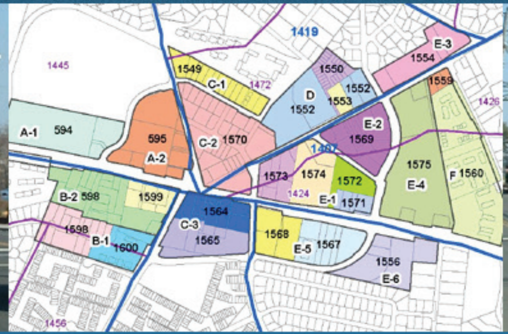
Annandale Transportation Study
FINAL REPORT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EXECUTIVE SUMMARY

Fairfax County's Comprehensive Plan for the Annandale Community Business Center (CBC) outlines several objectives related to future development. The Comprehensive Plan recommends several significant transportation improvements that are envisioned to have a positive impact on the revitalization efforts in the Annandale CBC. This Annandale Transportation Study was conducted to analyze transportation system network alternatives, and to develop associated recommendations for a transportation system plan that handles local and through traffic in an efficient manner, while facilitating the community redevelopment and revitalization needs.

Since the 1970's, Fairfax County's Comprehensive Plan for the Annandale CBC had included a future plan for a grade-separation of Ravensworth / Annandale and Backlick Roads over Little River Turnpike, and a widening of Little River Turnpike from four to six lanes through the Annandale CBC. Understanding the potential traffic and land use impacts of these improvements, the recent *Annandale Community Business Center Circulation Study* recommended that a one-way paired street system be added as an option to the Comprehensive Plan as a feasible alternative to the grade-separation, and that the possible need for a flyover at Annandale and Ravensworth Roads be studied. In 2006, the County updated the Transportation element of the Comprehensive Plan to allow for some additional potential roadway improvements pending additional analysis and study. Several subsequent studies have reinforced the need for a detailed study of a number of transportation network alternatives. This is the objective of the Annandale Transportation Study.

An Existing Conditions study was performed to summarize and document technical information regarding existing traffic conditions, roadway infrastructure and previous studies performed for the Annandale CBC and the greater region. As part of the effort to prepare the Existing Conditions report, a traffic-analysis microsimulation (VISSIM) model was developed to study existing transportation system operations for the Annandale CBC study area that served as a basis for evaluating future transportation improvements and land use changes.

Nine network alternatives were considered and, with the exception of Network 0 (No-Build), all of the alternatives included most if not all of the transportation improvements recommended in the Comprehensive Plan for Fairfax County. The nine networks included:

Network 0	No improvements to the current transportation network
Network 1	Only the Comprehensive Plan improvements
Network 2	Comprehensive Plan (Network 1) WITHOUT Annandale Road overpass
Network 4	Comprehensive Plan EXCEPT 4 lanes on Little River Turnpike
Network 4a	Comprehensive Plan EXCEPT 4 lanes on Little River Turnpike and WITHOUT overpass
Network 5	Comprehensive Plan WITHOUT overpass and one-way pair on LRT / south loop between John Marr Drive and Markham (3 WB lanes on LRT, 3 EB lanes on south loop)
Network 6	Comprehensive Plan W/O overpass and 4 lanes on LRT PLUS one-way pair using both north and south loops between John Marr and Markham (2 WB lanes on north loop and 2 EB lanes on south loop)
Network 7	Comprehensive Plan WITHOUT overpass and 3-1 pair on LRT / south loop between John Marr and Markham (3 WB & 1 EB lanes on LRT, 3 EB & 1 WB lanes on south loop)
Network 8	Comprehensive Plan WITHOUT overpass, with median U-turns in a wide median along the LRT corridor between Hummer/Heritage and Evergreen Lane; replaces existing service drive

The networks were evaluated using VISSIM, a microscopic traffic analysis tool that provides the input of origins-destinations according to the future land uses in the corridor. The model was developed and calibrated to current conditions, and an evaluation of existing conditions compared favorably to the results from the Annandale CBC Circulation Study.

An initial analysis was performed for all nine networks that resulted in several significant conclusions. The Annandale/Ravensworth flyover was shown to provide minimal operational benefits most likely outweighed by other transportation network and land use impacts. Also, the No-Build Alternative provided inadequate capacity and operations to support the future land use growth in the greater Annandale area. From the initial operational results, network Alternatives 2, 5, 6 and 7 were selected to be shortlisted for more detailed study including qualitative and quantitative analyses.

At a final meeting with Fairfax County Transportation and Department of Planning and Zoning, the results from the four shortlisted alternatives were reviewed and a determination was made that Alternatives 2 and 5 were the viable alternatives for implementation. Both Alternatives 2 and 5 have nearly equal merits from a traffic capacity and circulation aspect and the qualitative issues will be important in selecting the final preferred alternative. Detailed study of cross section and plan concepts of the alternatives showed that the widening of Little River Turnpike (for either the whole of Alternative 2 or in portions of Alternative 5) has less of an impact than previously believed because of the ability to forego the right-of-way requirements normally assumed for the continuous service drive. The removal of existing portions of the service drives in the corridor substantially reduces right-of-way impacts and allows for a number of pedestrian, bicycle, transit, land use and visual enhancements to be made in the corridor

A public meeting is currently planned to be held in the spring of 2010 to explain the study process and results, and network Alternatives 2 and 5 will be presented to the public as the viable candidates for implementation. Solicitation of comments from the public regarding their view of the pros and cons of each alternative is a desired step in the process.

1. INTRODUCTION

Fairfax County's Comprehensive Plan for the Annandale Community Business Center (CBC) within the Annandale Planning District outlines several objectives related to future development. These objectives support a vision for the Annandale CBC area that encourages and guides appropriate Annandale revitalization and redevelopment. The Comprehensive Plan recommends several significant transportation improvements, including the potential widening of Little River Turnpike from four to six lanes through the CBC (or an alternate one-way pair configuration), and grade separating Ravensworth / Annandale Roads over Little River Turnpike (or alternative at-grade intersection improvements). These significant transportation improvements will have a positive impact on the revitalization efforts in the Annandale CBC through the creation of additional capacity to support future growth and improved traffic operations in and around the CBC area. Due to the scope and significance of these future projects, this Annandale Transportation Study was conducted to provide a detailed study of the transportation network, taking into consideration that future land use alternatives have the potential to impact capacity and traffic operation improvements.

The objective of the Annandale Transportation Study is to analyze transportation system network alternatives and develop associated recommendations for a definitive transportation system plan. The desired transportation system plan for the area should meet the transportation needs for both local and through traffic in an efficient manner, while facilitating community redevelopment and revitalization needs to enhance the quality of life for the community and neighboring residents, and enable businesses to prosper and actively contribute to the economic and social vitality of Annandale.

The Annandale CBC is located in the heart of the Annandale community and includes the predominantly commercial area oriented to the Little River Turnpike and Columbia Pike corridors, between just west of Heritage Drive / Hummer Road to Evergreen Lane. At the center of the CBC are the intersections of Little River Turnpike with Annandale/Ravensworth Roads and Columbia Pike / Backlick Road. The CBC comprises nearly 170 acres, with scattered residential uses and more than two million square feet of retail, office, and public uses. It may be characterized primarily as a concentration of highway-oriented strip-commercial development, individual stores and older houses converted to commercial use, neighborhood shopping centers, and low-intensity office buildings.

For the purposes of this analysis, the overall study area encompasses the CBC area, from the intersection of Little River Turnpike and I-495 in the west, to the intersections of Little River Turnpike/Evergreen Lane and Columbia Pike/Gallows Road in the east; and the intersection of Gallows Road and Annandale Road in the north, to the intersection of Ravensworth Road and Heritage Drive in the south. The Annandale CBC Study Area is illustrated in **Figure 1.**

FIGURE 1: Transportation Study Area

2. EXISTING CONDITIONS REPORT

2.1. Introduction

The following section summarizes the Existing Condition information that was used in the development and refinement of alternatives. This Existing Conditions report is intended to document and analyze existing transportation and land us conditions in the Annandale CBC area and to provide a baseline for the comparison of future transportation improvement alternatives.

The purpose of this Existing Conditions report as part of the Annandale Transportation Study is to summarize and document technical information regarding existing traffic conditions, roadway infrastructure and previous studies performed for the Annandale CBC and the greater region. The Existing Conditions report includes information on current land uses and plans, roadway and intersection geometry, current operating conditions, transit service information and amenities, and pedestrian / bicycle facilities conditions and amenities. The report also details the construction and calibration of an existing conditions model. As part of the effort to prepare the Existing Conditions report, a traffic-analysis microsimulation (VISSIM) model was developed to study existing transportation system operations for the CBC study area, a model that will ultimately serve as a basis for evaluating future transportation improvements and land use changes.

2.2. Annandale Transportation Studies to Date

Since the 1970's, Fairfax County's Comprehensive Plan for the Annandale CBC had included a future plan for a grade-separation of Ravensworth / Annandale and Backlick Roads over Little River Turnpike, and a widening of Little River Turnpike from four to six lanes through the Annandale CBC. Understanding that these transportation improvements would have a significant impact on land use and redevelopment in the Annandale CBC, the Comprehensive Plan also recommended evaluating a system of one-way paired streets as an alternative to these improvements. That study was conducted in 2005 (called the *Annandale Community Business Center Circulation Study),* and recommended that the implementation of a one-way paired street system be considered as a feasible alternative to the grade-separation.

The Circulation study also recommended that the possible six-lane widening of Little River Turnpike be retained in the Comprehensive Plan until a feasible alternative is selected, that the provision for a full grade-separated interchange be removed from the plan; provided that a feasible option is placed into the Comprehensive Plan, and lastly that a flyover of Little River Turnpike at Ravensworth Road (or at an alternative intersection) be considered and added to the Comprehensive Plan if supported by further analysis. The study indicated additional analysis was needed to evaluate the feasibility of such improvements, examine the appropriate intersection configuration, and evaluate delay reduction and other benefits against potential impacts. In addition, some interim improvements and additional studies related to specific potential road improvements were recommended.

In 2006-2007, the County updated the Transportation element of the Comprehensive Plan to allow for some additional potential roadway improvements pending additional analysis and study (in addition to retaining the option to widen Little River Turnpike to six lanes and provide either a flyover at Annandale/Ravensworth or an alternative intersection).

In 2007, Fairfax County solicited the Urban Land Institute (ULI) to help develop a comprehensive strategy to encourage, regulate and support a revitalized Annandale area that addresses all aspects of infrastructure, urban design, and transportation, and supports the continued viability of this intrinsically important mixed use area. Many recommendations came forth from the ULI Advisory Panel, including a recommendation for a two-way paired transportation system in place of widening Little River Turnpike, as documented in the June 2007 *Annandale Virginia Urban Land Institute Advisory Services Panel Report.*

2.3. Summary of Previous Annandale Studies

The following sections provide summaries and recommendations brought forth by the aforementioned and other previously-conducted transportation-related studies for the Annandale area.

2.3.1. Annandale Community Business Center (CBC) Circulation Study

This study was conducted by the Virginia Department of Transportation (VDOT) in May 2005 in support of Fairfax County's efforts to update the adopted Comprehensive Plan. The transportation elements included in the current Comprehensive Plan for the Annandale Community Business Center (CBC) include a grade-separated interchange and widening of Little River Turnpike from its present four lanes to six lanes. In recognition of the potential impact that a grade-separated interchange could have on the redevelopment of the Annandale CBC, the Comprehensive Plan recommends that a system of one-way paired streets be considered as an option. The study findings indicated that a one-way paired street system could offer satisfactory levels of service through 2030, but more significant improvements such as a grade separated interchange or flyover may be needed beyond 2030.

The primary purpose of this study was to assess the feasibility of creating a system of one-way paired streets. The study proposed a one-way paired street improvement that would have Little River Turnpike converted to one-way westbound between John Marr Drive and Markham Street, and the section of the loop road south of Little River Turnpike (Markham / McWhorter / John Marr Drive) would be converted to one-way eastbound. Intersection improvements would be required at the "tie-in" locations, the intersections of Little River Turnpike at Markham Street and John Marr Drive. The plan would require the completion of the loop road system south of Little River Turnpike, including the realignment of Markham Street and the cul-de-sac of McWhorter Place west of Markham. With the one-way pair operations, Little River Turnpike would no longer be required to be widened to six lanes through the CBC.

The study assessed traffic operations for existing conditions, 2030 no-build conditions, and two variations of an east-west one-way paired street system. Alternative 1 of the One-Way Pair solution assumes that Little River Turnpike would be modified to a three-lane one-way westbound road between John Marr Drive and Markham Street. Additionally, the loop road south of Little River would be modified to a three-lane one-way eastbound road. Alternative 2 of the One-Way Pair has the same configuration of the Alternative 1 but with the following improvements:

- Widening of Little River Turnpike to a six-lane divided section between Hummer Road and Markham Street and between John Marr Drive and Evergreen Lane.
- Minor improvements to Annandale Rd to provide 4 travel lanes between Little River Turnpike and Maple Place and improve the horizontal alignment of the section south of Maple Place.
- Close the intersection of Columbia Pike and Little River Turnpike.
- Consolidate access and remove service drives along Columbia Pike where sufficient inter-parcel access can be provided.
- Improve Poplar Street to a standard two-lane section and extend it to Columbia Pike to provide a complete connection between Annandale Road and Columbia Pike. Improve the alignment of the existing Poplar/Markham Street intersection at Annandale Road to eliminate the offset.
- Construct a traffic circle at the intersection of Maple Place/Martin Avenue as part of a new town center area development.

With the One-Way Pair Alternative, acceptable levels of service (LOS D or better) are maintained at all intersections within the CBC. West of the CBC, the intersection of Little River Turnpike and Heritage Drive/Hummer Road would experience LOS F in the 2030 timeframe, unless improvements are implemented. One of the principal findings of the report is the relatively low throughput volume achieved due to the close spacing of intersections, each allowing all turning movements, and the number of driveway access points. The report mentions that while traffic volumes may not appear unusually high the capacity to handle the travel demand is limited within the CBC. Significant delays occur throughout the corridor during the peak hours, particularly during the PM peak hour. The reason the levels of service appear to be acceptable is that the delays and queuing of vehicles that occur within the study area are not captured by turning movement counts as they record only the traffic volumes clearing the intersection.

One of the contributing factors to poor traffic operations at the intersection of Hummer Road/Heritage Drive with Little River Turnpike is the proximity of the service road and Lafayette Village Drive on the north side of Little River Turnpike. Closing service road access to Hummer Road at this location would improve traffic flow and allow the provision of dual left turns from eastbound Little River Turnpike onto Hummer Road. These closures could be accomplished if a new roadway was constructed running north of the office tower in the northwest quadrant of the intersection and north of the 7-Eleven in the northeast quadrant.

In addition to the alternatives studied, the report identifies operating strategies/improvements that could increase capacity within the CBC:

- A north-south one-way paired street system utilizing Backlick Road and Maple Place for northbound traffic and Annandale Road and Ravensworth Road for southbound traffic.
- The upgrading of Markham Street/McWhorter Place between Little River Turnpike and Ravensworth Road (widening and realigning Markham Street/McWhorter Place T-intersection into a smooth curve) to alleviate traffic on Little River Turnpike.
- Creating a loop road, by making improvements to several streets including Poplar Street, Markham Street, and McWhorter Place, to create a circumferential road in order to direct commuter traffic around the CBC.

2.3.2. Comprehensive Plan of Fairfax County

The Comprehensive plan for Fairfax County was updated in 2006 to allow for some changes including several transportation recommendations for Annandale. Along with the addition of alternatives to the six-lane widening and overpass along Little River Turnpike, several other system improvements are specified in the Annandale CBC area. Together these improvements form the basis for the completion of a loop road around the Annandale CBC. The Plan recommends:

- Annandale Road is to be improved to a four-lane roadway, the Columbia Pike / Little River Turnpike intersection is to be closed, and the portion of Columbia Pike west of Backlick Road is to be closed after Columbia Pike is realigned with Backlick Road.
- Circulation improvements to collector and local streets in the area including Poplar Street (rather than Maple Place) serving as the major CBC east-west connector, and Poplar/Markham Streets are to operate as legs of an Annandale Loop Road system designed to improve traffic circulation within the CBC and divert local traffic away from Little River Turnpike. Poplar Street is to be improved to a standard two-lane section and extended to Columbia Pike, providing a complete connection between Annandale Road and Columbia Pike. The alignment of the existing Poplar/Markham Street intersection at Annandale Road is to be improved to eliminate the offset intersection.
- A roundabout should be constructed at the intersection of Maple Place/Martin Avenue (Maple Place could be redesigned after the improvement of Poplar Street between Annandale Road and Columbia Pike). Markham Street to McWhorter Place is to be realigned in a four lane section to complete the loop road system south of Little River Turnpike.

2.3.3. Annandale Virginia Urban Land Use Institute Advisory Services Panel Report

In 2007, the Fairfax County Department of Housing and Community Development, in partnership with the Department of Planning and Zoning and the newly formed Office of Community Revitalization and Reinvestment, invited The Urban Land Institute's Advisory Services Program to convene a panel of land use experts to recommend strategies for revitalizing the Annandale Community Business Center. The panel formulated economic, physical, and organizational solutions to advance the county's goals.

The recommendations of the panel of experts can be summarized as follows:

- Future development must balance Annandale's role as a regional transportation hub and commuter corridor with the presence of a community business center.
- By investing in infrastructure improvements, particularly transit and circulation, Annandale can create land assemblies to capture expected market demand and to facilitate the creation of a catalytic mixed-use town-center development.

Recommendations for managing traffic included:

- The panel recommends an aggressive strategy to reduce congestion by improving the pedestrian environment, establishing pedestrian connections between business and residential areas, facilitating commuter traffic flow around Annandale, improving local traffic flow, and increasing transit accessibility and visibility.
- After reviewing different studies from the Fairfax County and the Virginia Department of Transportation the panel concludes that a one-way pair will negatively affect commercial uses and will not support development of a town center. Retail development trends indicate that two-way streets improve access for traffic and pedestrians, whereas a one-way system is seen primarily as a conduit for traffic.
- The principal recommendation as far as managing traffic given by the panel is the creation of a two-way loop road system around the core, similar to the recommendations in the 1997 Hunter Study commissioned by the Fairfax County Department of Housing and Community Development. The proposed two-way loop system would create a loop around the entire core area, using John Marr Drive, Columbia Pike, Poplar Street, Markham Street, McWhorter Place, and Backlick Road. Columbia Pike would be closed as a traffic artery between Poplar Street and Little River Turnpike. The two-way loop would reduce left turns from Little River Turnpike by distributing traffic headed to Annandale Road, Columbia Pike, Backlick Road, and Ravensworth Road to the periphery of the commercial area. The existing four-lane cross section of Little River Turnpike should be maintained and enhanced with a completed frontage road system that has pedestrian facilities and landscaping through the core.

Recommendations for encouraging transit:

- The county should implement the proposed two-way loop and create a system of low-traffic, pedestrian-friendly streets within the loop. The county should establish signalized, well-marked, safe pedestrian crossings across Little River Turnpike and the two-way loop to provide pedestrian connections between the commercial area and adjacent neighborhoods.
- Development should be encouraged at residential densities greater than 50 units per acre, sufficient to support ten-minute transit headways based on national benchmarks for transit-oriented development. The highest-density development should be nearest to transit hubs, such as the proposed transit center.
- The panel recommends adopting the 2003 recommendation of the Washington Metropolitan Area Transit Authority (WMATA) to create an Annandale transit center near the intersection of Little River Turnpike and Columbia Pike. One option is to develop the transit center as a catalyst for additional town-center development at the 7200 Columbia Pike site, a property currently owned by Fairfax County on Columbia Pike north of Poplar Street. The panel also recommends creating structured parking at the transit center that can serve transit riders during the day and town-center users during evening and weekend off-peak hours.

2.3.4. The Washington Metropolitan Area Transit Authority Regional Bus Study

This 2003 study presents a plan to address the short and long term requirements for both regional and non-regional bus services in the District of Columbia, Montgomery County and Prince George's County in Maryland, Arlington, Fairfax and Loudoun Counties and the Cities of Alexandria, Fairfax and Falls Church in Virginia.

A regional telephone survey of 1,000 individuals revealed that the largest growth market for bus service is in the suburbs, but over half of this market is suburb-to-suburb trips, which are difficult to provide with traditional transit routes. The study establishes several types of priority corridors where improvements would range from traffic signals that give priority to buses, to bus-only lanes with high-quality transfer centers. On selected high-use routes, a new type of service called RapidBus is proposed that offers a quality of service comparable to rail transit without the need for rail tracks. It is designated to provide very frequent service using special buses, to operate on separate right-of-way to the extent possible, and to provide up-to-the-minute transit service information at attractive stations. Based on the findings of the analysis it recommends to implement RapidBus routes along the Columbia Pike and Little River Turnpike/US 50 corridors and to provide the corresponding running way improvements. Among the enhancements to running ways considered in the plan are:

- Removing on-street parking during peak service hours of the day
- Providing signal priority to transit vehicles
- Providing left turn lanes to enhance traffic operations
- Providing bus-only lanes or queue jumpers

The Regional Bus Study proposed new or improved services (through 2010) that have a direct effect on the mobility of Fairfax County:

- RapidBus service: After 2010, additional RapidBus corridors may include an extension of Columbia Pike RapidBus to Chantilly via Little River Turnpike/US 50.
- A new local route from Annandale to East Falls Church via Little River Turnpike/Leesburg Pike.

2.3.5. Annandale Pedestrian Walkway Feasibility Study

This June 2007 Technical Memorandum analyses pedestrian access, safety and circulation in the Annandale CBC and the surrounding residential communities that are located within walking distance. Consideration was also given to a broader geographical area to identify interconnectivity issues and opportunities.

- The intersections of Columbia Pike at John Marr Drive and at Gallows Road do not have signal head indications for pedestrians.
- The existing crosswalk across Maple Place at the intersection of Annandale Road and Maple Place leads to a driveway and is in conflict with a drainage inlet. This crosswalk should be relocated and a new crosswalk should be placed across Annandale Road on the south side of the intersection.
- Based on the historic pedestrian accident records for a 3-year period, the intersection of Columbia Pike at Backlick Road/Maple Place has a higher pedestrian accident rate compared to other study locations. For this reason the study proposes 2 alternatives to improve pedestrian safety conditions: Alternative 1 consists of additional pavement markings and warning signs. Alternative 2 involves reconfiguring the intersection to eliminate the free-flow right-turn lane. This improvement was proposed because during field observations for this study, it was noted that the northbound right-turn vehicles using the free-flow turn lane travel at a relatively high speed.
- Pedestrians crossing Columbia Pike between Tom Davis Drive and Backlick Road do not have convenient access to a signalized intersection. A traffic signal warrant study is recommended to determine whether a signal is justified at the intersection of Columbia Pike and Tom Davis Drive.
- County staff expressed concerns about the many challenges that pedestrians face at the intersection of Columbia Pike at Gallows Road. The intersection is adjacent to a church, a preschool, a daycare center, a shopping center and residential units. The intersection is signalized, however, there are no pedestrian signal heads and crosswalks are not properly located and lack handicap ramps.

2.3.6. Hunter Study Report

Hunter Interests, Inc. prepared for the Fairfax County's Department of Housing and Community Development a report about redevelopment planning for Annandale's proposed revitalization area, including the Community Business Center (CBC). The goal of the study was to identify feasible development alternatives and implementation strategies for the area's economic and physical revitalization.

The study conducted a series of focus group meetings to identify the interests and issues that should frame a development profile for Annandale. It was concluded that the flavor of Annandale would be founded upon food/beverage and entertainment venues. What its citizens are calling for is: an appealing place to stop for pleasure rather than a 6-lane drive-through.

Some of the general findings of the report are as follows:

- A new loop road and new internal road links are recommended for Annandale. These new roads would ease current and future access and mobility in the area, while also providing for improved pedestrian and bicycle access.
- The County applied to the US Department of Housing and Urban Development (HUD) for grants and loans for blighted properties. The program had an underlying anti-sprawl implication as lots are converted from lower to higher density of use.

- The Hunter team explained that in a town center, curbside parking is the most convenient for the shopper. However, longer term parking is also planned behind the Town Center buildings.
- During the analysis of existing roadway conditions, Columbia Pike was identified as the corridor that forms the "heart" of the CBC. It was also noted that the convergence of important highway corridors within Annandale creates significant congestion that impacts the quality of life and limits the redevelopment of this area as a meaningful community activity area. Additionally, on the north side of Little River Turnpike, there are two closely spaced signalized intersections created by Annandale Road and Columbia Pike.
- From the analysis of the roadway network it was identified that John Marr Drive will provide a less direct alternative to Columbia Pike should modifications be made along portions of Columbia Pike.
- Bus routes located along Little River Turnpike and Columbia Pike provide important regional bus service to the study area.
- There are sidewalks along portions of Columbia Pike, Little River Turnpike, Gallows Road, Ravensworth Road, and Backlick Road, but they are generally in disrepair and unattractive.

One of the key ideas for revitalization in the report is the two alternative redevelopment scenarios proposed. Alternative A recommends the following improvements:

- Extension of Poplar Street to the east to complete the loop road from Markham Street.
- Construction of a free-flow right turn lane from Little River Turnpike westbound onto Annandale Road.
- Realign and straighten Annandale Road on the north side of Route 236.
- Extend Ravensworth Road (one way) north of Little River Turnpike.
- Construct a roundabout at Maple Place and Martin Avenue.

Alternative B advocates the following improvements in addition to those on Alternative A:

- Extend John Marr Drive across Columbia Pike to Chatelain Road and then to Daniels Avenue.
- Realign Columbia Pike at the current intersection with Backlick Road and Maple Place to create a continuous movement.
- Close the western portion of Columbia Pike from the intersection with Backlick Road to the intersection with Route 236.
- Realign Markham Street in the southwest corner of the CBC to complete the loop road.
- Realign the Maple Place intersection with Annandale Road to create a right angle intersection.
- Realign offset intersection at Markham Street and Poplar Street. This would increase traffic capacity of this intersection and contribute to the loop road system around the study area.

2.4. Existing Roadway and Land Use Conditions

2.4.1. Existing Roadway Network

The roadway network surrounding the Annandale Community Business Center includes major thoroughfares, collector roadways and local streets. Below is a brief description of the key roadways in the study area, and **Table 1** summarizes functional information about each roadway.

Little River Turnpike (SR 236)

State Route 236 extends from Route 400 (Washington Street) in The City of Alexandria to Route 29 in The City of Fairfax (Includes Cameron Station Overpass). Little River Turnpike is classified as Urban Other Principal Arterial and is the major east-west corridor in the study area. For the most part SR 236 is a four-lane divided highway. Between Markham Street and Annandale Road it is a five lane undivided road with a two-way left turn lane. Westbound Little River Turnpike has a third lane between Hummer Road and just east of Woodland Rd. On the other hand, westbound Little River Turnpike has a third lane between Medford Drive and Hummer Road that is mostly used by right turning vehicles. There is a service road along both sides of SR 236 between Hummer Road and Markham Street and also between John Marr Drive and Evergreen Lane. All of the signalized intersections along SR 236 have exclusive turn lanes and are spaced approximately 900 ft in average in the study area.

Columbia Pike (SR 244)

State Route 244 extends from Route 27 at the Pentagon Network to State Route 236 in Annandale. Columbia Pike is classified as Urban Other Principal Arterial and is a major corridor that connects Arlington County and Washington, D.C. It runs southwest through Arlington and Fairfax Counties paralleling I-395. Even though this roadway is classified as a principal arterial it has very frequent driveway access points.

The section between Maple Place and Little River Turnpike is a one-way two-lane going southbound. Between Maple Place and Evergreen Lane is a four-lane undivided roadway with very few exclusive turn lanes. Between Evergreen Lane and Gallows Road it is a four-lane divided roadway with raised median.

Annandale Road (SR 650)

Annandale Road is part of the arterial route that connects Springfield to Tysons Corner paralleling the Capital Beltway (I-495). This road is classified as Urban Minor Arterial and is heavily traveled in the AM peak period as motorists destined to the Tysons Corner area can use it to bypass much of the morning congestion on the Beltway. Annandale Road is a four-lane undivided arterial as it approaches the Annandale CBC.

Gallows Road (SR 711)

Gallows Road is used by drivers who are traveling between Annandale and Tysons Corner area. This road is classified as an Urban Minor Arterial. State Road 711 between Little River Turnpike and Annandale Road is a two-lane undivided roadway with on-street parking on both sides of the road. North of Hummer Road it is a four-lane undivided roadway.

Backlick Road (SR 650)

Backlick Road is four-lane undivided roadway classified as Urban Minor Arterial. It runs through Springfield and terminates at Columbia Pike within the Annandale CBC. South of the study area, Backlick Road is four lanes and has relatively few driveways as compared to the area within the CBC. Therefore, the capacity is significantly higher and during peak periods, and this facility is able to "feed" more traffic to the study area than can currently be handled.

Ravensworth Road

Ravensworth Road is a two-lane undivided road classified as Urban Minor Arterial. This road serves as a collector road to residential subdivisions in North Springfield and Annandale. It is one of the access roads to Annandale High School, accounting for the higher number of buses using this road. The only two signalized intersections along this road are at John Marr Drive and Heritage Drive.

Hummer Road

Hummer Road is a 2-lane collector road that connects Little River Turnpike to Gallows Road. Hummer serves single residences and subdivisions and some office developments near its intersection with Little River Turnpike. The Hummer / Heritage intersection is among the most congested intersections along Little River Turnpike largely due to the impact of service drive intersections immediately adjacent to the major intersection.

Heritage Drive

Heritage Road is divided 4-lane collector road immediately south of Little River turnpike that transitions to a two-lane road near its terminus at Ravensworth Road. The northern section of Heritage Road serves office and commercial site uses and serves mostly residential houses on the two-lane section near Ravensworth Road.

Woodland Road

Woodland Road is a minor street that ends less than a half-mile north of its intersection with Little River Turnpike. Woodlawn Road serves single residences, small subdivisions and some office developments near its intersection with Little River Turnpike.

Evergreen Lane

Evergreen Lane is a short 3-lane collector road (one lane in each direction and a continual center turn lane) that connects Little River Turnpike to Columbia Pike to the north. Evergreen Lane serves multi-family residences and office and commercial developments.

Poplar Street

Poplar Street is a two-lane undivided collector road. The Poplar Street is a parallel road to Maple Place and serves as alternative route to residential subdivisions.

Markham Street

Markham Street is a two-lane undivided collector road with a center lane to make turns to local businesses. It provides alternative access to Little River Turnpike from Annandale Road.

McWhorter Place

McWhorter Place is a two-lane undivided local street and serves as a collector road to residential subdivisions. East and West parts of McWhorter Place are not connected.

Tom Davis Drive

Tom Davis Drive (formerly Annandale Center Drive) is a short 2-lane local collector between Columbia Pike and John Marr Drive and serves several municipal buildings in the Annandale CBC area.

Medford Drive

Medford Drive north of Little River Turnpike is a four-lane collector that serves as a northern by-pass of the CBC area over to Annandale Road. South of Little River Turnpike, Medford is a two lane local collector that service local residential homes.

TABLE 1: Functional Characteristic of Annandale Area Roadways

Roadway	Route No.	Functional Classification	Speed Limit (mph)	Total Number of Lanes	Lane Width (ft)
Little River Turnpike	SR 236	Urban Other Principal Arterial	35	4-lane road with 5-lane section between Markham & Annandale Rd; Third EB lane between Hummer and Woodland; Third WB lane between Medford & Hummer	12'
Columbia Pike	SR 244	Urban Other Principal Arterial	25	4-lane road. Between Maple Pl and Little River Turnpike is a one-way two-lane road	12'
Annandale Road	SR 650	Urban Minor Arterial	25 / 35	4-lane road	11'
Gallows Road	SR 711	Urban Minor Arterial	35	North of Hummer Rd is a 4-lane road. South of Annandale Rd is a 2-lane road	14-22' S of Hummer; 12 ft N of Hummer
Backlick Road	SR 650	Urban Minor Arterial	30 / 40	4-lane road	11'
Ravensworth Road	SR 649	Urban Minor Arterial	30 / 35	2-lane road. Between Jayhawk St and Little River Turnpike is 4-lane road.	12-14' S of Jayhawk; 12' N of Jayhawk
Hummer Road	n/a	Minor Collector	35	2-lanes with additional turn lanes at LRT	12'
Heritage Drive	n/a	Minor Collector	35	4-lane divided road from LRT to Annandale High School; 2-lanes east to Ravensworth	12'
Woodlawn Road	n/a	Minor Collector	35	2-lane road	11'
Evergreen Lane	n/a	Minor Collector	35	3-lane road (continuous center turn lane)	11'
Poplar Street	n/a	Local Street	35	2-lane road	11'
Markham St	n/a	Local Street / Collector	30 / 35	2-lane roadway south of LRT; 4-lane roadway north of LRT	12'
McWhorter Place	n/a	Local Street	30	2-lane road	11'
Tom Davis Drive	n/a	Minor Collector	35	2-lane road	11'
Medford Dr	n/a	Collector	35	2-lane road	12'
Maple Place	n/a	Local Street	25	2-lane road with on-street parking	20'
John Marr Drive	n/a	Collector	35	4-lane roadway south of LRT; 4-lane divided roadway north of LRT	11' / 12'

Maple Place

Maple Place is a short 2-lane local collector road between Backlick / Columbia Pike and Annandale Road that serves several small businesses in the Annandale CBC area.

John Marr Drive

John Marr Drive is a four-lane collector road that serves as a western by-pass around the Annandale CBC area from McWhorter/Annandale to Little River Turnpike. North of Little River Turnpike to Columbia Pike, John Marr is a divided 4-lane collector with turn bays at major intersections.

2.4.2. Existing Transit Facilities and Services

The study area is served by several local and regional bus routes. **Figure 2** illustrates the existing configuration of the bus routes and the location of the transit stops in the Annandale CBC and below is a description of the service routes:

- Metrobus 3A (Lee Highway Line): This route serves the communities of Annandale and Falls Church and provides connection to the Rosslyn and East Falls Church stations of the Metro System. This bus line provides service during weekdays from 5:30 am to 9:00 pm with headways of 30 minutes during peak-hours and one hour during off-peak hours. On Saturdays the route provides service from 8:00 am to 8:00 pm with one hour headways, whereas on Sundays the route runs from 9:00 am to 8:00 pm with one hour headways.
- Metrobus 16A, 16B, 16D, 16E and 16L: Bus Routes 16A, 16B, 16D and 16E are known as the Columbia Pike line and route 16L as the Annandale-Skyline City-Pentagon Line. These bus routes serve the communities of Annandale and Culmore and provide connection to the Pentagon and Pentagon City stations of the Metro System. These lines usually run with 30 minutes headways but they run with 10 minutes headways down Columbia Pike to the Pentagon in the peak hours.
- Metrobus 29H (Annandale Line): This bus route connects the community of Annandale with the Pentagon. This line only provides service from Monday through Friday.
- Fairfax Connector 401 (Backlick-Gallows Road Line): The Fairfax Connector serves the communities of Springfield, Annandale and Merrifield and provides connection to the Franconia-Springfield and Dunn Loring stations of the Metro System. This bus route operates with 30-minute headways during weekdays and one hour headways during weekends.

2.4.3. Current Pedestrian and Bicycle Network

The Annandale Pedestrian Walkway Feasibility Study prepared for the Fairfax County Public Works and Environmental Services included an inventory of the sidewalks within the Annandale CBC and found approximately 35,630 ft of curb line. The study found that 76% of the curb line has sidewalk in good condition, 9% has sidewalk that needs to be improved and 15% has missing sidewalk. **Figure 3** shows the locations of missing sidewalk in the study area.

The County staff has expressed concerns about the pedestrian conditions at two specific locations:

- Columbia Pike between Tom Davis Drive and Backlick Road: Pedestrians crossing this section of Columbia Pike do not have access to a signalized intersection and there is sidewalk missing along the south side of Columbia Pike. This corridor has a high level of pedestrian activity due to the presence of an adult day care center, the ACCA Child Development facility and a Giant supermarket.
- Columbia Pike at Gallows Road: This intersection is signalized, however, there are no pedestrian signal heads and crosswalks are not properly located and lack handicap ramps. Additionally, there is a need for a new sidewalk on the south side of Columbia Pike from Gallows Road to Martin Taylor Court.
- In general, the close spacing of intersections, each allowing all turning movements and the number of driveway access points present a challenge for pedestrians in the study area. Access control improvements should be implemented as part of an access management initiative in order to improve the traffic operations of the roads and at the same time create a more pedestrian friendly environment. Additionally, handicap ramps, pedestrian signals, pedestrian signs, pedestrian pavement markings and pedestrian-scale lighting should be revised to enhance the accessibility, safety and circulation of pedestrians in the Annandale area.

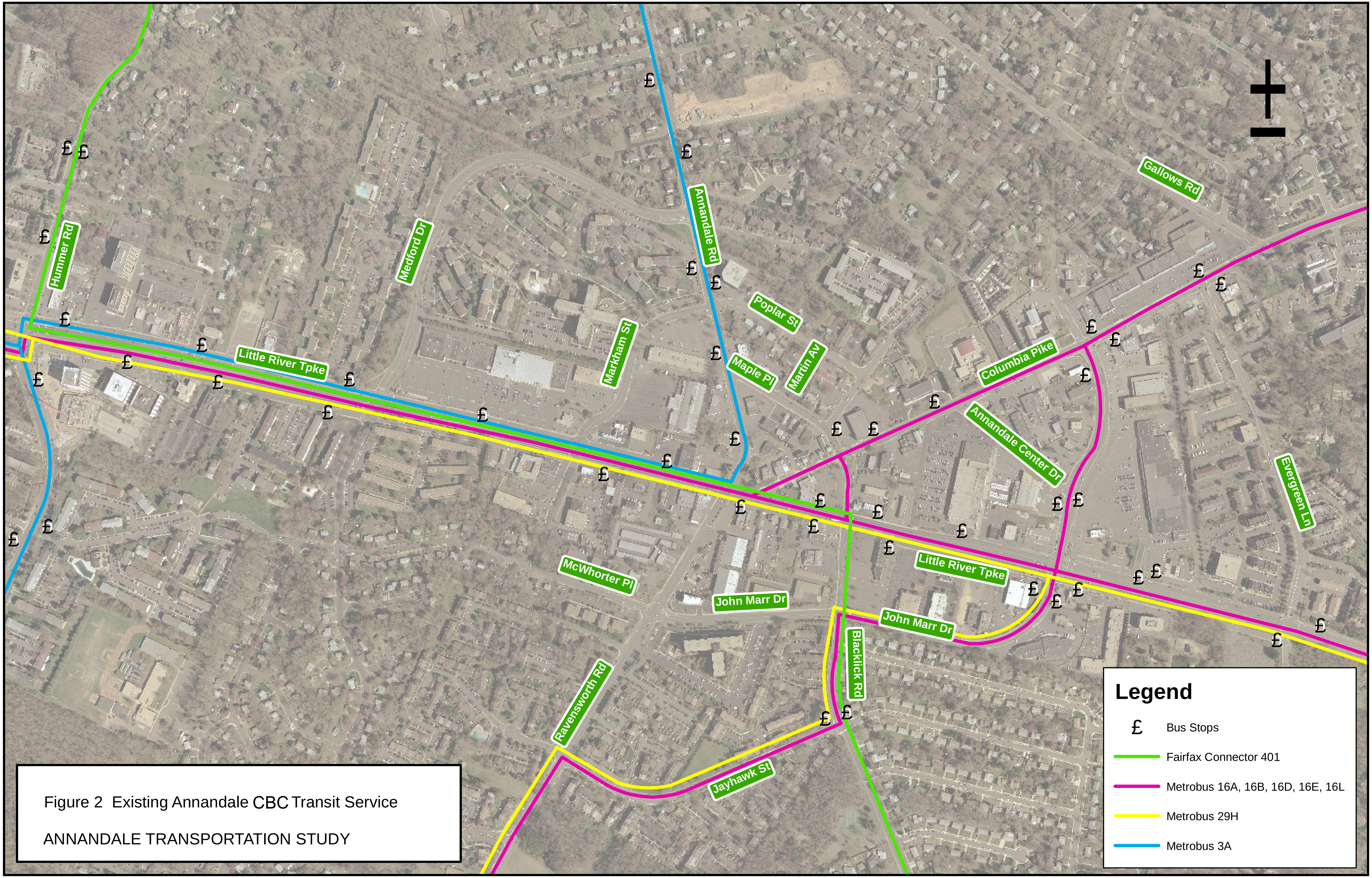

Figure 2 Existing Annandale CBC Transit Service

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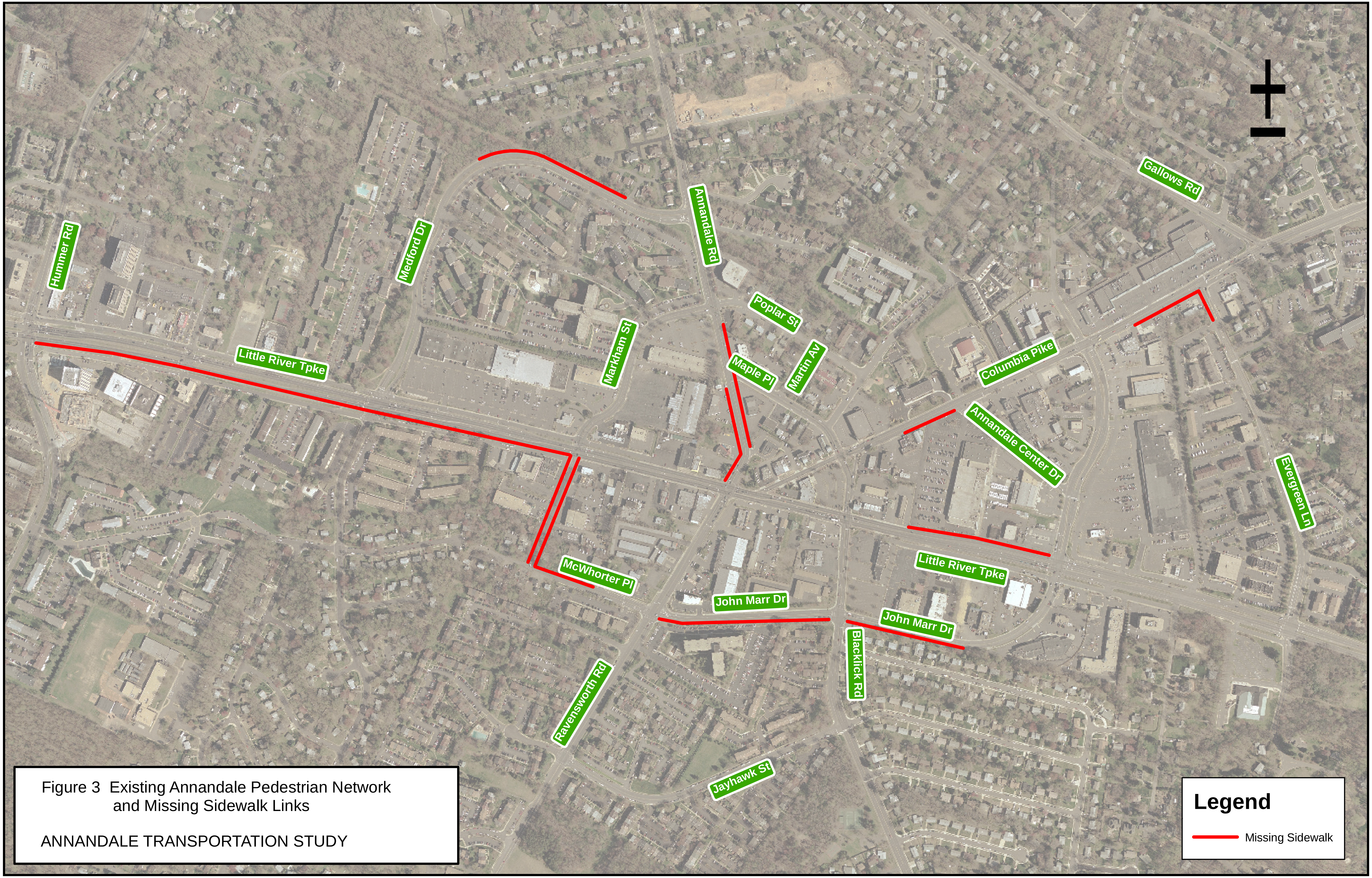

Figure 3 Existing Annandale Pedestrian Network and Missing Sidewalk Links

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2.5. Transportation Observations in the Study Area

The field reconnaissance of the study area is conducted to observe and document the existing conditions of the study area and traffic patterns. The field observations are documented as below:

Land Use: The study area is predominantly commercial area along Little River Turnpike and Columbia Pike. The commercial area can be characterized as concentration of strip commercial development, individual stores, neighborhood shopping centers and low intensity shopping centers. There are also residential apartments at the intersection of Little River Turnpike and Medford Drive.

Traffic Volumes and Patterns: The corridors, Little River Turnpike (Route 236) and Columbia Pike (Route 244) both experience frequent recurring congestion. For Little River Turnpike, there was no clear peak direction and the peak direction volumes for Eastbound and Westbound are similar.

Access Management: Several areas along Little River Turnpike and Columbia Pike exhibit frequent access points to commercial establishments, compromising the safe and efficient flow of through traffic.

1. Little River Turnpike (Route 236) - Hummer Road / Heritage Drive to Medford Drive.
2. Little River Turnpike (Route 236) - Markham Street through Backlick Road.
3. Columbia Pike (Route 244) - Maple Place / Backlick Road to Gallows Road.

Service Drive Access Points: The frequency of access points to the service road present challenges related to the conflict between traffic on the service road and turning movements to/from Little River Turnpike. The service road is stop-controlled, but it is difficult for vehicles on the service road to see traffic coming from Little River Turnpike. This issue was specifically noted at the following locations.

1. Route 236 WB - Hummer Road / Heritage Drive to Markham Street.
2. Route 236 EB - John Marr Drive to Carmico Drive.
3. Route 236 WB - Markham Street to Hummer Road / Heritage Drive.
4. Route 236 WB - Carmico Drive (236-10) to John Marr Drive.

Pedestrian Facility Continuity: There is an apparent unmet demand for pedestrian facilities in several areas where sidewalks do not currently exist. These areas are noted by "cow path" tracks along the roadside indicating heavy pedestrian usage. In some cases, these paths link bus shelters to the nearest sidewalk, which occasionally terminates prematurely.

Pedestrian Compliance / Crosswalk Safety: Pedestrian behavior is erratic and not always in compliance with marked crossings. Illegal mid-block crossings are common in congested areas where pedestrians appear to take the shortest path to cross the street, regardless of the availability of signalized crossings shortly down the street. These actions often occur in the vicinity of bus stops, where unexpected mid-block crossing by pedestrians are made more hazardous by the fact that stopped buses often obscure the ability of oncoming drivers to see pedestrians attempting to cross the street.

Transit Facilities and Bus Stops: The area is well served with regular bus transit services. There are many bus stops on both corridors. In some places, there is a bus stop every 300 feet. As many of the bus stops are on-street, they will contribute to the large delay of vehicular traffic, number of stops and rear end collisions due to close bus stops.

Sidewalks: Sidewalks on both the corridors are poor, and they are not continuous throughout the corridor. This will encourage people to cross at mid-block crossings to access bus stops.

2.6. Data Collection

Two sources of traffic data were provided by the Fairfax County Department of Transportation (FCDOT) for this study:

- In April 2008, FCDOT collected the average daily traffic volumes for 12 locations within the study area. The average daily traffic for Eastbound and Westbound are similar for the two major corridors Little River Turn Pike and Columbia Pike.
- In April of 2008, FCDOT also collected peak period turning movement counts at 12 intersections in the Annandale CBC on a typical weekday when schools were in session. The counts were collected between the hours of 6:30am to 9:30 am and 3:30pm to 6:00pm. This data was collected at the following intersections and from the data the peak hours for each intersection are shown below:

Name of the Intersection	AM Peak Hour	PM Peak Hour
Little River Turnpike at Hummer Rd / Heritage Rd	7:45am - 8.45am	5.30pm - 6.30pm
Little River Turnpike at Woodlawn Road	7:30am - 8.30am	5.15pm - 6.15pm
Little River Turnpike at Medford Drive	7:45am - 8.45am	4.30pm - 5.30pm
Little River Turnpike at Markham Street	7:30am - 8.30am	5.15pm - 6.15pm
Little River Turnpike at Ravensworth / Annandale Rd	7:45am - 8.45am	5.00pm - 6.00pm
Little River Turnpike at Columbia Pike	7:45am - 8.45am	4.45pm - 5.45pm
Little River Turnpike at Backlick Road	7:45am - 8.45am	4.00pm - 5.00pm
Little River Turnpike at John Marr Drive	7:45am - 8.45am	5.00pm - 6.00pm
Little River Turnpike at Hillbrook Dr / Evergreen Lane	7:45am - 8.45am	5.15pm - 6.15pm
Annandale Rd at Maple Pl	7:45am - 8.45am	4.45pm - 5.45pm
Annandale Rd at Poplar St	7:45am - 8.45am	4.45pm - 5.45pm
John Marr Dr at Columbia Pike	8:00am - 9.00am	5.30pm - 6.30pm
John Marr Dr at Backlick Rd	7:45am - 8.45am	5.00pm - 6.00pm
Ravensworth Rd at John Marr Dr / McWhorter Pl	7:30am - 8.30am	5.30pm - 6.30pm
Ravensworth Rd at Heritage Dr	7:45am - 8.45am	5.00pm - 6.00pm
Columbia Pike at Evergreen Road	7:45am - 8.45am	5.30pm - 6.30pm

Figure 4 illustrates the existing turning movement count data collected in the study area and **Figure 5** illustrates the ADT information (by direction) collected.

2.7. Travel Time Data

Travel time data for study area roadways were collected using Geographic Positioning System (GPS) technology. A portable GPS tracking device (GeoLogger®) was attached to the test vehicle and the vehicle was driven through study area corridors several times during the AM and PM peak hours. The GPS device recorded second-by-second location and speed data in the field which was later downloaded to a computer. The data was then processed to provide detailed travel time, speed and delay analysis.

Travel time data was collected between 4:15 PM to 6:45 PM on Wednesday, January 14 2009, for PM peak hour conditions, and between 6:45 AM to 9:15 AM on Thursday, January 15 2009, for AM peak hour conditions. **Table 2** summarizes observed peak hour speeds through the study area roadways. **Figure 6** illustrates the average speeds during the AM and PM peak hours. Detailed space-time graphs for each corridor are provided in **Appendix A**.

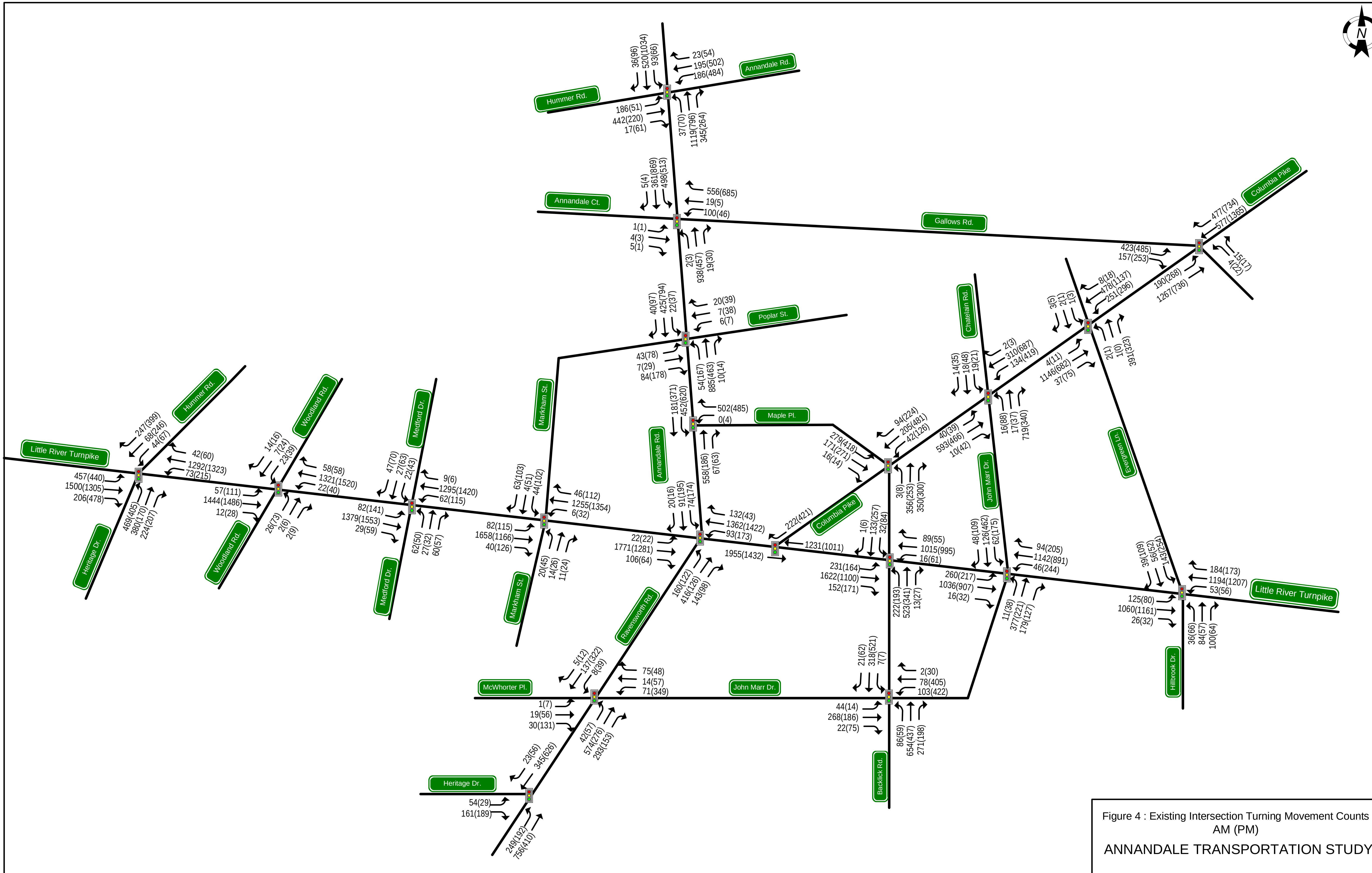

Figure 4 : Existing Intersection Turning Movement Counts AM (PM)

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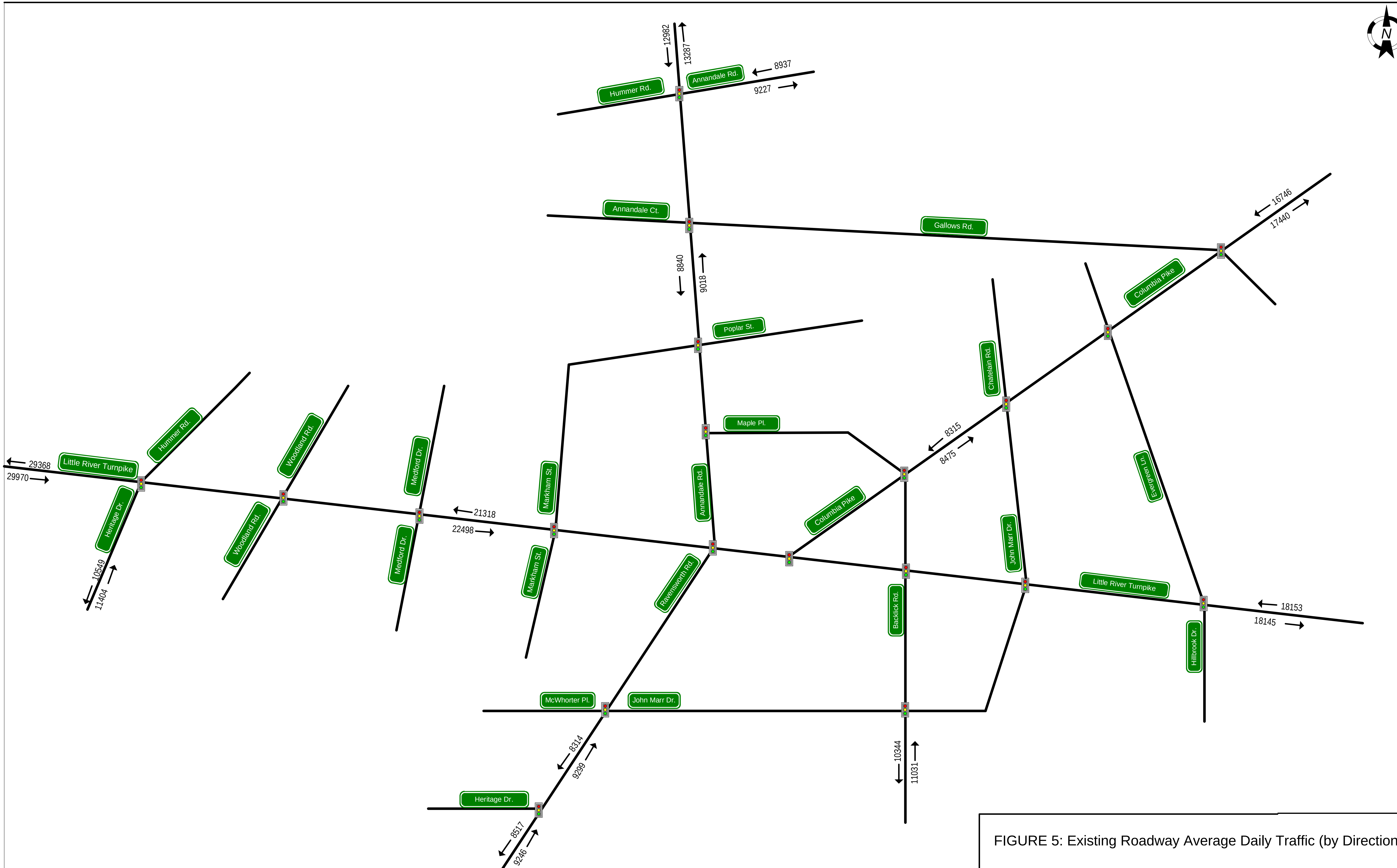
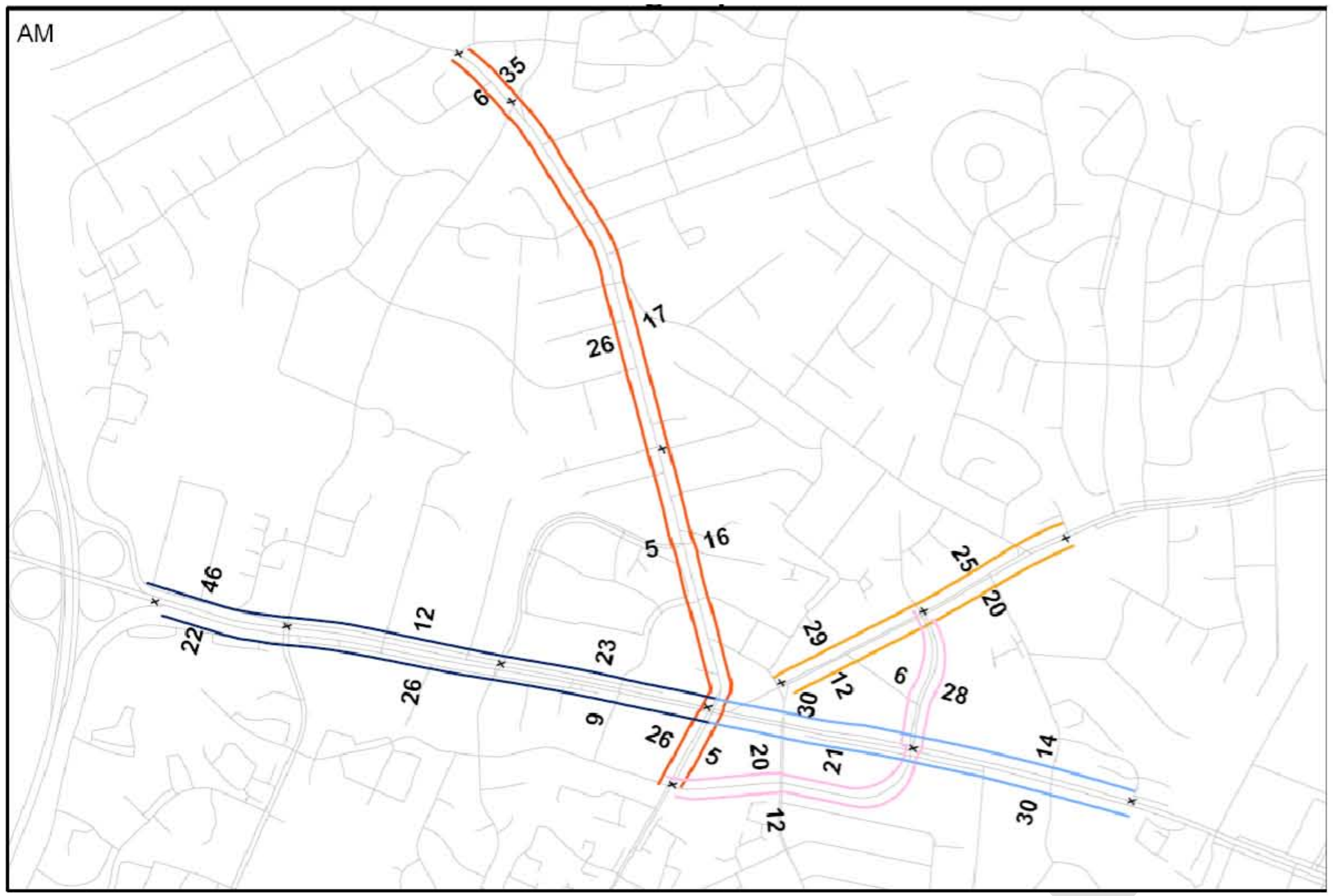


FIGURE 5: Existing Roadway Average Daily Traffic (by Direction)

ANNANDALE TRANSPORTATION STUDY

Figure 6: Average Peak Period Segment Speeds

AM Peak Period Average Segment Speeds (mph)



PM Peak Period Average Segment Speeds (mph)

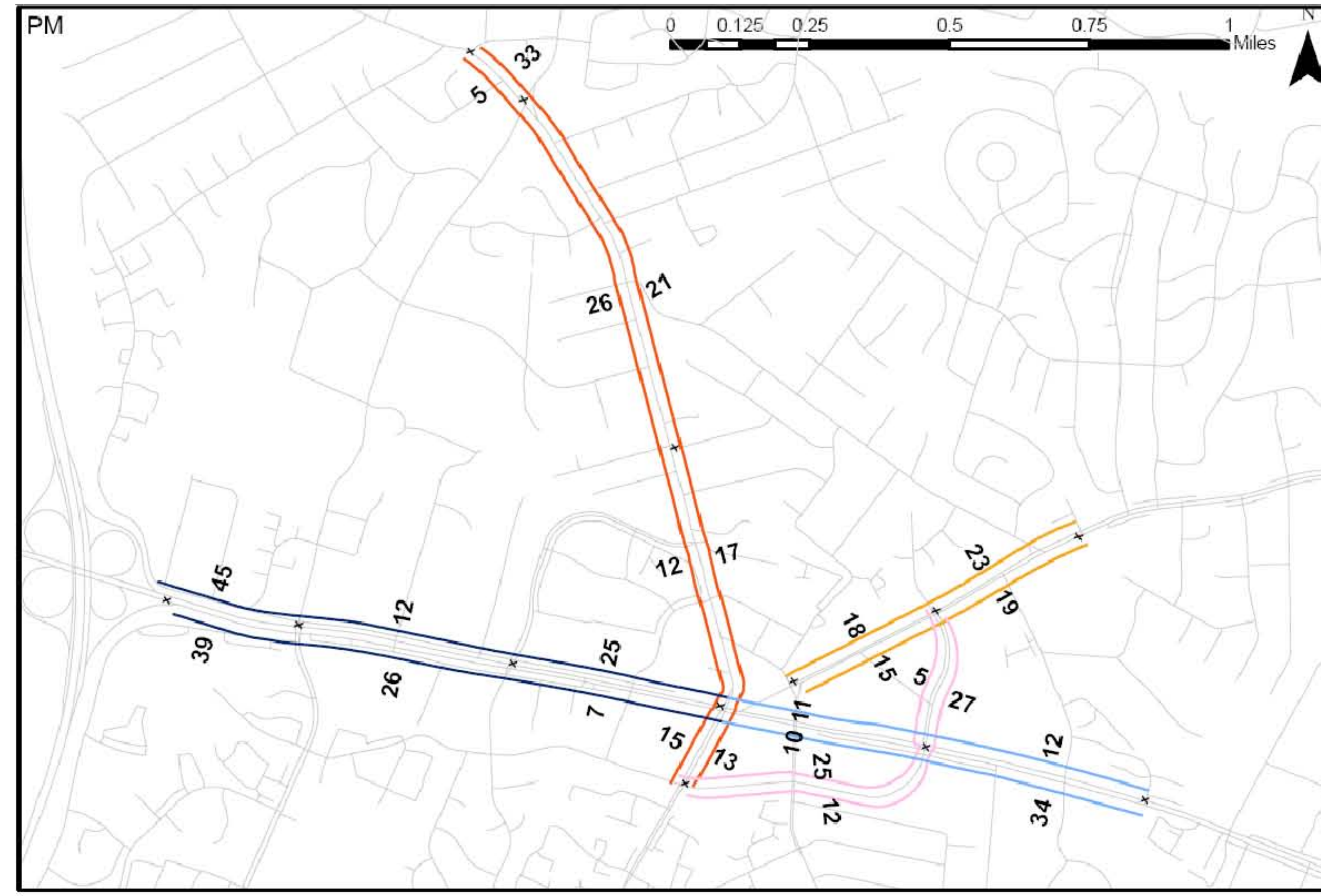


TABLE 2: Travel Time Data Collected

Roadway	Between		Distance (miles)	Dir	AM Peak Period No. of Runs	AM Peak Period Avg Speed (mi/hr)	PM Peak Period No. of Runs	PM Peak Period Avg Speed (mi/hr)
Annandale Road	McWhorter Pl / John Marr Dr	Masonville Dr	1.45	NB	2	13.6	2	19.9
				SB	3	14.1	3	15.9
Columbia Pike	Backlick Rd	0.08 mi East of Gallows Rd	0.58	EB	3	13.3	3	15.0
				WB	3	25.3	3	20.0
John Marr Dr	Ravensworth Rd	Columbia Pike	0.74	NB	3	14.3	2	14.3
				SB	3	10.7	2	11.0
Little River Turnpike	I-495 NB Ramp	High Pl (0.15 mi E of Evergreen Lane)	1.8	EB	4	21.4	4	17.5
				WB	4	19.0	4	14.0

2.8. VISUM / VISSIM Modeling

To evaluate existing and future transportation alternative networks operations and service of land uses in the study area, PTV's VISUM and VISSIM software were utilized. The VISUM software allows input of traffic volumes, origin-destination information, transit systems and operations, and pedestrian and bicycle networks to be modeled at the mesoscopic (local roadway system) level, while the VISSIM model allows detailed operations testing and evaluation of networks and alternatives at the microscopic (roadway intersection) level. The VISSIM model allows for creation and input of origin-destination (O-D) matrices and performing dynamic trip assignment to adequately evaluate alternative networks where vehicle paths may be altered according to the changes to the transportation network. Further, VISSIM provides system-wide operational performance measures that better capture system-level measured delay and intersection capacities, and provides 3-D visualizations of corridor operations that can be used to better identify operational bottlenecks or deficiencies and make appropriate improvement recommendations.

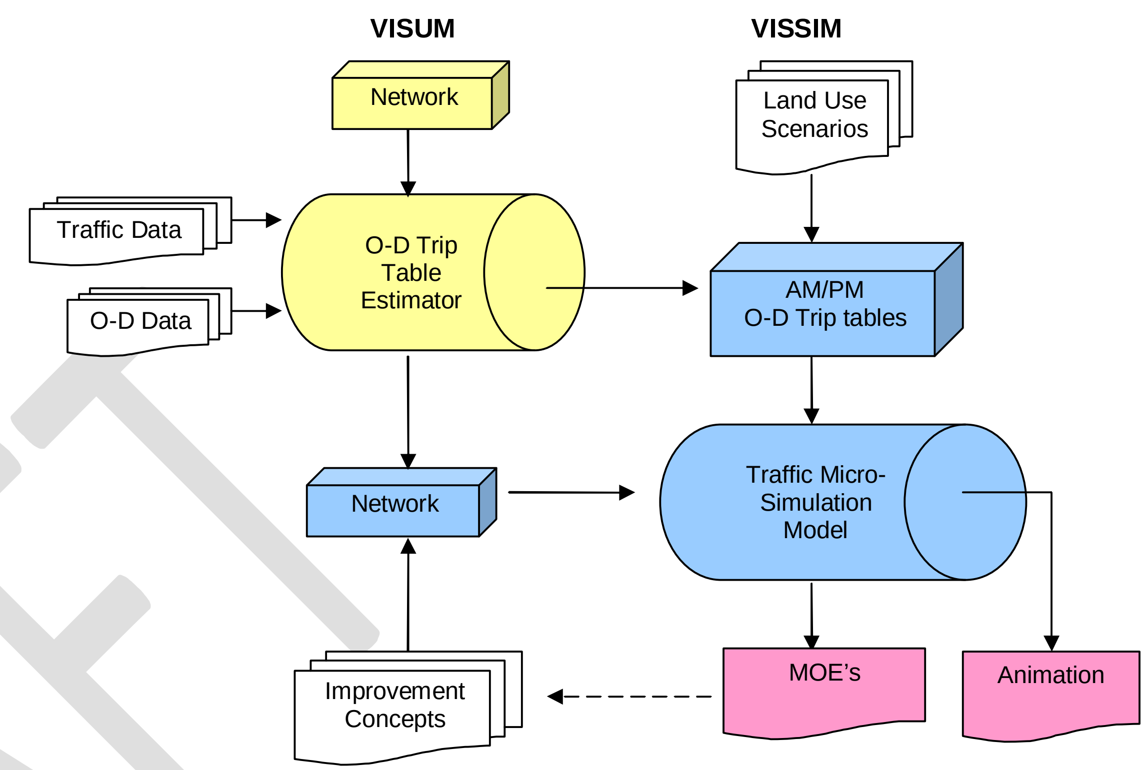
2.8.1. Model Development

The transportation network inside the Annandale CBC study area was coded in detail using VISUM and then exported to VISSIM for detailed operations evaluation. VISUM is a macroscopic traffic network input editor that allows input of the transportation network including streets, intersections, signals or other intersection priority, transit routes, and other network details. The VISUM model was also used to estimate origin-destination (O-D) trip tables based on the existing intersection turning movement and roadway link volumes. Coding a detailed network in VISUM makes the VISSIM network development more efficient and enables VISUM to incorporate traffic conditions when estimating the O-D trip table.

Once the street network was completed in VISUM and exported to VISSIM, the VISSIM model was constructed and given greater detail, including traffic signal operations, vehicle characteristics, driving behavior, and pedestrian and transit operations. Existing roadway and intersection geometry data such as number of lanes by turn movement, length of turn bay, lane alignments, stop bar placement, taper lengths, length of acceleration/deceleration lanes, and the location and type of traffic control devices were obtained through reviewing aerial photos (provided using Google Maps and Microsoft Virtual Earth) and verified by field reconnaissance. The VISSIM network also contains the setup for performing dynamic traffic assignment. The VISSIM network was developed to include "nodes" that represented each of the traffic analysis zones (TAZ) consistent with County subzones. The boundaries of the County subzones were refined to the VISSIM parking lots.

The flowchart in **Figure 7** presents a general overview of how the proposed VISUM and VISSIM modeling and analysis process was implemented.

FIGURE 7: Schematic of VISUM/VISSIM Traffic Analysis Methodology



VISSIM's capability to provide detailed 3D simulation models - depicting actual operating conditions, providing any audience with the ability to "see" the impacts and operations of various transportation systems - is an important tool in evaluating traffic operations. The simulation model will be run for two time periods (AM and PM peak) to determine peak-period operations including intersection delays, queues, signal failures, spillbacks and corridor travel times as well as overall network delays, travel times and vehicles served. The latter will be particularly helpful to determine the overall network efficiency in comparison to several other alternative networks.

2.8.2. Development of Existing Origin-Destination Trip Patterns

The use of dynamic traffic assignment in VISSIM requires input of the traffic demand in a trip table. An O-D trip table was estimated using the "TFlow Fuzzy" process in VISUM. Through this process, an O-D trip table is estimated using traffic count data and existing O-D information. Fairfax County provided O-D information derived from the Fairfax County Transportation Model, and land use information at the subzone level. The TAZs from the County model were refined into subzones based upon GIS employment and population data.

A by-product of this O-D trip table estimator process is the ability to address any potential trip diversion that may take place outside the VISSIM network due to congestion and/or improvements inside the VISSIM network. This capability is important when evaluating multiple networks that alter the trip path by network roadway and/or intersection changes.

Once the VISSIM trip assignments were made, a check was done to determine the accuracy of the OD derived link volume forecasts with the existing volume data. **Appendix B** includes a summary of the Base Year link and turn movement volume calibration data, showing on the x-axis the link model volume per hour and the y-axis the link volumes as determined by the field data. Overall the R-squared value for the linear regression analysis is 0.99 for both linear regression analyses, which indicates a very good fit to the existing data.

2.8.3. VISSIM Model Calibration

Validation of the VISSIM model results were based upon traffic operating conditions observed or collected in the field, ensuring the model can replicate field conditions. Desire speed curves were developed based upon the GPS data collected in the field and the speed data from the previous Annandale CBC Circulation Study. The performance of VISSIM model results was compared to existing conditions by these measures of effectiveness (MOEs):

- Intersection delays for critical movements
- Queues on critical intersection approaches
- Travel time along the major corridors

In general, the VISSIM model was able to replicate existing peak hour link and intersection volumes, with model differences of less than 10% in most locations. No adjustments were deemed necessary in the VISSIM model for the desired speed distribution curves. **Table 3** provides the comparison between model and existing condition volume and speed conditions. A full calibration report is available in **Appendix B**.

TABLE 3: VISSIM Calibration using Speed Data

Street & Direction	From	To	Distance (mile)	AM Peak Hour Model (mph)	AM Peak Hour GPS (mph)	PM Peak Hour Model (mph)	PM Peak Hour GPS (mph)
Little River Tprk EB	Start	Hummer Rd	0.20	10.3		5.4	
Little River Tprk EB	Hummer Rd	Woodland Rd	0.18	4.6		8.7	
Little River Tprk EB	Woodland Rd	Medford Dr	0.21	8.7	26.0	18.8	25.0
Little River Tprk EB	Medford Dr	Markham St	0.22	7.9		24.5	
Little River Tprk EB	Markham St.	Annandale Rd	0.17	6.3	9.0	6.4	7.0
Little River Tprk EB	Annandale Rd	Maple Pl	0.13	11.1	20.0	22.5	10.0
Little River Tprk EB	Maple Pl	John Marr Dr	0.23	17.7		13.5	
Little River Tprk EB	John Marr Dr	Evergreen Lane	0.26	18.2		18.2	
Little River Tprk EB	Evergreen Lane	End	0.25	31.5	30.0	31.4	34.0
Overall EB Average Travel Speed				**10.1**	**12-35**	**12.4**	**10-19**
Little River Tprk WB	Start	Evergreen Lane	0.25	21.1		20.0	
Little River Tprk WB	Evergreen Lane	John Marr Dr	0.26	14.2	14.0	12.0	12.0
Little River Tprk WB	John Marr Dr	Maple Pl	0.23	12.1	30.0	9.2	11.0
Little River Tprk WB	Maple Pl	Annandale Rd	0.13	13.8		6.5	
Little River Tprk WB	Annandale Rd	Markham St	0.17	27.4	23.0	19.3	25.0
Little River Tprk WB	Markham St	Medford Dr	0.22	14.0		14.0	
Little River Tprk WB	Medford Dr	Woodland Rd	0.21	4.8	12.0	3.6	12.0
Little River Tprk WB	Woodland Rd	Hummer Rd	0.18	5.3		5.0	
Little River Tprk WB	Hummer Rd	End	0.20	32.3		32.5	
Overall WB Average Travel Speed				**11.3**	**11-25**	**9.1**	**10-18**

2.9. Existing Conditions Operations Analysis

Based on the VISSIM analysis results of intersection delays for each approach link, a level of service (LOS) was developed for each intersection according to the level of service standards outlined by the Highway Capacity Manual (HCM). The HCM defines LOS according to the operational conditions and driver expectations for delays at signalized and unsignalized intersections on a grading scale of A through F, with A being optimal conditions and F being failure conditions. It is common practice to consider intersections operating at LOS D or better in the peak periods as having "acceptable" operations whereas intersections with a peak hour LOS exceeding LOS D to be in need of control or geometric improvements. The HCM LOS criteria are shown in **Table 4**. The LOS for existing condition intersections within the study area are summarized in **Table 5** and are illustrated in **Figure 8**. A full reporting of the LOS results for each intersection approach is included in **Appendix C**.

TABLE 4: HCM Level of Service Criteria

LOS	Description	Avg Delay Per Vehicle, sec Signalized	Avg Delay Per Vehicle, sec Unsignalized
A	Operations with very low control delay occurring with favorable progression and/or short cycle lengths.	0 to 10	0 to 10
B	Operations with low control delay, good progression and/or short cycle lengths.	10 to 20	10 to 15
C	Operations with average control delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear.	20 to 35	15 to 25
D	Operations with longer delays due unfavorable progression, occasional cycle failures and high V/C ratios; Considered limit of "acceptable" delay.	35 to 55	25 to 35
E	Operations with high control delays, poor progression, long cycle lengths, V/C ratios near 1.0; Considered limit of intersection capacity.	55 to 80	35 to 50
F	Operation with control delays unacceptable to most drivers occurring due to over-saturation, poor progression, or very long cycle lengths.	more than 80.0	more than 50.0

TABLE 5: Existing Conditions Level of Service Results

No	Intersection	Control	Level of Service AM	Level of Service PM
1	Little River Turnpike at Hummer Rd / Heritage Rd	Signal	**F**	**F**
2	Little River Turnpike at Woodlawn Road	Signal	**E**	D
3	Little River Turnpike at Medford Drive	Signal	**E**	-
4	Little River Turnpike at Markham Street	Signal	D	B
5	Little River Turnpike at Ravensworth / Annandale Rd	Signal	**F**	D
6	Little River Turnpike at Columbia Pike	Signal	C	**E**
7	Little River Turnpike at Backlick Road	Signal	**E**	**E**
8	Little River Turnpike at John Marr Drive	Signal	**F**	**E**
9	Little River Turnpike at Hillbrook Dr / Evergreen Lane	Signal	D	C
10	Annandale Rd at Maple Pl	Signal	B	C
11	Annandale Rd at Poplar St	Signal	B	C
12	John Marr Dr at Columbia Pike	Signal	**F**	D
13	John Marr Dr at Backlick Rd	Signal	**F**	D
14	Ravensworth Rd at John Marr Dr / McWhorter Pl	Signal	**F**	C
15	Ravensworth Rd at Heritage Dr	Signal	B	B
16	Columbia Pike at Evergreen Road	Signal	B	C
17	Columbia Pike at Maple Place	Signal	B	**F**
18	Columbia Pike at Gallows Road	Signal	C	**F**
19	Annandale Road at Gallows Road	Signal	**E**	D
20	Annandale Road at Hummer Road	Signal	D	D

Notes: BOLD text indicates an approach or intersection LOS that exceeds acceptable LOS D standards

2.10. Comparison to Existing Conditions and Annandale CBC Circulation Study

In general, the Existing Conditions analysis results compared favorably to the Annandale CBC Circulation Study with only a few signalized intersections showing no more than a one-letter difference in level of service grade and model intersection volumes reported within 10 percent of existing conditions.

The Annandale CBC Circulation Study indicates less delay and better LOS when compared to the results of this Annandale Transportation Study. Even though traffic volumes are similar in the two studies, increased delay and lower LOS for the present study is a function of the type of model used for traffic analysis. The VISSIM microscopic model captures the entire corridor delay and queues whereas Synchro, the macroscopic model used in Annandale CBC Circulation Study, captures only intersection delays.

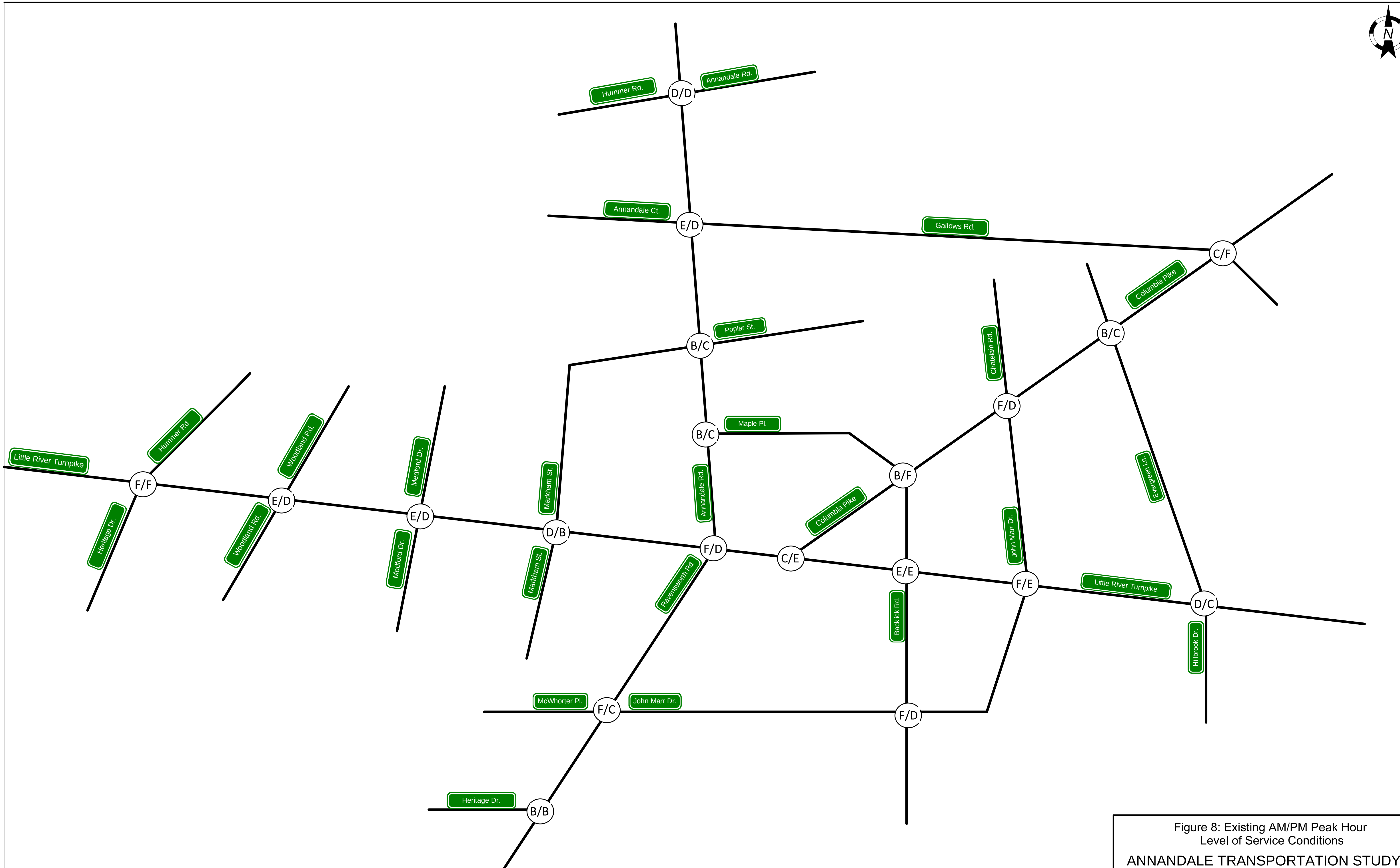


Figure 8: Existing AM/PM Peak Hour
Level of Service Conditions

ANNANDALE TRANSPORTATION STUDY

3. TRANSPORTATION NETWORK ALTERNATIVES

3.1. Networks Evaluated

Based on the previous transportation and land use studies for the Annandale CBC, nine transportation future condition networks were selected for detailed microsimulation analysis using the same models and methodologies used to evaluate existing conditions.

With the exception of Network 0 (No-Build) all of the alternatives included most if not all of the following transportation improvements recommended in the Comprehensive Plan for Fairfax County:

a) Widen Little River Turnpike to six lanes through the Annandale CBC.
b) Improvements to Annandale Road to upgrade to a continual four-lane roadway with turn bays at signalized intersections, including improvement of the horizontal alignment of Annandale Road north of Little River Turnpike.
c) Construct overpass that would take Annandale / Ravensworth over Little River Turnpike.
d) Closure of Little River Turnpike / Columbia Pike intersection; the current one-way section of Columbia Pike between Little River Turnpike and Backlick Road will be converted to two-way.
e) Realignment of Columbia Pike with Backlick Road including the realignment of Columbia Pike to intersect Poplar Street; the Maple Place / Columbia Pike / Backlick Road intersection is reconfigured to make Columbia Pike to Backlick Road the dominant through movement.
f) Consolidation of access and removal of service drives along Columbia Pike where sufficient inter-parcel access can be provided.
g) Construction of a roundabout at the intersection of Maple Place at Martin Avenue.
h) Extension of Poplar Street west of Daniels Avenue to Columbia Street, creating a new intersection with Tom Davis Drive.
i) Completion of the Southern Loop including improvements to Markham Street (south of Little River Turnpike) / McWhorter Place roadway connection to John Marr Drive.

The nine transportation networks that were evaluated using microsimulation are identified in **Table 6**. The network alternatives assumed the aforementioned Comprehensive Plan base conditions with the noted changes to the number and arrangement of lanes on Little River Turnpike and the condition with and without the Annandale/ Ravensworth overpass.

TABLE 6: Transportation Network Alternatives Evaluated using Microsimulation

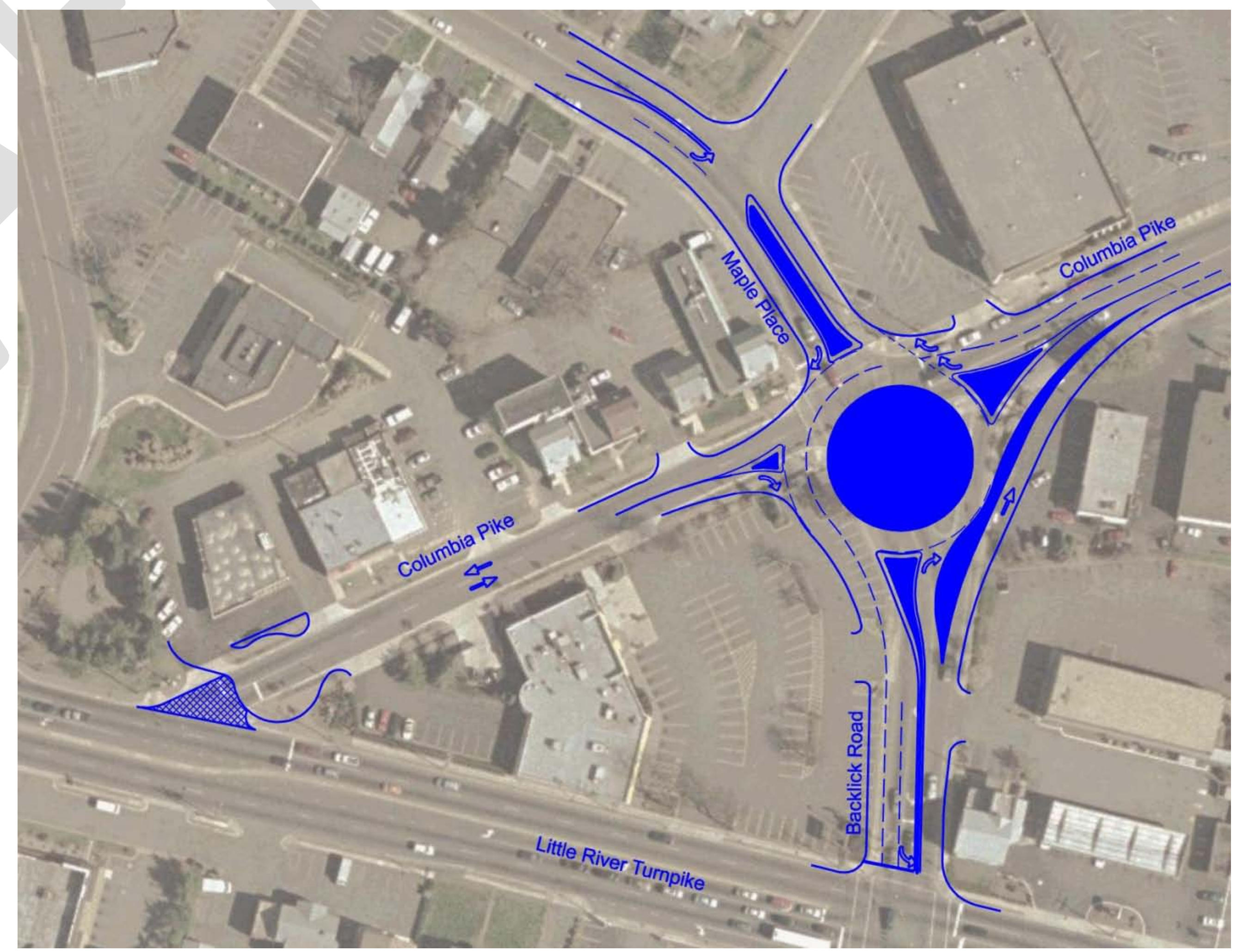
Network 0	No improvements to the current transportation network
Network 1	Only the Comprehensive Plan improvements
Network 2	Comprehensive Plan (Network 1) WITHOUT Annandale Road overpass
Network 4	Comprehensive Plan EXCEPT 4 lanes on Little River Turnpike
Network 4a	Comprehensive Plan EXCEPT 4 lanes on Little River Turnpike and WITHOUT overpass
Network 5	Comprehensive Plan WITHOUT overpass and one-way pair on LRT / south loop between John Marr Drive and Markham (3 WB lanes on LRT, 3 EB lanes on south loop)
Network 6	Comprehensive Plan WITHOUT overpass and 4 lanes on LRT PLUS one-way pair using both north and south loops between John Marr and Markham (2 WB lanes on north loop and 2 EB lanes on south loop)
Network 7	Comprehensive Plan WITHOUT overpass and 3-1 pair on LRT / south loop between John Marr and Markham (3 WB & 1 EB lanes on LRT, 3 EB & 1 WB lanes on south loop)
Network 8	Comprehensive Plan WITHOUT overpass, with median U-turns in a wide median along the LRT corridor between Hummer/Heritage and Evergreen Lane; replaces existing service drive

One additional change to the network was made to define the recommendation in the Comprehensive Plan to close Columbia Pike at Little River Turnpike and to establish the Backlick Road to Columbia Pike (north of Maple Place) connection as the dominant through movement. A concept was developed to place a dual-lane roundabout at the Columbia Pike / Backlick Road / Maple Place intersection allowing a better north-south movement connection, particularly in the northbound direction by creating a separate, exclusive lane so that northbound vehicles can by-pass entering the roundabout. This proposed configuration, identified in **Figure 9**, also provides better access to the properties in the section of Columbia Pike between Little River Turnpike and Maple Place after the intersection at Little River Turnpike is removed.

The proposed roundabout design provided better intersection operations than a conventional signalized intersection as the potential for queuing in the northbound direction is reduced and access to Columba Pike to the south is improved. The roundabout concept was evaluated in all the alternative networks. A signalized intersection that provides adequate capacity could be proposed as an alternative when intersection improvements are to be implemented.

With the addition of the Backlick / Columbia Pike / Maple Place roundabout into the network analyses, the Maple Place / Martin Avenue roundabout (currently in the Comprehensive Plan) becomes of lesser importance. Analysis results indicate the Maple Place / Martin Avenue intersection would have acceptable intersection operations as an unsignalized intersection. Further study, concept design and analysis are needed to determine if the proposed new roundabout precludes (due to close proximity) the roundabout at Maple Place included in the Comprehensive Plan.

FIGURE 9: Conceptual Backlick / Columbia Pike / Maple Place Roundabout



A forecast approach using the existing year O-D as the base had two major advantages including 1) it does not require further regional model runs, and 2) it provides consistent growth patterns for the internal zones according to the land use changes. Steps to developing the forecast model included the development of growth factors for the Parcel Groups inside the CBC and the external trips (not generated in the study area). The final growth factor table for the regional zone is shown in **Appendix D**, as is a figure illustrating the TP + regional forecast model TAZ zones.

Once the Year 2030 "Scenario A" regional subarea O-D was generated, the growth pattern was extrapolated to develop VISSIM "Scenario A" O-D trips. **Table 7** summarizes the total hourly traffic volume in the VISSIM network. The results show an overall 20% growth in the Annandale CBC transportation network traffic volumes between existing traffic levels and the 2030 forecast year.

TABLE 7: VISSIM Total Hourly Traffic Volume Growth Summary

	Existing	Scenario A	Overall Growth
AM	12,439	15,053	21.0%
PM	14,202	16,681	17.5%

This growth rate translates in similar overall growth rates of average daily traffic volumes on Little River Turnpike. Current average daily traffic volumes on Little River Turnpike range from 40,000 to 50,000 vehicles per day, and by 2030 the average daily traffic will have grown by an average of 10,000 vehicles to trip totals on Little River Turnpike of 50,000 to 60,000 vehicles per day.

3.2. Comparative Network Analysis Results

The VISSIM network analysis measures of effectiveness are compared in **Table 8** and intersection level-of-service are compared in and the resulting **Table 9** for each of the studied alternatives.

TABLE 8: Comparison of Network Measures of Effectiveness

	PM Peak Hour Intersection LOS Results								
Measure of Effectiveness	**Network 0:** No-Build	**Network 1:** 6-lane LRT (with flyover)	**Network 2:** 6-lane LRT (no flyover)	**Network 4:** 4-lane LRT (with flyover)	**Network 4A:** 4-lane LRT (no flyover)	**Network 5:** one-way pair LRT & S Loop	**Network 6:** 4-lane LRT & 1-way pair on N & S loops	**Network 7:** 1-way pair LRT & S loop, one EB lane on LRT	**Network 8:** Median U-turn corridor LRT
Little River Turnpike Avg EB travel speed, mph	6.2	9.4	8.7	7.6	4.0	8.3	7.7 / (6.7)	3.5 / (3.5)	5.5
Little River Turnpike Avg WB travel speed, mph	6.3	5.7	6.2	5.3	8.2	(10.9)	3.1 / (3.6)	6.5 / (5.2)	5.3
Network average delay time per vehicle, s	641.2	351.1	371.6	434.2	572.5	211.6	445.7	591.4	712.2
Network average speed (all vehicles), mph	4.1	7.0	6.7	6.1	4.5	10.9	5.6	4.5	3.5
Network total distance traveled (all vehicles), mi	16,101	21,003	20,340	19,637	16,606	24,483	18,070	16,445	14,149
Network number of vehicles processed (left network)	15,749	20,937	20,834	18,933	16,429	23,652	18,601	16,169	13,902

Legend: XX (YY) **= Traffic using Little River Turnpike (traffic using new loop roadways)**

TABLE 9: Comparison of Network PM Peak Hour LOS Results

		PM Peak Hour Intersection LOS Results								
ID	Intersection	**Network 0:** No-Build	**Network 1:** 6-lane LRT (with flyover)	**Network 2:** 6-lane LRT (no flyover)	**Network 4:** 4-lane LRT (with flyover)	**Network 4A:** 4-lane LRT (no flyover)	**Network 5:** one-way pair LRT & S Loop	**Network 6:** 4-lane LRT & 1-way pair on N & S loops	**Network 7:** 1-way pair LRT & S loop, one EB lane on LRT	**Network 8:** Median U-turn corridor LRT
1	Little River Turnpike at Hummer Rd / Heritage Rd	151.9 / F	149.4 / F	145.0 / F	168.3 / F	186.2 / F	164.8 / F	179.1 / F	180.0 / F	196.1 / F
2	Little River Turnpike at Woodlawn Road	70.5 / E	71.2 / E	76.1 / E	89.8 / F	78.1 / E	100.2 / F	135.4 / F	170.9 / F	180.9 / F
3	Little River Turnpike at Medford Drive	98.2 / F	121.9 / F	64.5 / E	90.4 / F	67.2 / E	59.7 / E	92.2 / F	229.9 / F	254.7 / F
4	Little River Turnpike at Markham Street	93.7 / F	80.9 / F	89.7 / F	120.3 / F	81.9 / F	26.5 / C	56.9 / E	142.2 / F	124.8 / F
5	Little River Turnpike at Ravensworth / Annandale	73.5 / E	n/a overpass	68.0 / E	n/a overpass	71.2 / E	48.6 / D	74.5 / E	58.2 / E	81.1 / F
6	Little River Turnpike at Columbia Pike	88.3 / F	n/a closed	n/a closed	n/a closed	n/a closed	n/a closed	n/a closed	n/a closed	n/a closed
7	Little River Turnpike at Backlick Road	120.8 / F	97.3 / F	54.2 / D	124.1 / F	57.8 / E	55.3 / E	107.2 / F	152.3 / F	171.3 / F
8	Little River Turnpike at John Marr Drive	131.5 / F	91.7 / F	130.6 / F	163.2 / F	123.4 / F	47.7 / D	133.6 / F	161.7 / F	201.6 / F
9	Little River Turnpike at Hillbrook Dr/Evergreen	140.5 / F	48.3 / D	112.3 / F	174.0 / F	175.6 / F	56.7 / E	178.0 / F	81.8 / F	94.2 / F
10	Annandale Road at Hummer Road	150.2 / F	55.7 / E	57.3 / E	59.7 / E	61.3 / E	56.2 / E	79.6 / E	112.8 / F	99.6 / F
11	Annandale Road at Gallows Road	121.6 / F	49.3 / D	50.2 / D	58.5 / E	50.8 / D	52.6 / D	57.7 / E	99.0 / F	88.7 / F
12	Annandale Road at Medford Drive	(F / F)	(C / D)	(B / C)	(E / F)	(D / F)	(A / B)	(F / F)	(F / F)	(F / F)
13	Annandale Road at Markham Street	158.5 / F	46.2 / D	52.4 / D	63.8 / E	80.8 / F	21.7 / C	131.6 / F	123.7 / F	136.2 / F
14	Annandale Road at Maple Place	133.0 / F	41.8 / D	38.8 / D	23.2 / C	105.8 / F	8.9 / A	91.3 / F	63.5 / E	70.5 / E
15	Ravensworth Rd at John Marr Drive / McWhorter	131.5 / F	19.5 / B	30.7 / C	160.2 / F	28.2 / C	34.0 / C	76.9 / E	80.1 / F	76.6 / E
16	Ravensworth Road at Heritage Dr	16.3 / B	14.6 / B	15.0 / B	15.2 / B	16.2 / B	15.0 / B	15.7 / B	16.1 / B	19.4 / B
17	John Marr Drive at Tom Davis	(F / F)	(D / F)	(F / F)	(F / F)	(F / F)	(A / A)	(A / A)	(F / F)	(F / F)
18	John Marr Drive at Columbia Pike	92.2 / F	73.4 / E	51.8 / D	242.6 / F	180.2 / F	21.9 / C	81.1 / F	250.9 / F	270.8 / F
19	John Marr Drive at Backlick Rd	126.6 / F	100.0 / F	47.0 / D	210.5 / F	57.4 / E	36.9 / D	111.7 / F	186.7 / F	194.1 / F
20	Columbia Pike at Gallows Road	303.5 / F	104.1 / F	125.6 / F	155.6 / F	233.8 / F	81.3 / F	119.4 / F	191.7 / F	185.9 / F
21	Columbia Pike at Evergreen Road	79.9 / E	34.1 / C	29.7 / C	90.9 / F	104.3 / F	20.3 / C	43.1 / D	105.1 / F	117.3 / F
22	Columbia Pike at Tom Davis Drive/Poplar Ext	114.3 / F	(E / F)	29.4 / C	146.7 / F	48.9 / D	(B / B)	(F / F)	115.9 / F	132.8 / F
23	Columbia Pike at Backlick Road / Maple Place	115.7 / F	82.1 / F	84.3 / F	65.2 / E	24.1 / C	62.1 / E	142.1 / F	115.2 / F	126.0 / F
24	Maple Place at Martin Ave	(F / F)	(F / F)	(F / F)	(F / F)	(F / F)	(D / D)	(F / F)	(E / F)	(E / F)

00.0 / A = Signalized Intersection Average Intersection Delay / LOS;
A / A = Unsignalized Intersection or Roundabout Overall LOS / Worst Movement LOS

A significant finding from the results in Tables 8 and 9 is that the Annandale flyover provides minimal operational benefits that are most likely outweighed by other transportation network and land use impacts. In comparing Network 1 (with the flyover) and Network 2 (without the flyover), the improvement in overall network delay between the networks is improved by less than 5-percent (351.1 sec per vehicle average delay with compared to 371.6 without). Comparing networks 1 with 2 and 4 with 4A (with and without the overpass) in Table 10, several individual intersections experience increased delay and worsening in LOS without the flyover, particularly at intersections adjacent to the overpass. Much of the delay timesavings by the overpass is merely transferred to these downstream intersections as shown by the minimal overall network timesavings in network 1 compared to network 2. The timesavings is more significant when comparing network 4 to network 4A, indicating a greater benefit by the inclusion of the overpass if Little River Turnpike is not widened and remains four lanes. However, network 4 (with the overpass) has significantly greater network delays compared to alternatives that widen Little River Turnpike, as the Annandale/Ravensworth intersection is not the sole cause of congestion along the Little River Turnpike corridor.

Construction of an overpass at Annandale / Ravensworth Road also limits access to the land parcels along Annandale and Ravensworth Roads, forcing motorists to pass through the Maple Place and John Marr intersections to gain access to these parcels. Lastly, an interchange would add significant costs to the project due to the complication of the realignment of Annandale, and may not be as cost-effective compared to at-grade solution with similar operational benefits.

The possibility of placing the overpass at Backlick Road in place of Annandale / Ravensworth Road was considered but rejected because the traffic volumes crossing Little River Turnpike at Annandale / Ravensworth are higher than at Backlick Road and fitting in an interchange at Little River Turnpike / Backlick Road would be more problematic due to its proximity to the Backlick / Columbia Pike intersection.

3.3. Short List of Network Alternatives

A meeting was held with Fairfax County Transportation and Department of Planning and Zoning to review the simulation model analysis result and make a determination on which of the nine future transportation networks would be shortlisted for further detailed evaluation.

In reviewing the results from Tables 8 and 9, the best performing networks in terms of overall network delays were Networks 1, 2, 4, 5 and 6, with a considerable decrease in performance between these networks and networks 0, 4a, 7 and 8. **Table 10** ranks the Ranks the network alternatives according to overall network delays and identifies the shortlisted networks.

- **Network 5** clearly provided the best intersection and network operational measures. It had the fewest intersections with failing operations (3), had the lowest network average delay and processed the most vehicles through the network.
- **Networks 1 and 2** were the next best network performers and both widen Little River Turnpike to six lanes. Of these two networks, Network 2 was selected to move forward based on the relatively small network improvement gains realized by the inclusion of the overpass (Network 1) compared to Network 2 without the interchange and the other negative impacts of the interchange as previously discussed.
- **Network 6**, which also retains four lanes on Little River Turnpike, showed better overall speeds, delays and vehicles processed than Network 4a and thus was recommended for further study as the best network that retains four lanes on Little River Turnpike.
- **Network 4** performed better than Network 4A, showing that if Little River Turnpike remains four lanes, the flyover included in Network 4 would have greater benefits.
- **Networks 7 and 8** had the most failing intersections (17) and that the highest network delays, lowest average speeds on Little River Turnpike and the fewest vehicles processed (except Alternative 0) and thus both Networks 7, 8 and 0 were dropped from further consideration.

In reviewing the network assumptions, the County suggested Network 7 would be substantially improved if the eastbound left turn lanes could be removed along the contraflow section on Little River Turnpike. This was one of the significant operational features identified as the cause for lower performance in the initial analysis. Therefore, the County requested that a revised Alternative 7 (Alternative 7A) be carried as a fourth shortlisted alternative to be studied in greater detail. Alternative 7A represents a compromise between Alternatives 2 and 5, providing both the one-way pair operations but with local access to businesses along LRT.

TABLE 10: Comparison of Network Measures of Effectiveness

Measure of Effectiveness	PM Peak Hour Intersection LOS Results								
	Network 5: one-way pair LRT & S Loop	**Network 1:** 6-lane LRT (with flyover)	**Network 2:** 6-lane LRT (no flyover)	**Network 4:** 4-lane LRT (with flyover)	**Network 6:** 4-lane LRT & 1-way pair on N & S loops	**Network 7:** 1-way pair LRT & S loop, one EB lane on LRT	**Network 4A:** 4-lane LRT (no flyover)	**Network 0:** No-Build	**Network 8:** Median U-turn corridor LRT
Little River Turnpike Avg EB travel speed, mph	8.3	9.4	8.7	7.6	7.7 / (6.7)	3.5 / (3.5)	4.0	6.2	5.5
Little River Turnpike Avg WB travel speed, mph	(10.9)	5.7	6.2	5.3	3.1 / (3.6)	6.5 / (5.2)	8.2	6.3	5.3
Network average delay time per vehicle, s	211.6	351.1	371.6	434.2	445.7	591.4	572.5	641.2	712.2
Network average speed (all vehicles), mph	10.9	7.0	6.7	6.1	5.6	4.5	4.5	4.1	3.5
Network total distance traveled (all vehicles), mi	24,483	21,003	20,340	19,637	18,070	16,445	16,606	16,101	14,149
Network number of vehicles processed (left network)	23,652	20,937	20,834	18,933	18,601	16,169	16,429	15,749	13,902

Legend: XX (YY) = Traffic using Little River Turnpike (traffic using new loop roadways)

4. DETAILED ANALYSIS OF SHORTLISTED ALTERNATIVES

The following section details the analysis of the range of shortlisted alternatives determined in the previous section to include Alternatives 2, 5, 6 and 7A.

4.1. Network Improvements

To determine if conditions for the networks selected for further study could be improved substantially by adding modest improvements to the networks, a series of testing and evaluating improvements to the model was undertaken, specifically identifying the intersections with the lowest level of service grades and identifying what feasible improvements might be implemented. The intersection improvements identified are summarized below.

- The Backlick / Columbia Pike / Maple Place roundabout was included in each alternative and signal timings were optimized at critical intersections.
- Right turn lanes were given overlap phasing (where applicable) to allow more right turns on red.
- Where safety permitted, left turn movements were changed to protected/permitted phasing (instead of just protected) to improve intersection efficiency.

<u>Network Alternative 2</u>:

- The northbound John Marr Drive approach to Little River Turnpike is improved to include left-only, through-only and right-only lanes.
- At the Little River Turnpike intersection with Hummer/Heritage, the eastbound Little Turnpike approach is improved to allow 3 through lanes.

- The southbound Backlick Road approach at Little River Turnpike was improved to include a left-only, a shared through-left, and a shared through-right with split phasing for the NB and SB phases.

Network Alternative 5:

- Improved the southbound approach lanes on Backlick Road at Little River Turnpike to a right turn only and two through lanes.
- At the Hummer/Heritage intersection, dedicated all 3 lanes of the Little River Turnpike as through lanes in the eastbound direction by adding an additional right turn bay.

Network Alternative 6:

- Improved the southbound lanes on Hummer / Heritage to be 1 right turn only and 2 through lanes at Little River Turnpike.
- At the Hummer/Heritage intersection, dedicated all 3 lanes of the Little River Turnpike as through lanes in the eastbound direction by adding an additional right turn bay.
- Improvements in vehicle paths were made in the model.

Network Alternative 7A:

- The Southern Loop on John Marr was made one-way eastbound only.
- On eastbound Little River Turnpike between Markham and John Marr (where there are three westbound travel lanes), left turn bays are provided at major intersections.
- Improvements in vehicle paths were made in the model.

4.2. Revised Network Analysis Results for Short listed Alternatives

Final VISSIM network and intersection results with these improvements are summarized in **Tables 11 and 12** respectively.

TABLE 11: Comparison of Shortlisted and Revised Network Measures of Effectiveness

	PM Peak Hour Intersection LOS Results			
Measure of Effectiveness	Network 5 one-way pair LRT & S Loop	Network 2 6-lane LRT (no flyover)	Network 6 4-lane LRT; NS loop 1-way pair	Network 7A LRT 1-way pair, contraflow EB ln
No of signalized intersections with failing operations (LOS F)	3	5	12	8
Number of intersections along LRT w/failing operations (LOS F)	2	4	6	3
Little River Turnpike Avg EB travel speed, mph	14.5	13.0	8.4 / (6.8)	11.4
Little River Turnpike Avg WB travel speed, mph	(13.9)	11.3	4.5 / (4.1)	6.2
Network average delay time per vehicle, s	217.3	220.8	430.6	471.0
Network average speed (all vehicles), mph	10.5	10.8	5.8	5.5
Network total distance traveled (all vehicles), mi	26,122	27,064	18,769	19,436
Network number of vehicles processed (left network)	25,119	25,600	18,995	18,454

Legend: XX (YY) = Traffic using Little River Turnpike (traffic using new loop roadways)

TABLE 12: Comparison of Selected Networks PM Peak Hour LOS Results

		PM Peak Hour Intersection LOS Results			
ID	Intersection	Network 5 one-way pair LRT & S Loop	Network 2 6-lane LRT (no flyover)	Network 6 4-lane LRT; NS loop 1-way pair	Network 7A LRT 1-way pair, contraflow EB ln
1	Little River Turnpike at Hummer Rd / Heritage Rd	**164.8 / F**	**145.0 / F**	**179.1 / F**	**116.9 / F**
2	Little River Turnpike at Woodlawn Road	**100.2 / F**	76.1 / E	**135.4 / F**	38.6 / D
3	Little River Turnpike at Medford Drive	59.7 / E	64.5 / E	**92.2 / F**	42.7 / D
4	Little River Turnpike at Markham Street	26.5 / C	**89.7 / F**	56.9 / E	41.3 / D
5	Little River Turnpike at Ravensworth / Annandale	48.6 / D	68.0 / E	74.5 / E	60.1 / E
6	Little River Turnpike at Columbia Pike	n/a closed	n/a closed	n/a closed	n/a closed
7	Little River Turnpike at Backlick Road	55.3 / E	54.2 / D	**107.2 / F**	72.5 / E
8	Little River Turnpike at John Marr Drive	47.7 / D	**130.6 / F**	**133.6 / F**	**183.3 / F**
9	Little River Turnpike at Hillbrook Dr/Evergreen	56.7 / E	**112.3 / F**	**178.0 / F**	**179.7 / F**
10	Annandale Road at Hummer Road	56.2 / E	57.3 / E	79.6 / E	70.6 / E
11	Annandale Road at Gallows Road	52.6 / D	50.2 / D	57.7 / E	52.7 / D
12	Annandale Road at Medford Drive	(A / B)	(B / C)	**(F / F)**	(C / D)
13	Annandale Road at Markham Street	21.7 / C	52.4 / D	**131.6 / F**	66.1 / E
14	Annandale Road at Maple Place	8.9 / A	38.8 / D	**91.3 / F**	21.4 / C
15	Ravensworth Rd at John Marr Drive / McWhorter	34.0 / C	30.7 / C	76.9 / E	62.2 / E
16	Ravensworth Road at Heritage Dr	15.0 / B	15.0 / B	15.7 / B	16.9 / B
17	John Marr Drive at Tom Davis	(A / A)	**(F / F)**	(A / A)	**(F / F)**
18	John Marr Drive at Columbia Pike	21.9 / C	51.8 / D	**81.1 / F**	**138.4 / F**
19	John Marr Drive at Backlick Rd	36.9 / D	47.0 / D	**111.7 / F**	70.3 / E
20	Columbia Pike at Gallows Road	**81.3 / F**	**125.6 / F**	**119.4 / F**	**154.3 / F**
21	Columbia Pike at Evergreen Road	20.3 / C	29.7 / C	43.1 / D	**118.7 / F**
22	Columbia Pike at Tom Davis Drive/Poplar Ext	17.7 / B	29.4 / C	**(F / F)**	**97.6 / F**
23	Columbia Pike at Backlick Road / Maple Place	62.1 / E	74.7 / E	**142.1 / F**	**135.0 / F**
24	Maple Place at Martin Ave	(D / D)	**(F / F)**	**(F / F)**	**(F / F)**

00.0 / A = Signalized Intersection Average Intersection Delay / LOS
A / A = Unsignalized Intersection or Roundabout Overall LOS / Worst Movement LOS

4.3. Qualitative Network Comparison

Table 13 provides a matrix summary of a study of several qualitative issues associated with transportation improvements in the study area for each of the shortlisted alternatives. The qualitative analysis highlights potential alternative impacts to traffic, utilities, property / right-of-way, pedestrian/bicyclists and transit in the corridor. An estimate of the magnitude of the costs for each alternative was made for comparison purposes only, as they are not based on details of construction costs and activities.

4.4. Final Networks Selected for Public Presentation

At a final meeting with Fairfax County Transportation and Department of Planning and Zoning, the results from the four shortlisted alternatives were reviewed and a determination was made that the County would present Alternatives 2 and 5 to the public as viable alternatives for implementation. It was determined that both alternatives have similar merits overall from a traffic capacity and circulation aspect, though each alternative have a distinct set of advantages and disadvantages. The qualitative issues will be important in selecting the final preferred alternative. County staff has reservations about the ability of Alternatives 6 and 7A to handle future traffic demands and circulation in the CBC area, but are comfortable with the implementation of either Alternative 2 or 5 and that these alternatives would be more readily accepted by the Virginia Department of Transportation as long-term solution for this corridor. The widening of Little River Turnpike (for either the whole of Alternative 2 or in portions of Alternative 5) has less of an impact than previously believed because of the ability to forego the right-of-way requirements normally assumed for the continuous service drive. Traffic operation study results shows that for both Alternatives 2 and 5, the service drive has a negative impact to traffic operations at cross street intersections, particularly at the Hummer / Heritage intersection. The removal of existing portions of the service drives in the corridor substantially reduces right-of-way impacts and at the planning level, can be implemented within the VDOT access management guidelines.

5. TESTING NETWORKS WITH ADDITIONAL LAND USE SCENARIOS

This Annandale Transportation Study was originally scoped to include an evaluation of up to three alternative land use scenarios, two others that would reflect either higher or lower future land use intensities in and around to the Annandale CBC area compared to the Comprehensive Plan modeling assumptions. However, the process of the Annandale Transportation Study led to the further development and refinement of several of the alternative networks using the funds previously allocated to the land use scenarios. The final networks selected (Alternatives 2 and 5) have nearly identical impacts to capacity and operations within the Annandale CBC network and slightly different land use scenarios would be unlikely to change either network performance or be a differentiator between the two networks. Further, the land use assumptions being developed in parallel to this study were not quite ready for analysis at the time this study was published. The County has reserved the ability to re-visit an additional land use study if warranted in the future.

TABLE 13: Qualitative Annandale Network Comparison Matrix

network alternative	impacts on land use	economic development impacts	impacts on urban design / visual realm	utility impacts	property and right-of-way impacts / takings	intersection improvements[1]	impacts on vehicular operations and access	parking, pedestrian/bicycle circulation impacts	overall impacts to traffic safety	transit impacts along LRT	relative project costs
Network 2: 6-lane LRT (no flyover)	No significant impact to current land use; land uses will be driven by those supporting traffic along main LRT corridor	No significant economic impacts to land uses along the LRT corridor	Building set-backs greater along LRT due to wider street cross section; parking would have to be collected in lots/garages or in the rear of most businesses	Widening of LRT will have some impact to roadside utilities; however, utilities can be relocated/buried in abandoned service drive areas	Requires sliver ROW acquisitions and/or or parking modifications along corridor; Requires 1 full take due to Annandale Road realignment and 1 full take in the NW quadrant of Annandale/LRT intersection - OR - 2 takes in the SW quadrant (depending if LRT is shifted north or south)	Dual lefts provided on eastbound LRT at Hummer; Dual lefts provided on westbound LRT at John Marr; Alignment Improvements at the LRT / Annandale / Ravensworth intersection	Design would remove frontage road for length of the corridor (where present); may require consolidation of some access points and elimination of direct access	Excess ROW where frontage roads removed provide additional green space, pedestrian amenities and/or transit service; pedestrians have longer cross distance but median refuge on LRT	Some safety improvement to the corridor, as access is managed by introducing a center median that also serves as a refuge for pedestrian crossings; number of direct access points to LRT are increased by removal of service drive; traffic operations are most efficient, which is good for transit headways	Most of corridor has additional room for transit amenities such as bus pull-offs, wider sidewalks and larger shelter pads; bus transfer station could be developed w/sufficient access and circulation fronting LRT	Moderate-High implementation costs due to rebuild of LRT corridor and property impacts
Network 5: one-way pair LRT & S Loop	Potential to spread out land use area of influence to the south, particularly along John Marr Drive; land uses likely to change to those that support commuter traffic needs; drivers need to become accustomed to different access patterns on one-way streets	Could be slight economic loss to site uses dependant on pass-by traffic along one-way segments; however, losses should be minimal as most corridor land uses are not dependant on pass-by traffic. Potential to increase land use value over wider area of influence in CBD	One-way streets can support closer building footprints to roadway and greater potential for on-street parking to support "activity" businesses; some of existing pavement on LRT can be reclaimed for transportation and streetscape amenities	Fewer impacts to utilities compared to Alternative 2 as one-way section along LRT does not require widening. In areas where LRT is widened, utilities can be relocated/buried in abandoned service drive areas	Requires new ROW for the Markham-to-McWhorter connection; Requires 1 full take due to Annandale Road realignment; no ROW or property impacts along LRT or John Marr Drive between Markham and the LRT/John Marr intersection	Dual lefts provided on eastbound LRT at Hummer; Alignment Improvements at the LRT / Annandale / Ravensworth intersection; LRT and John Marr intersections with Markham/McWhorter, Ravensworth and Backlick converted to one-way (signal, marking and sign improvements)	Design would remove frontage road for length of the corridor (where present); properties on one-way streets have new indirect access patterns, though no closings are required; Additional signage and wayfinding needed	Shorter pedestrian crossing distances of one-way streets; additional pavement on LRT between John Marr and Markham can be used for pedestrian and transit amenities	Potentially greatest improvement to safety of the alternatives, as access is managed by one-way streets and pedestrian crossings are shorter and only in conflict with vehicles in one direction; traffic operations are most efficient, which is good for transit headways	All of LRT / John Marr corridor has additional room for transit amenities such as bus pull-offs, wider sidewalks and larger shelter pads; however, bus circulation patterns and stops would be less straightforward	Low implementation costs due to no new pavement (costs inc. signals, signage and striping modifications
Network 6: 4-lane LRT & one-way pair on N & S loops	Potential to spread out land use area of influence to the north and south; residential land uses along northern loop would likely change to offices/commercial over time; drivers need to become accustomed to different access patterns on one-way streets	Could be slight economic loss to site uses dependant on pass-by traffic along one-way segments; however, losses should not be significant as most land uses along the corridor are not dependant on pass-by traffic. Potential to increase land use value over wider area of influence in CBD	One-way streets can support closer building footprints to roadway and greater potential for on-street parking to support "activity" businesses	Fewest impacts to utilities as no widening on LRT is required and utilities can largely remain	ROW and 1 property take for connection of Annandale Center Court to Poplar Street; Poplar and Markham Streets cuts through the core of the CBD area using smaller footprint street (conversion of two-lane street into two one-way lanes); No ROW/property impacts along LRT; Requires 1 full take due to Annandale Road realignment	North and South Loop cross street converted to one-way (signal, marking and sign improvements); Modifications for dual RT lanes on LRT at Markham and at John Marr	Properties on one-way streets along both one-way pairs (North and South Loop) have new indirect access patterns, though no closings or access consolidation is required; Additional signage and wayfinding needed	Additional pavement on Markham/McWhorter/John Marr and on Annandale Center/Poplar/ Markham could be used for bike lanes &other pedestrian amenities; Transit route would need to be revised to one-way patterns. Shorter and safer pedestrian crossings of one-way streets; No additional ROW for transit/ pedestrian amenities on LRT	High level of improvement to safety on loop roadways, as access is managed by one-way streets and pedestrian crossings are shorter and only in conflict with vehicles in one direction; number of direct access points to LRT are increased by removal of service drive.	Additional room for transit amenities such as bus pull-offs, wider sidewalks and larger shelter pads could be built into the corridor(s); circulatory system could be developed around the loop roadway	Moderate implement-ation costs due to additional impacts and construction of link on Northern Loop and conversion to one-way streets on both loops
Network 7A: 3+1 pair on LRT & south loop	No significant impact to current land use; land uses will be driven by those supporting traffic along main LRT corridor	Could be slight economic loss to site uses dependant on pass-by trips, particularly for thru traffic; mix of one-way and contraflow lane on LRT may help business access but may be confusing to motorists	One-way streets can support closer building footprints to roadway and greater potential for on-street parking to support "activity" businesses; however some of that is lost on LRT due to the contraflow lane	Fewest impacts to utilities as no widening on LRT is required and utilities can largely remain	Requires sliver ROW/property impacts along Markham / McWhorter; no impacts along LRT or John Marr Drive; Requires 1 full take due to Annandale Road realignment	Modest improvements to LRT intersections with John Marr and Markham to accommodate Southern Loop; One EB thru, one EB turn bay & three WB lanes provided on LRT	Frontage roads along LRT remain; LRT and Northern Loop streets remain two way - no closings or access consolidation is required, though additional signage and wayfinding needed to direct traffic to use local / through streets.	Conventional pedestrian crossings at all intersections; No additional ROW for transit/pedestrian amenities on LRT; Additional pavement on Markham/ McWhorter/John Marr could be used for bike lanes & other pedestrian amenities	Some safety improvement to the corridor, as access is managed by introducing a center median that also serves as a refuge for pedestrian crossings; number of direct access points to LRT are increased by removal of service drive.	Most of corridor has additional room for transit amenities such as bus pull-offs, wider sidewalks and larger shelter pads; bus transfer station could be developed w/sufficient access and circulation fronting LRT	Low implementation costs due to no new pavement (costs inc. signage and striping modifications only)

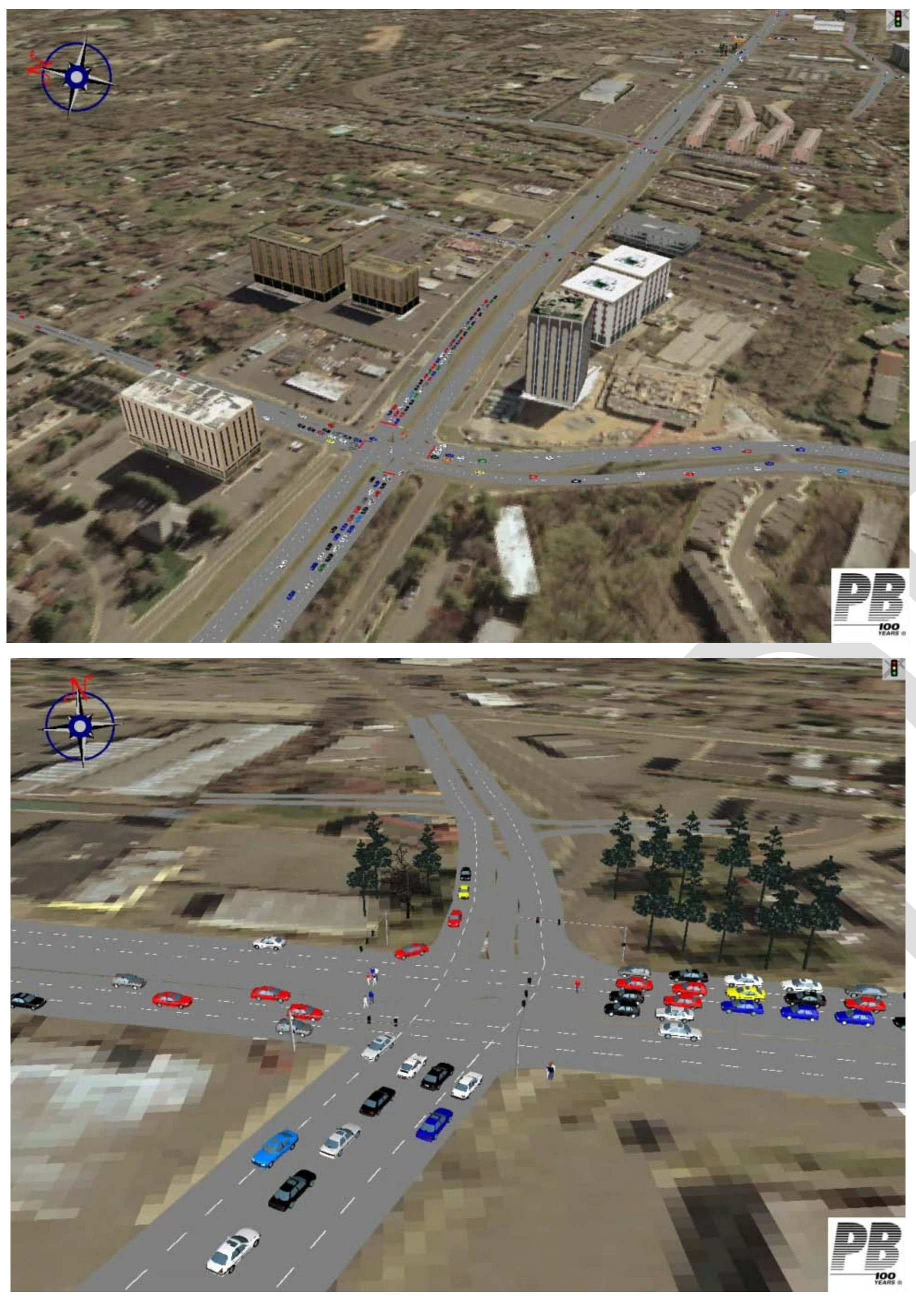
[1] **Note:** Intersection improvements shared by all alternatives include realignment of Annandale Road, closure of Columbia Pike at LRT and Backlick/Columbia Pike improvements (assumed roundabout)

6. ENHANCED SIMULATION ANALYSIS

Enhanced simulation models were prepared for the final network Alternatives 2 and 5, extrapolating the VISSIM models used for analysis to create animation files that present a better representation of traffic, pedestrian and transit operations in the corridor. The intent is to use these videos at the public presentation of the alternatives to give the public a clearer view of future operations and impacts of the future alternatives.

The videos include 3-D graphical enhancements of a representative number of identifiable buildings in the corridor so that the viewer can understand where they are in the corridor during all parts of the simulation. The simulations also include white block buildings in the corridor that represent the scope and scale of future land use changes in the corridor. Several snapshots of the visual animations are included in **Figure 10**

FIGURE 10: Enhanced Simulation Snapshots



7. CROSS-SECTION AND CONCEPT PLAN VIEW ANALYSIS

For the final network Alternatives 2 and 5, context-sensitive design (CSD) cross sections and plan view concepts were developed to determine the impacts of the respective concepts. Typical horizontal cross sections prepared illustrate the various cross-sectional elements in the corridor, including travel lanes, turn lanes, parking lanes, sidewalk widths, planting strips, tree wells, medians, bicycle lanes, transit stops, street lighting and building scale. The CSD concept plan illustrates all impacts to right-of-way, parking, access, driveways, properties, major utilities, transit stops, sidewalks and street trees.

The goal of the corridor cross sections and concept are to foster a future walkable environment within the Annandale CBC area, maximizing pedestrian and bicycle connectivity, accessibility to transit and enhanced green spaces along the corridor. Pedestrian and urban design features will also include benches, bicycle racks, parking buffers, outdoor seating, building entries, curb extensions etc. Linking the corridor public space with land use and the urban form of the corridor is a critical element of the Annandale CBC.

7.1. Alternative 2: Widen Little River Turnpike to 6 lanes

A cross section detail was prepared for the Alternative 2 (six-lane Little River Turnpike) for several points along the corridor and is illustrated in **Figure 11**. The current corridor cross section for most of the corridor (top) includes 166 feet from edge of curb to edge of curb on the service drives. However, it was noted in the evaluation of the current cross section along Little River Turnpike that there is more than sufficient room to widen Little River Turnpike if the service drives were removed (see **section 7.3** for a discussion on the removal of service drives). Figure 11 identifies two options for the widening of LRT that remove the service drives but stay significantly inside of the current right of way boundaries along Little River Turnpike.

For a several block section of Little River Turnpike between Annandale and Backlick Roads, the current corridor cross-section does not include continuous service drives, and the impacts of widening become greater. Through this section, there is only 78 feet from back of sidewalk to back of sidewalk and a minimum of 100 feet is needed for the widened cross section. The corridor impacts are most pronounced here and are examined in the plan view concept prepared for the corridor.

Figures 12a-d illustrate plan view concepts of Alternative 2 for the length of the study corridor.

7.2. Alternative 5: One-Way Pair on Little River Turnpike and John Marr

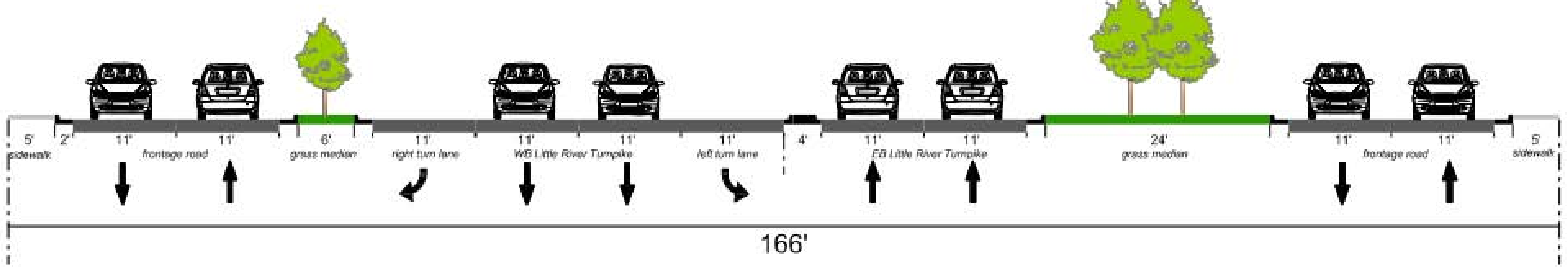
A cross section detail was also prepared for the Alternative 5 (one-way pair on Little River Turnpike and John Marr Drive) for several points along the corridor and is illustrated in **Figure 13**. The current corridor cross section for most of the corridor (top) includes the same 166 feet from edge of curb to edge of curb on the service drives. As was identified in the cross section for Alternative 2, there is more than sufficient room to widen Little River Turnpike if the service drives were removed for the sections west of Markham Street, and east of the Little River Turnpike /John Marr Drive intersection (top typical section).

For the section of Little River Turnpike and McWhorter / John Marr Drive between the Little River Turnpike / Markham and Little River Turnpike / John Marr Drive intersections, both roadways are converted to three directional lanes, with three eastbound lanes on Markham / John Marr Drive and three westbound lanes on Little River Turnpike. On both roadways, there is sufficient pavement and excess right-of-way so that no new right-of way is required. The exception is the need for a short connection between Markham Street and McWhorter. The typical section on both roadways allows for conversion of “excess” existing pavement and sidewalks to be used for either a greater boundary between the roadways and the adjacent land uses (potentially adding a tree-lined boundary), or greater pedestrian and bike path widths and amenities. As in Alternative 2, no attempt was made within this study to define or recommend a corridor configuration; rather to identify the options gained by converting travel lanes.

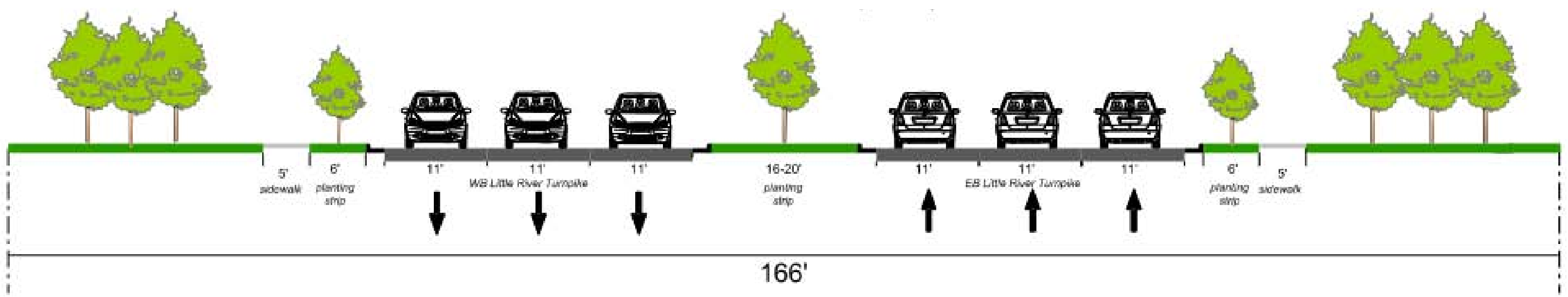
Figures 14a-d illustrate plan view concepts of Alternative 5 for the length of the study corridor.

FIGURE 11: Conceptual Alternative 2 Cross Section Details

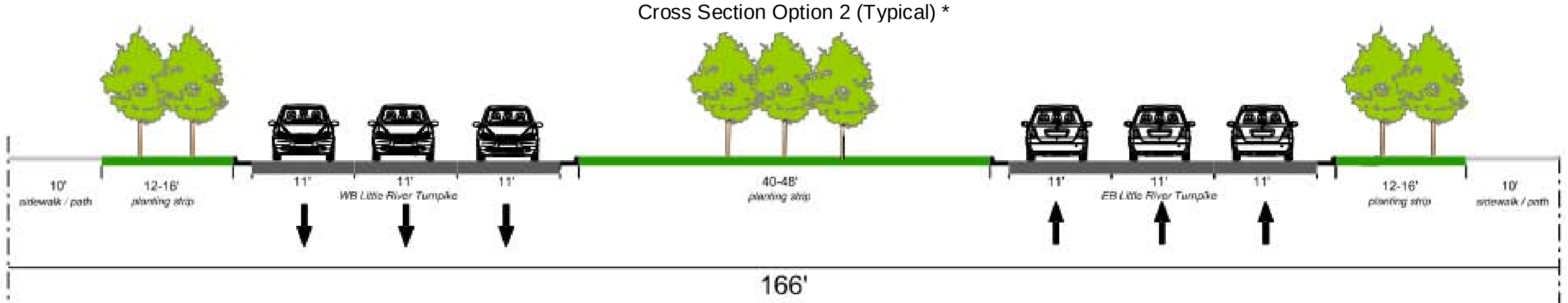
Little River Turnpike East of Medford Drive
Existing Cross Section (Typical)



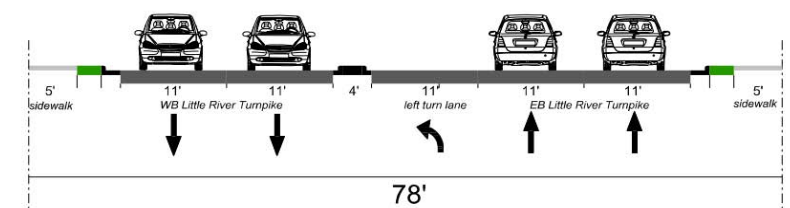
Little River Turnpike East of Medford Drive
Cross Section Option 1 (Typical) *



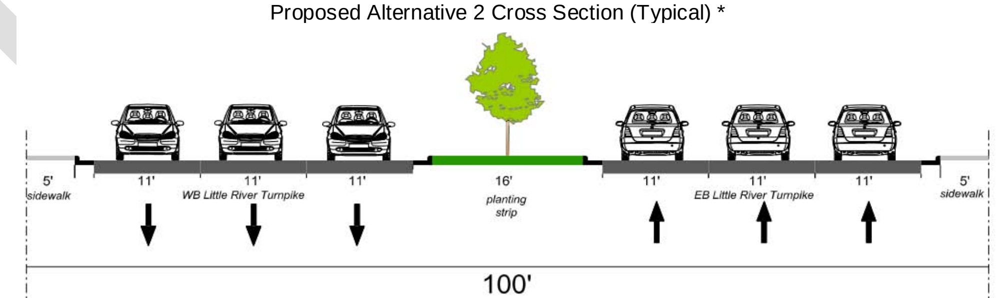
Little River Turnpike East of Medford Drive
Cross Section Option 2 (Typical) *



Little River Turnpike between Annandale / Backlick
Existing Cross Section (Typical) *



Little River Turnpike between Annandale / Backlick
Proposed Alternative 2 Cross Section (Typical) *

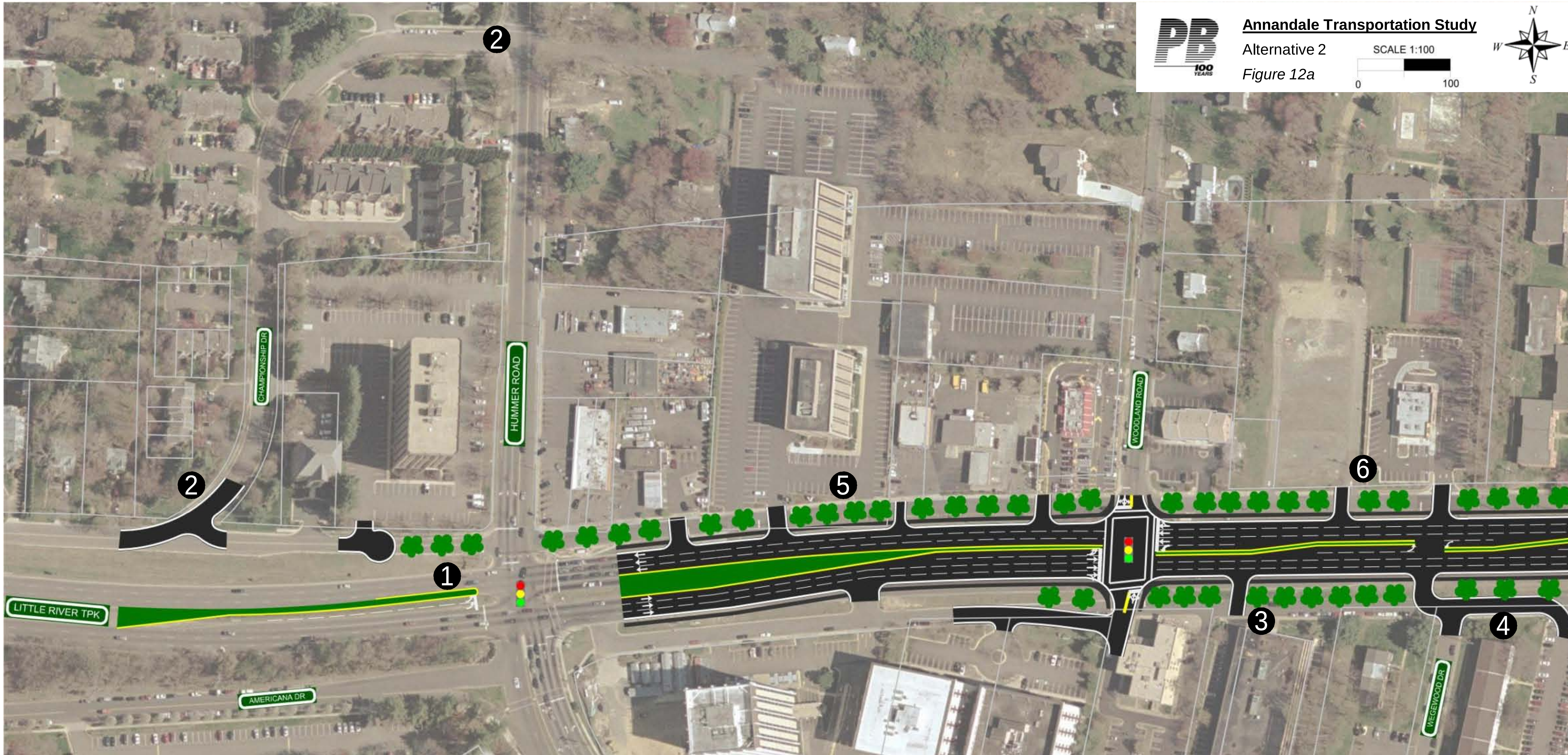


* Reduced median width where left turn bays are present

Annandale Transportation Study

Alternative 2

Figure 12a



1. Improvements in the westernmost section of Little River Turnpike include provision of an eastbound dual left turn lane at Hummer Road within the existing median; therefore, no additional ROW is required for this improvement .
2. The service drive on the north side is closed at its intersection with Hummer and realigned with Championship Drive which has access to Hummer Drive 1,000' north of Little River Turnpike. This will substantially improve operations at the Little River Turnpike/Hummer intersections by removing the Service Drive operational impacts.
3. The first south side driveway east of Woodland Road has adequate spacing from Woodlawn intersection but would require U-turn movements for access from east and to west on LRT unless an inter-parcel connection is made to the parcel to the west that has access to the signal at Woodlawn or access to the parcel to the east to gain access to the median break.
4. The first and second driveways (proposed to be consolidated) east of Wedgewood Road (serving the existing housing complex) has adequate spacing from the Medford intersection but would require U-turn movement for access from east unless the section of the current service drive is left that would connect all drives to Medford Drive.
5. The access points between Woodlawn and Hummer would all be made right-in/right-out (RIRO) due to the median in LRT. All these parcels have alternative access to Hummer Road. Interparcel access could possibly further reduce the number of direct access points to Little River Turnpike.
6. A mid-block unsignalized crossover in the median provides direct access to the McDonalds and the apartments on the south side of Little River Turnpike. One vacant parcel on the north side of Little River Turnpike will have right-in/right out access; however, an interparcel agreement may be reached at when this parcel is developed to provide access to either the signal at Woodland or the median crossover.

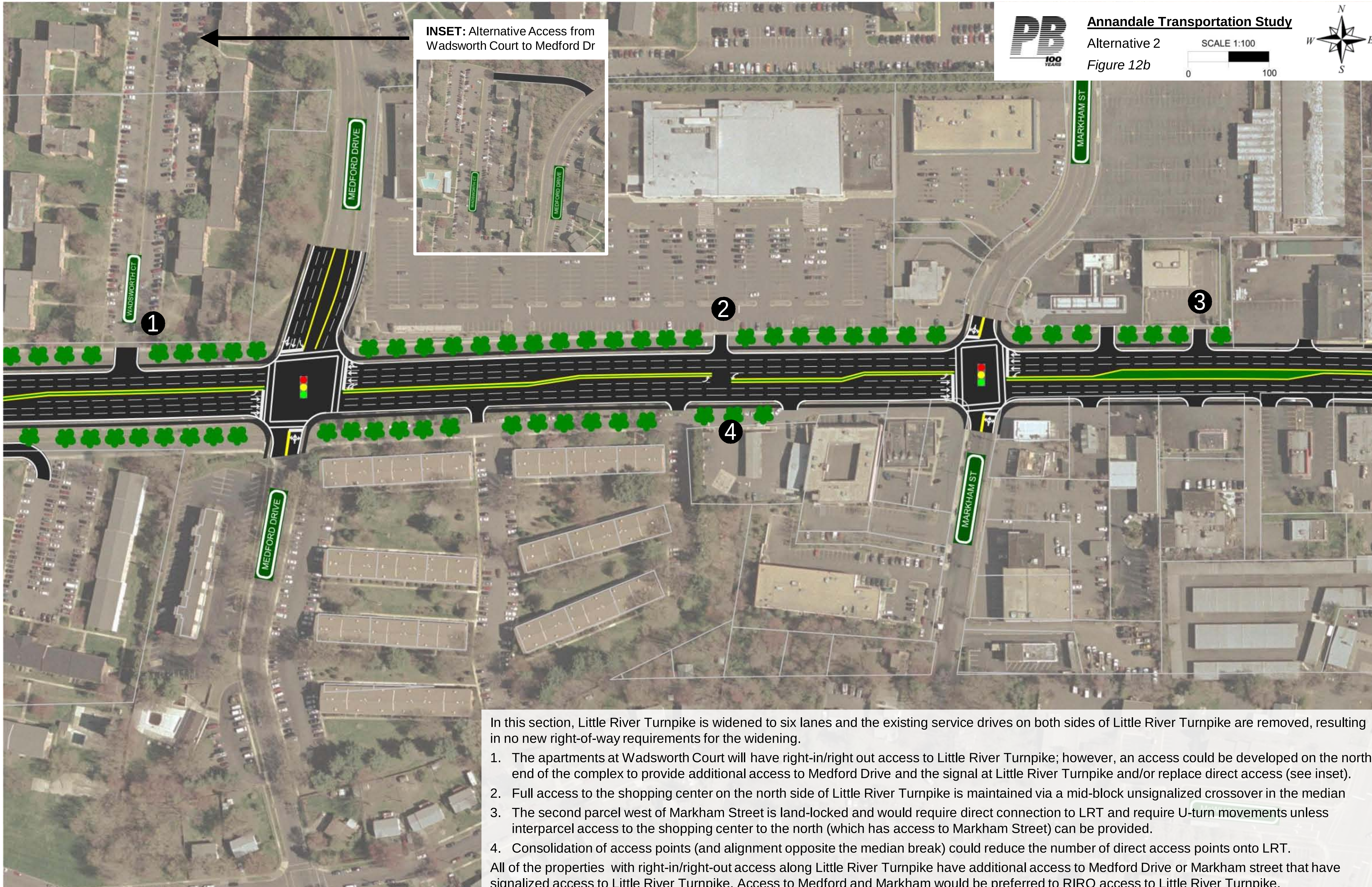
Annandale Transportation Study

Alternative 2

Figure 12b

SCALE 1:100

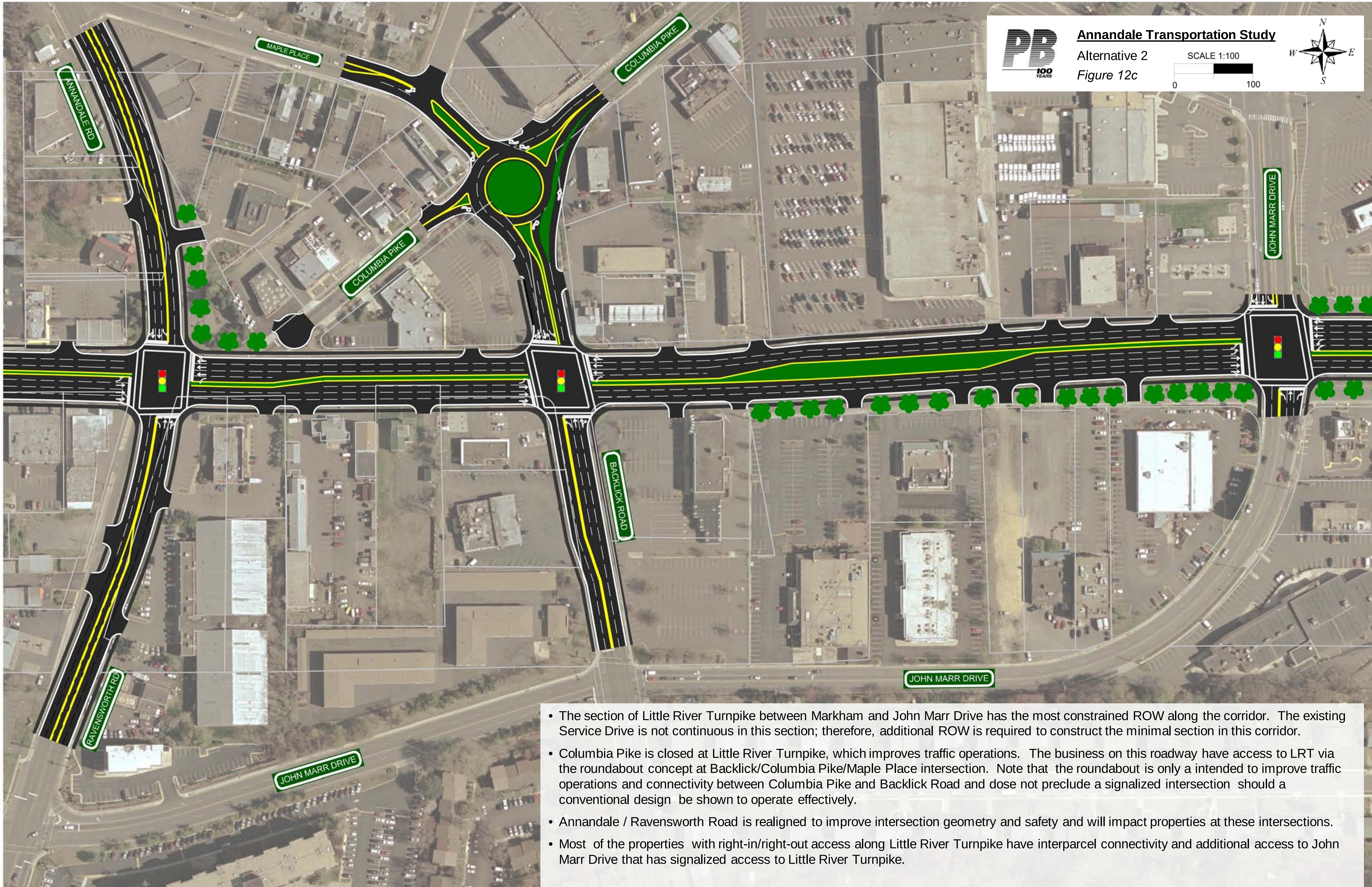
0 100



In this section, Little River Turnpike is widened to six lanes and the existing service drives on both sides of Little River Turnpike are removed, resulting in no new right-of-way requirements for the widening.

1. The apartments at Wadsworth Court will have right-in/right out access to Little River Turnpike; however, an access could be developed on the north end of the complex to provide additional access to Medford Drive and the signal at Little River Turnpike and/or replace direct access (see inset).
2. Full access to the shopping center on the north side of Little River Turnpike is maintained via a mid-block unsignalized crossover in the median
3. The second parcel west of Markham Street is land-locked and would require direct connection to LRT and require U-turn movements unless interparcel access to the shopping center to the north (which has access to Markham Street) can be provided.
4. Consolidation of access points (and alignment opposite the median break) could reduce the number of direct access points onto LRT.

All of the properties with right-in/right-out access along Little River Turnpike have additional access to Medford Drive or Markham street that have signalized access to Little River Turnpike. Access to Medford and Markham would be preferred to RIRO access to Little River Turnpike.



- The section of Little River Turnpike between Markham and John Marr Drive has the most constrained ROW along the corridor. The existing Service Drive is not continuous in this section; therefore, additional ROW is required to construct the minimal section in this corridor.
- Columbia Pike is closed at Little River Turnpike, which improves traffic operations. The business on this roadway have access to LRT via the roundabout concept at Backlick/Columbia Pike/Maple Place intersection. Note that the roundabout is only a intended to improve traffic operations and connectivity between Columbia Pike and Backlick Road and dose not preclude a signalized intersection should a conventional design be shown to operate effectively.
- Annandale / Ravensworth Road is realigned to improve intersection geometry and safety and will impact properties at these intersections.
- Most of the properties with right-in/right-out access along Little River Turnpike have interparcel connectivity and additional access to John Marr Drive that has signalized access to Little River Turnpike.

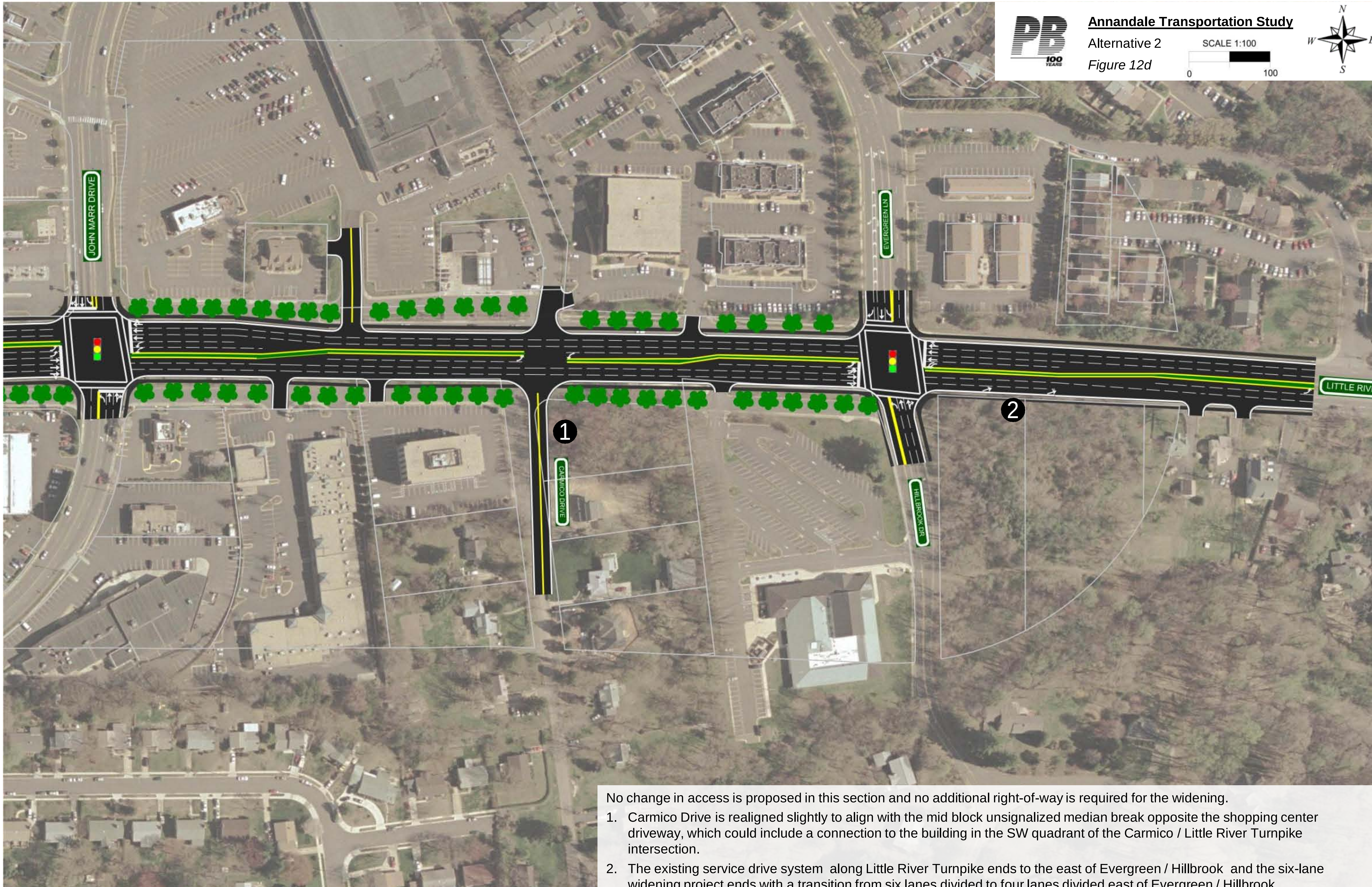
Annandale Transportation Study

Alternative 2

Figure 12d

SCALE 1:100

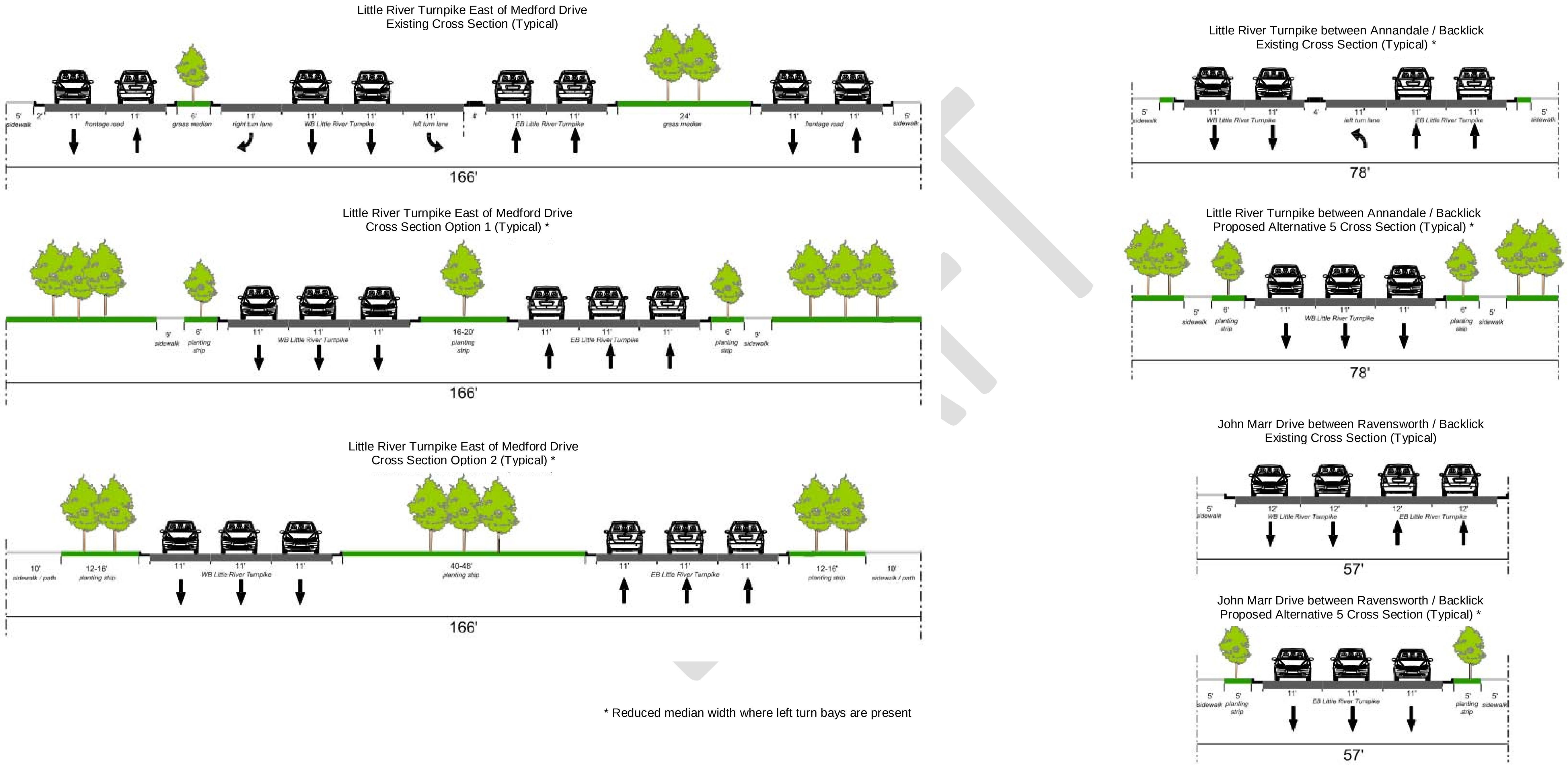
0 100



No change in access is proposed in this section and no additional right-of-way is required for the widening.

1. Carmico Drive is realigned slightly to align with the mid block unsignalized median break opposite the shopping center driveway, which could include a connection to the building in the SW quadrant of the Carmico / Little River Turnpike intersection.
2. The existing service drive system along Little River Turnpike ends to the east of Evergreen / Hillbrook and the six-lane widening project ends with a transition from six lanes divided to four lanes divided east of Evergreen / Hillbrook .

FIGURE 13: Conceptual Alternative 5 Cross Section Details



* Reduced median width where left turn bays are present

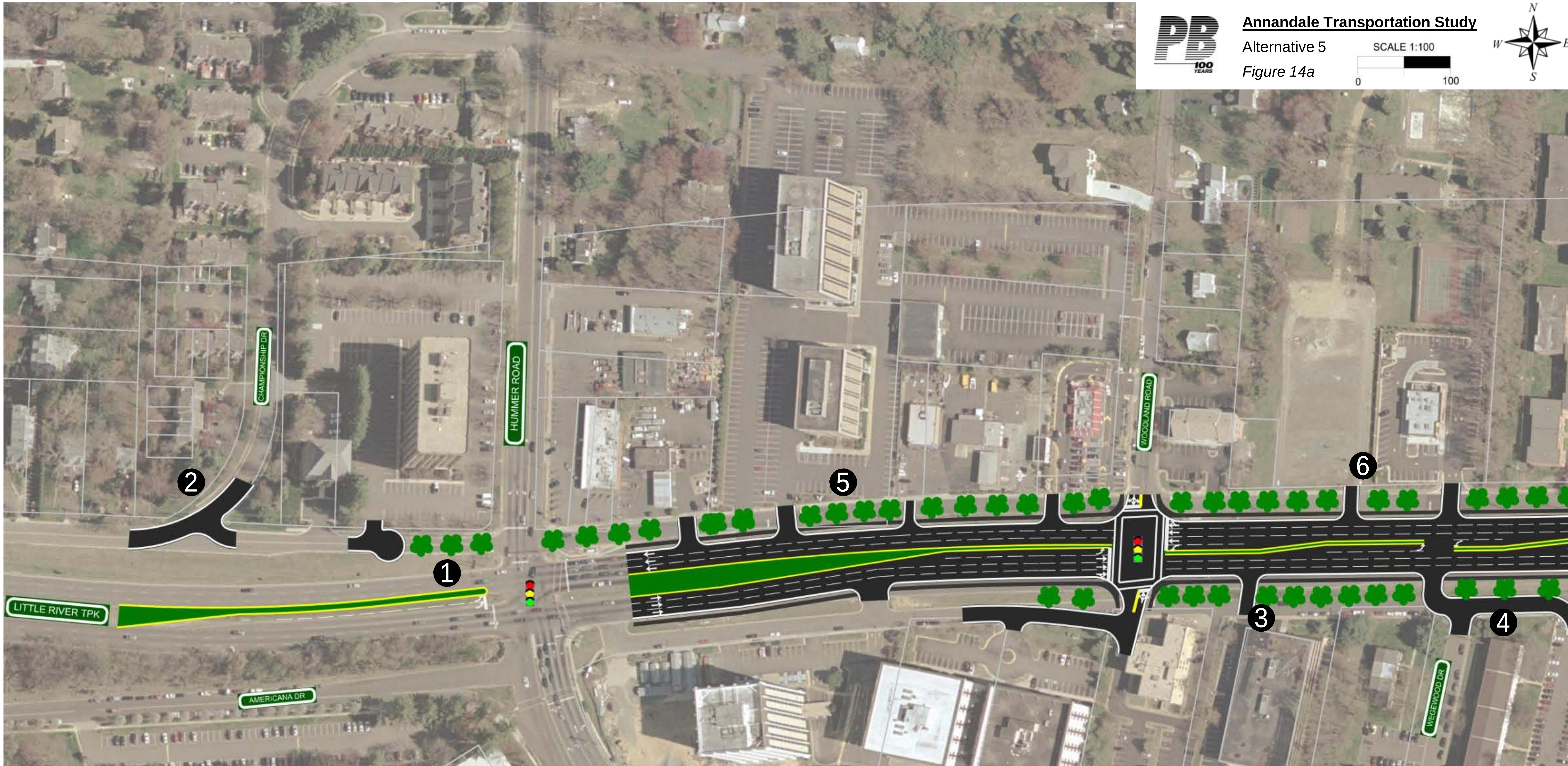
Annandale Transportation Study

Alternative 5

Figure 14a

SCALE 1:100

0 100

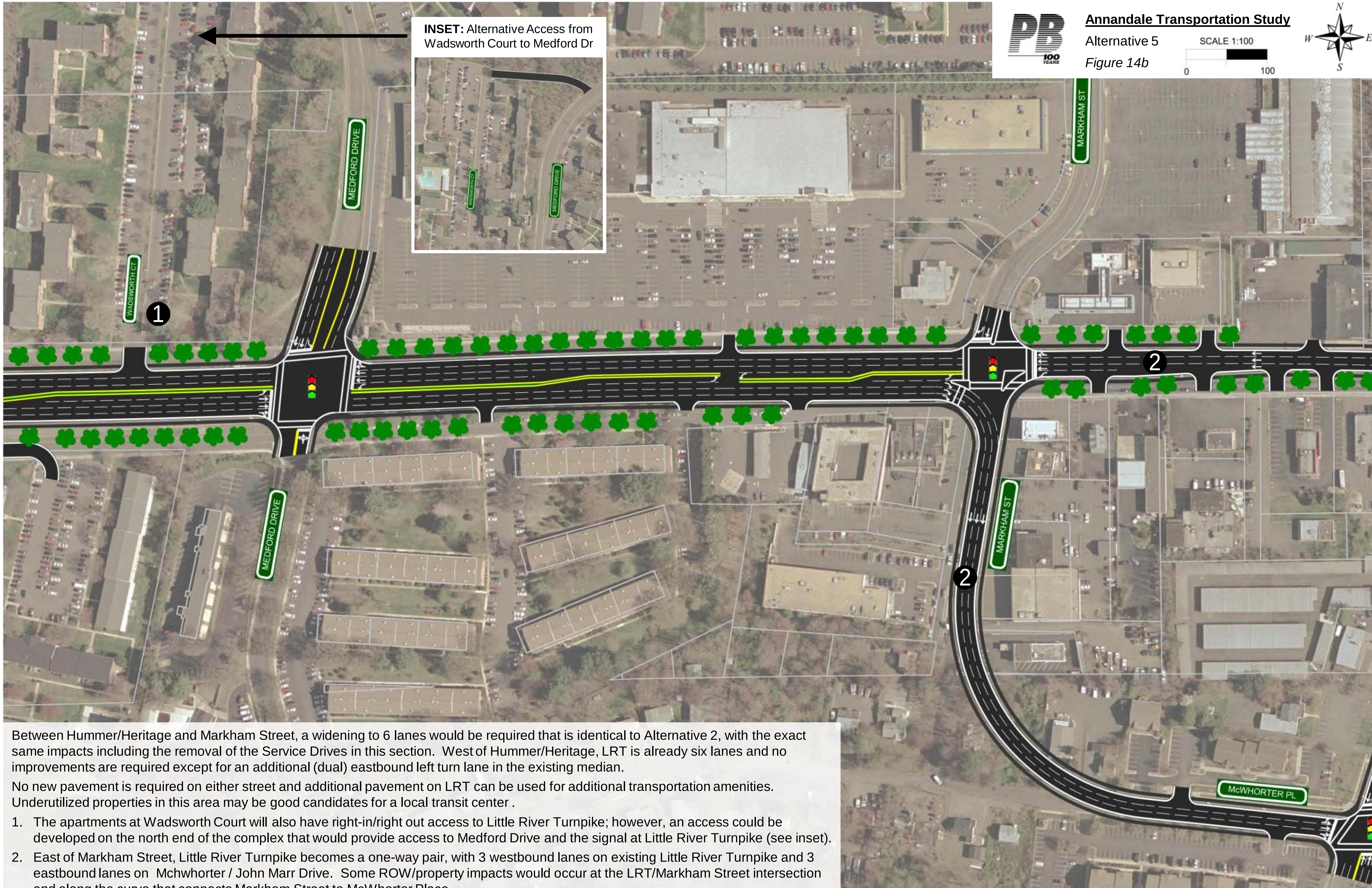


1. Improvements in the westernmost section of Little River Turnpike include provision of an eastbound dual left turn lane at Hummer Road within the existing median; therefore, no additional ROW is required for this improvement .
2. The service drive on the north side is closed at its intersection with Hummer and realigned with Championship Drive which has access to Hummer Drive 1,000' north of Little River Turnpike. This will substantially improve operations at the Little River Turnpike/Hummer intersections by removing the Service Drive operational impacts.
3. The first south side driveway east of Woodland Road has adequate spacing from Woodlawn intersection but would require U-turn movements for access from east and to west on LRT unless an inter-parcel connection is made to the parcel to the west that has access to the signal at Woodlawn.
4. The first and second driveways east of Medford Road (serving the existing housing complex) has adequate spacing from the Medford intersection but would require U-turn movement for access from east unless the section of the current service drive is left that would connect all drives to Medford Drive.
5. The access points between Woodlawn and Hummer would all be made right-in/right-out (RIRO) due to the median in LRT. All these parcels have alternative access to Hummer Road.
6. A mid-block unsignalized crossover in the median provides direct access to the McDonalds and the apartments on the south side of Little River Turnpike. One vacant parcel on the north side of Little River Turnpike will have right-in/right out access; however, an interparcel agreement may be reached at when this parcel is developed to provide access to either the signal at Woodland or the median crossover.

Annandale Transportation Study

Alternative 5

Figure 14b



Between Hummer/Heritage and Markham Street, a widening to 6 lanes would be required that is identical to Alternative 2, with the exact same impacts including the removal of the Service Drives in this section. West of Hummer/Heritage, LRT is already six lanes and no improvements are required except for an additional (dual) eastbound left turn lane in the existing median.

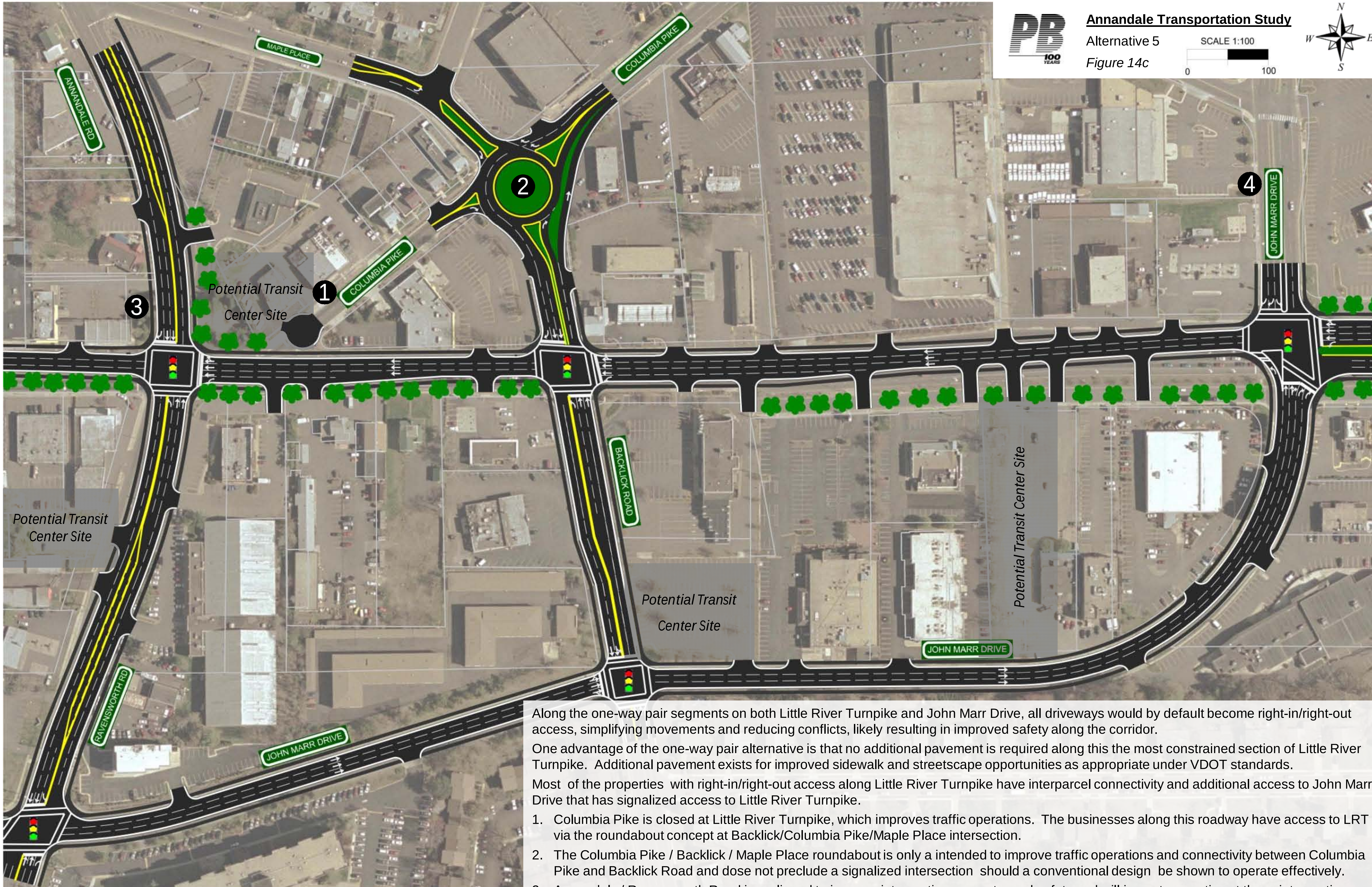
No new pavement is required on either street and additional pavement on LRT can be used for additional transportation amenities. Underutilized properties in this area may be good candidates for a local transit center .

1. The apartments at Wadsworth Court will also have right-in/right out access to Little River Turnpike; however, an access could be developed on the north end of the complex that would provide access to Medford Drive and the signal at Little River Turnpike (see inset).
2. East of Markham Street, Little River Turnpike becomes a one-way pair, with 3 westbound lanes on existing Little River Turnpike and 3 eastbound lanes on Mchwhorter / John Marr Drive. Some ROW/property impacts would occur at the LRT/Markham Street intersection and along the curve that connects Markham Street to McWhorter Place.

Annandale Transportation Study

Alternative 5

Figure 14c



Along the one-way pair segments on both Little River Turnpike and John Marr Drive, all driveways would by default become right-in/right-out access, simplifying movements and reducing conflicts, likely resulting in improved safety along the corridor.

One advantage of the one-way pair alternative is that no additional pavement is required along this the most constrained section of Little River Turnpike. Additional pavement exists for improved sidewalk and streetscape opportunities as appropriate under VDOT standards.

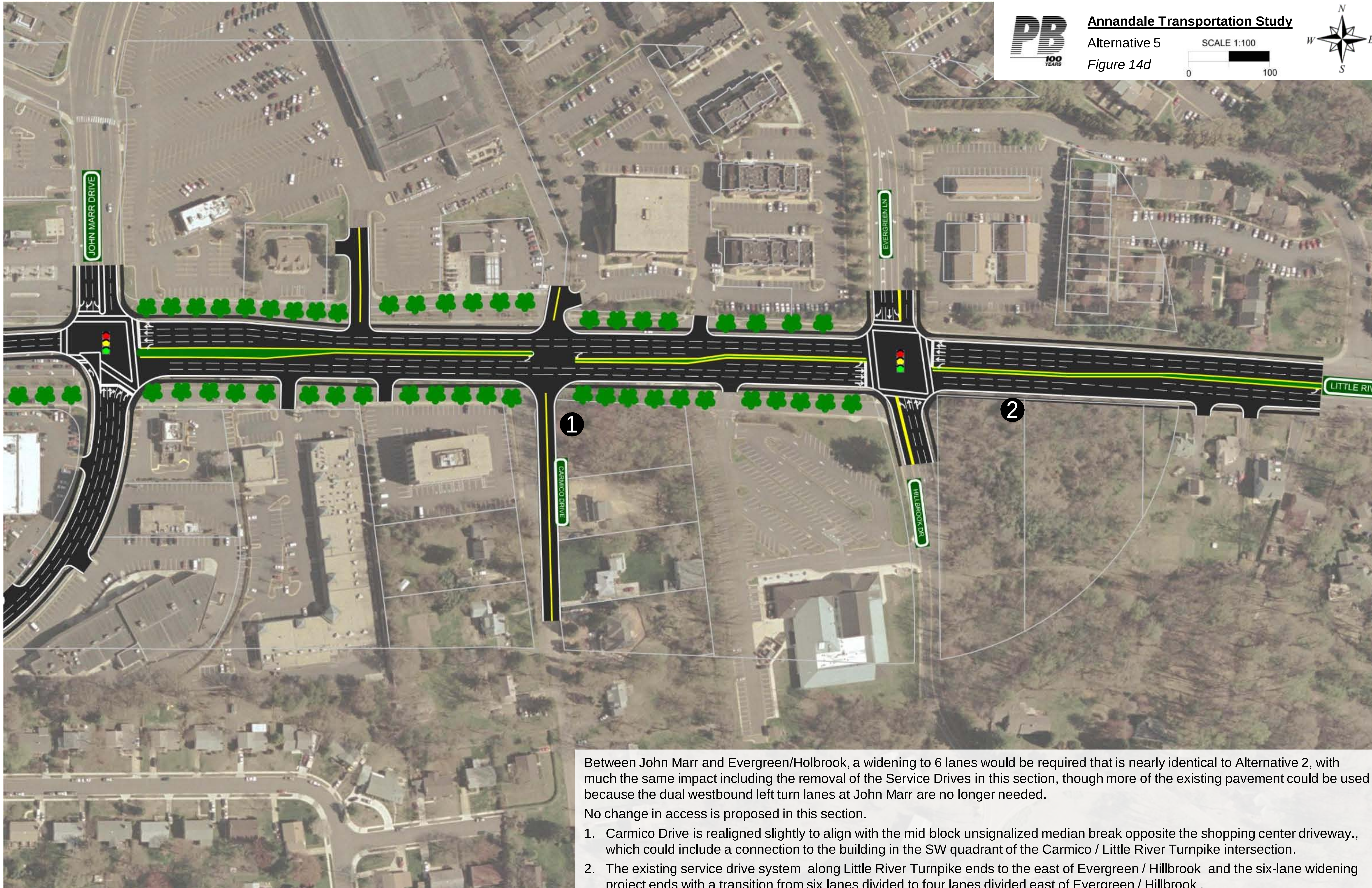
Most of the properties with right-in/right-out access along Little River Turnpike have interparcel connectivity and additional access to John Marr Drive that has signalized access to Little River Turnpike.

1. Columbia Pike is closed at Little River Turnpike, which improves traffic operations. The businesses along this roadway have access to LRT via the roundabout concept at Backlick/Columbia Pike/Maple Place intersection.
2. The Columbia Pike / Backlick / Maple Place roundabout is only a intended to improve traffic operations and connectivity between Columbia Pike and Backlick Road and dose not preclude a signalized intersection should a conventional design be shown to operate effectively.
3. Annandale / Ravensworth Road is realigned to improve intersection geometry and safety and will impact properties at these intersections.

Annandale Transportation Study

Alternative 5

Figure 14d



Between John Marr and Evergreen/Holbrook, a widening to 6 lanes would be required that is nearly identical to Alternative 2, with much the same impact including the removal of the Service Drives in this section, though more of the existing pavement could be used because the dual westbound left turn lanes at John Marr are no longer needed.

No change in access is proposed in this section.

1. Carmico Drive is realigned slightly to align with the mid block unsignalized median break opposite the shopping center driveway., which could include a connection to the building in the SW quadrant of the Carmico / Little River Turnpike intersection.
2. The existing service drive system along Little River Turnpike ends to the east of Evergreen / Hillbrook and the six-lane widening project ends with a transition from six lanes divided to four lanes divided east of Evergreen / Hillbrook .

7.3. Utilizing Existing Service Drive and ROW Considerations for Alternatives 2 and 5

Previous estimates of the right-of-way and impacts incurred by widening Little River Turnpike have assumed that the corridor would be expanded laterally and the service drives would have to be relocated and impact current property lines. However, it was noted in the evaluation of the current and potential cross sections along Little River Turnpike for Alternatives 2 and 5 that there is more than sufficient room to widen Little River Turnpike if the service drives were removed. **Table 14** summarizes existing and proposed service drive locations block-by-block along the Little River Turnpike corridor.

TABLE 14: Existing and Proposed Service Drive Locations

	Existing Conditions		Alternative 2		Alternative 5	
	North Side	South Side	North Side	South Side	North Side	South Side
West of Hummer/Heritage	Yes	Yes	Partial	Yes	Partial	Yes
Hummer to Woodlawn	Yes	Yes	No	Yes	No	Yes
Woodlawn to Medford	Yes	Yes	No	Partial	No	Partial
Medford to Markham	Yes	Yes	No	No	No	No
Markham to Annandale	Partial	No	No	No	No	No
Annandale to Backlick	No	No	No	No	No	No
Backlick to John Marr	No	Yes	No	No	No	No
John Marr to Carmico	Yes	Yes	No	No	No	No
Carmico to Evergreen	No	No	No	No	No	No
East of Evergreen	No	No	No	No	No	No

During field observations of traffic conditions in the corridor, it was noted that many of the service drive intersections cause operational problems at both the service drive intersections with the cross streets and the cross street intersections with Little River Turnpike. Due to the close proximity of these two intersections on the crossing streets (about 40 feet separation between LRT and the service drive in most locations), the traffic signals require that greater green-time be allotted to the cross street movements to sort out all the conflicting movements, reducing the green time allotment (and thus lowering capacity) for Little River Turnpike. Closely spaced intersections can lead to increased intersection accident rates, and the current service drive design violates VDOT's access management guidelines that recommend a minimum of 225 feet between the major street and the first service drive or driveway access.

The "excess" right-of-way taken up by the current service drives could be used for:

- a greater boundary between the Little River Turnpike and the adjacent land uses along the corridor (potentially adding a tree-lined boundary)
- a greater pedestrian sidewalk, bike lane, shared path and/or transit amenities along the corridor
- a greater center median width (giving the corridor a parkway appearance)
- on-street parking

or some combination thereof. It is not the intent to "give-back" or sell the excess right-of-way taken up by the service drives; further study is recommended to identify the optimal use of this corridor for needed transportation amenities and/or landscaping buffers. No attempt was made within this study to define or recommend exact transportation amenities within the corridor. At the planning level, the removal of continual service drive requirements can be implemented within the VDOT access management guidelines. However, certain design level modifications (such as median break locations and future parcel access consolidation requirements) will need to be examined in detail in future analyses. The focus of the contextual design concepts is only to identify potential transportation amenity options gained by the elimination of the service drives.

7.4. Right of Way Impacts for Alternatives 2 and 5

As illustrated in Figures 13 and 14, Alternative 5 requires no additional right of way along any portion of the corridor assuming the removal of the service drives. The sections of LRT that are to be widened to six lanes (from Hummer/Heritage to Markham Street in the western portion of the corridor and from John Marr to Evergreen Road in the eastern part of the corridor) can be accomplished within the footprint of the existing service drives between Markham and John Marr in the heart of the CBC area, the one-way pair roadways can be implemented using only the existing pavements on LRT and McWhorter Road/John Marr Drive.

In Alternative 2, there are sections in which the needed right-of-way is greater than the existing right-of-way. Figure 11 shows the minimum corridor cross section needed between Annandale and Backlick Roads where there are no current service drives and a widening would require the acquisition of right-or-way on one side or both of LRT and potential impacts to structures. The improvements required in the Comprehensive Plan for the realignment of Annandale/Ravensworth Road at Little River Turnpike may have additional impacts to right-of-way and properties in the vicinity of this intersection. Further study is recommended to determine the desired cross section and the extent of impacts in this two-block stretch of Little River Turnpike.

7.5. Access Impacts for Alternatives 2 and 5 with Utilizing Existing Service Drive ROW

Under any proposed widening scenario on Little River Turnpike, VDOT will review the access management and the effectiveness of the current service drives along the corridor. Current service road connections to the cross streets along LRT violate VDOT's Access Management Regulations (24VAC30-73-120 C 1). These provisions state that "access drives should be kept away from intersections to reduce congestion, entrance safety and prevent vehicles from backing up onto the highway". The recommended minimum distance from the major street to the first access drive / driveway is 225 feet. Alternatives to improve access management would be to relocate the service drive intersections away from LRT (at great impact to existing development) or to remove the service drives and provide interparcel or alternative access to the properties that front Little River Turnpike. The impacts to parcel access identified in the concept plans for both Alternatives 2 and 5 were reviewed, and the parcels impacted or with existing access in non-conformity to the VDOT Access Management Plan guidelines are identified in Figures 12a-d and 14a-d respectively. Effort to consolidate driveways and increase interparcel connectivity along the Little River Turnpike corridor would lessen access impacts and should be encouraged.

7.6. Project Termini Transitions

The Annandale Comprehensive Transportation Plan calls for Little River Turnpike to be widened to six lanes through the Annandale CBC area. Little River Turnpike is currently six lanes between I-495 and Hummer/Heritage Road. Both Alternatives 2 and 5 widen Little River Turnpike to a six lane divided roadway beginning at Hummer/Heritage Road to match the existing six lane section to the west. Both Alternatives 2 and 5 also widen Little River Turnpike to six lanes between John Marr Drive and Evergreen Lane. East of Evergreen Lane, Little River Turnpike transitions from a six to four lane divided section as the area changes from the urban CBC area to a suburban area with fewer driveways and greater spacing between signalized intersections. In the eastbound direction, three lanes are pulled though the Evergreen Lane signalized intersection and the right lane is merged at a safe and effective distance from the Evergreen Lane intersection (+/- 1,000 feet beyond the signal). In the westbound direction, a third lane is formed prior to the Evergreen Lane intersection to allow adequate storage at the Evergreen Lane signal.

Between Markham Street and John Marr Drive, Alternatives 2 and 5 differ but provide the same number of through travel lanes. Alternative 2 widens Little River Turnpike to six lanes, three in each direction. Alternative 5 provides three westbound travel lanes on Little River Turnpike (without widening) and provides three westbound travel lanes on parallel one-way pair route using Markham, McWhorter and John Marr Driver. Therefore, in both Alternatives 2 and 5, three through lanes of travel are provided in each direction between Hummer/Heritage and Evergreen Lane.

7.7. Multimodal Impacts

In general, both improvement Alternatives 2 and 5 have positive impacts on the multimodal aspects of the corridor. Certainly auto mobility is improved by the increase in roadway capacity under both alternatives. Also, in most sections of the corridor there is ample room for the improvement and expansion of sidewalk and bike facilities. Where the available right-of-way lessens and there is the potential for property impacts along Little River Turnpike in Alternative

2, sidewalks could blend in with a more urban environment. Alternative 5 has lesser constraints to right-of-way and provides for greater bike and pedestrian amenities.

At intersections, pedestrian crossings may be improved over current conditions in the CBC area. Where the corridor is widened from four to six through travel lanes, pedestrians have a longer crossing distance but would have access to a mid-crossing refuge in the median. Alternative 5 provides a narrower crossing for pedestrians, crossing only three lanes in one direction of travel.

Transit service could be enhanced under both alternatives by the availability of greater right-of-way for shelter and boarding areas. Buses would also benefit from the additional roadway capacity, which should translate into improved headway times along the corridor. While the location of a central potential bus transfer facility is outside the scope of this study, several locations were identified in Figures 12 and 14 (shaded areas) that may provide for efficient access in and out of the site and to the major roadways serving the Annandale CBC. Potentially one of the most efficient areas for a transit center may be along Little River Turnpike at the former Columbia Pike intersection, where a station could provide access for transit vehicles to both roadways. Also, Alternative 5 may provide the most beneficial access to transit vehicles, as a center located in a parcel between Little River Turnpike and John Marr Drive would provide right-in/right out circulatory access for transit vehicles.

There would be significant utility improvements needed in both alternatives, particularly the relocating or burial of the power/telephone lines running along much of the corridor between the travel lanes and the service drives. Removal of the lines and poles would improve intersection line of sight, particularity at signalized intersections.

7.8. Building Scale along the Corridor

While land use plans, zoning restrictions and developer investment will control the scale of building heights along the Little River Turnpike Corridor, a widened Little River Turnpike should be able to support greater building heights (6-8 stories with isolated taller buildings), such as currently exists along the corridor near the Hummer/Heritage intersection. Buildings of greater height and higher parking demands may require on-site or shared parking deck usage, which should positioned to have access to major crossing streets so that access to parking is not solely along Little River Turnpike. Given right-of-way constraints along Little River Turnpike in the core of the CBC area, building frontage may be closer to the roadway lanes (with hardscape in between), and parking provided underneath or to the rear of the buildings with access only to the major crossing streets.

8. MEETINGS AND DOCUMENTATION

8.1. Project Meetings

Project meetings and teleconferences were held on a regular basis with County Transportation staff to coordinate work activities and deliverables. The following in-person meetings were held:

December 17, 2008: A project kick off meeting was held at Fairfax County to discuss the project goals and objectives and determine what data needs and inputs will be part of the study

February 20, 2009: Meeting at Fairfax County to discuss the results of initial existing conditions model results and the draft of the Existing Conditions report.

March 16, 2009: Meeting at Fairfax County to discuss the results of the operations analysis of the nine transportation network analyses and make a recommendation on which networks should be shortlisted for more detailed analysis.

April 16, 2009: Meeting at Fairfax County to discuss the results of the operations analysis of the four shortlisted alternatives and make recommendations for improvements for each of the networks and a selection of final preferred network(s).

8.2. Stakeholder Meetings

8.2.1. Fairfax County Interagency Management Team Meeting

A meeting was held on June 2, 2009 with the Fairfax County START management team to update this group on the study progress to date and solicit comments and feedback on the direction of the study. The group looked forward to additional quantitative and qualitative analysis and on concept Alternatives 2 and 5 to help in the decision making process.

8.2.2. Annandale Citizens Advisory Committee Briefing

A meeting was held on July 7, 2009 with the Annandale Citizens Advisory Committee to update the advisory group on the study progress to date and solicit comments and feedback on the direction of the study. The group was in agreement in the selection of the two final network alternatives (Alternatives 2 and 5) and was pleased with the recommendations to reduce impacts for the widening alternative (Alternative 2). The group looked forward to additional quantitative and qualitative analysis to help in the decision making process.

8.3. Public Meeting

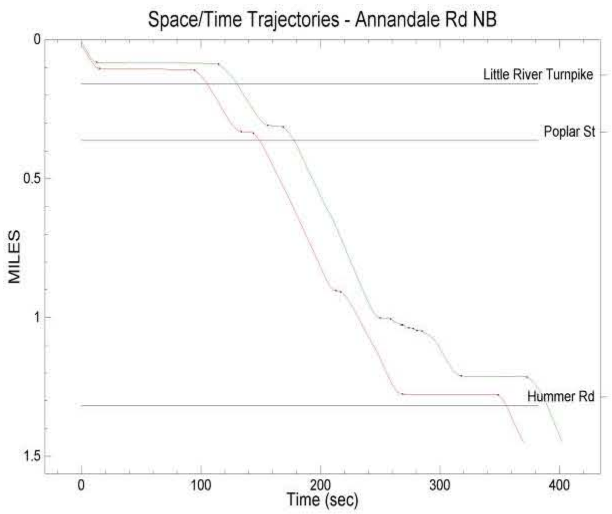
A public meeting is currently planned to be held in the spring of 2010 to explain the study process and results, and Alternative Networks 2 and 5 will be presented to the public as the viable candidates for implementation. Solicitation of comments from the public regarding their view of the pros and cons of each alternative is a desired step in the process.

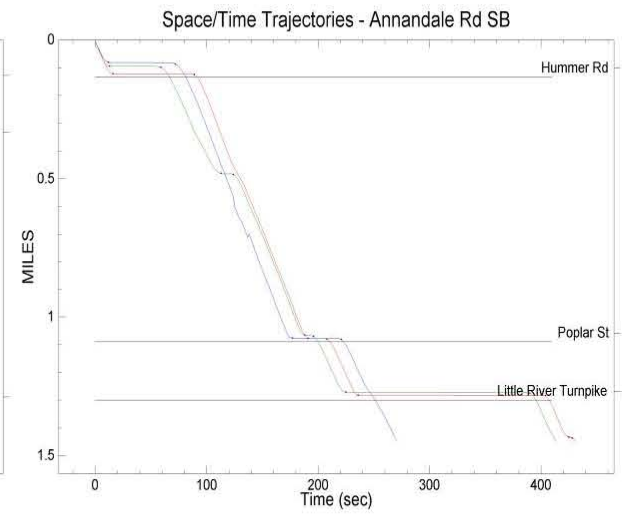
Appendix A

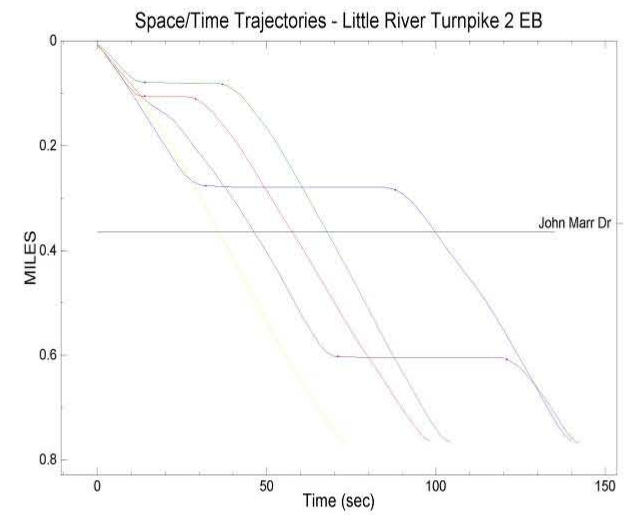
Travel Time Data Time Space Diagrams

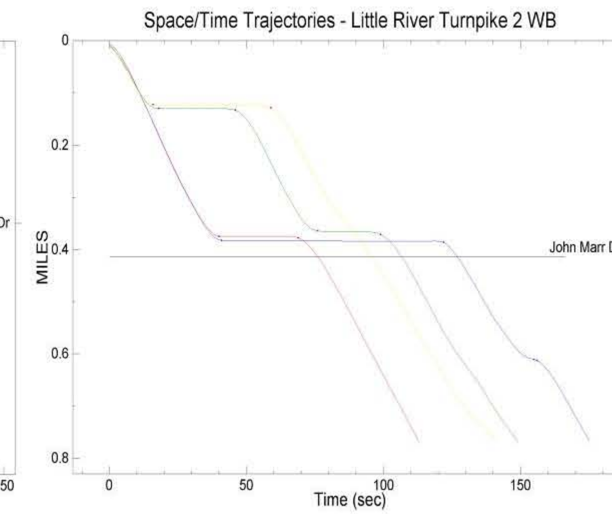
Time	Route	From	To	# Runs	Avg Distance	Avg Speed	Avg Travel Time	Min Travel Time	Max Travel Time	StDev Travel Time	StDev Avg Speed	Avg # Stops	Avg Stopped Time	Avg Congested Time	Avg Control Delay Time	Avg Approach Delay Time	Avg Stop Delay Time	Street Class	LOS	TTI Index
AM	Annandale Rd NB	(Route Start)	Little River Turnpike	2	0.16	4.78	2.01	1.83	2.18	0.25	0.59	1	1.51	1.82	1.68	1.69	1.51	III	F	10.67
		Little River Turnpike	Poplar St	2	0.20	15.99	0.75	0.72	0.78	0.04	0.97	1	0.19	0.36	0.32	0.32	0.19	III	D	2.45
		Poplar St	Hummer Rd	2	0.96	16.52	3.49	3.44	3.53	0.07	0.32	3	1.3	1.83	1.46	1.47	1.33	III	D	3.33
		Hummer Rd	(Route End)	2	0.13	35.31	0.22	0.20	0.24	0.03	4.75	0	0	0				III	A	1.01
	Annandale Rd NB			**2**	**1.45**	**13.59**	**6.44**	**6.17**	**6.72**	**0.39**	**0.62**	**5**	**3**					**III**	**E**	**2.58**
	Annandale Rd SB	(Route Start)	Hummer Rd	3	0.13	5.85	1.33	1.11	1.53	0.21	1.00	1	0.99	1.13	1.11	1.11	0.99	III	F	7.65
		Hummer Rd	Poplar St	3	0.96	26.40	2.18	1.98	2.35	0.19	2.38	1.33	0.44	0.6	0.46	0.46	0.38	III	B	1.99
		Poplar St	Little River Turnpike	3	0.21	5.40	2.33	0.47	3.28	1.61	13.31	0.67	1.85	1.95	1.95	1.95	1.85	III	F	6.91
		Little River Turnpike	(Route End)	3	0.15	26.34	0.34	0.31	0.40	0.05	3.57	0.33	0.02	0.04	0.07	0	0.02	III	B	1.42
	Annandale Rd SB			**3**	**1.45**	**14.14**	**6.19**	**4.50**	**7.18**	**1.47**	**4.26**	**3.33**	**3.3**					**III**	**D**	**2.48**
	Columbia Pike EB	(Route Start)	John Marr Dr	3	0.27	12.27	1.32	1.14	1.61	0.25	2.23	1	0.66	0.82	0.74	0.75	0.66	III	E	2.96
		John Marr Dr	(Route End)	3	0.29	19.82	0.88	0.85	0.92	0.03	0.78	1	0.36	0.51				III	C	1.64
	Columbia Pike EB			**3**	**0.57**	**13.30**	**2.21**	**2.00**	**2.48**	**0.25**	**1.31**	**2**	**1.01**					**III**	**E**	**2.26**
	Columbia Pike WB	(Route Start)	John Marr Dr	3	0.30	24.91	0.72	0.67	0.77	0.05	1.83	0.33	0.03	0.23	0.16	0.16	0.03	III	B	1.42
		John Marr Dr	(Route End)	3	0.29	29.00	0.60	0.55	0.63	0.04	2.19	0	0	0.06	0.05	0	0	III	B	1.14
	Columbia Pike WB			**3**	**0.59**	**25.35**	**1.18**	**1.17**	**1.20**	**0.02**	**0.33**	**0.33**	**0.03**					**III**	**B**	**1.18**
	John Marr Dr NB	(Route Start)	Little River Turnpike	3	0.49	11.60	2.53	1.89	2.91	0.56	3.05	1.67	1.36	1.63	1.03	1.04	0.94	IV	D	4.33
		Little River Turnpike	(Route End)	3	0.25	28.12	0.53	0.52	0.57	0.03	1.45	0	0	0.04	0.02	0	0	IV	A	1.13
	John Marr Dr NB			**3**	**0.74**	**14.28**	**3.07**	**2.45**	**3.43**	**0.54**	**2.69**	**1.67**	**1.36**					**IV**	**C**	**2.10**
	John Marr Dr SB	(Route Start)	Little River Turnpike	3	0.25	5.75	2.61	1.69	3.07	0.80	2.34	1	1.92	2.17	2	2	1.92	IV	F	5.20
		Little River Turnpike	(Route End)	3	0.48	20.17	1.43	1.30	1.63	0.18	2.40	1.33	0.37	0.59	0.09	0	0.05	IV	B	1.91
	John Marr Dr SB			**3**	**0.73**	**10.71**	**3.98**	**3.00**	**4.63**	**0.86**	**2.66**	**2.33**	**2.29**					**IV**	**D**	**2.80**
	Little River Turnpike 1 EB	(Route Start)	Heritage Dr	4	0.23	22.10	0.62	0.39	0.90	0.22	8.69	0.5	0.14	0.24				II	C	2.04
		Heritage Dr	Markham St	4	0.60	26.47	1.36	1.00	1.93	0.40	7.15	0.5	0.1	0.32	0.25	0.2	0.05	II	C	1.44
		Markham St	(Route End)	4	0.17	9.40	1.09	0.32	1.87	0.86	14.15	0.75	0.62	0.85	0.95	0	0.85	II	F	4.04
	Little River Turnpike 1 EB			**4**	**1.00**	**19.35**	**3.10**	**1.88**	**4.65**	**1.38**	**9.71**	**1.75**	**0.87**					**II**	**D**	**2.33**
	Little River Turnpike 1 WB	(Route Start)	Markham St	4	0.17	22.96	0.44	0.26	0.91	0.31	12.83	0.25	0.12	0.15				II	C	1.96
		Markham St	Heritage Dr	4	0.61	12.10	3.03	1.90	4.24	1.12	5.07	1.5	1.88	2.07	1.62	1.62	1.5	II	F	3.76
		Heritage Dr	(Route End)	4	0.26	45.79	0.34	0.32	0.36	0.02	2.31	0	0	0				II	A	1.18
	Little River Turnpike 1 WB			**4**	**1.04**	**16.25**	**3.80**	**2.53**	**4.93**	**1.29**	**6.08**	**1.75**	**2**					**II**	**E**	**2.77**
	Little River Turnpike 2 EB	(Route Start)	John Marr Dr	5	0.36	20.81	1.04	0.63	1.67	0.40	8.31	0.6	0.31	0.42	1.04	1.05	0.93	II	D	2.44
		John Marr Dr	(Route End)	5	0.41	29.88	0.82	0.60	1.58	0.43	10.57	0.2	0.17	0.21	0.03	0	0	II	B	1.51
	Little River Turnpike 2 EB			**5**	**0.77**	**24.57**	**1.86**	**1.22**	**2.37**	**0.49**	**7.43**	**0.8**	**0.48**					**II**	**C**	**1.83**
	Little River Turnpike 2 WB	(Route Start)	John Marr Dr	4	0.41	14.30	1.72	1.30	2.14	0.35	3.16	1.25	0.85	1.06	0.88	0.88	0.74	II	E	3.35
		John Marr Dr	(Route End)	4	0.36	30.14	0.72	0.62	0.80	0.08	3.43	0.25	0	0.07	0.13	0	0	II	B	1.25
	Little River Turnpike 2 WB			**4**	**0.77**	**19.09**	**2.42**	**1.88**	**2.93**	**0.43**	**3.54**	**1.5**	**0.85**					**II**	**D**	**2.36**
PM	Annandale Rd NB	(Route Start)	Little River Turnpike	2	0.16	12.79	0.75	0.24	1.26	0.73	23.04	0.5	0.45	0.5	0.5	0.5	0.45	III	E	3.99
		Little River Turnpike	Poplar St	2	0.20	16.78	0.72	0.69	0.74	0.03	0.71	1.5	0.16	0.37	0.22	0.22	0.12	III	D	2.33
		Poplar St	Hummer Rd	2	0.96	21.43	2.69	2.21	3.16	0.67	5.48	1	1.11	1.22	1.2	1.2	1.11	III	C	2.57
		Hummer Rd	(Route End)	2	0.13	32.72	0.24	0.24	0.24	0.00	0.55	0	0	0				III	A	1.09
	Annandale Rd NB			**2**	**1.45**	**19.86**	**4.41**	**3.40**	**5.42**	**1.43**	**6.67**	**3**	**1.72**					**III**	**C**	**1.76**
	Annandale Rd SB	(Route Start)	Hummer Rd	3	0.13	5.13	1.52	1.28	1.81	0.27	0.92	1	1.18	1.35	1.34	1.34	1.23	III	F	8.73
		Hummer Rd	Poplar St	3	0.96	25.56	2.25	1.71	2.55	0.47	6.20	1.33	0.49	0.62	0.67	0.66	0.6	III	B	2.05
		Poplar St	Little River Turnpike	3	0.21	11.52	1.09	0.55	1.48	0.48	7.90	1	0.51	0.82	0.82	0.83	0.68	III	E	3.24
		Little River Turnpike	(Route End)	3	0.15	14.66	0.61	0.36	0.82	0.23	7.27	0.67	0.24	0.33	0.42	0	0.36	III	D	2.56
	Annandale Rd SB			**3**	**1.45**	**15.87**	**5.48**	**4.90**	**6.27**	**0.71**	**1.98**	**4**	**2.42**					**III**	**D**	**2.21**
	Columbia Pike EB	(Route Start)	John Marr Dr	3	0.27	15.20	1.07	0.89	1.29	0.20	2.90	1	0.42	0.59	0.51	0.52	0.42	III	D	2.39
		John Marr Dr	(Route End)	3	0.29	19.45	0.89	0.88	0.90	0.01	0.21	1	0.32	0.5				III	C	1.68
	Columbia Pike EB			**3**	**0.57**	**14.95**	**2.01**	**1.87**	**2.20**	**0.17**	**1.38**	**2**	**0.74**					**III**	**D**	**2.01**
	Columbia Pike WB	(Route Start)	John Marr Dr	3	0.30	22.84	0.79	0.75	0.83	0.04	1.06	0.67	0.02	0.33	0.1	0.1	0.02	III	C	1.54
		John Marr Dr	(Route End)	3	0.29	17.69	0.98	0.85	1.12	0.13	2.42	1.33	0.28	0.49	0.4	0	0.38	III	D	1.87
	Columbia Pike WB			**3**	**0.59**	**20.04**	**1.53**	**1.38**	**1.70**	**0.16**	**2.28**	**2**	**0.29**					**III**	**C**	**1.50**
	John Marr Dr NB	(Route Start)	Little River Turnpike	2	0.49	11.58	2.54	1.77	3.30	1.08	5.43	1.5	1.44	1.65	1.37	1.37	1.29	IV	D	4.33
		Little River Turnpike	(Route End)	2	0.25	26.87	0.56	0.52	0.60	0.06	2.80	0	0	0.13	0.06	0	0	IV	A	1.19
	John Marr Dr NB			**2**	**0.74**	**14.30**	**3.10**	**2.38**	**3.83**	**1.03**	**5.11**	**1.5**	**1.44**					**IV**	**C**	**2.10**
	John Marr Dr SB	(Route Start)	Little River Turnpike	2	0.25	5.26	2.85	2.83	2.87	0.03	0.05	1	2.17	2.42	2.25	2.26	2.17	IV	F	5.69
		Little River Turnpike	(Route End)	2	0.48	25.41	1.13	1.10	1.17	0.05	1.06	1	0.08	0.27	0.01	0	0	IV	A	1.52
	John Marr Dr SB			**2**	**0.73**	**10.96**	**3.94**	**3.88**	**4.00**	**0.08**	**0.35**	**2**	**2.25**					**IV**	**D**	**2.74**
	Little River Turnpike 1 EB	(Route Start)	Heritage Dr	4	0.23	38.51	0.36	0.32	0.42	0.05	4.61	0	0	0	0.05	0.05	0	II	A	1.17
		Heritage Dr	Markham St	4	0.60	25.89	1.39	0.90	2.36	0.66	10.38	0.75	0.25	0.44	0.23	0.23	0.15	II	C	1.47
		Markham St	(Route End)	4	0.17	6.87	1.48	0.60	1.85	0.60	5.58	1	0.92	1.31	0.81	0	1.22	II	F	5.53
	Little River Turnpike 1 EB			**4**	**1.00**	**18.46**	**3.25**	**3.08**	**3.45**	**0.16**	**0.92**	**1.75**	**1.18**					**II**	**D**	**2.44**
	Little River Turnpike 1 WB	(Route Start)	Markham St	5	0.17	25.16	0.41	0.28	0.63	0.13	7.81	0.2	0.04	0.09	0.2	0.18	0.11	II	C	1.79
		Markham St	Heritage Dr	5	0.61	12.39	2.95	2.47	3.40	0.41	1.82	1.8	1.52	1.95	1.38	1.38	1.24	II	F	3.67
		Heritage Dr	(Route End)	5	0.26	45.05	0.35	0.24	0.42	0.07	10.75	0	0	0				II	A	1.20
	Little River Turnpike 1 WB			**5**	**1.04**	**16.56**	**3.70**	**3.08**	**4.20**	**0.50**	**2.81**	**2**	**1.56**					**II**	**E**	**2.72**
	Little River Turnpike 2 EB	(Route Start)	John Marr Dr	4	0.36	9.74	2.22	2.05	2.38	0.14	0.65	1	1.36	1.55	1.51	1.51	1.36	II	F	5.21
		John Marr Dr	(Route End)	4	0.41	34.33	0.72	0.65	0.78	0.06	2.91	0	0	0.03	0.04	0	0	II	B	1.32
	Little River Turnpike 2 EB			**4**	**0.77**	**15.55**	**2.93**	**2.70**	**3.13**	**0.19**	**1.17**	**1**	**1.36**					**II**	**E**	**2.89**
	Little River Turnpike 2 WB	(Route Start)	John Marr Dr	2	0.41	12.29	2.00	1.99	2.02	0.02	0.12	1	1.17	1.36	1.31	1.31	1.17	II	F	3.89
		John Marr Dr	(Route End)	2	0.36	10.71	2.02	1.00	3.03	1.44	10.18	1.5	1.05	1.45	1.94	0	1.77	II	F	3.50
	Little River Turnpike 2 WB			**2**	**0.77**	**11.66**	**4.01**	**2.98**	**5.05**	**1.46**	**4.41**	**2.5**	**2.22**					**II**	**F**	**3.86**

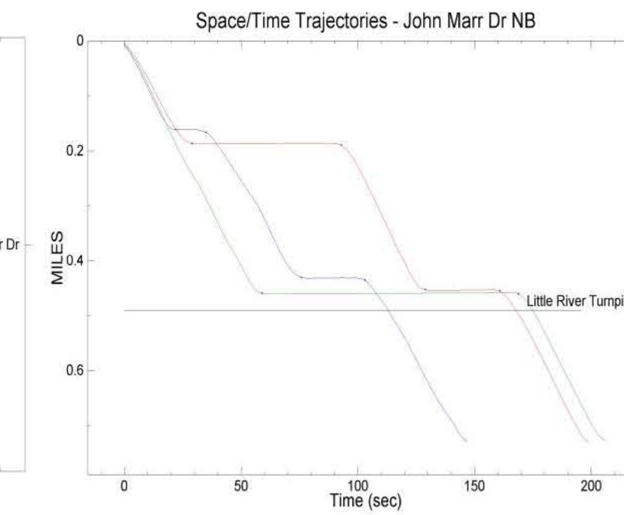
Travel Time-Space Diagrams for Roadways in Annandale CBC – AM Peak Period

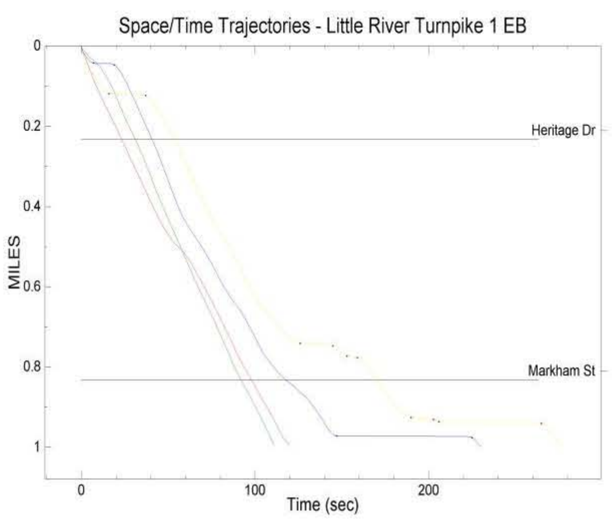


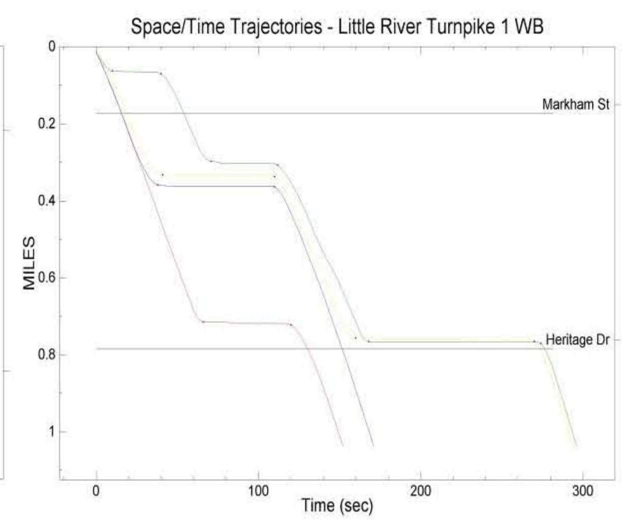


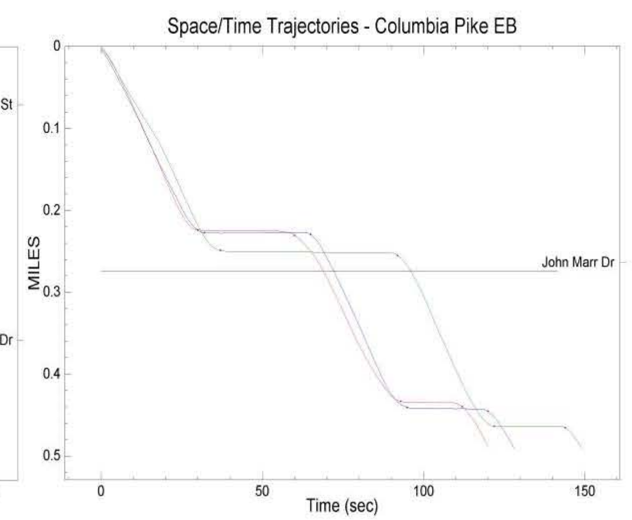


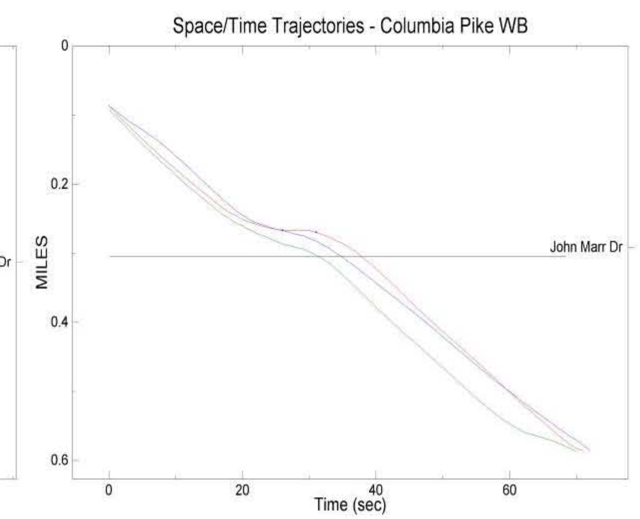




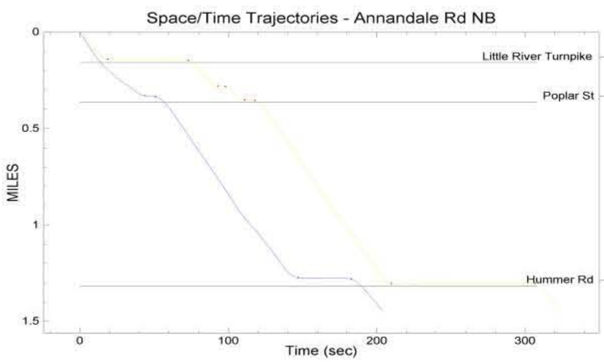


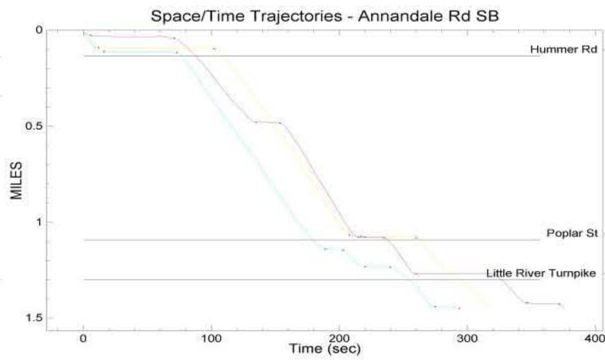


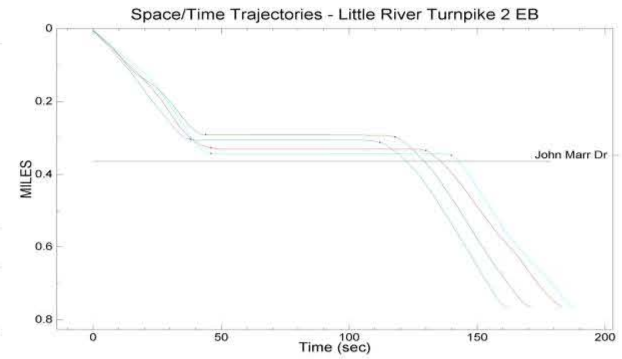


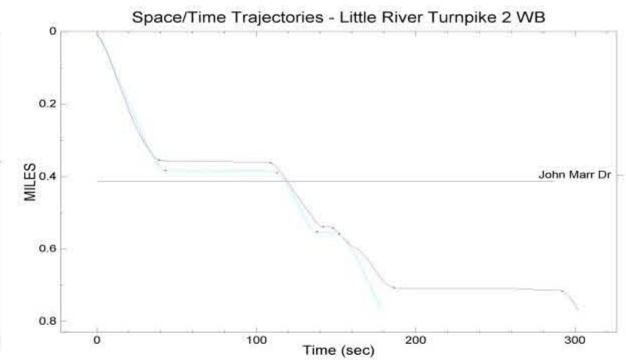


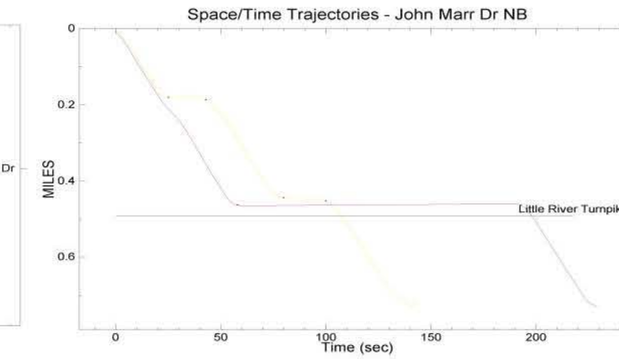
Travel Time-Space Diagrams for Roadways in Annandale CBC – PM Peak Period

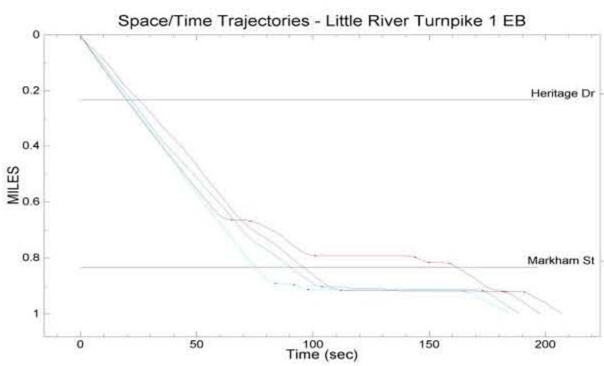


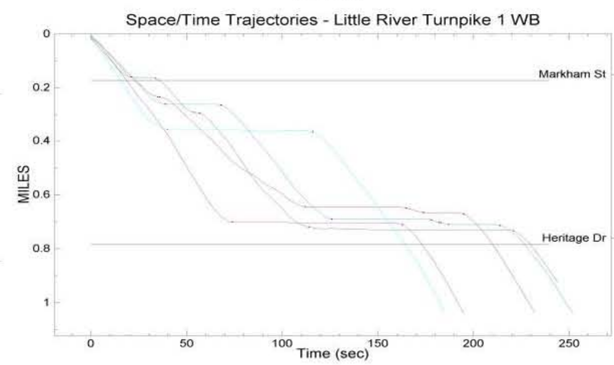


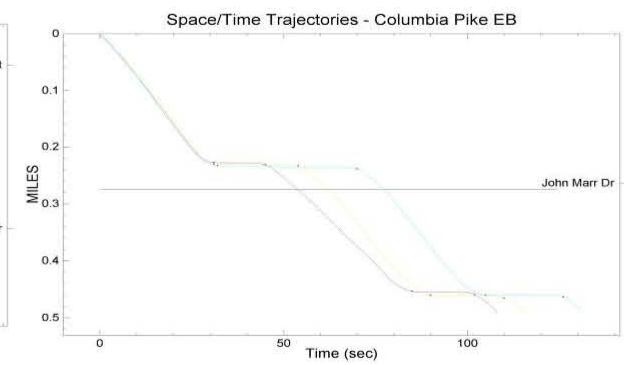


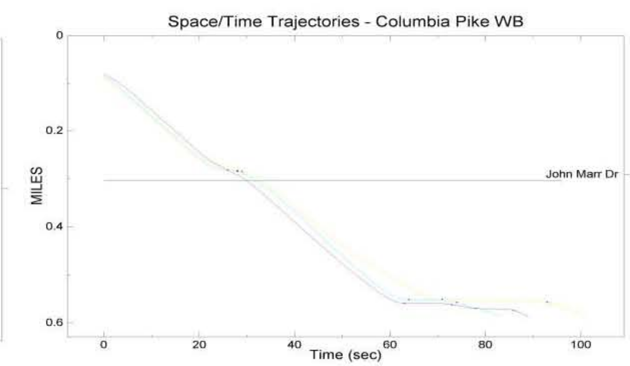


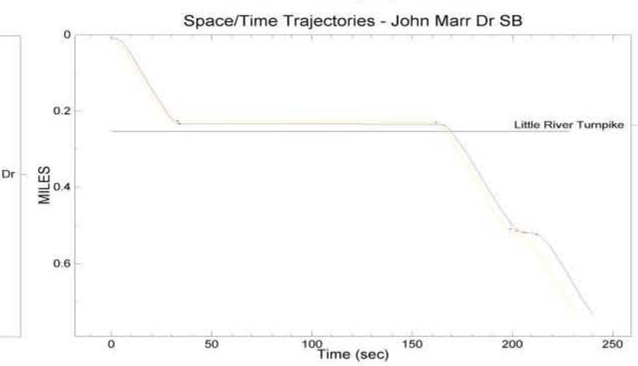








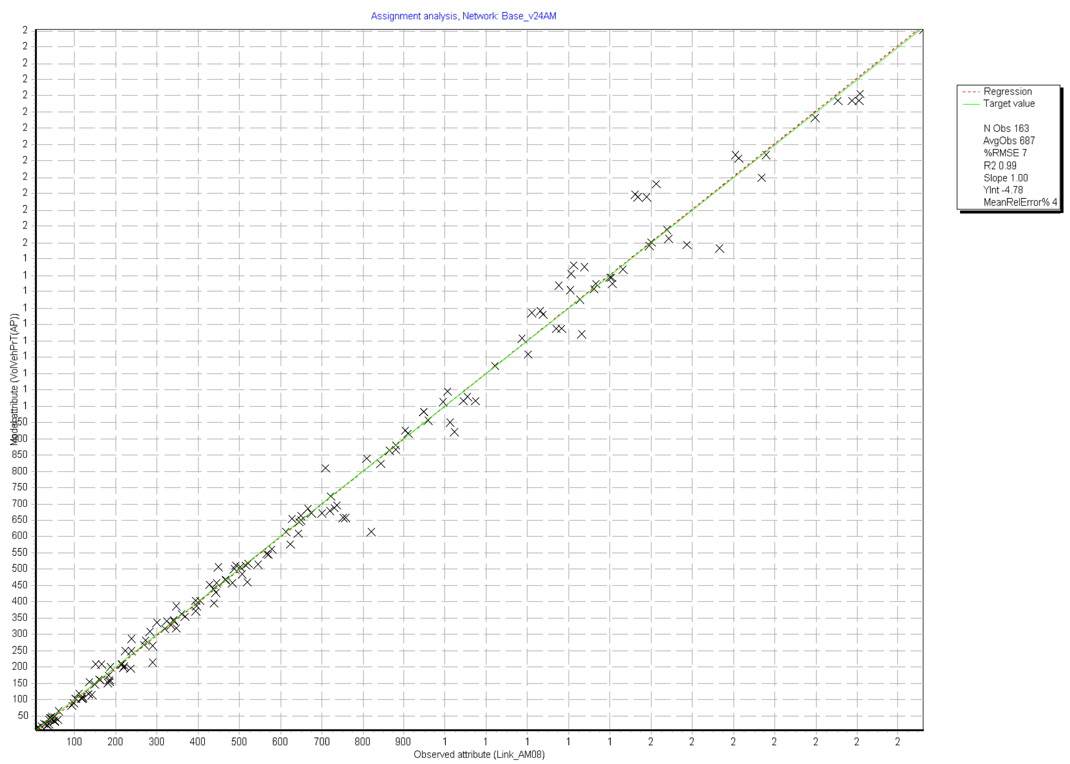




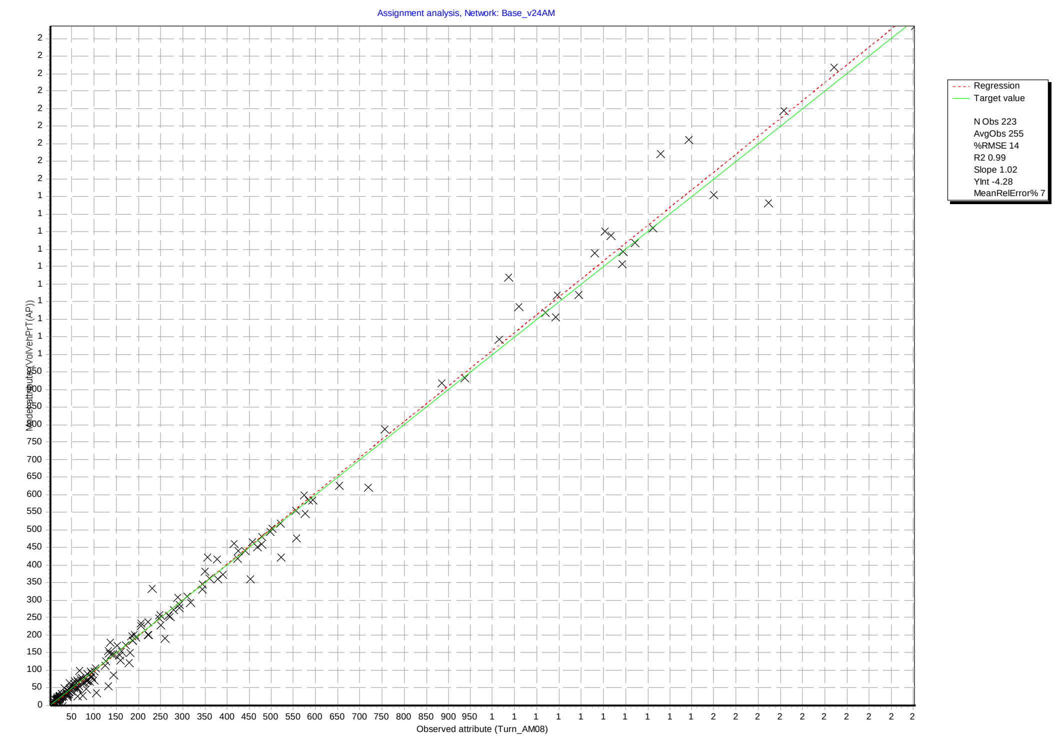
Appendix B

VISSIM Base Year Link and Turning Movement Calibration

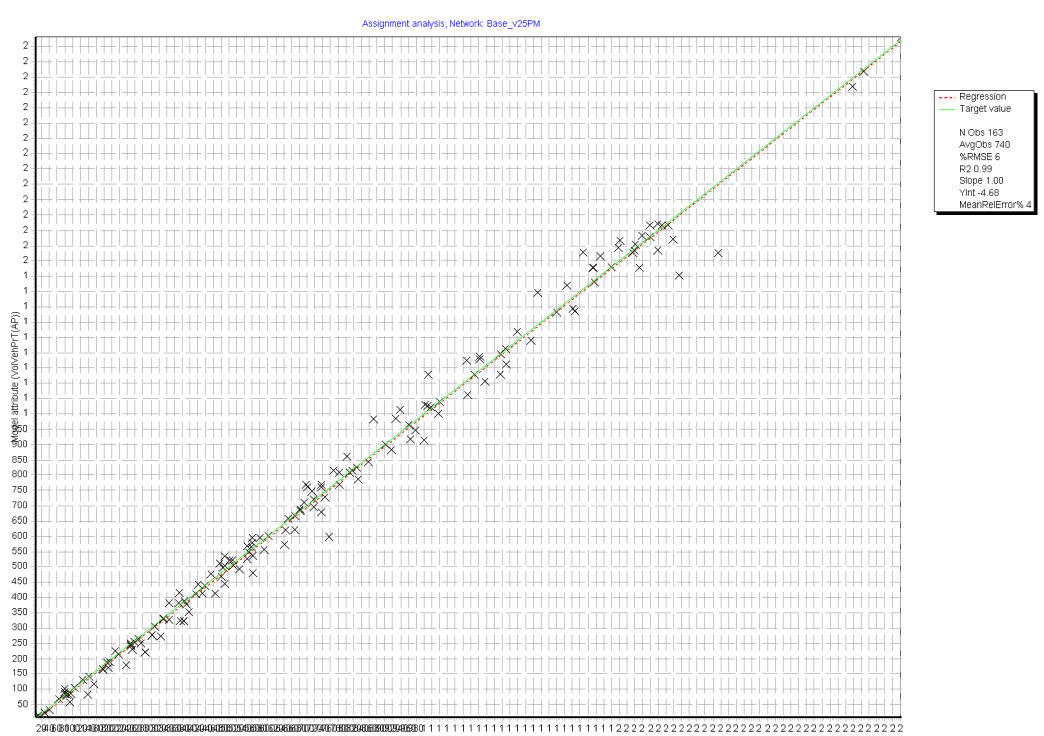
VISUM Model Calibration of Base Year AM Link Volume



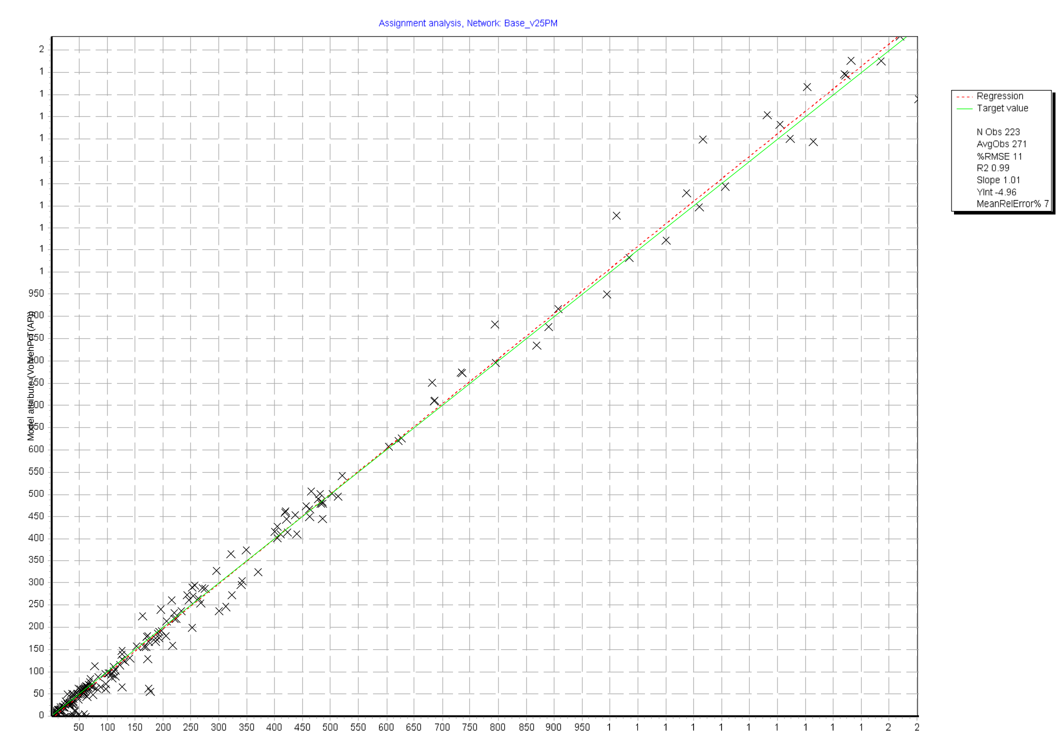
VISUM Model Calibration of Base Year AM Turning Movement Volume



VISUM Model Calibration of Base Year PM Link Volume



VISUM Model Calibration of Base Year PM Turning Movement Volume



The "X's" along the line represents the deviation of actual to model link or turning movement volumes from the diagonal line. Note that for higher link volume levels, the deviation can be slightly greater because the model attempts to replicate the base link and turning movement volumes within 5 percent, thus allowing for greater deviation at higher volume levels. Also, the base model link volumes are not balances whereas the VISSIM OD assignments constitute a balanced network.

Appendix C

VISSIM Model Calibration Comparison

VISSIM Calibration using Speed Data

Street - Direction	From	To	Distance (mile)	AM Peak Hour Model Speed (mph)	AM Peak Hour GPS Speed (mph)	PM Peak Hour Model Speed (mph)	PM Peak Hour GPS Speed (mph)
Little River Tprk EB	Start	Hummer Rd.	0.20	10.3		5.4	
Little River Tprk EB	Hummer Rd.	Woodland Rd.	0.18	4.6	26	8.7	25
Little River Tprk EB	Woodland Rd.	Medford Dr.	0.21	8.7		18.8	
Little River Tprk EB	Medford Dr.	Markhame St.	0.22	7.9		24.5	
Little River Tprk EB	Markhame St.	Annandale Rd.	0.17	6.3	9	6.4	7
Little River Tprk EB	Annandale Rd.	Maple Pl.	0.13	11.1	20	22.5	10
Little River Tprk EB	Maple Pl.	John Marr Dr.	0.23	17.7		13.5	
Little River Tprk EB	John Marr Dr.	Evergreen Ln.	0.26	18.2	30	18.2	34
Little River Tprk EB	Evergreen Ln.	End	0.25	31.5		31.4	
Overall EB Average Travel Speed				10.1	12-35	12.4	10-19
Little River Tprk WB	Start	Evergreen Ln.	0.25	21.1		20.0	
Little River Tprk WB	Evergreen Ln.	John Marr Dr.	0.26	14.2	14	12.0	12
Little River Tprk WB	John Marr Dr.	Maple Pl.	0.23	12.1	30	9.2	11
Little River Tprk WB	Maple Pl.	Annandale Rd.	0.13	13.8		6.5	
Little River Tprk WB	Annandale Rd.	Markhame St.	0.17	27.4	23	19.3	25
Little River Tprk WB	Markhame St.	Medford Dr.	0.22	14.0	12	14.0	12
Little River Tprk WB	Medford Dr.	Woodland Rd.	0.21	4.8		3.6	
Little River Tprk WB	Woodland Rd.	Hummer Rd.	0.18	5.3		5.0	
Little River Tprk WB	Hummer Rd.	End	0.20	32.3		32.5	
Overall WB Average Travel Speed				11.3	11-25	9.1	10-18

Appendix D

TP+ Regional Model TAZ Zones

Growth Rate for Scenario A

	AM		PM			
TAZ	Production	Attraction	Production	Attraction	Zone Type	Street Identification
1	1.66	1.66	1.77	1.80	Internal TAZ	n/a
2	1.45	1.46	1.44	1.45	Internal TAZ	n/a
3	1.43	1.54	1.54	1.44	Internal TAZ	n/a
4	1.00	1.00	1.00	1.00	Internal TAZ	n/a
5	1.49	1.52	1.64	1.64	Internal TAZ	n/a
6	1.00	1.00	1.00	1.00	Internal TAZ	n/a
7	1.10	1.51	1.42	1.13	Internal TAZ	n/a
8	1.00	1.00	1.00	1.00	Internal TAZ	n/a
9	1.00	1.00	1.00	1.00	Internal TAZ	n/a
10	1.00	1.00	1.00	1.00	Internal TAZ	n/a
11	1.00	1.00	1.00	1.00	Internal TAZ	n/a
12	1.00	1.00	1.00	1.00	Internal TAZ	n/a
13	1.15	1.12	1.13	1.15	Internal TAZ	n/a
14	1.15	1.12	1.13	1.15	Internal TAZ	n/a
15	0.95	0.94	0.94	0.95	Internal TAZ	n/a
16	1.00	1.00	1.00	1.00	Internal TAZ	n/a
17	1.00	1.00	1.00	1.00	Internal TAZ	n/a
18	2.09	2.07	2.02	2.04	Internal TAZ	n/a
19	1.00	1.00	1.00	1.00	Internal TAZ	n/a
20	1.66	1.66	1.77	1.80	Internal TAZ	n/a
21	1.19	1.16	1.10	1.10	External	Little River Trpk E Limit
22	1.19	1.16	1.10	1.10	External	Backlick S Limit
23	1.20	1.28	1.24	1.21	External	Americana
24	1.19	1.16	1.10	1.10	External	Columbia N Limit
25	1.20	1.28	1.24	1.21	External	Patriot
26	1.19	1.16	1.10	1.10	External	Annandale N Limit
27	1.19	1.16	1.10	1.10	External	Little River Trpk W Limit
28	1.19	1.16	1.10	1.10	External	Ravensworth S Limit
29	1.19	1.16	1.10	1.10	External	Gallows N Limit
30	1.20	1.28	1.24	1.21	External	Justine

Annandale CBC Forecast Model TAZ Trip Production