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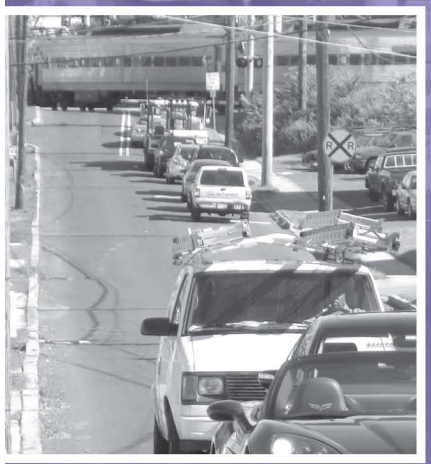
REGIONAL
PLANNING COMMISSION

DECEMBER 2010

Abington & Upper Moreland Townships, Montgomery County

CONGESTION & CRASH Site Analysis Program



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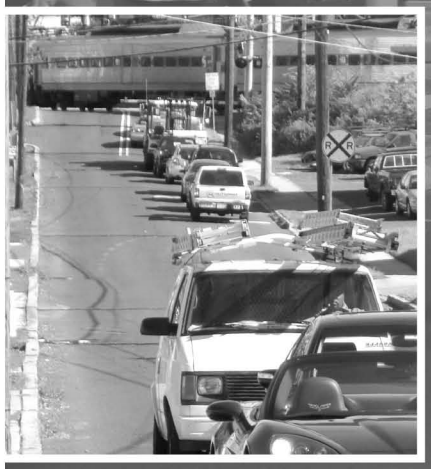

The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals, and the public with a common vision of making a great region even greater. Shaping the way we live, work, and play, DVRPC builds consensus on improving transportation, promoting smart growth, protecting the environment, and enhancing the economy. We serve a diverse region of nine counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey. DVRPC is the federally designated Metropolitan Planning Organization for the Greater Philadelphia Region — leading the way to a better future.

The symbol in our logo is adapted from the official DVRPC seal and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

DVRPC is funded by a variety of funding sources including federal grants from the U.S. Department of Transportation's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), the Pennsylvania and New Jersey departments of transportation, as well as by DVRPC's state and local member governments. The authors, however, are solely responsible for the findings and conclusions herein, which may not represent the official views or policies of the funding agencies.

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Executive Summary

The goals of the Congestion and Crash Site Analysis Program (CCSAP) are to improve access and efficiency of the region's transportation system, improve safety and air quality, and reduce congestion through analyses of specific highway locations with demonstrated problems in both New Jersey and Pennsylvania.

Due to their many conflict points, intersections experience more crashes than midblock locations. In addition, the geometry of an intersection can present many issues for the road user. Assuring the efficient operation of intersections is an increasingly important issue as municipalities attempt to maximize roadway capacity to serve the growing demand for travel. The objective is to identify cost-effective improvements that will reduce crashes and congestion.

The location for this study was selected by the Montgomery County Planning Commission and the Pennsylvania Department of Transportation (PennDOT) District 6, working with DVRPC. The location is the intersection of Moreland Road (PA 63) and Davisville Road, on the border of Upper Moreland Township and Abington Township. Appendix A provides more background information on the selection process for the study location.

The study area experiences a high number of angle crashes. With input from the advisory committee (local, county, and state officials) and the analyses performed by DVRPC, several improvement strategies were developed that would potentially increase the safety and mobility of all road users traveling through this intersection. The list of advisory committee participants is provided in Appendix B.

The range of strategies developed included the following: adding signage, improving pedestrian amenities, re-aligning lane configurations, and altering traffic signal timing/phasing. Many of the above-mentioned strategies were recommended for implementation. The majority of these improvements were low-cost and short-term solutions to help improve traffic flow and safety of all roadway users traveling through the Davisville Road and Moreland Road intersection.

CHAPTER 1

Introduction

This technical report provides analysis and recommendations for the intersection of Moreland Road (PA 63) and Davisville Road on the border of Abington Township and Upper Moreland Township, Pennsylvania. The recommended strategies cover both safety and operational improvements. The operational improvements were modeled and the results compared to existing conditions. It was not possible to model the safety improvements, but they were developed based on professional knowledge and discussions with members of the study advisory committee. The resulting recommendations are in the final chapter of the report.

Methodology

The DVRPC study team conducted field visits to observe the issues at this location. Data was then compiled and analyzed. This included crash records data, Average Annual Daily Traffic (AADT) data, turning movement counts, and traffic signal timings. On December 8, 2008, a kick-off meeting was held among representatives from the following agencies: Montgomery County Planning Commission, Upper Moreland Township, Abington Township, PennDOT District 6, and DVRPC. The field visits and kick-off meeting assisted in the identification of problems, with discussion of the advisory committee's observations and feedback.

DVRPC staff conducted follow-up field views to better define the existing conditions and refine the identification of problems. Subsequently, a technical analysis was performed to better understand and quantify the identified transportation problem areas. This included the preparation of a collision diagram displaying crash patterns and conducting a level of service (LOS) analysis for existing conditions.

Based on the crash and LOS analyses, a set of potential improvements was developed that addressed the identified problems.

Findings and preliminary recommendations were presented to the advisory committee at a follow-up meeting held at the Upper Moreland Municipal Building on June 11, 2009. The purpose of the meeting was to discuss the recommendations and get the advisory committee's perspectives on the practicality of the recommendations.

Level of Service (LOS) Analysis

The LOS analysis is a common tool for assessment of transportation facilities and was used extensively in this project. When applied as a measure of performance for an entire or a particular component of an intersection, LOS has a precise meaning: the average delay experienced by a vehicle traveling through the intersection or a specific component of it. The parameters of delay that determine the various LOS categories for a signalized intersection are displayed in Table 1.

SimTraffic software was utilized for several operational improvement scenarios to quantify the intersection's delay and LOS. These results are summarized in Chapter 5 of this report. SimTraffic is the stochastic micro-simulation counterpart to Synchro's deterministic analysis. It was chosen for this study due to its ability to accurately reflect the impact of closely spaced adjacent intersections and the efficacy of signal coordination. Necessary information for determining delay and LOS measurements include the following: turning movement counts, roadway geometry, signal timing, and signal actuation plans. The turning movement counts were mostly gathered by DVRPC staff; the signal timing, actuation data, and roadway geometrics were supplied by PennDOT District 6.

Table 1: LOS Designations and Associated Delays

LOS	Signalized Intersection Total Delay per Vehicle (seconds/vehicle)
A - Desirable	≤ 10
B - Desirable	> 10 and ≤ 20
C - Desirable	> 20 and ≤ 35
D - Acceptable	> 35 and ≤ 55
E - Undesirable	> 55 and ≤ 80
F - Unsatisfactory	> 80

Source: Highway Capacity Manual, 2000

CHAPTER 2

Study Location

The focus of the study, as shown in Figure 1, is the signalized intersection of Moreland Road and Davisville Road. This intersection is a popular shortcut through the heavily developed suburb of Willow Grove. This shortcut allows drivers to avoid two parallel major arterials just northeast of Easton Road (PA 263/611) and Old York Road/York Road (PA 611/263). The study intersection is closely sandwiched between the major intersection of Easton Road and Moreland Road and the SEPTA Warminster Regional Rail Line, which is an at-grade crossing. On a regional level, this intersection provides access to the Willow Grove Park Mall and is located approximately one-and one-half miles south of the Pennsylvania Turnpike exit #343.

The intersection of Easton Road and Moreland Road is located approximately 150 feet northwest of the study intersection. Due to its close proximity, the intersection of Easton Road and Moreland Road was also included in part of the LOS analysis. Many of the improvement scenarios developed have direct impact on the operation of this intersection.

Davisville Road and Easton Road run in a northeasterly and southwesterly direction. Moreland Road runs in a northwesterly and southeasterly direction. For the purposes of this document, the orientation along Davisville Road and Easton Road will be referenced as north and south. Moreland Road's orientation will be denoted as east and west.

Davisville Road and Moreland Road Intersection

Moreland Road is a principal arterial. It has a five-lane cross-section. In the westbound direction, there is one through lane, one shared through and right-turn lane, and one left-turn lane. In the eastbound direction, there is one shared through and right-turn lane and one lane for through and left-turn movements. Davisville Road is classified as a minor arterial. It has a two-lane cross-section with no dedicated turning lanes. This intersection is signalized. This intersection contains sidewalks at all approaches and no shoulders.

Easton Road and Moreland Road Intersection

The intersection of Easton Road and Moreland Road is signalized. Easton Road is classified as a principal arterial. The southbound approach to Moreland Road has a three-lane cross-section, with one dedicated left-turn lane, one through lane, and one through and right-turn lane. At the northbound approach, Easton Road consists of one dedicated left-turn lane and one shared through and right-turn lane. The westbound approach of Moreland Road provides a three-lane cross-secton containing one dedicated left-turn lane, one through lane and one shared through and right-turn lane. The dedicated left-turn lane extends 150 feet back to the intersection of Moreland Road and Davisville Road. A concrete median separates the eastbound and westbound travel lanes between both intersections. At the eastbound approach, the cross-section of Moreland Road consists of four lanes; one dedicated left-turn lane, two through lanes, and one dedicated right-turn lane. This intersection contains sidewalks at all approaches and no shoulders.


Figure 1
Study Area
Inset Area
WARMINSTER
Hatboro
HORSHAM
BUCKS CO
MONTGOMERY CO
463
332
276
PA TURNPIKE
INT 343
263
YORK RD
611
EASTON RD
63
UPPER DUBLIN
UPPER MORELAND
Bryn Athyn
Pennypack Creek
MORELAND RD
DAVISVILLE RD
LOWER MORELAND
OLD YORK RD
SEPTA WARMINSTER LINE
ABINGTON
Jenkintown
Analysis Area
PARK AVE
PA 611 OLD YORK RD
PA 63 W MORELAND RD
PA 263 EASTON RD
DAVISVILLE RD
SEPTA WARMINSTER LINE
CHERRY ST
PA 63 E MORELAND RD
EASTON RD
N
0
0.25
0.5
Miles
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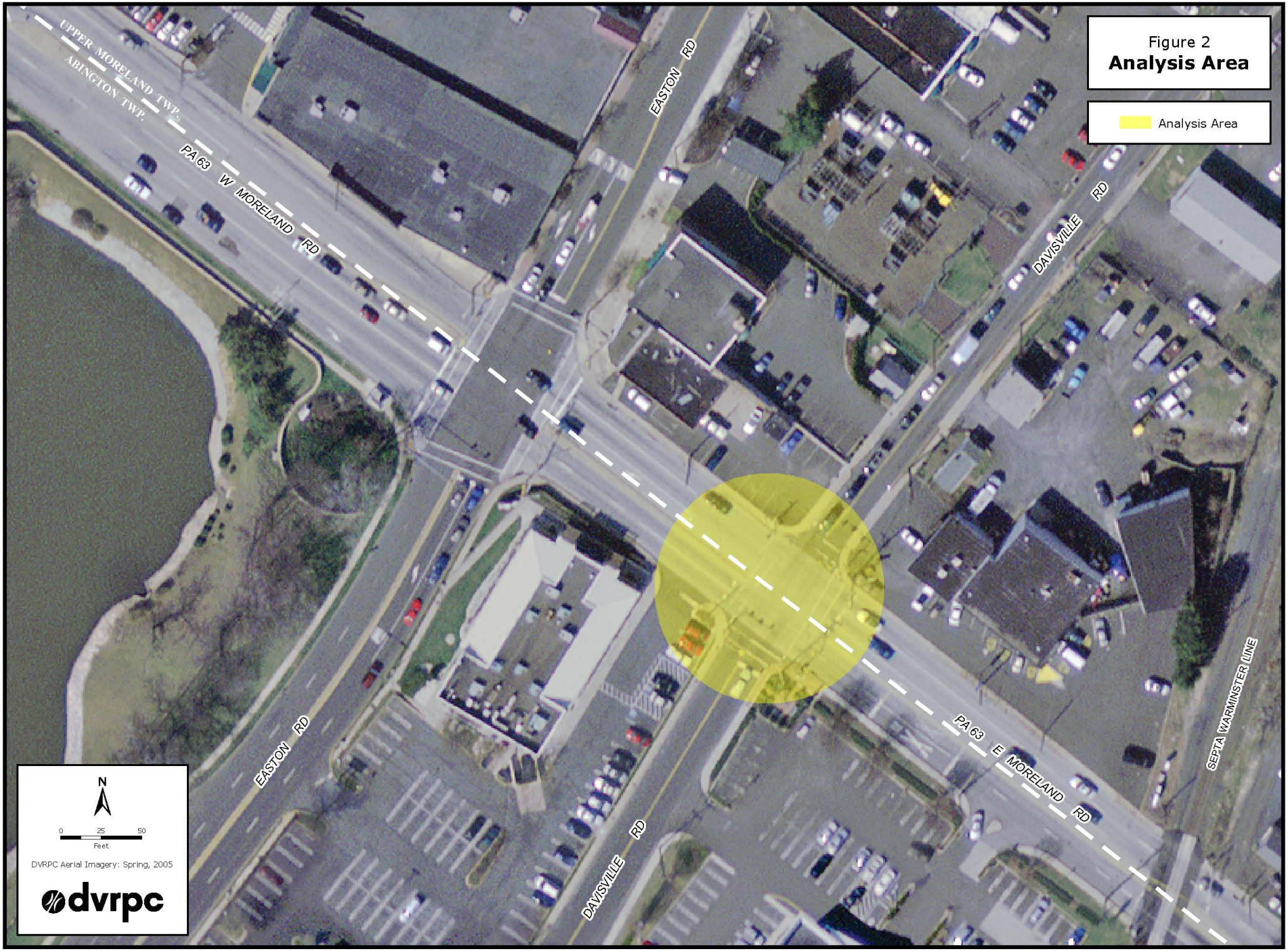


Figure 2
Analysis Area
Analysis Area
UPPER MORELAND TWP.
ABINGTON TWP.
PA 63 W MORELAND RD
EASTON RD
DAVISVILLE RD
EASTON RD
DAVISVILLE RD
PA 63 E MORELAND RD
SEPTA WARMINSTER LINE
N
0 25 50
Feet
DVRPC Aerial Imagery: Spring, 2005
dvrpc

CHAPTER 3

Existing Conditions

Moreland Road is a significant regional route on the border of Abington Township and Upper Moreland Township. The study intersection serves daily commuter traffic as well as evening and weekend shopping trips, particularly to the Willow Grove Park Mall. DVRPC traffic counts taken in 2008 on Moreland Road showed an AADT volume of 21,570 vehicles in both directions. In the area north of the study intersection, traffic counts taken in 2007 on Davisville Road showed an AADT volume of 11,118 vehicles approximately one-half mile north from the intersection. No AADT data was available on Davisville Road near the study intersection.

The following bullets summarize some of the comments made by municipal, county, and PennDOT officials during the field visit and at the kick-off meeting concerning existing vehicular and pedestrian movements at the intersection of Moreland Road and Davisville Road:

- The pedestrian ramp located at the southeast corner of the intersection is not aligned with the crosswalk for Davisville Road.
- It seems that drivers have trouble seeing the Moreland Road and Davisville Road traffic signal along the westbound Moreland Road approach. This is likely a result of the downhill grade and close proximity of the Moreland Road and Easton Road traffic signal.
- At the intersection left-turning vehicles from the eastbound and westbound Moreland Road approaches are often caught in the middle of the intersection after the signal turns red.
- A movement considered especially dangerous is the left turn made from westbound Moreland Road onto southbound Davisville Road.
- Moreland Road does not have a dedicated left-turn lane for the eastbound approach, which is problematic for the following reasons:
  - Vehicles traveling eastbound desiring to make a left turn onto Davisville Road obstruct the view for westbound left-turning vehicles.
  - The current signal timing does not take advantage of the provided 12-second left-turn lead for the eastbound approach.
  - Eastbound left-turning vehicles impede traffic flow for eastbound through traffic.

Signal Timing

The intersection of Moreland Road and Davisville Road is incorporated within a seven-signal coordinated system in the vicinity of the Willow Grove Park Mall. The study intersection is actuated and operates on an 80-second cycle length. The timing plan is composed of three phases. The first provides a 12-second lead phase for eastbound Moreland Road, which provides a signal-protected left-turn opportunity. The second phase accommodates the concurrent eastbound and westbound Moreland Road movements, with permissive left turns. No

signal protection is provided for westbound left turns. The third phase provides for concurrent northbound and southbound movements from the Davisville Road approaches. Signal pre-emption is provided for trains along the SEPTA Warminster Regional Rail Line and emergency vehicles.

Turning Movement Counts

Twelve-hour manual turning movement counts were taken at the intersection of Davisville Road and Moreland Road. These counts were taken by McMahon Associates over a two-day period in October 2006 as part of the *Willow Grove Redevelopment Area Vehicular and Pedestrian Traffic Improvement Feasibility Study*, which was released in February 2007. A peak hour turning movement diagram is shown in Figure 3. The morning peak hour is 7:30 AM to 8:30 AM and the afternoon peak hour is 4:45 PM to 5:45 PM.

During the morning peak hour, 1,650 vehicles traveled through this intersection. The dominant movement in the morning is the westbound (745 vehicles) through movement on Moreland Road, which represents 45 percent of the intersection's volume. The second highest approach is eastbound Moreland Road with 371 vehicles. There were fewer than 140 vehicles that traveled through Davisville Road in both directions. There were 103 right turns and 64 left turns recorded from the southbound Davisville Road and eastbound Moreland Road approaches. The remaining turning movements made at the intersection were fewer than 35 vehicles.

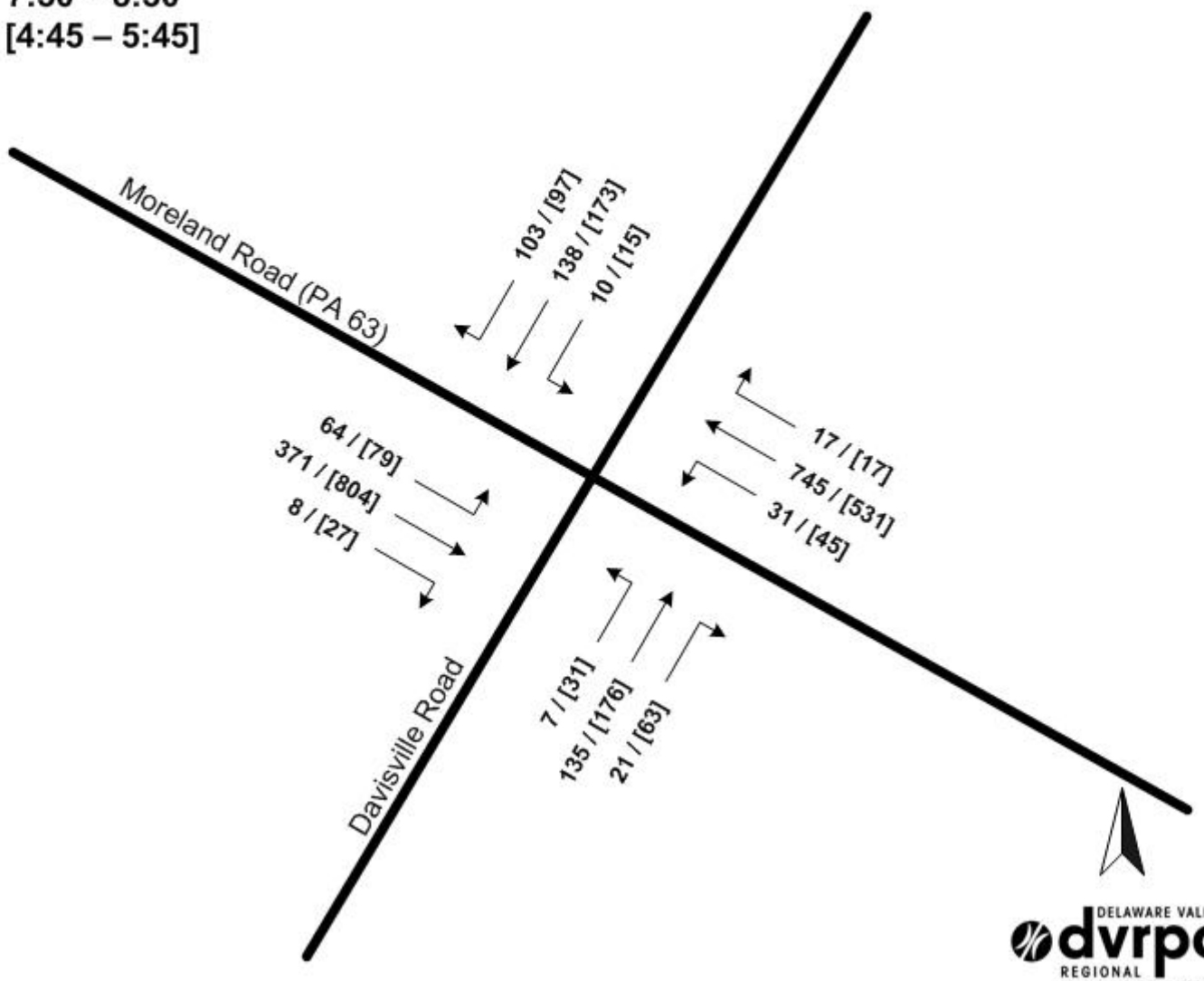
During the afternoon peak period, traffic flow in the area increases from traffic conditions in the morning. In the afternoon 2,058 vehicles traveled through the intersection. The highest movement at the intersection is the eastbound through movement (804 vehicles), which reflects nearly 40 percent of the intersection's volume. The second highest movement is westbound through traffic with 531 vehicles. The northbound and southbound through volumes along Davisville Road were fairly even at 176 and 173 vehicles, respectively. Similar to the morning conditions, the two heaviest turn movements are the southbound right-turn (97 vehicles) and eastbound left-turn (79 vehicles) movements. The remaining turning movements made at the intersection were fewer than 65 vehicles.

Existing LOS

An LOS analysis was performed for the signalized intersection of Moreland Road and Davisville Road. Table 2 shows the existing vehicle delay and LOS associated with the intersection.

Figure 3
Peak Hour Turning Movement Counts

AM Peak Hour: 7:30 – 8:30
PM Peak Hour: [4:45 – 5:45]



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This intersection operates at conditions that are desirable by engineering standards. The overall LOS for this intersection during the morning and afternoon peak period is B, with delays of 18 and 16 seconds, respectively. The delays and LOS on each approach were similar for both peak periods. The eastbound approach had the least amount of delay. The remaining approaches had delays ranging between 20 and 31 seconds.

Table 2: Existing LOS Analysis

Moreland Road and Davisville Road				
	AM		PM	
Direction	Delay (s)	LOS	Delay (s)	LOS
Moreland Road – eastbound	5	A	6	A
Moreland Road – westbound	21	C	20	B
Davisville Road – northbound	25	C	30	C
Davisville Road – southbound	31	C	30	C
Total Intersection	**18**	**B**	**16**	**B**

Source: DVRPC 2009

Land Use

The land use surrounding the intersection of Davisville Road and Moreland Road is commercial. An Olive Garden restaurant is located in the southwest quadrant of the intersection. A vacant Linen-N-Things building occupies the southeast quadrant of the intersection. La Fusion Café is located in the northwest corner of the intersection. The Terminal Luncheonette occupies the northeast corner of the intersection. The Willow Grove Park Mall is located approximately a quarter-mile west of this intersection. The SEPTA Warminster Regional Rail Line at-grade railroad crossing is located less than 300 feet east of the intersection.

View approaching Moreland Road from southbound Davisville Road

View approaching Davisville Road from westbound Moreland Road

Pedestrians

Pedestrian activity is evident throughout the study area. During the initial field visit, the advisory committee noticed that there were ADA accessible curb ramps missing on the southwest and southeast corners of the intersection. These curb ramps would provide connection to the crosswalk at Davisville Road. Sidewalks are located along all approaches, providing access to businesses located near the intersection.

Transit

The SEPTA 310 Horsham Breeze bus route provides services through this intersection. There are 561 weekday passenger trips on this route. Peak period headways are 10 to 15 minutes and off-peak headways are every 40 minutes.[1] The nearest bus stop is located at the intersection of Easton Road and Moreland Road. The SEPTA Warminster Regional Rail Willow Grove station is located northeast of the intersection. There are 496 weekday boardings at this station. Peak period headways are 30 minutes and off-peak headways are every hour.[2]

[1] Southeastern Pennsylvania Transportation Authority, *FY 2010 Annual Service Plan,* 6/2009, 66.
[2] Southeastern Pennsylvania Transportation Authority, *FY 2010 Annual Service Plan*, 6/2009, 64.

CHAPTER 4

Crash Analysis

This analysis includes all crashes that occurred at the intersection of Moreland Road and Davisville Road. The study was limited to crashes occurring in or near the intersection box (the area bordered by the approach leg stop bars).

The main goals of this analysis are to highlight crash trends and to determine causal factors. The collision diagram (Figure 4) is a graphic representation of the location, collision types, and frequency of vehicular crashes within the study intersection.

Data Description

The crash summaries and collision diagram used in this analysis were derived from reportable crash data provided by the PennDOT District 6 office, and non-reportable crash records were provided by the local police departments. In Pennsylvania, a crash is considered reportable when a person is injured or killed, or if a vehicle needs to be towed from the scene. Data from years 2003 through 2007 were utilized. Statistics are summarized in Table 3.

Crash Trends

There were 43 reportable crashes recorded during the analysis period. According to the crash summary, one fatality, 26 injury crashes, and 16 property-damage-only crashes were recorded.

There were also 24 non-reportable crashes recorded at the study intersection. Fifteen of the 24 crashes occurred within the intersection box. Though less detail is available for these crashes, it is likely that a fair number were angle crashes, given the proportionally large concentration of reportable angle crashes that also occurred within the intersection box.

The following crash analysis refers only to the reportable crashes.

During each of the study period years, 2003, 2004, 2006, and 2007, there were either nine or 10 crashes. There were five crashes in 2005. Considering crashes by month, January through May had consistent crash numbers between three or four. The remaining months demonstrated no significant trend.

The largest number of crashes occurred on Tuesday (12). The rest of the week had consistent crash frequencies, ranging between four to seven incidents per day; however, only two crashes

were recorded on Sunday. Crashes were spread relatively evenly throughout the day, with higher concentrations during the morning and afternoon commute.

Collision Type

The largest percentage of incidents was coded as angle crashes, which represented 86 percent of the total number of crashes (37). Thirty-two of these crashes involved eastbound and westbound vehicles turning left onto Davisville Road. According to police reports, 22 of the left-turn angle crashes occurred when westbound vehicles turning left collided with eastbound traffic traveling through the intersection. One of these left-turn angle crashes resulted in a fatality. The remaining ten left-turn angle crashes involved eastbound left-turning vehicles colliding with westbound through traffic. Table 3 summarizes the collision by type and Figure 4 illustrates where they occurred.

Table 3: Intersection of Moreland Road and Davisville Road Crash Data Summary

Collision Type	Frequency	
Angle	37	86.0%
Rear-End	3	7.0%
Head-On	1	2.3%
Sideswipe (Same Direction)	1	2.3%
Hit Pedestrian	1	2.3%

Source: DVRPC 2009

The “angle” nomenclature used to describe these crashes is often insufficiently descriptive, as the left-turn movements that caused nearly 90 percent of these incidents is not clearly inferred from their label. Given the clear correlation between left turns and crashes at this location, a safer left-turn accommodation for both directions, especially for the westbound approach, should be considered.

Figure 4

Intersection of
Moreland Road and Davisville Road

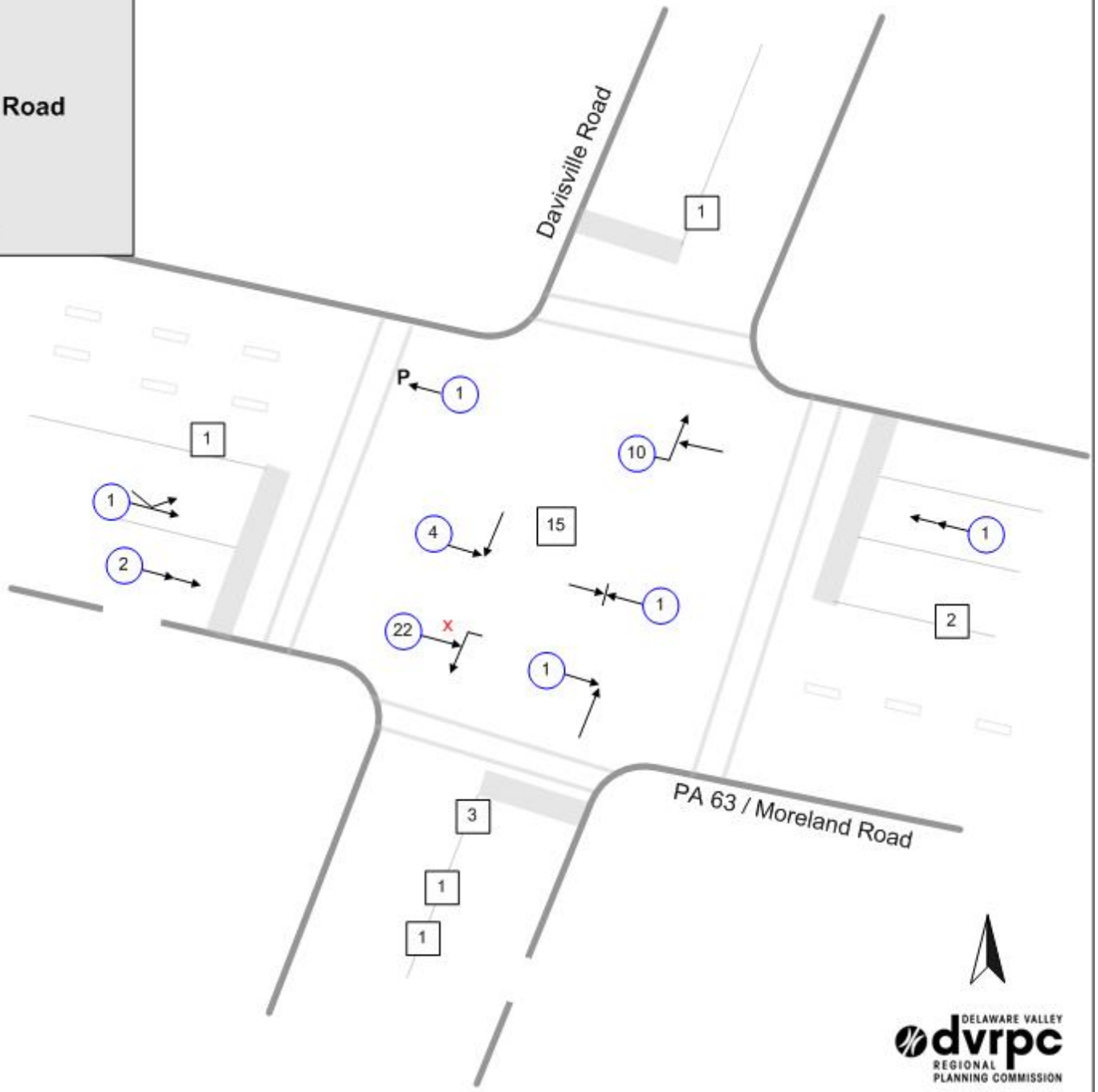
Collision Diagram

Crash Data Years 2003 – 2007

Reportable Crashes = 43
Fatal Crashes = 1
Pedestrian Crashes = 1

Non-reportable Crashes = 24

Combined Total Crashes = 67



Potential Strategies

DVRPC staff developed a range of potential strategies and then the study advisory committee reviewed and revised them. The strategies developed fell within the following two categories: safety and operational. Safety strategies consist of improvements that enhance and promote safer conditions for all roadway users traveling in the area. Examples of safety strategies include installing signage and upgrading pedestrian amenities. Operational strategies include alteration of traffic signal timing and/or geometry at the study intersection. Strategies were considered at a technical level; any additional actions should be taken by close partnership of stakeholders and working with surrounding land owners and businesses to minimize off-site impacts.

Issues

- ADA accessible curb ramps are missing on the southwest and southeast quadrant of the intersection to provide connection with the Davisville crosswalk.
- It is reported to be difficult to see the traffic signal at Moreland Road and Davisville Road when driving west on Moreland Road. This is likely a result of the downhill grade and close proximity of the Moreland Road and Easton Road traffic signal.
- At this intersection left-turning vehicles from eastbound and westbound Moreland Road are often caught in the middle of the intersection after the signal turns red.
- Moreland Road does not have a dedicated left-turn lane for the eastbound approach. This is problematic for the following reasons:
    - Vehicles traveling eastbound desiring to make a left turn onto Davisville Road obstruct the view for westbound left-turning vehicles.
    - The current signal timing does not take advantage of the provided 12-second left-turn lead for the eastbound approach.
    - Eastbound left-turning vehicles impede traffic flow for eastbound through traffic.
- This intersection has numerous crashes involving left turns made from westbound Moreland Road onto southbound Davisville Road.
- Sight distance for vehicles turning right from southbound Davisville Road is sometimes obscured by vehicles parked at the front of the Terminal Luncheonette parking lot.

Goals

- To minimize vehicle conflict, particularly for left turns from eastbound and westbound Moreland Road
- To provide safer driver and pedestrian operations

Safety Strategies

- Curb ramps should be installed and aligned with crosswalk at Davisville Road.
- Consideration should be taken to install overhead street signs at the study intersection for more visual differentiation of the two nearby intersections.
- Consideration should also be taken to install one or more red light strobes in the overhead signals and installation of optically programmable lenses for the westbound direction at Davisville Road.
- While it is preferable not to impact nearby businesses, it is encouraged that the owners of the Terminal Luncheonette consider, with support from Upper Moreland Township, an amenable way to relocate the few parking spaces at the corner to provide a safe sight distance at the intersection. Cars parked at the corner obsure the sight line for right turning southbound Davisville Road vehicles.

Operational Strategy – Geometric Improvement

- Consider adding an exclusive left-turn lane at the eastbound Moreland Road approach

Operational Strategies – Signal Improvements

- The all-red time wIncrease the all-red time from two to three seconds
- Consider prohibiting eastbound left-turn movements and reroute left turns via Easton Road and Old York Road
- Adjust the signal timing to provide concurrent protected and permissive left turns for both Moreland Road approaches
- Adjust the signal timing to provide concurrent protected left turns for both Moreland Road approaches

Operational Analysis for Improving Left-Turn Movements

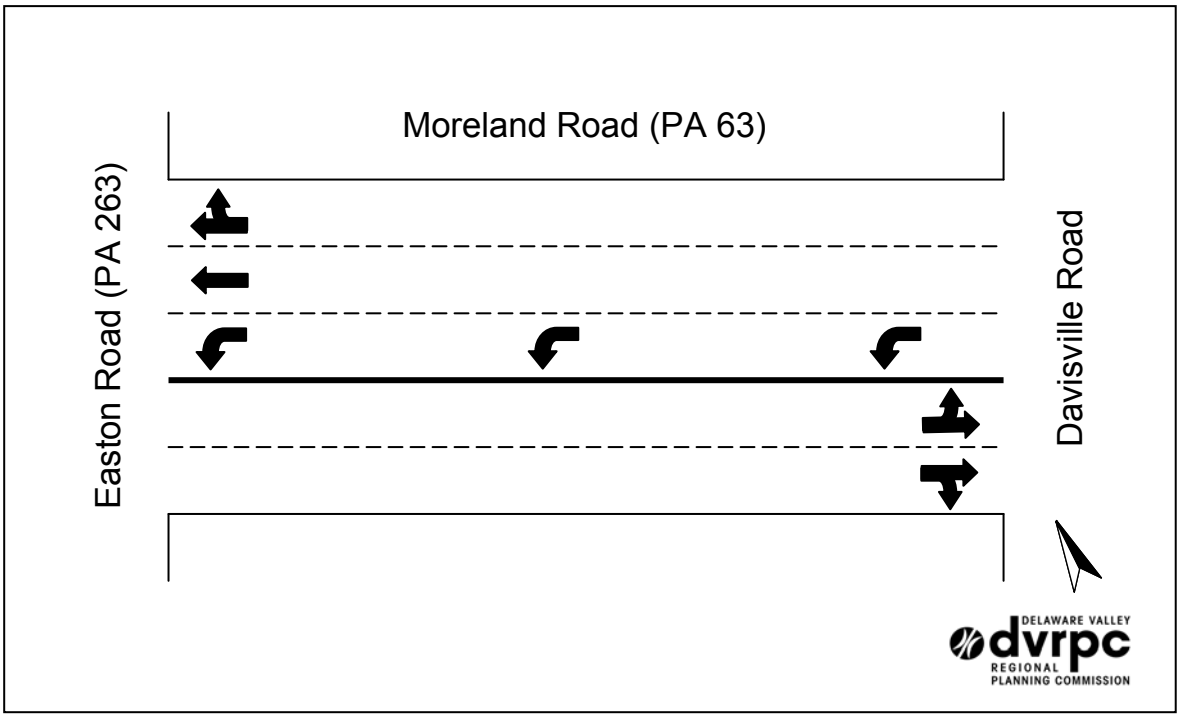
As indicated from the advisory committee's comments and the crash analysis, there are problems with vehicles making left turns at this intersection. Three alternatives were developed, two of which involve adding a dedicated left-turn lane on the eastbound Moreland Road approach. The advantage of a dedicated left-turn lane is to provide storage for eastbound left-turning traffic and to minimize the obstructed view for westbound left-turning traffic. However, this movement issue is a complex problem and additional strategies should continue to be identified, discussed, and evaluated.

Both alternatives that add a left-turn lane will impact the operation of the Easton Road and Moreland Road intersection, which lies approximately 150 feet west of the study intersection. As shown in Figure 5, the existing dedicated left-turn lane for westbound Moreland Road extends the entire length between the Easton Road and Moreland Road intersection and the Davisville Road and Moreland Road intersection. According to turning movement counts identified in the *Willow Grove Redevelopment Area Vehicular and Pedestrian Traffic Feasibility Study*, conducted by McMahon Associates, 14 and 28 left turns were made at the intersection of Easton Road and Moreland during the morning and afternoon peak hour, respectively.

Proposed Alternatives

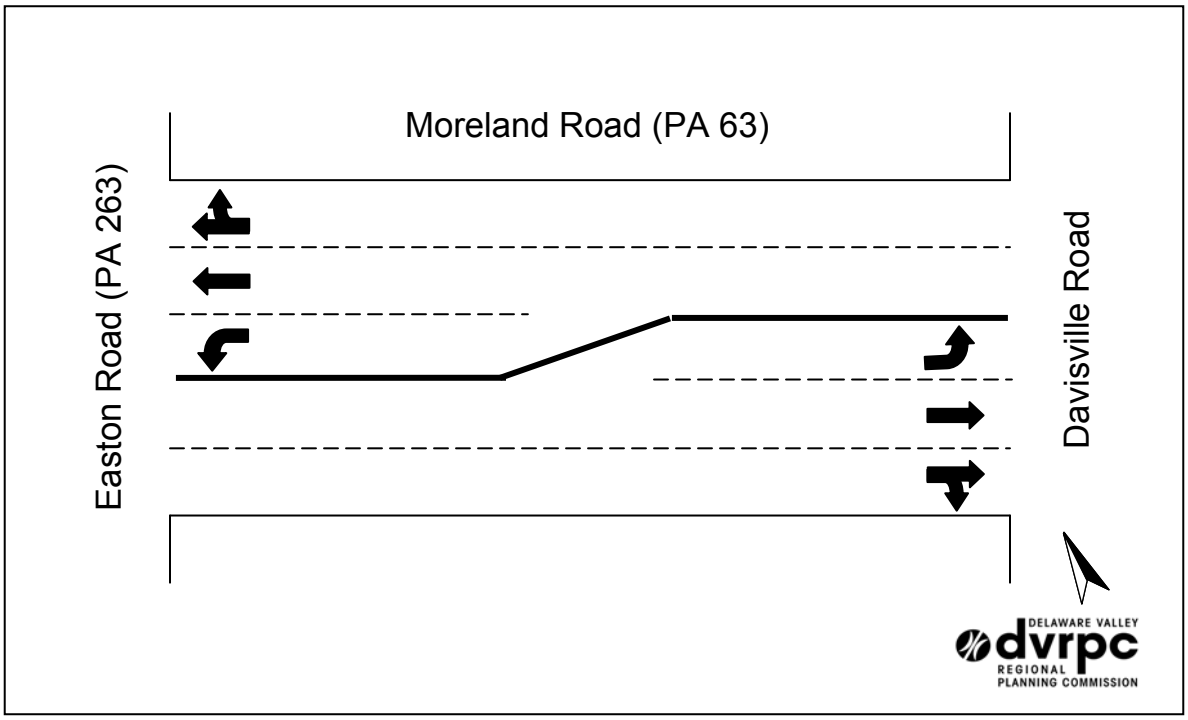
1. Add back-to-back left-turn bays on Moreland Road for drivers who had been traveling east and want to turn left to go north on Davisville Road. There would be 55 feet of storage and a 40-foot taper in each direction. See Figure 6. NOTE: The left-turn lane measurements are estimates.
2. Convert the entire existing westbound left-turn lane into an eastbound left-turn lane. This would provide more storage but eliminate the ability for westbound traffic to turn left at Easton Road. Drivers desiring to travel south on Easton Road would be rerouted via Davisville Road. See Figure 7.
3. Prohibit left turns by eastbound traffic on Moreland Road at Davisville Road, and instead route this movement via Easton Road and Old York Road.

Figure 5: Existing left-turn lane configuration



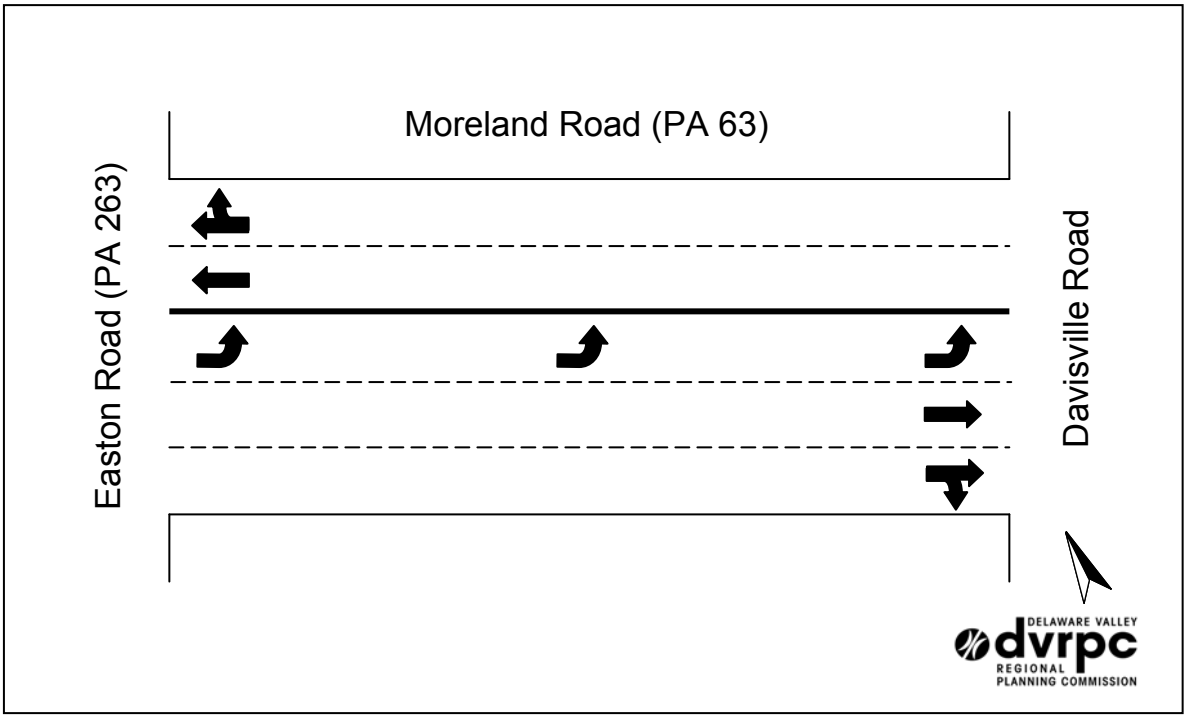
Source: DVRPC 2009

Figure 6: Proposed Alternative #1 – Back-to-back left turn bays



Source: DVRPC 2009

Figure 7: Proposed Alternative #2 – Exclusive eastbound left-turn lane



Source: DVRPC 2009

A diagram for Alternative 3 is not provided because the proposed traffic reroute lies outside of the area shown for the previous diagrams. Details highlighting the traffic reroute for proposed alternatives 2 and 3 are shown in Figure 8.

Operational Strategies – Signal Improvements

Utilizing SimTraffic software, the following four signal timing options were incorporated within the above-mentioned three proposed alternatives:

- Signal Timing Plan A – This is the existing signal plan for the intersection, which calls for a 12-second lead and protected and permissive left-turn movements for the eastbound approach. No left-turn signal protection is provided for the westbound approach.
- Signal Timing Plan B – This signal plan also provides a 12-second lead. It has concurrent protected and permissive left-turn movements for the eastbound and westbound approaches.
- Signal Timing Plan C – This signal plan allows for concurrent protected left-turn movements for the eastbound and westbound approaches.
- Signal Timing Plan D – This signal plan consists of a 12-second lead and protected and permissive left-turn movement only for the westbound approach.

These signal timing options were developed specifically to optimize safety for vehicles making left turns from Moreland Road to Davisville Road.

A total of seven scenarios combining left turn proposed alternatives and different signal timing improvements were tested and compared with the existing LOS conditions documented in Chapter 3. Summaries and tables are provided below for three scenarios that reflect the best overall intersection performance. The remaining four scenarios are documented in Appendix C.

Scenario #1 – Alternative # 1 with Signal Timing Plan B

This scenario tests the operation of the study intersection if an exclusive left-turn lane for vehicles turning left from eastbound Moreland Road approach was added in conjuction with left-turn protected and permissive movements for the eastbound and westbound approaches.

Advantages

- The new eastbound left-turn lane provides some storage for left-turning vehicles. Of the alternatives this is the second preference of PennDOT District 6. Their review of the SimTraffic modeling submitted with the draft report did show 95th-percentile queues that are minimal, and the left turn bay lengths should be able to handle expected queues.
- This scenario improves the sight distance for westbound left-turning traffic.
- This scenario utilizes the existing road network; therefore no additional right-of-way (ROW) is required.

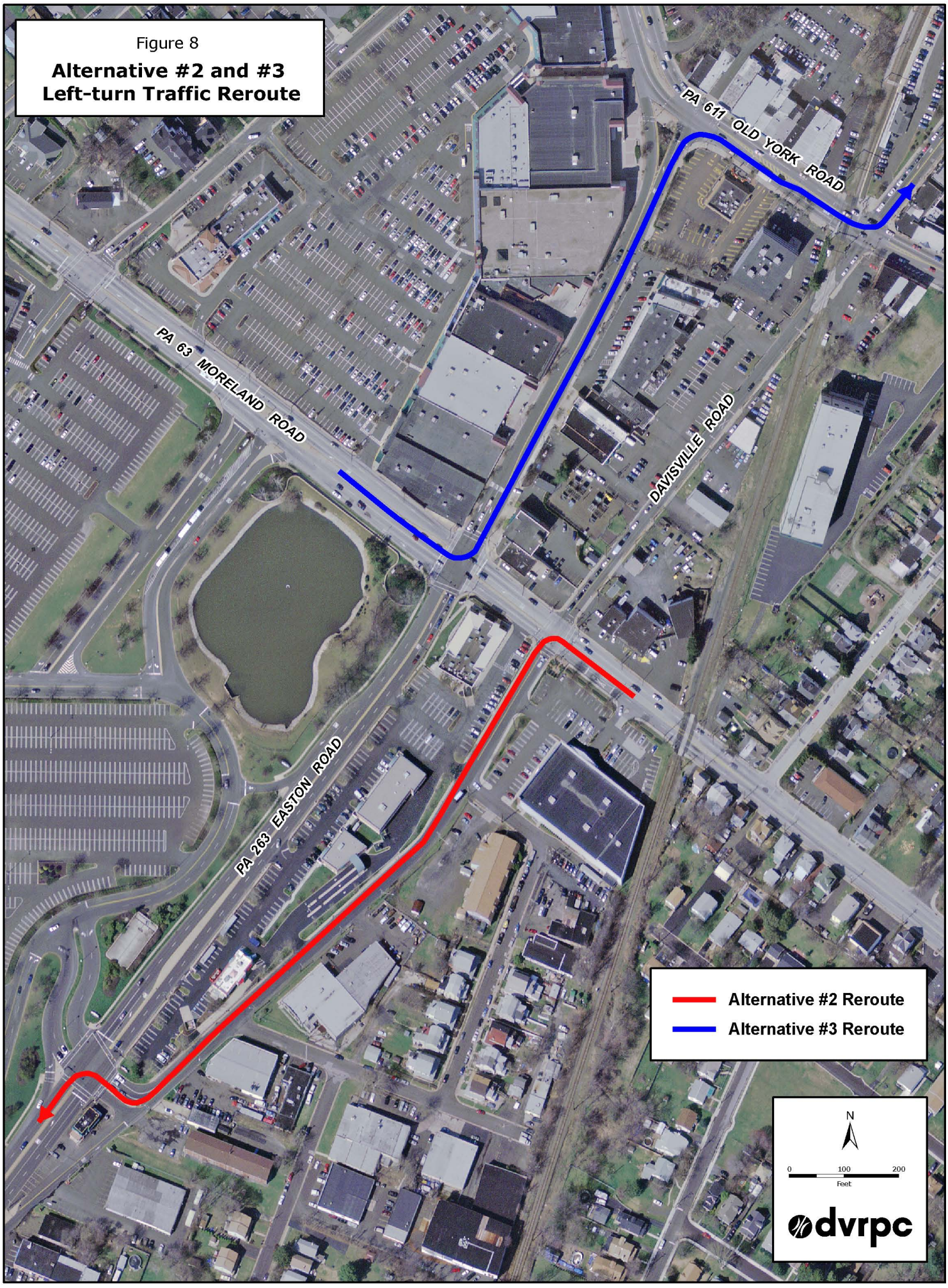


Figure 8
Alternative #2 and #3
Left-turn Traffic Reroute
PA 611 OLD YORK ROAD
PA 63 MORELAND ROAD
DAVISVILLE ROAD
PA 263 EASTON ROAD
Alternative #2 Reroute
Alternative #3 Reroute
N
0
100
200
Feet
dvrpc

- The timing plan is adjusted to provide concurrent protected and permissive left-turn phasing for both Moreland Road approaches, which minimizes the potential for angle crashes.

Disadvantages

- Montgomery County Planning Commission staff feel a dedicated left-turn lane for eastbound traffic is inappropriate for this intersection.
- Adding an exclusive left-turn lane to the eastbound approach (given the estimated storage and taper measurements) does not meet PennDOT's normal minimum standards, which requires 75-foot storage and 50-foot taper lengths. However, PennDOT District 6 staff recognize this may be the only way to make this alternative work, and it is their second preference of the three alternatives.
- PennDOT District 6 notes the concrete median would need to be rebuilt to maintain access management of neighboring driveways and prevent new safety concerns.
- The creation of two relatively short left-turn lanes increases the opportunities for left-turn lane queue spillover into the through travel lanes.
- Potentially unsafe and difficult permissive left turns are still permitted from the Moreland Road approaches.

LOS Analysis

As shown in Table 4, this scenario improves the performance of the study intersection. Although LOS remains the same, overall delay in the morning and afternoon is reduced by six and three seconds, respectively. During both peak periods, the westbound approach experiences the greatest improvement in vehicle delay compared with existing conditions. This reduction in delay is mainly attributed to the signal timing, which allows for more left-turning vehicles to get through the intersection. The remaining three approaches function similarly to existing conditions.

Table 4: Scenario #1 LOS Analysis

	Existing Condition				Proposed Alternative #1 with Signal Timing Plan B			
	AM		PM		AM		PM	
Direction	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Moreland Road – eastbound	5	A	6	A	5	A	6	A
Moreland Road – westbound	21	C	20	B	9	A	11	B
Davisville Road – northbound	25	C	30	C	25	C	30	C
Davisville Road – southbound	31	C	30	C	25	C	25	C
Total Intersection	**18**	**B**	**16**	**B**	**12**	**B**	**13**	**B**

Source: DVRPC 2009

Scenario #2 – Alternative # 2 with Signal Timing Plan C

This scenario tests the operation of the study intersection with the entire length of the westbound left-turn lane at the intersection of Easton Road and Moreland Road reallocated to create an exclusive eastbound left-turn lane for the Davisville Road and Moreland Road eastbound approach. Left turns at the westbound Moreland Road approach to Easton Road would be prohibited. Eastbound left turns at Easton Road would still be allowed. Based on the turning movement counts from the *Willow Grove Redevelopment Area Vehicular and Pedestrian Traffic Improvement Feasibility Study* obtained by DVRPC, there are less than 30 vehicles turning left at the Easton Road and Moreland Road intersection during the peak hours. This relatively small number of drivers desiring to make left turns will be rerouted via the Davisville Road and Moreland Road intersection and then at the intersection of Davisville Road and Easton Road. See Figure 8 for details. Signage would be posted to alert drivers of the left turn restriction and new traffic pattern. PennDOT District 6 recommends further investigation of providing a left-turn only and a single shared through right-turn lane eastbound. If that works reasonably, only one receiving lane eastbound would be needed because the Moreland Road existing cross-section changes downstream to a shared through left-turn lane and right-turn lane at Old York Road.

Advantages

- The new eastbound left-turn lane's capacity accomodates more left-turning vehicles, which prevents queue spillover into the through travel lane.
- This scenario improves the sight distance for westbound left-turning traffic.
- This scenario utilizes the existing road network; therefore no additional ROW is required.
- The new left-turn lane configuration meets PennDOT requirements.
- The timing plan is adjusted to provide left-turn signal protection for the eastbound and westbound approaches, thereby increasing the safety of these movements and the overall intersection.
- Minimal adverse impact expected to Easton Road and Davisville Road intersection given the low number of left turns made at the Easton Road and Moreland Road intersection.

Disadvantages

- Montgomery County Planning Commission staff feel a dedicated left-turn lane for eastbound traffic is inappropriate for this intersection.
- Westbound left-turning vehicles at the intersection of Easton Road and Moreland Road must be rerouted via an alternate route.
- The prohibition of permissive left turns decreases capacity of the exclusive left-turn lane.

LOS Analysis

Under this scenario, the overall LOS and vehicle delay in the morning and afternoon peak period is nearly identical to results from existing conditions. Compared with existing conditions, the delay in morning and afternoon on the eastbound approach increases by six and four seconds, respectively. See Table 5. Due to the new signal timing, the westbound approach in the morning and afternoon experiences LOS B and delays of 14 seconds and 18 seconds, respectively. The Davisville Road approaches function similarly to existing conditions.

Table 5: Scenario #2 LOS Analysis

	Existing Condition				Proposed Alternative #2 with Signal Timing Plan C			
	AM		PM		AM		PM	
Direction	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Moreland Road – eastbound	5	A	6	A	11	B	10	A
Moreland Road – westbound	21	C	20	B	14	B	18	B
Davisville Road – northbound	25	C	30	C	24	C	31	C
Davisville Road – southbound	31	C	30	C	29	C	23	C
Total Intersection	**18**	**B**	**16**	**B**	**16**	**B**	**17**	**B**

Source: DVRPC 2009

Scenario #3 – Alternative # 3 with Signal Timing Plan D

The third improvement scenario includes prohibiting eastbound left turn movements at the intersection of Davisville Road and Moreland Road. Under this scenario, eastbound left turns will be rerouted via the following intersections: Easton Road and Moreland Road; Easton Road and Old York Road; and Davisville Road and Old York Road. See Figure 8 for details. The timing plan for this option allows for left-turn protected and permissive movements for the westbound approach. Signage would be posted to alert drivers of the left turn restriction and new travel pattern.

Advantages

- This scenario eliminates angle crashes involving eastbound left-turning vehicles colliding with the westbound through traffic.
- Adding left-turn signal protection for the westbound Moreland Road approach minimizes the risk for angle crashes involving westbound left-turning vehicles colliding with eastbound through traffic.
- This scenario utilizes the existing road network; therefore no additional ROW is required.

- Of the alternatives, this is the first preference of PennDOT District 6. Their review of the SimTraffic models submitted with the draft report did not show significant strain placed on Easton Road/Old York Road or Old York Road/Davisville Road intersections due to rerouted traffic. This would eliminate a movement and allow for consideration of advanced westbound left-turn opportunity.

Disadvantages

- Eastbound left-turning vehicles at the intersection of Davisville Road and Moreland Road must be rerouted via an alternate route.
- The left-turn lane storage length for the Old York Road approach to Davisville Road is already often congested with occasional queue spillover into the Old York Road through travel lane.
- The municipalities stated that a disadvantage would be the potential for drivers to make left turns further downstream at the intersection of Church Street and Moreland Road. The residential area of Church Street between Moreland Road and Old York Road already experiences cut-through traffic, which has been brought to the attention of local police officials.

LOS Analysis

As depicted in Table 6, the overall morning and afternoon LOS results for this scenario are nearly identical to existing conditions. The westbound approach during both peak periods experiences the greatest improvement in vehicle delay. This reduction is attributed to the signal timing, which provides a 12-second lead for left-turning vehicles. Unlike previous scenarios, the delay along the eastbound approach is doubled during both peak periods compared with existing conditions. This increased delay is the result of the left-turn prohibition at this approach. The Davisville Road approaches function similarly to existing conditions.

Table 6: Scenario #3 LOS Analysis

	Existing Condition				Proposed Alternative # 3 with Signal Timing D			
	AM		PM		AM		PM	
Direction	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Moreland Road – eastbound	5	A	6	A	12	B	12	B
Moreland Road – westbound	21	C	20	B	8	A	11	B
Davisville Road – northbound	25	C	30	C	29	C	28	C
Davisville Road – southbound	31	C	30	C	29	C	31	C
Total Intersection	**18**	**B**	**16**	**B**	**15**	**B**	**16**	**B**

Source: DVRPC 2009

Technical Conclusions from Scenarios

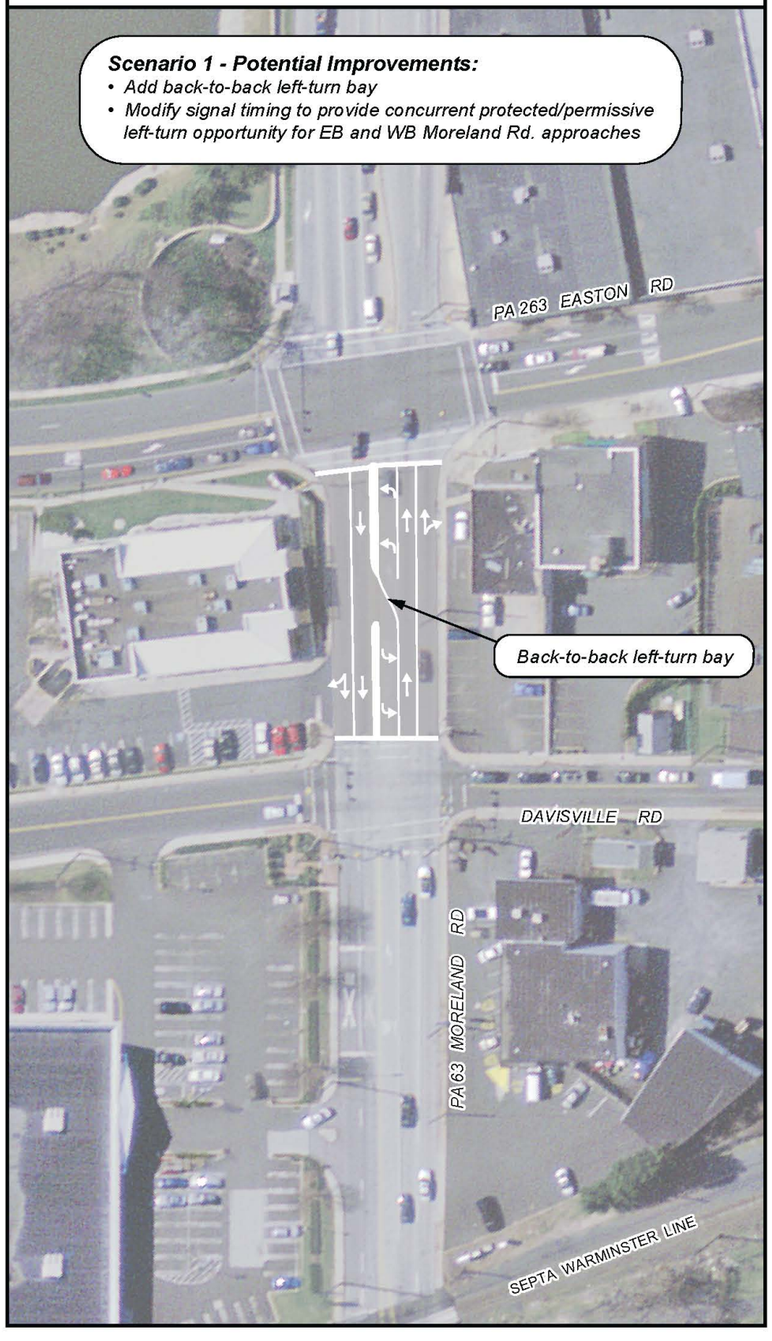
The three scenarios presented provide safety and operational improvements at the intersection of Davisville Road and Moreland Road. In all scenarios, delays were reduced along the westbound approach. This is mainly attributed to the signal timing providing protected and permissive left-turn movements, which has the potential of reducing angle crashes involving westbound left-turning vehicles colliding with eastbound through traffic. Although two of the three scenarios involved modification of the westbound left-turn lane between Easton Road and Davisville Road and rerouting left-turning movements, none of the three scenarios require any additional ROW. Overall performance levels during both peak periods for the intersection remains at desirable LOS B. While it was not possible to quantify the safety benefits, it is expected that any of these three alternatives would reduce crashes.

Many of the strategies described in this chapter are graphically depicted in Figure 9.

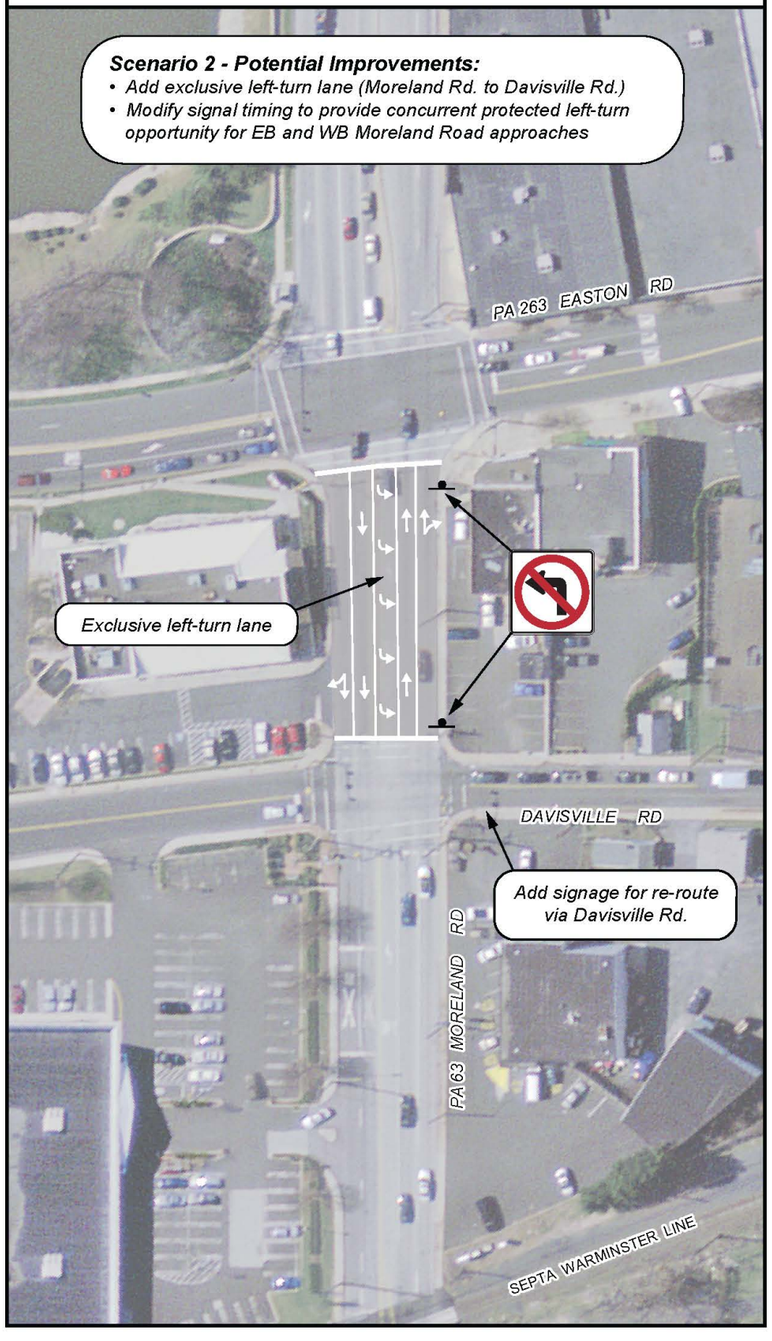
Figure 9

Potential Improvements

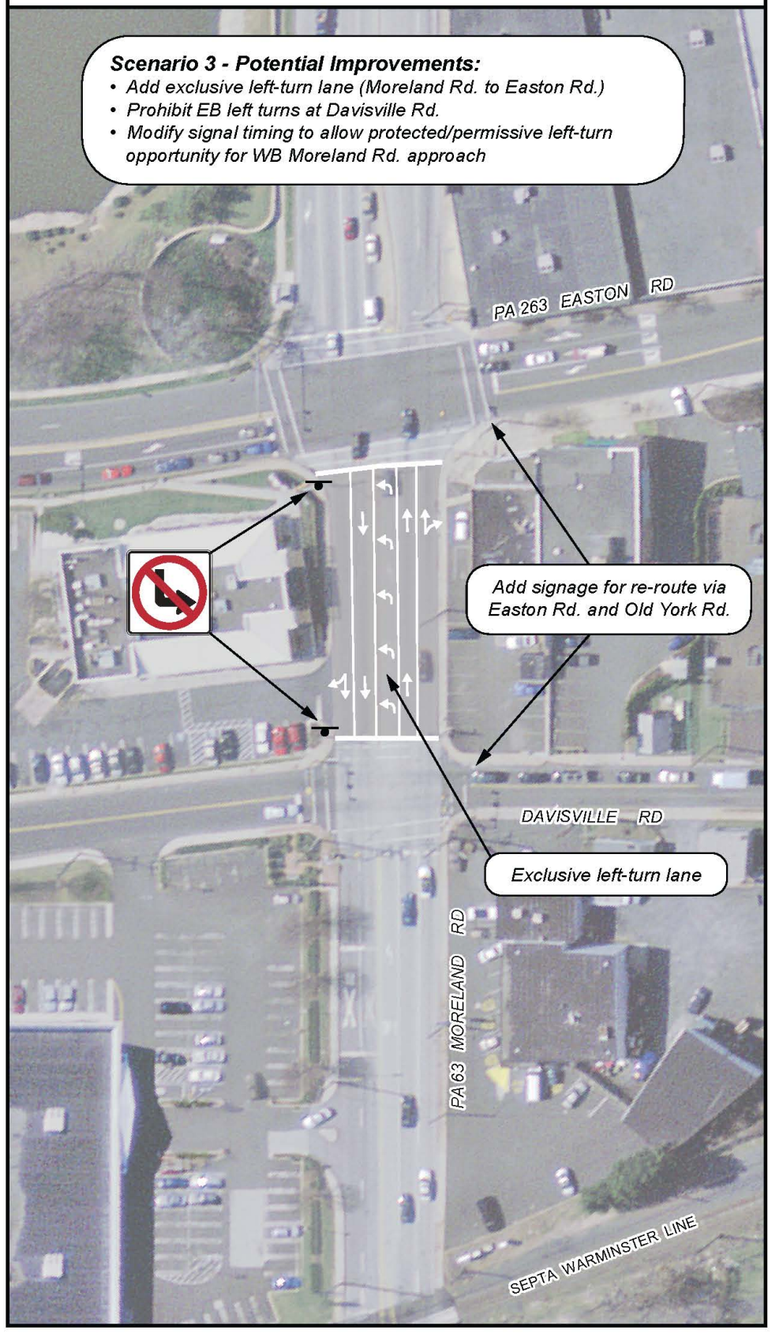
Scenario 1



Scenario 2



Scenario 3



0 50 100
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DVRPC Aerial Imagery: Spring, 2005

dvrpc

CHAPTER 6

Recommendations

Representatives from Montgomery County Planning Commission, Abington Township, Upper Moreland Township, PennDOT District 6, and DVRPC worked together and developed a set of recommendations. The agreed-upon recommendations should provide safety and operational benefits for the intersection of Davisville Road and Moreland Road.

Several of the recommendations are short-term and consist of both safety and operational improvements. These types of recommendations are generally low cost. The short-term recommendations are listed in Table 7.

Table 7: Short-term Recommended Improvements

Issue	Recommended Improvement
Curb ramps are missing on the southeast and southwest quadrants of the intersection to provide connection with the Davisville Road crosswalk.	■ Install curb ramps and align with crosswalk at Davisville Road.
Driver perception of viewing the Moreland Road and Davisville Road traffic signal is problematic along the westbound Moreland Road approach. This is likely a result of the downhill grade and close proximity of the traffic signals.	■ Consider installing overhead street signs at the study intersection for better comprehension of the signal locations. ■ Consider installing one or more red light strobes in the overhead signals at the Davisville Road and Moreland Road intersection.
At this intersection left-turning vehicles are often caught in the middle of the intersection after the signal turns red.	■ Increase the all-red time from two to three seconds.
Sight distance for vehicles turning right from southbound Davisville Road is sometimes obscured by vehicles parked at the front of the Terminal Luncheonette parking lot.	■ Encourage owners of the Terminal Luncheonette to consider, with support from Upper Moreland Township, an amenable way to relocate the few parking spaces at the corner to provide a safe sight distance at the intersection.

Source: DVRPC 2009

The issue of a high number of crashes relating to making left turns at the intersection of Davisville Road and Moreland Road is not easily resolved. Several strategies were identified and evaluated in this study. The recommendation is described below, but addressing this problem remains open for further investigation and discussion. In addition, the recommendations are likely not as inexpensive and quick as the items in Table 7.

The recommendation of this study is to prohibit eastbound vehicles on Moreland Road from making left turns at the intersection of Davisville Road. Instead, drivers would be instructed by

signs to turn left at the intersection of Moreland Road and Easton Road, right onto Old York Road, and left further north onto Davisville Road. Accompanying this change in travel pattern, steps should be taken to reduce cut-through traffic which is already reported in the residential area of Church Street between Moreland Road and Old York Road. This recommendation is further discussed in Chapter 5: Potential Strategies as Alternative 3.

This turn prohibition should be paired with a change in the signal plan at Moreland Road and Davisville Road. The revised plan should have a 12-second lead with protected and permissive left-turn movement only for the westbound approach. This recommendation is further discussed in Chapter 5 as Signal Timing Plan D.

Alternative 3 and Signal Timing Plan D were modeled together as Scenario #3. The results are reported in Chapter 5.

Implementation of the recommendations of this study or future refinements should include relevant stakeholders and include coordination with surrounding land owners and businesses. It will be important to minimize any negative impacts away from the direct facility of undertakings to improve the safety and operations of this intersection.

APPENDIX A

Background on Selection Process

In the fall of 2008 DVRPC solicited Montgomery County to provide candidate locations for the Congestion and Crash Site Analysis Program (CCSAP). Montgomery County then asked PennDOT District 6 for a recommendation. PennDOT's recommended location—the intersection of Moreland Road and Davisville Road—was eventually selected by DVRPC for the project.

At the beginning of the CCSAP effort, DVRPC received a copy of correspondence and associated data exchanged between PennDOT District 6 and Abington Township regarding perceived safety issues at the intersection of Moreland Road and Davisville Road. The following narrative provides a timeline and interpretation of this history, which is relevant to the CCSAP process and findings.

At the request of Abington Township, PennDOT District 6 conducted a study of the intersection of PA 63 (Moreland Road) and Davisville Road in October 2006. The Township's initial assessment of this intersection in July 2006, revealed that 43 accidents had occurred in the three years leading up to the study request. A statistically significant number of these incidents involved vehicles turning left from westbound Moreland Road onto southbound Davisville Road and colliding with eastbound through traffic on Moreland Road. The Township wanted to know if there was anything that could be done to reduce the number of turning accidents and suggested a dedicated left-turn signal for westbound traffic on Moreland Road.

The Township requested that PennDOT District 6 perform a study on September 7, 2006. PennDOT District 6 responded on September 28, 2006, stating its intention to move forward with an assessment of the intersection. The Department's study of the intersection began with a survey of left-turn movements at every approach on October 10, 2006. Left turns from westbound Moreland Road to southbound Davisville Road made up the only movement that justified the presence of a protected and permitted left-turn signal. However, the conflict factor generated by these turns was not sufficient to warrant a dedicated, protected and prohibited signal, as the Township had suggested.

PennDOT District 6's review of crashes occurring in the intersection between July 17, 2003 and July 16, 2006, confirmed the township's assessment that a large number of incidents were angle crashes. Furthermore, the crash diagram showed that many of these angle crashes consisted of vehicles turning south onto Davisville Road from westbound Moreland Road colliding with eastbound through traffic.

APPENDIX B

Study Advisory Committee Members

Table B-1: Study Advisory Committee Members

Name	Organization	Title
Mike DiDomonko	Abington Township Public Works Department	Traffic Signals and Street Light Foreman
Ellis Kim	DVRPC	Transportation Engineer
Regina Moore	DVRPC	Transportation Engineer
Kevin Murphy	DVRPC	Principal Transportation Planner
Matt Edmonds	Montgomery County Planning Commission	Transportation Planner
Wes Ratko	Montgomery County Planning Commission	Transportation Planner
David Adams	PennDOT – District 6	Traffic Signals Supervisor – Montgomery County
Chief Tom Nestel	Upper Moreland Township Police Department	Chief of Police
Jack Snyder	Upper Moreland Township Public Works Department	Public Works Supervisor

Source: DVRPC 2009

APPENDIX C

Additional Improvement Scenarios

Four additional improvement scenarios were considered during the development of the potential improvements process. As indicated in Chapter 5, listed below are the descriptions of the proposed alternatives and signal timing plans used for each scenario.

Proposed Alternatives

1. Add back-to-back left-turn bays on Moreland Road for drivers who had been traveling east and want to turn left to go north on Davisville Road. There would be 55 feet of storage and a 40-foot taper in each direction. See Figure 6. NOTE: The left-turn lane measurements are estimates.
2. Convert the entire existing westbound left-turn lane into an eastbound left-turn lane. This would provide more storage but eliminate the ability for westbound traffic to turn left at Easton Road. Drivers desiring to travel south on Easton Road would be rerouted via Davisville Road. See Figure 7.
3. Prohibit left turns by eastbound traffic on Moreland Road at Davisville Road, and instead route this movement via Easton Road and Old York Road.

Signal Timing Plans

- Signal Timing Plan A – This is the existing signal plan for the intersection, which calls for a 12-second lead and protected and permissive left-turn movements for the eastbound approach. No left-turn signal protection is provided for the westbound approach.
- Signal Timing Plan B – This signal plan also provides a 12-second lead. It has concurrent protected and permissive left-turn movements for the eastbound and westbound approaches.
- Signal Timing Plan C – This signal plan allows for concurrent protected left-turn movements for the eastbound and westbound approaches.

The advantages, disadvantages and LOS results for each of the scenarios are shown below.

Scenario #4 – Alternative # 1 with Signal Timing Plan A

Advantages

- The new eastbound left-turn lane provides some storage for left-turning vehicles.
- This scenario improves the sight distance for westbound left-turning traffic.
- This scenario utilizes the existing road network; therefore no additional ROW is required.
- No adjustments required for the signal timing plan.

Disadvantages

- Adding an exclusive left-turn lane to the eastbound approach (given the estimated storage and taper measurements) does not meet PennDOT's minimum standards, which requires 75-foot storage and 50-foot taper lengths.
- The creation of two relatively short left-turn lanes increases the opportunities for left-turn lane queue spillover into the through travel lanes.
- Potentially unsafe and difficult permissive left turns are still permitted from the Moreland Road approaches.

Table C-1: Scenario #4 LOS Analysis

	Existing Condition				Proposed Alternative # 1 with Signal Timing A			
	AM		PM		AM		PM	
Direction	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Moreland Road – eastbound	5	A	6	A	5	A	4	A
Moreland Road – westbound	21	C	20	B	21	C	20	B
Davisville Road – northbound	25	C	30	C	25	C	30	C
Davisville Road – southbound	31	C	30	C	33	C	25	C
Total Intersection	**18**	**B**	**16**	**B**	**19**	**B**	**15**	**B**

Source: DVRPC 2009

Scenario #5 – Alternative # 1 with Signal Timing Plan C

Advantages

- The new eastbound left-turn lane provides some storage for left-turning vehicles.
- This scenario improves the sight distance for westbound left-turning traffic.
- This scenario utilizes the existing road network; therefore no additional ROW is required.
- The timing plan is adjusted to provide left-turn signal protection for the eastbound and westbound approaches, thereby increasing the safety of these movements and the overall intersection.

Disadvantages

- Adding an exclusive left-turn lane to the eastbound approach (given the estimated storage and taper measurements) does not meet PennDOT's minimum standards, which requires 75-foot storage and 50-foot taper lengths.
- The creation of two relatively short left-turn lanes increases the opportunities for left-turn lane queue spillover into the through travel lanes.

- The prohibitation of permissive left turns decreases capactity of the exclusive left-turn lane.

Table C-2: Scenario #5 LOS Analysis

	Existing Condition				Proposed Alternative # 1 with Signal Timing C			
	AM		PM		AM		PM	
Direction	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Moreland Road – eastbound	5	A	6	A	12	B	10	A
Moreland Road – westbound	21	C	20	B	14	A	17	B
Davisville Road – northbound	25	C	30	C	25	C	29	C
Davisville Road – southbound	31	C	30	C	30	C	25	C
Total Intersection	**18**	**B**	**16**	**B**	**17**	**B**	**17**	**B**

Source: DVRPC 2009

Scenario #6 – Alternative # 2 with Signal Timing Plan A

Advantages

- The new eastbound left-turn lane's capacity accomodates more left-turning vehicles, which prevents queue spillover into the through travel lane.
- This scenario improves the sight distance for westbound left-turning traffic.
- This scenario utilizes the existing road network; therefore no additional ROW is required.
- The new left-turn lane configuration meets PennDOT requirements.
- No adjustments are required for the signal timing plan.

Disadvantages

- Westbound left-turning vehicles at the intersection of Easton Road and Moreland Road must be rerouted via an alternate route.
- The prohibitation of permissive left turns decreases the capactity of the exclusive left-turn lane.

Table C-3: Scenario #6 LOS Analysis

	Existing Condition				Proposed Alternative # 2 with Signal Timing A			
	AM		PM		AM		PM	
Direction	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Moreland Road – eastbound	5	A	6	A	4	A	4	A
Moreland Road – westbound	21	C	20	B	21	C	21	B
Davisville Road – northbound	25	C	30	C	24	C	24	C
Davisville Road – southbound	31	C	30	C	31	C	31	C
Total Intersection	**18**	**B**	**16**	**B**	**18**	**B**	**18**	**B**

Source: DVRPC 2009

Scenario #7 – Alternative # 2 with Signal Timing Plan B

Advantages

- The new eastbound left-turn lane's capacity accomodates more left-turning vehicles, which prevents queue spillover into the through travel lane.
- This scenario improves the sight distance for westbound left-turning traffic.
- This scenario utilizes the existing road network; therefore no additional ROW is required.
- The new left-turn lane configuration meets PennDOT requirements.
- The timing plan is adjusted to provide concurrent protected and permissive left-turn phasing for both Moreland Road approaches, which minimizes the potential for angle crashes.

Disadvantages

- Westbound left-turning vehicles at the intersection of Easton Road and Moreland Road must be rerouted via an alternate route.
- Potentially unsafe and difficult permissive left turns are still permitted from the Moreland Road approaches.

Table C-4: Scenario #7 LOS Analysis

	Existing Condition				Proposed Alternative # 2 with Signal Timing B			
	AM		PM		AM		PM	
Direction	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
Moreland Road – eastbound	5	A	6	A	5	A	5	A
Moreland Road – westbound	21	C	20	B	9	A	12	B
Davisville Road – northbound	25	C	30	C	26	C	30	C
Davisville Road – southbound	31	C	30	C	25	C	24	C
Total Intersection	**18**	**B**	**16**	**B**	**12**	**B**	**13**	**B**

Source: DVRPC 2009

APPENDIX D

References

The following resources were used as references in this report.

Publications

- Southeastern Pennsylvania Transportation Authority. *FY 2010 Annual Service Plan,* 6/2009, 66.
- McMahon Associates Inc. *Willow Grove Redevelopment Area Vehicular and Pedestrian Traffic Improvement Feasibility Study (McMahon Project No. 804183.00).* 2/2007.

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Abstract:

This document represents the findings and recommendations for the Montgomery County Congestion and Crash Site Analysis Program. This Program represents an effort to improve the mobility and safety of the roadways in the DVRPC region. The goal of the program is to identify cost-effective improvement strategies that will reduce congestion and crashes and improve mobility and safety for all road users.

Working with Montgomery County Planning Commission, the intersection of Moreland Road (PA 63) and Davisville Road were chosen for analysis. This intersection area was identified as having congestion and safety issues. An in-depth crash and level of service analysis was performed to quantify and gain an understanding of the issues. With input from the study advisory committee, improvement strategies were identified to address the issues. As appropriate, proposed improvement strategies were tested for level of effectiveness.

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