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REGIONAL
PLANNING COMMISSION

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LAWRENCE & WEST WINDSOR TOWNSHIPS, MERCER COUNTY

CONGESTION & CRASH

site
Analysis
Program



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Executive Summary

The goals of the Congestion and Crash Site Analysis Program (CCSAP) are to improve the accessibility 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.

A range of appropriate intersections was initially developed from the Congestion Management Process (CMP) and data-driven process. Four intersections were generated from this method for representatives from the Mercer County Planning Division and the Mercer County Engineering Department to consider for further study. None of the intersections were applicable because there were improvements already programmed for these locations. As an alternative, Mercer County representatives provided analysis recommending the intersections of Quakerbridge Road (CR 533) at Village Road/Lawrence Square Boulevard and Quakerbridge Road at Lawrence Station Road in Lawrence and West Windsor Townships.

With input from the advisory committee of local and county representatives, and the analyses performed by the Delaware Valley Regional Planning Commission (DVRPC), some improvement strategies were developed that would increase the safety and mobility of all road users traveling through both intersections. The list of advisory committee participants is provided in the [Appendix](#).

The range of considered strategies included the following: adding signage, adding a channelized right-turn lane, constructing a near-side jug handle, extending the southbound left-turn lane, adding sidewalks, restriping, and signal optimization. With guidance from the advisory committee, the range was refined into a set of recommendations. These recommendations should help improve the traffic flow and safety of all roadway users traveling through both intersections.

Introduction

This technical report provides analysis and recommendations for the intersections of Quakerbridge Road (CR 533) at Village Road/Lawrence Square Boulevard and Quakerbridge Road at Lawrence Station Road, in Lawrence and West Windsor townships. The recommended strategies cover both safety and operational improvements. Many of 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 these locations. Data was then compiled and analyzed. This included crash records data, Annual Average Daily Traffic (AADT) data, turning movement counts, and traffic signal timings. On March 14, 2012, a kick-off meeting was held with the study advisory committee that included representatives from the following agencies: Mercer County Planning Division, Mercer County Engineering Department, Lawrence Township, West Windsor Township, 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 visits 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 collision diagrams 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 Lawrence Township Municipal Building on April 23, 2012. The purpose of the meeting was to discuss the recommendations and to get the advisory committee's perspectives on prioritizing and implementing the recommendations.

Level of Service (LOS) Analysis

LOS analysis is a common tool for assessment of transportation facilities and was used extensively for 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 driver traveling through the intersection or a specific component of it. The parameters of delay that determine the various LOS categories for a signalized or unsignalized intersection are displayed in [Table 1](#).

A review of the existing conditions and the various potential improvement scenarios was conducted using Synchro software for the study intersections. Necessary information for determining delay and LOS measures include turning movement counts, roadway geometry, signal timing, and signal actuation plans. The turning movement counts were gathered by DVRPC staff, and the signal timing data was provided by Mercer County Engineering Department.

Table 1: LOS Designations and Associated Delays

LOS	Signalized Intersection Total Delay per Vehicle (seconds/vehicle)	Unsignalized Intersection Total Delay per Vehicle (seconds/vehicle)
A - Desirable	≤ 10	≤ 10
B - Desirable	> 10 and ≤ 20	> 10 and ≤ 15
C - Desirable	> 20 and ≤ 35	> 15 and ≤ 25
D - Acceptable	> 35 and ≤ 55	> 25 and ≤ 35
E - Undesirable	> 55 and ≤ 80	> 35 and ≤ 55
F - Unsatisfactory	> 80	> 55

Source: *Highway Capacity Manual*, 2000.

For signalized intersections, Synchro calculates a control delay and a queue delay. The control delay is calculated by a percentile delay method. This approach uses formulas from the *Highway Capacity Manual* (HCM) to calculate delay; however, the final delay measure is taken from an average of the 10th, 30th, 50th, 70th, and 90th percentile volume levels. As a result, the calculated delay is a product of the various operating conditions that a signal may actually encounter.

For an unsignalized intersection, Synchro only utilizes control delay, for which it relies exclusively upon HCM methods.

For the revision of timing plans, Synchro is capable of optimizing intersection splits, cycle lengths, and offsets. These efforts seek to establish a timing plan that provides the most efficient performance and serves as optimal volume of vehicles.

Study Location

The focus of the study as shown in **Figure 1** on page 8 is the intersections of Quakerbridge Road at Village Road/Lawrence Square Boulevard and Quakerbridge Road at Lawrence Station Road. The intersections are less than one-quarter of a mile apart. On a regional level, Quakerbridge Road is the border between Lawrence and West Windsor townships, and provides direct access to the Quakerbridge Mall and Route 1 corridor. Quakerbridge Road links the two study intersections. Lawrence Square Boulevard and Lawrence Station Road connect to residential areas in Lawrence Township. Village Road is one of the main thoroughfares through West Windsor Township, providing access to Mercer County Park and connecting with Old Trenton Road and US 130/NJ 33.

Quakerbridge Road runs in a northwesterly and southeasterly direction. Village Road/Lawrence Square Boulevard and Lawrence Station Road run in a northeasterly and southwesterly direction. For the purpose of this document, the orientation along Quakerbridge Road will be referenced as north and south. The orientation of Village Road/Lawrence Square Boulevard and Lawrence Station Road will be denoted as east and west.

Quakerbridge Road at Village Road/Lawrence Square Boulevard Intersection

Quakerbridge Road is classified as an urban minor arterial. As shown in the photographs of each leg on the next page, the southbound Quakerbridge Road approach contains one dedicated left-turn lane, two through lanes, and one channelized right-turn lane. The southbound approach is on a down slope from the bridge. The northbound approach contains one dedicated left-turn lane, one through lane, and one shared through and right-turn lane. Village Road and Lawrence Square Boulevard are classified as urban collector and urban local roadways, respectively. On Village Road, the roadway widens from one lane to form one dedicated left-turn and one shared through and right-turn lane. The lane configuration on Lawrence Square Boulevard, a private roadway to the Lawrence Square Village housing development, consists of one dedicated left-turn lane and one shared through and right-turn lane. This intersection is signalized.



View of northbound approach.
Source: DVRPC, 2012.



View of southbound approach.
Source: DVRPC, 2012.



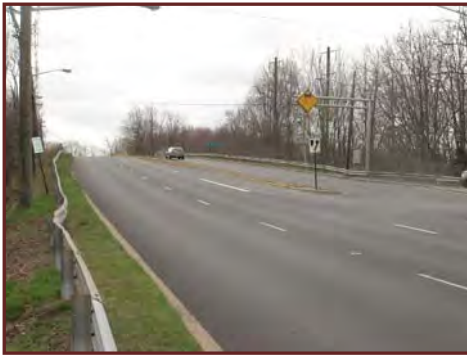
Eastbound view from Lawrence
Square Boulevard.
Source: DVRPC, 2012.



View of Village Road.
Source: DVRPC, 2012.

Quakerbridge Road at Lawrence Station Road Intersection

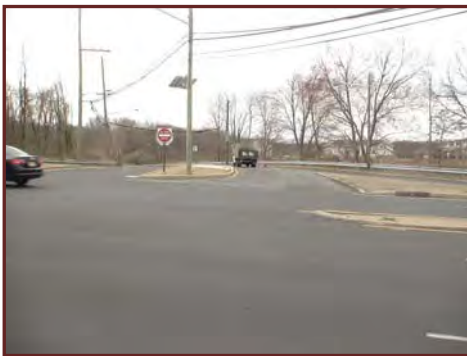
Lawrence Station Road is classified as an urban minor arterial. The eastbound approach is stop controlled and forms a T-intersection with Quakerbridge Road. It contains one dedicated left-turn lane and one channelized right-turn lane. The northbound Quakerbridge Road approach has one left-turn lane and two through lanes. The southbound Quakerbridge Road approach contains two through lanes and one channelized right-turn lane.



View of northbound approach.
Source: DVRPC, 2012.



View from Lawrence Station Road.
Source: DVRPC, 2012.



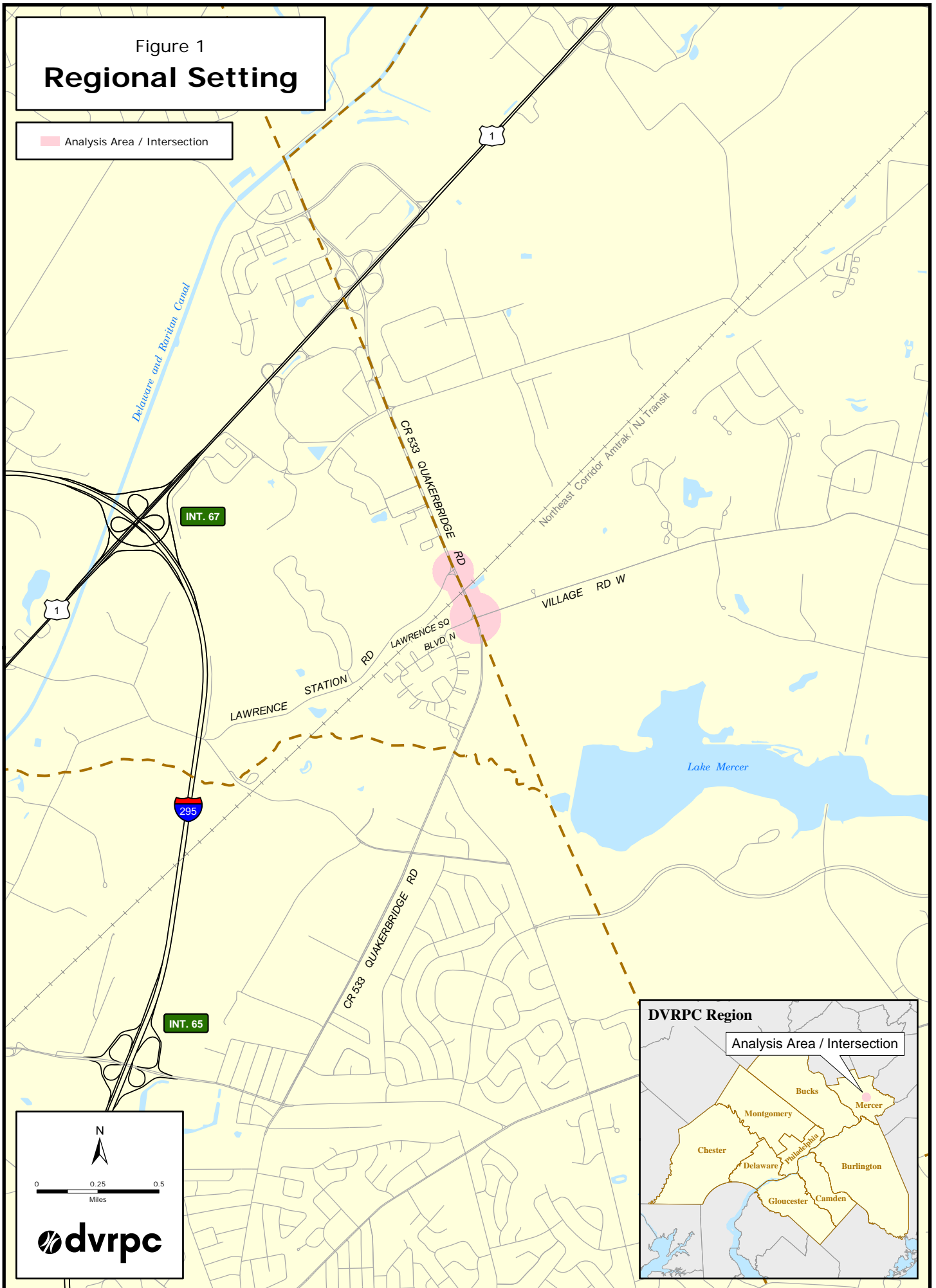
Westbound view of Lawrence Station Road.
Source: DVRPC, 2012.



View of northbound vehicle turning left onto Lawrence Station Road.
Source: DVRPC, 2012.

Figure 1
Regional Setting

Analysis Area / Intersection



Existing Conditions

The study intersections serve daily commuter traffic as well as evening and weekend shopping trips, particularly to the Quakerbridge Mall. DVRPC counts taken in 2010 on Quakerbridge Road between both study intersections showed an AADT volume of 31,007 vehicles. Counts taken in 2007 on Lawrence Station Road showed an AADT volume of nearly 5,000 vehicles. Counts taken in 2012 on Village Road showed an AADT volume of nearly 5,200 vehicles. AADT data was not available for Lawrence Square Boulevard.

The following bullets summarize some of the comments made by the study advisory committee at the kick-off meeting concerning existing traffic conditions at the study intersections.

Advisory Committee Comments

Quakerbridge Road at Village Road/Lawrence Square Boulevard Intersection

- ◆ The southbound left-turn lane is too short to accommodate the high left-turn traffic volume during the afternoon peak period. Left turning vehicles block southbound through traffic. Traffic queues often extend onto the bridge.
- ◆ The turning radius is tight for northbound vehicles turning right onto Village Road.
- ◆ The westbound stop bar on Village Road is set too far back from the intersection. Right-turn-on-red is permitted at the intersection. Right-turning vehicles stop past the stop bar to see oncoming northbound traffic.
- ◆ There is a lack of pedestrian amenities. People walk the narrow cattle trail on the west side of Quakerbridge Road.
- ◆ Long traffic queues form along Village Road, which may be attributed to the lane configuration and heavy right- and left-turn movements.

Quakerbridge Road at Lawrence Station Road Intersection

- ◆ It is difficult to make left turns from Lawrence Station Road. Township official said during the afternoon peak period, southbound traffic often blocks the intersection. Traffic is blocked due to the traffic queue to the signal at the Quakerbridge Road and Village Road/Lawrence Square Boulevard intersection.
- ◆ There were numerous left-turn and angle crashes at the intersection in the last few years.
- ◆ Southbound and northbound traffic speed through the intersection.

Signal Timing

The intersection of Quakerbridge Road and Village Road/Lawrence Square Boulevard is actuated and operates on a 117-second cycle length. The eastbound and westbound left turns are protected-permitted. The northbound and southbound left turns are protected. A protected-permitted signal phase provides a dedicated movement where the driver can turn left unimpeded as opposing traffic is held with a red signal. After the phase has ended, drivers have to wait for gaps created by the opposing traffic to turn left. Protected left-turn signals allow vehicles to proceed during the display of the green left-turn arrow only.

Peak Hour Turning Movement Counts

Quakerbridge Road at Village Road/Lawrence Square Boulevard Intersection

Manual turning movement counts at the intersection were taken on March 1, 2012, between the hours of 6:00 AM and 9:00 AM and between 3:00 PM and 6:00 PM. A peak hour turning movement diagram is shown in [Figure 2](#) on page 12. The morning peak hour is 7:45 AM to 8:45 AM, and the afternoon peak hour is 5:00 PM to 6:00 PM.

During the morning peak hour, 2,864 vehicles traveled through this intersection. The dominant movements in the morning were the northbound through movement (933 vehicles) and southbound through movement (502 vehicles). There were also significant right-turn movements (northbound right-turn from Quakerbridge Road, 307 vehicles; and westbound right-turn from Village Road, 388 vehicles). Vehicles traveling north on Quakerbridge Road were likely heading to access Route 1. These movements represented 52 percent of the intersection's volume.

During the afternoon peak hour, 3,347 vehicles traveled through the intersection. This is a 14-percent increase in traffic compared to morning conditions. Similar to morning peak period conditions, the dominant movements were the northbound through movement (731 vehicles) and southbound through movement (1,158 vehicles) on Quakerbridge Road, which represent 56 percent of the intersection's volume. Traffic movement from Lawrence Square Boulevard was fairly light.

Quakerbridge Road at Lawrence Station Road Intersection

Manual turning movement counts were taken at the intersection. These counts were taken on February 29, 2012, between the hours of 6:00 AM and 9:00 AM and between 3:00 PM and 6:00 PM. A peak hour turning movement diagram is shown in [Figure 3](#) on page 13. 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, 2,404 vehicles traveled through this intersection. The dominant movements in the morning were the northbound (1,386 vehicles) and southbound (555 vehicles) through movements on Quakerbridge Road, which represent 81 percent of the intersection's volume. There were also significant right-turn movements (214 vehicles) from Lawrence Station

Road. Right turns onto Lawrence Station Road were fairly light at 28 vehicles. Vehicles traveling north on Quakerbridge Road were likely heading to access Route 1.

Counts taken during the afternoon peak period showed 2,687 vehicles traveled through this intersection. Similar to the morning peak period conditions, the highest traffic volumes were the northbound and southbound through movements on Quakerbridge Road, 812 and 1,419 vehicles, respectively. The southbound right-turn and northbound left-turn movements onto Lawrence Station Road were fairly even.

Figure 2

Peak Hour Turning Movement Counts

Intersection of Quakerbridge Road at
Village Road/Lawrence Square Boulevard

AM Peak Hour: 7:45 – 8:45 AM
PM Peak Hour: 5:00 – 6:00 PM

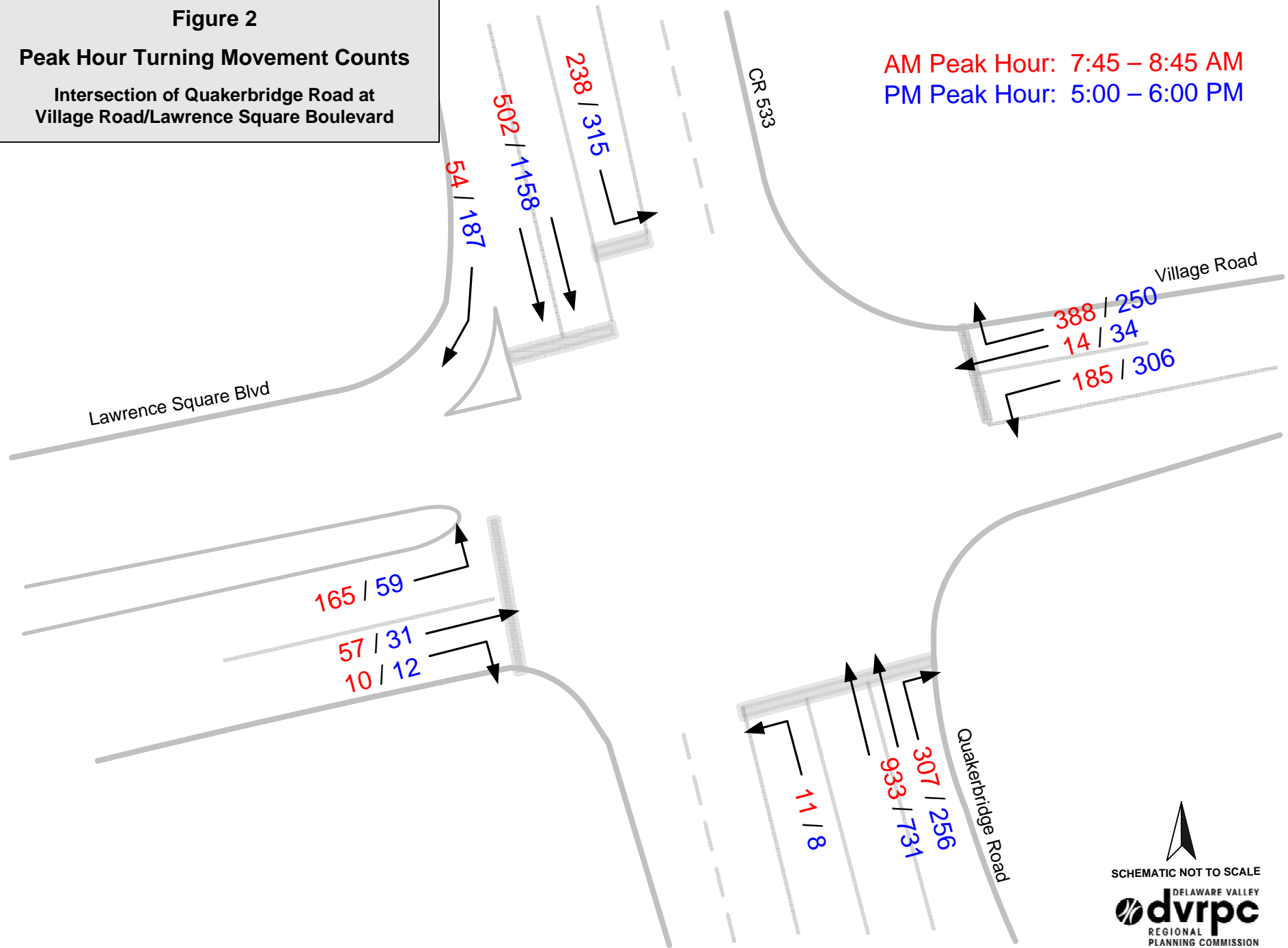
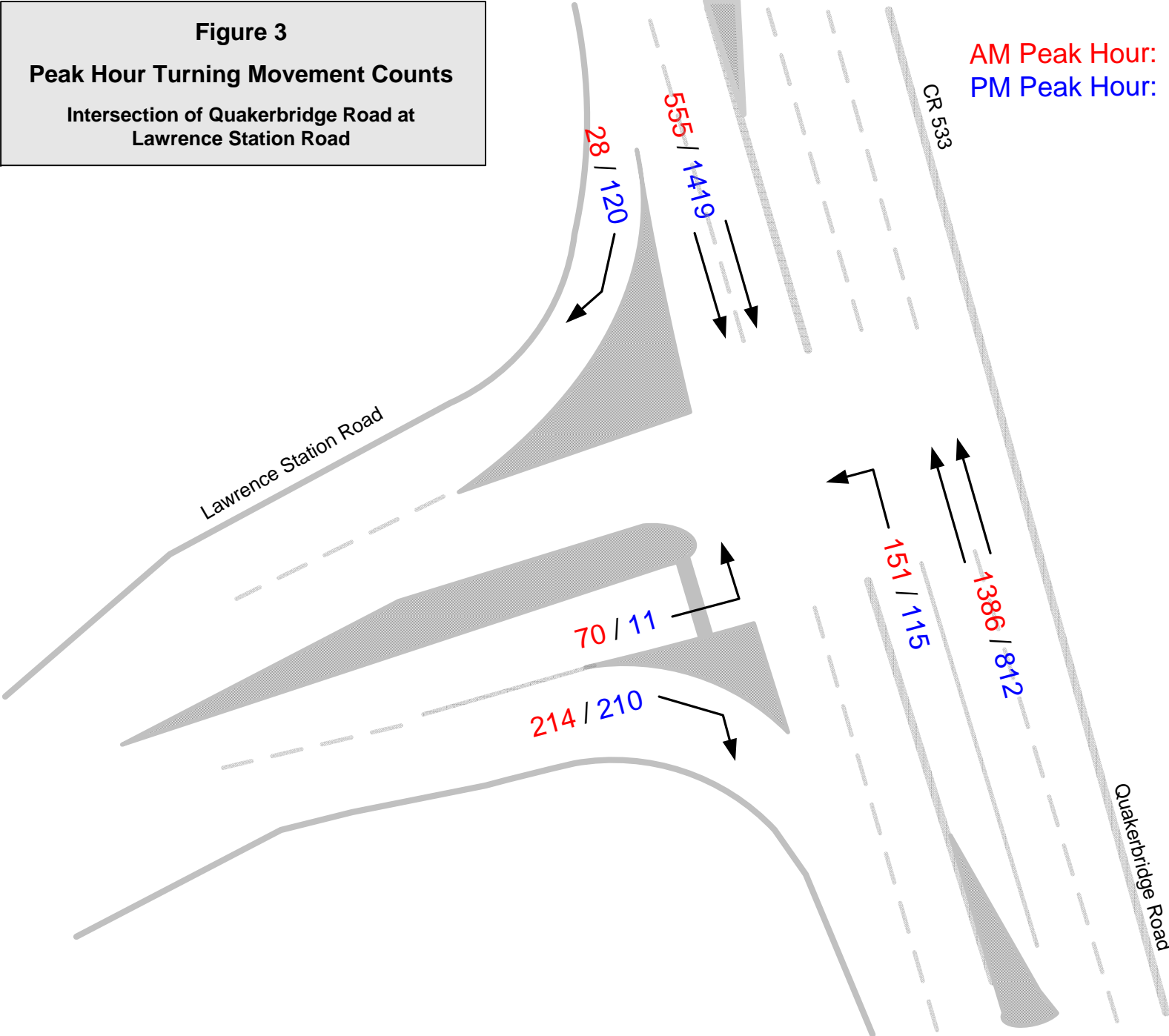


Figure 3
Peak Hour Turning Movement Counts
 Intersection of Quakerbridge Road at
 Lawrence Station Road

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



Existing LOS

The LOS calculations in Tables 2, 3, 8, and 9 are indicated by vehicle delay in seconds and a corresponding letter designation for each approach of the intersection. The approach LOS averages the total delay for each left-turn and through and right-turn movements. In some instances, the approach LOS may indicate a desirable level of delay, which may be misleading. For example the LOS in a left-turn lane may indicate F (unsatisfactory) and the LOS calculated for the through and right-turn lane may indicate B (desirable). However, the combined approach LOS will average to LOS C. The lane configuration of the approach can also impact the LOS results as indicated below.

Quakerbridge Road at Village Road/Lawrence Square Boulevard Intersection

Table 2 shows that the Quakerbridge Road at Village Road/Lawrence Square Boulevard intersection is currently operating at acceptable conditions of LOS D in both peak hours. Although the southbound approach has the most crashes (see Chapter 4) and is the most congested, it experiences the least amount of delay. This is likely due to the channelized right-turn lane which maximizes traffic flow for the southbound through traffic. The remaining approaches in the morning experience delays ranging between 39 and 50 seconds. In the afternoon, westbound traffic on Village Road experiences the greatest amount of delay at 54 seconds. This is the result of the heavy left-turn and right-turn movements.

Table 2: Existing LOS Analysis for Quakerbridge Road at Village Road/Lawrence Square Boulevard Intersection

Direction	Morning		Afternoon	
	Delay (s)	LOS	Delay (s)	LOS
NB Quakerbridge Road	40	D	25	C
SB Quakerbridge Road	32	C	33	C
EB Lawrence Square Boulevard	50	D	30	C
WB Village Road	39	D	54	D
Total Intersection	38	D	32	D

Source: DVRPC, 2012.

Quakerbridge Road at Lawrence Station Road Intersection

Table 3 indicates that the Quakerbridge Road at Lawrence Station Road intersection performs at desirable conditions. During both peak periods, the eastbound approach experiences the highest amount of delay, which is attributed to the stop control. Often, delays are further exacerbated due to the heavy traffic volume along Quakerbridge Road blocking access to Lawrence Station Road. This is likely due to traffic waiting at the signal at the Quakerbridge Road at Village Road/Lawrence Square Boulevard intersection. The southbound approach experiences no delays.

Table 3: Existing LOS Analysis for Quakerbridge Road at Lawrence Station Road Intersection

Direction	Morning		Afternoon	
	Delay (s)	LOS	Delay (s)	LOS
NB Quakerbridge Road	10	A	17	C
SB Quakerbridge Road	0	A	0	A
EB Lawrence Station Road	66	F	158	F
Total Intersection	5	A	11	B

Source: DVRPC, 2012

Land Use

Quakerbridge Road at Village Road/Lawrence Square Boulevard Intersection

The land use surrounding the immediate intersection is a mix of commercial and undeveloped. Figure 4 on page 16 is an aerial view of the intersection. Medical and dental office buildings are located south of the intersection. The Lawrence Square Village residential community lies west of this intersection. The properties on the north side of the intersection are for sale. At the kick-off meeting, West Windsor Township officials mentioned there was interest from developers to build a convenience store. Plans are on hold due to zoning, access, and wastewater issues.

Quakerbridge Road at Lawrence Station Road Intersection

An attorney's office is located on the east side of the intersection across from Lawrence Station Road. The property on the northwest side of the intersection is currently vacant. It was the former site of a chemical facility. The southwest quadrant of the intersection is wooded. The Avalon Run East and Liberty Green housing developments lie west of the intersection.

Figure 4
Study Area

Darren M. Baldo
Attorney-At-Law

Northeast Corridor Amtrak/NJ Transit

LAWRENCE
STATION
RD

CR 533
QUAKERIDGE RD

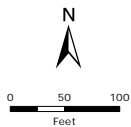
Site of Potential
Future Commercial
Development

VILLAGE RD W

Dental Office

LAWRENCE SQUARE BLVD N

Medical Office

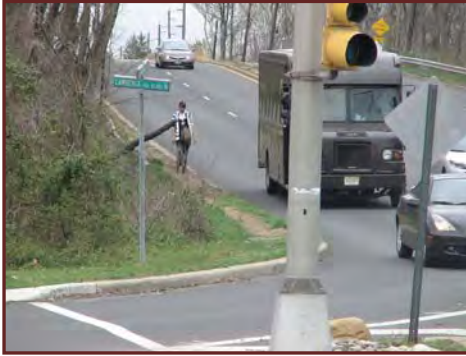


Aerial Imagery: NJOIT, 2012



Pedestrians

Pedestrian activity is evident in the study area. During field visits, pedestrians were observed walking the narrow cow path worn in the grass along the west side of Quakerbridge Road. These observations were confirmed by township officials at the kick-off meeting. Residents living in the Lawrence Square Village community often walk along Quakerbridge Road to travel to Quakerbridge Village Commons and other shopping centers, north of Lawrence Station Road.



View of pedestrian walking narrow path along westside Quakerbridge Road. Source: DVRPC, 2012.

Transit

Within the study area there are no bus stops located along Quakerbridge Road; however, NJ Transit Bus 612 provides service to the Lawrence Square Village, Liberty Green, and Avalon Run East residential communities.

Crash Analysis

This analysis includes all crashes that occurred at the intersections of Quakerbridge Road at Village Road/Lawrence Square Boulevard and Quakerbridge Road at Lawrence Station Road from 2009 through 2011. The main goals of this analysis are to highlight crash trends and determine causal factors.

Data Description

The crash summaries and collision diagrams used in this analysis were derived from reportable and non-reportable crash records provided by the Lawrence and West Windsor township police departments. In New Jersey, a crash is considered reportable if it results in an injury, fatality, or property damage of \$500 or more as determined by the responding officer.

Quakerbridge Road at Village Road/Lawrence Square Boulevard Intersection

There were 64 reportable crashes and 8 non-reportable crashes recorded during the study period, within a 250-foot buffer around the intersection. Collision by type for this intersection is summarized in Table 4.

Crash Trends

Major findings of non-reportable crash report analysis:

- ◆ Rear-end crashes were the most common collision type at 63 percent.
- ◆ The most common locations for crashes were the southbound through lane approaches. This is likely due to vehicles speeding and the downgrade slope on the approach to the intersection.
- ◆ Six of the eight crashes occurred under daylight and clear weather conditions, and between 2:00 PM and 7:00 PM. During this time period, more vehicles are on the roadway.

Major findings for reportable crash report analysis:

- ◆ Thirty-eight of the 64 crashes occurred on the north side of the intersection.
- ◆ Rear-end crashes accounted for 67 percent of the total. These crashes were predominately located along the southbound approach through and left-turn lanes, and westbound approach

right-turn lane. These crashes may be occurring due to the downgrade slope in the southbound direction and overall heavy traffic volume attempting to travel through the intersection.

- ◆ Five of the seven reportable sideswipe crashes occurred on the north side of the intersection in the southbound direction. The southbound left-turn lane is too short to accommodate the heavy left-turning volume in the afternoon. Based on weekday peak hour observations, the vehicles desiring to turn left at the signal often spill over into the far left through lane, thus impeding traffic flow for southbound through traffic. Therefore, these crashes may be attributed to southbound through vehicles switching lanes to avoid the long queue associated with the heavy left-turning traffic.

Table 4: Crash Summary for Quakerbridge Road at Village Road/Lawrence Square Boulevard Intersection

Collision Type	Reportable	Non-reportable
Rear-End	43	5
Same Direction Sideswipe	7	2
Hit-Fixed-Object	5	0
Angle	4	0
Left-Turn	2	0
Encroachment	1	0
Pedalcyclist	1	0
Backing	1	0
Hit-Non-Fixed Object	0	1
Total	64	8

Source: DVRPC, 2012.

The following crash analysis refers only to the reportable crashes:

Of the 64 reportable crashes recorded during the analysis period, there were zero fatalities, 10 injury crashes, and 54 property-damage-only crashes.

During the study period years 2009 – 2011, there were 13 crashes recorded in 2009, 26 crashes recorded in 2010, and 25 crashes recorded in 2011. Considering crashes by month, April and July were the two highest in terms of crash frequency with 10 and 8 crashes, respectively. Crash trends by day-of-week showed Monday through Friday as having the highest totals accounting for 80 percent, which is common given that most of the traffic volume through this intersection is associated with weekday commuters. Nearly 50 percent of the crashes occurred between 2:00 PM and 7:00 PM. These findings are consistent with the higher peak period volumes common during the afternoon and evening commutes.

The collision diagram (Figure 5) shows the location, collision type, and frequency of vehicular crashes for the Quakerbridge Road and Village Road/Lawrence Square Boulevard intersection.

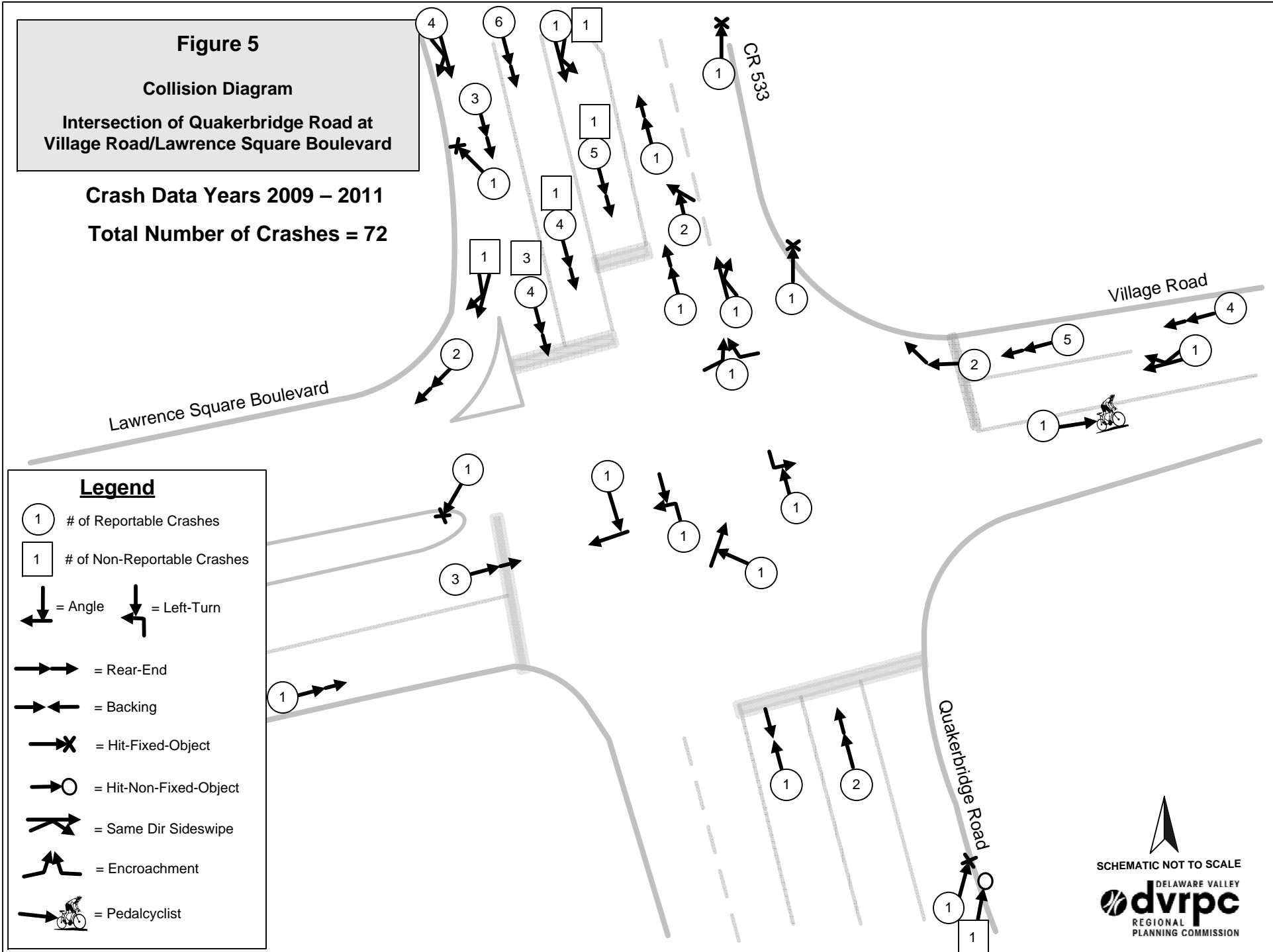
Figure 5

Collision Diagram

**Intersection of Quakerbridge Road at
Village Road/Lawrence Square Boulevard**

Crash Data Years 2009 – 2011

Total Number of Crashes = 72



Crash Analysis Conclusion

- ◆ Sixty percent of the crashes were located on the north side of the intersection.
- ◆ Southbound rear-end crashes are a major issue at this intersection.
- ◆ Major geometric improvements such as extending the southbound left-turn lane and widening Quakerbridge Road would likely have an effect at improving safety at this intersection. A list of potential safety improvements is provided in **Chapter 5**.

Quakerbridge Road at Lawrence Station Road Intersection

There were 19 reportable crashes and 2 non-reportable crashes recorded during the study period within a 250-foot buffer around the intersection. Collision by type for this intersection is summarized in **Table 5**.

Crash Trends

Major findings of **non-reportable** crash report analysis:

- ◆ The two crashes were coded as sideswipe and occurred in the vicinity of the channelized right-turn lane heading southbound along Quakerbridge Road.
- ◆ Both crashes happened in 2009.

Major finding for **reportable** crash report analysis:

- ◆ Four of the five left-turn crashes involved drivers turning left from Lawrence Station Road colliding with southbound through traffic on Quakerbridge Road. There are two southbound through lanes. In the afternoon the southbound through traffic (specifically the far right lane) often blocks access to Lawrence Station Road due to traffic waiting at the traffic signal at the Quakerbridge Road at Village Road/Lawrence Station Boulevard intersection. On occasion, southbound through lane drivers will leave a gap for left-turning vehicles to turn left from Lawrence Station Road. According to the police records, left-turning crashes often happen because vehicles in the far left southbound through lane do not see vehicles from Lawrence Station Road.

Table 5: Crash Summary for Quakerbridge Road at Lawrence Station Road Intersection

Collision Type	Reportable	Non-reportable
Rear-End	7	0
Same Direction Sideswipe	2	2
Hit-Fixed-Object	1	0
Angle	2	0
Left-Turn	5	0
Hit Animal	1	0
Unknown	1	0
Total	19	2

Source: DVRPC, 2012.

The following crash analysis refers only to the reportable crashes:

Of the 19 reportable crashes recorded during the analysis period, there were zero fatalities, 3 injury crashes, and 16 property-damage-only crashes.

During the study period years 2009 – 2011, there were six crashes recorded in 2009, seven crashes recorded in 2010, and six crashes recorded in 2011. Considering crashes by month, zero crashes were recorded in January, March, and August. The month of May had the highest crash frequency with four crashes. Crash trends by day-of-week showed Monday through Friday as having the highest totals accounting for 84 percent. This trend is common given that most of the traffic volume through this intersection is associated with weekday commuters. No crashes were recorded on Sundays. Nearly 63 percent of the crashes occurred between 3:00 PM and 7:00 PM. These findings are consistent with the higher peak period volumes common during the afternoon and evening commutes.

The collision diagram (Figure 6) shows the location, collision type, and frequency of vehicular crashes for the Quakerbridge Road and Lawrence Station Road intersection.

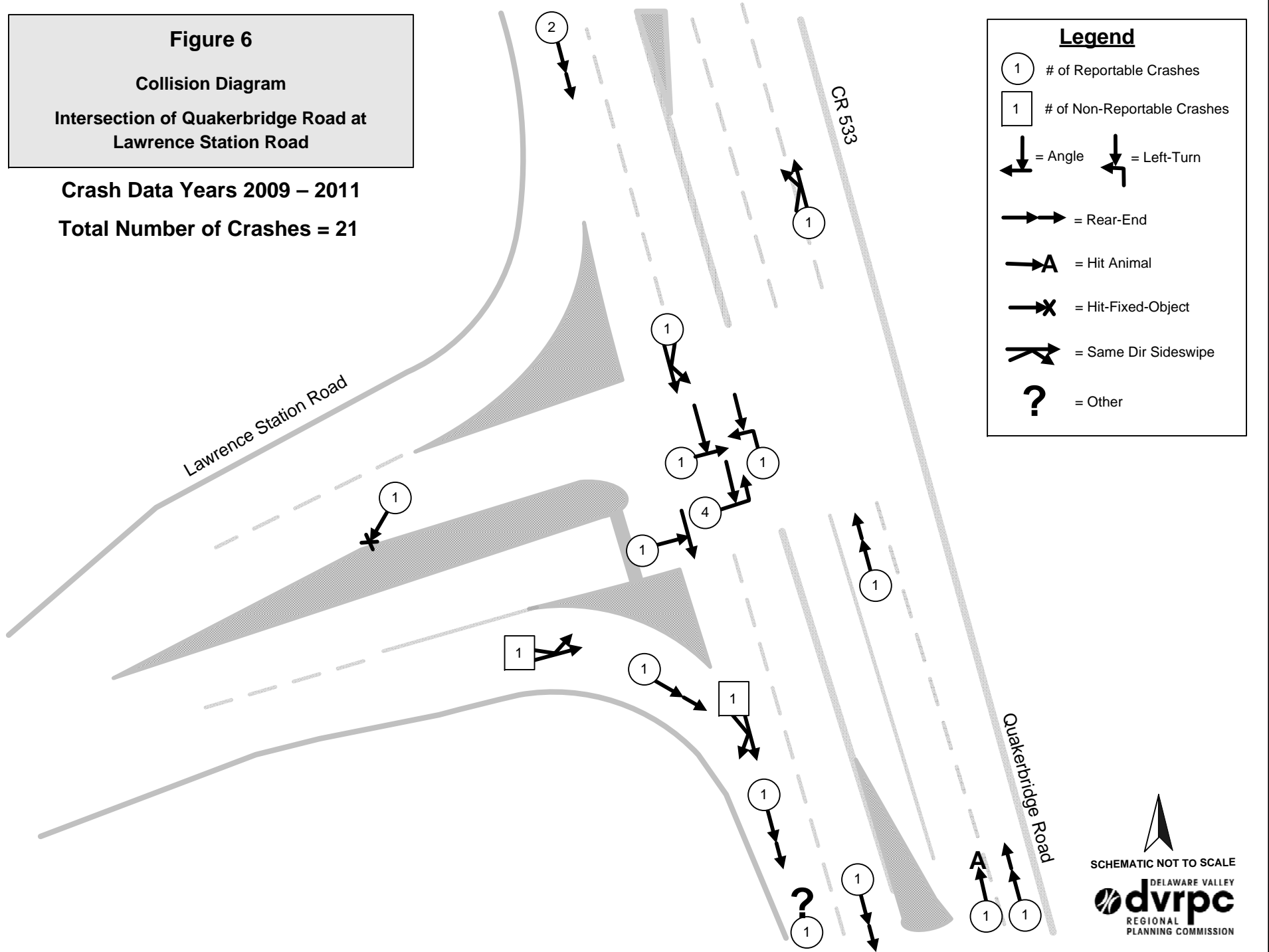
Figure 6

Collision Diagram

**Intersection of Quakerbridge Road at
Lawrence Station Road**

Crash Data Years 2009 – 2011

Total Number of Crashes = 21



Crash Analysis Conclusion

- ◆ In the afternoon peak period southbound traffic often blocks access to Lawrence Station Road.
- ◆ Drivers attempting the turn left from Lawrence Station Road is the largest safety issue at this intersection.
- ◆ Adding intersection ahead warning signage and “Do Not Block the Box” pavement marking are low cost solutions, which may have an effect at improving safety at this intersection. A list of potential safety improvements is provided in [Chapter 5](#).

Issues and Potential Improvements

A range of strategies was developed by the study advisory committee for these intersections. 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 adding or modifying pavement markings. Operational strategies include signal and geometric improvements.

Tables 6 and 7 and the following sections describe the main issues and the corresponding potential strategies for alleviating these safety and operational concerns. The red highlighted text in the table reflects operational strategies.

Table 6: Quakerbridge Road at Village Road/Lawrence Square Boulevard Intersection Issues and Potential Strategies

Issues	Potential Strategies
<ul style="list-style-type: none"> ■ 1. The southbound left-turn lane is too short to accommodate the high left-turn traffic volume. 	<ul style="list-style-type: none"> ■ 1A. Optimize the signal timing. ■ 1B. Extend the southbound left-turn lane. ■ 1C. Construct a near-side jug handle.
<ul style="list-style-type: none"> ■ 2. There is a tight turning radius for northbound vehicles turning right onto Village Road. 	<ul style="list-style-type: none"> ■ 2. Increase the curb radius.
<ul style="list-style-type: none"> ■ 3. The westbound stop bar on Village Road is set too far back from the intersection. 	<ul style="list-style-type: none"> ■ 3. Shift the stop bar toward the intersection.
<ul style="list-style-type: none"> ■ 4. Long traffic queues form along Village Road, which may be attributed to the lane configuration and heavy right- and left-turn movements. 	<ul style="list-style-type: none"> ■ 4. Modify the approach by adding a channelized right-turn lane.
<ul style="list-style-type: none"> ■ 5. There is a lack of pedestrian amenities at and near the intersection. 	<ul style="list-style-type: none"> ■ 5A. Investigate constructing a sidewalk along the west side of Quakerbridge Road. This would require widening the bridge between both intersections. ■ 5B. Restripe crosswalk markings.

Source: DVRPC, 2012.

Table 7: Quakerbridge Road at Lawrence Station Road Intersection Issues and Potential Strategies

Issues	Potential Strategies
<ul style="list-style-type: none"> ■ 1. It is difficult and dangerous to make a left turn onto Quakerbridge Road from Lawrence Station Road due to heavy southbound traffic. 	<ul style="list-style-type: none"> ■ 1A. Add intersection warning signs. ■ 1B. Consider adding “Do Not Block the Box” pavement marking for southbound Quakerbridge Road.
<ul style="list-style-type: none"> ■ 2. There were numerous left-turn and angle crashes. 	<ul style="list-style-type: none"> ■ 2A. Add intersection warning signs. ■ 2B. Consider adding “Do Not Block the Box” pavement marking for southbound Quakerbridge Road.
<ul style="list-style-type: none"> ■ 3. Vehicles speed through the intersection. 	<ul style="list-style-type: none"> ■ 3. Consider adding transverse rumble strips.

Source: DVRPC, 2012.

Operational Strategies

Several operational strategies were developed and discussed to improve safety at the intersection of Quakerbridge Road and Village Road/Lawrence Square Boulevard. Two operational strategies were refined so they could be simulated using Synchro software. Summaries are provided for each scenario tested. The results are for comparison to the existing LOS conditions documented in Chapter 3. No operational strategies were identified for the intersection of Quakerbridge Road at Lawrence Station Road.

Many of the strategies described in this chapter are graphically depicted in [Figure 7](#) on page 33.

Scenario 1 – Optimize the Traffic Signal Timing

Description

- ◆ Adjust the signal timing to optimize traffic flow through the intersection.

Advantages

- ◆ Timing modifications may be implemented in the short term with little cost.
- ◆ This option reduces the cycle length from 117 seconds to 90 seconds in both periods, which allows more vehicles to travel through the intersection.

Disadvantage

- ◆ This timing plan increases delay at some of the approaches for the intersection during both peak periods.

LOS Analysis

Under this scenario, the overall LOS and vehicle delay in the morning and afternoon peak period is nearly identical, with a slight increase in delay. Compared with existing conditions and the other approaches, in the morning the eastbound approach would experience the highest delay with an increase of 9 seconds. This is the result of the shorter green time allocated for the approach and vehicles waiting to turn left. Vehicle delay along the remaining approaches ranges between an increase of 1 and 6 seconds. In the afternoon, the highest delays are found along the westbound approach with 75 seconds compared to 54 seconds. This may be attributed to the lane configuration and high left- and right-turn volumes. The southbound approach experiences the largest reduction in delay of 6 seconds. These results are shown in [Table 8](#).

Table 8: LOS Analysis – Scenario 1

Direction	Existing Condition				Scenario 1			
	AM		PM		AM		PM	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
NB Quakerbridge Road	39	D	29	C	45	D	31	C
SB Quakerbridge Road	32	C	27	C	36	D	21	C
EB Lawrence Square Boulevard	50	D	33	C	59	E	29	C
WB Village Road	39	D	54	D	40	D	75	E
Total Intersection	38	D	32	C	43	D	34	C

Source: DVRPC, 2012.

Scenario 2 – Add Channelized Right-Turn Lane on Village Road

Description

- ◆ The traffic signal timing would be optimized. The cycle length would be 90 seconds for both periods.
- ◆ A channelized right-turn lane would be added to the Village Road approach.

Advantages

- ◆ Traffic flow from this approach will improve, particularly for the right-turning vehicles. Queues approaching the intersection will be reduced.
- ◆ This option could be funded by developers as a condition for approval of plans and permits for building the convenience store on the northeast quadrant if that goes forward.

Disadvantages

- ◆ This option is expensive. Right-of-way (ROW) would have to be acquired.
- ◆ The land on the northeast quadrant is located on steep grades, and there may be adverse environmental impacts.

- ◆ If the property is developed, access would be requested onto Quakerbridge Road, which could interfere with movements from the channelized right-turn lane.

This scenario was not modeled because this option only modified the geometry of the intersection and optimized the signal. Adding the channelized right-turn lane did not hinder the operation of the intersection; therefore, the LOS results for this scenario are the same as for Scenario 1.

Scenario 3 – Construct a Near-Side Jug Handle

Description

- ◆ The traffic signal would be optimized. The cycle length would be 80 seconds in the morning and 90 seconds in the afternoon peak period.
- ◆ A channelized right-turn lane would be added to the Village Road approach.
- ◆ Southbound left-turn movements would be eliminated.
- ◆ A near-side jug handle would be constructed on the northwest quadrant of the intersection. Motorists desiring to turn left will use the jug handle to access Village Road.
- ◆ This scenario creates a stop-controlled intersection on Lawrence Square Boulevard.

Advantages

- ◆ This scenario eliminates the spill back queue from the southbound left-turn lane into the through lanes and should reduce rear end crashes and same direction sideswipe crashes.
- ◆ Southbound through movements are improved.

Disadvantages

- ◆ The land on the northwest quadrant is located on a retention basin and has steep grades.
- ◆ This option is expensive. ROW would have to be acquired.
- ◆ This option would cause an inconvenience for southbound motorists desiring to access Village Road, including motorists desiring to make a U-turn at the signal.
- ◆ Additional traffic is added to Lawrence Square Boulevard by the intersection, which is a private roadway to the Lawrence Square Village housing development.

LOS

Compared with existing conditions, the overall delay is reduced by 12 seconds in the morning peak period and remains the same in the afternoon. As shown in **Table 8**, the morning delays are reduced along all the approaches, with the highest reductions shown on the northbound (18 seconds) and southbound (17 seconds) approaches. In the afternoon, the delay on the eastbound approach increases by 25 seconds. This is attributed to the additional traffic from the southbound left-turning vehicles from Quakerbridge Road. The westbound approach has a significant decrease in delay of 15 seconds, which is the result of the channelized right-turn lane.

Table 9: LOS Analysis – Scenario 3

Direction	Existing Condition				Scenario 3			
	AM		PM		AM		PM	
	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS	Delay (s)	LOS
NB Quakerbridge Road	39	D	29	C	24	C	20	B
SB Quakerbridge Road	32	C	27	C	17	B	29	C
EB Lawrence Square Boulevard	50	D	33	C	37	D	58	E
WB Village Road	39	D	54	D	32	C	39	D
Total Intersection	38	D	32	C	26	C	32	C

Source: DVRPC, 2012.

Scenario 4 – Widen Quakerbridge Road between the Two Study Intersections

Description

- ◆ The traffic signal at the Quakerbridge Road and Village Road/Lawrence Square Road intersection would be optimized. The cycle length would be 90 seconds for both periods.
- ◆ This option would widen the existing Quakerbridge Road northbound and southbound through lanes and includes the partial removal of the concrete median to accommodate a longer southbound left-turn lane at the Quakerbridge Road and Village Road/Lawrence Square Boulevard intersection.
- ◆ A sidewalk would be added along the west side of Quakerbridge Road.

Advantages

- ◆ This option would maximize traffic flow along Quakerbridge Road between the study intersections.
- ◆ The southbound left-turn lane is able to accommodate more vehicles, thus minimizing conflict with southbound through traffic.
- ◆ Pedestrians would be able to travel safely between the study intersections.

Disadvantages

- ◆ This option is expensive. This would be a major capital improvement, requiring ROW acquisition. Quakerbridge Road crosses the Northeast Corridor; thus, there are major grading issues and adverse environmental impacts.
- ◆ Widening Quakerbridge Road would take several years to construct. It would have to go through the Transportation Improvement Program funding process, preliminary engineering, environment impact assessments, etc.

This scenario was not modeled because it did not add lanes along Quakerbridge Road and optimize the signal; therefore, the LOS results for this scenario are the same as for Scenario 1.

Conclusions from Scenarios

The intersection of Quakerbridge Road at Village Road/Lawrence Square Boulevard currently operates at acceptable levels. All of the scenarios considered provide some benefit in reducing the traffic delays and making the intersection safer. Although delay is added on some of the approaches, Scenario 1 shortens the cycle length, which moves more traffic through the intersection. Scenario 4 provides the best safety benefit for pedestrians; however, the very high cost and long timeframe for implementation is not worth consideration. Scenario 3 would likely have the greatest impact; since it provides a reduction in delay at most of the intersection approaches, particularly in the morning for the southbound approach and in the afternoon for the westbound approach.

Figure 7

Potential Improvements

Note: **RED** text denotes shorter-term potential improvement
GREEN text denotes medium-term potential improvement
BLUE text denotes longer-term potential improvement



ADD INTERSECTION AHEAD WARNING SIGNS

CONSIDER ADDING TRANSVERSE RUMBLE STRIPS

ADD CROSSWALKS

WIDEN AND CONSTRUCT SIDEWALK ACROSS THE BRIDGE

CONSIDER ADDING DO NOT BLOCK THE BOX PAVEMENT MARKING FOR SB CR 533 TRAFFIC

EXTEND THE LEFT-TURN LANE

ADD CHANNELIZED RIGHT-TURN LANE

SHIFT STOP BAR TOWARDS THE INTERSECTION

INCREASE THE CURB RADIUS

INVESTIGATE CONSTRUCTING SIDEWALK ALONG CR 533 AND RESTRIPE CROSSWALK MARKINGS

OPTIMIZE THE SIGNAL TIMING

CONSTRUCT NEAR-SIDE JUG HANDLE TO ELIMINATE CR 533 SB LEFT-TURNING MOVEMENTS

0 50 100 Feet

Aerial Imagery: NJOIT, 2012



Recommendations

At the follow-up meeting held on April 23, 2012, representatives from the Mercer County Engineering Department, Mercer County Planning Division, Lawrence and West Windsor townships, and DVRPC worked together to develop a set of recommendations from the potential strategies. Numerous options were discussed; however, given the land use limitations and high costs, developing recommendations for the Quakerbridge Road at Village Road/Lawrence Square Boulevard and Quakerbridge Road at Lawrence Station Road intersections was challenging. Many of the recommendations described below in Tables 9 and 10 are short term, low in cost, and could be implemented in less than one year. There is one medium term recommendation that is more expensive and would take between one to five years to implement. All of these recommendations could be implemented depending on available funding.

Table 10: Recommendations for Quakerbridge Road at Village Road/Lawrence Square Boulevard Intersection

Item	Who Plans to Do It?	Approximately When Would It Be Done?
1. Increase the turn radius for the northbound right-turn traffic.	Mercer County Engineering Department	Medium term
2. Shift the stop bar toward the intersection.	Mercer County Engineering Department	Short term
3. Restripe crosswalk markings.	Mercer County Engineering Department	Short term

Source: DVRPC, 2012.

Table 11: Recommendation for Quakerbridge Road at Lawrence Station Road Intersection

Item	Who Plans to Do It?	Approximately When Would It Be Done?
1. Add intersection warning signs.	West Windsor Township Engineering Department	Short term

Source: DVRPC, 2012.

The traffic and safety impacts of future development should be carefully considered. After the follow-up meeting, some additional recommendations were made regarding future development of properties adjacent to both study intersections.

Quakerbridge Road at Village Road/Lawrence Square Boulevard Intersection

Issue

There is possible interest from developers in constructing a convenience store at the northeast corner of Quakerbridge Road and Village Road. If plans were to move forward, the developer would likely request access on Quakerbridge Road.

Recommendation

Mercer County Planning and Engineering Departments recommend that limited access be given on Quakerbridge Road. Full access will be given on Village Road.

Quakerbridge Road at Lawrence Station Road Intersection

Issue

A big box retailer recently expressed interest in building a store at the northwest corner of Quakerbridge Road and Lawrence Station Road. If plans were to move forward, the developer would likely request access on Quakerbridge Road.

Recommendations

Mercer County Planning and Engineering Departments recommend the following:

- ◆ Access points on Quakerbridge Road should be limited. The primary access should be on Lawrence Station Road.
- ◆ The intersection of Quakerbridge Road at Lawrence Station Road should be signalized.

APPENDIX



Study Advisory Committee Members

Table A-1: Study Advisory Committee Members

Name	Organization	Title
Jesse Buerk	DVRPC	Transportation Planner
Regina Moore	DVRPC	Transportation Engineer
Zoe Neaderland	DVRPC	Manager of the Office of Transportation Safety and Congestion Management
James Parvesse	Lawrence Township	Township Engineer
Dan Posluszny	Lawrence Township	Chief of Police
George Fallat	Mercer County Engineering Department	County Engineer
Matt Lawson	Mercer County Planning Division	Principal Planner
Francis Guzik	West Windsor Township	Township Engineer
Pat Ward	West Windsor Township	Director of Community Development
Joe Pica	West Windsor Township	Chief of Police

Source: DVRPC, 2012.

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Abstract: This document represents the findings and recommendations for the Congestion and Crash Site Analysis Program study conducted in Mercer County in Fiscal Year 2012. This program represents an effort to improve the mobility and safety on 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 a data-driven process and the Mercer County Planning and Engineering Departments, the intersections of Quakerbridge Road (CR 533) at Village Road/Lawrence Square Boulevard and Quakerbridge Road at Lawrence Station Road were chosen. In-depth crash and level of service analyses were performed to gain an understanding of the issues. With input from the advisory committee, improvement strategies were identified to address the issues. As appropriate, proposed improvement strategies were tested for effectiveness. The study resulted in recommendations to improve safety and reduce congestion at the two intersections.

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