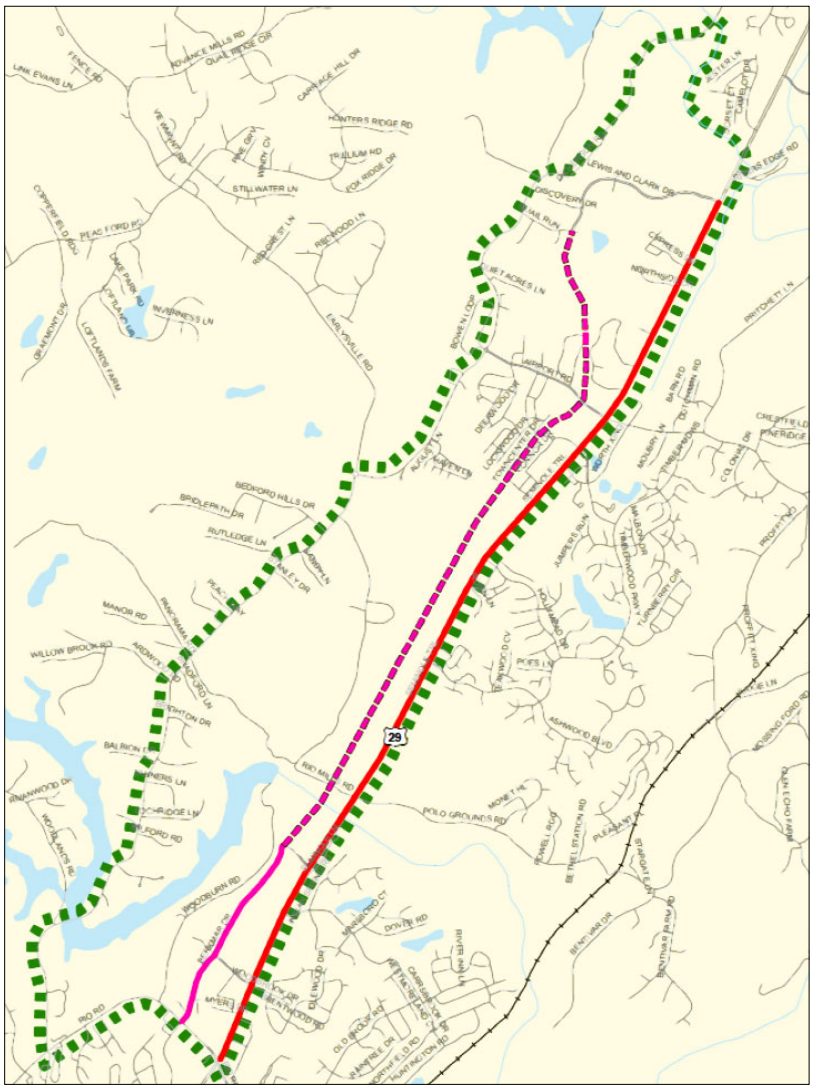
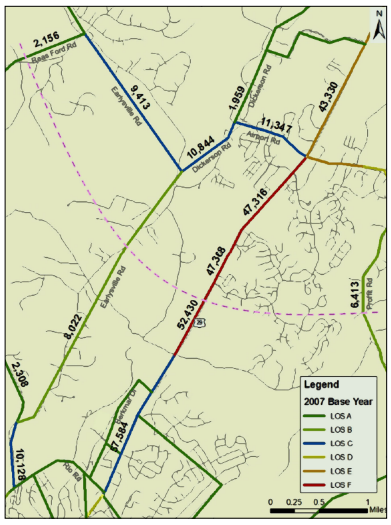
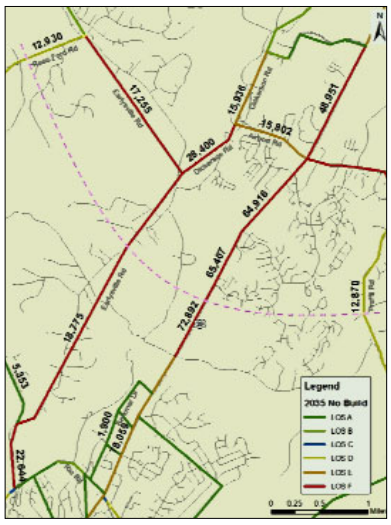
Berkmar Drive Extension Study

Charlottesville-Albemarle Metropolitan Planning Organization

May, 2010







Technical Memorandum - Final

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1.0 Introduction

In 2008, Virginia Department of Transportation (VDOT), in conjunction with Thomas Jefferson Planning District Commission (TJPDC) and Albemarle County, completed a *US 29 North Corridor Transportation Study* to develop a context-sensitive, multimodal transportation plan for the US 29 North Corridor within Albemarle County north of the City of Charlottesville (Places29 Area). This effort has been incorporated with development of the *Places29 Master Plan* (*Places29 Plan*) by Albemarle County. In November 2009, the Charlottesville-Albemarle Metropolitan Planning Organization (MPO) Policy Board requested that TJPDC staff analyze the traffic impacts of extending Berkmar Drive as recommended in the *Places29 Plan* as well as traffic impacts of increasing the growth area in the US 29 corridor. The existing heavy traffic volumes on US 29 North and nearby local roads are expected to increase as development of this area continues. The Berkmar Drive Extension is predicated on improved movement of traffic, enhanced access, and land use development to the rapidly developing area.

1.1 Study Area

The Charlottesville-Albemarle Metropolitan Planning Organization (MPO) area includes the City of Charlottesville and the portions of Albemarle County that are urban or expected to be urban within the next twenty years. The *Places29 Plan* was developed for the Places29 Area which covers the 10.8 miles stretch of US 29 from the US 250 Bypass north to the Greene County line. This study focuses on roadways that will be directly impacted by the proposed Berkmar Drive Extension. A study area was chosen that encompasses roadways significantly impacted by travel changes in the vicinity of the proposed Berkmar Drive Extension. These study corridors include:

- US 29 from Lewis and Clark Drive to Rio Road
- Existing Berkmar Drive from Hilton Heights Road to Rio Road
- Dickerson Road from Lewis and Clark Drive to Airport Road
- Earlysville Road from Airport Road to Rio Road
- Roads connecting US 29 and Berkmar Drive (Extension)

This study area encompasses less than one half of the Places29 Area but will experience nearly all of the traffic changes that will result from the proposed extension of Berkmar Drive. Figure 1.1 displays the study area. For study purposes, five segments are defined along the study area from North to South. Table 1.1 summarizes mileages and number of lanes for US 29 and Berkmar Drive (Extension) for each segment.

Figure 1.1 Study Area

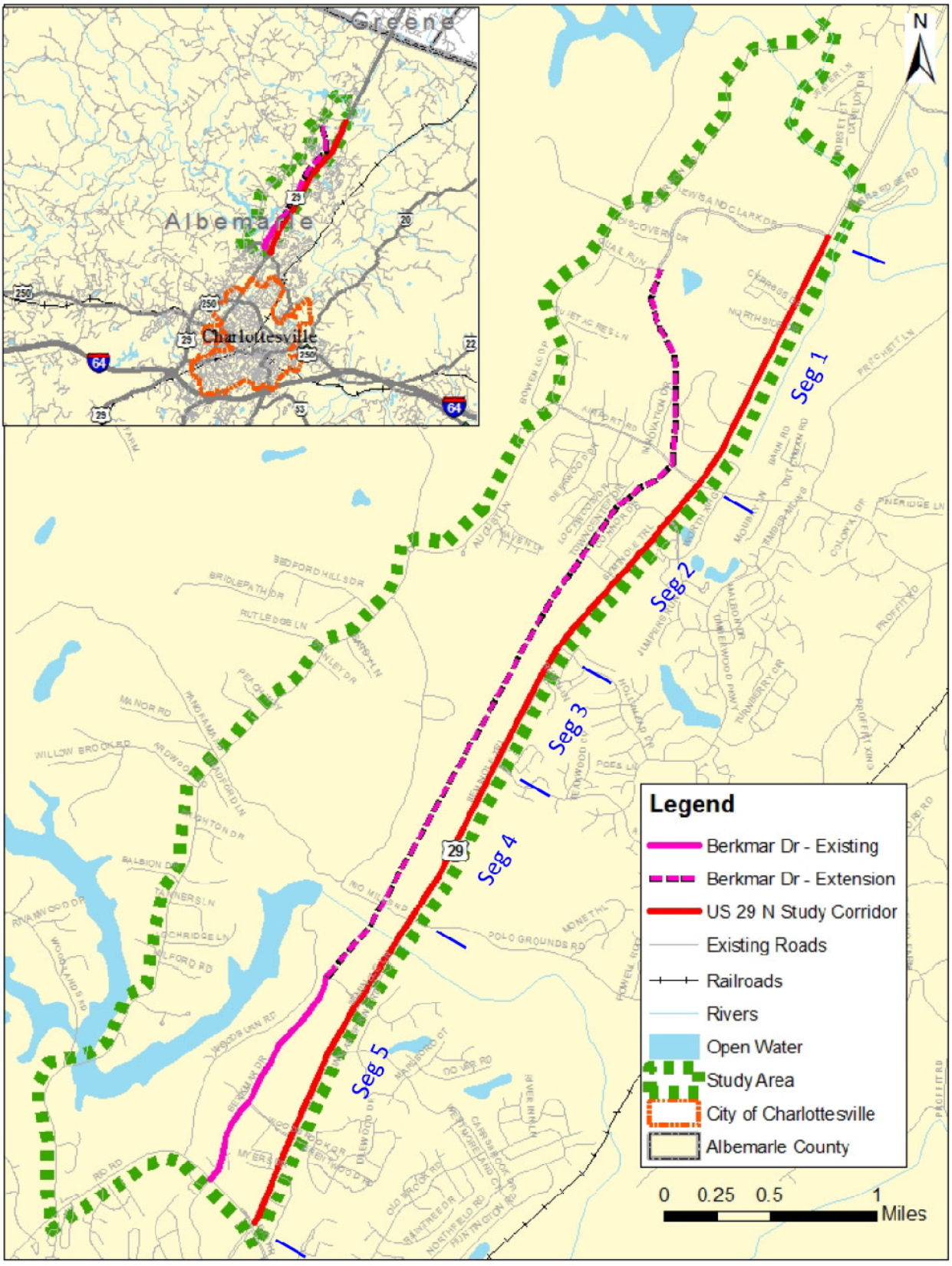


Table 1.1 Study Segments of US 29 and Berkmar Drive (Extension)

Segment	From	To	US 29 N		Berkmar Dr (Extension)	
			Miles	Lanes	Miles	Lanes
1	Lewis and Clark Dr	Airport Rd	1.3	4	1.0	4
2	Airport Rd	Hollymead Dr	1.0	4	1.0	4 (1)
3	Hollymead Dr	Ashwood Blvd	0.6	4	0.6	4
4	Ashwood Blvd	Rio Mills Rd	0.8	4	0.8	4
5	Rio Mills Rd	Rio Rd	1.6	8	1.6 (2)	2 (2)
Total			**5.3**		**5.0**	

(1) Proposed as 2 through travel lanes between Timberwood Blvd and Towncenter Dr.
(2) The existing Berkmar Dr. segment is from Hilton Heights Rd to Rio Rd, 1.1 miles with 2 lanes. It will be widened to 4 lanes when the extension is developed.

1.2 Problem

The current average daily traffic (ADT) volumes on US 29 range from about 35,000 at the Greene County boundary to about 50,000 near Rio Mills Road (South Fork of Rivanna River) and climb to about 60,000 south of the river. Such heavy traffic volumes, when combined with the rolling terrain present in the US 29 corridor, causes periodic queuing upstream of intersections.

The *Places29 Plan* identifies several factors that lead to this traffic pattern:

"… *the primary of which is that Albemarle County and the US 29 North Corridor in particular attract regional travel from neighboring areas. Commuting patterns from the 2000 Census indicate that people from neighboring counties and cities come to work in Albemarle County and the City of Charlottesville. Similarly, among workers who reside in Albemarle County, a vast majority of residents commute to jobs in either Albemarle County or Charlottesville. … This means that there is a concentration of traffic along destination corridors where employment, retail, and residential land uses are located. The developed portions of Albemarle County adjacent to the US 29 North Corridor are both a major attractor of regional and local travel, as well as a generator of trips by residents living in these areas.*"

Due to the importance of land uses in the US 29 corridor as regional destinations, the corridor within the study area is characterized by a large number of turns and cross traffic at intersections between US 29 and connection roads, which causes delays and safety issues at these locations. Therefore, adding capacity for through traffic on US 29, by itself, is not able to sufficiently resolve the long term transportation problems in the corridor and accommodate land use development in the study area. Rather, it is a combination of improvements to US 29 and to the parallel and connecting network that is needed, as well as a land use pattern that enables increased use of transit, bike and pedestrian modes. The *Places29 Plan* states benefits of such a combination of on- and off-US 29 improvements:

"*One benefit is that the pattern of development encouraged by the parallel road network improvement is more transit-ready and supportive of bicycling and walking for shorter trips than a pattern of development that continues to concentrate on US 29 frontage alone. The other benefit is that the improvements both to US 29 and to the parallel road network are not needed all at once and can be implemented incrementally over time as development and growth occur in the corridor.*"

1.3 Study Purpose

The purpose of this study is to provide the MPO with information to evaluate the traffic impacts of the several alternative concepts for the proposed Berkmar Drive Extension as well as other roadway capacity improvements and land use plans in the study area for the horizon year 2035. The report documents the following activities and criteria for MPO's evaluation:

- Review of *Places29 Plan*
- Identification of existing conditions
- Examination of area growth and development
- Development of proposed roadway improvement concept
- Development of alternatives
- Model improvement for future travel demand forecast
- Evaluation of proposed roadway improvements
- Impact analysis of land use plans

2.0 Existing Conditions

Data was collected for the transportation facilities in the study area. This information helps document the 2007 baseline operating conditions and forms the foundation for analyzing existing and future (2035) conditions. This section reviews the existing characteristics of the study area, including:

- Existing population and employment
- Existing roadways
- Existing traffic conditions

2.1 Socioeconomic Data

Table 2.1 below provides a comparison between Albemarle County and the State of Virginia based on the 2000 US Census. This data shows that Albemarle County has had a relatively fast population growth compared to the statewide growth trend since 1980. This data shows that in the 20 years from 1980 to 2000 population in Albemarle County grew at a faster rate than the rest of the Commonwealth.

Table 2.1 Historical Population Profile

County / State	1900	1920	1940	1960	1980	2000	Change % 1980 - 2000
Albemarle	28,473	26,005	24,652	30,969	55,783	84,197	50.9%
Virginia	1,854,184	2,309,187	2,677,773	3,966,949	5,346,818	7,079,025	32.4%

Source: 2000 US Census

This study was conducted using the updated Charlottesville-Albemarle MPO model which as developed with a 2007 base year. In 2007, the Charlottesville-Albemarle MPO area was estimated to have a population of 117,339 and total employment of 69,607. In 2007, the study area defined for this analysis had a population of 1,702 and employment of 3,589.

2.2 Existing Roadways

At this time the main roadway in the study area is US 29. US 29 is a multi-lane principal arterial with 8 lanes south of Rio Mills Road (South Fork of Rivanna River) and 4 lanes north of the river. It is the only continuous north-south roadway traversing the Places29 Area. The existing Berkmar Drive is a 2-lane local roadway which has its south end at US 29, extends north across Rio Road and ends at an intersection with Hilton Heights Rd. It is proposed to be extended north across the South Fork of the Rivanna River to Lewis and Clark Drive in the draft *Places29 Plan*. The current major parallel routes are Dickerson Road and Earlysville Road west to US 29. Airport Road and Rio Road provide the main connections between US 29 and Dickerson/Earlysville Road.

Table 2.2 below presents characteristics of major roadway segments in the study area from the VDOT roadway inventory and confirmed through field inspection.

Table 2.2 Roadway Characteristics Inventory

Road Segment	Access Management	Bike/Ped Facilities	Intersection Control	Posted Speed (mph)
US 29 N	4-8 Through Lanes w/ Turn Lanes	Limited	Traffic Signal	55
Berkmar Dr	2 Through Lanes w/ Turn Lanes	Yes	Traffic Signal	35
Dickerson Rd	2 Through Lanes w/ Turn Lanes	No	Roundabout	35 - 45
Earlysville Rd	2 Through Lanes w/ Turn Lanes	No	Roundabout	45
Airport Rd	4 Through Lanes w/ Turn Lanes	Yes	Traffic Signal / Roundabout	45
Rio Rd	4 Through Lanes w/ Turn Lanes	Yes	Traffic Signal	35

Source: VDOT's TPD Roads GIS database

2.3 Existing Traffic Conditions

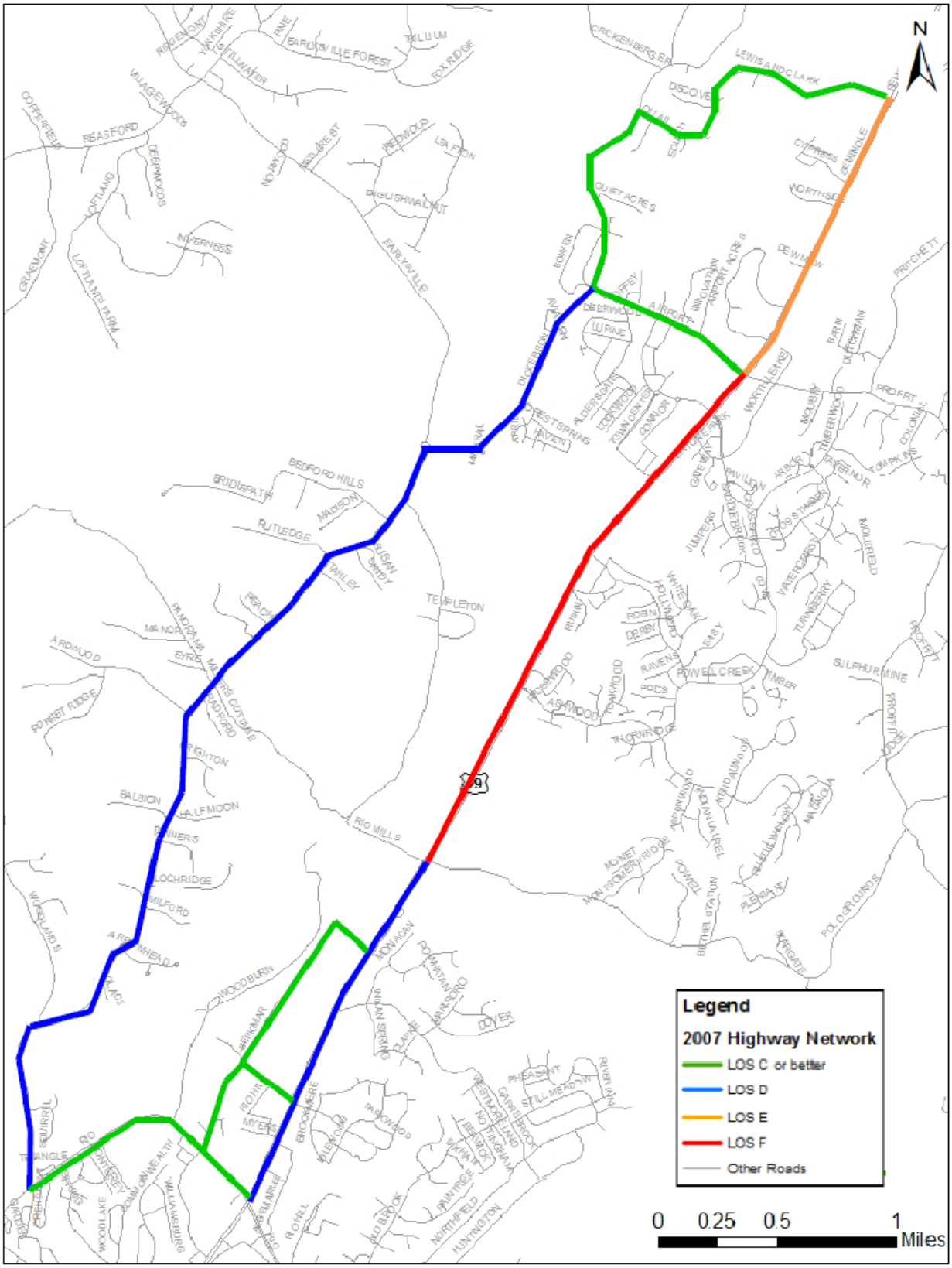
The VDOT 2007 SPS Lite database was reviewed to identify existing traffic conditions on major roads in the study area. Due to the absence of data in the VDOT database for Berkmar Drive, traffic counts collected in a the *Traffic Impact Analysis Berkmar Business Park*, (Renaissance Planning Group, 2008) was used for analysis.

Existing traffic conditions in the study area were evaluated by Level of Service (LOS). Level of Service is a six level qualitative approach which describes the drivers experience and identifies those conditions with letter designations from A to F, with LOS A representing the best operating conditions and F the worst. A qualitative description of the six levels of service is provided below.

LOS A – Drivers perceive little or no delay and easily progress along a corridor.
LOS B – Drivers experience some delay but generally driving conditions are favorable.
LOS C – Travel speeds are slightly lower than the posted speed with noticeable delay in intersection areas.
LOS D – Travel speeds are well below the posted speed with few opportunities to pass and considerable intersection delay.
LOS E – The facility is operating at capacity and there are virtually no useable gaps in the traffic.
LOS F – More traffic desires to use a particular facility than it is designed to handle resulting in extreme delays.

Figure 2.1shows existing LOS on major study corridors.

Figure 2.1 Existing Level of Service (LOS)



Drivers on the US 29 corridor north of Airport Road experience LOS E and experience LOS F between Airport Road and Rio Mills Road (South Fork of Rivanna River), due to high demand of traffic through these segments. South of Rio Mill Road, US 29 has a better traffic condition with LOS D, because it changes to 8 lanes and provides increased capacity. Berkmar Drive and major connecting roads (Lewis and Clark Road, Airport Road, Hilton Heights Road and Rio Road) all maintain LOS C or better. For parallel roads, LOS D is observed on Earlysville Road and Dickerson Road, except a small segment of Dickerson Road from Lewis and Clark Road to Airport Road with LOS C.

3.0 Future Conditions

This describes the anticipated future conditions in the Charlottesville-Albemarle MPO as represented in the 2035 Travel Demand Model that was used to test alternatives for this study. The following provides an overview of the expected future characteristics of the region.

- Future population and employment
- Future land use and developments
- Potential improvements

3.1 Future Population and Employment

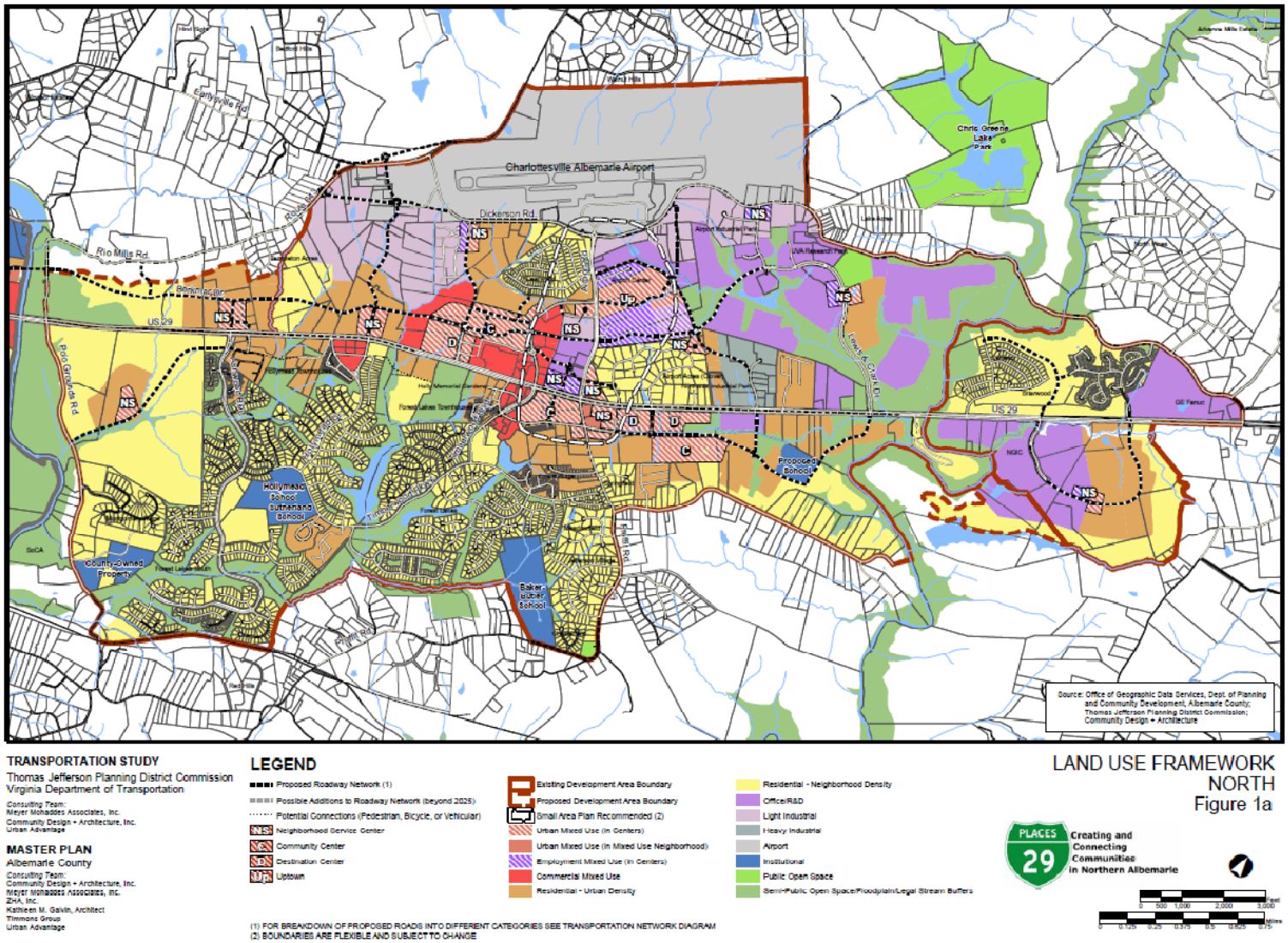
The population forecasts for the MPO in 2035 that are used in the 2035 Travel Demand Model were based on the Weldon Cooper Center forecasts for City of Charlottesville and Albemarle County. These were then disaggregated to the small geographic areas that are used for modeling purposes. These forecasts anticipate a population of 160,254 in 2035 (37% increase from year 2007) and employment of 103,498 (49% increase from year 2007) for the Charlottesville-Albemarle MPO region. The Berkmar Drive Extension study area is expected to grow to 2,379 population (40% increase from 2007) and 9,300 employment (160% increase from 2007) in 2035. This study area is expected to become an employment center in the next decades, which will increase the number of trips to the area.

3.2 Future Land Use and Developments

The *Places29 Plan* defines the land use pattern and neighborhood structure for the Places29 Area, including the study area defined in this report. The population and employment growth associated with the future development has been incorporated in the 2035 Charlottesville Travel Demand Model. Figure 3.1 illustrates the future land use plan for the north portion of the Places29 Area.

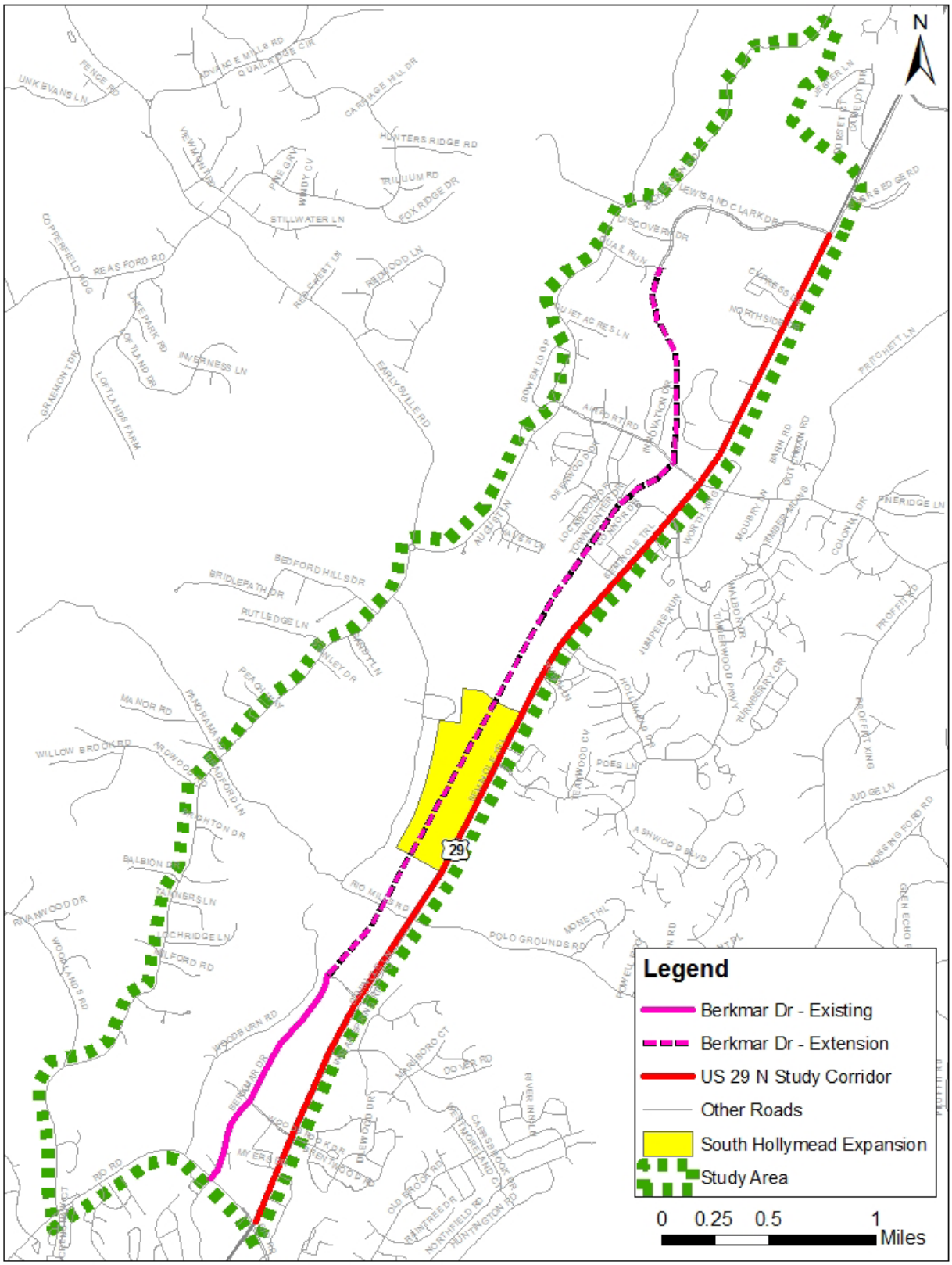
The *Places29 Plan* also recommends a potential development area boundary adjustment to expand the South Hollymead area. Figure 3.2 illustrates the approximate location of the potential South Hollymead expansion area.

Figure 3.1 Future Land Use Plan



Source: US 29 North Corridor Transportation Study

Figure 3.2 Potential South Hollymead Expansion Area



The South Hollymead expansion is the area south of the current southern boundary of the Hollymead Development Area and west of US 29. This expansion area is related to the proposed extension of Berkmar Drive across the South Fork of the Rivanna River to Meeting Street in Hollymead Town Center.

To forecast traffic generated by the South Hollymead expansion, it is necessary to make assumptions of additional land use of the expansion area. Based on inputs from Albemarle County planning staff, the expansion area will represent about 1/3 of potential build-out in the next 20 years. The proposed land uses and assumptions for horizon year 2035 are summarized as below.

- Neighborhood Service Center
  - approximately 10 acres
  - assume 120,000 square feet of office and/or 12,500 square feet of neighborhood scale retail
- Urban Mixed Use
  - approximately 30 acres
  - assume 15 acres for one large format retail (Big-Box, Wal-Mart, Home Depot or similar) of 120,000 square feet
  - assume 100 dwelling units
- Neighborhood Density Residential
  - approximately 75 acres
  - assume 150 dwelling units

For modeling purpose, these land areas were converted to number of employees by applying a set of employment density factors derived from available data sources from California, Ohio and Portland, Oregon. Table 3.1 shows the factors for different land use categories used by this study.

Table 3.1 Employment Density Factors

Land Use Category	Square Feet per Employee
Office	288
Large Format Retail	857
Neighborhood Retail	344

Based on the employment density factors in Table 3.1, the South Hollymead expansion area will generate total 593 (176 retail and 417 non-retail) new employees through 2035. Total 580 population and 572 autos were forecasted corresponding to 250 newly generated households by using same household occupancy and auto ownership rates in the 2035 Charlottesville Travel Demand Model. Given these levels of new population and employment the expansion area is anticipated to result in an additional 4,424 daily vehicle trips.

3.3 Potential Improvements

Several transportation system improvements were recommended by the *Places29 Plan* or are under VDOT consideration for the study area. This study focuses on proposed improvements to US 29, Berkmar Drive and associated connecting roads, as well as a new roadway connection between US 29, Berkmar Drive and Earlysville Road. These potential roadway improvements are described below and illustrated on a map in Figure 3.3.

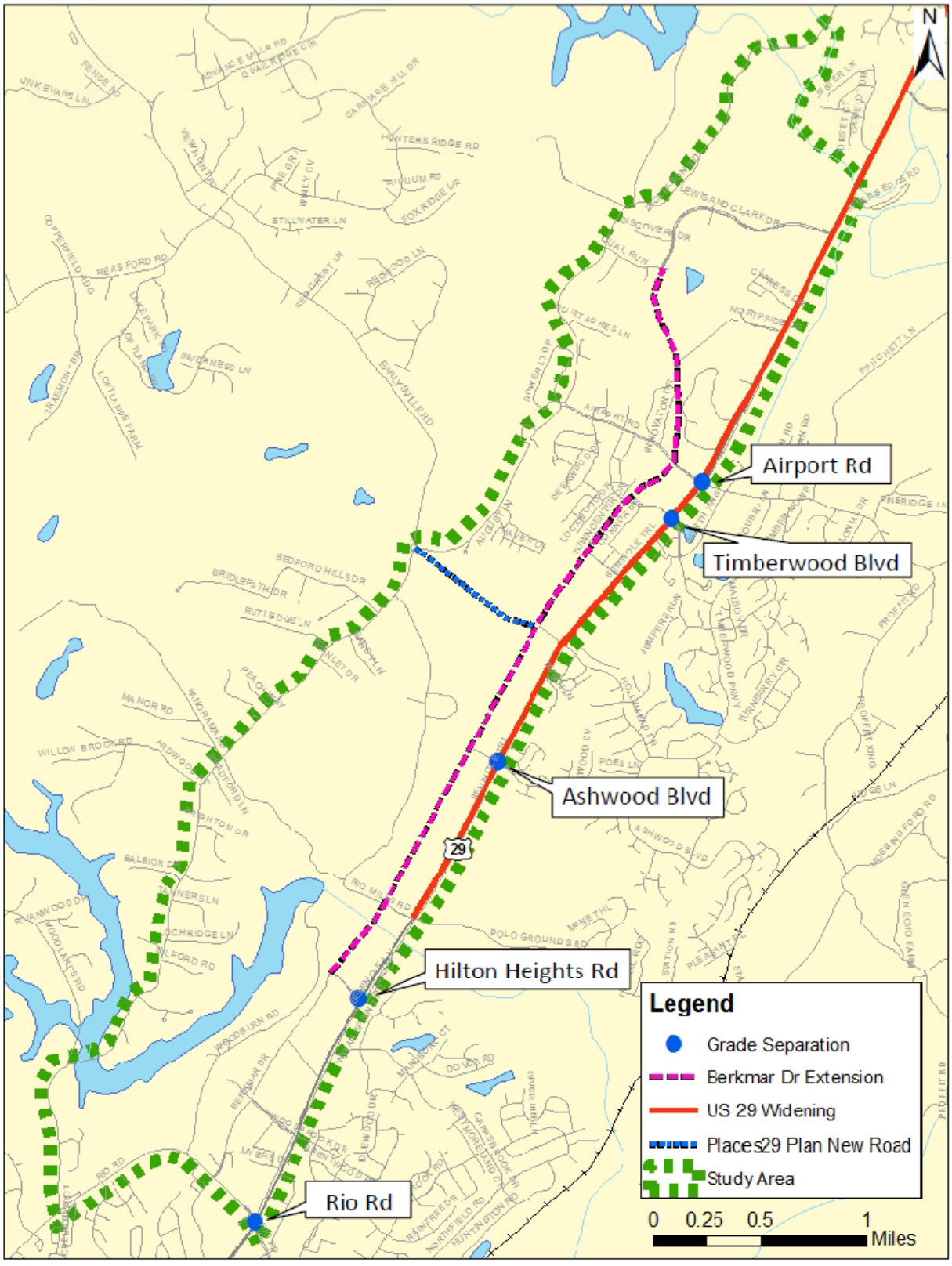
US 29 N Widening & Intersection Improvement
US 29 N currently has four through travel lanes north of the South Fork of Rivanna River. VDOT is considering widening US 29 to six lanes from Rio Mills Road (Polo Grounds Road) to US 33 in Ruckersville, Greene County, in order to increase the corridor's capacity. As proposed by *Places29 Plan*, US 29 corridor will introduce grade-separations at Airport Road, Timberwood Blvd, Ashwood Blvd and Hilton Heights Road in the planning horizon. New traffic signals will also be introduced on US 29 at Northside Drive and Airport Acres Road North. According to *Places29 Plan*, the cost of all US 29 projects that have been proposed within the study area will be $123,000,000.

It should be noted that the modeling for all the "build" alternatives in this study assume that the grade separations described above will be in place by 2035. The traffic forecasts and the measures of effectiveness for these roadway alternatives reported in this study will not be valid if the grade separations are not included. It is possible to analyze the operations of US 29 in the corridor with at-grade intersections but will require the development of a corridor simulation and significant data collection.

Berkmar Drive Extension and Connecting Roads
The *Places29 Plan* proposes extending Berkmar Drive north to Lewis and Clark Drive with an option of building a new bridge across the Rivanna River. The Berkmar Drive Extended is proposed as a 4-lane minor arterial with a posted speed of 45 mph. A small segment between Timberwood Blvd and Towncenter Drive will only have two through travel lanes because the remaining two lanes are planned for parking purpose to serve adjacent commercial areas. However, the two parking lanes can be re-striped for through travel lanes to provide additional capacity if future traffic volumes require additional capacity. Construction of Berkmar Drive Extension will require a few new connecting roads to provide adequate connections between Berkmar Drive and US 29. These connecting roads include: Lewis and Clark Drive, Northside Drive, Airport Road, Timberwod Blvd, Towncenter Drive, N Hollymead Drive, Ashwood Blvd, Rio Mills Road, Hilton Heights Road, Woodbrook Road, and Rio Road. According to *Places29 Plan*, all project costs related to Berkmar Drive Extension will be $56,730,000.

Places29 Plan New Road
The *Places29 Plan* proposes a new 2-lane road parallel with Airport Road, connecting US 29 and Earlysville Road. In this study, this new road is modeled as a minor collector with a posted speed of 35 mph. The construction cost of this new road will be provided by the developer.

Figure 3.3 Potential Improvements



4.0 Alternatives

This section discusses the five build alternatives for horizon year 2035 that are evaluated in this study. The alternatives were developed for evaluation using available data and are compared to a baseline No Build alternative. Table 4.1 summarizes all alternatives. A detailed description of each alternative follows.

Table 4.1 Summary of Alternatives

2035 Alternative	2035 Network	Potential Improvements				South Hollymead Expansion
		US 29 6-Lane Widening	Berkmar Dr Extension - w/o Bridge (1)	Berkmar Dr Extension - w/ Bridge (2)	Places29 New Road	
No Build	√					
Build 1	√	√				
Build 2	√	√		√	√	
Build 3	√			√	√	√
Build 4	√	√	√		√	√
Build 5	√	√		√	√	√

(1) Berkmar Dr is extended from Rio Mills Rd to Lewis and Clark Dr. No bridge is built across Rivanna River.
(2) Berkmar Dr is extended from Hilton Heights Rd to Lewis and Clark Dr, with a new bridge across Rivanna River.

Baseline Alternative – No Build
The baseline alternative (No Build) used for comparison in this analysis assumes 2035 population and employment for the MPO region and does not include the South Hollymead Expansion. It has the same highway network as 2035 Charlottesville model, which does not include any of the potential improvements described above.

Build Alternative 1 – US 29 6-Lane Widening
This alternative includes the 6-lane widening improvement on US 29 from Rio Mills Road to US 33 in Greene County. This alternative does not include the South Hollymead Expansion and has the same population and employment inputs as the 2035 No Build alternative. This alternative was modeled to identify the mobility improvement that is resulted by solely enhancing US 29.

Build Alternative 2 – US 29 6-Lane Widening + Berkmar Dr Extension w/ Bridge + Places29 New Road
Build Alternative 2 assumes the same population and employment inputs for 2035 as the No Build alternative. It does not include additional land use of the South Hollymead Expansion. This alternative completely incorporates all new road construction and highway capacity improvement projects proposed in the study area. In addition to the US 29 6-lane widening project in Build Alternative 1, the alternative includes a 4-lane Berkmar Drive Extension (except a 2-lane design between Timberwood Blvd and Towncenter Drive) with a new bridge across the South Fork of Rivanna River, connecting to Lewis and Clark Drive in north Albemarle County. It also includes the

new 2-lane local road parallel with Airport Road, which connects US 29 and Earlysville Road, as proposed by *Places29 Plan*. This alternative was analyzed to identify the traffic that would result in the study area with all proposed improvements and expected growth in the Charlottesville-Albemarle MPO not including the South Hollymead Growth Area Expansion.

Build Alternative 3 – Berkmar Dr Extension w/ Bridge + Places29 New Road + South Hollymead Expansion

Build Alternative 3 is identical to Build Alternative 2, except that the improvement of US 29 to 6-lanes is not included and this alternative incorporates the additional population and employment anticipated in the South Hollymead expansion area. The benefit of Berkmar Drive Extension (with a new bridge across Rivanna River) and the impact of potential South Hollymead expansion were primarily evaluated in this alternative.

Build Alternative 4 – US 29 6-Lane Widening + Berkmar Dr Extension w/o Bridge + Places29 New Road + South Hollymead Expansion

This alternative was included to enable an analysis of the value of the Berkmar Drive bridge over the South Fork of the Rivanna River. It includes all the proposed improvements included in Build Alternative 3 with the exception of the bridge that would connect existing Berkmar Drive south of the South Fork of the Rivanna River with the Berkmar Drive Extension north of the river. North of the river, the Berkmar Drive Extension is modeled from Rio Mills Road to Lewis and Clark Drive, with the same design as Build Alternatives 2 and 3. This alternative also incorporates US 29 6-lane widening, Places29 new road and South Hollymead expansion.

Build Alternative 5 – US 29 6-Lane Widening + Berkmar Dr Extension w/ Bridge + Places29 New Road + South Hollymead Expansion

Build Alternative 5 combines elements of Build Alternative 1 (US 29 6-lane widening) and Build Alternative 3 (Berkmar Drive Extension with bridge, Places29 new road and South Hollymead expansion). It has exactly same improvements as Build Alternative 2, but incorporates additional land use of South Hollymead expansion area.

5.0 Modeling Analysis – Evaluation of Alternatives

Each alternative described above was evaluated using the 2035 Charlottesville-Albemarle Travel Demand Model. In this study, the model's traffic analysis zones (TAZ) were refined to achieve more accurate forecasting results. The details of TAZ refinement process are described in Appendix A. A corridor-level analysis was conducted to compare all alternatives' critical measures of effectiveness (MOE) for major corridors, parallel roads and connecting roads. A system-level analysis was also performed to show regional mobility benefits resulting from each build alternative. Finally, a benefit/cost analysis was conducted for each build alternative.

5.1 Corridor-Level Analysis

The 2035 No Build and Build alternatives were evaluated by conducting a corridor-level analysis. The 2007 base year traffic condition was also evaluated for comparison.

5.1.1 Measures of Effectiveness

This analysis summarized critical Measures of Effectiveness (MOE) for road segments of US 29, Berkmar Drive Extension, parallel roads and connecting roads, and then compared all alternatives. The examined MOEs include: average daily traffic (ADT), volume to capacity ratio (V/C), level of service (LOS) and travel time.

Average Daily Traffic

Average daily traffic (ADT) is the average number of two-way vehicular volumes passing a specific point in a 24-hour period. It is the standard measurement for vehicle traffic load on a section of road. In this study, ADT numbers were directly obtained from model runs. The link-length-weighted average ADT was calculated for desired corridor segments for alternative evaluation.

Volume to Capacity Ratio

Volume to capacity (V/C) ratio is the ratio of demand traffic flow to capacity for a highway facility. It is widely used to measure different levels of congestion. A roadway with a V/C ratio of 1.0 means the traffic volume is at its capacity. In this study, V/C ratio of each roadway segment can be directly obtained from model runs. The link-length-weighted average V/C ratio was calculated for desired corridor segments for alternative evaluation.

Level of Service

Level of Service (LOS) is a qualitative measure of traffic flow describing operating conditions. Six levels of service are defined by the Federal Highway Administration (FHWA) in the Highway Capacity Manual for use in evaluating roadway operating conditions. They are given letter designations from A to F, with LOS A representing the best operating conditions and F the worst. A qualitative description of the different levels of service and V/C ratio thresholds used to assign a level of service for highway facility are provided below.

LOS A – Drivers perceive little or no delay and easily progress along a corridor.
LOS B – Drivers experience some delay but generally driving conditions are favorable.
LOS C – Travel speeds are slightly lower than the posted speed with noticeable delay in intersection areas.
LOS D – Travel speeds are well below the posted speed with few opportunities to pass and considerable intersection delay.
LOS E – The facility is operating at capacity and there are virtually no useable gaps in the traffic.
LOS F – More traffic desires to use a particular facility than it is designed to handle resulting in extreme delays.

In this study, the following V/C ratio thresholds were used to assign a level of service for highway facilities:

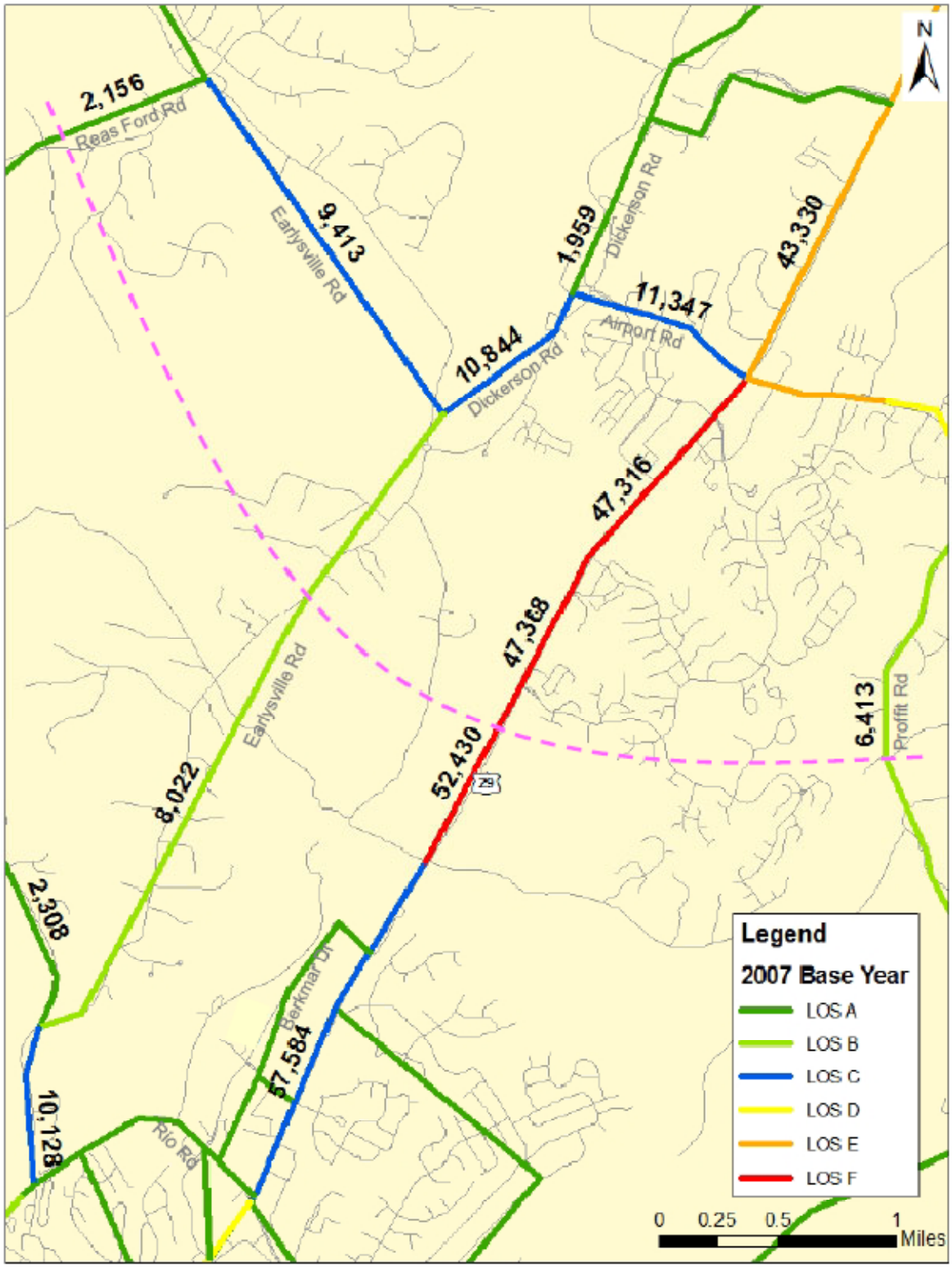
LOS A: $0.00 \leq V/C < 0.35$
LOS B: $0.35 \leq V/C < 0.55$
LOS C: $0.55 \leq V/C < 0.70$
LOS D: $0.70 \leq V/C < 0.85$
LOS E: $0.85 \leq V/C < 1.00$
LOS F: $V/C \geq 1.00$

Travel Time
Travel time is the accumulated time that a vehicle costs to travel through a roadway segment. The Charlottesville model output provides travel time (in minutes) for each roadway segment.

5.1.2 Corridor Analysis Results

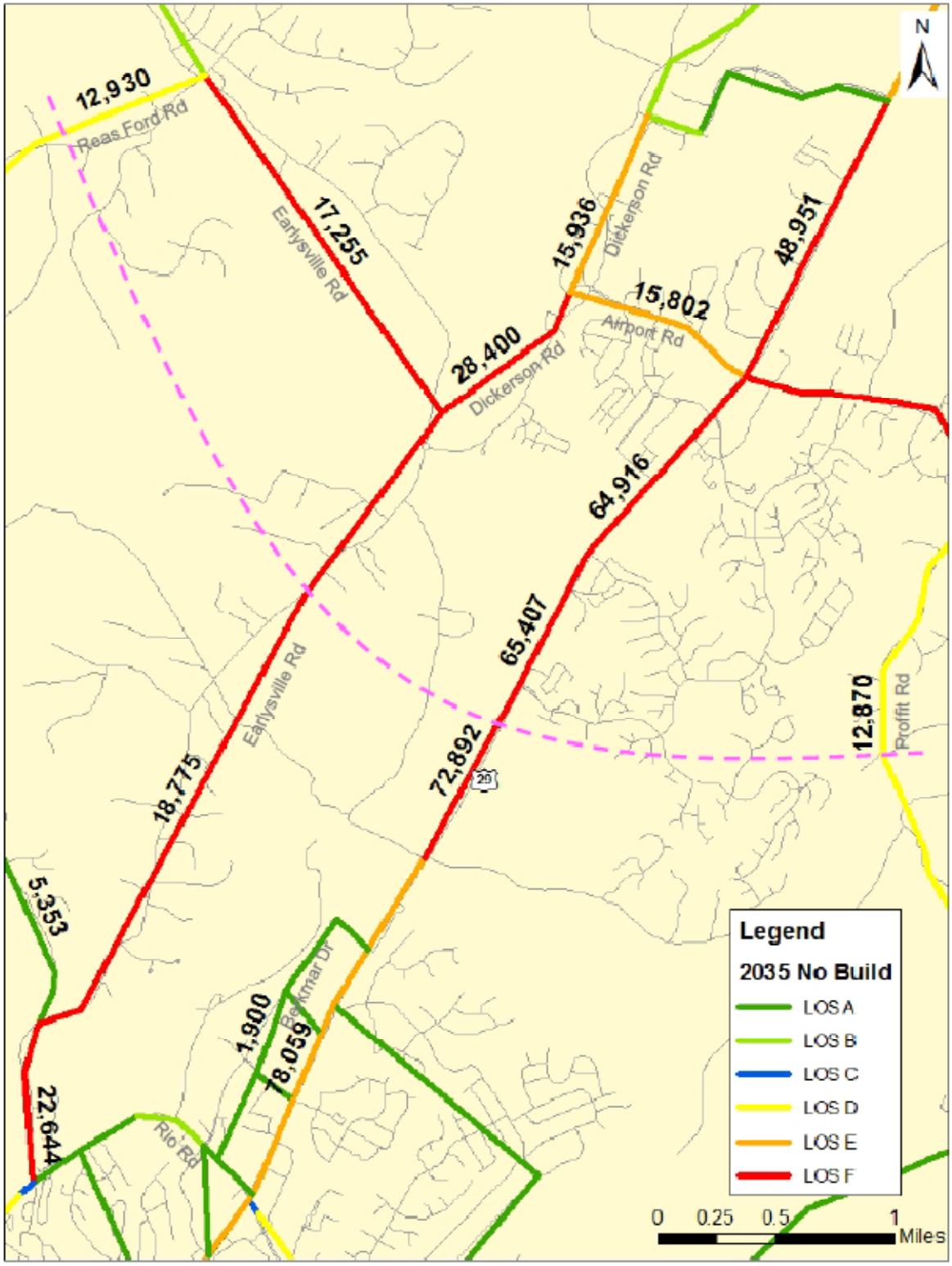
Figure 5.1 through 5.7 illustrate ADT and LOS for roadway segments in base year 2007 and all 2035 alternatives, respectively. A cutline was also developed to capture total daily traffic volumes traveling on major corridors for each alternative. Detailed MOEs of roadways in the study area are provided in Table 5.1 through 5.5.

Figure 5.1 Corridor ADT & LOS (2007)



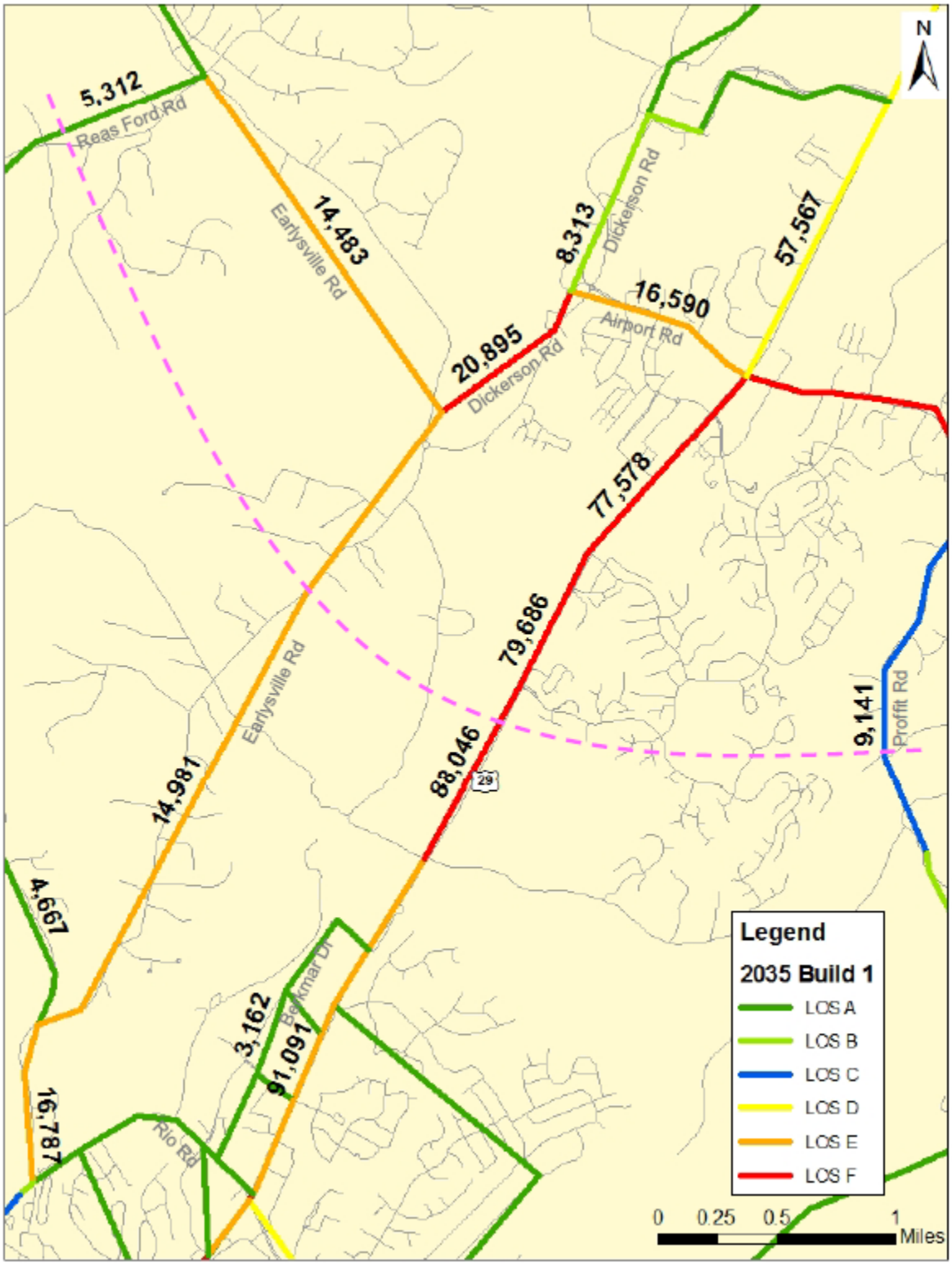
Note: Cutline total volume = 69,021

Figure 5.2 Corridor ADT & LOS (2035 No Build)



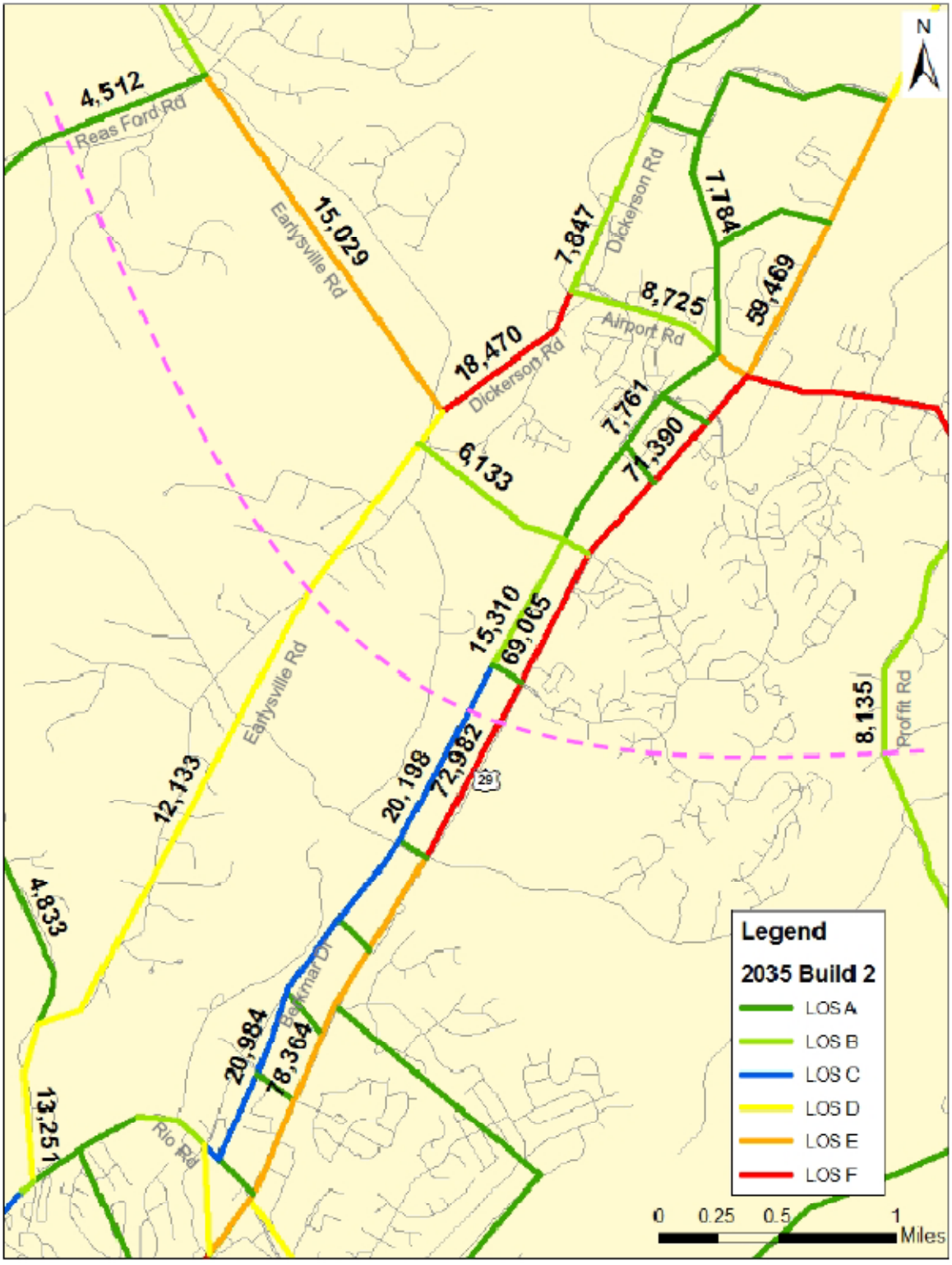
Note: Cutline total volume = 117,467

Figure 5.3 Corridor ADT & LOS (2035 Build 1)



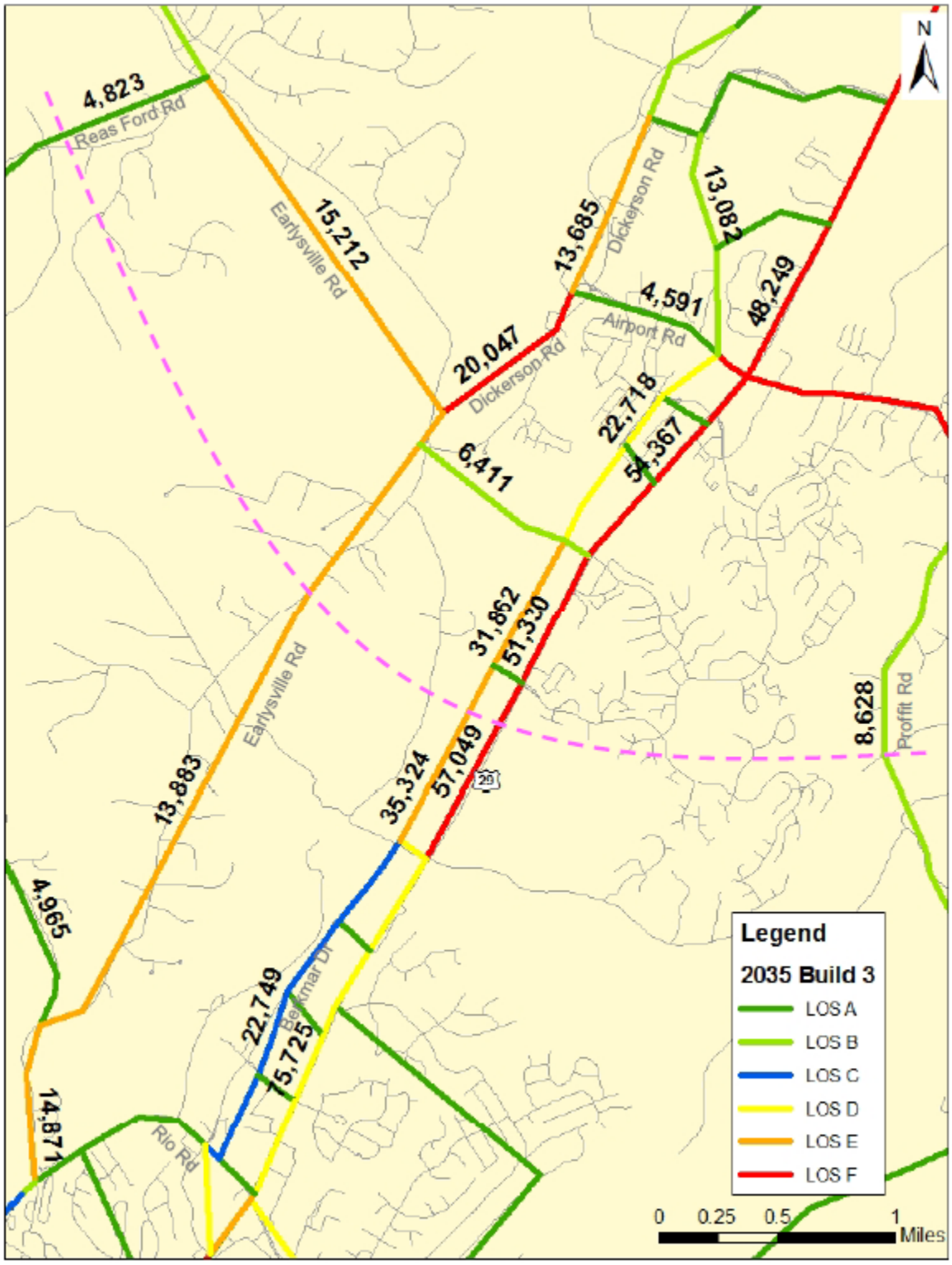
Note: Cutline total volume = 117,480

Figure 5.4 Corridor ADT & LOS (2035 Build 2)



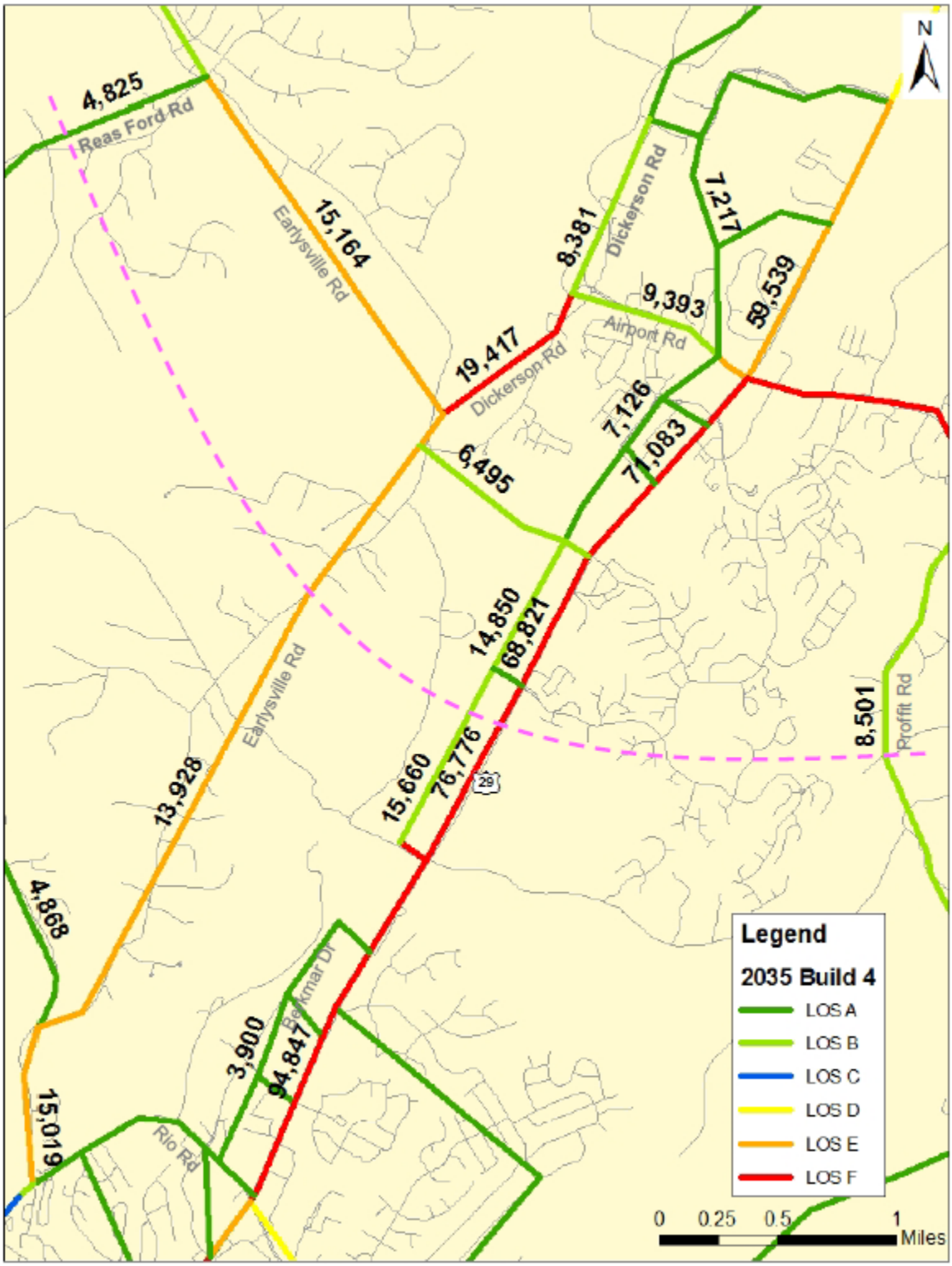
Note: Cutline total volume = 117,960

Figure 5.5 Corridor ADT & LOS (2035 Build 3)



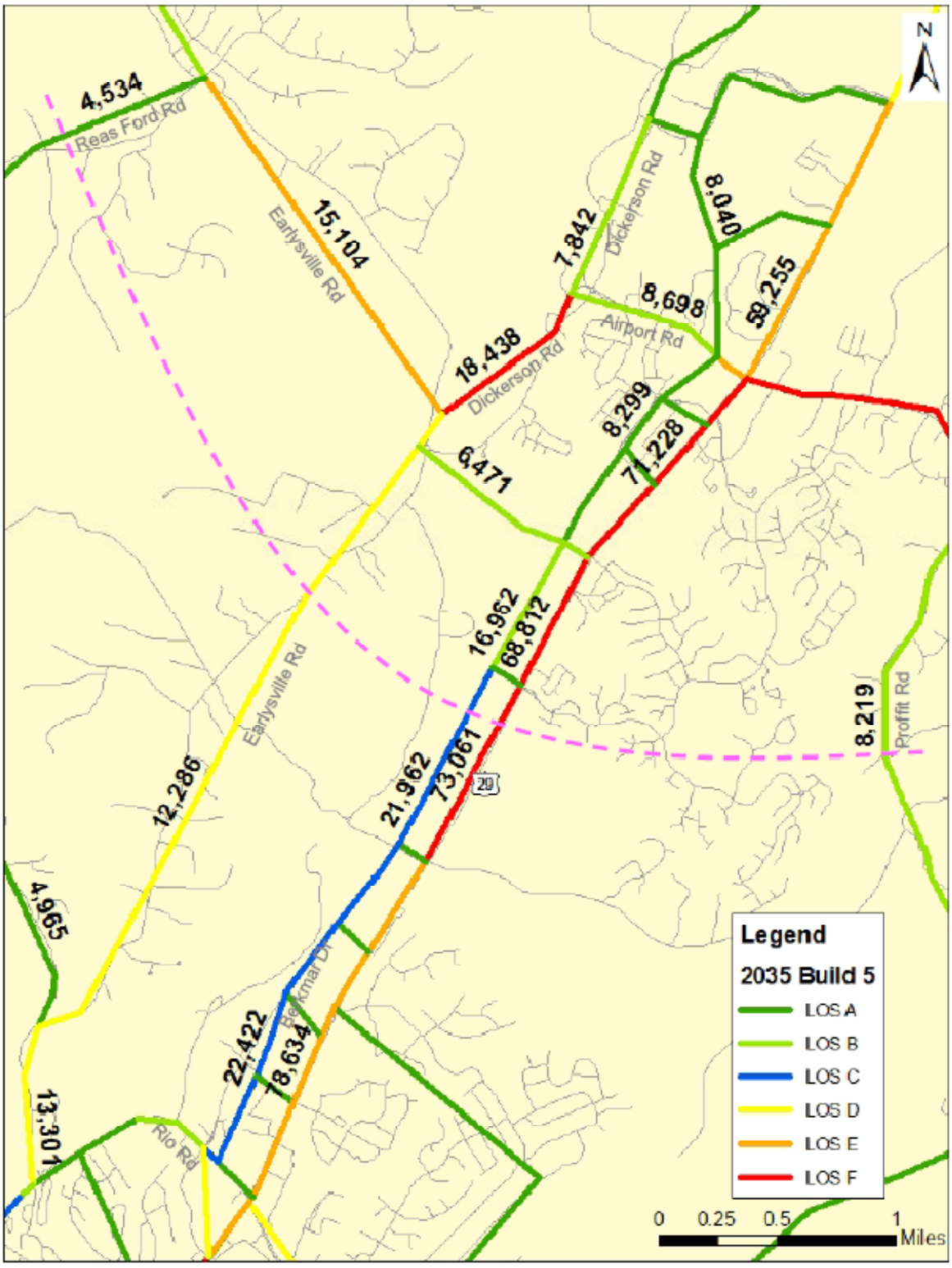
Note: Cutline total volume = 119,707

Figure 5.6 Corridor ADT & LOS (2035 Build 4)



Note: Cutline total volume = 119,690

Figure 5.7 Corridor ADT & LOS (2035 Build 5)



Note: Cutline total volume = 120,062

Table 5.1 US 29 Measures of Effectiveness

From	To	2007				2035 No Build				2035 Build 1				2035 Build 2				2035 Build 3				2035 Build 4				2035 Build 5			
		ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)
Lewis and Clark Dr	Airport Rd	43,330	0.95	E	1.5	48,951	1.07	F	1.8	57,567	0.84	D	1.4	59,469	0.87	E	1.4	48,249	1.06	F	1.8	59,539	0.87	E	1.4	59,255	0.87	E	1.4
Airport Rd	Hollymead Dr	47,316	1.04	F	1.3	64,916	1.42	F	3.4	77,578	1.13	F	1.6	71,390	1.04	F	1.4	54,367	1.19	F	1.8	71,083	1.04	F	1.3	71,228	1.04	F	1.3
Hollymead Dr	Ashwood Blvd	47,368	1.04	F	0.8	65,407	1.43	F	2.2	79,686	1.17	F	1.1	69,065	1.01	F	0.8	51,330	1.13	F	1.0	68,821	1.01	F	0.8	68,812	1.01	F	0.8
Ashwood Blvd	Rio Mills Rd	52,430	1.15	F	1.4	72,892	1.60	F	4.9	88,046	1.29	F	1.9	72,982	1.07	F	1.2	57,049	1.25	F	1.7	76,776	1.12	F	1.3	73,061	1.07	F	1.2
Rio Mills Rd	Rio Rd	57,584	0.63	C	2.1	78,059	0.86	E	2.3	91,091	1.00	E	2.6	78,364	0.86	E	2.3	75,725	0.83	D	2.2	94,847	1.04	F	2.8	78,634	0.86	E	2.3
		Total Travel Time:			7.1	Total Travel Time:			14.5	Total Travel Time:			8.6	Total Travel Time:			7.0	Total Travel Time:			8.5	Total Travel Time:			7.6	Total Travel Time:			7.0

Note: Green – improved LOS in Build alternatives; Red – degraded LOS in Build alternatives.

Table 5.2 Berkmar Drive Extension Measure Of Effectiveness

From	To	2007				2035 No Build				2035 Build 1				2035 Build 2				2035 Build 3				2035 Build 4				2035 Build 5			
		ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)
Lewis and Clark Dr	Airport Rd	n/a				n/a				n/a				7,784	0.22	A	1.3	13,082	0.37	B	1.3	7,217	0.20	A	1.3	8,040	0.23	A	1.3
Airport Rd	Hollymead Dr													7,761	0.27	A	1.4	22,718	0.79	D	1.8	7,126	0.25	A	1.4	8,299	0.29	A	1.4
Hollymead Dr	Ashwood Blvd													15,310	0.43	B	0.8	31,862	0.89	E	1.0	14,850	0.42	B	0.8	16,962	0.48	B	0.8
Ashwood Blvd	Rio Mills Rd													20,198	0.57	C	1.1	35,324	0.99	E	1.4	15,660	0.44	B	1.1	21,962	0.62	C	1.1
Rio Mills Rd	Rio Rd	344	0.02	A	2.0	1,900	0.11	A	2.0	3,162	0.19	A	2.0	20,984	0.59	C	2.1	22,749	0.64	C	2.1	3,900	0.23	A	2.0	22,422	0.63	C	2.1
		Total Travel Time:			2.0	Total Travel Time:			2.0	Total Travel Time:			2.0	Total Travel Time:			6.7	Total Travel Time:			7.6	Total Travel Time:			6.6	Total Travel Time:			6.7

Note: Green – improved LOS in Build alternatives; Red – degraded LOS in Build alternatives.

Table 5.3 Dickerson Road Measure Of Effectiveness

From	To	2007				2035 No Build				2035 Build 1				2035 Build 2				2035 Build 3				2035 Build 4				2035 Build 5			
		ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)
Lewis and Clark Dr	Airport Rd	1,959	0.12	A	0.8	15,936	1.00	E	1.0	8,313	0.52	B	0.8	7,847	0.49	B	0.8	13,685	0.86	E	0.9	8,381	0.52	B	0.8	7,842	0.49	B	0.8
Airport Rd	Earlysville Rd	10,844	0.68	C	0.8	28,400	1.78	F	4.6	20,895	1.31	F	1.6	18,470	1.15	F	1.2	20,047	1.25	F	1.4	19,417	1.21	F	1.3	18,438	1.15	F	1.2
		Total Travel Time:			1.5	Total Travel Time:			5.6	Total Travel Time:			2.4	Total Travel Time:			2.0	Total Travel Time:			2.3	Total Travel Time:			2.1	Total Travel Time:			2.0

Note: Green – improved LOS in Build alternatives; Red – degraded LOS in Build alternatives.

Table 5.4 Earlysville Road Measure Of Effectiveness

From	To	2007				2035 No Build				2035 Build 1				2035 Build 2				2035 Build 3				2035 Build 4				2035 Build 5			
		ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)
Dickerson Rd	Woodlands Rd	8,022	0.50	B	4.0	18,775	1.17	F	6.6	14,981	0.94	E	4.8	12,133	0.76	D	4.3	13,883	0.87	E	4.6	13,928	0.87	E	4.6	12,286	0.77	D	4.3
Woodlands Rd	W Rio Rd	10,128	0.60	C	0.9	22,644	1.33	F	2.1	16,787	0.99	E	1.1	13,251	0.78	D	0.9	14,871	0.87	E	1.0	15,019	0.88	E	1.0	13,301	0.78	D	0.9
		Total Travel Time:			4.9	Total Travel Time:			8.7	Total Travel Time:			5.9	Total Travel Time:			5.2	Total Travel Time:			5.5	Total Travel Time:			5.6	Total Travel Time:			5.2

Note: Green – improved LOS in Build alternatives; Red – degraded LOS in Build alternatives.

Table 5.5 Connecting Roads Measure Of Effectiveness

Road Segment	2007				2035 No Build				2035 Build 1				2035 Build 2				2035 Build 3				2035 Build 4				2035 Build 5			
	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)	ADT	V/C	LOS	Time (min)
Lewis and Clark Dr	3,083	0.10	A	1.8	10,541	0.33	A	1.8	10,899	0.34	A	1.8	7,691	0.24	A	1.8	7,589	0.24	A	1.8	7,692	0.24	A	1.8	7,674	0.24	A	1.8
Airport Rd: Dickerson Rd -> Berkmar Dr	11,347	0.67	C	1.1	15,802	0.93	E	1.4	16,590	0.98	E	1.5	8,725	0.51	B	0.9	4,591	0.27	A	0.9	9,393	0.55	C	0.9	8,698	0.51	B	0.9
Airport Rd: Berkmar Dr -> US 29													15,881	0.93	E	0.2	18,533	1.09	F	0.3	15,743	0.93	E	0.2	15,601	0.92	E	0.2
Timberwoood Blvd	n/a				n/a				n/a				741	0.02	A	0.3	9,778	0.29	A	0.3	723	0.02	A	0.3	736	0.02	A	0.3
Towncenter Dr													257	0.01	A	0.4	335	0.01	A	0.4	249	0.01	A	0.4	251	0.01	A	0.4
N Hollymead Dr													6,727	0.42	B	0.2	6,490	0.41	B	0.2	7,946	0.50	B	0.2	7,597	0.47	B	0.2
Ashwood Blvd													8,366	0.25	A	0.2	9,273	0.27	A	0.2	7,924	0.23	A	0.2	9,062	0.27	A	0.2
Rio Mills Rd													914	0.06	A	0.2	13,323	0.83	D	0.3	16,433	1.03	F	0.3	1,129	0.07	A	0.2
Hilton Heights Rd	1,786	0.05	A	0.3	2,102	0.06	A	0.3	2,227	0.07	A	0.3	1,821	0.05	A	0.3	1,994	0.06	A	0.3	3,074	0.09	A	0.3	1,829	0.05	A	0.3
Woodbrook Rd	4,202	0.09	A	0.2	7,658	0.17	A	0.2	6,104	0.13	A	0.2	5,608	0.12	A	0.2	8,551	0.19	A	0.2	6,465	0.14	A	0.2	6,373	0.14	A	0.2
Rio Rd	3,605	0.10	A	0.4	4,222	0.12	A	0.4	3,829	0.11	A	0.4	4,339	0.12	A	0.4	4,936	0.14	A	0.4	3,891	0.11	A	0.4	4,424	0.12	A	0.4

Note: Green – improved LOS in Build alternatives; Red – degraded LOS in Build alternatives.

Base Year 2007
In 2007, US 29 experiences 52,430 average daily traffic volumes between Ashwood Blvd and Rio Mills Road. The average total travel time along the 5.4 mile stretch of US 29 from Lewis and Clark Drive to Rio Road is 7.1 minutes.

2035 No Build
In 2035 No Build, due to socioeconomic growth and limited transportation improvements in the region, traffic volumes on US 29 will climb to 72,892 ADT (39% increase compared to year 2007) between Ashwood Blvd and Rio Mills Road. US 29 will be heavily congested with LOS F from Lewis and Clark Drive to Rio Mills Road (V/C ratio of 1.07 between Lewis and Clark Drive and Airport Road, V/C ratio of 1.42 between Airport Road and Hollymead Drive, V/C Ratio of 1.43 between Hollymead Drive and Ashwood Blvd, V/C ratio of 1.60 between Ashwood Blvd and Rio Mills Road), and LOS E (V/C ratio of 0.86) from Rio Mills Road to Rio Road. The total travel time on US 29 between Lewis and Clark Drive and Rio Road will be 14.5 minutes. The heavy congestion on US 29 will cause high volume of traffic diverting to avoid this corridor, which will result in heavy traffic and congestion on parallel roads such as Dickerson Road and Earlysville Road and to a lesser extent on Reas Ford Road and Proffit Road.

2035 Build 1
In 2035 Build 1, widening US 29 to six lanes will allow additional traffic to use US 29. Traffic volume on US 29 between Ashwood Blvd and Rio Mills Road will be 88,046 ADT. Travel time from Lewis and Clark Drive to Rio Road will average 8.6 minutes, about 1.5 minutes more than 2007 but about 6 minutes less than travel time without any improvement on US 29. This will eliminate diversion traffic onto Rae's Ford Road and Proffit Road but still cannot completely relieve high levels of congestion on Dickerson Road and Earlysville Road that will continue to experience diverted traffic.

2035 Build 2
The 2035 Build 2 alternative widens US 29 to six lanes and extends Berkmar Drive with a new bridge across Rivanna River. This scenario completely mitigates the impact of 20 years of population and employment growth in the MPO area. The 2035 Build 2 alternative results in a travel time of 7.0 minutes on US 29 from Lewis and Clark Drive to Rio Road, which is slightly less than the 2007 travel time. In this scenario traffic volume on US 29 between Ashwood Blvd and Rio Mills Road will be 72,982 ADT. For the same segment, the Berkmar Drive extended will have 20,198 ADT with a LOS of C. On other segments of Berkmar Drive extended, the motorist will experience LOS B between Hollymead Drive and Ashwood Blvd, and LOS A between Airport Road and Hollymead Drive. Earlysville Road will have traffic volumes of 12,000 to 13,000 ADT with LOS D. Dickerson Road between Airport Road and Earlysville Road will remain at LOS F.

2035 Build 3
The alternatives of 2035 Build 3, Build 4 and Build 5 all include additional land use of the South Hollymead expansion that will result in an additional 4,424 vehicle trips each day. As a result, these three alternatives (Figure 5.5 through 5.7) show more cutline

total volumes in the region than No Build, Build 1 and Build 2 alternatives (Figure 5.2 through 5.4). The addition of the South Hollymead expansion with the Berkmar Drive extension and existing 4-lane US 29 in 2035 Build 3 alternative, traffic conditions on US 29 will be somewhat worse than 2007 conditions. Traffic volume on US 29 will be 57,049 ADT between Ashwood Blvd and Rio Mills Road and total travel time of 8.5 minutes from Lewis and Clark Drive and Rio Road. South of Hollymead Drive, traffic on Berkmar Drive will be at LOS E with 35,324 ADT between Ashwood Blvd and Rio Mills Road, and 31,862 ADT between Hollymead Drive and Ashwood Blvd. In this scenario, traffic on Dickerson Road will be LOS E or F and Earlysville Road will be at LOS E.

2035 Build 4

The 2035 Build 4 alternative extends Berkmar Drive but does not include the bridge over the South Fork of the Rivanna River and widens US 29 to six lanes with South Hollymead expansion area. In this scenario, Berkmar Drive extension provides access to new land uses, but since there is no bridge across the Rivanna River, it does not serve through traffic. As a result, US 29 functions similar to the scenario in which US 29 was widened to six lanes without Berkmar Drive extension. Travel time on US 29 from Lewis and Clark Drive to Rio Road is 7.6 minutes and traffic on US 29 between Ashwood Blvd and Rio Mills Road is 76,776 ADT. Berkmar Drive extension maintains good LOS (A or B) with a peak volume of 15,660 ADT between Ashwood Blvd and Rio Mills Road. Earlysville Road will be at LOS E. Dickerson Road between Airport Road and Earlysville Road will remain LOS F.

2035 Build 5

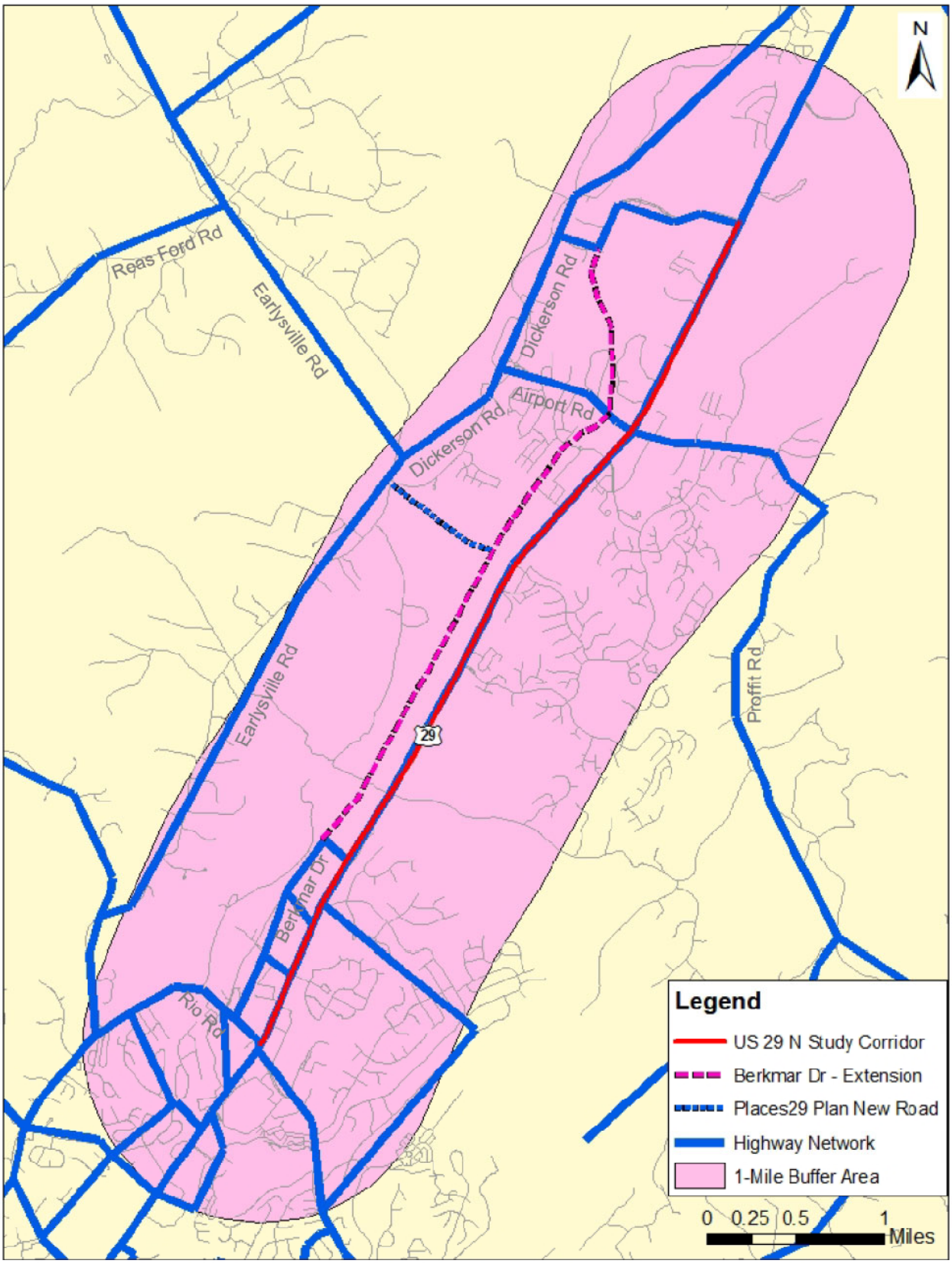
The 2035 Build 5 alternative provides almost identical levels of services on both US 29 and Berkmar Drive as the Build 2 alternative, because the only difference between the two alternatives is the addition of South Hollymead expansion. In this scenario, US 29 will provide the same level of service and travel time as the motorist experiences today. Berkmar Drive will function at good LOS (C or better) for its entire length. However, Dickerson Road between Airport Road and Earlysville Road will still remain LOS F.

For all alternatives, the connecting roads function at acceptable LOS (E or better). The exceptions are LOS F on Airport Road in Build 3 alternative and Rio Mills Road in Build 4 alternative, between US 29 and Berkmar Drive Extension. The failure of service at the two places is caused by large numbers of turning movements switching between US 29 and Berkmar Drive extended.

5.2 System-Level Analysis

A system-level analysis was conducted to evaluate the impact of each alternative on overall traffic conditions within the study area. A 1-mile buffer area of the proposed improvements was developed for the analysis purpose. Figure 5.8 illustrates the 1-mile buffer area.

Figure 5.8 1-Mile Buffer Area



5.2.1 System Evaluation Criteria

The study area impact within the 1-mile buffer area was evaluated based on system evaluation criteria such as daily vehicle hours traveled (VHT) and total vehicle delay.

Vehicle Hours Traveled
Vehicle hours traveled (VHT) is the total accumulated travel time spent by all vehicles on the transportation system within the study area during one 24 hour period. It is widely used to evaluate overall performance of highway network within a study area.

Vehicle Delay
Vehicle delay represents the difference between the travel time and the theoretical travel time at the free-flow speed. It is a standard criteria to evaluate congestions.

5.2.2 System Analysis Results

Table 5.6 shows the total daily VHT and vehicle delays (in hours) of the 1-mile buffer area for 2007 base year and all 2035 alternatives.

Table 5.6 1-Mile Buffer Area Daily VHT and Vehicle Delays

1-Mile Buffer Area	2007	2035 No Build	2035 Build 1	2035 Build 2	2035 Build 3	2035 Build 4	2035 Build 5
VHT	13,851	34,756	26,147	22,997	25,676	24,473	23,311
Vehicle Delay (Hours)	1,546	15,662	6,572	3,576	5,656	4,918	3,654

In 2007 base year, there are 13,851 VHT and 1,546 hours of vehicle delay per day within the 1-mile buffer area. Without any transportation improvement, the VHT and vehicle delays will respectively increase to 34,756 hours and 15,662 hours per day in 2035 as shown in the No Build Alternative.

By widening the US 29 to six lanes, the Build 1 alternative will significantly decrease the daily study area VHT to 26,147 hours and the vehicle delays to 6,572 hours. By introducing Berkmar Drive Extension with bridge over Rivanna River in addition to US 29 widening, the Build 2 alternative will further reduce 3,000 hours of VHT and vehicle delays, which results in the least regional VHT (22,997 hours) and vehicle delays (3,576 hours) in all Build alternatives. This is reasonable because the Build 2 alternative considers all proposed improvements and does not include additional land use of South Hollymead expansion. The Build 3 and 4 alternatives lead to moderate regional VHT and vehicle delays due to inclusion of South Hollymead expansion and partial improvement projects. The total VHT and vehicle delays of the Build 5 alternative are slightly more than Build 2 alternative but significantly fewer than Build 1, 3 and 4. This result is because Build 5 alternative includes all proposed improvements but considers additional trips generated by the South Hollymead expansion.

5.3 Benefit/Cost Analysis

A benefit/cost analysis compares the value of potential benefits of transportation investments against the actual cash investment that is made to build the facility. In order to determine the benefit/cost ratio, actual project costs are compared to a derived dollar value that represents the benefits to system users. The following describes the development of costs and benefits for each of the build alternatives.

5.3.1 Project Costs

For each of the proposed improvements within the study area described above, project costs were directly obtained from *Technical Memorandum 11: Preferred Alternative* of the completed *US 29 N Corridor Transportation Study*. For each project, the right of way and utilities costs have been estimated as 50% of the corresponding construction cost.

In this analysis, the intersection grade-separation on US 29 at Hilton Heights Road, Ashwood Blvd, Timberwood Blvd and Airport Road were assumed to be constructed for all 2035 Build alternatives. These improvements can reduce vehicle delays that occur at intersections. However, it should be noted that it would be difficult to grade-separate these intersections without widening US 29 to 6 lanes.

It should also be noted that for several projects, the construction cost was proposed in Places29 to be covered by the property owners or developers. This portion of the cost was not included in the total amount of project costs for analysis. Table 5.7 summarizes the cost for each project and the total amount of project costs for each Build Alternative.

5.3.2 Project Benefits

Benefits were derived for each build alternative based on the saved hours of system-wide (1-mile buffer area) vehicle delays, which is the difference of total vehicle delays between each alternative and the No Build alternative. Using Texas Transportation Institute's assumptions of $17.20 per hour and 0.68 gallons of fuel per hour (*Atlanta Regional Managed Lane System Plan*, Georgia DOT), the potential daily monetary time savings and gallon savings that can be realized in the buffer area were estimated. The total gallons of fuel saved per day were then converted to dollars by using 2007 average fuel price of $3.00 per gallon (US Energy Information Administration). Therefore, the total daily benefit is the sum of daily monetary time and fuel savings. For analysis purpose, the resulting daily benefit was annualized (based on 253 weekdays, 112 weekends/holidays at half the weekday factor) to assign a dollar value to the resulting project benefit.

Table 5.8 shows annual system benefits calculated for the 1-mile buffer area.

Table 5.7 Summary of Project Costs

Design Element/Location		Construction Cost [1]	Construction Cost + R/W & Utilities [1]	Description	Note	2035 Build 1	2035 Build 2	2035 Build 3	2035 Build 4	2035 Build 5
Short Term (1-5 Yr)	US 29 at Airport Acres Road North	$270,000	$405,000	Signalize	By developer	√	√	√	√	√
	US 29 at Northside Drive	$270,000	$405,000	Signalize	By developer	√	√	√	√	√
	Short Term Total [2]					**$0**	**$0**	**$0**	**$0**	**$0**
Mid Term (6-10 Yr)	US 29 at Woodbrook Drive	$910,000	$1,365,000	Extend LT Storage		√	√	√	√	√
	US 29 at Hollymead Drive	$100,000	$150,000	New 2 lane (24')		√	√	√	√	√
	Berkmar Drive - east of Rio Road to Hilton Heights	$10,020,000	$15,030,000	Widen to 5 lanes			√	√		√
	Berkmar Drive Extended - Hilton Heights to River	$2,660,000	$3,990,000	New 5 lane			√	√		√
	Berkmar Drive Bridge (1020lf, 86 ft c/s)	$14,910,000	$22,365,000	New Bridge			√	√		√
	Berkmar Drive Extended - River to Hollymead Ext	$10,230,000	$15,345,000	New Street			√	√	√	√
	Berkmar Drive Extended - Hollymead Ext to Airport			New Street	By developer		√	√	√	√
	Berkmar Drive Extended - Airport to Northside			New Street			√	√	√	√
	Berkmar Drive Extended - Northside to Lewis and Clark			New Street	By developer		√	√	√	√
	Hollymead Drive Extended	$1,010,000	$1,515,000	New Street	By developer		√	√	√	√
	Mid Term Total [2]					**$1,515,000**	**$58,245,000**	**$58,245,000**	**$16,860,000**	**$58,245,000**
Long Term (11-20 Yr)	US 29 at Hilton Heights Road	$15,000,000	$22,500,000	Cross Over/Access		√	√	√	√	√
	US 29 - Polo Grounds Road to Town Center Drive	$15,060,000	$22,590,000	New 6 lane		√	√		√	√
	US 29 at Ashwood Blvd	$10,000,000	$15,000,000	Cross Over/Access		√	√	√	√	√
	US 29 at Timberwood Blvd	$15,000,000	$22,500,000	Cross Over/Access		√	√	√	√	√
	US 29 at Airport Road/Proffit Road	$15,000,000	$22,500,000	Cross Over/Access		√	√	√	√	√
	US 29 - Airport Road to Lewis and Clark Drive	$10,690,000	$16,035,000	New 6 lane		√	√		√	√
	US 29 at Lewis and Clark Drive	$240,000	$360,000	Transition on US 29		√	√	√	√	√
	Long Term Total [2]					**$121,485,000**	**$121,485,000**	**$82,860,000**	**$121,485,000**	**$121,485,000**
Total [2]						**$123,000,000**	**$179,730,000**	**$141,105,000**	**$138,345,000**	**$179,730,000**

(1) Source: *US 29 N Corridor Transportation Study*. Right of Way and utilities costs are estimated as 50% of construction cost.
(2) Project costs that are covered by property owner or developer are not included in total costs.

Table 5.8 Summary of Project Benefits

	1-Mile Buffer Area Benefit	2035 Build 1	2035 Build 2	2035 Build 3	2035 Build 4	2035 Build 5
Daily	Time Savings (hours)	9,090	12,085	10,006	10,744	12,008
	Gas Savings (gallons)	6,181	8,218	6,804	7,306	8,165
	Time Savings ($)	$156,349	$207,867	$172,104	$184,794	$206,538
	Gas Savings ($)	$18,544	$24,654	$20,412	$21,917	$24,496
	Total Savings ($)	**$174,892**	**$232,521**	**$192,516**	**$206,711**	**$231,035**
Annual	Time Savings (hours)	2,807,523	3,732,627	3,090,434	3,318,310	3,708,771
	Gas Savings (gallons)	1,909,116	2,538,187	2,101,495	2,256,451	2,521,964
	Time Savings ($)	$48,289,397	$64,201,193	$53,155,466	$57,074,931	$63,790,865
	Gas Savings ($)	$5,727,347	$7,614,560	$6,304,486	$6,769,352	$7,565,893
	Total Savings ($)	**$54,016,744**	**$71,815,753**	**$59,459,952**	**$63,844,283**	**$71,356,758**

Note: Dollar value is in 2007 dollars.

5.3.3 Benefit/Cost Ratio

In this study, the benefit/cost (B/C) ratio was determined by comparing annual project benefit to entire project cost for each Build alternative. Although this B/C ratio does not reflect cumulative dollar amount for the benefit and costs through the design year when the projects would be open to traffic, it still provides straightforward perception of financial effectiveness of each build alternative. Table 5.9 summarizes the B/C ratios.

Table 5.9 Benefit/Cost Ratio

	2035 Build 1	2035 Build 2	2035 Build 3	2035 Build 4	2035 Build 5
Annual Benefit	$54,016,744	$71,815,753	$59,459,952	$63,844,283	$71,356,758
Cost	$123,000,000	$179,730,000	$141,105,000	$138,345,000	$179,730,000
B/C Ratio	0.44	0.40	0.42	0.46	0.40

The Build 4 alternative has the highest B/C ratio, which results from its moderate benefit on both regional as well as local traffic and relatively low construction cost which excludes the Berkmar Bridge across South Fork of Rivanna River. The Build 2 & 5 alternatives have the lowest B/C ratio, since they include all proposed improvement projects including construction of the new Berkmar Bridge, which results in a higher construction cost than other Build alternatives.

6.0 Findings

In this study, different transportation improvements and additional land development were examined for the study area by evaluating corridor performances and regional impacts. The key findings are summarized as the following.

In 2035 horizontal year, traffic conditions on US 29 can be greatly improved by increasing the roadway's capacity, building a parallel route, or combining all improvement strategies. Widening US 29 to six lanes (Build 1) will significantly decrease V/C ratio and result in a reduction of 6 minutes on travel time along the 5.4-mile long study corridor, compared to the scenario without any improvement (No Build). If Berkmar Drive is extended to serve as a parallel route of US 29 (Build 3), it will result in the same travel time savings on US 29 as Build 1. The combination of US 29 widening and Berkmar Drive Extension (Build 2 & 5) will provide the greatest benefit to US 29 and the region by further improving V/C ratio and reducing travel time by 7.5 minutes along US 29. Build 2 & 5 will also save about 12,000 hours of VHT and vehicle delays in the 1-mile buffer area, compared to the No Build alternative. Although the Build 2 & 5 alternatives will significantly reduce congestion, their construction costs are relatively expensive because they require a new bridge to be built across Rivanna River when Berkmar Drive is extended. The benefit/cost analysis confirms that Build 2 & 5 have the lowest B/C ratio. The Build 4 alternative with all proposed improvements, but without the new bridge across Rivanna River, will improve traffic conditions more than individual improvement of either the US 29 widening (Build 1) or Berkmar Drive Extension (Build 3). With the highest B/C ratio, the Build 4 alternative is cost-effective while balancing both local and regional transportation improvements. For all 2035 alternatives, it is noted that US 29 may still experience LOS F between South Fork of Rivanna River and Airport Road due to demand in excess of capacity.

Berkmar Drive extended will maintain acceptable LOS (E or better) for all 2035 alternatives. The additional land use of South Hollymead expansion will slightly increase traffic volumes on Berkmar Drive Extension without changing LOS. Based on this study, the expansion area does not have a significant impact on the regional traffic and will not result in a significant decrease in traffic operations on either Berkmar Drive or US 29 in the immediate area.

All 2035 Build alternatives will significantly improve LOS on parallel roads. The alternatives with Berkmar Drive Extension as well as the new Rivanna River Bridge (Build 2, 3 & 5) improve Earlysville Road more than those alternatives without Berkmar Drive Extension (Build 1) or without the new bridge across the river (Build 4). This result is reasonable because, with the new bridge across the Rivanna River, Berkmar Drive extended is able to fully function as a parallel route to relieve regional congestion. It is noted that Dickerson Road between Airport Road and Earlysville Road has a LOS F in all 2035 alternatives, so consideration should be given to widening this segment to four lanes.

All connecting roads between US 29 and Berkmar Drive Extension maintain acceptable LOS (E or better) for all 2035 alternatives, except LOS F on Airport Road in Build 3 and Rio Mills Road in Build 4. These two locations with failure of service are key links connecting US 29 and Berkmar Drive Extended that accommodate a great number of turning movements. Additional traffic study may be necessary at these locations where operation and safety issues may arise.

Appendix A TAZ Refinement

In this study, the Charlottesville Travel Demand Model was employed to develop and test the alternatives described above. As designed for regional transportation planning purposes, the Charlottesville Travel Demand Model covers the large Charlottesville-Albemarle MPO area but does not have sufficiently detailed TAZ structure in the study area along the Berkmar Drive Extension. Therefore, the old TAZs need to be refined to better represent existing land use patterns and future framework land use assumptions.

The two TAZs (TAZ 120 and 121) between US 29 and the existing Berkmar Drive (south of the Rivanna River) were refined to four smaller ones to more accurately represent land use in the area. When Berkmar Drive is extended, the old TAZs (TAZ 98, 100 and 104) are split using Berkmar Drive Extended and connecting roads as new boundaries. Figure A.1 compares the old and refined TAZ structures within the study area.

After the TAZ boundary was refined, the zonal land use data was updated based on available data sources. This study examined the subdivided zone system used for previously completed *US 29 N Corridor Transportation Study* to obtain percentage shares of socioeconomic data for refined TAZs. When data is not available, the socioeconomic percentage shares were determined based on refined TAZ's area size and professional judgment. These percentage shares were then applied to each old TAZ to get land use data for refined TAZs. In this study, the additional land use of South Hollymead expansion was assumed to occur in old TAZ 104 and proportionally allocated to refined sub-zones. Table A.1 shows zonal land use data for all 2035 alternatives.

Figure A.1 TAZ Refinement

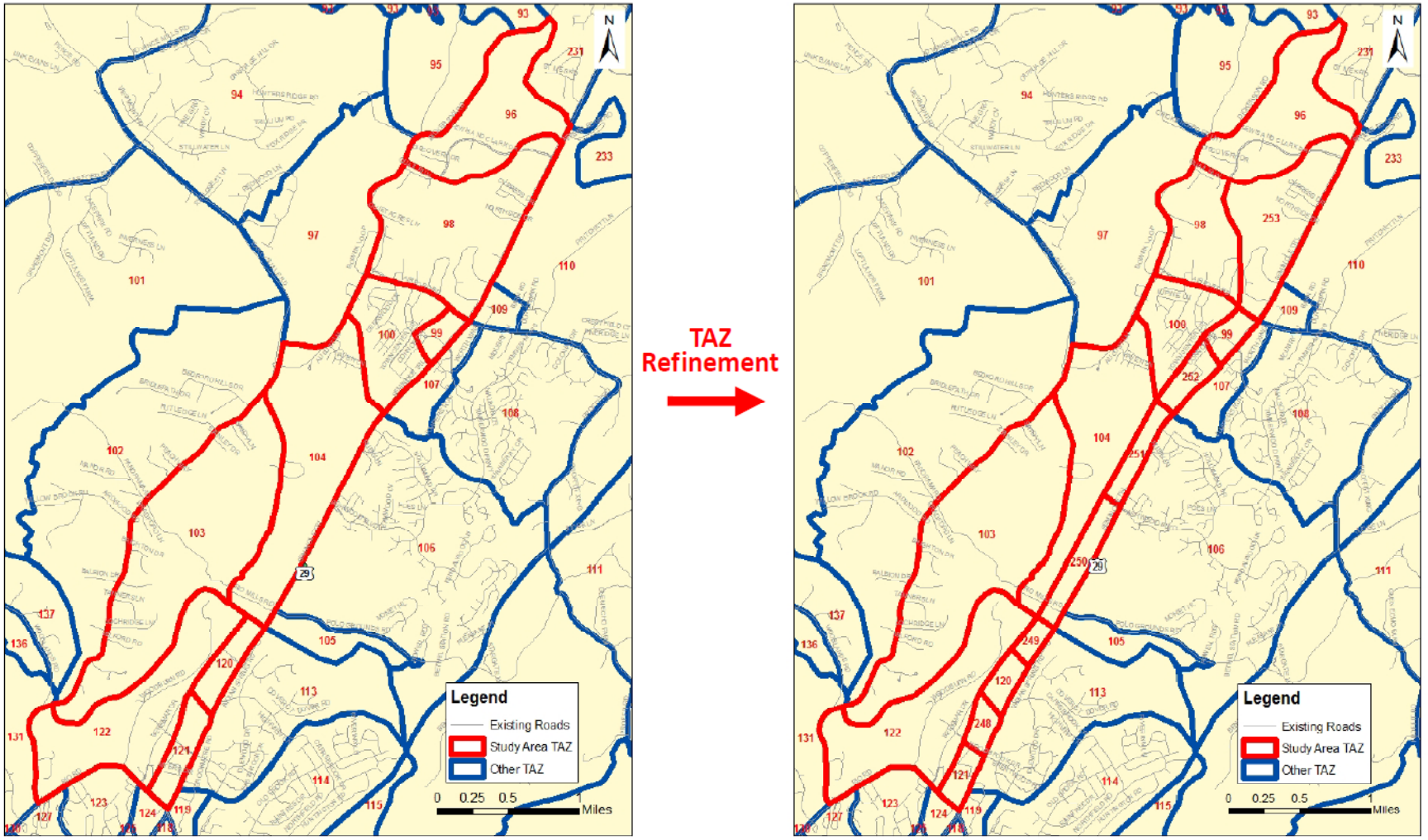


Table A.1 Zonal Land Use Data of 2035 Alternatives

Charlottesville Model TAZ	No Build			Build 1			Build 2			Build 3			Build 4			Build 5		
	TAZ	Pop	Emp	TAZ	Pop	Emp	TAZ	Pop	Emp	TAZ	Pop	Emp	TAZ	Pop	Emp	TAZ	Pop	Emp
96	96	11	4,832	96	11	4,832	96	11	4,832	96	11	4,832	96	11	4,832	96	11	4,832
98	98	385	5,377	98	385	5,377	98	0	4,915	98	0	4,915	98	0	4,915	98	0	4,915
							253	385	462	253	385	462	253	385	462	253	385	462
99	99	7	136	99	7	136	99	7	136	99	7	136	99	7	136	99	7	136
100	100	457	106	100	457	106	100	457	53	100	457	53	100	457	53	100	457	53
							252	0	53	252	0	53	252	0	53	252	0	53
103	103	508	0	103	508	0	103	508	0	103	508	0	103	508	0	103	508	0
104	104	441	2,368	104	441	2,368	104	221	1,658	104	511	2,073	104	511	2,073	104	511	2,073
							250	88	355	250	204	444	250	204	444	250	204	444
							251	132	355	251	306	444	251	306	444	251	306	444
120	120	18	333	120	18	333	120	18	333	120	18	333	120	18	333	120	18	333
	249	0	225	249	0	225	249	0	225	249	0	225	249	0	225	249	0	225
121	121	7	291	121	7	291	121	7	291	121	7	291	121	7	291	121	7	291
	248	0	194	248	0	194	248	0	194	248	0	194	248	0	194	248	0	194
122	122	556	269	122	556	269	122	556	269	122	556	269	122	556	269	122	556	269
Total		**2,390**	**14,131**		**2,390**	**14,131**		**2,390**	**14,131**		**2,970**	**14,724**		**2,970**	**14,724**		**2,970**	**14,724**