

VDOT Repaving Design and  
Operational Analysis  
*2024 Road Diet Assessments*

**FINAL REPORT – Annandale Road**

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Prepared for:



Prepared by:

**Kimley»»Horn**

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## Executive Summary

The Virginia Department of Transportation (VDOT) will be repaving the Annandale Road corridor between Little River Turnpike and Gallows Road/Annanwood Court. As such, the Fairfax County Department of Transportation (FCDOT) initiated an assessment for a road diet to potentially reallocate existing pavement width for the purposes of accommodating bike lanes. The corridor contains four signalized intersections and eight unsignalized intersections. This report summarizes the findings of a crash analysis, existing traffic conditions, a road diet assessment, and final recommendations and conclusions.

There were a total of 54 reported crashes along the entire corridor between January 1, 2021 and December 31, 2023, with the majority of crashes occurring at the intersections with Gallows Road, Little River Turnpike, and Maple Place. The results of the crash analysis suggest that the crashes at Gallows Road are most likely the result of poor sight distance for left-turning vehicles on Gallows Road. The results of the crash analysis suggest that the crashes at Little River Turnpike were more likely a result of human error rather than existing road geometry or operations. Three of the crashes at Maple Place were pedestrian crashes, and field observations indicate that there is likely a need for a marked pedestrian crossing at that intersection, as there currently is none.

Using turning movement count (TMC) data collected in March 2024 and Synchro software, weekday AM and PM peak hour traffic conditions were analyzed for existing conditions. The results of this analysis indicate that the intersection of Annandale Road and Gallows Road operates at a level of service (LOS) C during the AM and PM peak hour. This can be attributed to a high number of westbound right turns from Gallows Road and the inner southbound through lane on Annandale Road at Gallows Road operating as a dedicated left-turn lane. At the intersection of Annandale Road and Medford Drive, the eastbound Medford Drive approach operates at a LOS F for left turns during the PM peak hour. As for the intersection of Annandale Road and Little River Turnpike, the overall intersection operates at LOS C during the AM peak hour and LOS D during the PM peak hour. This can be attributed in part to the 180-second cycle length operating at this intersection.

Given the existing configuration of Annandale Road with no median, the potential road diet conforms to the typical reconfiguration from a four-lane undivided roadway to two travel lanes with a center left-turn lane. A Build traffic analysis was completed using the 2024 TMC data and the existing Synchro model, which was updated to reflect the road diet conditions.

Overall, operations are maintained comparable to existing conditions. During the AM and PM peak hours, delay at the intersection of Annandale Road and Gallows Road decreases, with overall delay decreasing by approximately five to ten seconds, which can be attributed to the geometric modifications. During the PM peak hour, the only significant delay increase occurs at Medford Drive for the eastbound left turn, maintaining the existing LOS F operations. The geometric modifications of the build condition at Gallows Road may improve the driver experience by designating the travel lane that has been functioning as a de-facto left-turn lane as a dedicated left-turn lane. While delay for left turns from Medford Drive is increased, there is the potential that the two-way left-turn lane could be used to assist drivers in completing a two-stage left turn. Also, an added benefit with the road diet is that there is an opportunity to install additional crosswalks with pedestrian refuge islands to facilitate safer crossings of Annandale Road at unsignalized intersections, as noted below.

Based on the outcome of the road diet assessment, it is recommended that the following be considered as part of the implementation of bike lanes on Annandale Road between Gallows Road and Little River Turnpike:

- Southbound Annandale Road
  - Maintain two southbound travel lanes along Annandale Road north of Gallows Road, then merge into a single through travel lane at Gallows Road/Annanwood Court. The inner most travel lane becomes a left-turn only lane at Gallows Road/Annanwood Court.
  - Install a bike lane (5' bike lane) beginning at Gallows Road/Annanwood Court up to Little River Turnpike.
  - Install a two-way left-turn lane (TWLTL) beginning at Galanis Drive up to Little River Turnpike. At signalized intersections, the TWLTL becomes a dedicated left-turn lane.
- Northbound Annandale Road
  - Restripe the northbound approach at Little River Turnpike to position a dedicated right-turn lane as the rightmost lane and provide a bike lane crossover to position the bike lane between the through and right-turn lanes.
  - Install a bike lane (5' bike lane) beginning at Little River Turnpike up to Gallows Road.
  - Install a TWLTL beginning at Little River Turnpike up to Galanis Drive. At signalized intersections, the TWLTL becomes a dedicated left turn lane.
  - Between Galanis Drive and Gallows Road, two northbound through lanes are maintained.
  - North of Gallows Road/Annanwood Court, add a sharrow to indicate a shared lane. Bicyclists could continue their trip in the existing travel lanes or navigate to the existing sidewalk that begins north of Annandale Court.
- Other Considerations:
  - Improve pedestrian facilities at Markham Street and Medford Drive (repaint crosswalks).
  - Remove one right-turn lane on Maple Place at Annandale Road. This is outside the scope of repaving along Annandale Road and may require further coordination in later stages of design to capture this adjacent modification.
  - Long-term, consider adding a pedestrian crosswalk across Annandale Road on the south leg at Maple Place (subject to a VDOT approved crosswalk study).
  - Optimize signal operations at all intersections to balance green time among the different signal phases to best align with the reduction in capacity for the through movements along Annandale Road.
  - Install additional crosswalks at unsignalized intersections to reduce the spacing of crosswalks along the corridor. This should be evaluated in accordance with VDOT TE-384.1. Considering spacing and sight distance, potential candidate locations for crosswalks could include:
    - Rodeo Court
    - Beverly Manor Drive
    - Hamilton Street
    - Farr Street

## Introduction

As part of the 2024 Virginia Department of Transportation (VDOT) annual paving program, the Fairfax County Department of Transportation (FCDOT) requested that two separate corridors be evaluated to explore the feasibility of implementing a road diet to reallocate pavement space by removing a travel lane in each direction and to install bicycle lanes. Annandale Road is one corridor included in this evaluation. The corridor extents begin at the signalized intersection of Annandale Road and Gallows Road/Annanwood Court and end at the signalized intersection of Annandale Road and Little River Turnpike (approximately 0.8 miles). The corridor contains two other signalized intersections, at Annandale Road and Maple Place and Annandale Road and Markham Street/Poplar Street. The corridor also contains eight unsignalized intersections:

1. Annandale Road and Galanis Drive,
2. Annandale Road and Walton Lane,
3. Annandale Road and Rodeo Court,
4. Annandale Road and Beverly Manor Drive,
5. Annandale Road and Hamilton Street,
6. Annandale Road and Farr Street,
7. Annandale Road and Quiet Cove, and
8. Annandale Road and Medford Drive/Glen Hollow Court.

Annandale Road is a four-lane undivided minor arterial roadway and provides access to residential neighborhoods located along the corridor, as well as commercial areas along the south end of the corridor. The posted speed limit along this stretch of Annandale Road is 35 mph. This segment of Annandale Road provides a means for vehicles to access I-495 to the north via Gallows Road (Annandale Road changes names to Gallows Road to the north at the Hummer Road intersection), which generally runs north-south in the vicinity of the study corridor. To the south, Annandale Road provides access to the Annandale area, Little River Turnpike which connects to both I-495 and I-395, and provides access to Braddock Road. **Figure 1** provides an overview of the study area and location relative to the surrounding area. In general, turn lanes are not provided along Annandale Road at the intersections north of Little River Turnpike. According to the most recent Fairfax County Bicycle Network map, there is a bikeable sidewalk on the eastern side of the corridor from Gallows Road to Markham Street and on the western side of the corridor from Markham Street to Little River Turnpike, both running north-south. Also noted in **Figure 1** is the intersection spacing between study intersections as well as the typical cross-section of Annandale Road.

FCDOT has initiated this road diet study to evaluate the potential to improve the four-lane corridor regarding accessibility, safety, and improved mobility for all travel modes. Annandale Road is identified as recommended for a bike lane facility according to the most recent Fairfax County Countywide Bicycle Master Plan. This report outlines the analysis of existing traffic conditions, build condition traffic analysis accounting for the proposed bike lanes, potential cross sections, and recommendations. FCDOT reviewed potential redevelopment and lack of population growth in Annandale and along this corridor, and thus concluded that projecting future traffic volumes was not necessary.

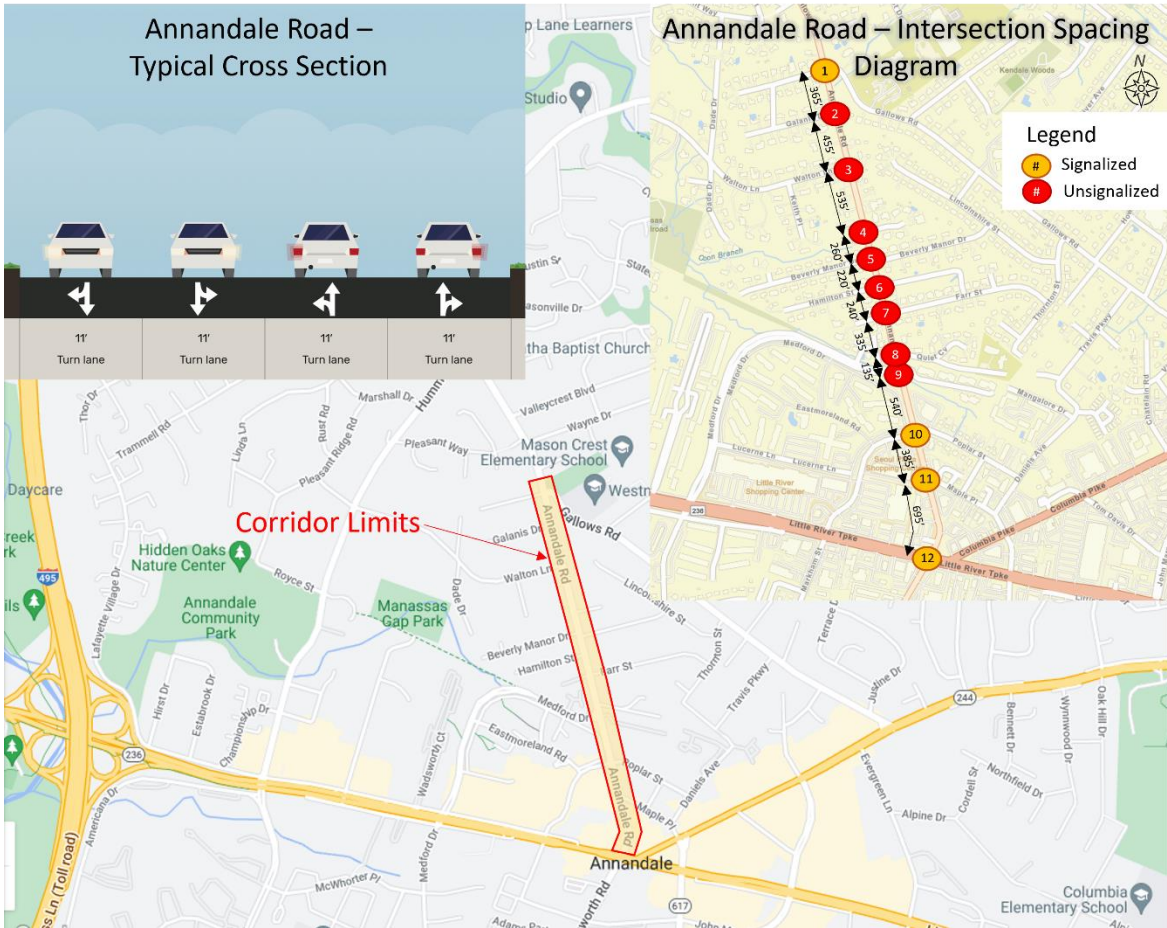


Figure 1: Study Corridor Map and Intersection Spacing Diagram (Not to scale)

### Data Collection

Turning movement count (TMC) data was collected Tuesday, March 5<sup>th</sup>, 2024 from 6:00 AM to 9:00 AM and from 4:00 PM to 7:00 PM for the following intersections:

1. Annandale Road and Gallows Road (signalized)
2. Annandale Road and Walton Lane
3. Annandale Road and Beverly Manor Drive
4. Annandale Road and Farr Street
5. Annandale Road and Medford Drive/Glen Hollow Court
6. Annandale Road and Markham Street/Poplar Street (signalized)
7. Annandale Road and Maple Place (signalized)
8. Annandale Road and Little River Turnpike (signalized)

Based upon a review of the collected TMC data, the network peak hour for the corridor was determined to be 7:15 AM to 8:15 AM and 4:30 PM to 5:30 PM.

Turning volumes for the AM and PM peak hours were estimated based on similar intersections for the following intersections:

1. Annandale Road and Galanis Drive
2. Annandale Road and Rodeo Court
3. Annandale Road and Hamilton Street
4. Annandale Road and Quiet Cove

At the first three intersections listed above, the turns from Annandale Road were estimated using the number of turns onto the side street at a comparable intersection on the corridor that counts were collected for, multiplied by a ratio based on the number of units the side street contains (all side streets were dead ends), multiplied by a directionality factor based on the counts collected for the corridor. The number of turns off the side street followed a similar process. Finally, based on the estimated turning values, the through volumes were calculated to balance the volumes between intersections.

The volume approximation approach was different at the intersection of Annandale Road and Quiet Cove, where the Pinecrest School exists at the end of Quiet Cove. The Pinecrest School has approximately 100 students. Before-care opens at 8:00 AM and regular student arrival begins at 8:30 AM after the AM peak hour of 7:15 AM to 8:15 AM. After-care runs from 3:35 PM to 6:00 PM, which overlaps with the PM Peak Hour. In this case, it was assumed that 10% of student trips by vehicle for drop-off/pick-up occurred during the peak hours. This volume was added to the turning movements to and from Quiet Cove.

The network peak hours were used to evaluate the existing traffic conditions and build scenario conditions (with road diet). Peak hour turning movement count data is summarized in **Figure 2**. Based on a review of the network peak hour volumes in Synchro, collected traffic volumes were fairly balanced along the corridor and no adjustments were made to the source volumes.

Figure 2: Annandale Road Peak Hour Traffic Volumes (7:15-8:15 AM, 4:30-5:30 PM)

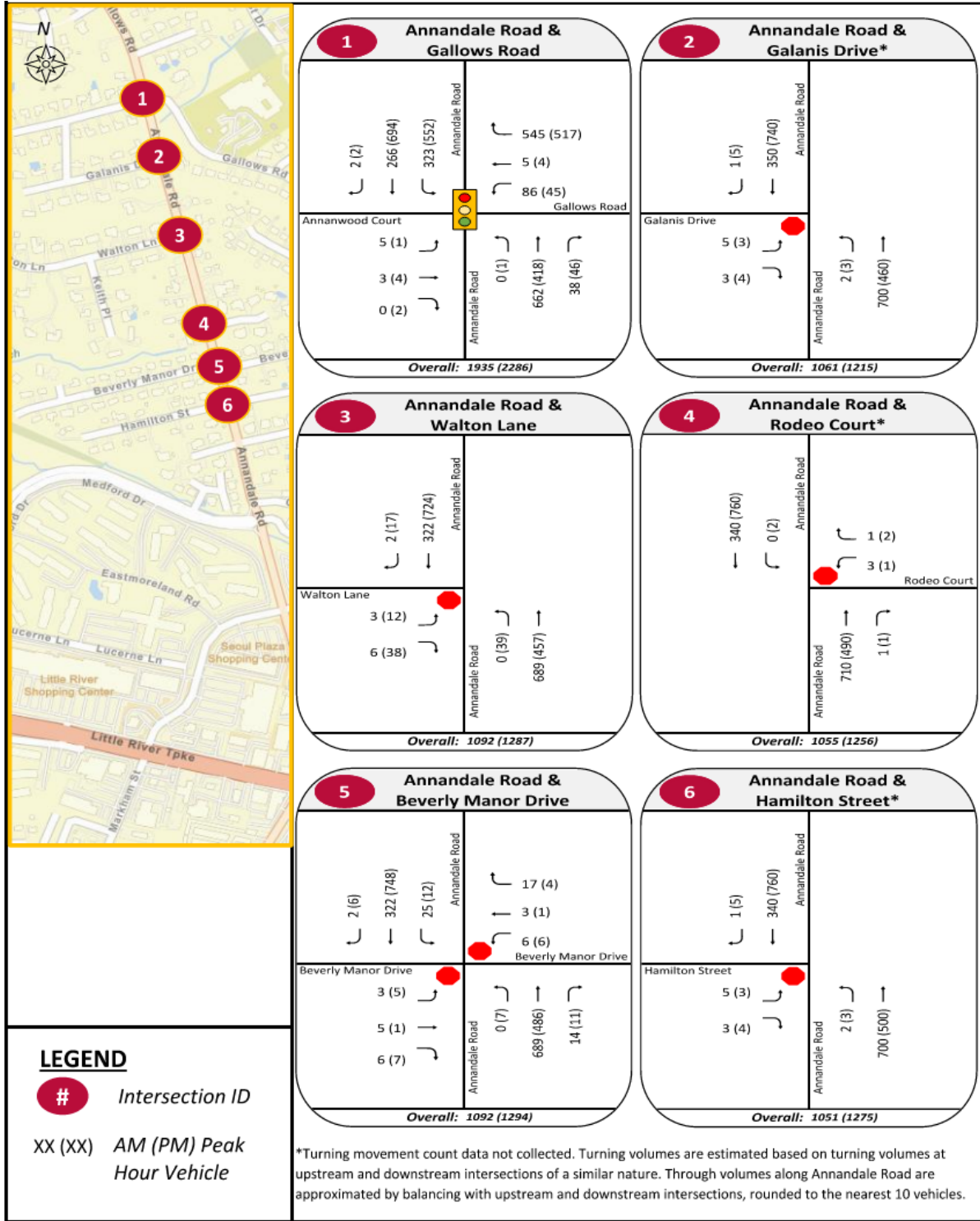
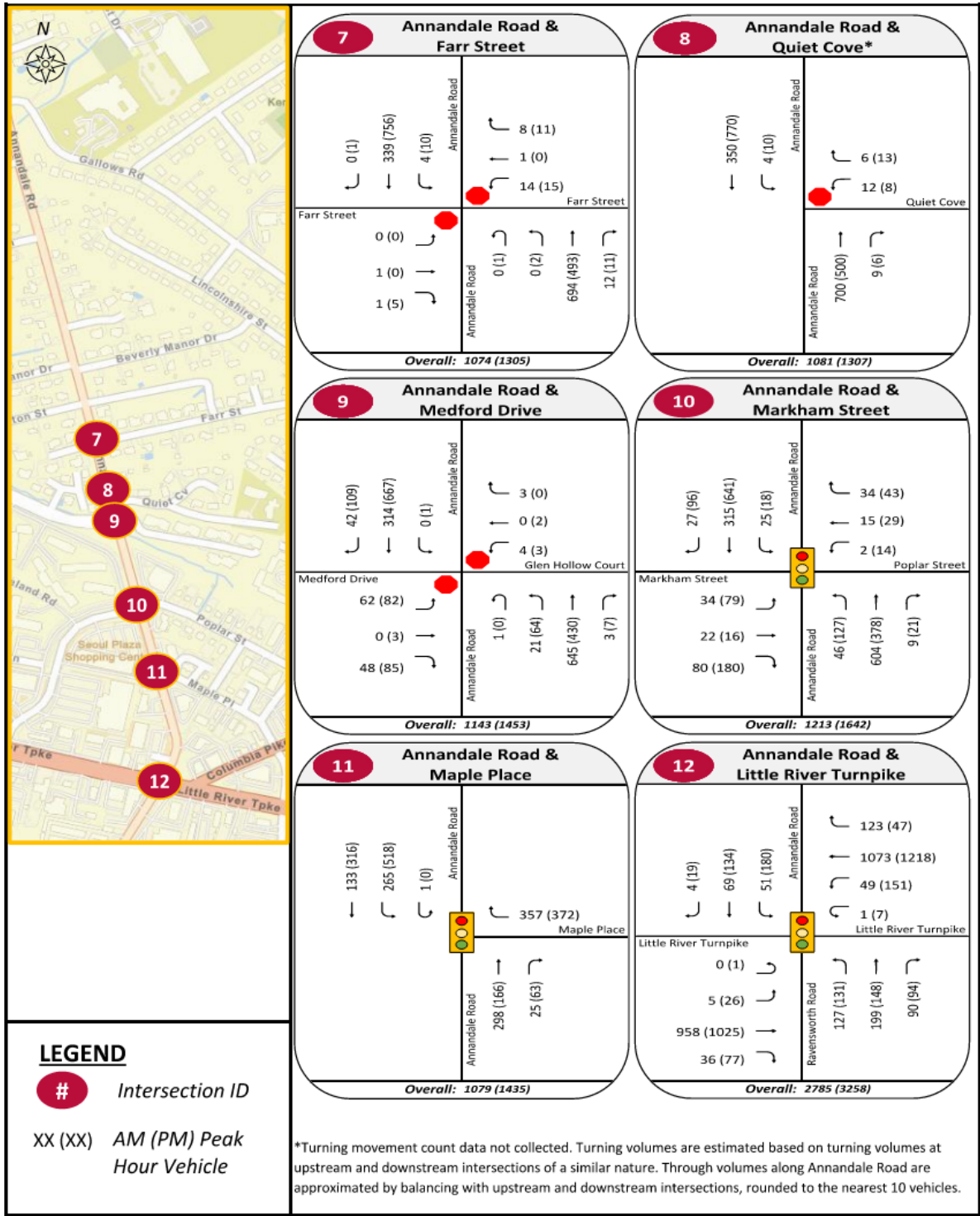


Figure 2: Annandale Road Peak Hour Traffic Volumes (7:15-8:15 AM, 4:30-5:30 PM)



**Table 1** contains the historical annual average daily traffic (AADT) volumes along the study corridor from the most recent five years of traffic data provided by VDOT. The data below shows that between 2018 and 2022, the annual average daily traffic along Annandale Road between Gallows Road and Little River Turnpike has decreased by just over 2,000 vehicles per day from the peak of 16,000 in 2019. Based upon the 2024 traffic data collected and a K factor of 0.086 the hourly peak hour TMC data at the endpoint intersections with Gallows Road and Little River Turnpike would suggest an average daily volume between 6,000 and 13,000 vehicles. This approximated daily volume suggests that 2024 daily volumes may be comparable to 2020 and 2021 traffic conditions.

*Table 1: Historical AADT*

Street	From	To	Year	AADT	%T	K	D
Annandale Road	Little River Turnpike	Gallows Road	2018	15,000	2%	0.084	0.64
			2019	16,000	2%	0.084	0.64
			2020	12,000	2%	0.084	0.64
			2021	13,000	2%	0.086	0.59
			2022	13,900	2%	0.086	0.59

On March 7<sup>th</sup>, 2024, at approximately 12:40 PM, field observations were completed to evaluate the current traffic conditions and document existing roadway geometry. These observations were documented in a field data collection checklist and can be referenced in **Appendix A**. The corridor appeared to be operating at what would be considered typical volume for that time of day with no notable activity along the road. One instance of a driver traveling at a high rate of speed was observed. Current bus operations are limited to the Fairfax Connector Route 803, which operates all day during weekdays and the weekend. There are twelve bus stops located along the corridor; however, no bus activity was observed as the Fairfax Connector bus drivers were on strike during the observation period. A photograph of one of the existing bus stop signs that is broken is shown in **Figure 3** below, suggesting a vehicle crashed into the sign. This photo was taken south of Walton Lane on the southbound side of Annandale Road looking south.



*Figure 3: Broken bus stop sign south of Walton Lane*

Intersection sight distance is limited at Gallows Road on the northbound approach of Annandale Road. A vertical curve in the roadway north of the intersections limits the visibility of left-turning drivers to identify oncoming southbound through traffic, as does queuing for southbound left turns. This can be referenced below in **Figure 4**. The photograph shown in **Figure 4** was taken from a vehicle at the stop bar in the inside northbound travel lane on Annandale Road, looking north at queuing in the inside southbound travel lane for left-turning vehicles, which limit sight distance in addition to the vertical curve in the roadway. According to the American Association of State Highway and Transportation Officials (AASHTO), considering the speed and grade of the roadway, the required intersection sight distance (ISD) for this location is 375 feet (left-turning vehicle from the

mainline). This distance is not satisfied for southbound vehicles by northbound left-turning drivers, especially when southbound left-turning vehicles are present.



*Figure 4: Limited visibility northbound on Annandale Road at Gallows Road*

Sight distance is also limited for eastbound left turns from Beverly Manor Drive onto northbound Annandale Road due to vertical curvature in the roadway and shrubbery; however, the minimum required ISD of 495 feet (left-turning vehicle from a minor approach) is available for a vehicle turning left. See **Figure 5** below.

Storm drains are present within the existing curb along the corridor, but the gutter slope from the roadway edge to the curb appears to match a typical curb and gutter installation and would not be expected to impact bicyclists.



*Figure 5: Looking north from eastbound Beverly Manor Drive approach*

TMC data indicates that there is a need for additional pedestrian crossing facilities along Annandale Road between Markham Street and Little River Turnpike. There are currently no marked crosswalks within this approximately 1,100-foot stretch of roadway. During the AM peak hour, 13 pedestrians crossed Annandale Road at Maple Place, and during the PM peak hour, 18 pedestrians crossed Annandale Road at Maple Place. Many pedestrian generators exist in this area. Field observations confirmed a need for pedestrian accommodations to cross Annandale Road at the intersection with Maple Place, and the following Crash Analysis section details three pedestrian crashes that occurred in this area.

## Crash Analysis

A crash analysis for the Annandale Road corridor was conducted using the previous three years of crash data to identify crash patterns that may impact recommendations in the road diet assessment. The crash reports for the calendar years 2021 through 2023 were obtained from the Virginia Department of Transportation database. Each study intersection was isolated to a 150-foot radius around the center of the intersection and analyzed individually. The crash data along the corridor segments, which includes roadway outside of each 150-foot intersection radius, was also collected and analyzed.

There was a total of 54 reported crashes between January 1, 2021 and December 31, 2023 along the Annandale Road corridor. Of the 54 crashes, 22 were at the intersection with Gallows Road, 11 were reported at the intersection with Little River Turnpike, six were reported at the intersection with Maple Place, and four crashes were reported at the intersections with Markham Street and Medford Drive. Two or fewer crashes occurred at the remaining study intersections. The majority of the crashes were property damage only and occurred in the off-peak hours. The occurrence of primarily off-peak hour crashes indicates that traffic congestion was not a likely contributing factor. There were five total pedestrian crashes, three of which were at the intersection of Annandale Road and Maple Place. The location of the pedestrian crashes suggests that the pedestrian was crossing the road outside of the intersection where there is no crosswalk. The findings from the crash analysis are summarized in **Appendix B**.

## Existing Conditions Traffic Analysis

The existing operating conditions for each study intersection along the corridor were analyzed using Synchro software for the AM and PM peak hours. The key steps in preparing the network for existing AM and PM peak hour conditions were as follows:

- Modifying VDOT-provided Synchro files to include all study intersections and geometry
- Estimating turning volumes using the method provided above for intersections not collected
- Inputting AM and PM peak hour TMC data for all study intersections, including peak hour factors
- Inputting heavy truck percentages
- Network review for volume balancing

The TMC data indicated that the study intersections had various AM and PM intersection-specific peak hours. For the volumes at each intersection to be properly balanced, the network peak hour was used, which represented the highest total network volume across all study intersections. The network peak hour for the morning was found to be 7:15-8:15 AM, and it was 4:30-5:30 PM for the evening. Several measures of effectiveness (MOE) generated by Synchro software were used to analyze existing operations at the 12 intersections along the study corridor. Highway Capacity Manual (HCM) 6<sup>th</sup> Edition methodology was used to report MOEs from Synchro at unsignalized intersections. HCM 2000 methodology was used to report MOEs from Synchro at signalized intersections due to limitations of HCM 6 methodology to analyze current signal operations.

**Table 2** below summarize the findings from the MOEs for all intersections, including average vehicular delay, level of service (LOS), available storage, and 95<sup>th</sup> percentile queue length. Overall intersection delay is not reported for unsignalized intersections since delay cannot be calculated for uncontrolled through movements along Annandale Road. Movements for which delay cannot be calculated are indicated with “(-)” in the table. The eight unsignalized intersections did not have significant delay results. The highest delay for any side street approach at unsignalized intersections was 27.3 seconds in the AM peak hour for the eastbound approach of Farr St and 51.7 seconds in the PM peak hour for the eastbound approach at Medford Drive. This is primarily attributed to the need for a gap in both northbound and southbound traffic on Annandale Road in order to cross or turn left at these intersections.

The four signalized intersections did not have significant delay results except for Annandale Road and Little River Turnpike. At Annandale Road and Little River Turnpike, overall intersection delay during the AM peak hour was 31.1 seconds (LOS C) and PM peak hour overall intersection delay was 44.7 seconds (LOS D). The highest delay for any approach was 111.5 seconds (LOS F) in the AM peak hour and 115.0 seconds (LOS F) in the PM peak hour for the eastbound left-turn movement on Little River Turnpike. This is attributed to the cycle length of 180 seconds with protected-only left turns.

MOEs for AM and PM peak hour existing conditions for all intersections can be found in **Appendix C**.

Table 2: AM and PM Peak Hour Results

Approach	Movement	Storage Length	Existing AM			Existing PM		
			LOS+Delay	VC_Ratio	95th % Queue Length	LOS+Delay	VC_Ratio	95th % Queue Length
<b>Intersection 1: Annandale Road and Gallows Road (Signalized)</b>								
<b>Overall Intersection</b>			C (28.8)	0.93	-	C (24.5)	0.95	-
Eastbound (Annanwood Court)	EBLTR	-	B (16.5)	0.02	14	C (29.2)	0.02	15
	EB Approach	-	B (16.5)	-	-	C (29.2)	-	-
Westbound (Gallows Road)	WBLT	-	B (18.0)	0.23	84	C (30.4)	0.17	61
	WBR	280	E (63.9)	1.00	#531	D (50.8)	0.83	#345
	WB Approach	-	E (57.3)	-	-	D (49.0)	-	-
Northbound (Annandale Road)	NBLTR	-	B (12.4)	0.46	158	A (6.4)	0.22	87
	NB Approach	-	B (12.4)	-	-	A (6.4)	-	-
Southbound (Annandale Road)	SBLTR	-	B (17.7)	1.31dl	178	B (20.0)	0.99dl	#533
	SB Approach	-	B (17.7)	-	-	B (20.0)	-	-
<b>Intersection 2: Annandale Road and Galanis Drive (Unsignalized)</b>								
Eastbound (Galanis Drive)	EBLR	-	B (13.8)	0.02	3	C (15.1)	0.02	3
	EB Approach	-	B (13.8)	-	-	C (15.1)	-	-
Northbound (Annandale Road)	NBL	-	A (8.1)	0.00	0	A (9.2)	0.00	0
	NBT	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	NB Approach	-	(-)	-	-	A (0.1)	-	-
	SBTR	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	SBTR	-	(-)	-	-	(-)	-	-
	SB Approach	-	(-)	-	-	(-)	-	-
<b>Intersection 3: Annandale Road and Walton Lane (Unsignalized)</b>								
Eastbound (Walton Lane)	EBLR	-	B (11.5)	0.02	3	C (15.7)	0.14	13
	EB Approach	-	B (11.5)	-	-	C (15.7)	-	-
Northbound (Annandale Road)	NBL	-	(N/A)	-	0	A (9.5)	0.05	5
	NBT	-	(-)	-	-	A (0.3)	-	-
Southbound (Annandale Road)	NB Approach	-	(-)	-	-	A (1.0)	-	-
	SBTR	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	SBTR	-	(-)	-	-	(-)	-	-
	SB Approach	-	(-)	-	-	(-)	-	-
<b>Intersection 4: Annandale Road and Rodeo Court (Unsignalized)</b>								
Westbound (Rodeo Court)	WBLR	-	C (18.0)	0.02	3	B (12.8)	0.01	0
	WB Approach	-	C (18.0)	-	-	B (12.8)	-	-
Northbound (Annandale Road)	NBTR	-	(-)	-	-	(-)	-	-
	NB Approach	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	SBL	-	(N/A)	-	0	A (8.4)	0.00	0
	SBT	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	SBT	-	(-)	-	-	(-)	-	-
	SB Approach	-	(-)	-	-	(-)	-	-
<b>Intersection 5: Annandale Road and Beverly Manor Drive (Unsignalized)</b>								
Eastbound (Beverly Manor Drive)	EBLTR	-	C (18.3)	0.06	5	C (20.4)	0.06	5
	EB Approach	-	C (18.3)	-	-	C (20.4)	-	-
Westbound (Beverly Manor)	WBLTR	-	C (18.3)	0.06	5	C (20.4)	0.06	5
	WB Approach	-	C (17.3)	-	-	C (19.9)	-	-
Northbound (Annandale Road)	NBL	-	(N/A)	-	0	A (9.4)	0.01	0
	NBTR	-	(-)	-	-	A (0.1)	-	-
Southbound (Annandale Road)	NB Approach	-	(-)	-	-	A (0.2)	-	-
	SBL	-	A (9.5)	0.04	3	A (8.5)	0.01	0
Southbound (Annandale Road)	SBTR	-	A (0.2)	-	-	A (0.1)	-	-
	SB Approach	-	A (0.9)	-	-	A (0.2)	-	-
<b>Intersection 6: Annandale Road and Hamilton Street (Unsignalized)</b>								
Eastbound (Hamilton Street)	EBLR	-	B (13.6)	0.02	3	C (16.5)	0.02	3
	EB Approach	-	B (13.6)	-	-	C (16.5)	-	-
Northbound (Annandale Road)	NBL	-	A (8.0)	0.00	0	A (9.5)	0.00	0
	NBT	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	NB Approach	-	(-)	-	-	A (0.1)	-	-
	SBTR	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	SBTR	-	(-)	-	-	(-)	-	-
	SB Approach	-	(-)	-	-	(-)	-	-

Table 2 (continued): AM and PM Peak Hour Results

Approach	Movement	Storage Length	Existing AM			Existing PM			
			LOS+Delay	VC_Ratio	95th % Queue Length	LOS+Delay	VC_Ratio	95th % Queue Length	
<b>Intersection 7: Annandale Road and Farr Street (Unsignalized)</b>									
Eastbound (Farr Street)	EBLTR	-	D (27.3)	0.01	0	B (11.2)	0.01	0	
	EB Approach	-	D (27.3)	-	-	B (11.2)	-	-	
Westbound (Farr Street)	WBLTR	-	C (21.1)	0.10	8	C (18.8)	0.10	8	
	WB Approach	-	C (21.1)	-	-	C (18.8)	-	-	
Northbound (Annandale Road)	NBL	-	(N/A)	-	0	B (10.7)	0.00	0	
	NBTR	-	(-)	-	-	A (0.1)	-	-	
Southbound (Annandale Road)	NB Approach	-	(-)	-	-	A (0.2)	-	-	
	SBL	-	A (9.3)	0.01	0	A (8.6)	0.01	0	
	SBTR	-	(-)	-	-	A (0.1)	-	-	
	SB Approach	-	A (0.1)	-	-	A (0.2)	-	-	
<b>Intersection 8: Annandale Road and Quiet Cove (Unsignalized)</b>									
Westbound (Quiet Cove)	WBLR	-	C (15.9)	0.06	5	B (12.8)	0.05	3	
	WB Approach	-	C (15.9)	-	-	B (12.8)	-	-	
Northbound (Annandale Road)	NTBR	-	(-)	-	-	(-)	-	-	
	NB Approach	-	(-)	-	-	(-)	-	-	
Southbound (Annandale Road)	SBL	-	A (9.3)	0.01	0	A (8.5)	0.01	0	
	SBT	-	(-)	-	-	A (0.1)	-	-	
	SB Approach	-	A (0.1)	-	-	A (0.2)	-	-	
<b>Intersection 9: Annandale Road and Medford Drive (Unsignalized)</b>									
Eastbound (Medford Drive)	EBL	-	C (22.6)	0.26	25	F (51.7)	0.54	68	
	EBT	-	(N/A)	-	-	D (30.6)	0.02	3	
	EBR	-	A (9.6)	0.07	5	B (11.5)	0.14	13	
	EB Approach	-	C (16.9)	-	-	D (31.2)	-	-	
Westbound (Glen Hollow Court)	WBLTR	-	C (18.7)	0.03	3	D (28.3)	0.03	3	
	WB Approach	-	C (18.7)	-	-	D (28.3)	-	-	
Northbound (Annandale Road)	NBL	-	A (8.1)	0.02	3	A (9.3)	0.08	5	
	NBT	-	A (0.1)	-	-	A (0.4)	-	-	
	NBR	-	(-)	-	-	(-)	-	-	
	NB Approach	-	A (0.4)	-	-	A (1.5)	-	-	
Southbound (Annandale Road)	SBL	-	(N/A)	-	0	A (8.3)	0.00	0	
	SBT	-	(-)	-	-	(-)	-	-	
	SBR	-	(-)	-	-	(-)	-	-	
	SB Approach	-	(-)	-	-	(-)	-	-	
<b>Intersection 10: Annandale Road and Markham Street (Signalized)</b>									
<b>Overall Intersection</b>			-	A (8.2)	0.37	-	B (11.0)	0.40	-
Eastbound (Markham Street)	EBLT	-	D (41.7)	0.48	69	D (39.8)	0.55	99	
	EBR	100	D (37.5)	0.06	24	C (34.6)	0.12	55	
	EB Approach	-	D (39.2)	-	-	D (36.4)	-	-	
Westbound (Poplar Street)	WBLTR	-	D (38.1)	0.14	41	D (35.3)	0.22	63	
	WB Approach	-	D (38.1)	-	-	D (35.3)	-	-	
Northbound (Annandale Road)	NTBR	-	A (2.4)	0.32	74	A (3.4)	0.33	52	
	NB Approach	-	A (2.4)	-	-	A (3.4)	-	-	
Southbound (Annandale Road)	SBT	-	A (2.8)	0.17	44	A (4.5)	0.30	103	
	SBR	205	A (2.4)	0.02	0	A (3.6)	0.07	12	
	SB Approach	-	A (2.8)	-	-	A (4.4)	-	-	
<b>Intersection 11: Annandale Road and Maple Place (Signalized)</b>									
<b>Overall Intersection</b>			-	B (12.9)	0.24	-	B (10.5)	0.40	-
Westbound (Maple Place)	WBR	250	D (35.6)	0.16	0	C (30.7)	0.14	0	
	WB Approach	-	D (35.6)	-	-	A (0.0)	-	-	
Northbound (Annandale Road)	NBTR	-	A (2.0)	0.15	31	A (9.9)	0.10	111	
	NB Approach	-	A (2.0)	-	-	A (9.9)	-	-	
Southbound (Annandale Road)	SBT	-	A (1.5)	0.24	3	A (1.7)	0.40	19	
	SB Approach	-	A (1.5)	-	-	A (1.7)	-	-	

Table 2 (continued): AM and PM Peak Hour Results

Approach	Movement	Storage Length	Existing AM			Existing PM		
			LOS+Delay	VC_Ratio	95th % Queue Length	LOS+Delay	VC_Ratio	95th % Queue Length
<b>Intersection 12: Annandale Road and Little River Turnpike (Signalized)</b>								
<b>Overall Intersection</b>			C (31.1)	0.67	-	D (44.7)	0.79	-
Eastbound (Little River Turnpike)	EBL	195	F (93.9)	0.26	25	F (82.6)	0.28	70
	EBTR	-	C (26.9)	0.58	559	D (41.3)	0.73	701
	EB Approach	-	C (27.2)	-	-	D (42.3)	-	-
Westbound (Little River Turnpike)	WBL	160	F (111.5)	0.33	124	F (115.0)	0.67	m285
	WBTR	-	A (6.4)	0.62	181	B (13.8)	0.70	255
	WB Approach	-	B (10.6)	-	-	C (25.0)	-	-
Northbound (Ravensworth Road)	NBL	390	F (85.5)	0.69	237	F (109.9)	0.84	#277
	NBT	-	F (85.0)	0.76	228	F (81.6)	0.63	170
	NB Approach	-	F (85.2)	-	-	F (91.6)	-	-
Southbound (Annandale Road)	SBL	-	F (81.0)	0.47	120	F (91.3)	0.82	300
	SBTR	-	F (88.7)	0.64	156	E (77.9)	0.69	245
	SB Approach	-	F (85.5)	-	-	F (85.1)	-	-

# = 95th percentile volume exceeds capacity, queue may be longer  
m = Volume for 95th percentile queue is metered by upstream signal  
dl = Defacto Left Lane  
N/A - zero volume movement; therefore, delay cannot be reported.

From the MOE results for the intersection of Annandale Road at Gallows Road, it can be concluded that the intersection operations are acceptable in the AM peak hour, with an overall intersection LOS C, and the worst intersection movements operating at LOS E, which is the westbound approach. This is primarily attributed to volume being at capacity on this approach, as evidenced by the volume-to-capacity (V/C) ratio of 1.0. The same is true for this intersection during the PM peak hour, during which the intersection operates with an overall intersection LOS C and the westbound approach at LOS D.

From the MOE results for the intersection of Annandale Road at Markham Street and Maple Place, it can be concluded that the intersection operations are acceptable in the AM and PM peak hours, with an overall intersection LOS B or better, and the worst intersection movements operating at LOS D, on the eastbound and westbound approaches. This is primarily attributed to these approaches being side street movements and receiving a smaller proportion of the signal cycle duration than mainline Annandale Road.

The intersection of Annandale Road at Little River Turnpike operates poorly under existing conditions, with several movements operating at LOS F during both the AM and PM peak hours. Furthermore, the 95<sup>th</sup> percentile queue lengths reported indicate that the volume exceeds available capacity for the westbound and northbound left-turn movements during the PM peak hour (indicated with a “#” symbol in the tables above), and queues could be longer than reported. The primary factors contributing to the poor operations are cycle length and volume. AM and PM peak hour signal operations run a cycle length of 180 seconds. This inherently increases delay as certain movements can experience a dwell time of over two minutes waiting for the signal phase to be served. In addition, the high volumes and limited number of lanes to accommodate movements impacts the capacity of the intersection to process volume. Note that this signal is part of a coordinated signal system network, so it is likely that delays along Little River Turnpike could be lower when accounting for corridor progression; however, the worst delay exists for westbound left turns, which are protected. Overall AM peak hour operations are better when compared to the PM peak hour, likely as a result of approximately 470 fewer vehicles (nearly 15% less volume) traveling through the intersection.

## Road Diet Assessment

### GEOMETRY

Using the information from the analysis of existing roadway geometry and traffic conditions, an assessment of the impact of the proposed road diet was completed. The modifications of the corridor include the removal of one northbound and one southbound through travel lane to install a bike lane along the east and west curbs. **Figure 6** shows the existing cross section of the corridor, while **Figure 7** shows a typical cross section for the potential build conditions. The graphics were created using Streetmix. Cross section graphics do not include existing gutters, which represent additional horizontal space to accommodate reconfiguration of the roadway width for bike lanes. Gutters along Annandale Road were measured to be 2 feet, except between Gallows Road and Galanis Drive where they were 1.5 feet on the west side and 2 feet on the east side of Annandale Road.

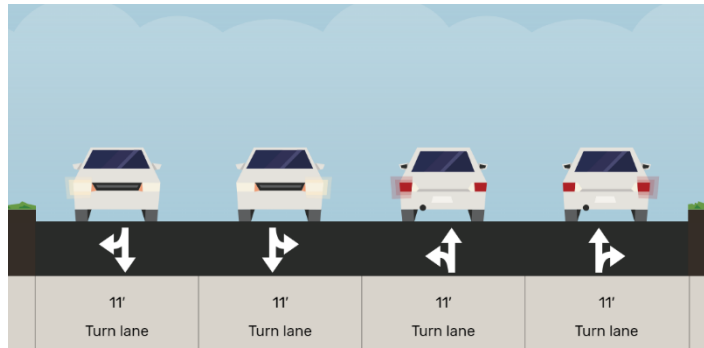


Figure 6: Annandale Road Existing Conditions Typical Cross Section

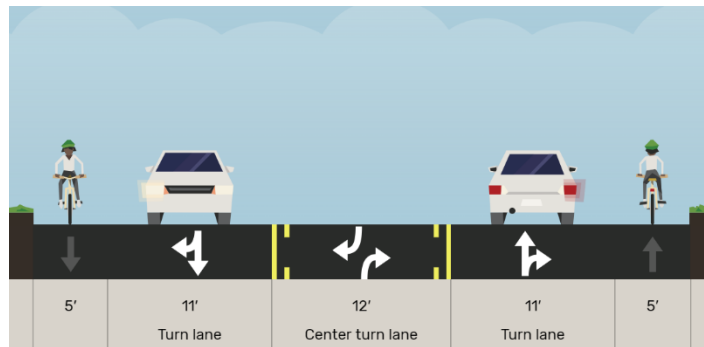


Figure 7: Annandale Road Build Conditions Typical Cross Section

Potential changes at the intersection of Annandale Road and Gallows Road are recommended as follows to accommodate bike lanes at the intersection:

- Repurpose the existing inside southbound through-left lane as a dedicated left-turn lane
- Add a sharrow on the north side of the intersection in the outside northbound lane to guide bicyclists to the sidewalk just to the north at Annandale Court

**Figure 8** illustrates the modifications proposed at this signalized intersection (cross section and plan view). The five-foot bike lane will begin on the south leg of the intersection and continue along the curb along Annandale Road. To access the southbound bicycle lane, bicycles will use the pedestrian crosswalks. Signs and pavement markings should be considered to direct bicyclists through the intersection and to warn drivers of the presence of bicyclists at the intersection. The position of the northbound bike lane to the right of the shared northbound through/right-turn lane was identified after reviewing traffic volumes. The northbound right-turn movement is relatively low (highest hourly volume is 46 vehicles in the AM peak hour).

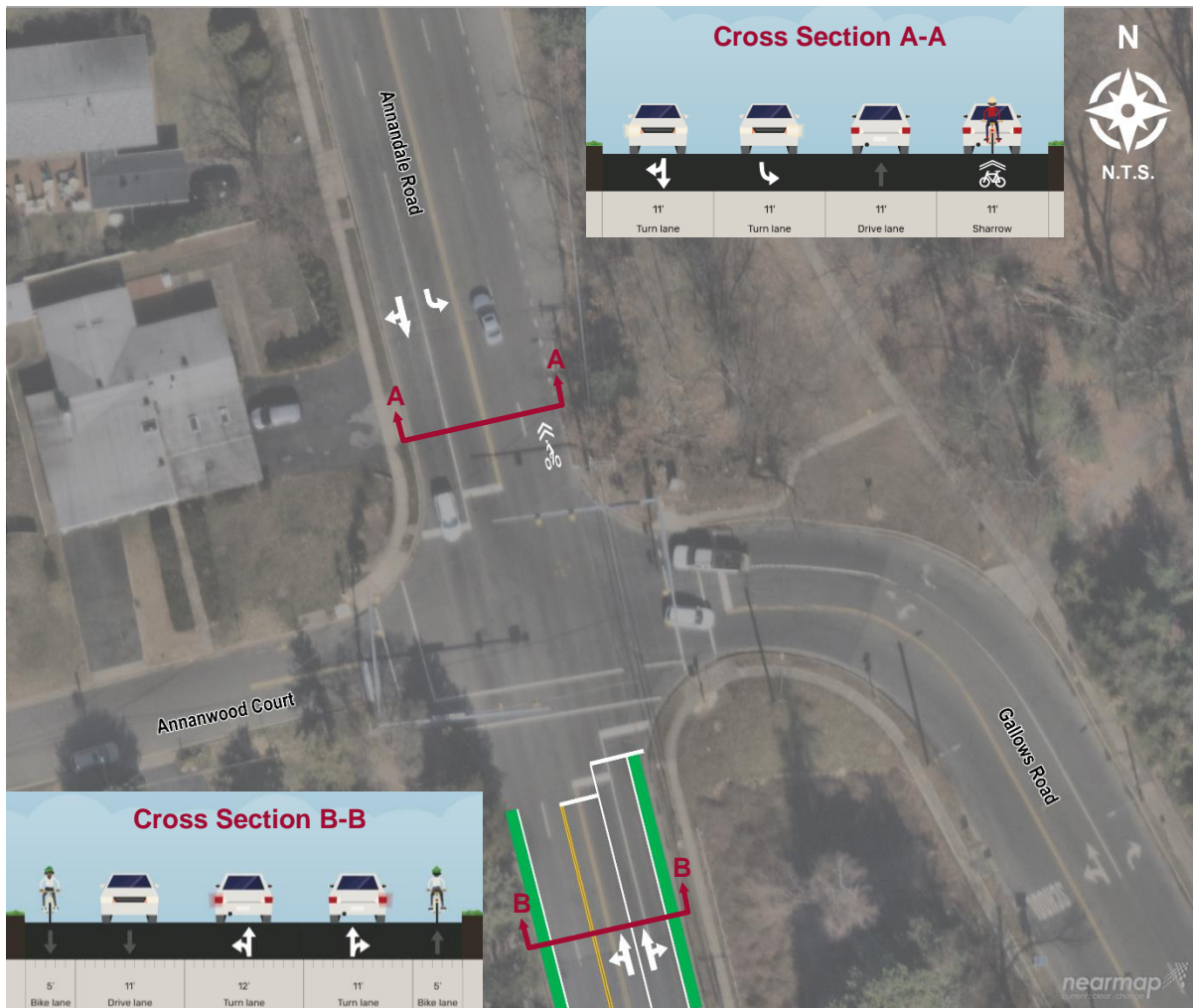


Figure 8: Intersection of Annandale Road and Gallows Road Build Conditions Cross Section and Plan View

Potential changes at the intersection of Annandale Road and Little River Turnpike are recommended as follows to accommodate bike lanes at the intersection:

- Repurpose the existing northbound and southbound outside travel lanes as bike lanes north of Little River Turnpike, with the remaining cross-sectional width marked with a shared southbound through and right-turn lane, a dedicated southbound left-turn lane, and a single northbound departure lane.
- Restripe the northbound approach to position a dedicated right-turn lane to the outside of the northbound approach, repositioning the existing bike lane between the existing through and new dedicated right-turn lanes.

**Figure 9** illustrates the modifications proposed at this signalized intersection (cross section and plan view). The proposed bike lanes will tie into existing bike lanes on Ravensworth Road. Given the presence of a single northbound right-turn lane, the bike lane would need to transition from the curb

to be located between the northbound through lane and the northbound right-turn lane to mitigate the potential right-turn conflict, which has a volume of 94 vehicles during the PM peak hour. Note that the existing travel lanes on the northbound approach are approximately 10 feet wide, so there is no effective change to the available space for vehicular travel on this leg of the intersection. Lane control figures for existing and proposed conditions can be found in **Appendix D**.

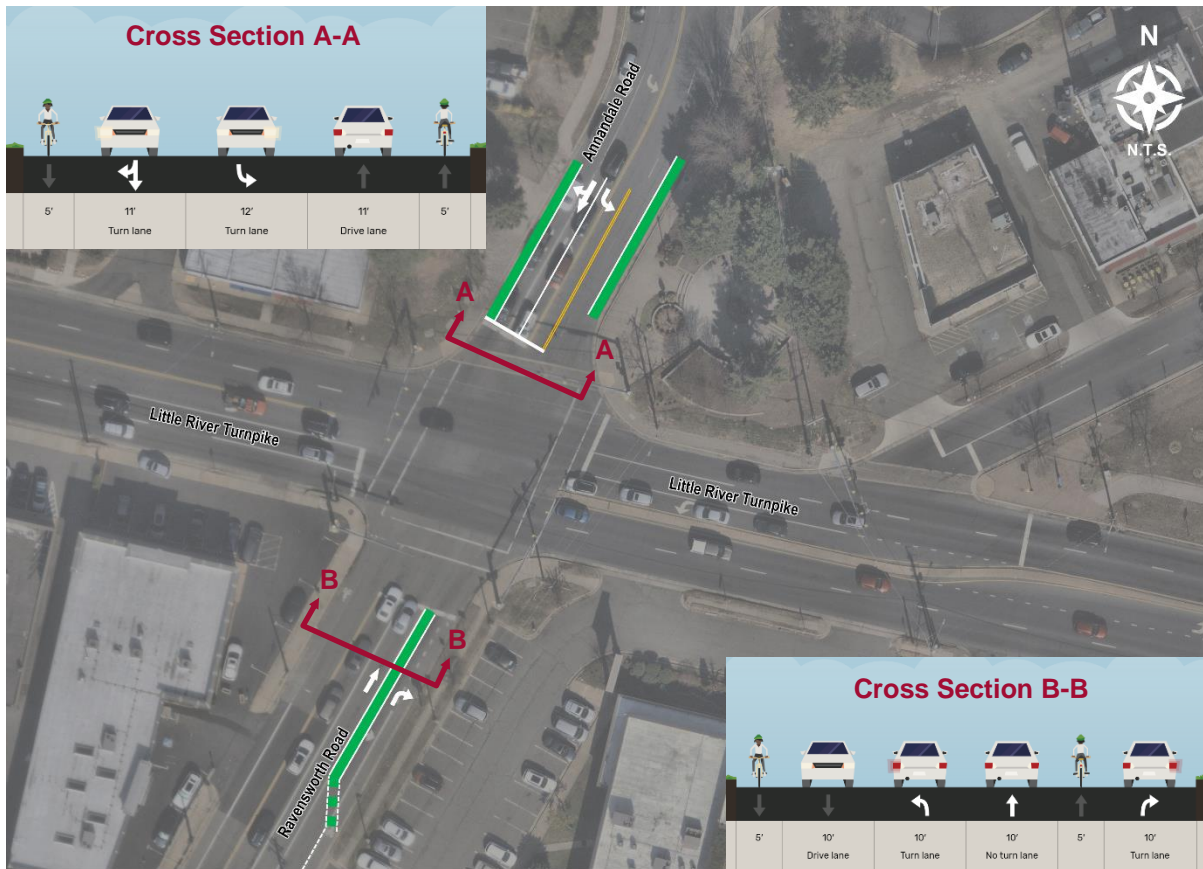


Figure 9: Intersection of Annandale Road and Little River Turnpike Build Conditions Cross Section and Plan View

## POTENTIAL CRASH MITIGATION

### Pedestrian and Bicycle-Focused Mitigation

The Virginia state preferred crash modification factors (CMF) list<sup>1</sup> was referenced to identify appropriate modification factors and the potential impact on crash likelihood along the corridor. Given the primary objective of this project to implement enhanced accommodations for non-auto users, the

<sup>1</sup> [https://www.vdot.virginia.gov/media/vdotvirginiagov/doing-business/technical-guidance-and-support/traffic-operations/vhsip/VA-State-Preferred-CMF-List\\_acc050222.pdf](https://www.vdot.virginia.gov/media/vdotvirginiagov/doing-business/technical-guidance-and-support/traffic-operations/vhsip/VA-State-Preferred-CMF-List_acc050222.pdf)

assessment of potential crash mitigation was focused on bicycle and pedestrian-related crashes. There were five reported crashes that involved a pedestrian at the three southernmost signalized intersections on Annandale Road. Three of the five crashes occurred at or near existing crosswalks that are already signalized. Two crashes at Maple Place occurred within twelve months of each other and involved pedestrians crossing Annandale Road, which does not currently have marked or signalized crosswalks across Annandale Road. One crash involved a pedestrian fatality and one involved possible injury. The relevant CMF pertaining to these crashes is described as follows:

- **Add Pedestrian Signal Heads**, CMF = 0.92 this factor applies to all crashes and has a service life of 20 years. Note that the CMF = 0.85 for K (fatal), A (suspected serious injury), and BC (possible injury) crashes.

Applying this CMF could reduce the number of crashes to less than two expected crashes (1.7 crashes) per year. Note that the installation of a crosswalk alone has a CMF of 1.0, indicating it would not impact crash frequency.

Of the three remaining crashes at signalized crosswalks, two occurred at or near crosswalks that are marked with parallel pavement markings only (Poplar Street and Little River Turnpike). The third occurred at a signalized crosswalk across Maple Place that is marked with high visibility pavement markings. Further mitigation within the parameters of the at-grade signalized intersection is not feasible outside of implementing an exclusive pedestrian phase at Maple Place. This mitigation is not recommended given the low pedestrian volume. The relevant CMFs for Poplar Street and Little River Turnpike are described as follows:

- **Convert Standard Crosswalk Pavement Marking to High-Visibility Crosswalk**, CMF = 0.63 this factor applies to all crashes and crash severities and has a service life of 2 years.
- **Implement Leading Pedestrian Interval (LPI)**, CMF = 0.413 this factor applies to all crashes and crash severities and has a service life of 20 years.
  - This is only applicable at Poplar Street as the crash occurred with a pedestrian crossing Annandale Road. Current VDOT policy does not allow for LPIs to be programmed for crossings of the minor approach to an intersection, as was the case of the pedestrian crash at Little River Turnpike.

There was one crash over a three-year period that occurred at Poplar Street. Applying both CMFs could reduce the number of crashes from 1 crash every three years to less than 1 crash every three years (0.26 crashes). Applying the CMF for installing high-visibility crosswalk markings at Little River Turnpike, this could reduce the number of crashes from 1 crash every three years to less than 1 crash every three years (0.63 crashes).

### Other Mitigation

Related to vehicle countermeasures, there is a CMF for roadway segments with the countermeasure of a road diet. A road diet is also another fundamental component of this study as a means of creating space for bicyclists within the roadway. The road diet countermeasure is specific to the conversion of a four-lane undivided roadway to two travel lanes with a center turn lane. Annandale Road from Little River Turnpike to Gallows Road is currently a four-lane undivided roadway. The relevant CMF is described as follows:

- **Road Diet (4U to 3T)**, CMF = 0.71 this factor applies to all crashes and crash severities and has a service life of 20 years.

There was one crash over a three-year period that occurred along Annandale Road outside of study intersections. Applying this CMF could reduce the number of crashes from 1 crash every three years to less than 1 crash every three years (0.71 crashes).

Although not related to the purpose of this study, there were a significant number of angle crashes reported at the intersection of Annandale Road and Gallows Road (13 total) over a three-year period. 12 of the crashes appear to have occurred along Annandale Road. Field conditions indicate the required intersection sight distance for left turns from a major road are not provided for northbound left-turning drivers<sup>2</sup>. This movement operates as a permissive-only left turn. Based on the lack of adequate intersection sight distance, protected only left-turn operations would be recommended. The relevant CMF is described as follows:

- **Change from Permitted Left-Turn to Protected on Major Approach**, CMF = 0.01 this factor applies to angle crashes and all crash severities and has a service life of 20 years.

Applying this CMF could reduce the number of crashes to almost zero expected crashes (0.04 crashes) per year, assuming an average crash rate of four crashes per year. Since the information in the available crash data is limited to crash type and location only, further review of detailed crash data is recommended to determine the number of crashes that involved northbound left-turning vehicles and the resulting reduction in crash frequency. Note that protected only left-turn operations, while expected to reduce crashes, cannot be implemented without a dedicated left-turn lane. The northbound left-turn movement is a low-volume movement (one vehicle in the AM peak hour, zero vehicles in the PM peak hour). Thus, alternate mitigation should be considered if the findings of a detailed crash analysis indicate a conflict between northbound left turn and southbound through movements.

## BUILD TRAFFIC ANALYSIS

The Build analysis results for the study intersections are summarized below in **Table 3** and **Table 4**, with complete results included in **Appendix E**. During the AM peak hour, overall delay at the intersection of Annandale Road and Gallows Road decreases by approximately five seconds. The eastbound and northbound approaches change from LOS B to LOS C. The southbound through delay decreases to 9.2 seconds. This is a result of the modified geometry with the inside southbound through-left lane becoming a dedicated left-turn lane. The westbound approach delay decreases significantly, from 57.3 seconds to 28.8 seconds. This reduction in delay is a product of increased actuated green time for the southbound left-turn movement, which operates with an overlap phase for the westbound right-turn movement. While the effective cycle length increases, the signal is able to more efficiently accommodate demand at the intersection as less time is required for vehicle clearance intervals over the course of the peak hour. The PM peak hour results indicate a decrease

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<sup>2</sup> American Association of State Highway and Transportation Officials (AASHTO), "A Policy on Geometric Design of Highways and Streets", 2018, 7<sup>th</sup> Edition, Section 9.5.3.6

in overall intersection delay by almost ten seconds. The improvement in operations in the PM peak hour can be attributed to balanced distribution of volume on the southbound approach. Given that the left-turn and through volumes on this approach are similar (552 vs. 694), the exclusive lanes for each movement results in a shorter actuation of the signal phases than in the existing shared lane configuration for this approach. The signal is able to operate at lower effective cycle length, which impacts the overall intersection delay.

The signalized intersections of Annandale Road at Markham Street and Maple Place operate at an acceptable level of delay during the AM and PM peak hours with an overall intersection LOS B or better. All movements operate at LOS D or better, with nearly zero change in delay for side street movements. This is to be expected given that signal timings matched existing conditions and there were no modifications to side street geometry. The signalized intersection at Little River Turnpike demonstrates a slight increase in overall delay compared to existing conditions during the AM and PM peak hours; however, results are comparable to existing conditions.

HCM 6 results during the AM peak hour indicate the highest unsignalized intersection delay occurs for the eastbound left-turn movement at Medford Drive, with a delay of just over 40 seconds. This is due to a combination of high turning volume from Medford Drive and the limited gaps in northbound and southbound volume. The build conditions increase delay for this movement compared to existing conditions by 18 seconds. The same movement experiences the highest delay increase during the PM peak hour, with a delay of almost 78 seconds. This represents an increase in delay of 26.1 seconds for this movement compared to existing conditions. While there is an increase in delay, the dedicated left-turn lane provides a safe space for drivers to wait for a gap in traffic.

Table 3: AM Peak Hour Build Condition Results

Approach	Movement	Storage Length	Existing AM			Build AM			
			LOS+Delay	VC_Ratio	95th % Queue Length	LOS+Delay	VC_Ratio	95th % Queue Length	
<b>Intersection 1: Annandale Road and Gallows Road (Signalized)</b>									
<b>Overall Intersection</b>			-	C (28.8)	0.93	-	C (24.0)	0.87	-
Eastbound (Annanwood Ct)	EBLTR	-	B (16.5)	0.02	14	C (23.8)	0.02	17	
	EB Approach	-	B (16.5)	-	-	C (23.8)	-	-	
Westbound (Gallows Road)	WBLT	-	B (18.0)	0.23	84	C (25.9)	0.28	98	
	WB Approach	280	E (63.9)	1.00	#531	C (29.3)	0.81	378	
Northbound (Annandale Road)	NBLTR	-	B (12.4)	0.46	158	C (24.2)	0.63	256	
	NB Approach	-	B (12.4)	-	-	C (24.2)	-	-	
Southbound (Annandale Road)	SBL	-	s	s	s	C (26.2)	0.84	#240	
	SBTR	-	B (17.7)	1.31dl	178	A (9.2)	0.28	123	
SB Approach	-	B (17.7)	-	-	B (18.5)	-	-		
<b>Intersection 2: Annandale Road and Galanis Drive (Unsignalized)</b>									
Eastbound (Galanis Drive)	EBL	-	B (13.8)	0.02	3	C (18.4)	0.03	3	
	EB Approach	-	B (13.8)	-	-	C (18.4)	-	-	
Northbound (Annandale Road)	NBL	-	A (8.1)	0.00	0	A (8.1)	0.00	0	
	NBT	-	(-)	-	-	(-)	-	-	
Southbound (Annandale Road)	SBTR	-	(-)	-	-	(-)	-	-	
	SB Approach	-	(-)	-	-	(-)	-	-	
<b>Intersection 3: Annandale Road and Walton Lane (Unsignalized)</b>									
Eastbound (Walton Lane)	EBLR	-	B (11.5)	0.02	3	B (12.2)	0.02	3	
	EB Approach	-	B (11.5)	-	-	B (12.2)	-	-	
Northbound (Annandale Road)	NBL	-	(N/A)	-	0	N/A	-	0	
	NBT	-	(-)	-	-	(-)	-	-	
Southbound (Annandale Road)	SBTR	-	(-)	-	-	(-)	-	-	
	SB Approach	-	(-)	-	-	(-)	-	-	
<b>Intersection 4: Annandale Road and Rodeo Court (Unsignalized)</b>									
Westbound (Rodeo Court)	WBLR	-	C (18.0)	0.02	3	C (15.7)	0.01	0	
	WB Approach	-	C (18.0)	-	-	C (15.7)	-	-	
Northbound (Annandale Road)	NBTR	-	(-)	-	-	(-)	-	-	
	NB Approach	-	(-)	-	-	(-)	-	-	
Southbound (Annandale Road)	SBL	-	(N/A)	-	0	N/A	-	0	
	SBT	-	(-)	-	-	(-)	-	-	
SB Approach	-	(-)	-	-	(-)	-	-		
<b>Intersection 5: Annandale Road and Beverly Manor Drive (Unsignalized)</b>									
Eastbound (Beverly Manor)	EBLTR	-	C (18.3)	0.06	5	C (21.4)	0.07	5	
	EB Approach	-	C (18.3)	-	-	C (21.4)	-	-	
Westbound (Beverly Manor)	WBLTR	-	C (18.3)	0.06	5	C (21.4)	0.07	5	
	WB Approach	-	C (17.3)	-	-	C (21.1)	-	-	
Northbound (Annandale Road)	NBL	-	(N/A)	-	0	N/A	-	0	
	NBTR	-	(-)	-	-	(-)	-	-	
Southbound (Annandale Road)	SBL	-	A (9.5)	0.04	3	A (9.5)	0.04	3	
	SBTR	-	A (0.2)	-	-	(-)	-	-	
SB Approach	-	A (0.9)	-	-	A (0.7)	-	-		
<b>Intersection 6: Annandale Road and Hamilton Street (Unsignalized)</b>									
Eastbound (Hamilton Street)	EBLR	-	B (13.6)	0.02	3	B (13.8)	0.02	3	
	EB Approach	-	B (13.6)	-	-	B (13.8)	-	-	
Northbound (Annandale Road)	NBL	-	A (8.0)	0.00	0	A (8.0)	0.00	0	
	NBT	-	(-)	-	-	(-)	-	-	
Southbound (Annandale Road)	SBTR	-	(-)	-	-	(-)	-	-	
	SB Approach	-	(-)	-	-	(-)	-	-	

# = 95th percentile volume exceeds capacity, queue may be longer  
m = Volume for 95th percentile queue is metered by upstream signal  
dl = Defacto Left Lane  
N/A - zero volume movement; therefore, delay cannot be reported.

Table 3 (continued): AM Peak Hour Build Condition Results

Approach	Movement	Storage Length	Existing AM			Build AM		
			LOS+Delay	VC_Ratio	95th % Queue Length	LOS+Delay	VC_Ratio	95th % Queue Length
<b>Intersection 7: Annandale Road and Farr Street (Unsignalized)</b>								
Eastbound (Farr Street)	EBLTR	-	D (27.3)	0.01	0	C (22.0)	0.01	0
	EB Approach	-	D (27.3)	-	-	C (22.0)	-	-
Westbound (Farr Street)	WBLTR	-	C (21.1)	0.10	8	s	s	s
	WB Approach	-	C (21.1)	-	-	C (24.5)	-	-
Northbound (Annandale Road)	NBL	-	(N/A)	-	0	(N/A)	-	0
	NBTR	-	(-)	-	-	(-)	-	-
	NB Approach	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	SBL	-	A (9.3)	0.01	0	A (9.3)	0.01	0
	SBT	-	(-)	-	-	(-)	-	-
	SBR	-	s	s	s	(-)	-	-
	SB Approach	-	A (0.1)	-	-	A (0.1)	-	-
<b>Intersection 8: Annandale Road and Quiet Cove (Unsignalized)</b>								
Westbound (Quiet Cove)	WBLR	-	C (15.9)	0.06	5	C (15.2)	0.05	5
	WB Approach	-	C (15.9)	-	-	C (15.2)	-	-
Northbound (Annandale Road)	NTBR	-	(-)	-	-	(-)	-	-
	NB Approach	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	SBL	-	A (9.3)	0.01	0	A (9.3)	0.01	0
	SBT	-	(-)	-	-	(-)	-	-
	SB Approach	-	A (0.1)	-	-	A (0.1)	-	-
<b>Intersection 9: Annandale Road and Medford Drive (Unsignalized)</b>								
Eastbound (Medford Drive)	EBL	-	C (22.6)	0.26	25	E (40.7)	0.42	48
	EBT	-	(N/A)	-	-	(N/A)	-	-
	EBR	-	A (9.6)	0.07	5	B (10.7)	0.08	8
	EB Approach	-	C (16.9)	-	-	D (27.6)	-	-
Westbound (Glen Hollow Court)	WBLTR	-	C (18.7)	0.03	3	C (22.4)	0.04	3
	WB Approach	-	C (18.7)	-	-	C (22.4)	-	-
Northbound (Annandale Road)	NBL	-	A (8.1)	0.02	3	A (8.1)	0.02	3
	NBT	-	A (0.1)	-	-	(-)	-	-
	NBR	-	(-)	-	-	(-)	-	-
	NB Approach	-	A (0.4)	-	-	(-)	-	-
Southbound (Annandale Road)	SBL	-	(N/A)	-	0	N/A	-	0
	SBT	-	(-)	-	-	(-)	-	-
	SBR	-	(-)	-	-	(-)	-	-
	SB Approach	-	(-)	-	-	(-)	-	-

# = 95th percentile volume exceeds capacity, queue may be longer  
m = Volume for 95th percentile queue is metered by upstream signal  
dl = Defacto Left Lane  
N/A - zero volume movement; therefore, delay cannot be reported.

Table 3 (continued): AM Peak Hour Build Condition Results

Approach	Movement	Storage Length	Existing AM			Build AM			
			LOS+Delay	VC_Ratio	95th % Queue Length	LOS+Delay	VC_Ratio	95th % Queue Length	
<b>Intersection 10: Annandale Road and Markham Street (Signalized)</b>									
<b>Overall Intersection</b>			-	A (8.2)	0.37	-	B (10.7)	0.55	-
Eastbound (Markham Street)	EBLT	-	D (41.7)	0.48	69	D (41.7)	0.48	69	
	EBR	100	D (37.5)	0.06	24	D (37.5)	0.06	24	
Westbound (Poplar Street)	EB Approach	-	D (39.2)	-	-	D (39.2)	-	-	
	WB Approach	-	D (38.1)	-	-	D (38.1)	-	-	
Northbound (Annandale Road)	NBL	-	s	s	s	A (2.6)	0.07	22	
	NTBR	-	A (2.4)	0.32	74	A (5.1)	0.51	263	
	NB Approach	-	A (2.4)	-	-	A (4.9)	-	-	
Southbound (Annandale Road)	SBL	-	s	s	s	A (5.5)	0.06	18	
	SBT	-	A (2.8)	0.17	44	A (7.0)	0.30	148	
	SBR	205	A (2.4)	0.02	0	A (5.2)	0.02	0	
	SB Approach	-	A (2.8)	-	-	A (6.8)	-	-	
<b>Intersection 11: Annandale Road and Maple Place (Signalized)</b>									
<b>Overall Intersection</b>			-	B (12.9)	0.24	-	B (13.7)	0.34	-
Westbound (Maple Place)	WBR	250	D (35.6)	0.16	0	C (34.5)	0.37	60	
	WB Approach	-	D (35.6)	-	-	A (0.0)	-	-	
Northbound (Annandale Road)	NBTR	-	A (2.0)	0.15	31	A (5.5)	0.31	169	
	NB Approach	-	A (2.0)	-	-	A (5.5)	-	-	
Southbound (Annandale Road)	SBL	-	s	s	s	A (2.4)	0.33	0	
	SBT	-	A (1.5)	0.24	3	A (0.2)	0.09	0	
	SB Approach	-	A (1.5)	-	-	A (1.7)	-	-	
<b>Intersection 12: Annandale Road and Little River Turnpike (Signalized)</b>									
<b>Overall Intersection</b>			-	C (31.1)	0.67	-	C (32.3)	0.72	-
Eastbound (Little River Turnpike)	EBL	-	F (93.9)	0.26	25	F (93.9)	0.26	25	
	EBTR	-	C (26.9)	0.58	559	C (31.0)	0.62	600	
	EB Approach	-	C (27.2)	-	-	C (31.3)	-	-	
Westbound (Little River Turnpike)	WBL	-	F (111.5)	0.33	124	F (113.3)	0.33	m117	
	WBTR	-	A (6.4)	0.62	181	A (7.6)	0.65	188	
	WB Approach	-	B (10.6)	-	-	B (11.8)	-	-	
Northbound (Ravensworth Road)	NBL	-	F (85.5)	0.69	237	E (72.9)	0.55	228	
	NBTR	-	F (85.0)	0.76	228	F (93.7)	0.83	350	
	NBR	-	s	s	s	E (65.4)	0.07	30	
	NB Approach	-	F (85.2)	-	-	F (81.2)	-	-	
Southbound (Annandale Road)	SBL	-	F (81.0)	0.47	120	E (77.7)	0.47	117	
	SBTR	-	F (88.7)	0.64	156	F (86.1)	0.64	157	
	SB Approach	-	F (85.5)	-	-	F (82.6)	-	-	

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dl = Defacto Left Lane  
N/A - zero volume movement; therefore, delay cannot be reported.

Table 4: PM Peak Hour Build Condition Results

Approach	Movement	Storage Length	Existing PM			Build PM			
			LOS+Delay	VC_Ratio	95th % Queue Length	LOS+Delay	VC_Ratio	95th % Queue Length	
<b>Intersection 1: Annandale Road and Gallows Road (Signalized)</b>									
<b>Overall Intersection</b>			-	C (24.5)	0.95	-	B (15.7)	0.83	-
Eastbound (Annanwood Ct)	EBLTR	-	C (29.2)	0.02	15	C (26.2)	0.02	12	
	EB Approach	-	C (29.2)	-	-	C (26.2)	-	-	
Westbound (Gallows Road)	WBLT	-	C (30.4)	0.17	61	C (27.4)	0.19	50	
	WB Approach	280	D (50.8)	0.83	#345	B (20.0)	0.55	152	
Northbound (Annandale Road)	NBLTR	-	A (6.4)	0.22	87	B (17.7)	0.37	147	
	NB Approach	-	A (6.4)	-	-	B (17.7)	-	-	
Southbound (Annandale Road)	SBL	-	s	s	s	B (17.2)	0.85	#389	
	SBTR	-	B (20.0)	0.99dl	#533	A (9.1)	0.60	383	
SB Approach	-	-	B (20.0)	-	-	B (12.7)	-	-	
	-	-	-	-	-	-	-	-	
<b>Intersection 2: Annandale Road and Galanis Drive (Unsignalized)</b>									
Eastbound (Galanis Drive)	EBL	-	C (15.1)	0.02	3	C (18.5)	0.03	3	
	EB Approach	-	C (15.1)	-	-	C (18.5)	-	-	
Northbound (Annandale Road)	NBL	-	A (9.2)	0.00	0	A (9.2)	0.00	0	
	NBT	-	(-)	-	-	(-)	-	-	
Southbound (Annandale Road)	NB Approach	-	A (0.1)	-	-	A (0.1)	-	-	
	SBTR	-	(-)	-	-	(-)	-	-	
SB Approach	-	-	(-)	-	-	(-)	-	-	
	-	-	(-)	-	-	(-)	-	-	
<b>Intersection 3: Annandale Road and Walton Lane (Unsignalized)</b>									
Eastbound (Walton Lane)	EBLR	-	C (15.7)	0.14	13	C (16.7)	0.15	13	
	EB Approach	-	C (15.7)	-	-	C (16.7)	-	-	
Northbound (Annandale Road)	NBL	-	A (9.5)	0.05	5	A (9.5)	0.05	5	
	NBT	-	A (0.3)	-	-	(-)	-	-	
Southbound (Annandale Road)	NB Approach	-	A (1.0)	-	-	A (0.7)	-	-	
	SBTR	-	(-)	-	-	(-)	-	-	
SB Approach	-	-	(-)	-	-	(-)	-	-	
	-	-	(-)	-	-	(-)	-	-	
<b>Intersection 4: Annandale Road and Rodeo Court (Unsignalized)</b>									
Westbound (Rodeo Court)	WBLR	-	B (12.8)	0.01	0	B (13.3)	0.01	0	
	WB Approach	-	B (12.8)	-	-	B (13.3)	-	-	
Northbound (Annandale Road)	NBTR	-	(-)	-	-	(-)	-	-	
	NB Approach	-	(-)	-	-	(-)	-	-	
Southbound (Annandale Road)	SBL	-	A (8.4)	0.00	0	A (8.4)	0.00	0	
	SBT	-	(-)	-	-	(-)	-	-	
SB Approach	-	-	(-)	-	-	(-)	-	-	
	-	-	(-)	-	-	(-)	-	-	
<b>Intersection 5: Annandale Road and Beverly Manor Drive (Unsignalized)</b>									
Eastbound (Beverly Manor)	EBLTR	-	C (20.4)	0.06	5	D (26.0)	0.08	5	
	EB Approach	-	C (20.4)	-	-	D (26.0)	-	-	
Westbound (Beverly Manor)	WBLTR	-	C (20.4)	0.06	5	D (26.0)	0.08	5	
	WB Approach	-	C (19.9)	-	-	D (28.5)	-	-	
Northbound (Annandale Road)	NBL	-	A (9.4)	0.01	0	A (9.4)	0.01	0	
	NBTR	-	A (0.1)	-	-	(-)	-	-	
Southbound (Annandale Road)	NB Approach	-	A (0.2)	-	-	A (0.1)	-	-	
	SBL	-	A (8.5)	0.01	0	A (8.5)	0.01	0	
SBTR	-	-	A (0.1)	-	-	(-)	-	-	
	-	-	A (0.2)	-	-	A (0.1)	-	-	
<b>Intersection 6: Annandale Road and Hamilton Street (Unsignalized)</b>									
Eastbound (Hamilton Street)	EBLR	-	C (16.5)	0.02	3	C (16.3)	0.02	3	
	EB Approach	-	C (16.5)	-	-	C (16.3)	-	-	
Northbound (Annandale Road)	NBL	-	A (9.5)	0.00	0	A (9.5)	0.00	0	
	NBT	-	(-)	-	-	(-)	-	-	
Southbound (Annandale Road)	NB Approach	-	A (0.1)	-	-	A (0.1)	-	-	
	SBTR	-	(-)	-	-	(-)	-	-	
SB Approach	-	-	(-)	-	-	(-)	-	-	
	-	-	(-)	-	-	(-)	-	-	

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m = Volume for 95th percentile queue is metered by upstream signal  
dl = Defacto Left Lane  
N/A - zero volume movement; therefore, delay cannot be reported.

Table 4 (continued): PM Peak Hour Build Condition Results

Approach	Movement	Storage Length	Existing PM			Build PM		
			LOS+Delay	VC_Ratio	95th % Queue Length	LOS+Delay	VC_Ratio	95th % Queue Length
<b>Intersection 7: Annandale Road and Farr Street (Unsignalized)</b>								
Eastbound (Farr Street)	EBLTR	-	B (11.2)	0.01	0	B (14.7)	0.01	0
	EB Approach	-	B (11.2)	-	-	B (14.7)	-	-
Westbound (Farr Street)	WBLTR	-	C (18.8)	0.10	8	s	s	s
	WB Approach	-	C (18.8)	-	-	D (29.3)	-	-
Northbound (Annandale Road)	NBL	-	B (10.7)	0.00	0	(-)	-	-
	NBTR	-	A (0.1)	-	-	(-)	-	-
	NB Approach	-	A (0.2)	-	-	(-)	-	-
Southbound (Annandale Road)	SBL	-	A (8.6)	0.01	0	A (8.6)	0.01	0
	SBTR	-	A (0.1)	-	-	(-)	-	-
	SB Approach	-	A (0.2)	-	-	A (0.1)	-	-
<b>Intersection 8: Annandale Road and Quiet Cove (Unsignalized)</b>								
Westbound (Quiet Cove)	WBLR	-	B (12.8)	0.05	3	B (12.9)	0.05	3
	WB Approach	-	B (12.8)	-	-	B (12.9)	-	-
Northbound (Annandale Road)	NTBR	-	(-)	-	-	(-)	-	-
	NB Approach	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	SBL	-	A (8.5)	0.01	0	A (8.5)	0.01	0
	SBT	-	A (0.1)	-	-	(-)	-	-
	SB Approach	-	A (0.2)	-	-	A (0.1)	-	-
<b>Intersection 9: Annandale Road and Medford Drive (Unsignalized)</b>								
Eastbound (Medford Drive)	EBL	-	F (51.7)	0.54	68	F (77.8)	0.67	93
	EBT	-	D (30.6)	0.02	3	D (29.9)	0.02	3
	EBR	-	B (11.5)	0.14	13	C (15.3)	0.21	20
	EB Approach	-	D (31.2)	-	-	E (45.7)	-	-
Westbound (Glen Hollow Court)	WBLTR	-	D (28.3)	0.03	3	E (36.9)	0.05	3
	WB Approach	-	D (28.3)	-	-	E (36.9)	-	-
Northbound (Annandale Road)	NBL	-	A (9.3)	0.08	5	A (9.3)	0.08	5
	NBT	-	A (0.4)	-	-	(-)	-	-
	NBR	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	NB Approach	-	A (1.5)	-	-	A (1.2)	-	-
	SBL	-	A (8.3)	0.00	0	A (8.3)	0.00	0
	SBT	-	(-)	-	-	(-)	-	-
Southbound (Annandale Road)	SBR	-	(-)	-	-	(-)	-	-
	SB Approach	-	(-)	-	-	(-)	-	-

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 dl = Defacto Left Lane  
 N/A - zero volume movement; therefore, delay cannot be reported.

Table 4 (continued): PM Peak Hour Build Condition Results

Approach	Movement	Storage Length	Existing PM			Build PM			
			LOS+Delay	VC_Ratio	95th % Queue Length	LOS+Delay	VC_Ratio	95th % Queue Length	
<b>Intersection 10: Annandale Road and Markham Street (Signalized)</b>									
<b>Overall Intersection</b>			-	B (11.0)	0.40	-	B (15.8)	0.61	-
Eastbound (Markham Street)	EBLT	-	D (39.8)	0.55	99	D (40.1)	0.55	99	
	EBR	100	C (34.6)	0.12	55	C (34.6)	0.12	55	
EB Approach			-	D (36.4)	-	-	D (36.5)	-	
Westbound (Poplar Street)	WBLTR	-	D (35.3)	0.22	63	D (35.3)	0.22	63	
	WB Approach	-	D (35.3)	-	-	D (35.3)	-	-	
Northbound (Annandale Road)	NBL	-	s	s	s	A (5.0)	0.31	25	
	NTBR	-	A (3.4)	0.33	52	A (3.4)	0.32	74	
	NB Approach	-	A (3.4)	-	-	A (3.8)	-	-	
Southbound (Annandale Road)	SBL	-	s	s	s	A (8.0)	0.03	17	
	SBT	-	A (4.5)	0.30	103	B (15.4)	0.64	435	
	SBR	205	A (3.6)	0.07	12	A (8.3)	0.07	20	
	SB Approach	-	A (4.4)	-	-	B (14.4)	-	-	
<b>Intersection 11: Annandale Road and Maple Place (Signalized)</b>									
<b>Overall Intersection</b>			-	B (10.5)	0.40	-	B (12.0)	0.51	-
Westbound (Maple Place)	WBR	250	C (30.7)	0.14	0	C (31.5)	0.25	0	
	WB Approach	-	A (0.0)	-	-	(-)	-	-	
Northbound (Annandale Road)	NBTR	-	A (9.9)	0.10	111	B (14.0)	0.20	268	
	NB Approach	-	A (9.9)	-	-	B (14.0)	-	-	
Southbound (Annandale Road)	SBL	-	s	s	s	A (4.1)	0.51	61	
	SBT	-	A (1.7)	0.40	19	A (0.2)	0.20	0	
	SB Approach	-	A (1.7)	-	-	A (2.7)	-	-	
<b>Intersection 12: Annandale Road and Little River Turnpike (Signalized)</b>									
<b>Overall Intersection</b>			-	D (44.7)	0.79	-	D (47.1)	0.80	-
Eastbound (Little River Turnpike)	EBL	-	F (82.6)	0.28	70	F (82.6)	0.28	70	
	EBTR	-	D (41.3)	0.73	701	D (42.7)	0.74	715	
	EB Approach	-	D (42.3)	-	-	D (43.6)	-	-	
Westbound (Little River Turnpike)	WBL	-	F (115.0)	0.67	m285	F (115.1)	0.67	m281	
	WBTR	-	B (13.8)	0.70	255	B (15.1)	0.71	280	
	WB Approach	-	C (25.0)	-	-	C (26.2)	-	-	
Northbound (Ravensworth Road)	NBL	-	F (109.9)	0.84	#277	F (97.4)	0.78	#255	
	NBTR	-	F (81.6)	0.63	170	F (100.8)	0.81	#286	
	NBR	-	s	s	s	E (72.3)	0.07	30	
	NB Approach	-	F (91.6)	-	-	F (92.4)	-	-	
Southbound (Annandale Road)	SBL	-	F (91.3)	0.82	300	F (103.5)	0.82	309	
	SBTR	-	E (77.9)	0.69	245	F (90.2)	0.69	266	
	SB Approach	-	F (85.1)	-	-	F (97.4)	-	-	

# = 95th percentile volume exceeds capacity, queue may be longer  
m = Volume for 95th percentile queue is metered by upstream signal  
dl = Defacto Left Lane  
N/A - zero volume movement; therefore, delay cannot be reported.

## Conclusions and Recommendations

Annandale Road has existing roadway geometry that can be easily modified to introduce bike lanes. During the AM peak hour, the conditions worsen at Medford Drive, but deterioration in operations is limited to select movements. During the PM peak hour, the only significant delay increase occurs at Medford Drive for the eastbound left turn, maintaining the existing LOS F operations. The decrease in delay at Gallows Road can be attributed to the geometric changes. The geometric modifications of the build condition may improve the driver experience by designating the travel lane that has been functioning as a de-facto left-turn lane as a dedicated left-turn lane. While delay for left turns from Medford Drive is increased, there is the potential that the two-way left-turn lane could be used to assist drivers in completing a two-stage left turn.

Based on the outcome of the road diet assessment, it is recommended that the following be considered as part of the implementation of bike lanes on Annandale Road between Gallows Road and Little River Turnpike:

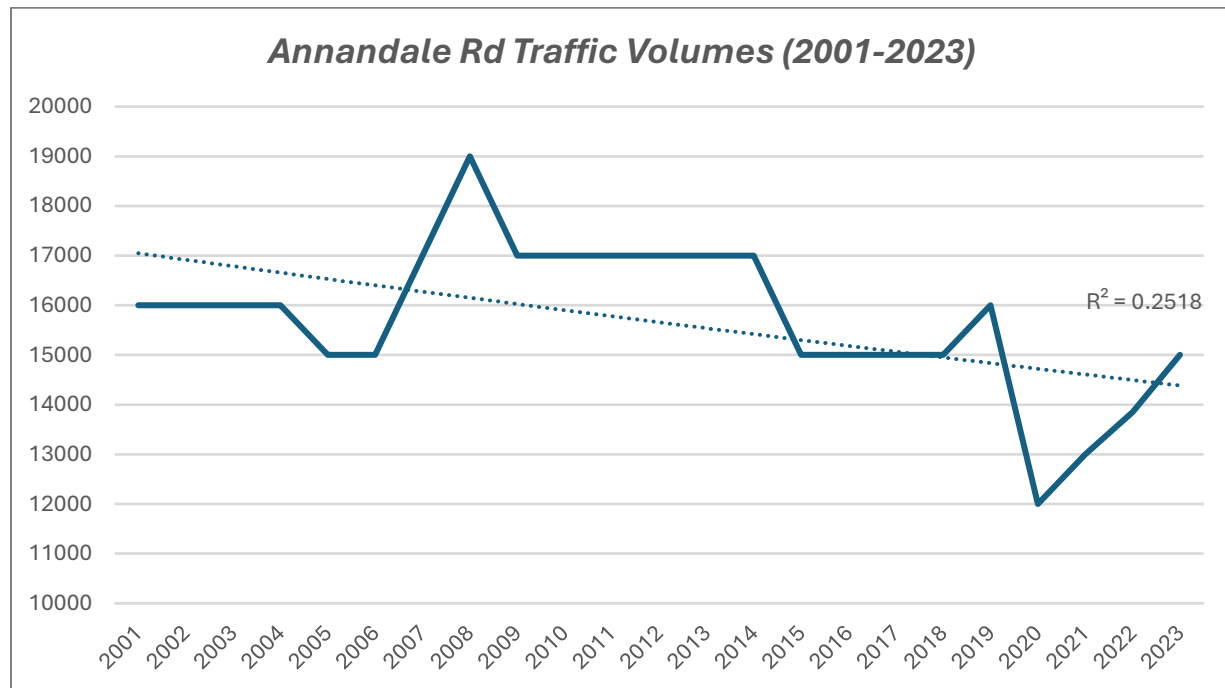
- Southbound Annandale Road
  - Maintain two southbound travel lanes along Annandale Road north of Gallows Road, then merge into a single through travel lane at Gallows Road/Annanwood Court. The inner most travel lane becomes a left-turn only lane at Gallows Road/Annanwood Court.
  - Install a bike lane (5' bike lane) beginning at Gallows Road/Annanwood Court up to Little River Turnpike.
  - Install a two-way left-turn lane (TWLTL) beginning at Galanis Drive up to Little River Turnpike. At signalized intersections, the TWLTL becomes a dedicated left-turn lane.
- Northbound Annandale Road
  - Restripe the northbound approach at Little River Turnpike to position a dedicated right-turn lane as the rightmost lane and provide a bike lane crossover to position the bike lane between the through and right-turn lanes.
  - Install a bike lane (5' bike lane) beginning at Little River Turnpike up to Gallows Road.
  - Install TWLTL beginning at Little River Turnpike up to Galanis Drive. At signalized intersections, the TWLTL becomes a dedicated left turn lane.
  - Between Galanis Drive and Gallows Road, two northbound through lanes are maintained.
  - North of Gallows Road/Annanwood Court, add a sharrow to indicate a shared lane. Bicyclists could continue their trip in the existing travel lanes or navigate to the existing sidewalk that begins north of Annandale Court.
- Other Considerations:
  - Improve pedestrian facilities at Markham Street and Medford Drive (repaint crosswalks).
  - Remove one right-turn lane on Maple Place at Annandale Road. This is outside the scope of repaving along Annandale Road and may require further coordination in later stages of design to capture this adjacent modification.

- Long-term, consider adding a pedestrian crosswalk across Annandale Road on the south leg at Maple Place (subject to a VDOT approved crosswalk study).
- Optimize signal operations at all intersections to balance green time among the different signal phases to best align with the reduction in capacity for the through movements along Annandale Road.
- Install additional crosswalks at unsignalized intersections to reduce the spacing of crosswalks along the corridor. Also consider pedestrian refuge islands. This should be evaluated in accordance with VDOT TE-384.1. Considering spacing and sight distance, potential candidate locations for crosswalks could include:
  - Rodeo Court
  - Beverly Manor Drive
  - Hamilton Street
  - Farr Street

## FUTURE GROWTH ASSESSMENT (PREPARED BY FCDOT)

Annandale Rd is located in the Community Business Center (CBC) of Annandale. The CBC has not seen significant redevelopment in many years, population has declined and has had a commercial revitalization program since 1987. As a result, traffic volumes have declined on Annandale Rd since 2001 and even omitting the COVID-19 pandemic, traffic growth is unlikely.

Fairfax County's Comprehensive Plan for the Annandale CBC encourages residential, pedestrian-oriented redevelopment. The Plan envisions a vibrant mix of land uses that will allow people to live within walking distance of jobs and retail. One of the objectives is to include elements of "complete streets" such as the proposed road diet and bike lane design proposed for Annandale Rd. The plan states that an overall minimum level of service "E" desired for collectors and local streets in the Center and that transportation demand management can help mitigate future traffic impacts. The proposed bike lanes on Annandale Rd will encourage some people to make trips by bicycle or walking instead of driving.



Given the County's Comprehensive Plan and a two-decade long decline in traffic volumes, Fairfax County anticipates a road diet on Annandale Rd will have enough capacity until the next repaving cycle in a decade and likely beyond.