM PM D D — Intersection Level of Service
- D D — Pedestrian and Bicycle Level of Service
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- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

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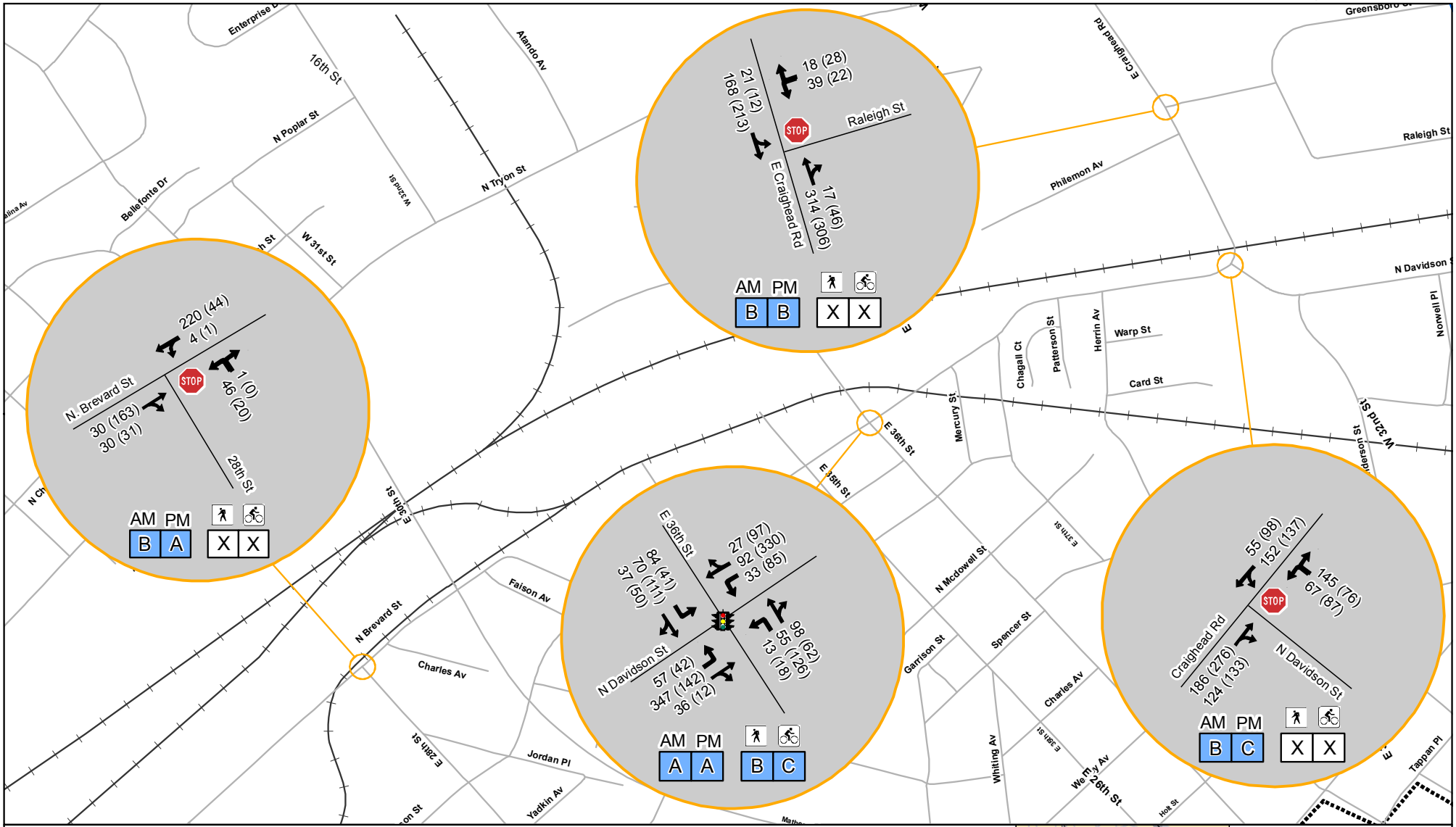
Existing_Fig2.1_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 2.2

Measures of Effectiveness - 2008 Existing Conditions



Legend

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Map Vicinity

400 200 0 400

Feet

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Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

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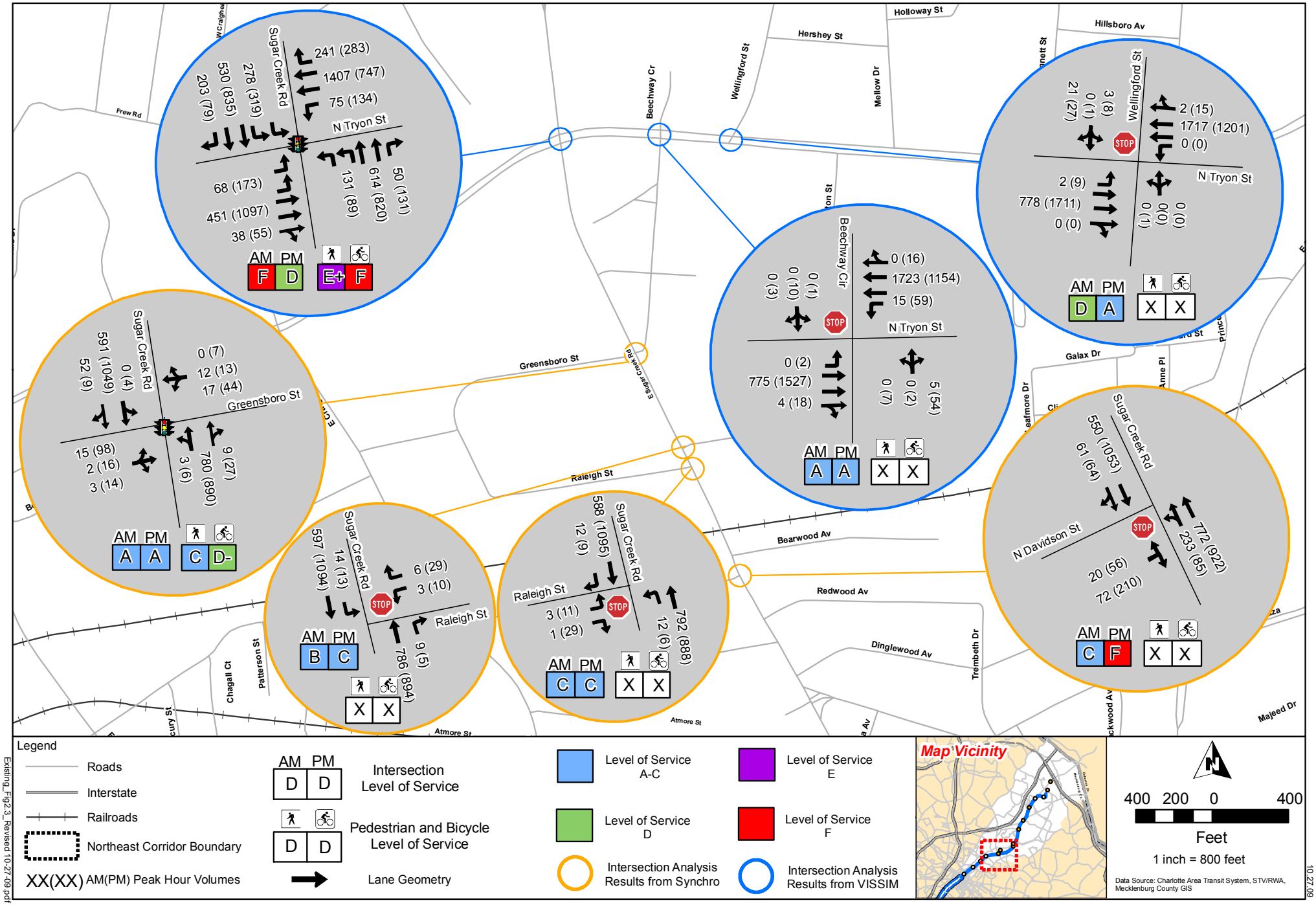
Existing_Fig2.2_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 2.3

Measures of Effectiveness - 2008 Existing Conditions



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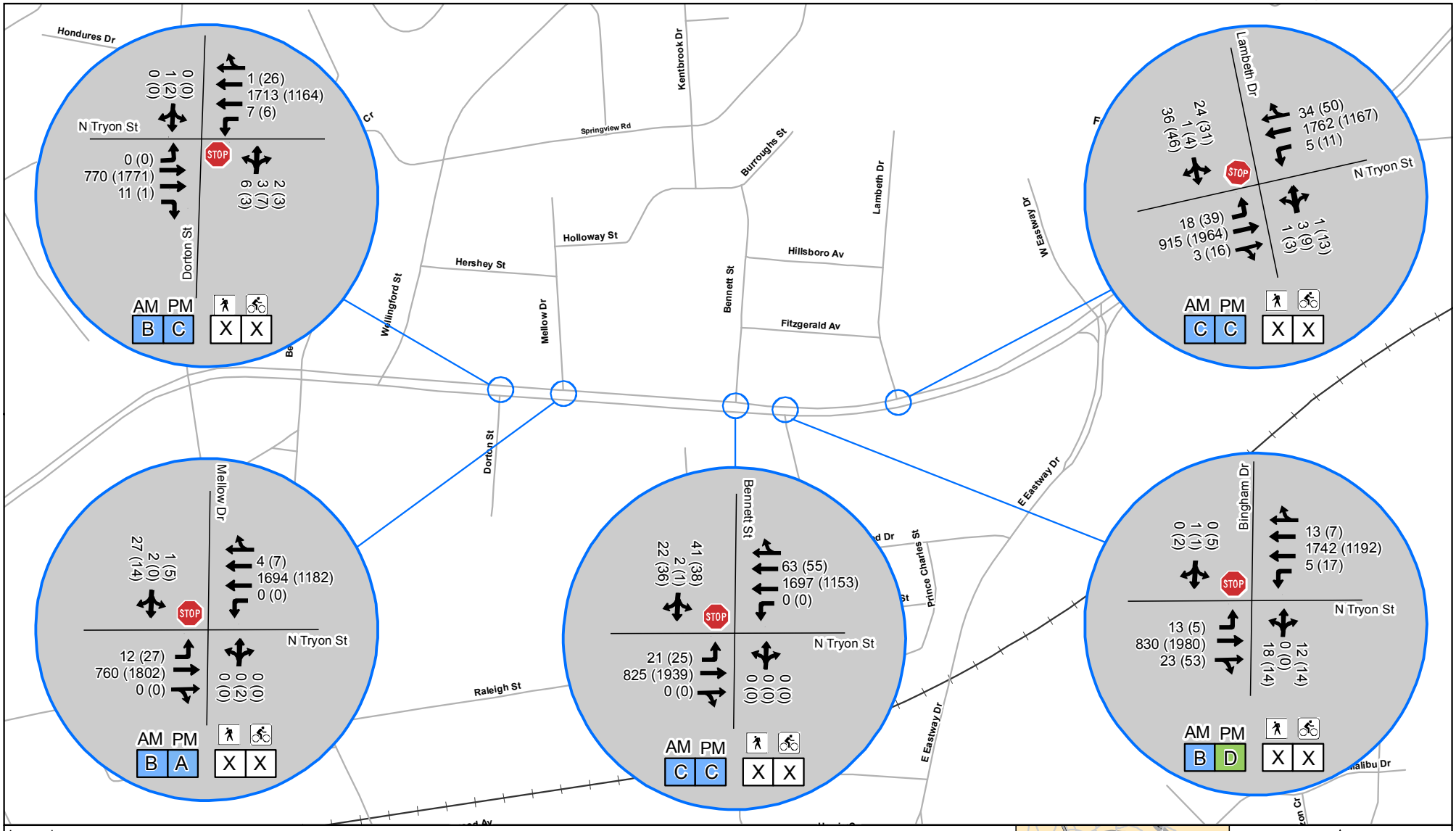
LYNX Blue Line Extension

Figure 2.4

Measures of Effectiveness - 2008 Existing Conditions



Legend

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Feet

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Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

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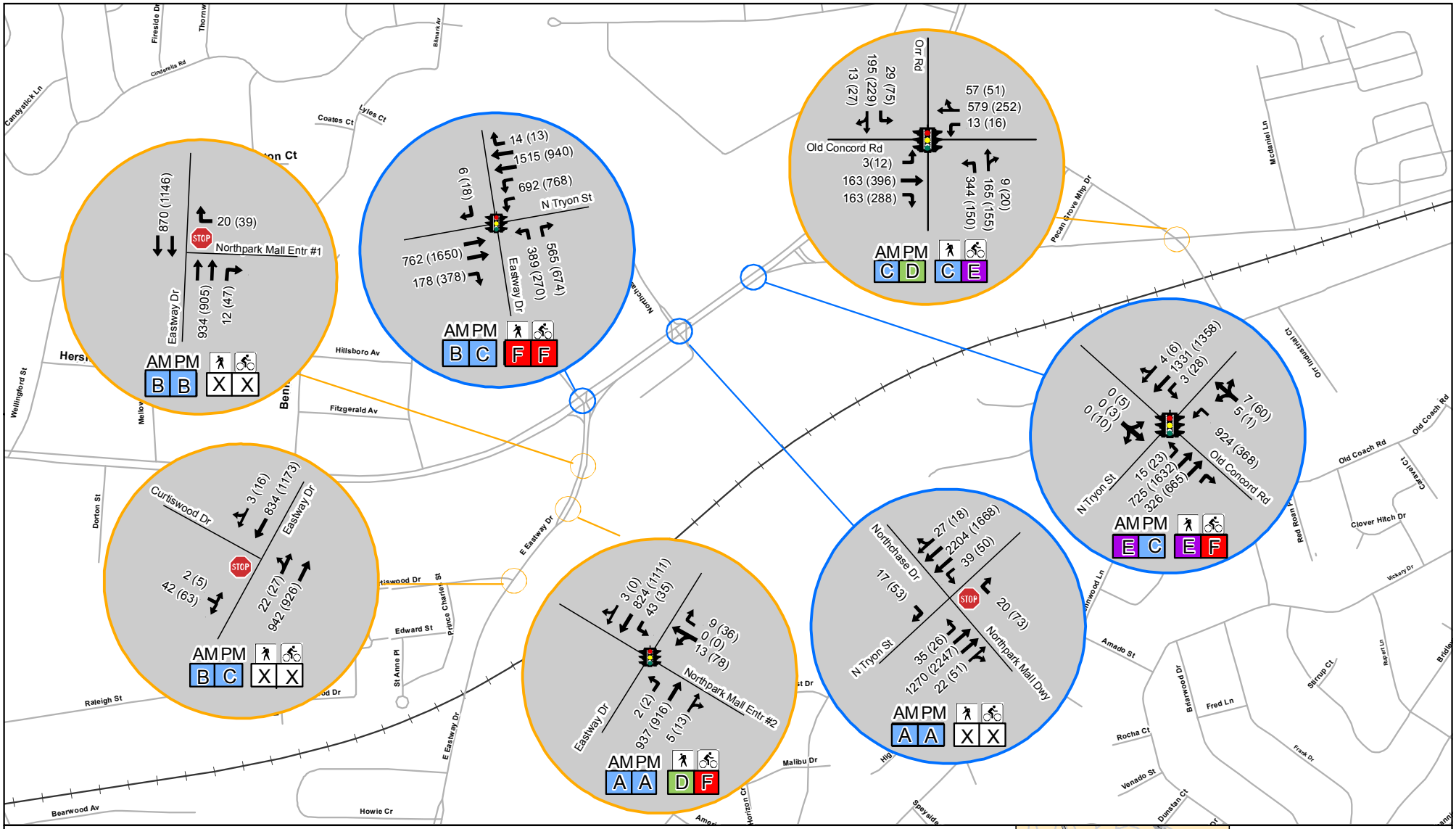
LYNX Blue Line Extension

Figure 2.5

Measures of Effectiveness - 2008 Existing Conditions



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LYNX Blue Line Extension

Figure 2.6

Measures of Effectiveness - 2008 Existing Conditions

Legend

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Map Vicinity

400 200 0 400

Feet

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Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

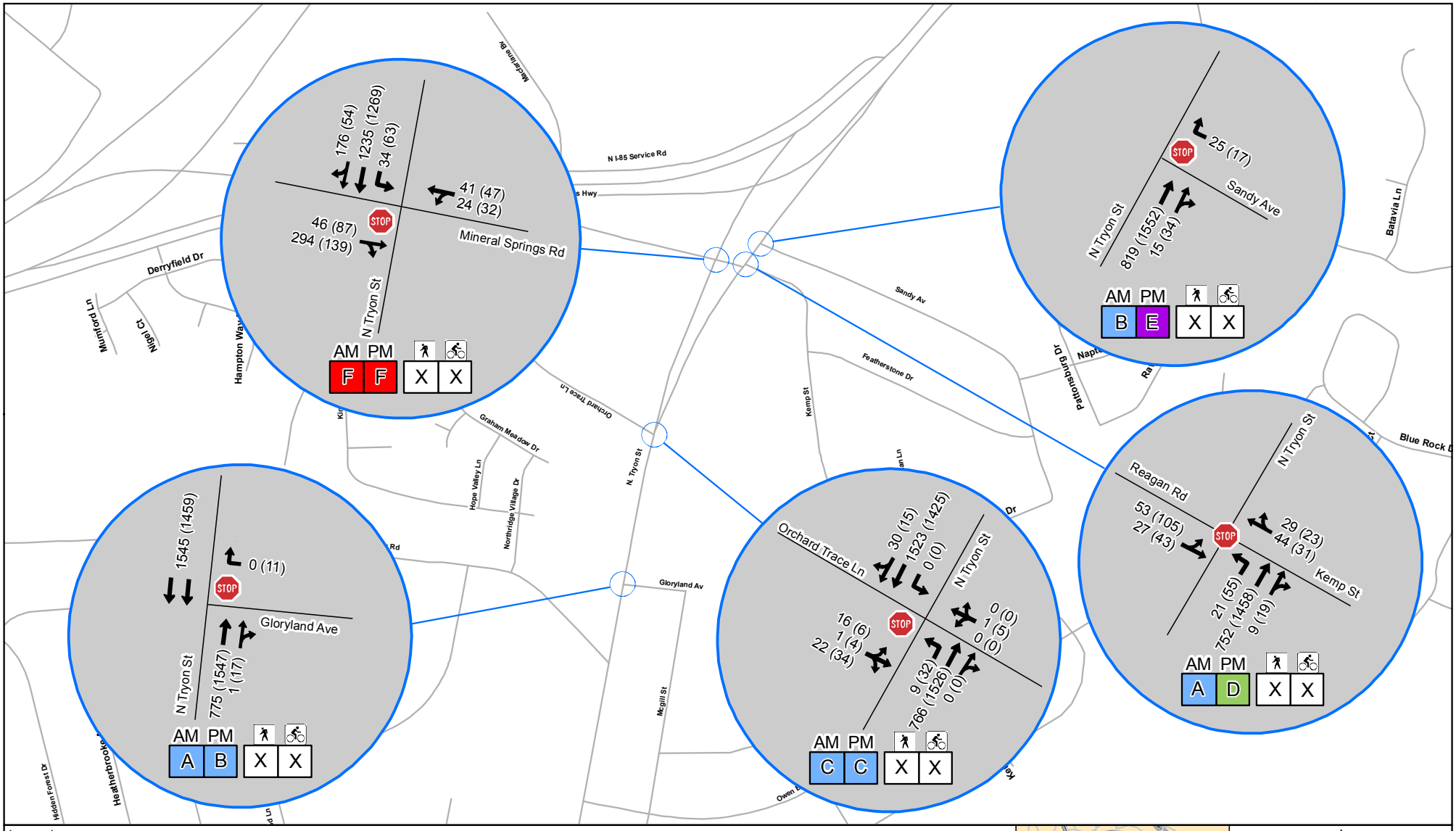
Existing_Fig2.6_Revised 10-27-09.pdf

10.27.09

LYNX Blue Line Extension

Figure 2.7

Measures of Effectiveness - 2008 Existing Conditions



Legend

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Feet

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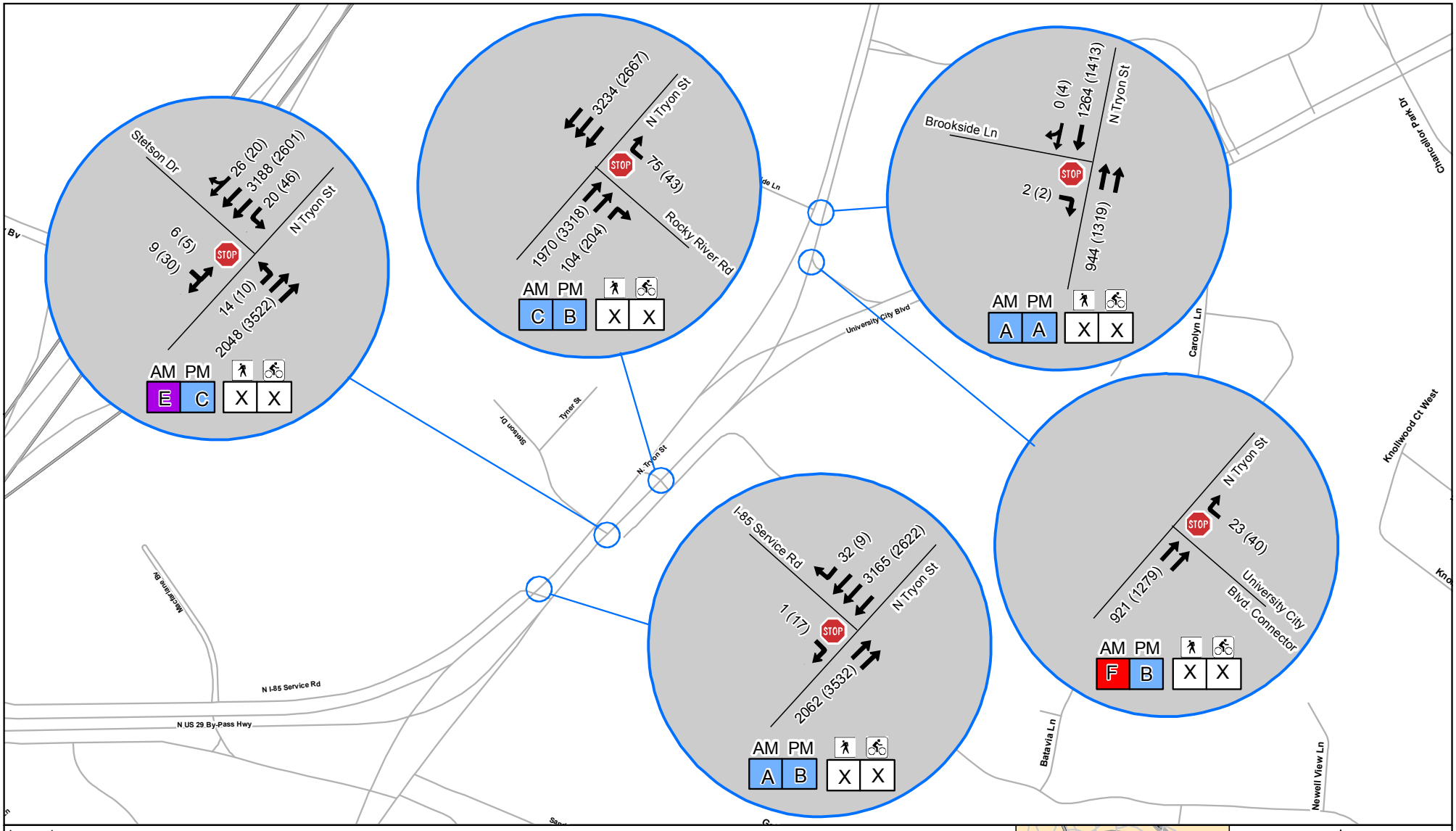
Existing_Fig2.7_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 2.8

Measures of Effectiveness - 2008 Existing Conditions



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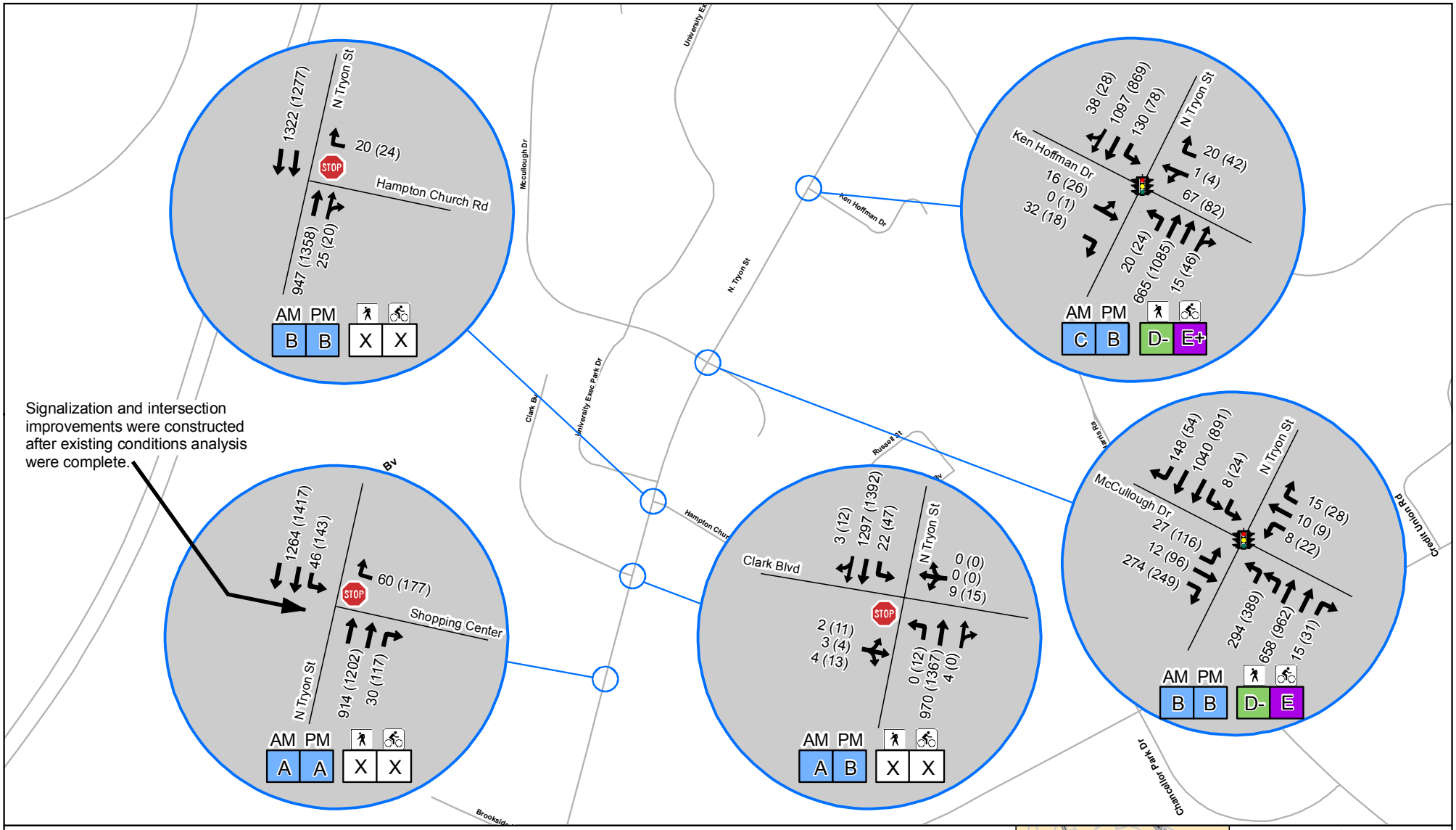
Existing_Fig2.8_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 2.9

Measures of Effectiveness - 2008 Existing Conditions



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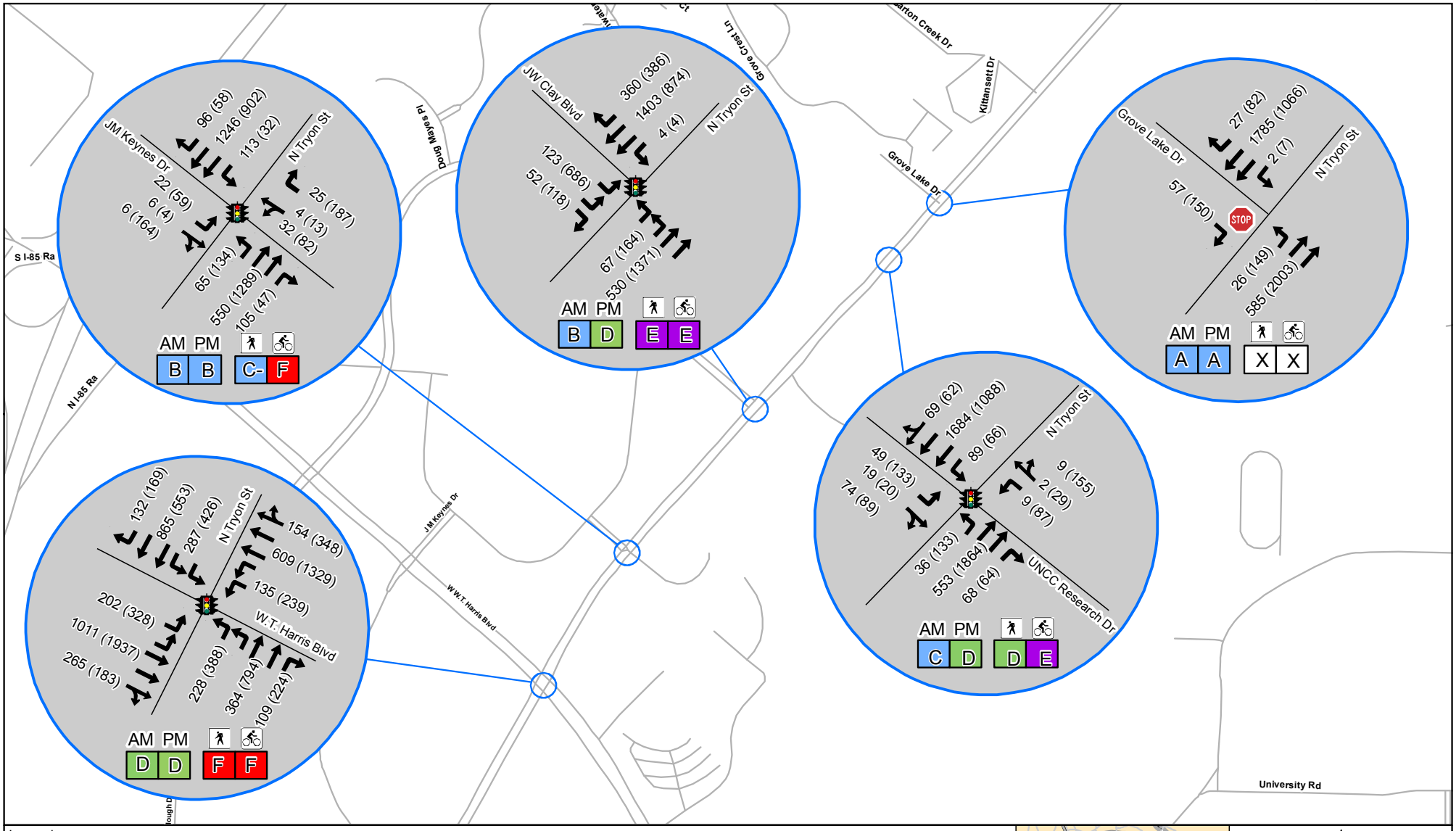
Existing_Fig2.9_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 2.10

Measures of Effectiveness - 2008 Existing Conditions



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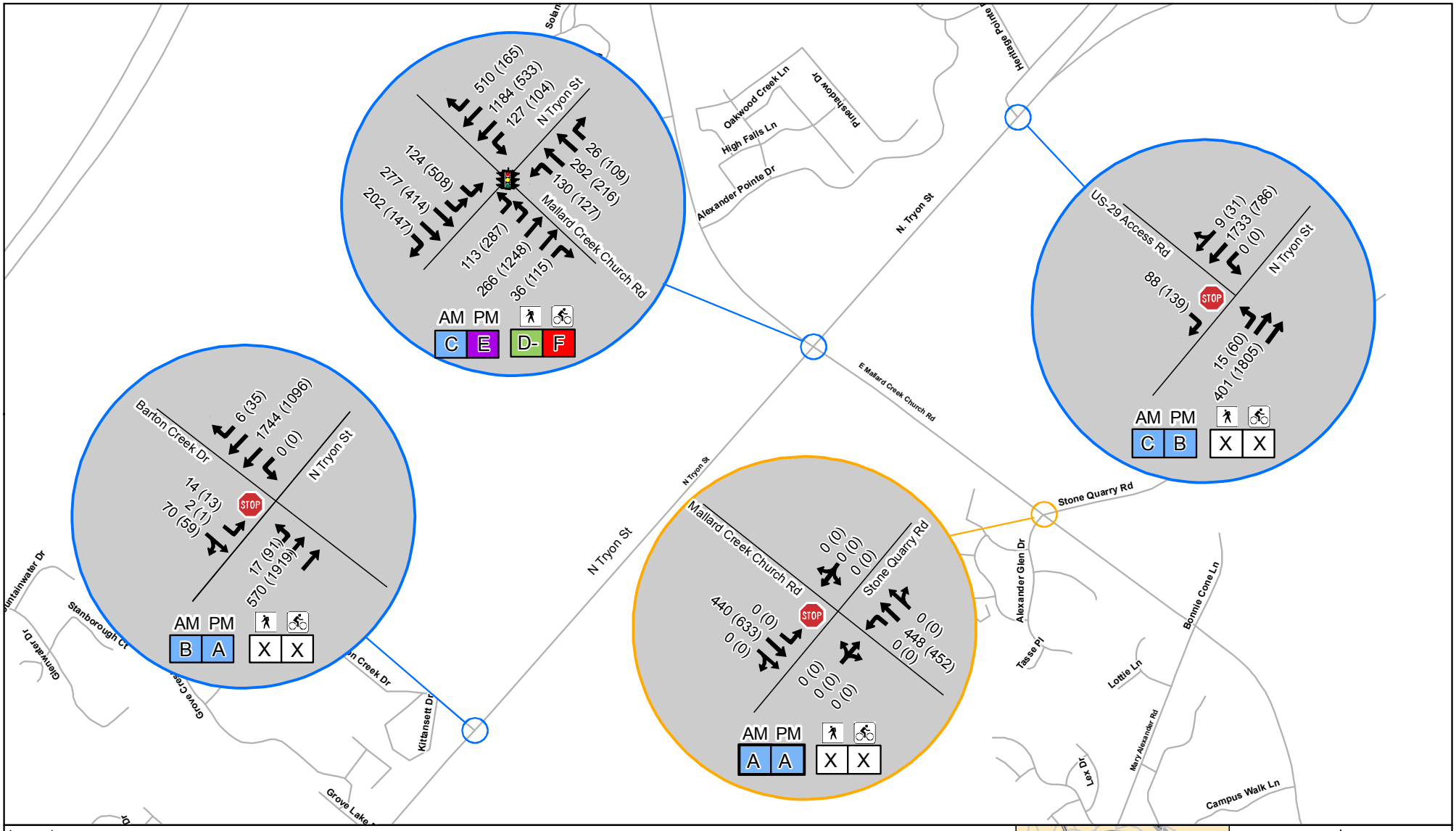
Existing_Fig2.10_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 2.11

Measures of Effectiveness - 2008 Existing Conditions



Legend

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Map Vicinity

400 200 0 400

Feet

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Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

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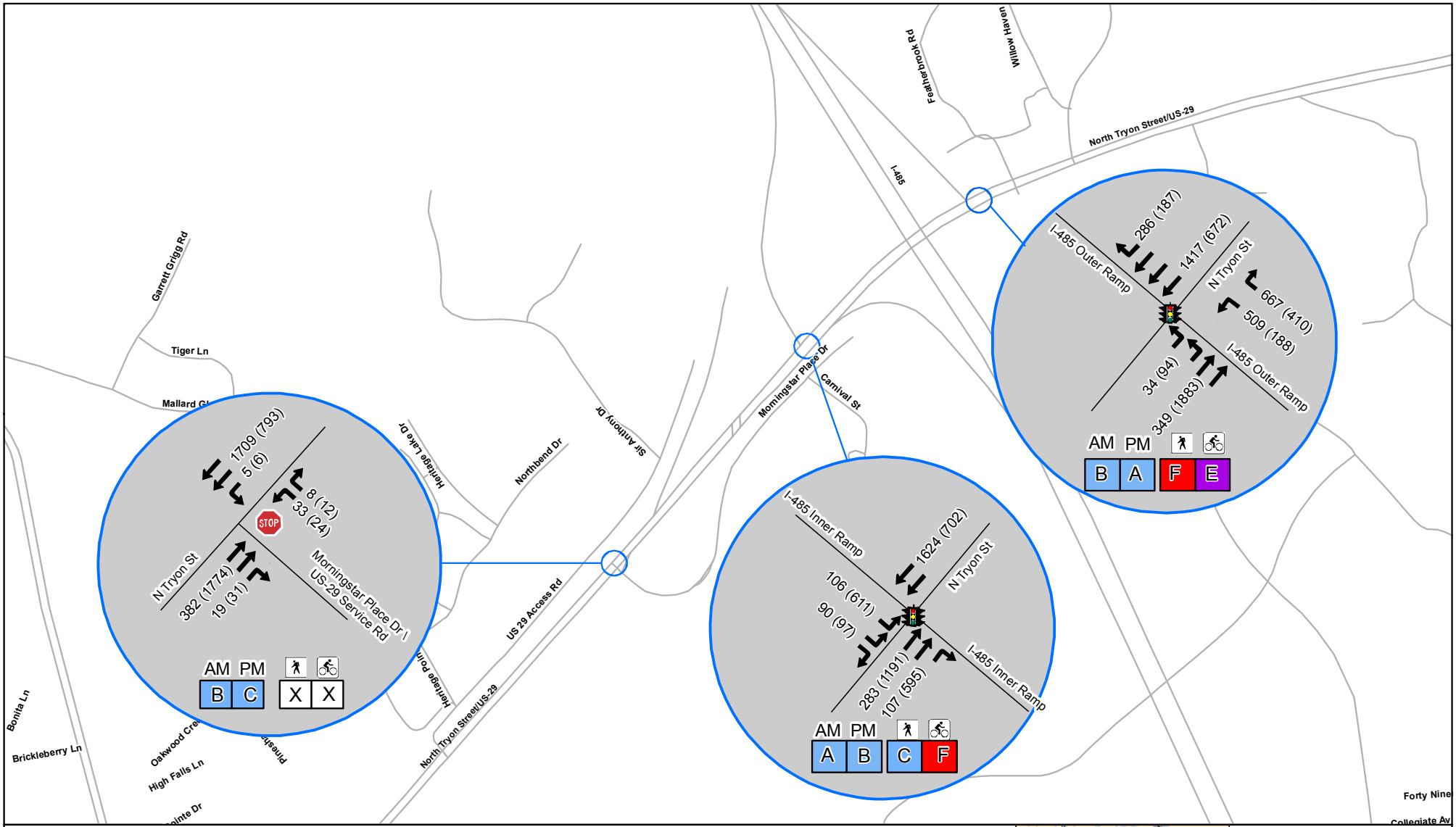
Existing_Fig2.11_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 2.12

Measures of Effectiveness - 2008 Existing Conditions



Legend

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Feet

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Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

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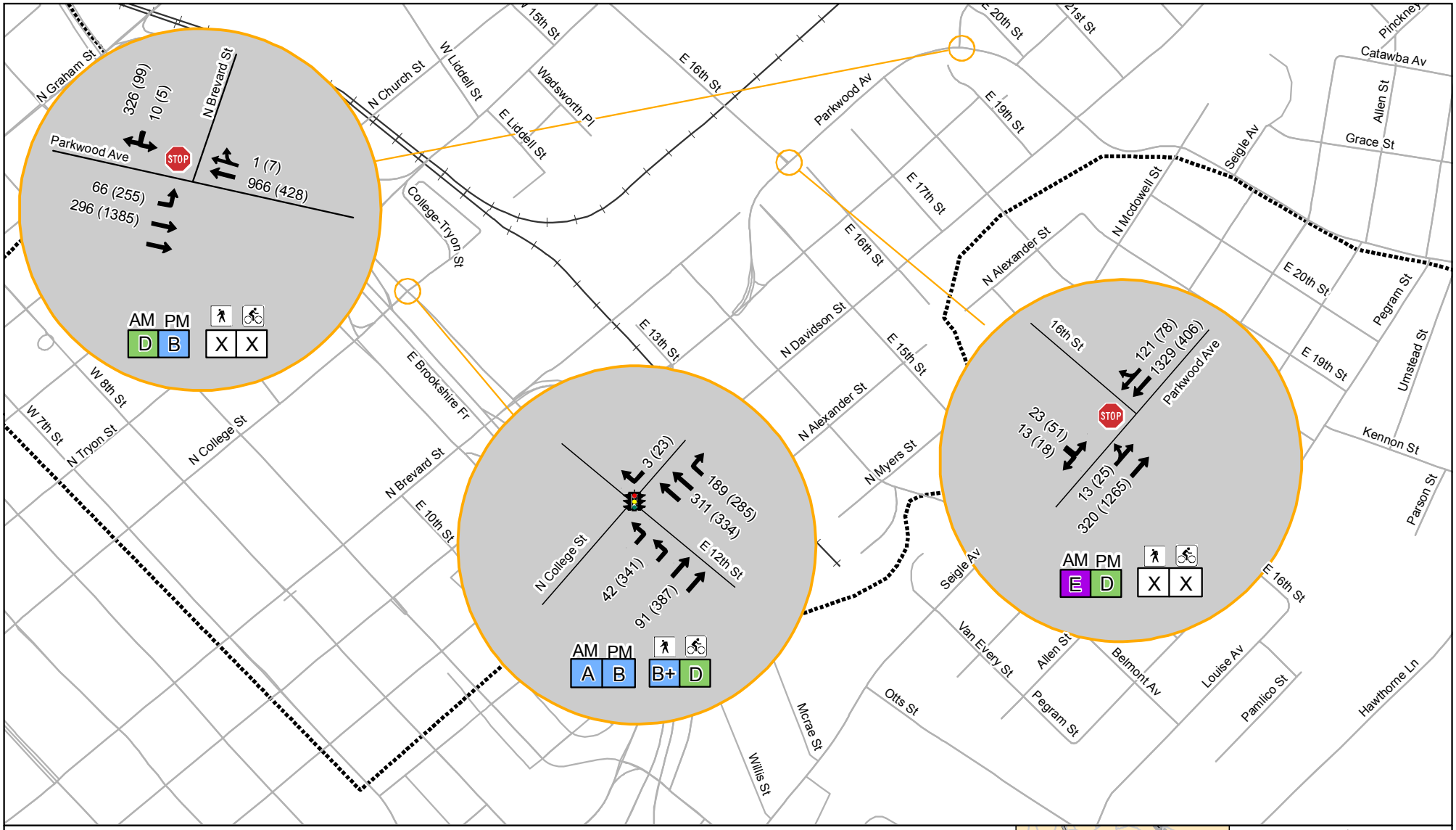
Existing_Fig2.12_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 3.1

Measures of Effectiveness - 2030 No-Build Alternative



Legend

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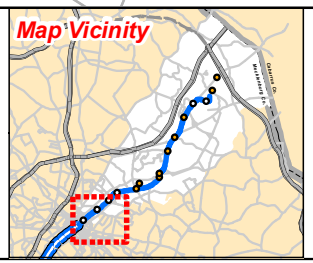
Map Vicinity



400 200 0 400

Feet

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Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

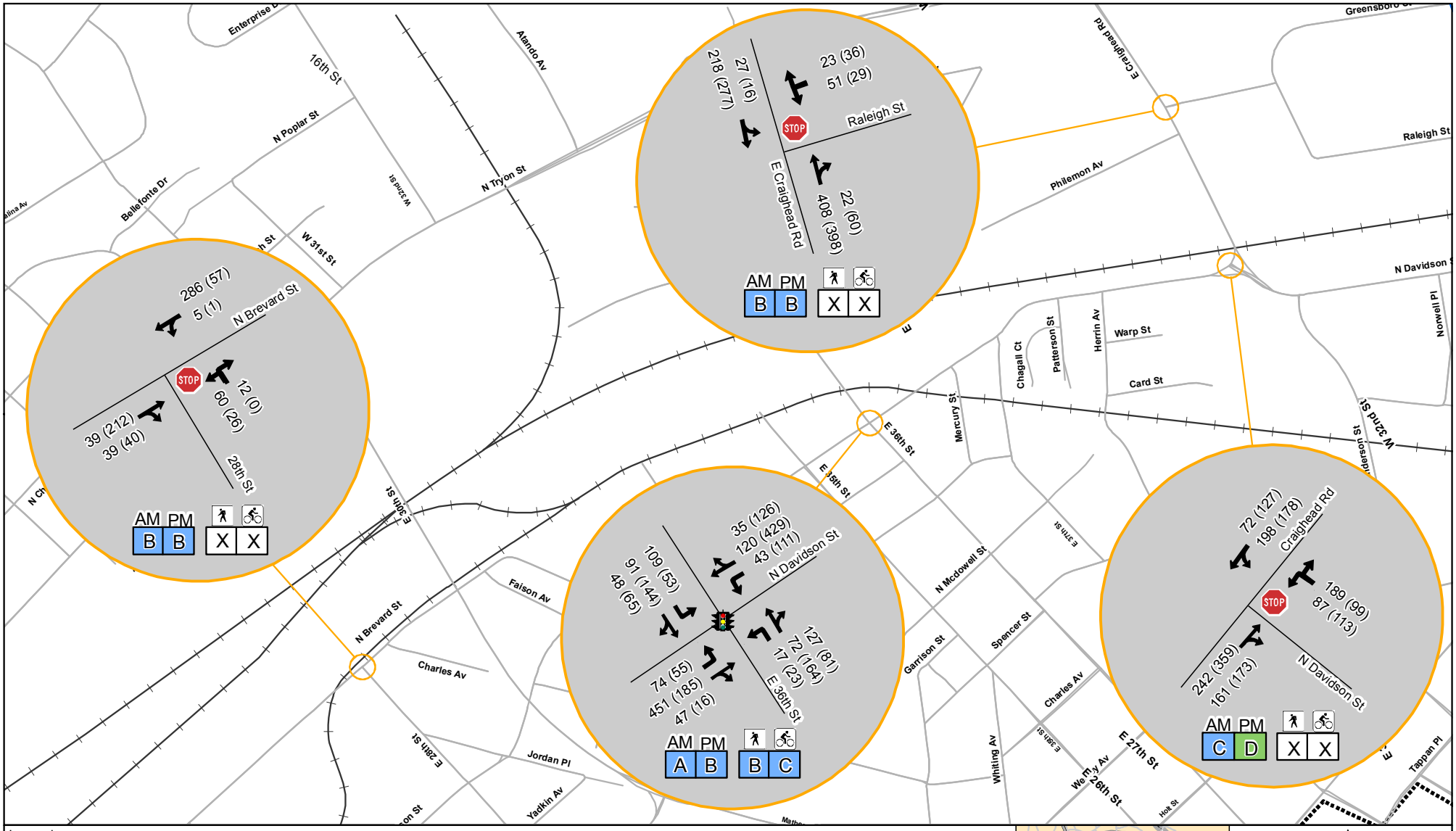
10.27.09

NoBuild_Fig3.1_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 3.2

Measures of Effectiveness - 2030 No-Build Alternative



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Map Vicinity

400 200 0 400

Feet

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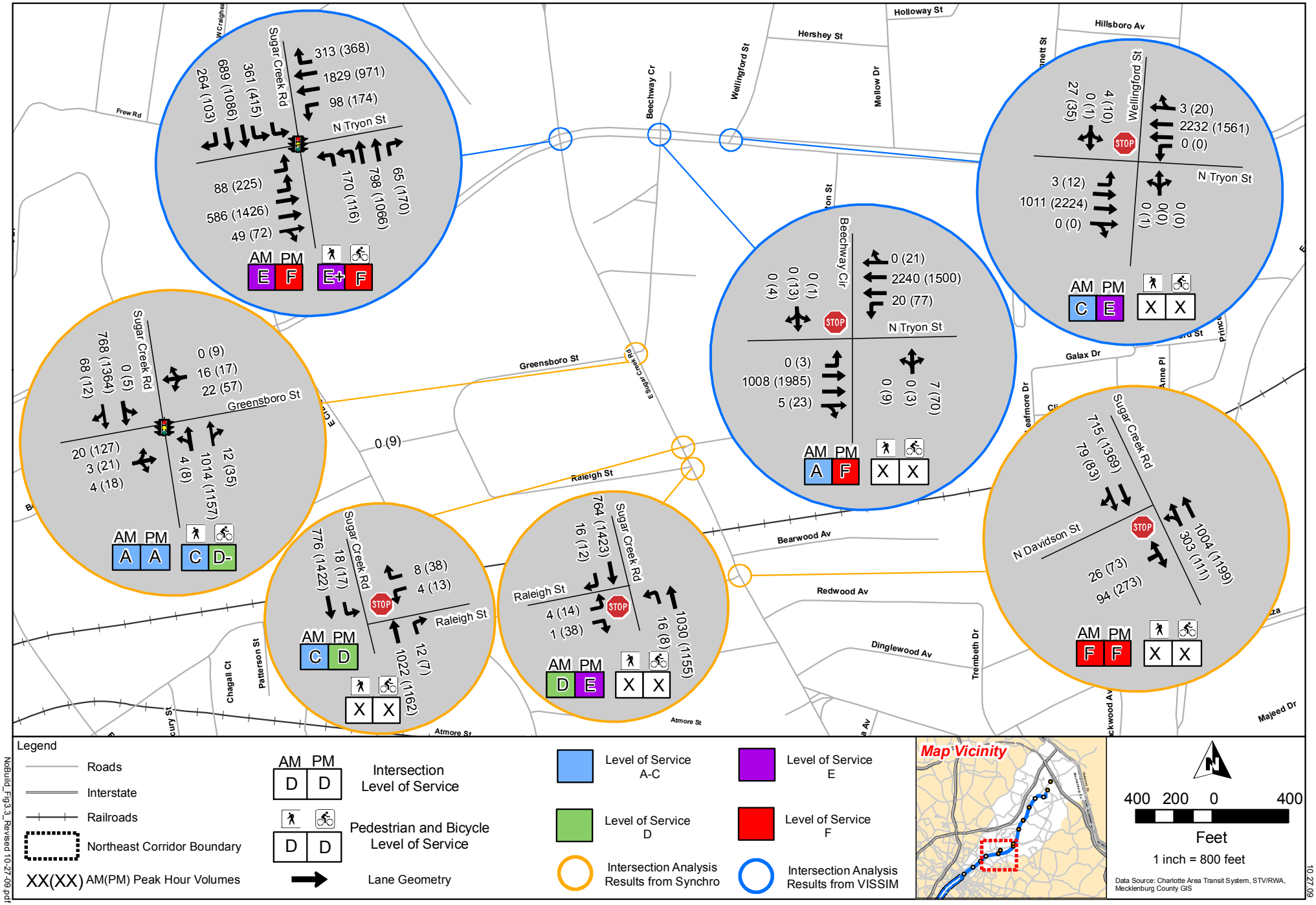
NoBuild_Fig3.2_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 3.3

Measures of Effectiveness - 2030 No-Build Alternative



Legend

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Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

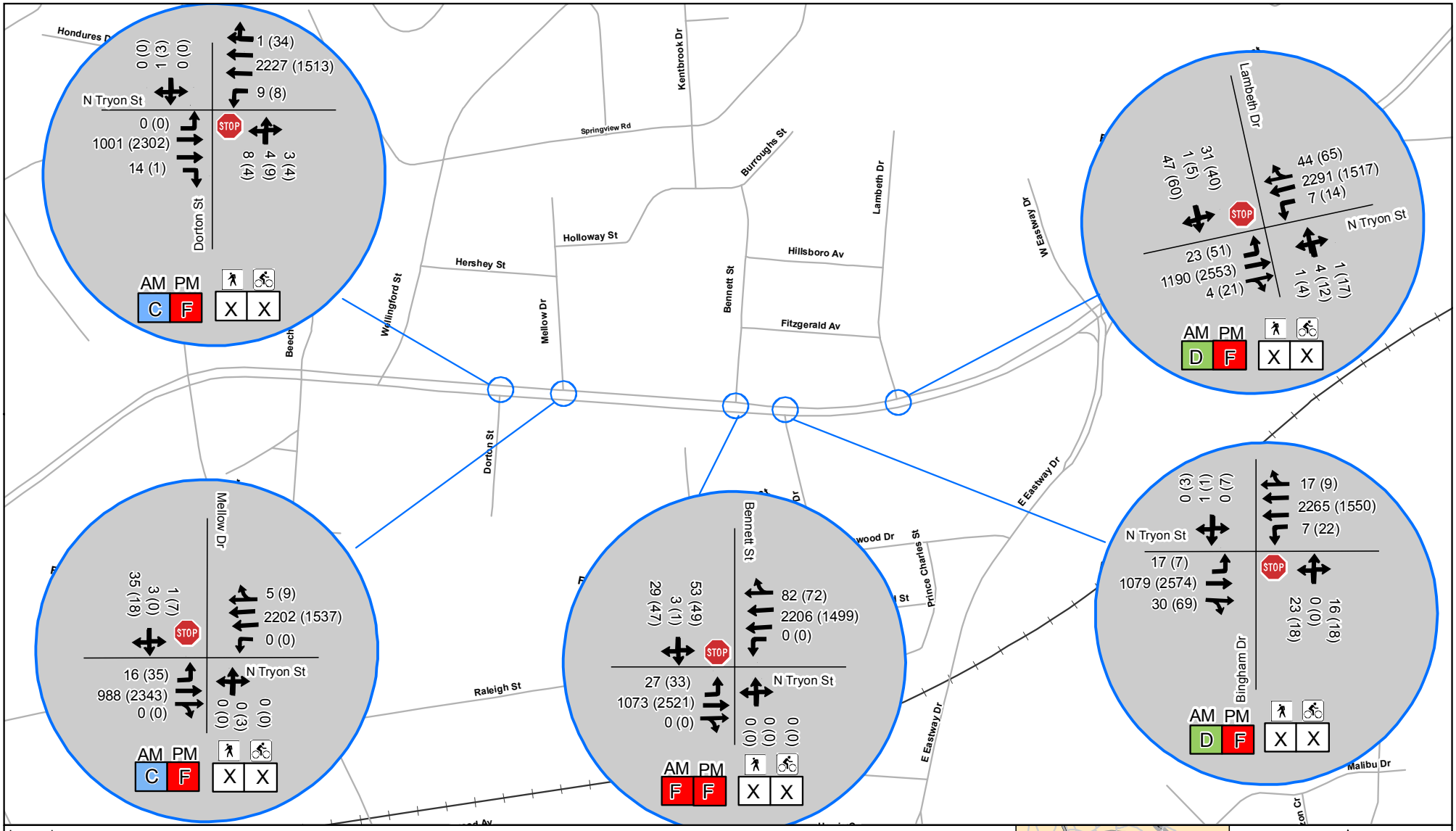
NoBuild_Fig3.3_Revised 10-27-09.pdf

10.27.09

LYNX Blue Line Extension

Figure 3.4

Measures of Effectiveness - 2030 No-Build Alternatives



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Feet

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Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

NoBuild_Fig3.4_Revised 10-27-09.pdf

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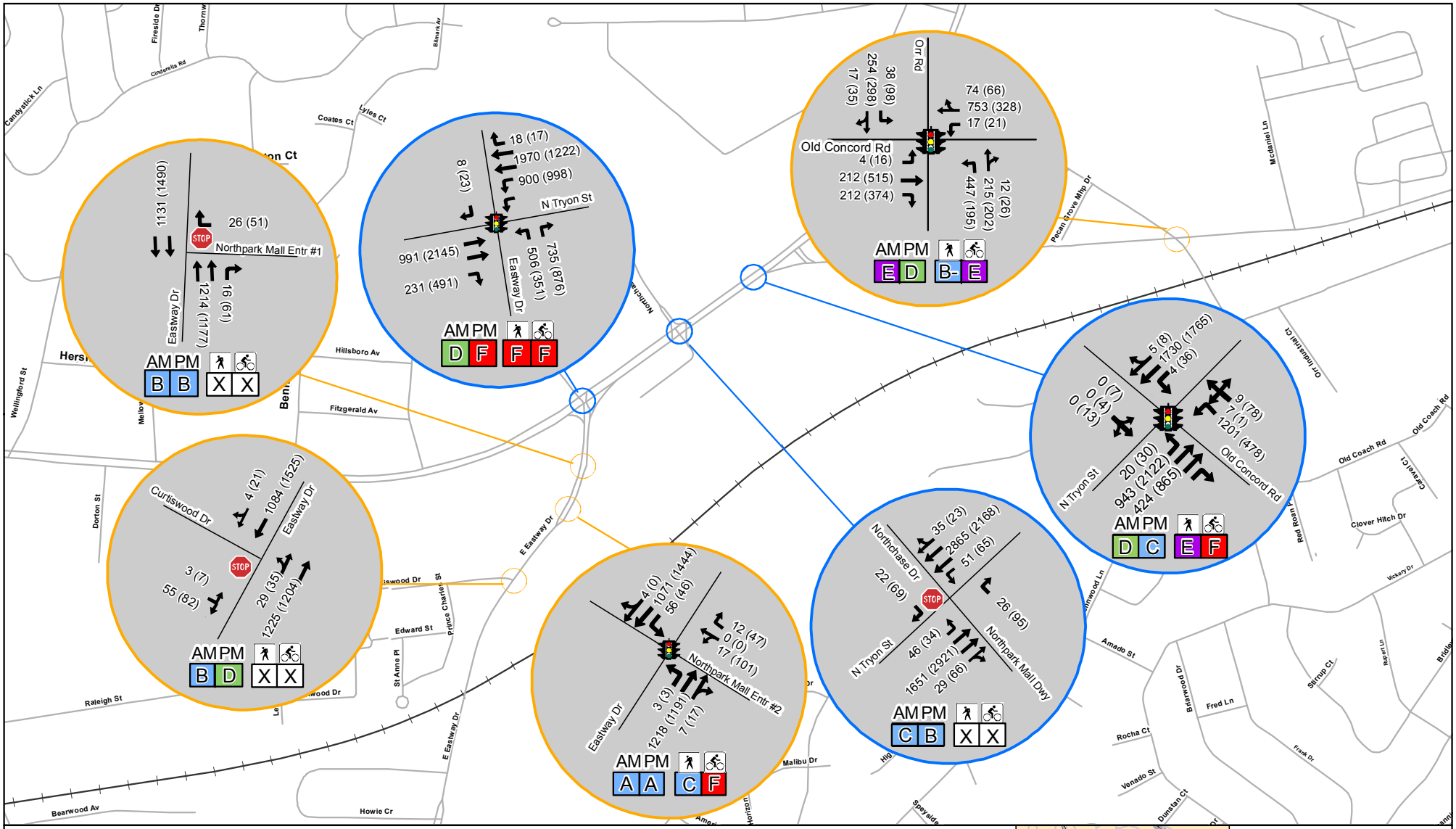
LYNX Blue Line Extension

Figure 3.5

Measures of Effectiveness - 2030 No-Build Alternatives



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LYNX Blue Line Extension

Figure 3.6

Measures of Effectiveness - 2030 No-Build Alternatives

NoBuild_Fig3.6_Revised 10-27-09.pdf

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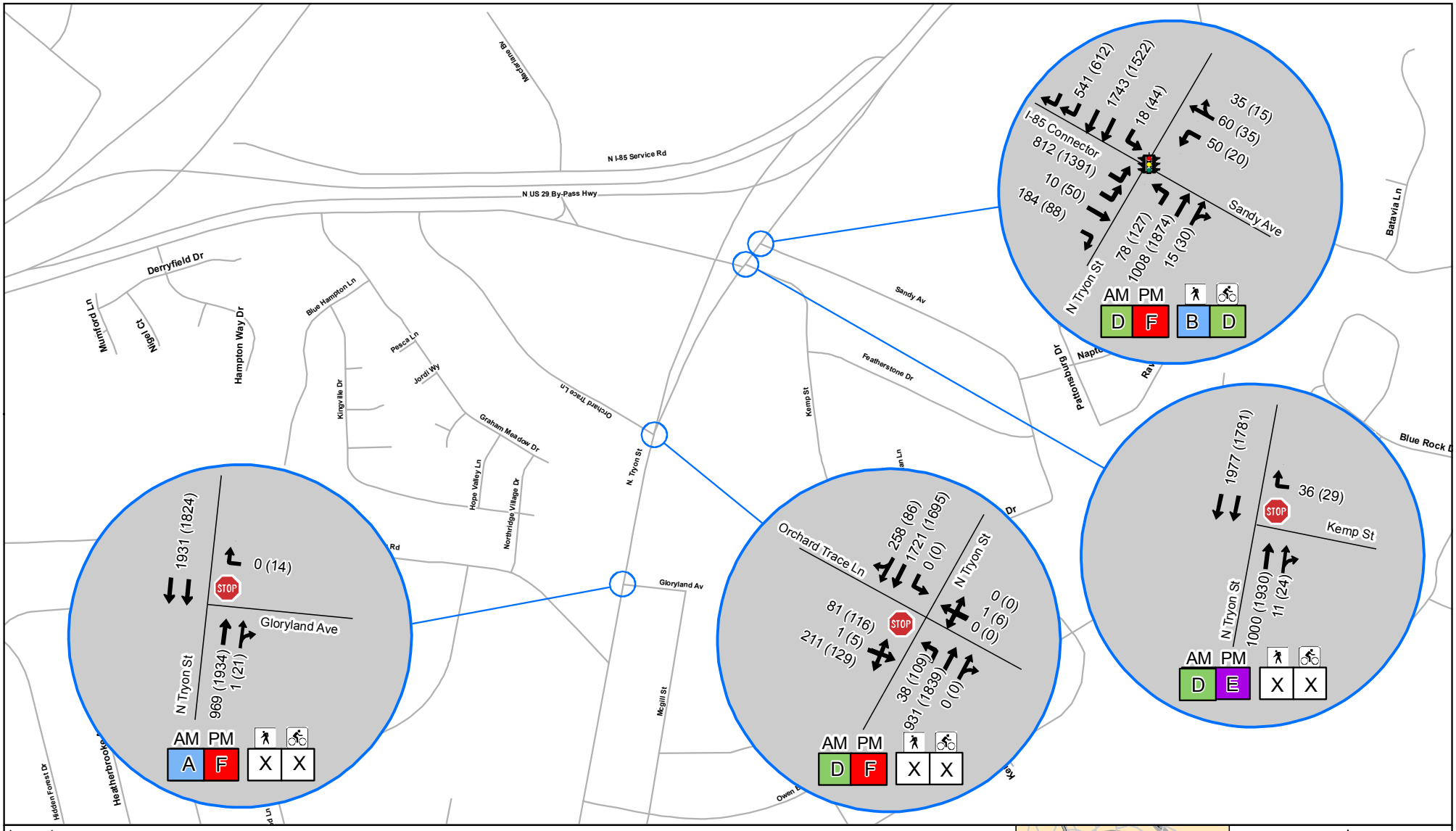
LYNX Blue Line Extension

Figure 3.7

Measures of Effectiveness - 2030 No-Build Alternatives



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Feet

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Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

NoBuild_Fig3.7_Revised 10-27-09.pdf

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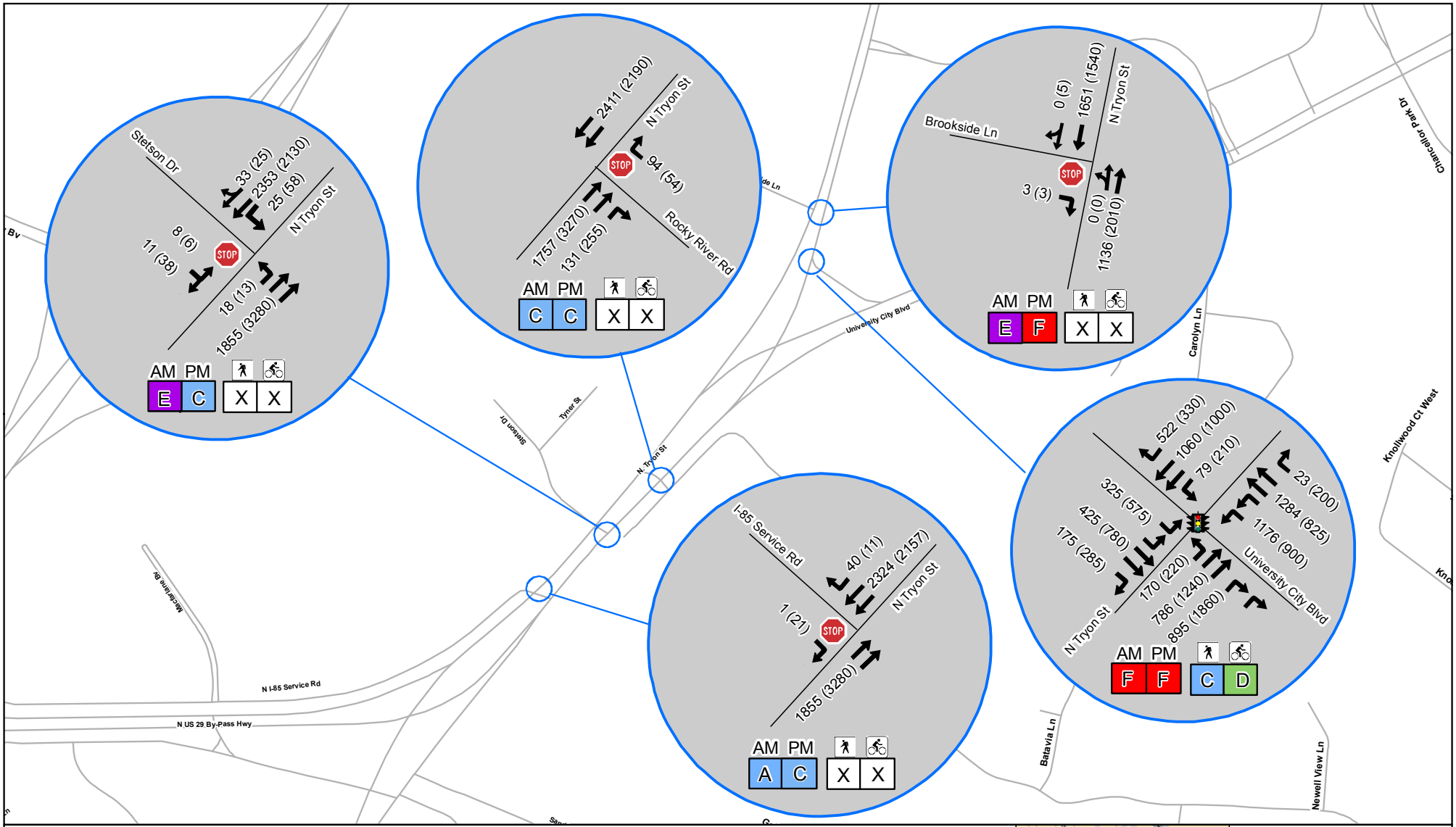
LYNX Blue Line Extension

Figure 3.8

Measures of Effectiveness - 2030 No-Build Alternatives



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Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

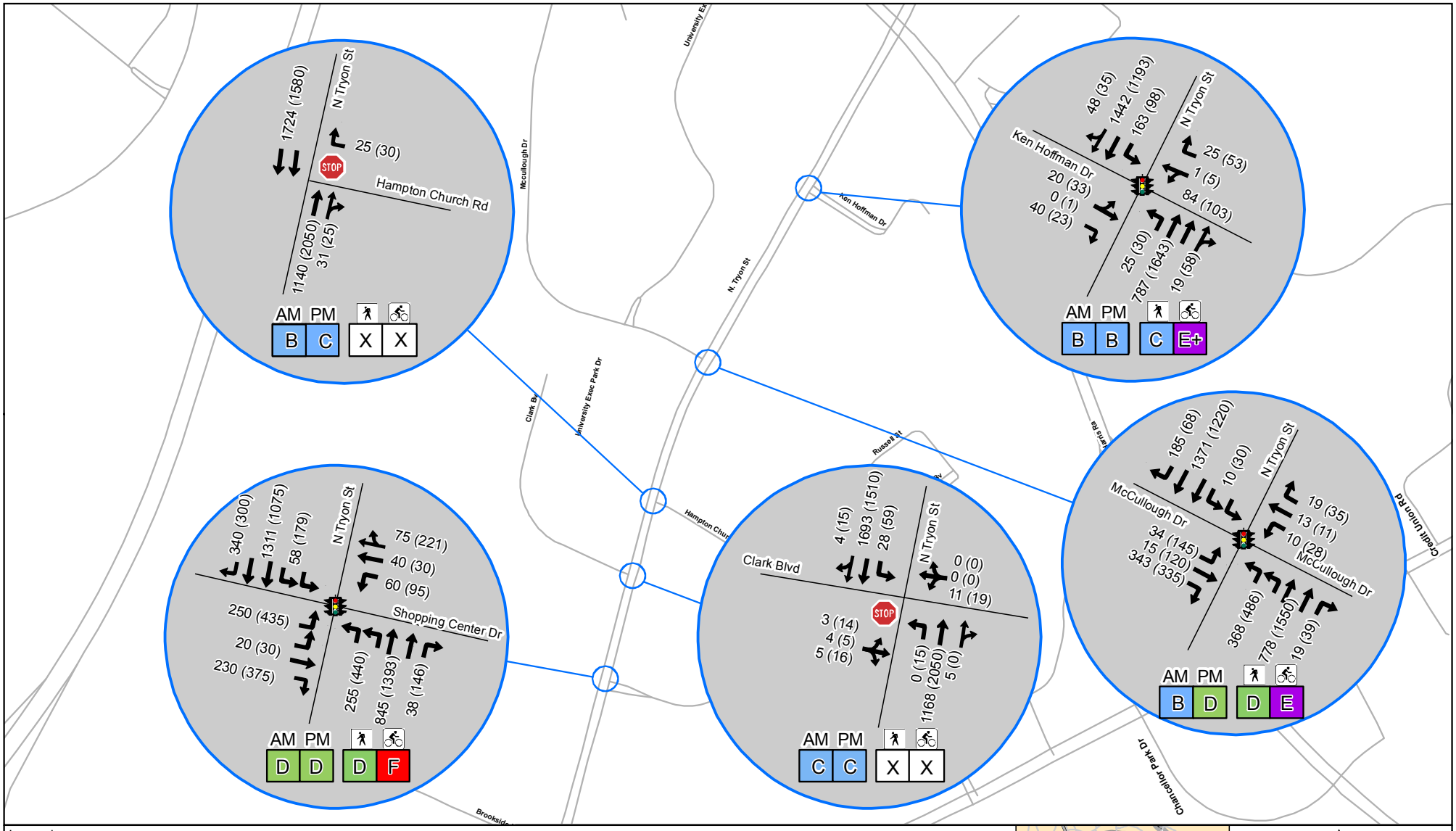
10.27.09

NoBuild_Fig3.8_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 3.9

Measures of Effectiveness - 2030 No-Build Alternative



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- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

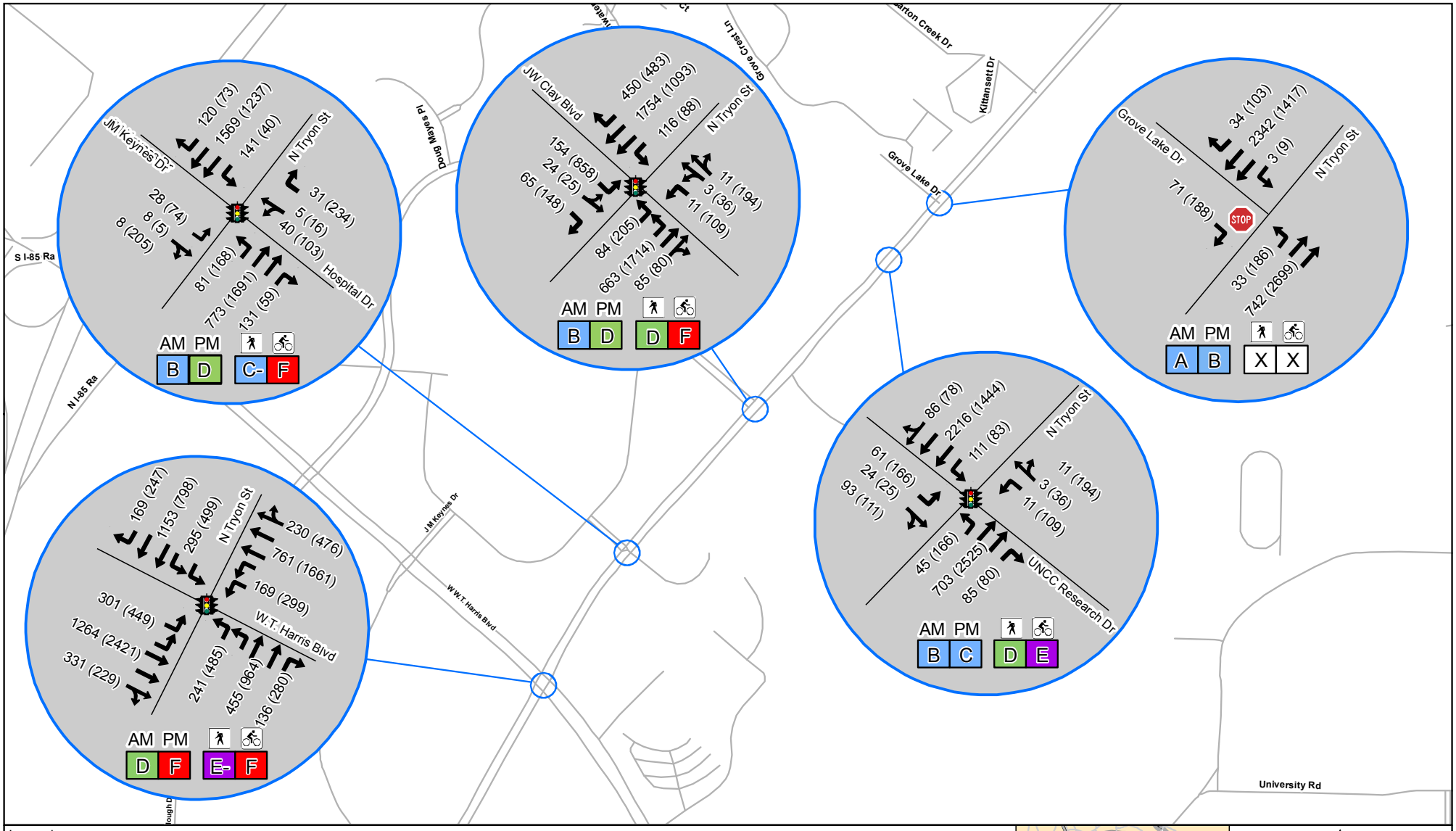
10.27.09

NoBuild_Fig3.9_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 3.10

Measures of Effectiveness - 2030 No-Build Alternative



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM: D (D) — Intersection Level of Service

D D — Pedestrian and Bicycle Level of Service

Lane Geometry

- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

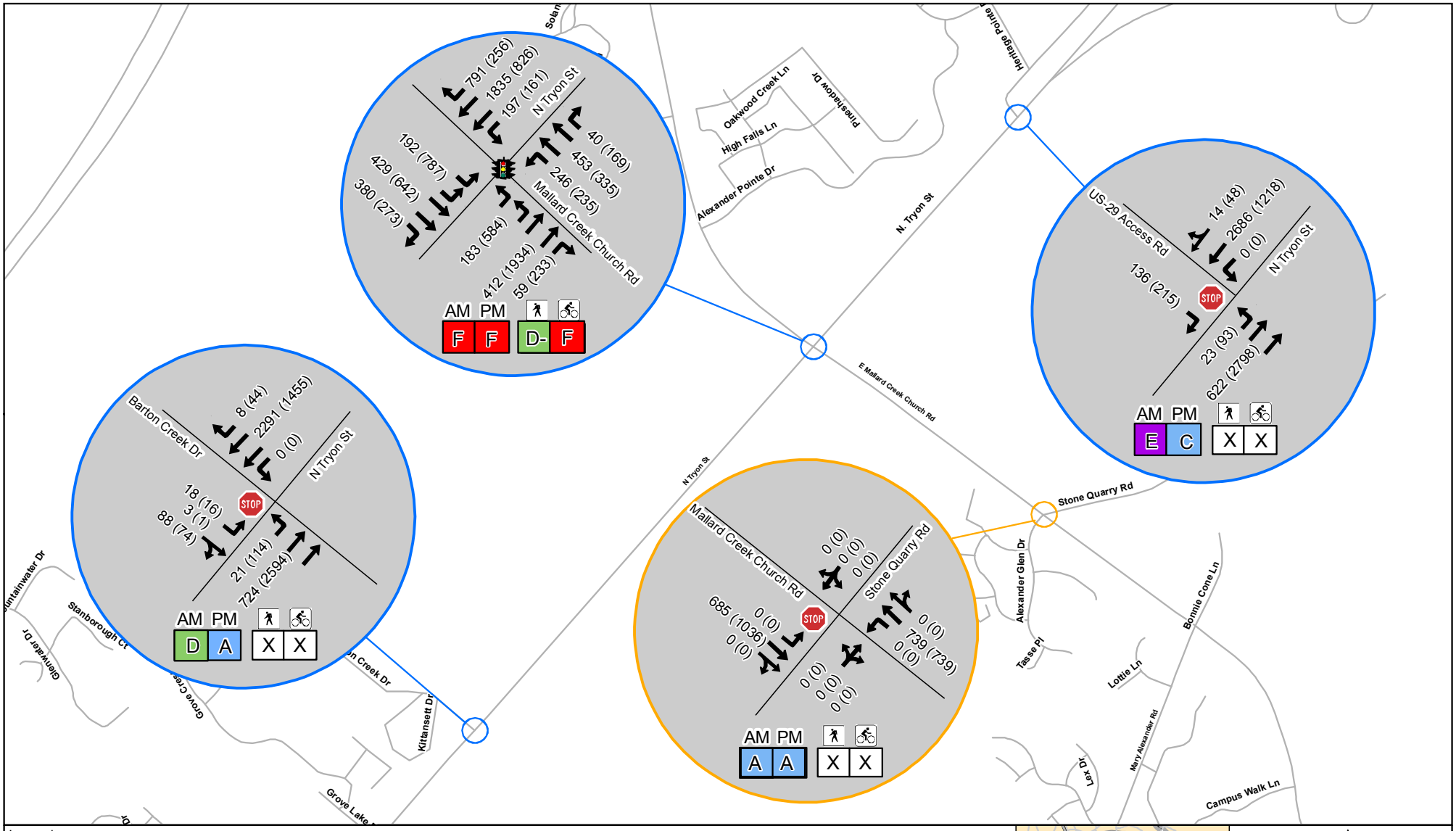
10.27.09

NoBuild_Fig3.10_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 3.11

Measures of Effectiveness - 2030 No-Build Alternative



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes
- AM PM D (D) — Intersection Level of Service
- D D — Pedestrian and Bicycle Level of Service
- Lane Geometry
- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

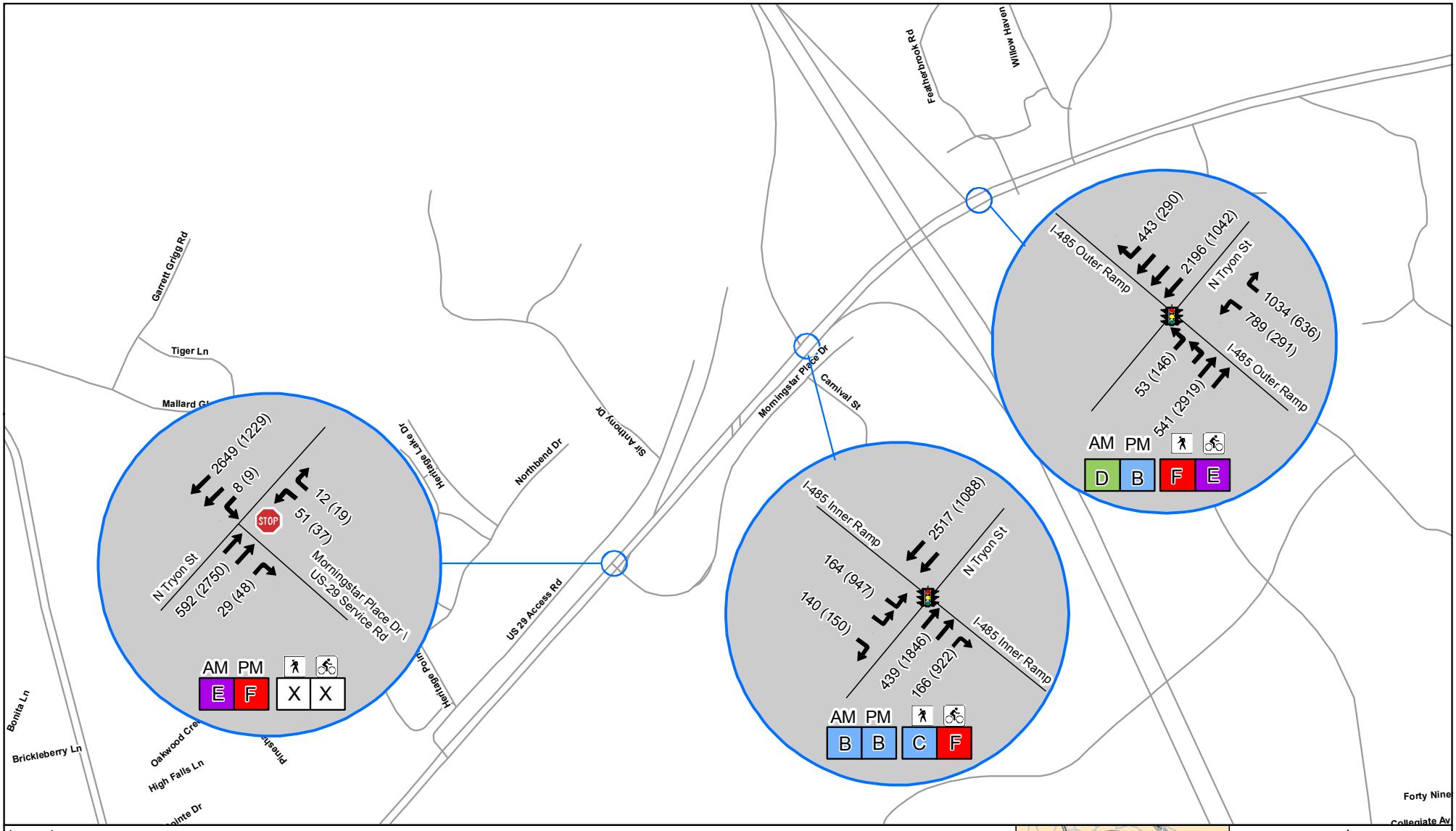
10.27.09

NoBuild_Fig3.11_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 3.12

Measures of Effectiveness - 2030 No-Build Alternative



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes
- AM PM D D — Intersection Level of Service
- Pedestrian and Bicycle Level of Service
- Lane Geometry
- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

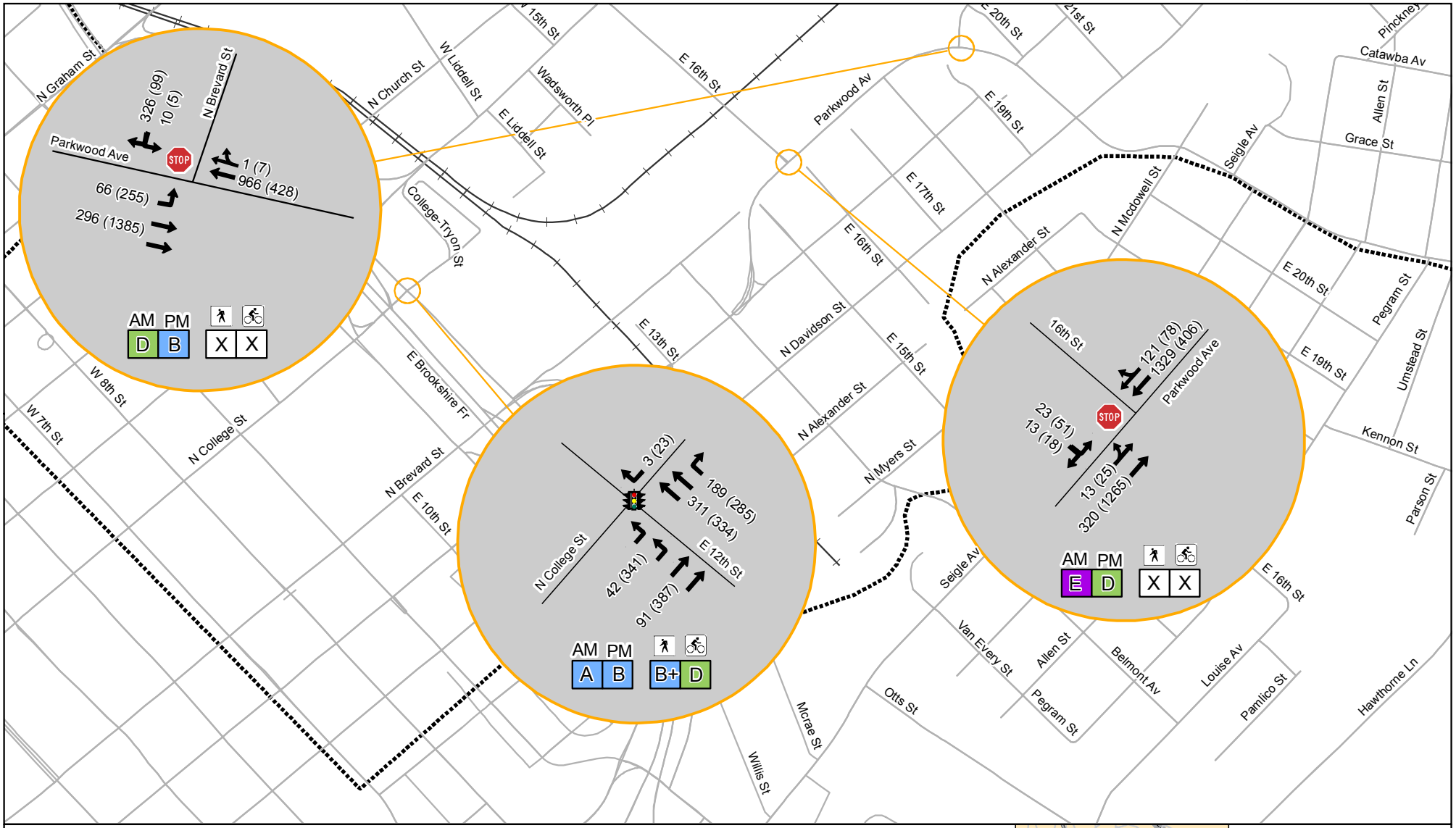
10.27.09

NoBuild_Fig3.12_Revised 10-27-09.pdf

LYNX Blue Line Extension

Figure 4.1

Measures of Effectiveness - 2030 Light Rail Alternative



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

D D — Pedestrian and Bicycle Level of Service

Lane Geometry

- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

10.28.09

Build_Fig4.1_Revised 10-28-09.pdf

LYNX Blue Line Extension

Figure 4.2

Measures of Effectiveness - 2030 Light Rail Alternative

Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

D D — Pedestrian and Bicycle Level of Service

Lane Geometry

- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

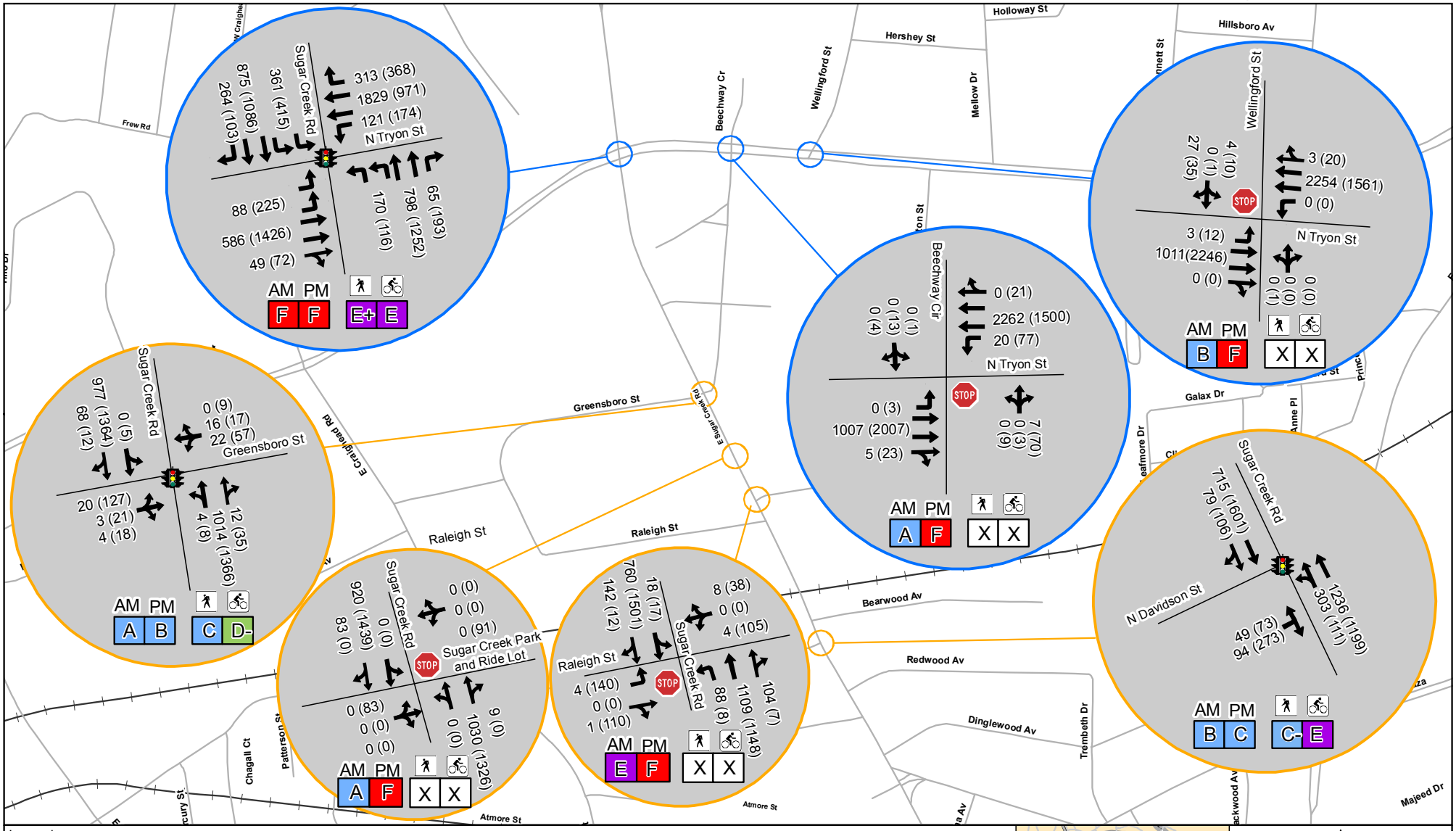
Build_Fig4.2_Revised 10-28-09.pdf

10.28.09

LYNX Blue Line Extension

Figure 4.3

Measures of Effectiveness - 2030 Light Rail Alternative



*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

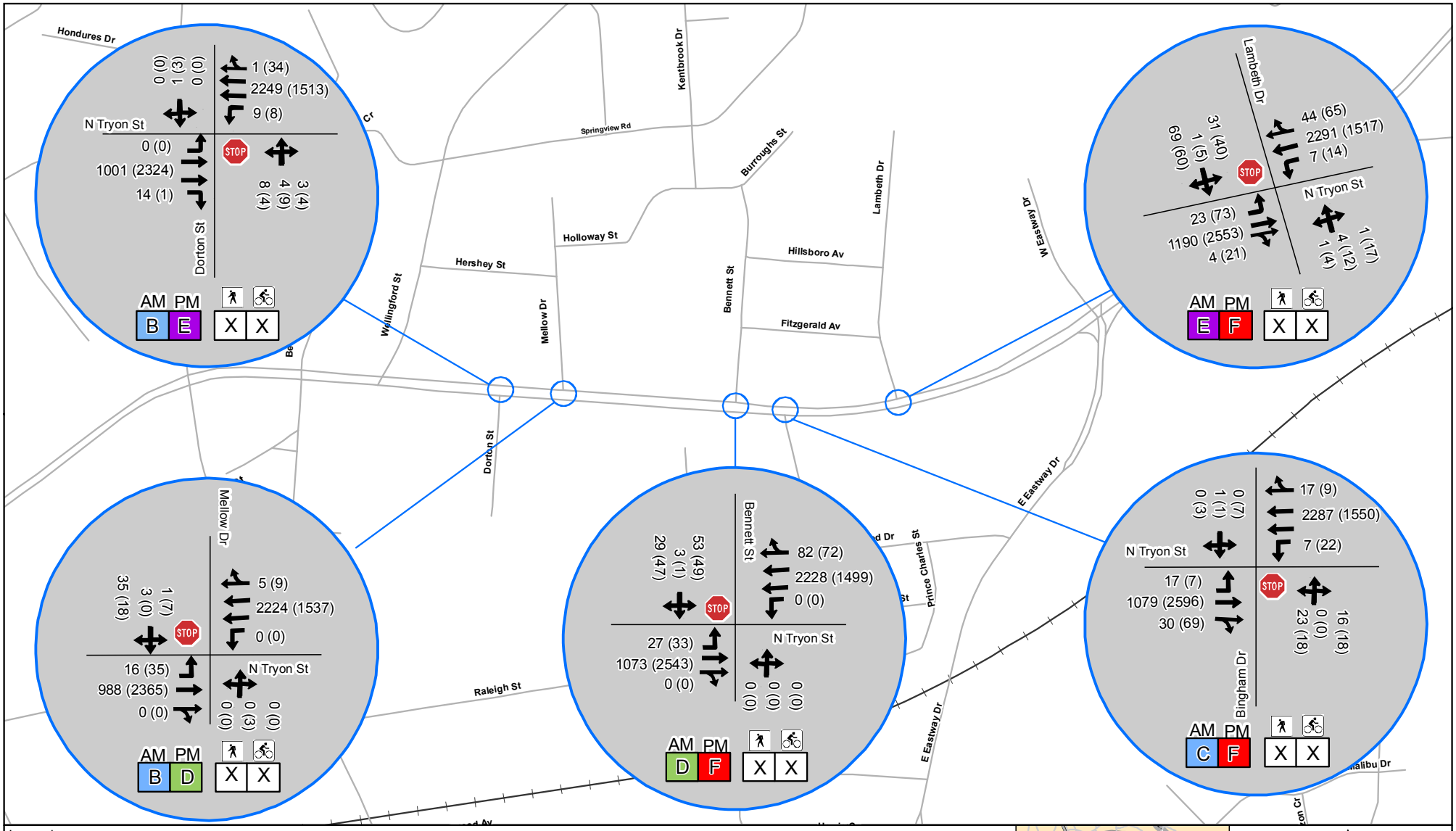
Build_Fig4.3_Revised 10-28-09.pdf

10.28.09

LYNX Blue Line Extension

Figure 4.4

Measures of Effectiveness - 2030 Light Rail Alternative



*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

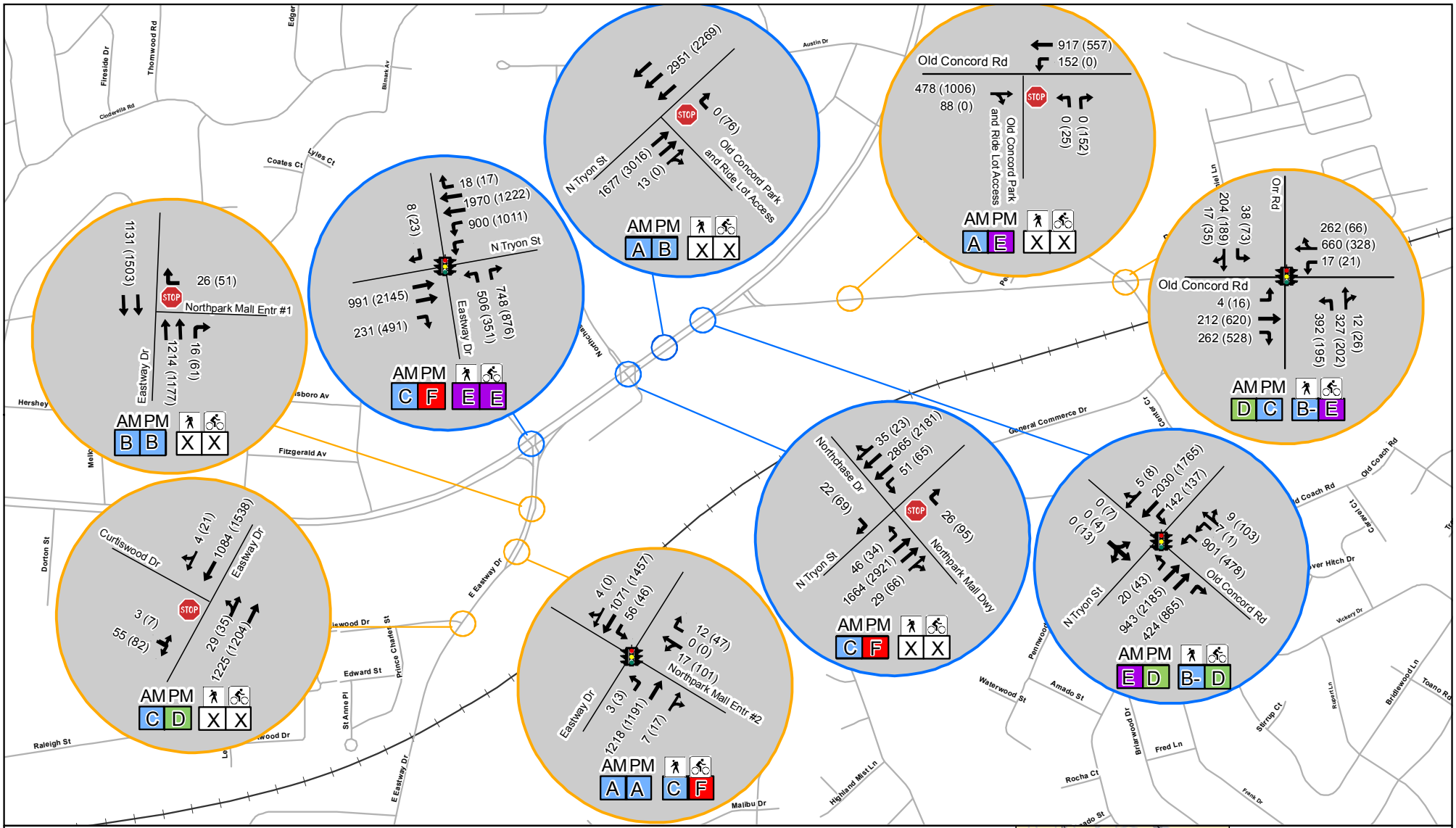
Build_Fig4.4_Revised 10-28-09.pdf

10.28.09

LYNX Blue Line Extension

Figure 4.5

Measures of Effectiveness - 2030 Light Rail Alternative

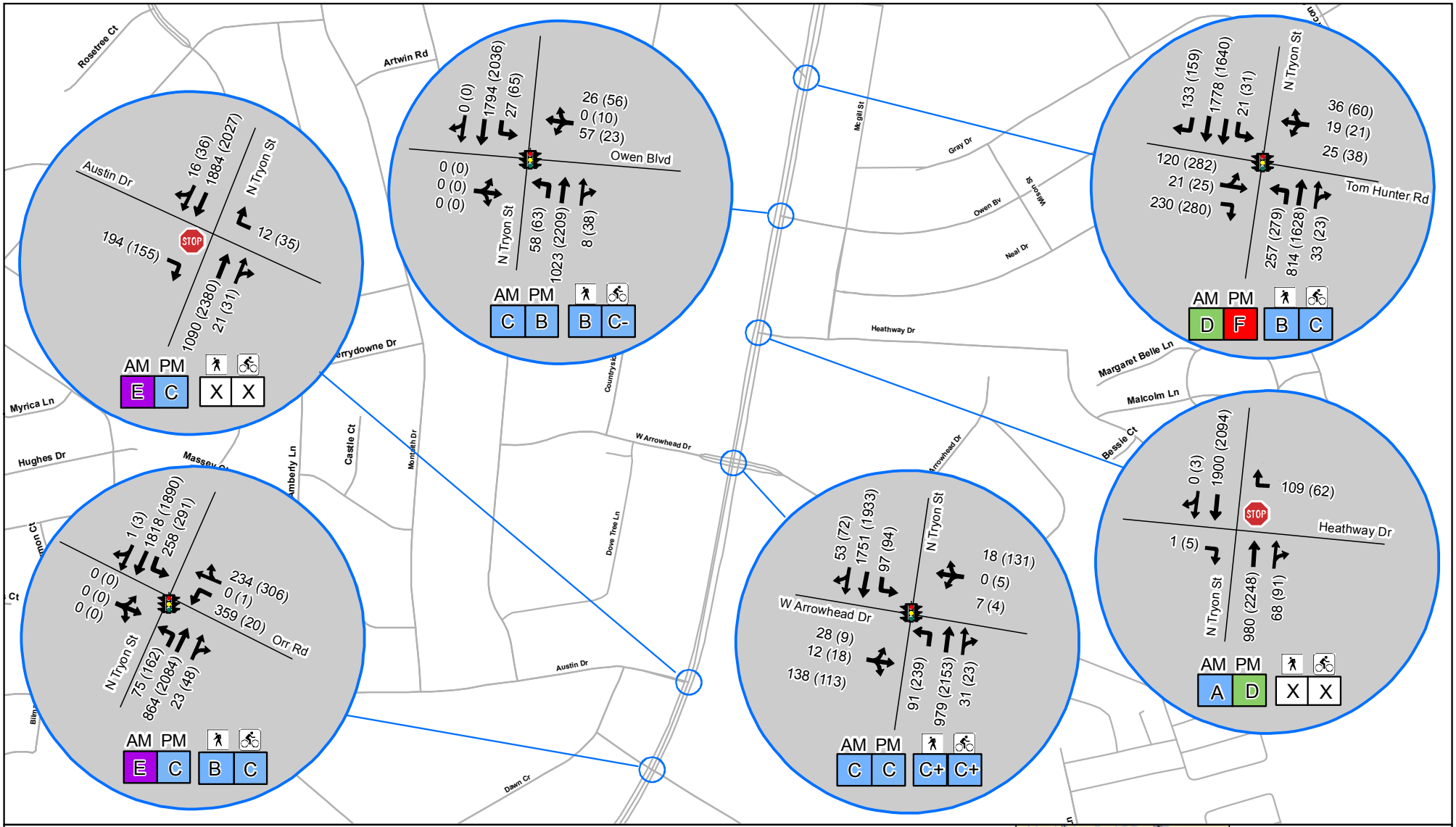


Build_Fig4.5_Revised 10-28-09.pdf

*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

LYNX Blue Line Extension

Figure 4.6
Measures of Effectiveness - 2030 Light Rail Alternative



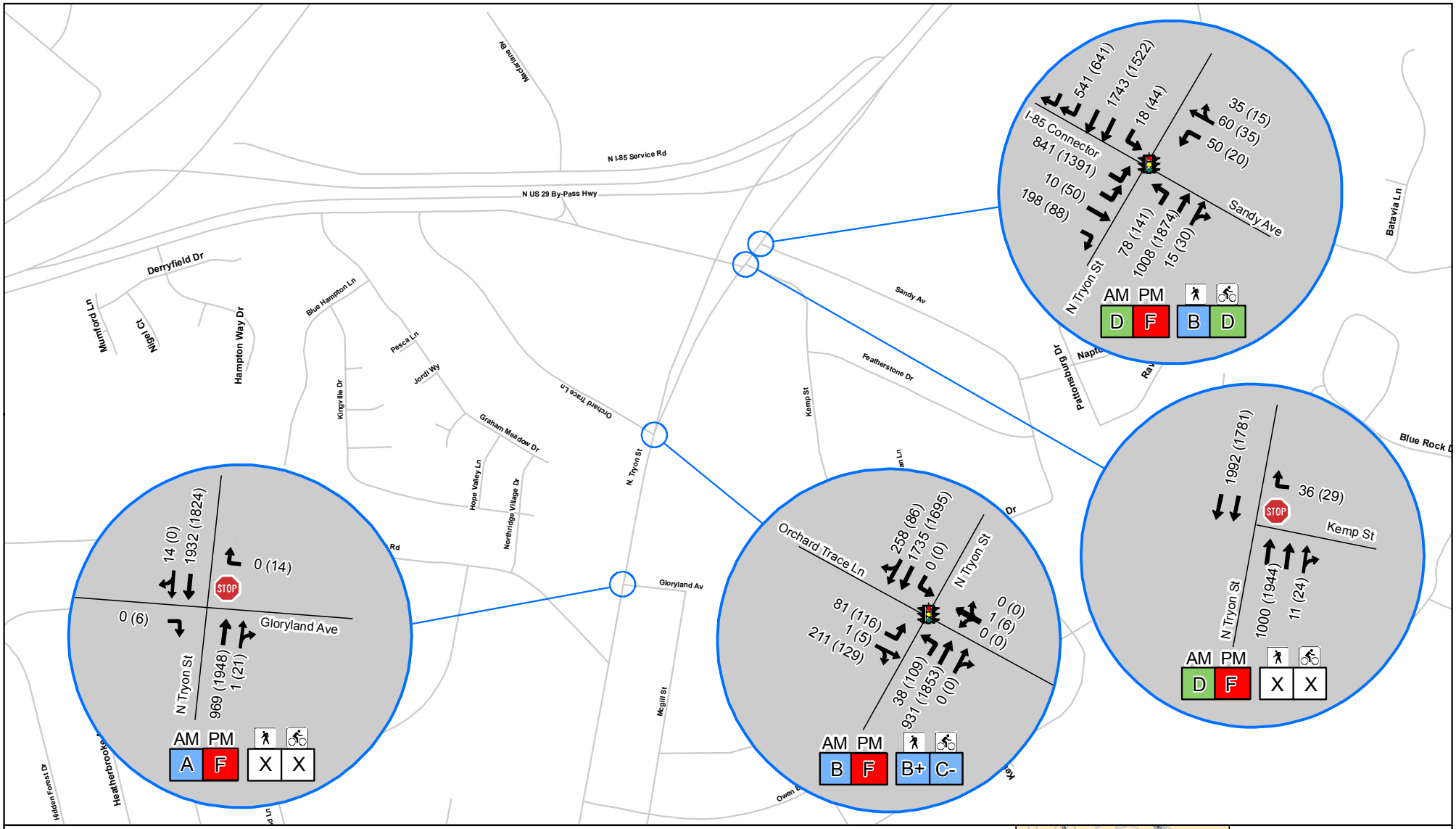
*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

Build_Fig4.6_Revised 10-28-09.pdf

LYNX Blue Line Extension

Figure 4.7

Measures of Effectiveness - 2030 Light Rail Alternative



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

D D — Pedestrian and Bicycle Level of Service

Lane Geometry

- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

10.28.09

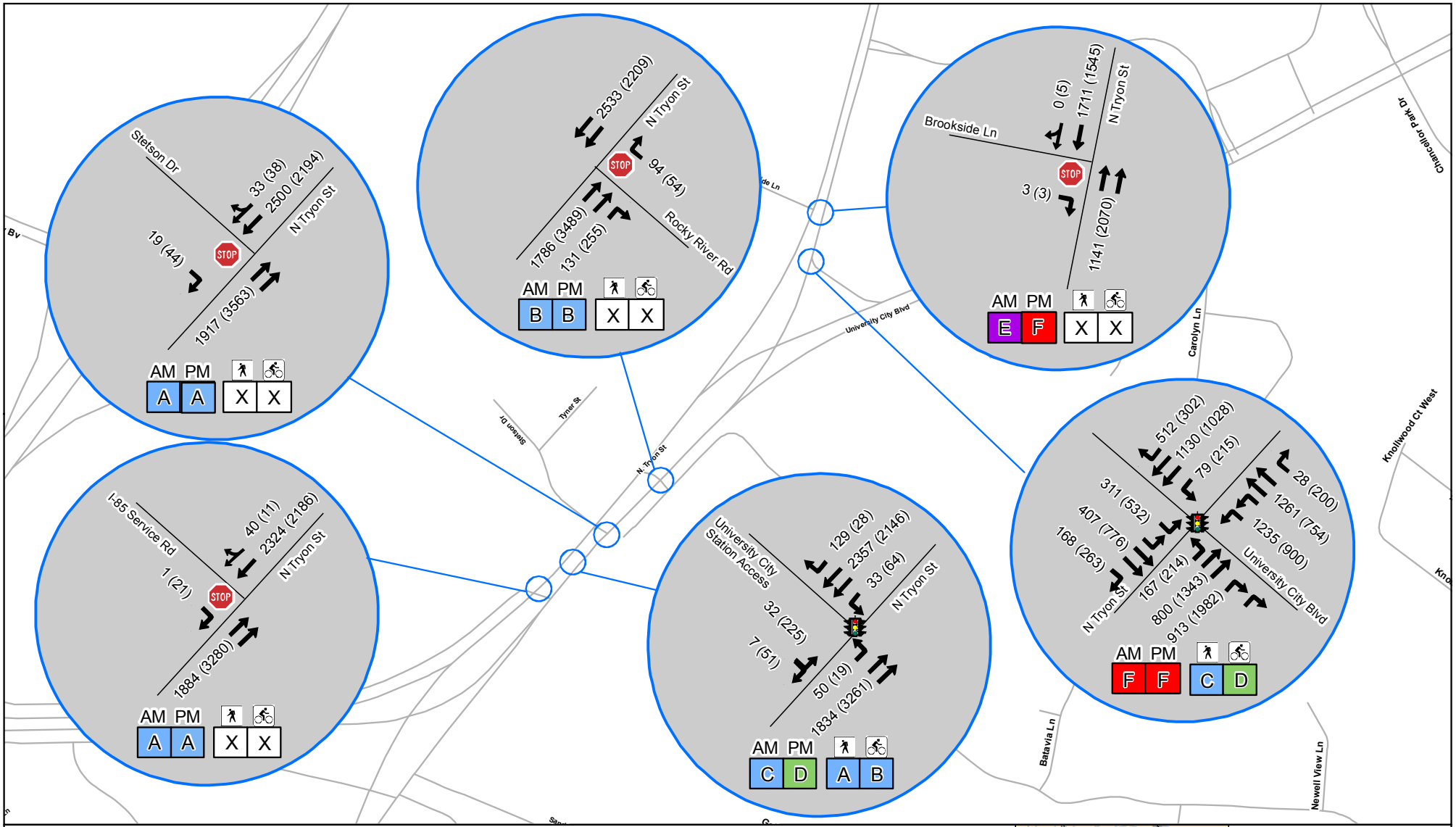
Build_Fig4.7_Revised 10-28-09.pdf

*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

LYNX Blue Line Extension

Figure 4.8

Measures of Effectiveness - 2030 Light Rail Alternative



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

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- Level of Service D
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- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

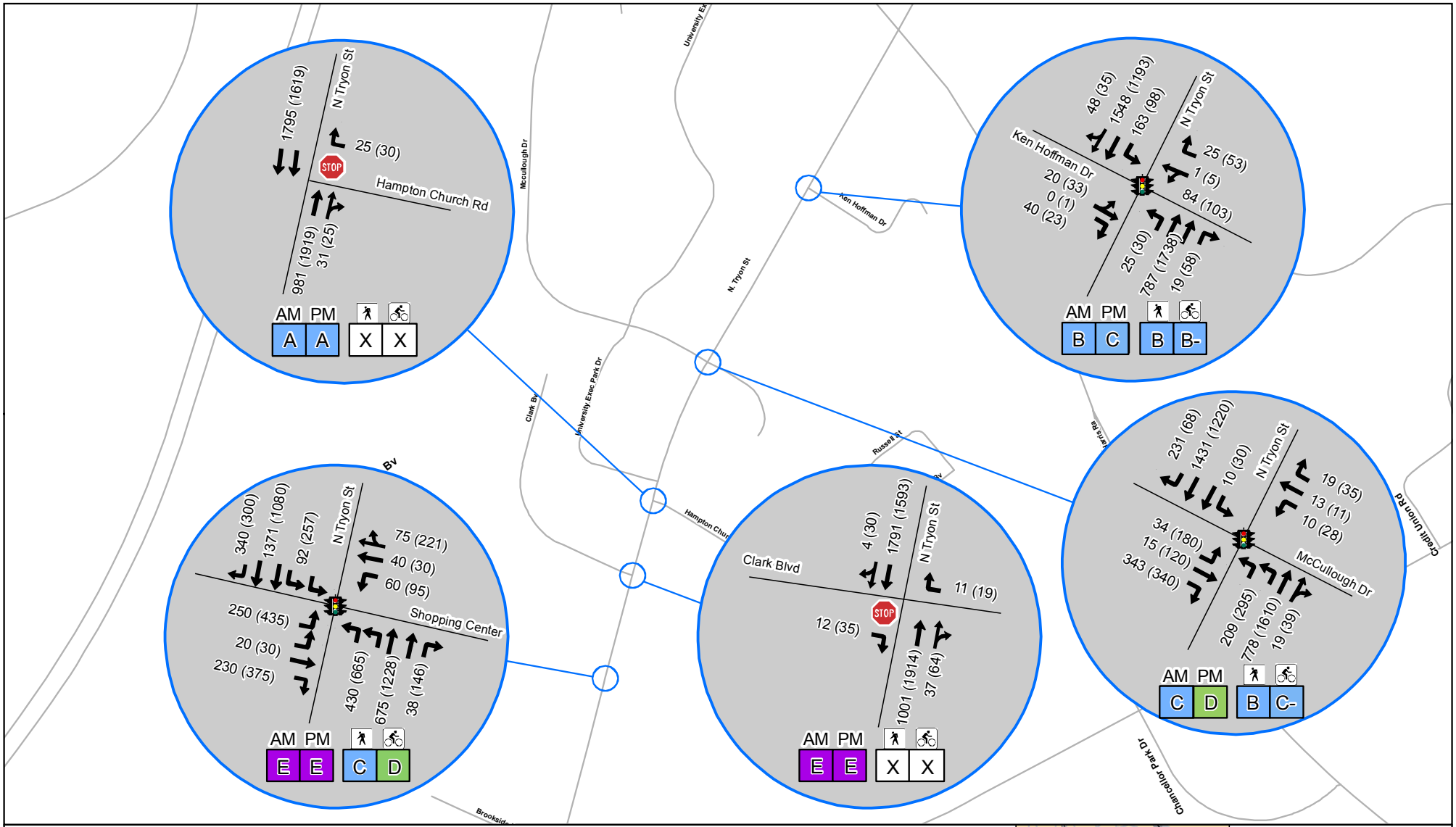
Build_Fig4-8_Revised 10-28-09.pdf

10.28.09

LYNX Blue Line Extension

Figure 4.9

Measures of Effectiveness - 2030 Light Rail Alternative



*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

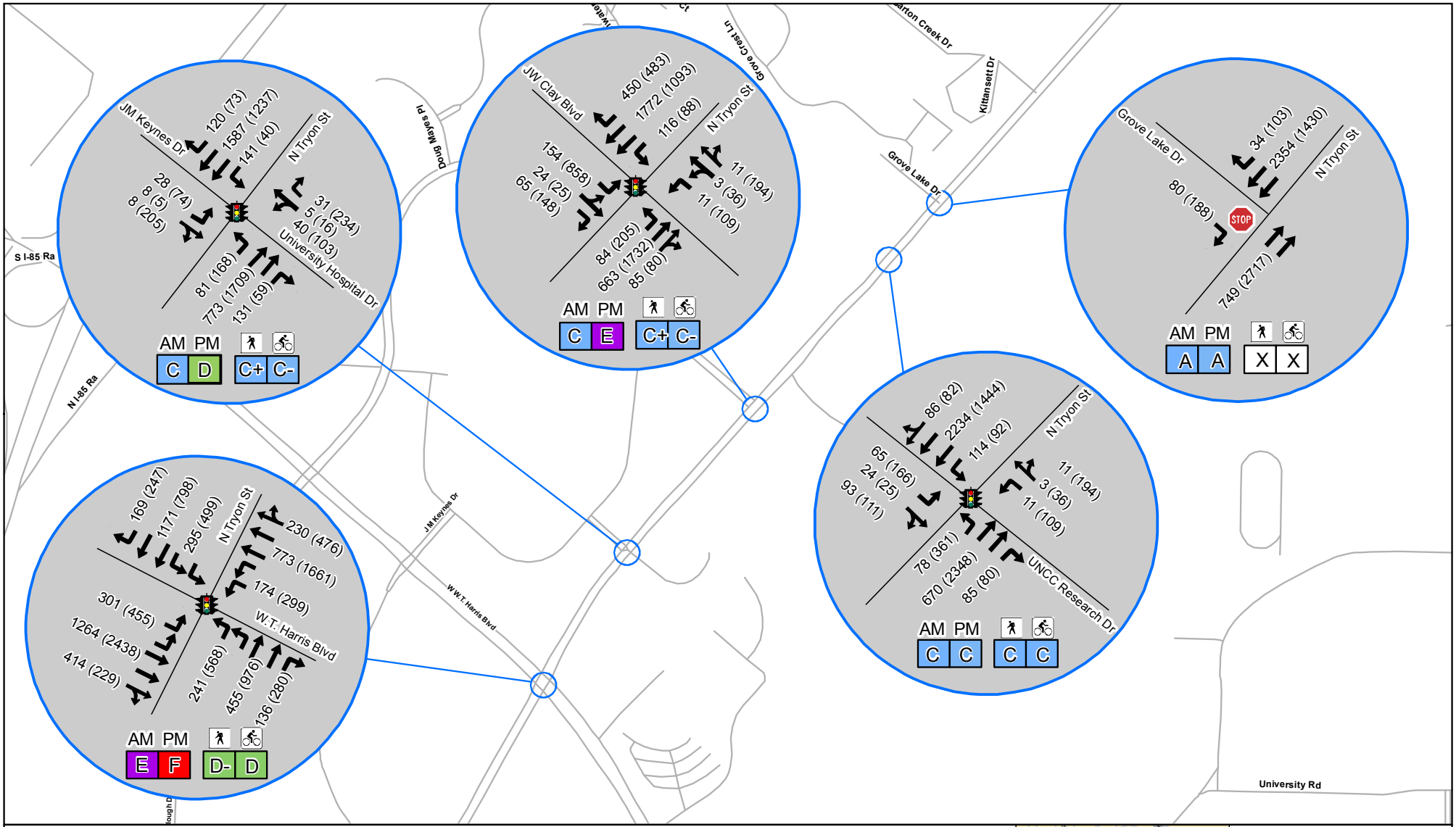
Build_Fig4.9_Revised 10-28-09.pdf

10.28.09

LYNX Blue Line Extension

Figure 4.10

Measures of Effectiveness - 2030 Light Rail Alternative



*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

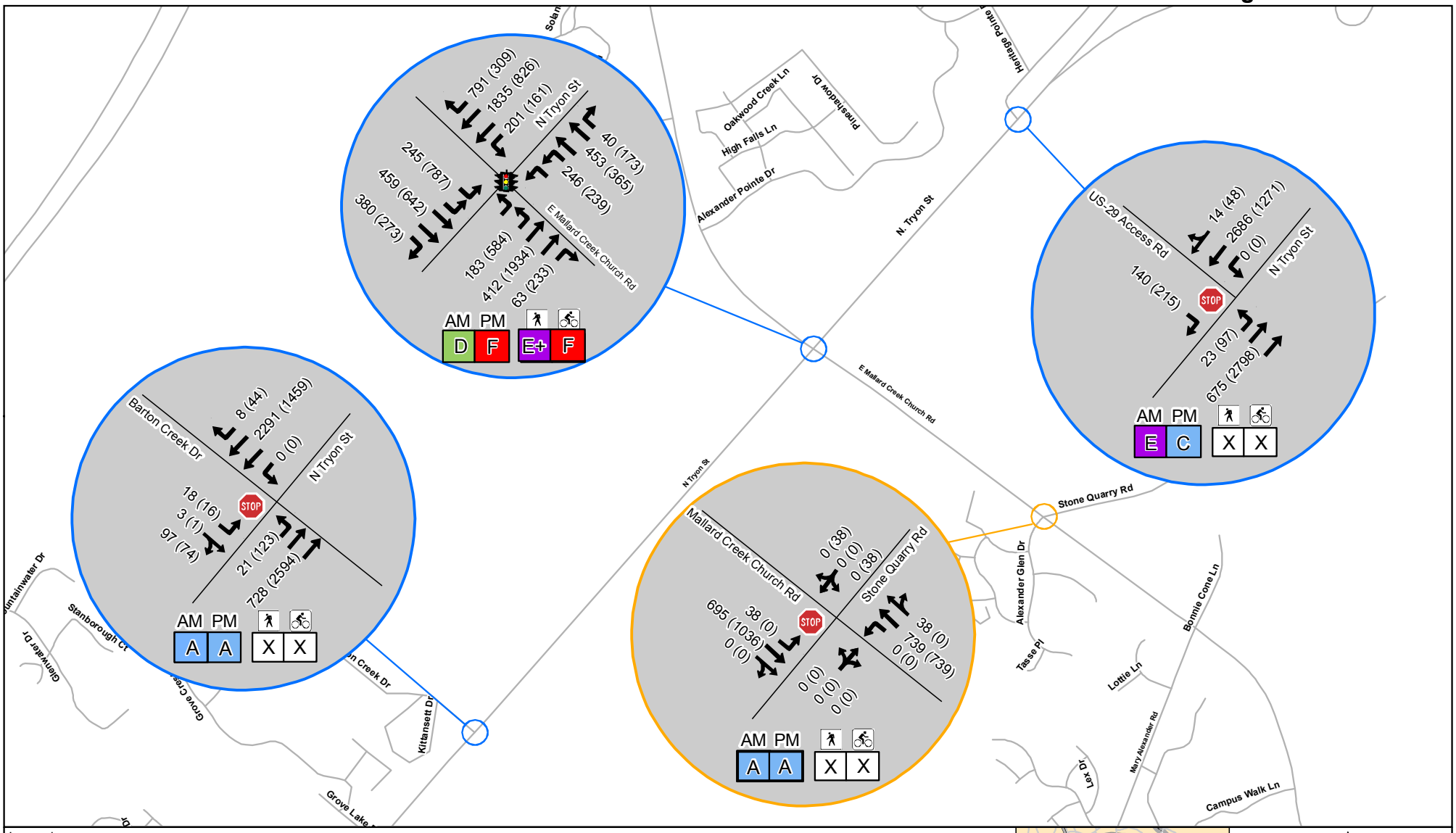
Build_Fig4.10_Revised 10-28-09.pdf

10.28.09

LYNX Blue Line Extension

Figure 4.11

Measures of Effectivness - 2030 Light Rail Alternative



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

D D — Pedestrian and Bicycle Level of Service

Lane Geometry

- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

10.28.09

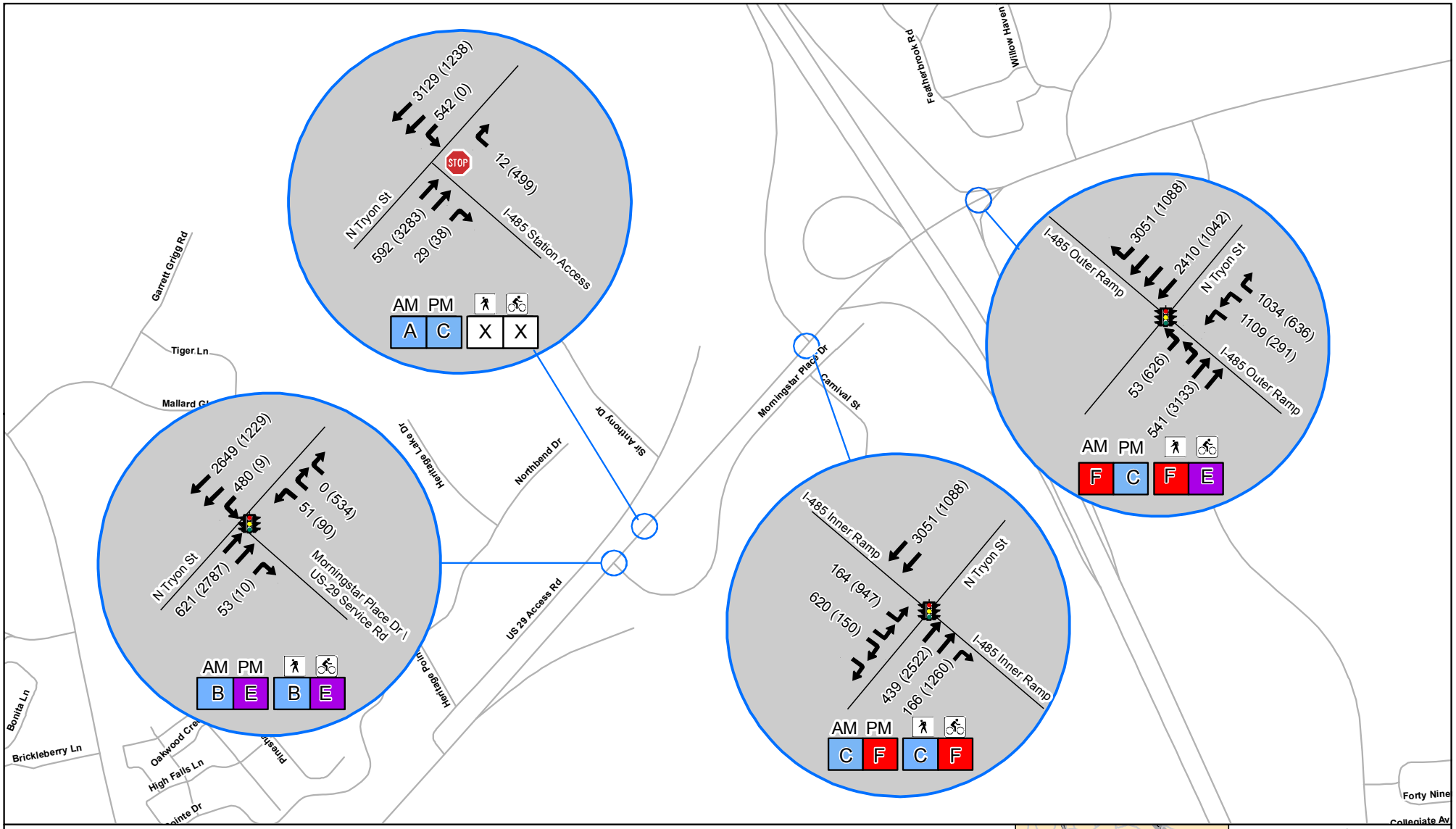
Build_Fig4.11_Revised 10-28-09.pdf

*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

LYNX Blue Line Extension

Figure 4.12

Measures of Effectiveness - 2030 Light Rail Alternative



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

D D — Pedestrian and Bicycle Level of Service

Lane Geometry

- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

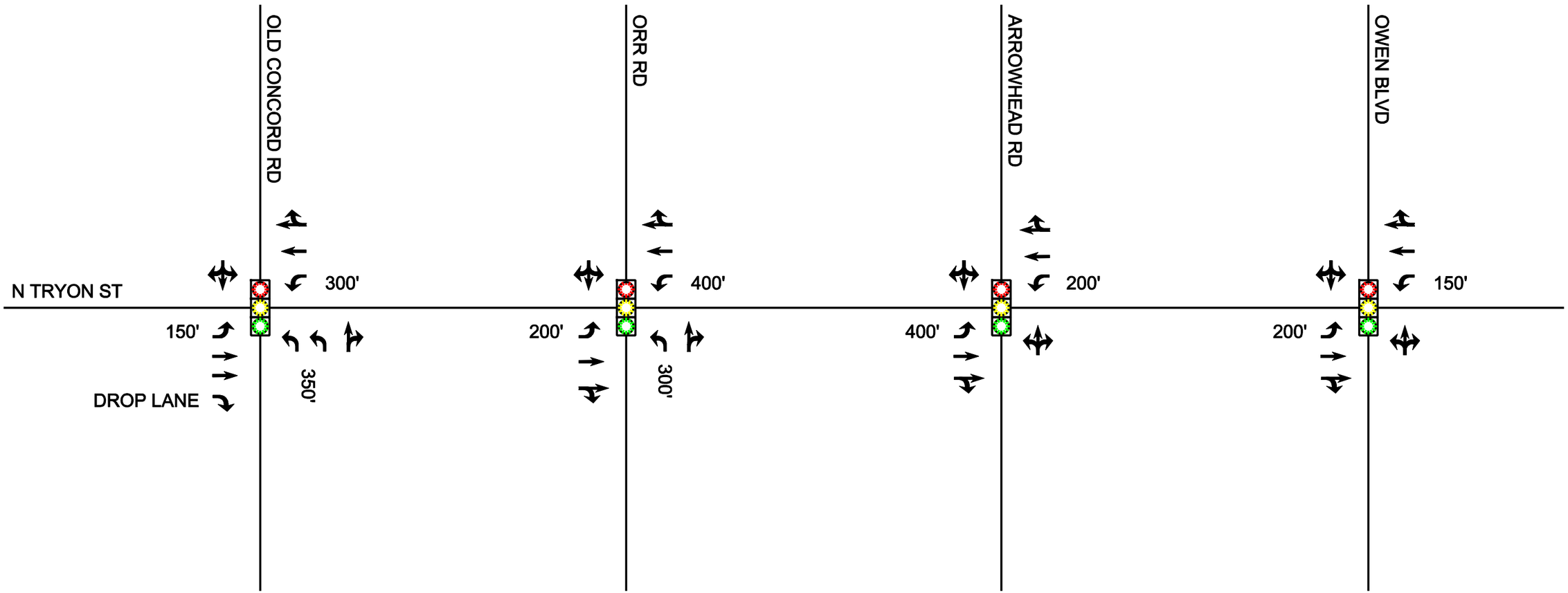
1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

10.28.09

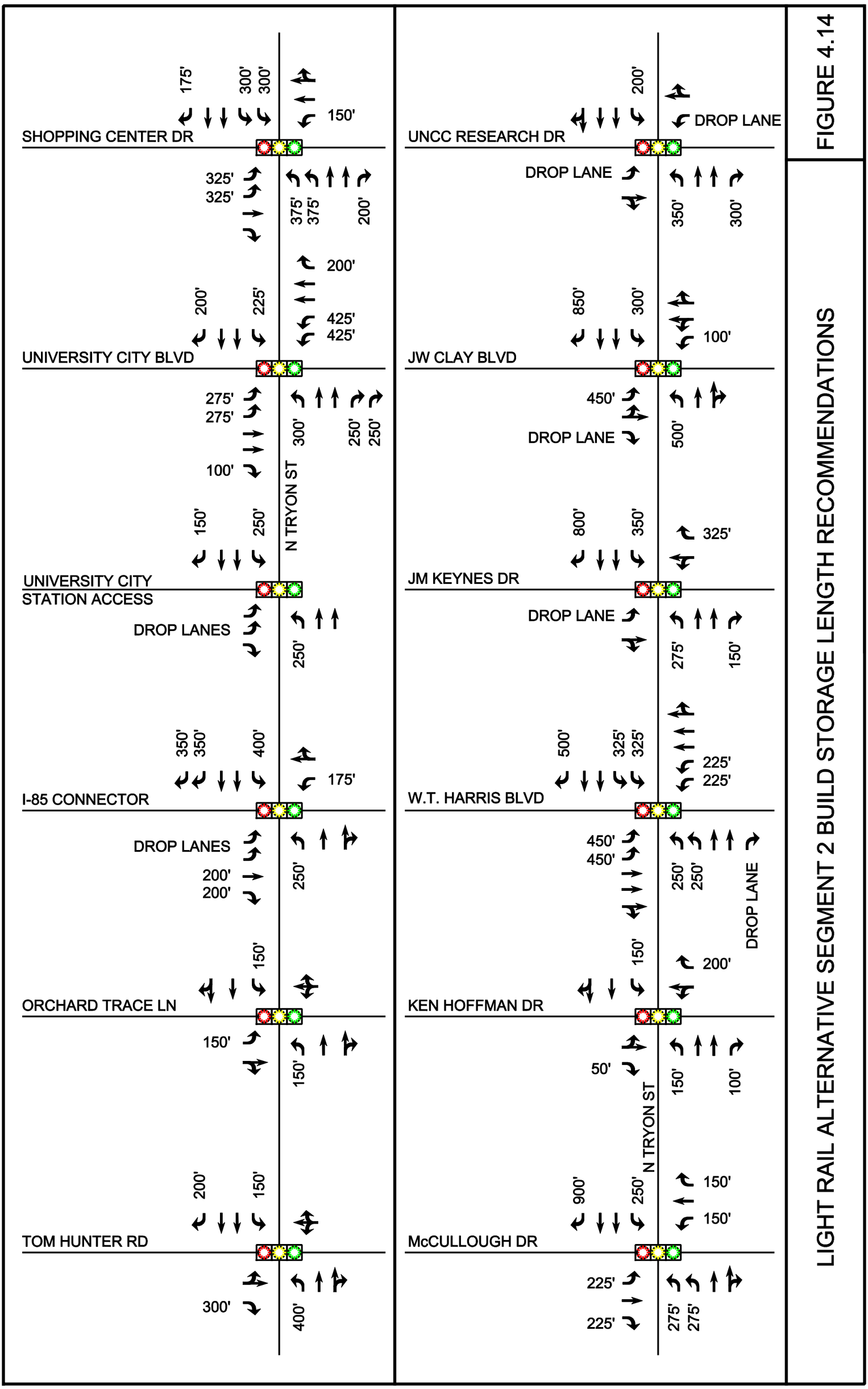
Build Fig4-12_Revised 10-28-09.pdf

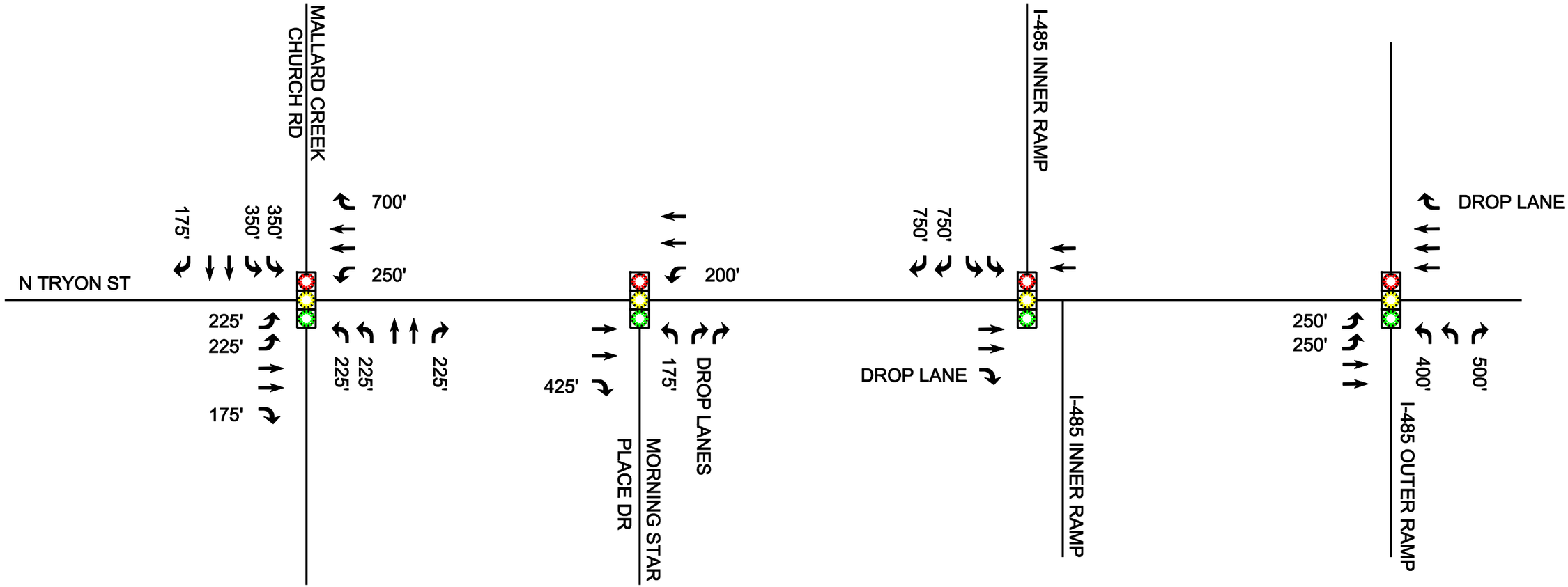
*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option



LIGHT RAIL ALTERNATIVE SEGMENT 1 BUILD STORAGE LENGTH RECOMMENDATIONS

FIGURE 4.13


SHOPPING CENTER DR
UNIVERSITY CITY BLVD
UNIVERSITY CITY STATION ACCESS
I-85 CONNECTOR
ORCHARD TRACE LN
TOM HUNTER RD
N TRYON ST
UNCC RESEARCH DR
JW CLAY BLVD
JM KEYNES DR
W.T. HARRIS BLVD
KEN HOFFMAN DR
McCULLOUGH DR
N TRYON ST
DROP LANE
DROP LANES
FIGURE 4.14
LIGHT RAIL ALTERNATIVE SEGMENT 2 BUILD STORAGE LENGTH RECOMMENDATIONS



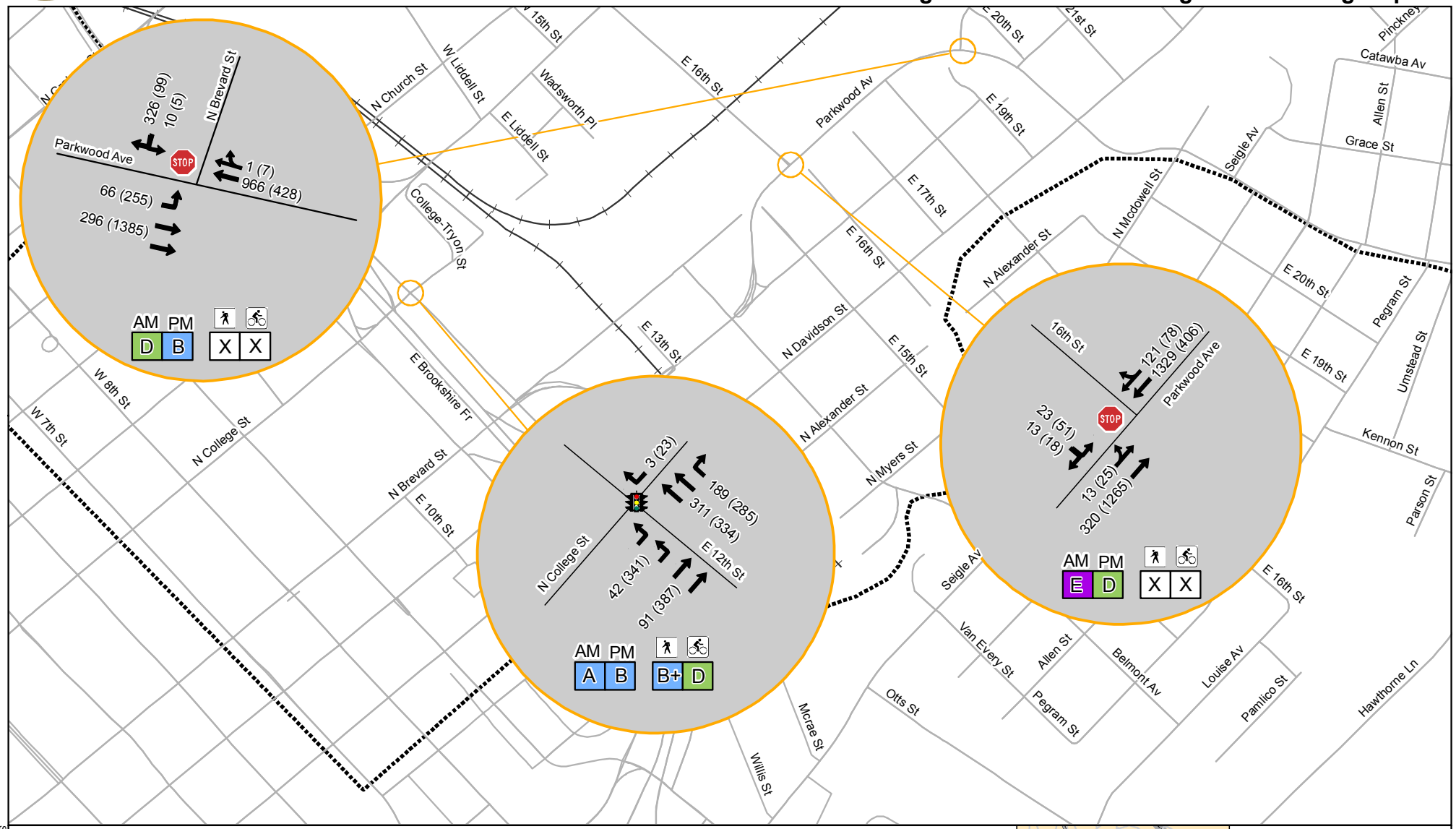
LIGHT RAIL ALTERNATIVE SEGMENT 3 BUILD STORAGE LENGTH RECOMMENDATIONS

FIGURE 4.15

LYNX Blue Line Extension

Figure 5.1

Measures of Effectiveness - 2030 Light Rail Alternative - Sugar Creek Design Option



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes
- AM PM D D — Intersection Level of Service
- D D — Pedestrian and Bicycle Level of Service
- Lane Geometry
- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

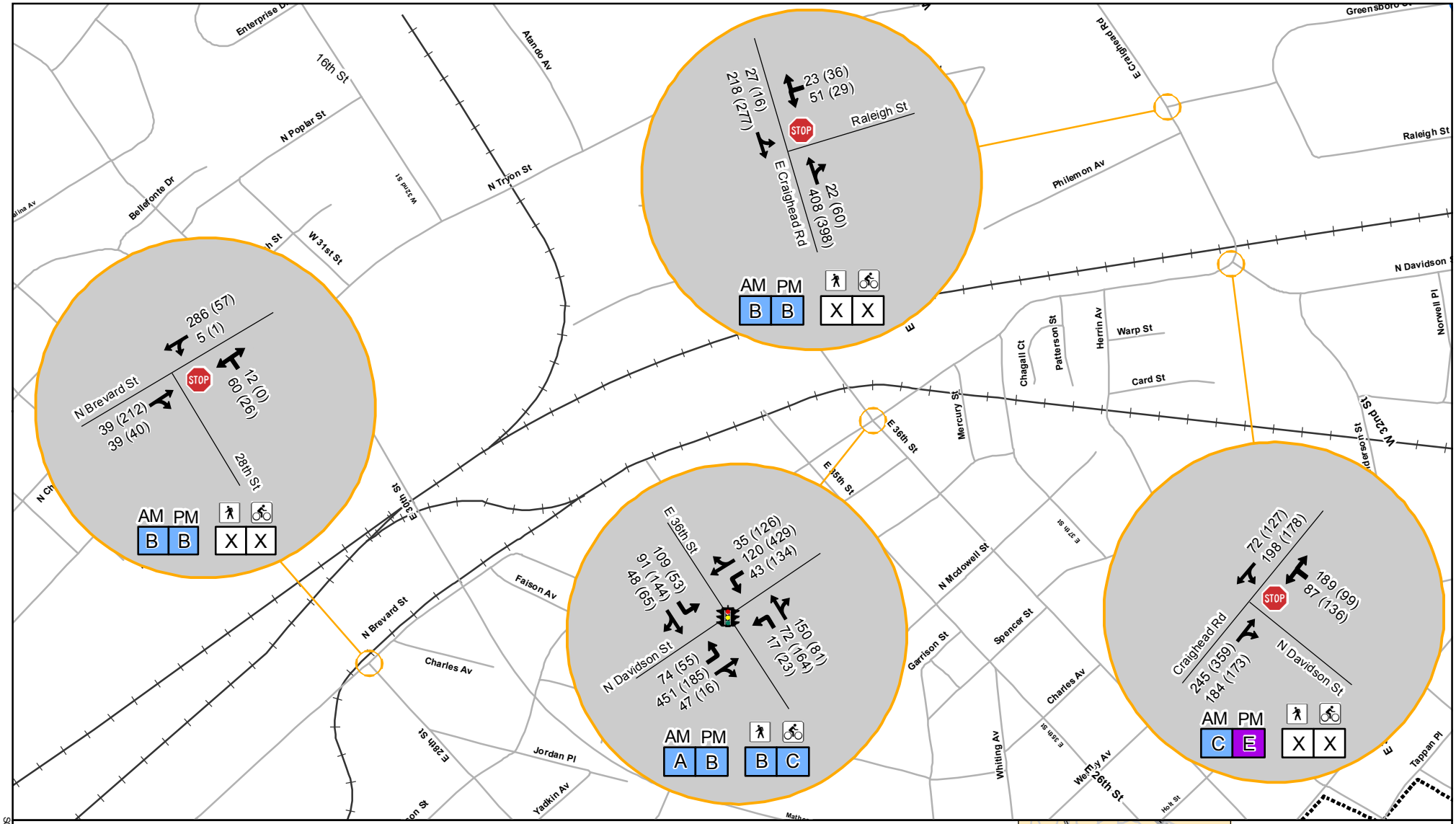
10.28.09

SCDO Build_Fig5.1_Revised 10-28-09.pdf

LYNX Blue Line Extension

Figure 5.2

Measures of Effectiveness - 2030 Light Rail Alternative - Sugar Creek Design Option



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

D D — Pedestrian and Bicycle Level of Service

Lane Geometry

- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

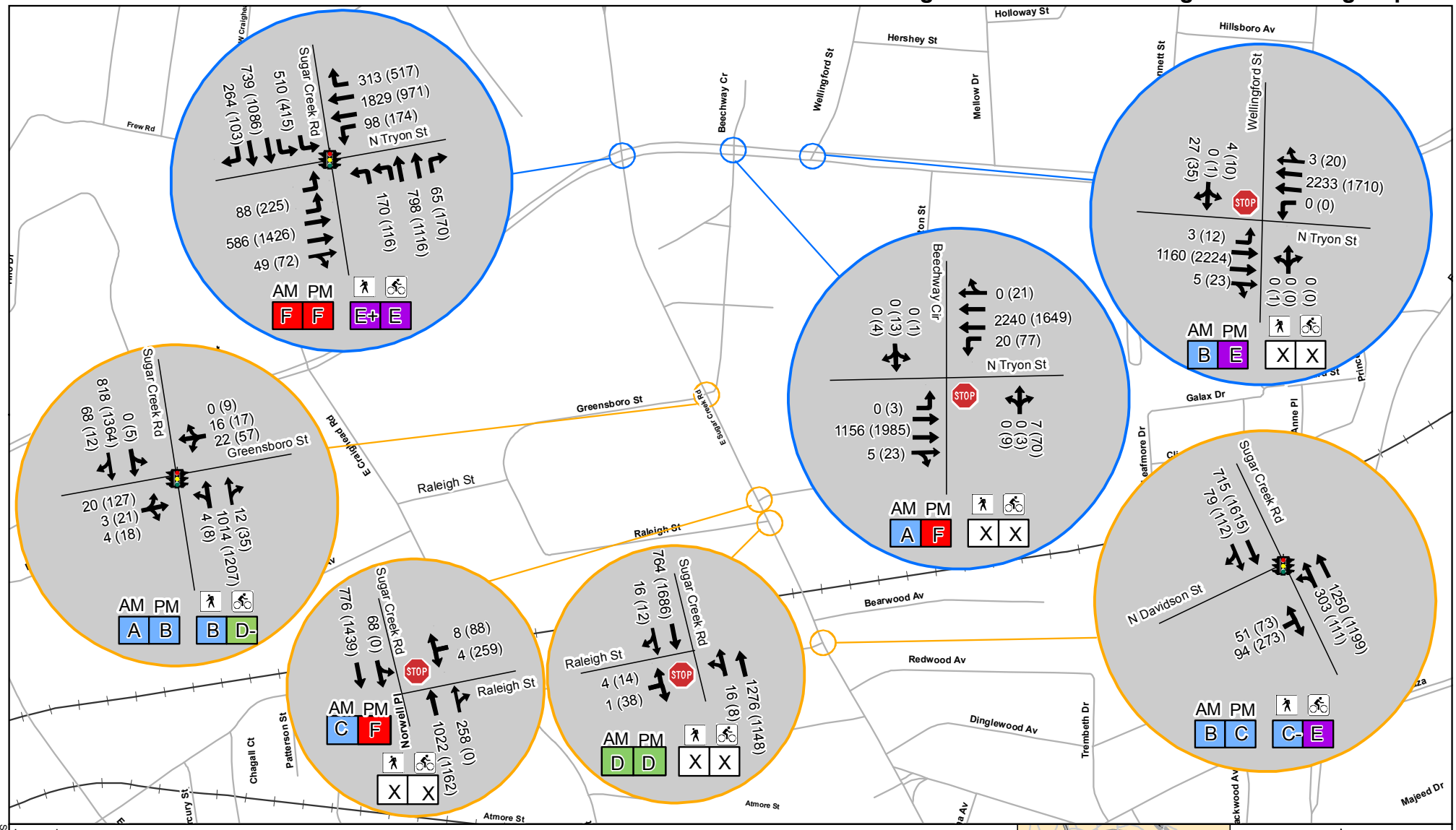
10.28.09

SCDO Build_Fig52_Revised 10-28-09.pdf

LYNX Blue Line Extension

Figure 5.3

Measures of Effectiveness - 2030 Light Rail Alternative - Sugar Creek Design Option



*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

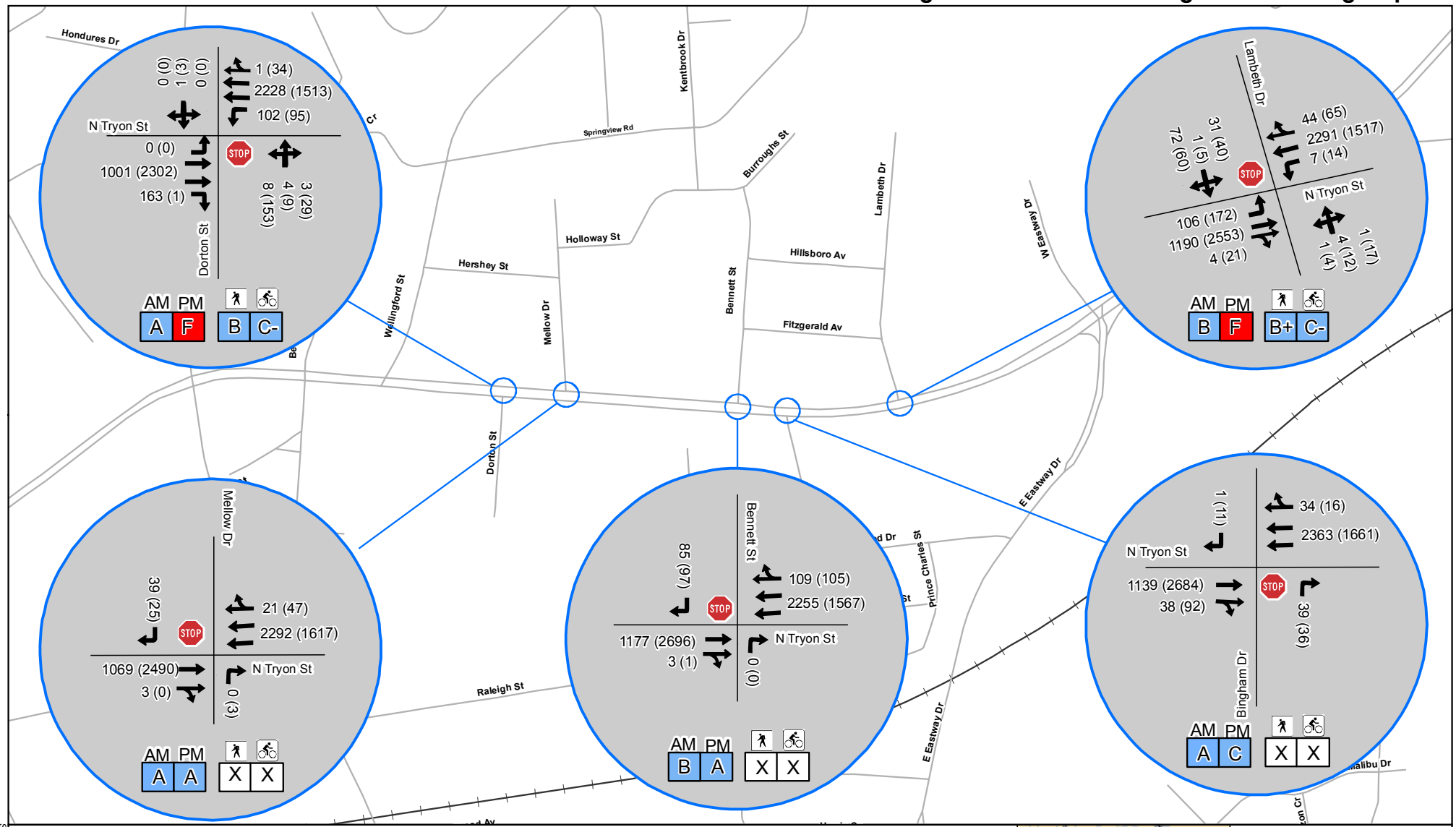
SCDO Build_Fig5.3_Revised 10-28-09.pdf

10.28.09

LYNX Blue Line Extension

Figure 5.4

Measures of Effectiveness - 2030 Light Rail Alternative - Sugar Creek Design Option



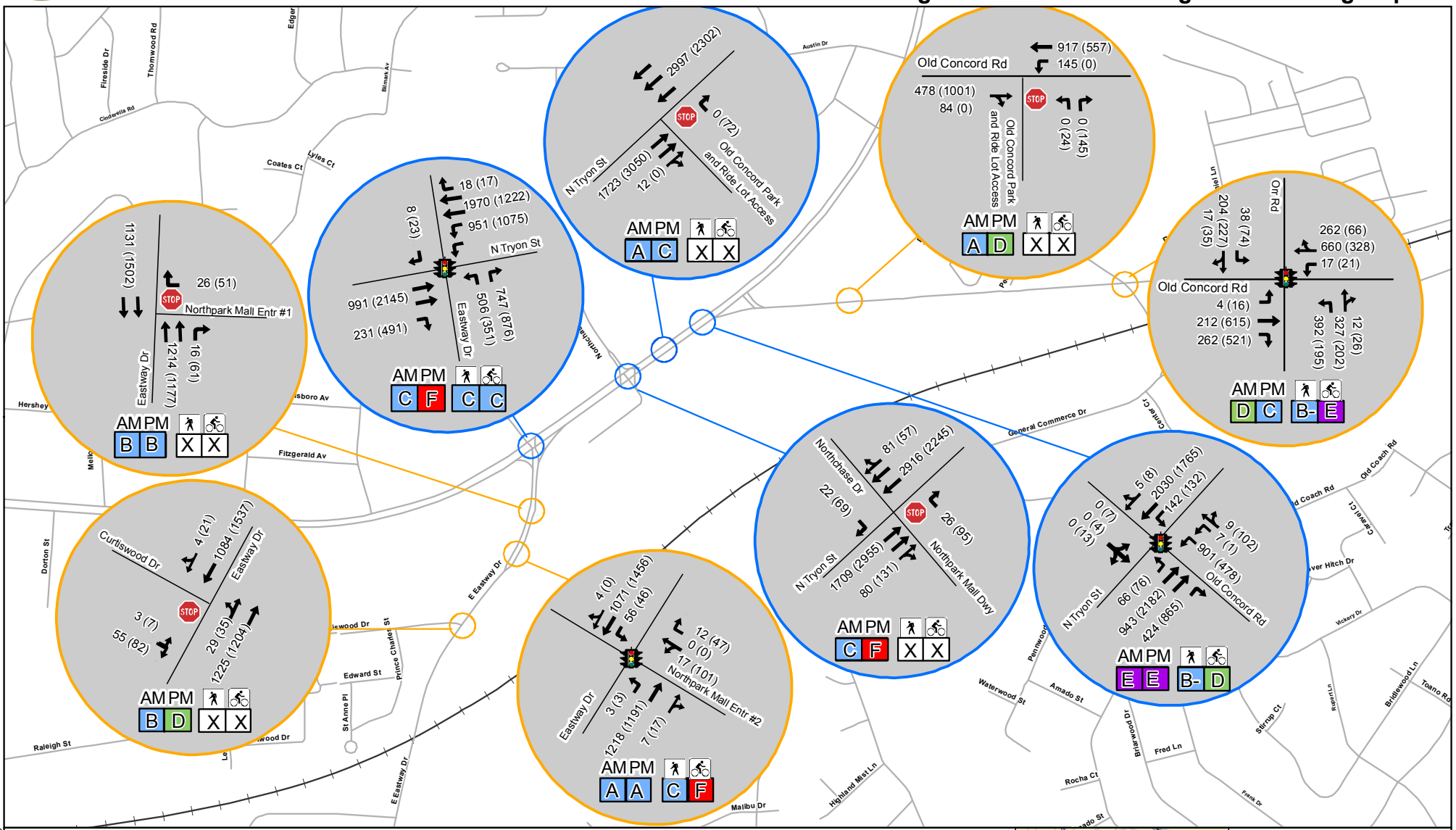
SCDO Build_Fig5.4_Revised 10-28-09.pdf

*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

LYNX Blue Line Extension

Figure 5.5

Measures of Effectiveness - 2030 Light Rail Alternative - Sugar Creek Design Option



SC DO Build_Fig5.5_Revised 10-28-09.pdf

*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

LYNX Blue Line Extension

Figure 5.6

Measures of Effectiveness - 2030 Light Rail Alternative - Sugar Creek Design Option

SCDO Build_Fig5.6_Revised 10-28-09.pdf

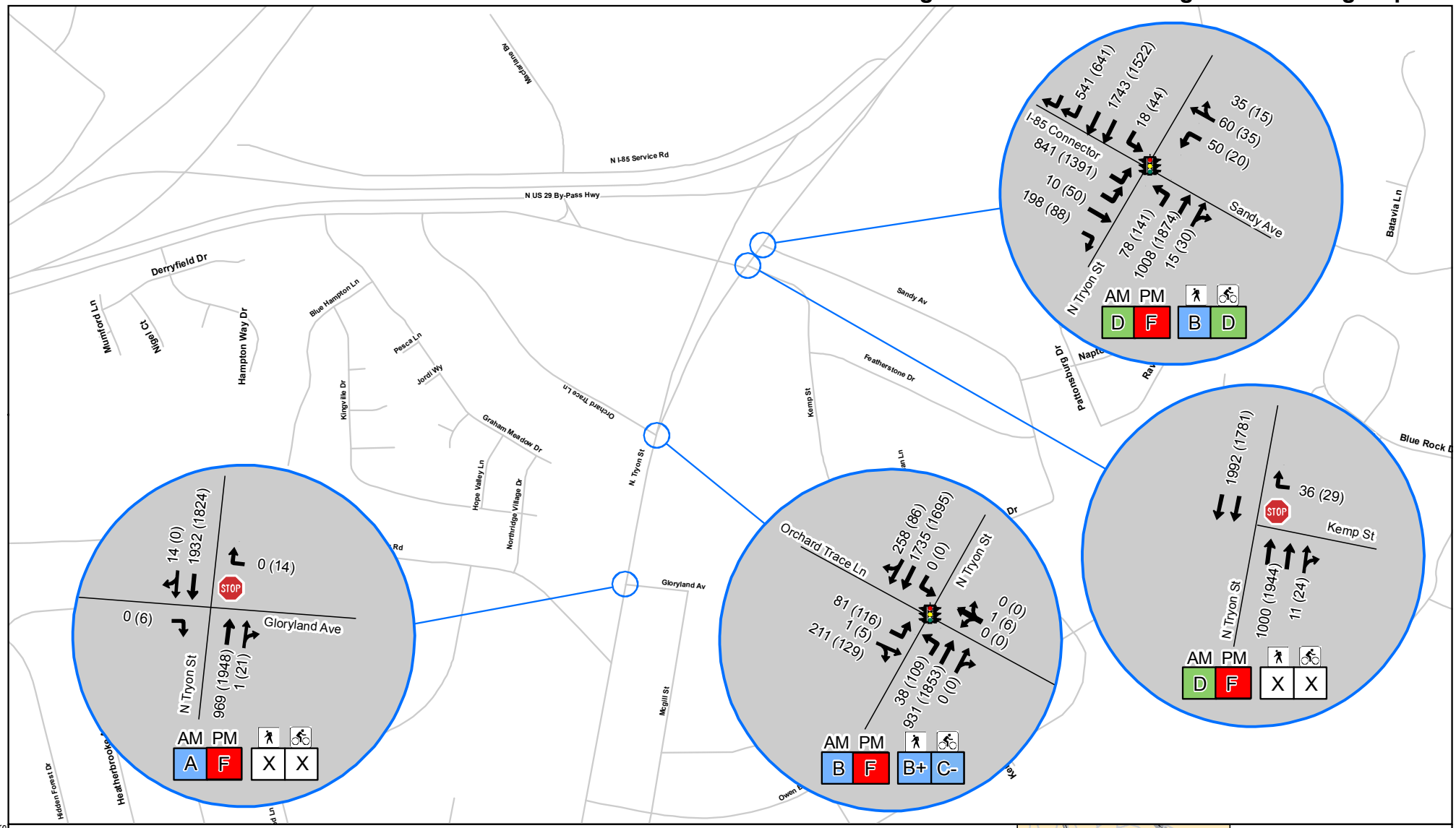
10.28.09

*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

LYNX Blue Line Extension

Figure 5.7

Measures of Effectiveness - 2030 Light Rail Alternative - Sugar Creek Design Option



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

D D — Pedestrian and Bicycle Level of Service

Lane Geometry

- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

10.28.09

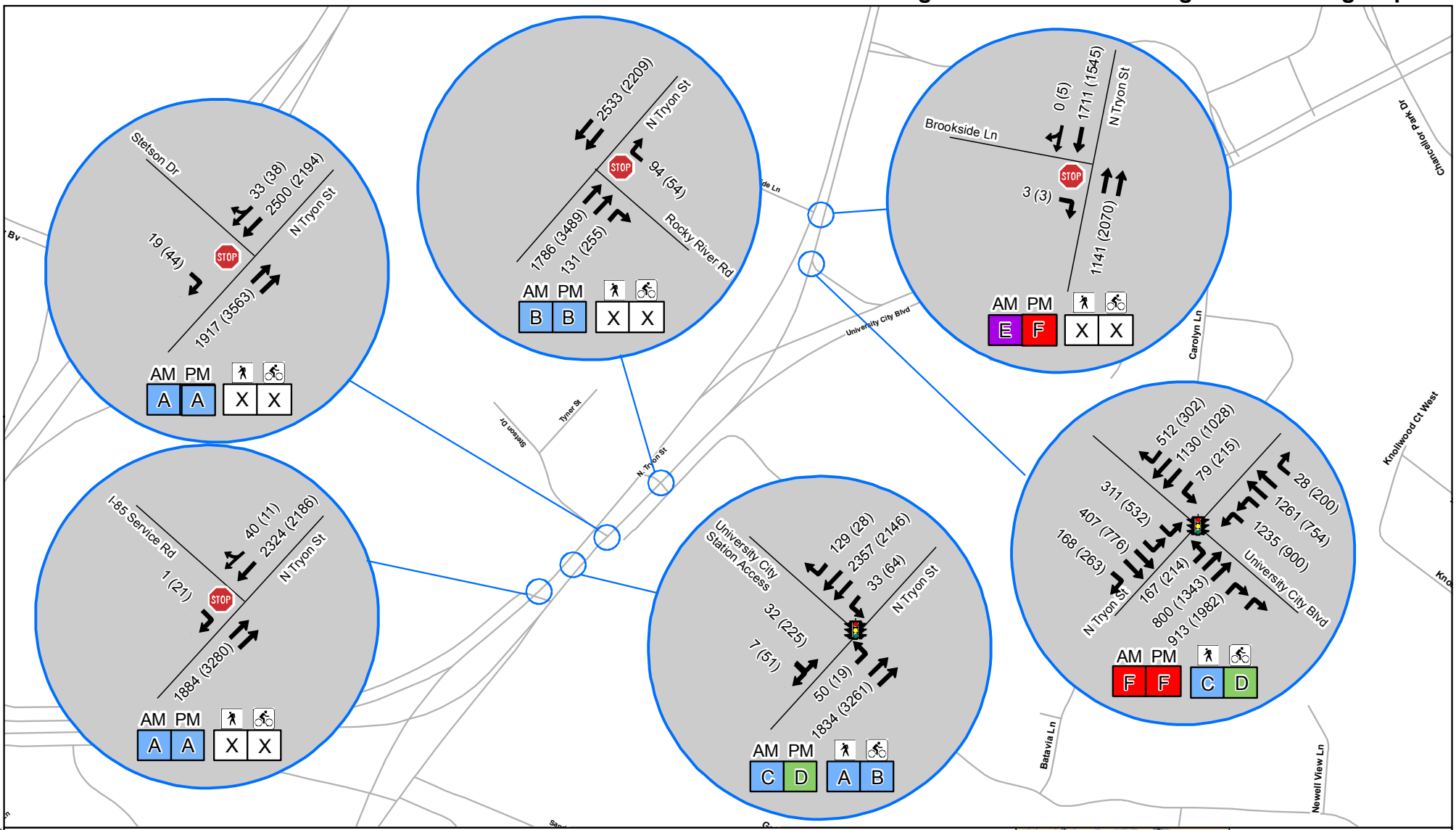
SCDO Build_Fig5.7_Revised 10-28-09.pdf

*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

LYNX Blue Line Extension

Figure 5.8

Measures of Effectiveness - 2030 Light Rail Alternative - Sugar Creek Design Option



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

D D — Pedestrian and Bicycle Level of Service

Lane Geometry

- Level of Service A-C
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- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

10.28.09

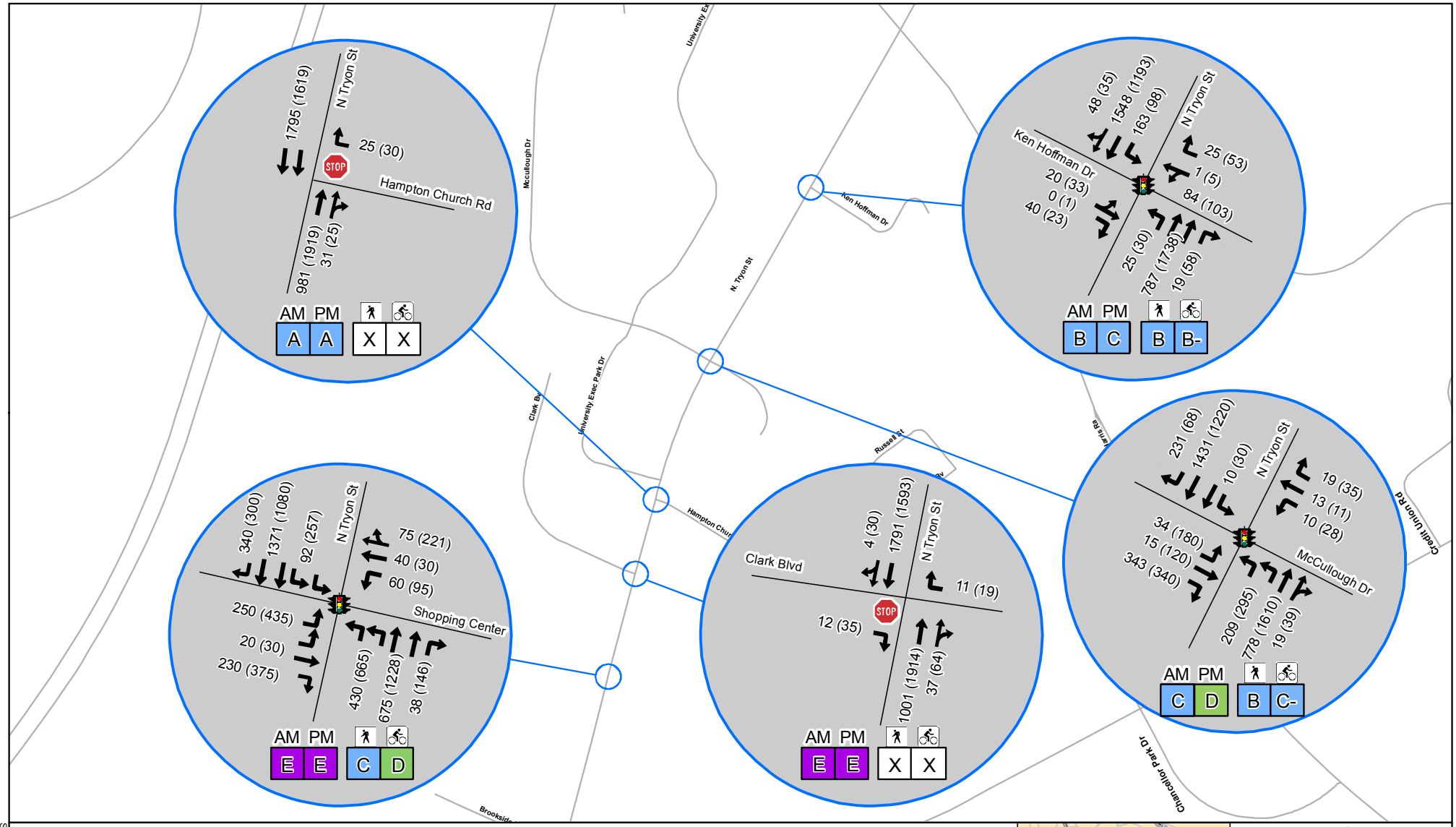
SCDO Build_Fig5-8_Revised 10-28-09.pdf

*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

LYNX Blue Line Extension

Figure 5.9

Measures of Effectiveness - 2030 Light Rail Alternative - Sugar Creek Design Option



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

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- Level of Service A-C
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- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

10.28.09

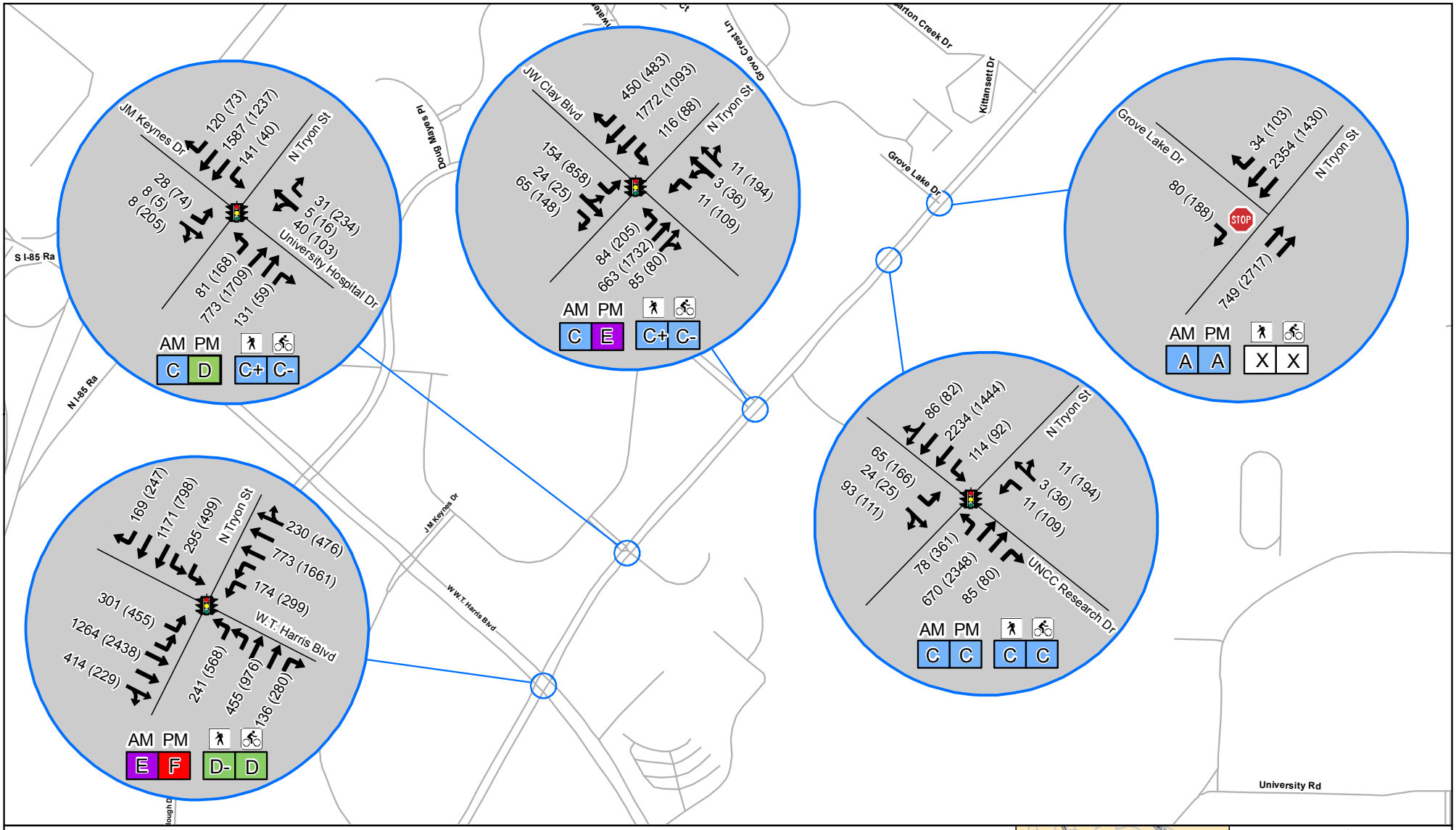
SCDO Build_Fig5.9_Revised 10-28-09.pdf

*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

LYNX Blue Line Extension

Figure 5.10

Measures of Effectiveness - 2030 Light Rail Alternative - Sugar Creek Design Option



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

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- Intersection Analysis Results from VISSIM

Map Vicinity

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Feet

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*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

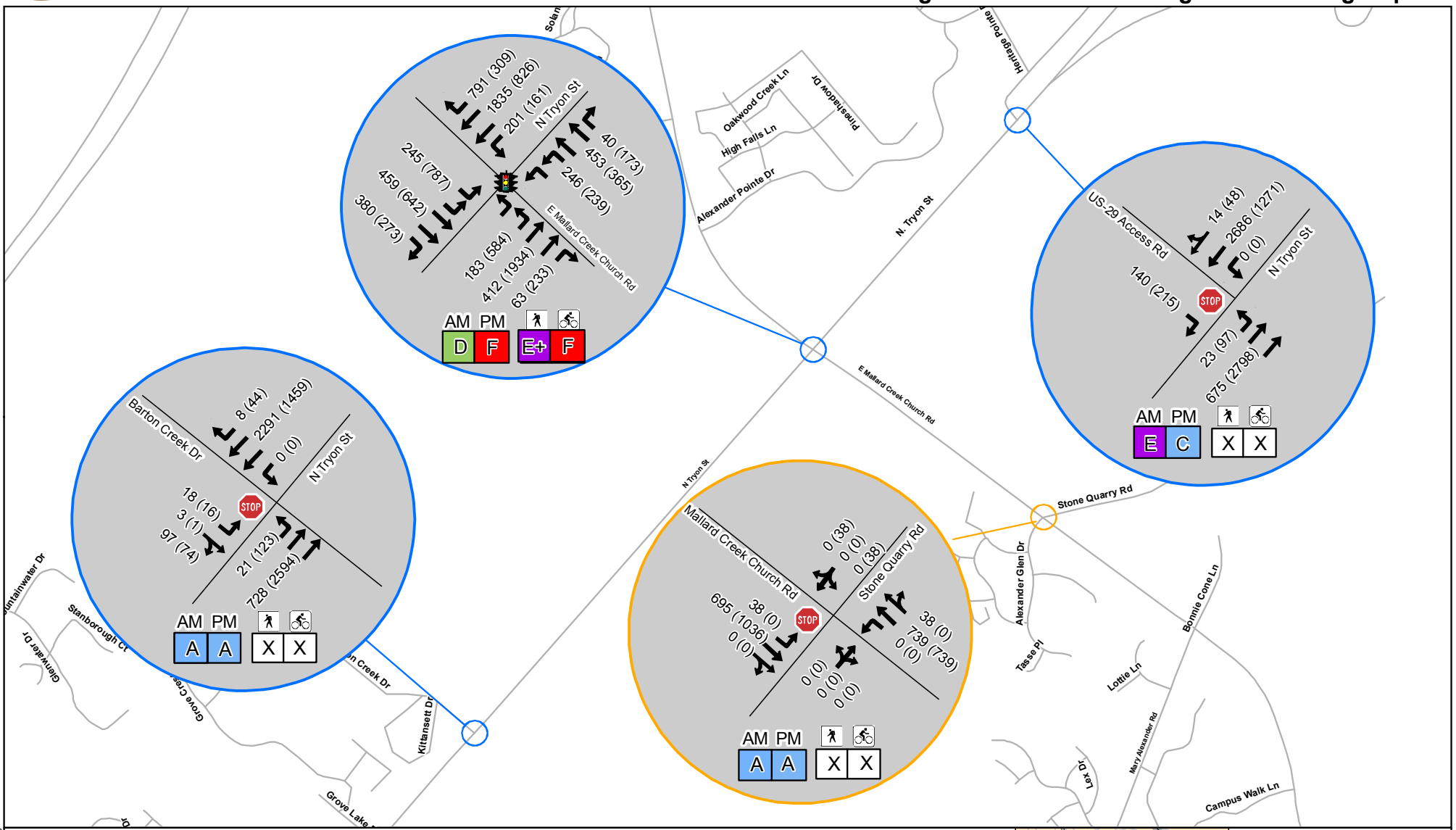
SCDO Build_Fig5.10_Revised 10-28-09.pdf

10.28.09

LYNX Blue Line Extension

Figure 5.11

Measures of Effectivness - 2030 Light Rail Alternative - Sugar Creek Design Option



Legend

- Roads
- Interstate
- Railroads
- Northeast Corridor Boundary
- XX(XX) AM(PM) Peak Hour Volumes

AM PM D D — Intersection Level of Service

D D — Pedestrian and Bicycle Level of Service

Lane Geometry

- Level of Service A-C
- Level of Service D
- Intersection Analysis Results from Synchro
- Level of Service E
- Level of Service F
- Intersection Analysis Results from VISSIM

Map Vicinity

400 200 0 400

Feet

1 inch = 800 feet

Data Source: Charlotte Area Transit System, STV/RWA, Mecklenburg County GIS

10.28.09

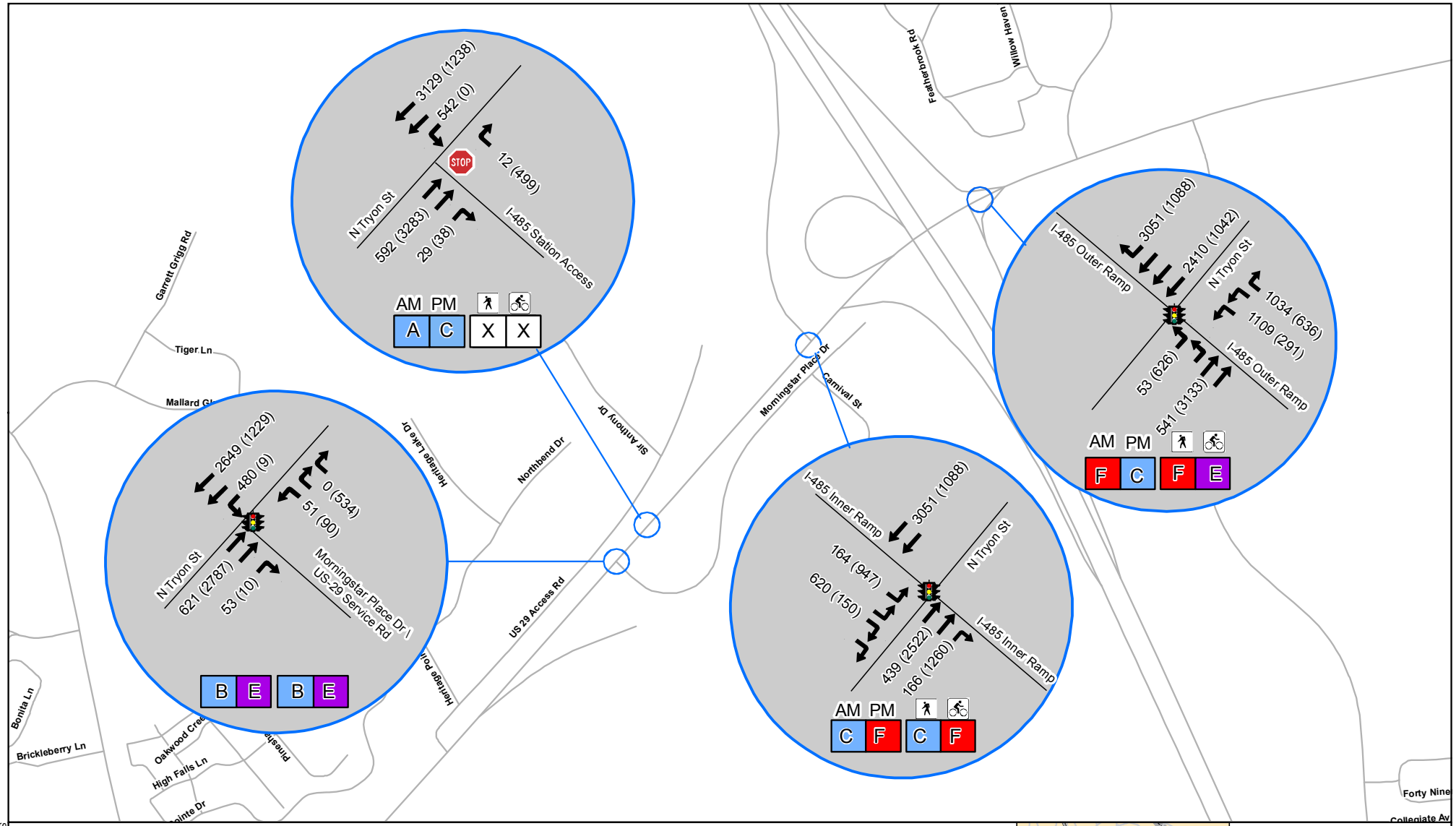
SCDO Build_Fig5.11_Revised 10-28-09.pdf

*NOTE: VISSIM results incorporate three-car trains with 10 minute headways wirh a grade separation rail option

LYNX Blue Line Extension

Figure 5.12

Measures of Effectiveness - 2030 Light Rail Alternative - Sugar Creek Design Option



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