SCHOENERSVILLE ROAD CORRIDOR SIGNAL STUDY

City of Bethlehem, Hanover Township (Lehigh County), and Hanover Township (Northampton County)

Lehigh County & Northampton County

Prepared by:

Lehigh Valley Planning Commission
961 Marcon Blvd., Suite 310
Allentown, PA 18109-9397

Prepared for:

Lehigh Valley Transportation Study
PennDOT District 5

August 2013
b Schoenersville Road Corridor Signal Study
The preparation of this report has been financed in part through grants from the Federal Highway Administration, U.S. Department of Transportation, under the Metropolitan Planning Program, Section 104(f) of Title 23, U.S. Code.

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the views or policies of either the U.S. Department of Transportation, Federal Highway Administration (FHWA), Federal Transit Administration (FTA) or the Commonwealth of Pennsylvania at the time of publication. This report does not constitute a standard, specification, or regulation.
INTRODUCTION

The Lehigh Valley Planning Commission (LVPC) conducted a study of a portion of the Schoenersville Road corridor in the City of Bethlehem, Lehigh County and Hanover Township, Northampton County to gauge the potential for improving traffic signals to more efficiently move people and goods. Building additional road capacity in today’s economic climate with transportation funds more limited now than at any point in the recent past is much more difficult. Instead of building additional capacity, traffic flow improvements are more likely to be obtained through improved management and operation of the existing infrastructure. Improvements to traffic signals can yield a low cost/high benefit impact. Updating or modernizing signal components or entire signal heads can reduce congestion, improve safety, improve mobility by reducing the overall number of vehicle stops thus decreasing delay, and reduce fuel consumption and the associated negative impact to air quality.

Nationwide, there are about 330,000 traffic signals and, according to FHWA, 75% of those signals could be improved by updating equipment or adjusting the timing. Statewide, there are 13,600 traffic signals; 718 traffic signals are located in Lehigh and Northampton counties.

PennDOT does not own or maintain any traffic signals in the Commonwealth. All traffic signals are owned, maintained, and operated by the 2,566 municipalities located within Pennsylvania’s 67 counties. Municipalities often treat traffic signals, with regards to revising signal timing plans, as the responsibility of PennDOT. PennDOT’s authority is limited to the review and approval of signal permitting and timing plans.

The purpose of this planning report is to present the data collected within the corridor and the analysis performed in the interest of determining if further engineering-type analysis is warranted to retime the traffic signals. If further analysis is warranted, additional data collection efforts will be undertaken.

IDENTIFICATION OF CANDIDATE CORRIDORS

The Lehigh Valley Transportation Study (LVTS), the Metropolitan Planning Organization (MPO) for Lehigh and Northampton counties, utilized multiple sources of data to identify candidate corridors for study. Corridors were first identified through a review of the Lehigh Valley Congestion Management Process — 2008 report. This document identifies corridors of at least one mile in length anticipated to be congested in the year 2030. Four corridors were identified in this report as a candidate for study. The second identification of candidate corridors utilized a geographic information system for transportation (GIS-T). A geographic information system is an information system specializing in the input, management, analysis and reporting of geographical (spatially related) information. GIS-T refers to the principles and applications of applying geographic information technologies to transportation problems. The GIS-T was reviewed for signalized corridors, length of corridor, number of traffic signals within the corridor, traffic signal density per linear mile, roadway functional classification of the facility, traffic volumes within the corridor, and type of signals present (fully-actuated, semi-actuated, pre-timed, volume-density). Corridor field views were conducted as necessary. Six corridors were identified through this process. All ten corridors are listed in Table 1.
**DESCRIPTION OF SELECTED CORRIDOR**

The entire Schoenersville Road corridor (SR 1009) spans the City of Bethlehem, Hanover Township (Lehigh County), and Hanover Township (Northampton County) from Airport Road to Mauch Chunk Road for a distance of 2.80 miles. A portion of the Schoenersville Road corridor from Avenue C/Stoke Park Road to 8th Avenue was chosen for study, a distance of 1.84 miles as shown on Map 1. This corridor was chosen due to its traffic signals operating on dated signal timing plans and due to the importance of this corridor for access to US Route 22, medical facilities, varied retail establishments, and proximity to large residential developments. This corridor was considered a high priority for study after the Lehigh Street corridor in Allentown and Northampton Street corridor in Easton were completed.

The surrounding area contains a mixture of various zoning classifications/land uses ranging from light industrial, office/business, commercial, institutional, mixed use, urban residential, retail commercial, and suburban residential. Most of these zoning classifications/land uses have frontage and access on Schoenersville Road. A few of the zoning classifications do not have frontage but are located within close proximity to the corridor.

The majority of the corridor is a bituminous-type paving. Only the section between the US Route 22 westbound ramp and Macada Road is concrete. It is classified as a minor arterial. This higher-level classification has the primary function of moving traffic with a lesser function of providing access to properties. The entire length of the corridor from 8th Avenue to Avenue C/Stoke Park Road is 1.84 miles and contains 11 traffic signals for a signal density of nearly six traffic signals per mile.

Annual Average Daily Traffic (AADT) varies throughout the corridor. Traffic volumes were obtained utilizing PennDOT's Internet Traffic Monitoring System (ITMS). The northern portion
of the corridor (north of Industrial Drive) has the lowest traffic volumes at 9,900 AADT. The central portion of the corridor, in the vicinity of the US Route 22 interchange, has traffic volumes as high as 31,200 AADT. The section of the corridor between the US Route 22 eastbound ramps and Catasauqua Road/Birchwood Drive also sees high volumes of traffic up to 19,000 AADT. The southernmost portion of the corridor between Catasauqua Road/Birchwood Drive and 8th Avenue has traffic volumes of 24,400 AADT. In addition, six of the 11 intersections have signal timing plans dating back to 2004. These high volumes, coupled with the high density of traffic signals along the corridor, and outdated signal timing plans indicate the need for signal system upgrades. Table 2 defines signal timing plan issue dates/revision dates by intersection. Table 3 depicts signal control type by intersection.

The 11 traffic signals are located at the following intersections along Schoenersville Road: 8th Avenue, Illicks Mill Road, Catasauqua Road/Birchwood Drive, Jacksonville Road, Westgate Drive, West Macada Road, US Route 22 Eastbound ramps, US Route 22 Westbound ramps, Industrial Drive, City Line Road/Valley Center Parkway, and Avenue C/Stoke Park Road.

The corridor is an important one for the City of Bethlehem for a number of reasons. The north-south corridor (SR 1009) provides access to varied retail/commercial/industrial/residential and other important economic-generating land uses. Four industrial parks employing over 10,000
persons are located either adjacent to or within close proximity to Schoenersville Road. It also provides a direct access point onto US Route 22, the Lehigh Valley’s main thoroughfare. This corridor is also important to emergency service vehicles for access to Lehigh Valley Hospital Center’s Muhlenberg campus.

**TRAFFIC SIGNAL TERMINOLOGY AND EXISTING SIGNAL CONTROL TYPES**

Modern traffic signals allocate time in a variety of ways from the most simple two-phase pre-timed mode to the most complex adaptive traffic signal control. This section briefly describes the basic terminology of traffic signals and the various types of signal operations. The following terms are commonly used to describe traffic signal operations:

**CYCLE** - any complete sequence of signal indications.

**CYCLE LENGTH** - the total time for a signal to complete one cycle.

---

**TABLE 2**

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Date of Timing Plan Last Issue Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avenue C/Stoke Park Rd.</td>
<td>9/9/2009</td>
</tr>
<tr>
<td>City Line Rd./Valley Center Parkway</td>
<td>1/18/2008</td>
</tr>
<tr>
<td>Industrial Drive</td>
<td>9/9/2009</td>
</tr>
<tr>
<td>Rt. 22 Westbound Ramps</td>
<td>4/9/2004</td>
</tr>
<tr>
<td>Rt. 22 Eastbound Ramps</td>
<td>1/7/2005</td>
</tr>
<tr>
<td>W. Macada Rd./Private Dr.</td>
<td>4/9/2004</td>
</tr>
<tr>
<td>Westgate Dr.</td>
<td>4/9/2004</td>
</tr>
<tr>
<td>Jacksonville Rd.</td>
<td>4/9/2004</td>
</tr>
<tr>
<td>Catasauqua Rd./Birchwood Dr.</td>
<td>4/9/2004</td>
</tr>
<tr>
<td>Illicks Mill Rd.</td>
<td>11/23/2004</td>
</tr>
<tr>
<td>8th Ave.</td>
<td>5/3/2006</td>
</tr>
</tbody>
</table>

**TABLE 3**

<table>
<thead>
<tr>
<th>#</th>
<th>Intersection</th>
<th>Control Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Schoenersville Road/Avenue C/Stoke Park Road</td>
<td>Semi-Actuated</td>
</tr>
<tr>
<td>2</td>
<td>Schoenersville Road/City Line Road/Valley Center Parkway</td>
<td>Semi-Actuated</td>
</tr>
<tr>
<td>3</td>
<td>Schoenersville Road/Industrial Drive</td>
<td>Fully-Actuated</td>
</tr>
<tr>
<td>4</td>
<td>Schoenersville Road/US Route 22 Westbound Ramps</td>
<td>Semi-Actuated</td>
</tr>
<tr>
<td>5</td>
<td>Schoenersville Road/US Route 22 Eastbound Ramps</td>
<td>Semi-Actuated</td>
</tr>
<tr>
<td>6</td>
<td>Schoenersville Road/W Macada Road/Private Drive</td>
<td>Fully-Actuated</td>
</tr>
<tr>
<td>7</td>
<td>Schoenersville Road/Westgate Drive</td>
<td>Semi-Actuated</td>
</tr>
<tr>
<td>8</td>
<td>Schoenersville Road/Jacksonville Road</td>
<td>Fully-Actuated</td>
</tr>
<tr>
<td>9</td>
<td>Schoenersville Road/Catasauqua Road/Birchwood Drive</td>
<td>Fully-Actuated</td>
</tr>
<tr>
<td>10</td>
<td>Schoenersville Road/Illicks Mill Road</td>
<td>Fully-Actuated</td>
</tr>
<tr>
<td>11</td>
<td>Schoenersville Road/8th Avenue</td>
<td>Fully-Actuated</td>
</tr>
</tbody>
</table>
**PHASE** - the part of a cycle allocated to any combination of traffic movements receiving the right-of-way simultaneously during one or more intervals.

**CHANGE INTERVAL** - the “yellow” plus “all red” intervals that occur between phases to provide for clearance of the intersection before conflicting movements are released.

**GREEN TIME** - the time within a given phase during which the “green” indication is shown.

**LOST TIME** - time during which the intersection is not effectively used by any movement. These times occur during the change interval (when the intersection is clearing) and at the beginning of each phase as the first few cars in a standing queue experience start-up delays.

**EFFECTIVE GREEN TIME** - the time during a given phase that is effectively available to the permitted movement, generally taken to be the green time plus the change interval minus the lost time for the designated phase.

**GREEN RATIO** - the ratio of effective green time to the cycle length.

**EFFECTIVE RED** - the time during which a given movement or set of movements is effectively not permitted to move.

Traffic signals may operate in five basic modes depending on the type of control equipment used. The five modes are described below.

**PRE-TIMED** - Pre-timed control is ideally suited to closely spaced intersections where traffic volumes and patterns are consistent on a daily or day-of-week basis. Such conditions are often found in downtown areas. They are also better suited to intersections where three or fewer phases are needed. Pre-timed control has several advantages. For example, it can be used to provide efficient coordination with adjacent pre-timed signals, since both the start and end of green are predictable. Also, it does not require detectors, thus making its operation immune to problems associated with detector failure. Finally, it requires a minimum amount of training to set up and maintain. On the other hand, pre-timed control cannot compensate for unplanned fluctuations in traffic flows, and it tends to be inefficient at isolated intersections where traffic arrivals are random.

**SEMI-ACTUATED** - Semi-actuated control uses detection only for the minor movements at an intersection. The phases associated with the major-road through movements are operated as “non-actuated.” That is, these phases are not provided detection information. In this type of operation, the controller is programmed to dwell in the non-actuated phase and, thereby, sustain a green indication for the highest flow movements (normally the major-road through movement). Minor movement phases are serviced after a call for their service is received. Semi-actuated control is most suitable for application at intersections that are part of a coordinated arterial street system. Semi-actuated control may also be suitable for isolated intersections with a low-speed major road and lighter crossroad volume. Semi-actuated control has several advantages. Its primary advantage is that it can be used effectively in a coordinated signal system. Also, relative to pre-timed control, it reduces the delay incurred by the major-road through movements (i.e., the movements associated with the non-actuated phases) during periods of light traffic. Finally, it does not require detectors for the major-road through movement phases and hence, its operation is not compromised by the failure of these detectors. The major disadvantage of semi-actuated operation is that continuous demand on the phases associated with one or more minor movements can cause excessive delay.
to the major-road through movements if the maximum green and passage time parameters are not appropriately set. Another drawback is that detectors must be used on the minor approaches, thus requiring installation and ongoing maintenance. Semi-actuated operation also requires more training than that needed for pre-timed control.

**FULLY-ACTUATED** - Fully-actuated control refers to intersections for which all phases are actuated and hence, it requires detection for all traffic movements. Fully-actuated control is ideally suited to isolated intersections where the traffic demands and patterns vary widely during the course of the day. Most modern controllers in coordinated signal systems can be programmed to operate in a fully-actuated mode during low-volume periods where the system is operating in a “free” (or non-coordinated) mode. Fully-actuated control can also improve performance at intersections with lower volumes that are located at the boundary of a coordinated system and do not impact progression of the system. Fully-actuated control has also been used at the intersection of two arterials to optimize green time allocation in a critical intersection control method. There are several advantages of fully-actuated control. First, it reduces delay relative to pre-timed control by being highly responsive to traffic demand and to changes in traffic pattern. In addition, detection information allows the cycle time to be efficiently allocated on a cycle-by-cycle basis. Finally, it allows phases to be skipped if there is no call for service, thereby allowing the controller to reallocate the unused time to a subsequent phase. The major disadvantage of fully-actuated control is that its cost (initial and maintenance) is higher than that of other control types due to the amount of detection required. It may also result in higher percentage of vehicles stopping because green time is not held for upstream platoons.

**VOLUME-DENSITY** – Volume-density signal control is more advanced than fully-actuated control. The signal records and retains actual traffic volumes. Vehicles queued up over a certain distance cause information to be sent to a traffic controller, and the controller adjusts the length of green time.

**ADAPTIVE TRAFFIC SIGNAL CONTROL** – Adaptive traffic signal control is a concept where vehicular traffic in a network is detected at an upstream and/or downstream point and an algorithm is used to predict when and where the traffic will be and to make signal adjustments at the downstream intersections based on those predictions. The signal controller utilizes these algorithms to compute optimal signal timings based on detected traffic volume and simultaneously implement the timings in real-time. This real-time optimization allows a signal network to react to volume variations, which results in reduced vehicle delay, shorter queues, and decreased travel times. Adaptive traffic control can have an impact where traffic conditions fluctuate randomly on a day-to-day basis, traffic conditions change rapidly due to new or changing developments in land use, incidents, crashes, or other events result in unexpected changes to traffic demand, and other disruptive events, such as a preemption, require a response.
INTERSECTION AND LANE GEOMETRY AND EXISTING SIGNAL TIMING PLANS

The following is a description of each signalized intersection including aerial photographs. Signal permit plans can be found in Appendix B.

Schoenersville Road/Avenue C/Stoke Park Road Intersection

Schoenersville Road (SR 1009) is classified as a minor arterial and runs in a northwest to southeast manner along the border between Lehigh and Northampton County and the City of Bethlehem and Hanover Township. Figure 1 shows the location of the intersection. Its posted speed limit at this location is 40 mph. Avenue C is classified as a local road, runs in a west to east manner, and joins Schoenersville Road from the west. The western terminus of Stoke Park Road is classified as a local road, runs in a west to east manner, and joins Schoenersville Road from the east.

This intersection is a four-way, semi-actuated signalized intersection. The southbound approach of Schoenersville Road to Avenue C/Stone Park Road is a four-lane road with a dedicated left turn only lane, a dedicated right turn only lane, and two through lanes. No on-street parking is allowed. The northbound approach of Schoenersville Road is a four-lane road with a dedicated left turn only lane, a dedicated right turn only lane, and two through lanes. No on-street parking is allowed. Signal preemption exists on all approaches. Curb cuts with truncated domes, pedestrian signal heads, and marked crosswalks exist on all intersection quadrants. Sidewalks are present only on the southwest quadrant. Traffic signals do not contain backplates.
Schoenersville Road/City Line Road/Valley Center Parkway Intersection

Figure 2 shows the location of the intersection. Schoenersville Road’s posted speed limit at this location is 40 mph. City Line Road is classified as an urban collector, runs in a west to east manner, and joins Schoenersville Road from the west. Valley Center Parkway is classified as a local road, runs in a west to east manner, and joins Schoenersville Road from the east.

This intersection is a four-way, semi-actuated signalized intersection. The southbound approach of Schoenersville Road is three lanes with a dedicated left turn only lane, a through lane, and a shared through/right turn lane. No on-street parking is allowed. The northbound approach is four-lanes with a dedicated left turn only lane, a dedicated right turn only lane, and two through lanes. No on-street parking is allowed. Signal preemption exists for the northbound, southbound, and westbound approaches. Curb cuts exist only on the two northern quadrants. However, no sidewalks, truncated domes, or signal backplates exist. Pedestrian signal heads and marked crosswalks occupy all quadrants.

FIGURE 2
Schoenersville Road/City Line Road/Valley Center Parkway Intersection

Source: Pictometry International Corp., 2009
Schoenersville Road/Industrial Drive Intersection

Figure 3 shows the location of the intersection. Schoenersville Road’s posted speed limit at this location is 40 mph. Industrial Drive is classified as a local road, runs in a west to east manner, and joins Schoenersville Road from the west.

This intersection is a three-way, fully-actuated signalized intersection. The southbound approach of Schoenersville Road to Industrial Drive is three lanes with a dedicated left turn only lane, a through lane, and a shared through/right turn lane. No on-street parking is allowed. The northbound approach of Schoenersville Road to Industrial Drive is three lanes with a dedicated left turn only lane and two through lanes. No on-street parking is allowed. All quadrants of this intersection lack curb cuts, truncated domes, pedestrian signal heads, and sidewalks. Signal preemption exists for the southbound and northbound approaches. Signal backplates are present. Marked crosswalks are present on the northbound, southbound, and eastbound approaches.

**FIGURE 3**
Schoenersville Road/Industrial Drive Intersection

*Source: Pictometry International Corp., 2009*
Schoenersville Road/US Route 22 Westbound Intersection

Figure 4 shows the location of the intersection. Schoenersville Road’s posted speed limit at this location is 40 mph. The US Route 22 exit and entrance ramps are classified as freeways and expressways and run in an east to west manner.

This intersection is a four-way, semi-actuated signalized intersection. The southbound approach of Schoenersville Road is two lanes with a through lane and a shared through/right turn lane. No on-street parking is allowed. The northbound approach of Schoenersville Road is three lanes with a dedicated left turn only lane and two through lanes. No on-street parking is allowed. All quadrants of this intersection lack curb cuts, truncated domes, pedestrian signal heads, and sidewalks. However, marked crosswalks are present on all quadrants. Signal backplates exist on the westbound approach. Signal preemption is on all three approaches.

**FIGURE 4**
Schoenersville Road/US Route 22 West Intersection

*Source: Pictometry International Corp., 2009*
Schoenersville Road/US Route 22 Eastbound Intersection

Figure 5 shows the location of the intersection. Schoenersville Road’s posted speed limit at this location is 40 mph. The US Route 22 exit and entrance ramps are classified as freeways and expressways and run in a west to east manner.

This intersection is a three-way, semi-actuated signalized intersection. The southbound approach of Schoenersville Road is three lanes with a dedicated left turn only lane and two through lanes. No on-street parking is allowed. The northbound approach is two lanes with two through lanes and a right turn channelized lane. No on-street parking is allowed. Signal preemption and back-plates exist for all 3 approaches. Curb cuts, truncated domes, pedestrian signal heads, marked crosswalks, and sidewalks are absent from the intersection.

FIGURE 5
Schoenersville Road/US Route 22 East Intersection

Source: Pictometry International Corp., 2009
Schoenersville Road/West Macada Road/Private Drive Intersection

Figure 6 shows the location of the intersection. Schoenersville Road's posted speed limit at this location is 40 mph. West Macada Road is classified as an urban collector, runs in a west to east manner, and joins Schoenersville Road from the east. A private drive to access Lehigh Valley Hospital's Muhlenberg campus runs in an east to west manner and joins Schoenersville Road from the west.

This intersection is a four-way, fully-actuated signalized intersection. The southbound approach of Schoenersville Road is four lanes with a dedicated left turn only lane, a dedicated right turn only lane, and two through lanes. No on-street parking is allowed. The northbound approach of Schoenersville Road is three lanes with a dedicated left turn only lane and one shared through right turn lane. No on-street parking is allowed. This intersection contains signal preemption, signal backplates, pedestrian signal heads and marked crosswalks for all approaches. However, sidewalks and truncated domes are absent. Curb cuts are present on the two western quadrants.

FIGURE 6
Schoenersville Road/West Macada Road/Private Drive Intersection

Source: Pictometry International Corp., 2009
Schoenersville Road/Westgate Drive Intersection

Figure 7 shows the location of the intersection. Schoenersville Road’s posted speed limit at this location is 40 mph. Westgate Drive is classified as an urban collector, runs in an east to west manner, and joins Schoenersville Road from the west.

This intersection is a three-way, semi-actuated signalized intersection. The southbound approach of Schoenersville Road is two lanes with a through lane and a shared through/right turn lane. No on-street parking is allowed. The northbound approach of Schoenersville Road is three lanes with a dedicated left turn only lane and two through lanes. No on-street parking is allowed. This intersection contains signal preemption, signal backplates, pedestrian signal heads, and marked crosswalks on all approaches. Curb cuts exist on the two northern quadrants while a sidewalk exists only on the northeast quadrant. Truncated domes are absent.

**FIGURE 7**
Schoenersville Road/Westgate Drive Intersection

*Source: Pictometry International Corp., 2009*
Schoenersville Road/Jacksonville Road Intersection

Figure 8 shows the location of the intersection. Schoenersville Road’s posted speed limit at this location is 40 mph. Jacksonville Road is classified as an urban collector and runs in a north-north-east to south-southwest manner.

This intersection is a three-way, fully-actuated signalized intersection. The southbound approach of Schoenersville Road is four lanes with a dedicated left turn only lane and three through lanes. No on-street parking is allowed. The northbound approach of Schoenersville Road is two lanes with a through lane and a shared through/right turn lane. No on-street parking is allowed. This intersection is absent of any signal backplates, pedestrian signal heads, marked crosswalks, or truncated domes. Traffic signal preemption is present only for the southbound Schoenersville Road and Jacksonville Road movements. One curb cut exists on the east intersection quadrant.

FIGURE 8
Schoenersville Road/Jacksonville Road Intersection

Source: Pictometry International Corp., 2009
Schoenersville Road/Catasauqua Road/Birchwood Drive Intersection

Figure 9 shows the location of the intersection. Schoenersville Road’s posted speed limit at this location is 40 mph. Catasauqua Road (SR 1020) is classified as an urban collector, runs in a west to east manner, and joins Schoenersville Road from the west. Birchwood Drive is classified as a local road, runs in a west to east manner, and joins Schoenersville Road from the east.

This intersection is a four-way, fully-actuated signalized intersection. The southbound approach of Schoenersville Road is three lanes with a dedicated right turn only lane, a through lane, and a shared through/left turn lane. No on-street parking is allowed. The northbound approach is three lanes with a dedicated left turn only lane, a through lane, and a shared through/right turn lane. No on-street parking is allowed. Traffic signal preemption exists for the northbound, eastbound, and westbound approaches. Curb cuts, truncated domes, signal backplates, pedestrian signal heads, and marked crosswalks are absent. However, sidewalks are present on the northeast and southwest quadrants.

FIGURE 9
Schoenersville Road/Catasauqua Road/Birchwood Drive Intersection

Source: Pictometry International Corp., 2009
Schoenersville Road/Illicks Mill Road Intersection

Figure 10 shows the location of the intersection. Schoenersville Road’s posted speed limit at this location is 40 mph. Illicks Mill Road is classified as an urban collector, runs in an east to west manner and joins Schoenersville Road from the east.

This intersection is a three-way, fully-actuated signalized intersection. The southbound approach of Schoenersville Road is three lanes with a dedicated left turn only lane and two through lanes. On-street parking is allowed on the west side of the street. The northbound approach of Schoenersville Road to Illicks Mill Road is two lanes with a through lane and a shared through/right turn lane. No on-street parking is allowed on the east side of the street. This intersection contains pedestrian signal heads and marked crosswalks. Sidewalks are present on the western and south-eastern quadrants of the intersection. Curb cuts, truncated domes, signal preemption, and signal backplates are absent.

**FIGURE 10**
Schoenersville Road/Illicks Mill Road Intersection

*Source: Pictometry International Corp., 2009*
Schoenersville Road/8th Avenue Intersection

Figure 11 shows the location of the intersection. Schoenersville Road’s posted speed limit at this location is 40 mph. 8th Avenue between Schoenersville Road and Eaton Avenue is classified as a minor arterial, runs in a north to south manner, and joins Schoenersville Road from the south.

This intersection is a three-way, fully-actuated signalized intersection. The southbound approach of Schoenersville Road is two lanes with a dedicated right turn only lane and a through lane. On-street parking is allowed on the west side of the street. The northbound approach of Schoenersville Road is two lanes, both of which are through lanes. No on-street parking is allowed. Curb cuts are present within the pedestrian island, at the northern Wawa property line, and on the north and south sides of Jerome Street. Truncated domes are present within the pedestrian island and at the northern Wawa property line. Signal preemption is present for the northbound and southbound Schoenersville Road approaches. Pedestrian signal heads exist at Jerome Street Sidewalks are present within the pedestrian island, along the east and west sides of the Wawa property, and along the west side of Schoenersville Road and 8th Avenue Signal backplates and marked crosswalks are absent from the intersection.

**FIGURE 11**
Schoenersville Road/8th Avenue Intersection

*Source: Pictometry International Corp., 2009*
CRASH ANALYSIS

Crash data was compiled using PennDOT’s Crash Data Analysis Retrieval Tool (CDART) system. The most recent crash data from years 2008 to 2012 was utilized. According to Section 3746(a) of Title 75, Pennsylvania’s Consolidated Statute defines a reportable crash as a crash that involves injury to or death of any person and/or damage to any motor vehicle to the extent that it cannot be driven under its own power in its customary manner without further damage or hazard to the vehicle or other traffic elements or the roadway, and therefore requires towing. The crash analysis shows that there were a total of 168 reportable crashes along the corridor, including one fatality and five major crashes. Among the crashes, 50% were angle collisions and 33% were rear end collisions. The one fatality that occurred during this period was a bicycle-related crash that was a combination of an automobile speeding and the cyclist entering the highway improperly. US Route 22 eastbound and westbound ramps connecting to Schoenersville Road had a high frequency of crashes with 46 reported crashes and one major injury. Three of the signalized intersections out of the 11 that are accounted for in this study had 20 or more crashes. The following intersections are worth noting:

► Schoenersville Road/Avenue C/Stoke Park Road – This intersection contained 21 crashes. Three of the crashes involved caused major injuries. Two of these major crashes were angle collisions. Five of these crashes were caused by improper or careless turns.

► Schoenersville Road/US Route 22 Eastbound Ramps – Twenty-two crashes occurred at this intersection with one major injury. Seven of these crashes were caused by improper or careless left turns from vehicles traveling south. The signal should be reviewed for possible upgrades.

► Schoenersville Road/US Route 22 Westbound Ramps – This intersection contained 24 crashes. Five of these crashes involved running red lights. Six of them were caused by improper or careless turns, three of these were cars traveling west in the PM peak hours and may have been affected by sun glare. The signals should be reviewed for possible visibility upgrades.

► Schoenersville Road/8th Avenue – Fourteen crashes occurred at this intersection. Six of these crashes involved running red lights. Among them, five were from vehicles traveling south. The signal should be reviewed for possible upgrades.

Detailed crash data will be provided to PennDOT for their consideration. However, it has been suppressed in this report considering its confidentiality pursuant to 75 PA C.S. 3754 and 23 U.S.C. 409 and may not be disclosed or used in litigation without written permission from PennDOT.

SPEED AND DELAY RUNS

LVPC conducted data collection in January 2013. Data collected involved contact with the City of Bethlehem to obtain recent traffic count data along Schoenersville Road. The City provided a current traffic count conducted in April 2012 for the intersections of Schoenersville Road with Jacksonville Road and Catasauqua Road/Birchwood Drive. This data provided the AM and PM peak hour of traffic (the four consecutive 15-minute intervals of highest traffic volumes) which is the targeted time of the speed and delay runs. The AM peak hour for the Schoenersville Road/Jacksonville Road intersection started at 7:30. The PM peak hour began at 4:30. The AM peak hour for the Schoenersville Road/Catasauqua Road/Birchwood Drive intersection started at 7:45. The PM peak hour began at 4:30.
Speed and delay are two principal measures of roadway system performance. A speed and delay study provides valuable data prior to implemented improvements that may be compared to data obtained after the implementation of improvements to show a net benefit through increased speeds and reduced delay. Speed and delay data collection involves conducting travel runs along the corridor in a test vehicle, documenting travel times between signals, stopped delay, and delay-causing events. The test vehicle driver travels at a speed dictated by the prevailing speed (not the posted speed limit) of vehicles along the corridor. This is accomplished by attempting to safely pass as many vehicles as pass the test vehicle. Speed and delay runs were conducted for the AM and PM peak periods on Thursday, January 17, 2013.

Table 4 depicts a summation of all nine directional travel runs conducted during both the AM and PM peak periods for Schoenersville Road. The speed limit throughout the entire corridor is 40 mph. The cumulative travel time and cumulative stopped delay depict the travel time and stopped delay for all nine speed and delay runs conducted for the corridor.

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Direction</th>
<th>Time AM/PM</th>
<th>Cumulative Travel Time (min) : (sec)</th>
<th>Cumulative Stopped Delay (min) : (sec)</th>
<th>Travel Speed (mph)</th>
<th>Posted Speed (mph)</th>
<th>% of Intersections Experiencing Stops</th>
<th>% Travel Speed of Posted Speed</th>
<th>Average Queue Lengths</th>
<th># of Cycle Failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schoenersville Rd.</td>
<td>Northbound</td>
<td>AM</td>
<td>19 : 17</td>
<td>2 : 56</td>
<td>28.6</td>
<td>40</td>
<td>50.0%</td>
<td>71.6%</td>
<td>4.7</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Southbound</td>
<td>AM</td>
<td>26 : 28</td>
<td>7 : 30</td>
<td>20.9</td>
<td>40</td>
<td>100.0%</td>
<td>52.2%</td>
<td>2.7</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Northbound</td>
<td>PM</td>
<td>23 : 3</td>
<td>6 : 23</td>
<td>19.2</td>
<td>40</td>
<td>80.0%</td>
<td>48.0%</td>
<td>4.7</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Southbound</td>
<td>PM</td>
<td>21 : 28</td>
<td>5 : 21</td>
<td>20.6</td>
<td>40</td>
<td>80.0%</td>
<td>51.5%</td>
<td>4.1</td>
<td>0</td>
</tr>
</tbody>
</table>

The cumulative travel times and cumulative stopped delays vary moderately not only from the AM peak to the PM peak, but also by directional flow. The morning northbound flow had the shortest cumulative travel time at 19 minutes 17 seconds and the lowest cumulative stopped delay at 2 minutes 56 seconds. This resulted in the fastest travel speed of 28.6 mph and the fewest number of intersections experiencing stopped delay (50% of intersections experienced stopped delay). The travel speed as a percentage of the posted speed limit was the highest at 71.6%. However, it had tied for first with longest average queue lengths at 4.7 vehicles. Conversely, the longest cumulative travel time and cumulative stopped delay also occurred in the AM peak but for the southbound movement at 26 minutes 28 seconds and 7 minutes 30 seconds, respectively. Stopped delay was experienced at each intersection. Its travel speed was second highest at 20.9 mph and also had the second highest travel speed as a percentage of the posted speed limit at 52.2%. The relatively high travel speed could be attributed, in part, to having the shortest average queue lengths at 2.7 vehicles.

The PM peak period operational characteristics were more homogenous with much smaller differences between the northbound and southbound flows. The northbound flow had a cumulative travel time of 23 minutes 3 seconds with cumulative stopped delay measuring 6 minutes 23 seconds, the slowest travel speed at 19.2 mph representing 48% of the posted speed limit, 80% of intersections experiencing stopped delay, and tied for the highest average queue lengths at 4.7 vehicles. The southbound flow had a cumulative travel time of 21 minutes 28 seconds and a cumulative stopped delay of 5 minutes 21 seconds, a travel speed of 20.6 mph representing 51.5% of the posted speed limit, 80% of intersections experiencing stopped delay, and average queue lengths of 4.1 vehicles. At no time were signal cycle failures witnessed (a signal failure is defined as a traffic signal cycle where queued vehicles were not able to progress through the signal during a single cycle).

Detailed speed and delay run data by intersection for the entire corridor may be found in Appendix A. Information presented includes cumulative travel time, stopped delay, running speed, travel speed, queue lengths, and number of cycle failures.
**RECOMMENDATIONS**

The results of this study indicate that the Schoenersville Road corridor, Stoke Park Road to 8th Avenue, generally operates sufficiently to allow for the smooth but slow flow of vehicular traffic given the volumes utilizing the corridor. However, excessive delay and long travel times occur during the AM peak period primarily in the southbound direction. Considering that signals within this corridor are operating on timing plans that date back as far as 2004, signal retimings and optimization should be considered. Municipalities should utilize the Automated Red Light Enforcement (ARLE) program to apply for 100% State funds for the replacement, upgrading, and retiming of traffic signals, controllers, and other signal-related components. This program funds improvements through the use of funds obtained from red light running fines captured within the City of Philadelphia. This program specifically allows for retiming of existing traffic-control signals; upgrading, modernization, or improvements to traffic-control signals; the interconnection and coordination of traffic-control signals to improve mobility; the installation of a traffic-control signal system or the expansion of an existing system to improve mobility; revisions to traffic-control signal operational modes to improve safety or mobility including conversion to actuated, traffic responsive, or traffic adaptive modes of operation; improvements to traffic-control signals or other official traffic-control devices to reduce energy consumption; the installation of new or improved detection systems for traffic-control signals; and the upgrading, modernization, or safety improvements to traffic-control signals having railroad preemption.

**NEXT STEPS**

Contingent upon approval and programming of this project, additional data collection in the form of intersection traffic counts will be needed for the purpose of developing alternative signal timing plans. Once improvements are implemented and traffic flows have had time to adjust accordingly, an after-action review of the corridor will be conducted to determine the reduction in peak hour travel time and delay. The goal is to obtain at least a 10% reduction in travel time. A 10% reduction in travel time would result in average speeds of 24.5 miles per hour for the entire corridor compared to a 22.1 miles per hour average obtained from current travel conditions.

Considering that many traffic signals function on outdated timing plans, are owned and maintained by Pennsylvania’s local municipalities, coupled with the historically robust population growth of the area which has continued to add traffic to the regional road network, a new smarter approach is being considered. This approach introduces the concept of “Priority Arterial Corridors” which are a selected set of regionally critical highways where the state would have a greater role in operation of traffic signals. This role could include PennDOT contracts to review and optimize these selected signals on a routine basis as part of their asset management systems approach to highway operations and maintenance. This new role might be funded through the state’s capital program as a continuing program. Much of this proposal has been discussed in one form or another among members of the State Transportation Advisory Committee and the two funding commissions. Pennoni Associates, Inc. has been retained by PennDOT to develop a Traffic Signal Operations and Maintenance Plan that addresses this issue. The consultant has conducted a review of best practices from Georgia, New Jersey, North Carolina, Ohio, and Virginia and is currently obtaining input from municipal officials, vendors/contractors, design engineers, planning officials, PennDOT Central and District offices, and Federal Highway Administration representatives. A draft plan was submitted by the consultant to PennDOT for their review in June 2013. The plan is currently under PennDOT review awaiting release.
Table 5 depicts a summation of all five southbound travel runs conducted during the AM peak period for the Schoenersville Road corridor. The distance in miles depicted between intersections is cumulative for all travel runs conducted. For example, the distance between Illicks Mill Road and 8th Avenue is 0.14 miles. The distance for five runs equates to a total of 0.70 miles. The posted speed limit through the corridor is 40 mph. Average travel speed, which is a calculated vehicle speed that includes stopped delay times and acceleration/deceleration times, was 20.86 mph. This is 52.15% of the posted speed limit. The highest average travel speed for any section was 32.21 mph for the section between West Macada Road and Westgate Drive. The lowest average travel speed for any section was 14.91 mph for the section between Industrial Drive and the US Route 22 Westbound ramps. Delay may be caused by numerous factors such as bus loading/unloading, double parked vehicles, vehicles making turns, pedestrians, traffic signals, etc. The only southbound delay experienced in this corridor was a result of traffic volumes and signals. The intersection should be evaluated for possible signal timing improvements or optimization.

### TABLE 5
**TRAVEL TIME & DELAY STUDY - FIELD SHEET SUMMARY**

<table>
<thead>
<tr>
<th>Control Point</th>
<th>Posted Speed (mph)</th>
<th>Distance (mi.)</th>
<th>Cumulative Travel Time (seconds)</th>
<th>Stopped Delay (sec)</th>
<th>Running Speed (mph)</th>
<th>Travel Speed (mph)</th>
<th>Delay Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avenue C/Stoke Park Road</td>
<td>40</td>
<td>0.90</td>
<td>170</td>
<td>1</td>
<td>29.45</td>
<td>19.06</td>
<td>TS</td>
</tr>
<tr>
<td>City Line Road/Center Valley Parkway</td>
<td>40</td>
<td>1.40</td>
<td>335</td>
<td>11</td>
<td>32.73</td>
<td>30.55</td>
<td>TS</td>
</tr>
<tr>
<td>Industrial Drive</td>
<td>40</td>
<td>0.70</td>
<td>504</td>
<td>3</td>
<td>23.77</td>
<td>14.91</td>
<td>TS</td>
</tr>
<tr>
<td>US Route 22 Westbound Ramps</td>
<td>40</td>
<td>0.75</td>
<td>618</td>
<td>23</td>
<td>29.67</td>
<td>23.68</td>
<td>TS</td>
</tr>
<tr>
<td>US Route 22 Eastbound Ramps</td>
<td>40</td>
<td>0.30</td>
<td>682</td>
<td>22</td>
<td>25.71</td>
<td>16.88</td>
<td>TS</td>
</tr>
<tr>
<td>W Macada Road</td>
<td>40</td>
<td>1.70</td>
<td>872</td>
<td>11</td>
<td>34.19</td>
<td>32.21</td>
<td>TS</td>
</tr>
<tr>
<td>Westgate Drive</td>
<td>40</td>
<td>1.75</td>
<td>1234</td>
<td>39</td>
<td>31.03</td>
<td>17.40</td>
<td>TS</td>
</tr>
<tr>
<td>Jacksonville Road</td>
<td>40</td>
<td>0.25</td>
<td>1288</td>
<td>12</td>
<td>21.43</td>
<td>16.67</td>
<td>TS</td>
</tr>
<tr>
<td>Catasauqua Road/Birchwood Drive</td>
<td>40</td>
<td>0.75</td>
<td>1428</td>
<td>37</td>
<td>26.21</td>
<td>19.29</td>
<td>TS</td>
</tr>
<tr>
<td>Illicks Mill Road</td>
<td>40</td>
<td>0.70</td>
<td>1588</td>
<td>52</td>
<td>23.33</td>
<td>15.75</td>
<td>TS</td>
</tr>
<tr>
<td>8th Avenue</td>
<td>40</td>
<td>9.20</td>
<td></td>
<td>30</td>
<td>29.10</td>
<td>20.86</td>
<td></td>
</tr>
</tbody>
</table>

**Delay Factor Codes:**
- BS = Bus Loading/Unloading
- PK = Parked Cars
- LO = Delivery Loading/Unloading
- DP = Double Parking
- PD = Pedestrians
- CY = Cyclist
- EV = Emergency Vehicle
- RR = Railroad Crossing
- RT = Right Turn
- GC = General Congestion
- SS = Stop Sign
- GT = Garbage Trucks
- LT = Left Turns
- TK = Truck
- OT = Other
- TS = Traffic Signal

Stopped Delay - Time spent motionless in a vehicle.
Running Speed - Calculated speed of the vehicle while in motion, including acceleration and deceleration times.
Travel Speed - Calculated speed of the vehicle including stopped delay times.
Queue Lengths - number or distance of vehicles in a queue
# of Cycle Failures - (queues not completely discharging during each signal cycle)

Stopped Delay as a percentage of total run time for the corridor = 28.34%
Table 6 depicts a summation of all five northbound travel runs conducted during the AM peak period for the Schoenersville Road corridor. The distance in miles depicted between intersections is cumulative for all travel runs conducted. The posted speed limit through the corridor is 40 mph. Average travel speed, which is a calculated vehicle speed that includes stopped delay times and acceleration/deceleration times, was 28.63 mph. This is 71.58% of the posted speed limit. The highest average travel speed for any section was 42.57 mph for the section between Jacksonville Road and Westgate Drive. The lowest average travel speed for any section was 16.70 mph for the section between City Line Road/Valley Center Parkway and Avenue C/Stoke Park Road. Delay may be caused by numerous factors such as bus loading/unloading, vehicles making turns, pedestrians, traffic signals, etc. The only northbound delay experienced in this corridor was a result of traffic volumes and signals. The intersection should be evaluated for possible signal timing improvements or optimization.

### TABLE 6

**TRAVEL TIME & DELAY STUDY - FIELD SHEET SUMMARY**

<table>
<thead>
<tr>
<th>Road: Schoenersville Road</th>
<th>Direction: NorthBound</th>
<th>RUN: NorthBound Summary of All Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project: Signal Corridor Study</td>
<td>Date: 1/17/2013</td>
<td>Performed by: JG &amp; MD</td>
</tr>
<tr>
<td>Location: Bethlehem City/Hanover (LC &amp; NC)</td>
<td>Day of Wk: Thursday</td>
<td>Peak Period: AM</td>
</tr>
<tr>
<td>Weather: Partly Sunny</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Point</th>
<th>Posted Speed (mph)</th>
<th>Distance (mi.)</th>
<th>Cumulative Travel Time (seconds)</th>
<th>Stopped Delay (sec)</th>
<th>Running Speed (mph)</th>
<th>Travel Speed (mph)</th>
<th>Delay Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>8th Avenue</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illicks Mill Road</td>
<td>40</td>
<td>0.14</td>
<td>114</td>
<td>0</td>
<td>17</td>
<td>25.98</td>
<td>22.11</td>
</tr>
<tr>
<td>Catasauqua Road/Birchwood Drive</td>
<td>40</td>
<td>0.15</td>
<td>234</td>
<td>0</td>
<td>32</td>
<td>30.68</td>
<td>22.50</td>
</tr>
<tr>
<td>Jacksonville Road</td>
<td>40</td>
<td>0.05</td>
<td>266</td>
<td>0</td>
<td>0</td>
<td>28.13</td>
<td>28.13</td>
</tr>
<tr>
<td>Westgate Drive</td>
<td>40</td>
<td>0.35</td>
<td>414</td>
<td>0</td>
<td>0</td>
<td>42.57</td>
<td>42.57</td>
</tr>
<tr>
<td>W Macada Road</td>
<td>40</td>
<td>0.34</td>
<td>594</td>
<td>0</td>
<td>11</td>
<td>36.21</td>
<td>34.00</td>
</tr>
<tr>
<td>US Route 22 Eastbound Ramps</td>
<td>40</td>
<td>0.06</td>
<td>643</td>
<td>0</td>
<td>0</td>
<td>22.04</td>
<td>22.04</td>
</tr>
<tr>
<td>US Route 22 Westbound Ramps</td>
<td>40</td>
<td>0.15</td>
<td>766</td>
<td>0</td>
<td>31</td>
<td>29.35</td>
<td>21.95</td>
</tr>
<tr>
<td>Industrial Drive</td>
<td>40</td>
<td>0.14</td>
<td>838</td>
<td>0</td>
<td>0</td>
<td>35.00</td>
<td>35.00</td>
</tr>
<tr>
<td>City Line Road/Center Valley Parkway</td>
<td>40</td>
<td>0.28</td>
<td>963</td>
<td>0</td>
<td>0</td>
<td>40.32</td>
<td>40.32</td>
</tr>
<tr>
<td>Avenue C/Stoke Park Road</td>
<td>40</td>
<td>0.18</td>
<td>1157</td>
<td>1</td>
<td>25</td>
<td>29.72</td>
<td>16.70</td>
</tr>
</tbody>
</table>

| 1.84 | 1157 | 2 | 56 | 33.76 | 28.63 | |

**Delay Factor Codes:**
- BS = Bus Loading/Unloading
- PK = Parked Cars
- LO = Delivery Loading/Unloading
- DP = Double Parking
- PD = Pedestrians
- CY = Cyclist
- EV = Emergency Vehicle
- RR = Railroad Crossing
- RT = Right Turn
- GC = General Congestion
- SS = Stop Sign
- GT = Garbage Trucks
- LT = Left Turns
- TK = Truck
- TS = Traffic Signal

**Stopped Delay -** Time spent motionless in a vehicle.
**Running Speed -** Calculated speed of the vehicle while in motion, including acceleration and deceleration times.
**Travel Speed -** Calculated speed of the vehicle including stopped delay times.
**Queue Lengths -** number or distance of vehicles in a queue
**# of Cycle Failures -** (queues not completely discharging during each signal cycle)

Stopped Delay as a percentage of total run time for the corridor = 15.21%
Table 7 depicts a summation of all four southbound travel runs conducted during the PM peak period for the Schoenersville Road corridor. The distance in miles depicted between intersections is cumulative for all travel runs conducted. The posted speed limit through the corridor is 40 mph. Average travel speed, which is a calculated vehicle speed that includes stopped delay times and acceleration/deceleration times, was 20.57 mph. This is 51.43% of the posted speed limit. The highest average travel speed for any section was 31.79 mph for the section between West Macada Road and Westgate Drive. The lowest average travel speed for any section was 11.52 mph for the section between the US Route 22 Eastbound ramp and West Macada Road. Delay may be caused by numerous factors such as bus loading/unloading, vehicles making turns, pedestrians, traffic signals, etc. The only southbound delay experienced in this corridor was a result of traffic volumes and signals. The intersection should be evaluated for possible signal timing improvements or optimization.

### Table 7

<table>
<thead>
<tr>
<th>Control Point</th>
<th>Posted Speed (mph)</th>
<th>Distance (mi.)</th>
<th>Cumulative Travel Time (seconds)</th>
<th>Stopped Delay (min)</th>
<th>Running Speed (mph)</th>
<th>Travel Speed (mph)</th>
<th>Delay Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avenue C/Stoke Park Road</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City Line Road/Center Valley Parkway</td>
<td>40</td>
<td>0.72</td>
<td>163</td>
<td>0</td>
<td>25.17</td>
<td>15.90</td>
<td>TS</td>
</tr>
<tr>
<td>Industrial Drive</td>
<td>40</td>
<td>1.12</td>
<td>309</td>
<td>0</td>
<td>33.32</td>
<td>27.62</td>
<td>TS</td>
</tr>
<tr>
<td>US Route 22 Westbound Ramps</td>
<td>40</td>
<td>0.56</td>
<td>446</td>
<td>0</td>
<td>22.15</td>
<td>14.72</td>
<td>TS</td>
</tr>
<tr>
<td>US Route 22 Eastbound Ramps</td>
<td>40</td>
<td>0.60</td>
<td>525</td>
<td>0</td>
<td>27.34</td>
<td>27.34</td>
<td></td>
</tr>
<tr>
<td>W Macada Road</td>
<td>40</td>
<td>0.24</td>
<td>600</td>
<td>0</td>
<td>21.07</td>
<td>11.52</td>
<td>TS</td>
</tr>
<tr>
<td>Westgate Drive</td>
<td>40</td>
<td>1.36</td>
<td>754</td>
<td>0</td>
<td>31.79</td>
<td>31.79</td>
<td></td>
</tr>
<tr>
<td>Jacksonville Road</td>
<td>40</td>
<td>1.40</td>
<td>1000</td>
<td>1</td>
<td>29.82</td>
<td>20.49</td>
<td></td>
</tr>
<tr>
<td>Catasauqua Road/Birchwood Drive</td>
<td>40</td>
<td>0.20</td>
<td>1056</td>
<td>0</td>
<td>19.46</td>
<td>12.86</td>
<td></td>
</tr>
<tr>
<td>Illicks Mill Road</td>
<td>40</td>
<td>0.60</td>
<td>1184</td>
<td>0</td>
<td>25.41</td>
<td>16.88</td>
<td></td>
</tr>
<tr>
<td>8th Avenue</td>
<td>40</td>
<td>0.56</td>
<td>1288</td>
<td>0</td>
<td>23.17</td>
<td>19.38</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.36</td>
<td>1288</td>
<td>5</td>
<td>27.40</td>
<td>20.57</td>
<td></td>
</tr>
</tbody>
</table>

**Delay Factor Codes:**
- BS = Bus Loading/Unloading
- PK = Parked Cars
- LO = Delivery Loading/Unloading
- DP = Double Parking
- PD = Pedestrians
- CY = Cyclist
- EV = Emergency Vehicle
- RR = Railroad Crossing
- RT = Right Turn
- GC = General Congestion
- SS = Stop Sign
- DV = Disabled Vehicle
- LT = Left Turns
- TK = Truck
- GT = Garbage Truck
- OT = Other
- TS = Traffic Signal

Stopped Delay - Time spent motionless in a vehicle.
Running Speed - Calculated speed of the vehicle while in motion, including acceleration and deceleration times.
Queue Lengths - number or distance of vehicles in a queue
Queue Failures - (queues not completely discharging during each signal cycle)

Stopped Delay as a percentage of total run time for the corridor = 24.92%
Table 8 depicts a summation of all four northbound travel runs conducted during the PM peak period for the Schoenersville Road corridor. The distance in miles depicted between intersections is cumulative for all travel runs conducted. The posted speed limit through the corridor is 40 mph. Average travel speed, which is a calculated vehicle speed that includes stopped delay times and acceleration/deceleration times, was 19.16 mph. This is 47.90% of the posted speed limit. The highest average travel speed for any section was 41.65 mph for the section between Jacksonville Road and Westgate Drive. The lowest average travel speed for any section was 10.05 mph for the section between West Macada Road and the US Route 22 Eastbound ramp. Delay may be caused by numerous factors such as bus loading/unloading, vehicles making turns, pedestrians, traffic signals, etc. The only northbound delay experienced in this corridor was a result of traffic volumes and signals. The intersection should be evaluated for possible signal timing improvements or optimization.

<table>
<thead>
<tr>
<th>Control Point</th>
<th>Posted Speed (mph)</th>
<th>Distance (mi.)</th>
<th>Cumulative Travel Time (seconds)</th>
<th>Stopped Delay (min)</th>
<th>Running Speed (mph)</th>
<th>Travel Speed (mph)</th>
<th>Delay Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>8th Avenue</td>
<td>40</td>
<td>0.56</td>
<td>157</td>
<td>0</td>
<td>52</td>
<td>19.20</td>
<td>12.84</td>
</tr>
<tr>
<td>Illicks Mill Road</td>
<td>40</td>
<td>0.60</td>
<td>286</td>
<td>0</td>
<td>44</td>
<td>25.41</td>
<td>16.74</td>
</tr>
<tr>
<td>Catasauqua Road/Birchwood Drive</td>
<td>40</td>
<td>0.20</td>
<td>314</td>
<td>0</td>
<td>0</td>
<td>25.71</td>
<td>25.71</td>
</tr>
<tr>
<td>Jacksonville Road</td>
<td>40</td>
<td>1.40</td>
<td>435</td>
<td>0</td>
<td>0</td>
<td>41.65</td>
<td>41.65</td>
</tr>
<tr>
<td>Westgate Drive</td>
<td>40</td>
<td>1.36</td>
<td>722</td>
<td>2</td>
<td>2</td>
<td>29.67</td>
<td>17.06</td>
</tr>
<tr>
<td>W Macada Road</td>
<td>40</td>
<td>0.24</td>
<td>808</td>
<td>0</td>
<td>32</td>
<td>16.00</td>
<td>10.05</td>
</tr>
<tr>
<td>US Route 22 Eastbound Ramps</td>
<td>40</td>
<td>0.60</td>
<td>917</td>
<td>0</td>
<td>13</td>
<td>22.50</td>
<td>19.82</td>
</tr>
<tr>
<td>US Route 22 Westbound Ramps</td>
<td>40</td>
<td>0.56</td>
<td>1014</td>
<td>0</td>
<td>4</td>
<td>21.68</td>
<td>20.78</td>
</tr>
<tr>
<td>Industrial Drive</td>
<td>40</td>
<td>1.12</td>
<td>1175</td>
<td>0</td>
<td>16</td>
<td>27.81</td>
<td>25.04</td>
</tr>
<tr>
<td>City Line Road/Center Valley Parkway</td>
<td>40</td>
<td>0.72</td>
<td>1383</td>
<td>1</td>
<td>40</td>
<td>24.00</td>
<td>12.46</td>
</tr>
<tr>
<td>Avenue C/Stoke Park Road</td>
<td>40</td>
<td>7.36</td>
<td>1383</td>
<td>6</td>
<td>23</td>
<td>26.50</td>
<td>19.16</td>
</tr>
</tbody>
</table>

Delay Factor Codes:
BS = Bus Loading/Unloading
DP = Double Parking
EV = Emergency Vehicle
GC = General Congestion
LT = Left Turns
PK = Parked Cars
PO = Pedestrians
RR = Railroad Crossing
SS = Stop Sign
TK = Truck
OT = Other
TS = Traffic Signal
LO = Delivery Loading/Unloading
CY = Cyclist
RT = Right Turn
GT = Garbage Truck

Stopped Delay - Time spent motionless in a vehicle.
Running Speed - Calculated speed of the vehicle while in motion, including acceleration and deceleration times.
Travel Speed - Calculated speed of the vehicle including stopped delay times.
Queue Lengths - number or distance of vehicles in a queue
# of Cycle Failures - (queues not completely discharging during each signal cycle)

Stopped Delay as a percentage of total run time for the corridor = 27.69%
### Schoenersville Road Corridor Signal Study – 33

**Phase Timing and Color Sequence Chart**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Timing</th>
<th>Color Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.57s</td>
<td>Yellow, Red</td>
</tr>
<tr>
<td>B</td>
<td>0.57s</td>
<td>Green, Yellow</td>
</tr>
<tr>
<td>C</td>
<td>0.57s</td>
<td>Red, Green</td>
</tr>
</tbody>
</table>

**Emergency Pre-emption Phasing**

- Green, Yellow, Red
- Pre-emption only
- Minimum 20% pre-emption

**Program Chart**

- Event 1
- Event 2
- Event 3

**General Notes**

- Installation, operation, and maintenance of the traffic signals shall be in accordance with Pennsylvania Department of Transportation Specifications on Office Traffic Control Devices.
- All signal assemblies shall be made of weather-resistant materials and shall be located in accordance with the specifications of the Pennsylvania Department of Transportation.
- All signal faces shall be protected from weather elements.
- All signal heads shall be mounted on a sturdy pole or other support structure that is capable of withstanding wind and snow loads.
- All signal heads shall be designed to withstand impact loads from vehicles and other sources.

**Legend**

- Phase Number
- Arrow
- Stop Line
- Pedestrian
- Average
- Speed Limit
- All Traffic
- Emergency
- Traffic Control
- Traffic Sign

**Signal Indications**

- Signal Head
- Pedestrian Signal Head
- Sign
- Vehicle Detector
- Pedestrian Push Button
- Crosswalk Assembly
- Ball Unit
- Light Unit
- Emergency Power Supply