



## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

- Center Street and US 422 – The tether wire, which prevents the traffic signals and signs installed on the span wire from aggressively swaying, is not present.

#### *Traffic Signal with Burnt Lenses*

- Center Street and US 422 – The signal lenses on the eastbound approach are burnt. Burnt traffic signal lenses decrease the visibility of the signal indication.

#### *Utility Poles for Span Wire Installation*

- Center Street and US 422 – Typically utility poles are not utilized for permanent signal installations.

### Pedestrian Accommodations

Pedestrians are present throughout the US 422 Corridor. With the downtown settings in Palmyra, Annville, and Cleona, pedestrians are attracted to the local businesses in the area. Students from Lebanon Valley College generate a significant amount of pedestrian traffic in Annville Township. Sidewalks are not consistently present throughout the corridor which can make walking difficult and at times an unattractive alternative to driving. The following specific conditions related to pedestrian accommodations were noted at the following study intersections:

#### *Sidewalks Not Present*

- Apple Blossom Road and US 422
- Shady Lane and US 422
- Wal-Mart Driveway and US 422

#### *Ramps in the Curbs Not Present*

- Apple Blossom Road and US 422
- Shady Lane and US 422
- Wal-Mart Driveway and US 422
- Center Street and US 422 (stairs in northeast quadrant – see photo to the right)



Stairs in NE quadrant of Center Street and US 422

#### *Dedicated Pedestrian Signal Indications Not Provided*

- Grant Street and US 422
- Forge Street and US 422 – A dedicated pedestrian signal is provided to protect pedestrians only during the westbound protected left phase.
- Duke Street and US 422 – A dedicated pedestrian signal is provided to protect pedestrians only during the eastbound protected left phase.
- Apple Blossom Road and US 422 – Dedicated pedestrian signals are provided to protect pedestrians only during the eastbound protected left phase.
- Mill Street and US 422
- Center Street and US 422 – A dedicated pedestrian signal is provided to protect pedestrians only during the eastbound protected left phase.



## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

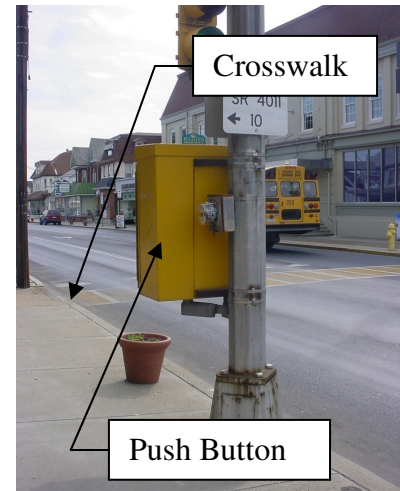
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#### *Crosswalks Not Present*

- Apple Blossom Road and US 422

#### *Issues with Pedestrian Push Buttons*

- Railroad Street and US 422 – The pedestrian push button in northeast quadrant is not located adjacent to sidewalk. (See the photo to the right).
- Mill Street and US 422 – Pedestrian push buttons are only provided to movements crossing US 422.



Push button and crosswalk location in NE quadrant of Railroad Street and US 422

#### Vertical Intersection Alignment

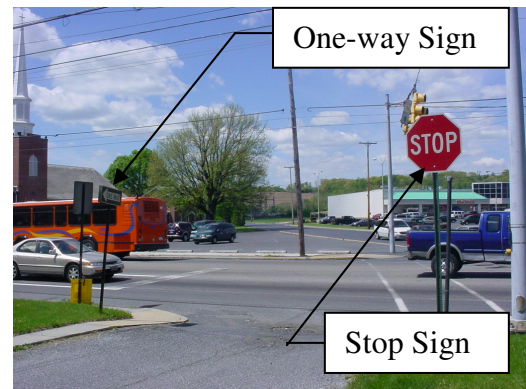
Based on the way US 422 and the cross streets align, driver comfort is compromised at some locations. This alignment causes vehicles to “bottom out” when traveling through the intersection. Vertical alignment issues were noted on the southbound approaches of Grant Street and Center Street.

#### Intersection Alignment

The northbound and southbound approaches of Railroad Street at US 422 are offset. The opposing left turn lanes are not aligned and the intersection is forced to operate split phased which introduces a longer cycle length.

#### Conflicting Signage

Hoffer Street is located west of the Mill Street and US 422 intersection. One-way signage is provided on Hoffer Street at US 422. On the northbound approach of Hoffer Street at US 422, a stop sign is provided. These two signs provide conflicting messages to motorists (see picture to the right).



NB approach of Hoffer Street – adjacent to Mill Street and US 422 intersection.

#### Luminaires Not Installed

At the intersection of Shady Lane and US 422, luminaire poles are provided but luminaires are not installed on the poles.



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## V. Alternative Analysis

### A. Short-Term Improvements (1-3 years)

In 2016, it is estimated that it will take over 40 minutes to travel the 6.7 mile corridor in the eastbound direction during the PM peak hour; this is three times longer than it takes to travel the existing corridor. The increase in travel time is related to the additional intersection delays.

**Table 8 and 9** provide a summary of the LOS and travel time for Future No-Build Conditions with Phasing Adjustments, **Appendix E** includes detailed LOS and travel time information. To improve future intersection operations and travel time, two short-term improvement options were reviewed. To contain costs, improvements reviewed for the short-term recommendations had minimal right-of-way impact. **Table 10** provides a summary of the short-term recommendations.

In general, Short-Term Improvement Option 1 will replace existing signal equipment, include full pedestrian operations with dedicated man/hand signals, optimize traffic signal timings, and re-stripe left turn lanes where necessary. Short-Term Improvement Option 2 includes all of the Option 1 improvements but includes minor right-of-way acquisition to provide dedicated left turn lanes. **Tables 11, 12A, and 12B** summarize the LOS results and travel time reductions resulting from the traffic signal optimization and geometric improvements. Overall, there are some slight changes in the LOS at the intersections. The improvements are generally seen where specific geometry improvements were included. The travel time improvements were negligible in the Annville/Cleona section of the corridor as minimal signal improvements could be applied. In the Palmyra/North Londonderry section of the corridor, the improvements in travel time ranged from an 8 to 77 percent reduction. The more significant improvements were realized in this area because of the improvements in the coordination of the traffic signal operations.



# CONGESTED CORRIDOR IMPROVEMENT PROGRAM

## US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

**Table 10: Summary of Short-Term Improvements**

Intersection	Option 1	Option 2
	<i>Included pedestrian accommodations and adjusted signal operations.</i>	<i>Option 1 improvements plus additional geometry with minor right-of-way impacts.</i>
<b>Railroad Street and US 422</b>	Included walk/don't walk pedestrian accommodations. Adjusted signal cycle length and offsets.	N/A
<b>Grant Street and US 422</b>	Included walk/don't walk pedestrian accommodations. Adjusted signal cycle length and offsets.	N/A
<b>Forge Street (PA 117) and US 422</b>	Included walk/don't walk pedestrian accommodations. Adjusted signal cycle length and offsets. Lengthen WB left turn lane from 250-ft to 375-ft (re-striping).	Included SB left turn lane (SB approach 33-ft).
<b>Duke Street and US 422</b>	Included walk/don't walk pedestrian accommodations. Adjusted signal cycle length and offsets.	N/A
<b>Apple Blossom Road and US 422</b>	Included walk/don't walk pedestrian accommodations. Adjusted signal cycle length and offsets.	Included NB left turn lane (as shown on the signal plan).
<b>Shady Lane and US 422</b>	Adjusted signal cycle length and offsets.	N/A
<b>Wal-Mart and US 422</b>	Adjusted signal cycle length and offsets.	N/A
<b>White Oak Street and US 422</b>	N/A	N/A
<b>Mill Street (SR 3023) and US 422</b>	Included walk/don't walk pedestrian accommodations. Coordinated intersection with Mill Street.	Included NB and SB left turn lane (NB and SB approach 34-ft – investigate skew).
<b>Center Street (SR 4002) and US 422</b>	Included walk/don't walk pedestrian accommodations. Coordinated intersection with Center Street.	Included SB left turn lane (SB approach 35-ft – remove parking).

**Table 11: Summary of Future No-Build with Phasing Adjustments and Future Short-Term Improvements Option 1 and 2 LOS**

Intersection	AM			Midday			PM		
	Future No-Build w/ Phasing	Future Option 1	Future Option 2	Future No-Build w/ Phasing	Future Option 1	Future Option 2	Future No-Build w/ Phasing	Future Option 1	Future Option 2
Railroad St & US 422	F*	E*	E*	F*	D*	D	F*	F*	F*
Grant St & US 422	A	A	A	A	A	A	B	A	A
Forge Rd & US 422	D*	C*	C*	E*	F*	D*	F*	F*	F*
Duke St & US 422	D	C*	C*	D*	C*	C*	F*	F*	E*
Apple Blossom Rd & US 422	C*	C*	B	D*	C*	C	E*	E*	D*
Shady Ln & US 422	C	B	B	C	B	B	E*	C	C
Wal-Mart Drway & US 422	B	B	B	C	B	B	C	C	C
White Oak St & US 422	F*	F*	F*	F*	F*	F*	F*	F*	F*
Mill Street & US 422	C	C	B	D*	D	C	E*	E*	D*
Center Street & US 422	B	B	B	C	C	C	D	C	C

\* Notes where movements and/or approaches are operating with LOS F.



# CONGESTED CORRIDOR IMPROVEMENT PROGRAM

## US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

**Table 12A: Future No-Build with Phasing Adjustments vs. Short-Term Improvements Option 1 Travel Times**

Roadway Links	AM			Midday			PM		
	Future No-Build w/Phasing	Future Option 1	Change	Future No-Build w/Phasing	Future Option 1	Change	Future No-Build w/Phasing	Future Option 1	Change
EB – Palmyra/North Londonderry Corridor	06:49	05:42	-16%	08:53	07:03	-21%	20:40	19:04	-8%
WB – Palmyra/North Londonderry Corridor	11:54	07:23	-38%	32:17	07:36	-76%	62:58	32:49	-48%
EB – Annville/Cleona Corridor	10:53	10:26	-4%	09:16	08:47	-5%	23:44	23:47	0%
WB – Annville/Cleona Corridor	12:44	12:34	-1%	08:05	07:47	-4%	21:52	21:17	-3%

**Table 12B: Future No-Build with Phasing Adjustments vs. Short-Term Improvements Option 2 Travel Times**

Roadway Links	AM			Midday			PM		
	Future No-Build w/Phasing	Future Option 2	Change	Future No-Build w/Phasing	Future Option 2	Change	Future No-Build w/Phasing	Future Option 2	Change
EB – Palmyra/North Londonderry Corridor	06:49	05:45	-16%	08:53	08:11	-8%	20:40	18:05	-13%
WB – Palmyra/North Londonderry Corridor	11:54	07:39	-36%	32:17	07:17	-77%	62:58	26:47	-57%
EB – Annville/Cleona Corridor	10:53	09:55	-9%	09:16	08:36	-7%	23:44	23:40	0%
WB – Annville/Cleona Corridor	12:44	13:28	6%	08:05	08:22	3%	21:52	22:23	2%



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### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

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#### ***B. Long-Term Improvements (3+ years)***

To improve future intersection operations and travel time, two long-term improvement options were reviewed. Long-term improvements included significant geometric improvements; **Table 13** provides a summary.

Option 3, the first long-term improvement option, involves geometric improvements at specific intersections. Option 4 widens US 422 to include two travel lanes in each direction from Railroad Street to east of the White Oak Street intersection. **Tables 14, 15A, and 15B** summarize the LOS results and travel time reductions that resulted from the geometric improvements. With either option, significant LOS improvements are anticipated with the construction of geometric improvements. In the future AM and Midday peak hours, all of the intersections were forecasted to operate with a LOS D or better. The travel time improvements throughout the corridor were dramatic with reductions ranging from 12 to 91 percent. Option 4, the widening of US 422, provides enough capacity for the future traffic volumes, allowing the corridor to operate with travel times similar to existing conditions.



# CONGESTED CORRIDOR IMPROVEMENT PROGRAM

## US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

**Table 13: Summary of Long-Term Improvements**

Intersection	Option 3	Option 4
	<i>Option 2 improvements plus additional geometry with right-of-way impacts.</i>	<i>Widen US 422 to have two lanes in each direction.</i>
<b>Railroad Street and US 422</b>	Realign NB and SB approaches.	Widen US 422, two lanes each direction.
<b>Grant Street and US 422</b>	N/A	Widen US 422, two lanes each direction.
<b>Forge Street (PA 117) and US 422</b>	Included NB right turn lane.	Widen US 422, two lanes each direction. Included SB left turn lane (SB approach 33-ft). Included NB left turn lane.
<b>Duke Street and US 422</b>	N/A	Widen US 422, two lanes each direction.
<b>Apple Blossom Road and US 422</b>	N/A	Widen US 422, two lanes each direction. Included NB left turn lane (on signal plan). Removed EB and WB exclusive right turn lane.
<b>Shady Lane and US 422</b>	N/A	Widen US 422, two lanes each direction. Removed EB and WB exclusive right turn lane.
<b>Wal-Mart and US 422</b>	N/A	Widen US 422, two lanes each direction. Removed WB exclusive right turn lane.
<b>White Oak Street and US 422</b>	Included EB, WB, NB, and SB right turn lanes. Increased EB, WB, NB, and SB left turn lane lengths.	Widen US 422, two lanes each direction.
<b>Mill Street (SR 3023) and US 422</b>	N/A	Included NB and SB left turn lane (NB and SB approach 34-ft – investigate skew).
<b>Center Street (SR 4002) and US 422</b>	N/A	Included SB left turn lane (SB approach 35-ft – remove parking).



**Table 14: Summary of Future No-Build with Phasing Adjustments and Long-Term Improvements Option 3 and 4 LOS**

Intersection	AM			Midday			PM		
	Future No-Build w/Phasing	Future Option 3	Future Option 4	Future No-Build w/ Phasing	Future Option 3	Future Option 4	Future No-Build w/ Phasing	Future Option 3	Future Option 4
Railroad St & US 422	F*	D*	D	F*	C*	C	F*	C*	D*
Grant St & US 422	A	A	A	A	A	A	B	B	A
Forge Rd & US 422	D*	C	B	E*	C	B	F*	E*	B
Duke St & US 422	D	C*	A	D*	C*	B	F*	E*	B
Apple Blossom Rd & US 422	C*	B	B	D	C	B	E*	D*	B
Shady Ln & US 422	C	B	B	C	B	B	E*	C	B
Wal-Mart Drway & US 422	B	B	B	C	B	B	C	C	B
White Oak St & US 422	F*	D*	D	F*	D	C	F*	F*	E*
Mill Street & US 422	C	B	B	D*	C	C	E*	D*	D*
Center Street & US 422	B	B	B	C	C	C	D	C	B

\* Notes where movements and/or approaches are operating with LOS F.



# CONGESTED CORRIDOR IMPROVEMENT PROGRAM

## US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

**Table 15A: Future No-Build with Phasing Adjustments vs. Long-Term Improvements Option 3 Travel Times**

Roadway Links	AM			Midday			PM		
	Future No-Build w/Phasing	Future Option 3	Change	Future No-Build w/Phasing	Future Option 3	Change	Future No-Build w/Phasing	Future Option 3	Change
EB – Palmyra/North Londonderry Corridor	06:49	05:37	-17%	08:53	07:19	-18%	20:40	15:08	-27%
WB – Palmyra/North Londonderry Corridor	11:54	05:51	-51%	32:17	07:18	-77%	62:58	16:28	-74%
EB – Annville/Cleona Corridor	10:53	07:40	-30%	09:16	08:02	-13%	23:44	18:23	-23%
WB – Annville/Cleona Corridor	12:44	05:53	-54%	08:05	07:08	-12%	21:52	10:36	-52%

**Table 15B: Future No-Build with Phasing Adjustments vs. Long-Term Improvements Option 4 Travel Times**

Roadway Links	AM			Midday			PM		
	Future No-Build w/Phasing	Future Option 4	Change	Future No-Build w/Phasing	Future Option 4	Change	Future No-Build w/Phasing	Future Option 4	Change
EB – Palmyra/North Londonderry Corridor	06:49	04:53	-28%	08:53	04:55	-45%	20:40	05:47	-72%
WB – Palmyra/North Londonderry Corridor	11:54	05:07	-57%	32:17	05:10	-84%	62:58	05:31	-91%
EB – Annville/Cleona Corridor	10:53	07:20	-33%	09:16	07:32	-19%	23:44	10:08	-57%
WB – Annville/Cleona Corridor	12:44	05:24	-58%	08:05	06:40	-18%	21:52	07:47	-64%



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### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

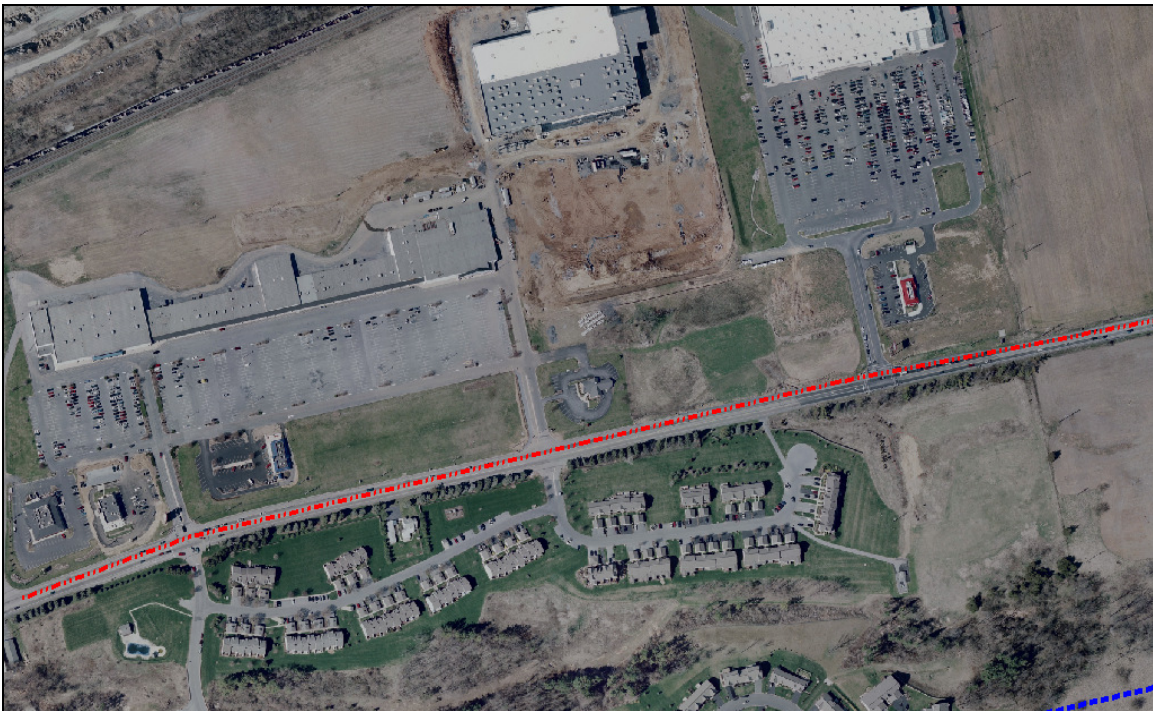
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#### *C. Other Potential Improvements*

Understanding that right-of-way impacts of both long-term improvement options may be problematic, McCormick Taylor investigated several additional transportation improvement options for consideration. These improvements were not formally analyzed utilizing Synchro and SimTraffic but are transportation improvement options and alternatives that may improve long-term traffic operations along the US 422 Corridor.

#### Turning Restrictions and Access Management

The US 422 Corridor between the intersection of Shady Lane and Wal-Mart Driveway, shown in the graphic below, is a good example of controlled access and rear and internal access to multiple shopping and commercial areas. This concept should be extended throughout the corridor and accomplished with any new developments that occur along the US 422 Corridor in the future. This restriction of access and turns increases safety and preserves the capacity of the existing arterial system.



Good Example of Access Control along US 422

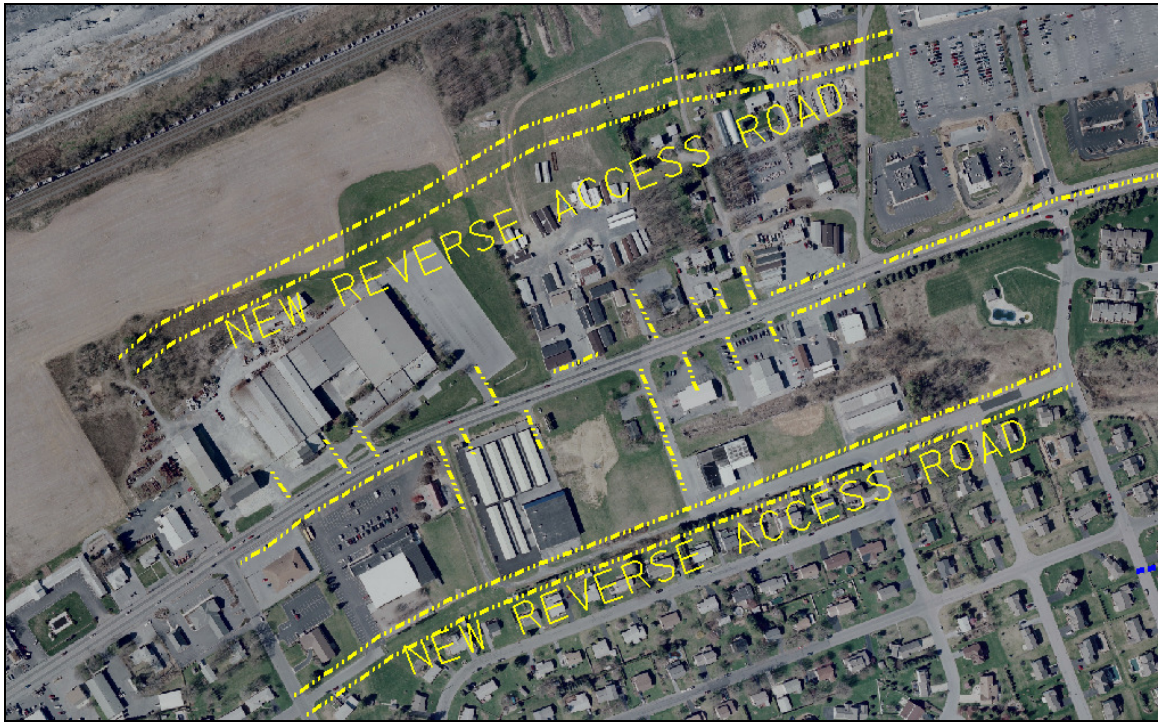


## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

The area west of the Wal-Mart/Londonderry Square development is an example of poor access management and control. As illustrated below, this area could be reconfigured to provide rear access and create network connections that would preserve the capacity of US 422 in the future.



Poor Example of Access Control along US 422 and Proposed Solution

With alternate routes via Clear Spring Road, truck-turning restrictions could be considered at the intersection of White Oak Street and US 422 in Annville. For further detail, please refer to the section on truck routes and alternate routes.



## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

#### Guide Future Development Connections and Access

The development in the Clear Spring Road area will be one of the largest trip generators in the corridor and the undeveloped nature of US 422 in this area will allow the greatest potential for good connections and access management as the land is developed. Close coordination with the developers, planning agencies and PennDOT will be required to take advantage of this opportunity.

Internal connections as well as east-west connections that provide alternatives to US 422 will be key to making this a successful development. Although capacity is available on US 422, looking upstream and downstream into Palmyra and Annville shows that throughput for the traffic from this additional development will be constrained by the intersection of Railroad Street and US 422 in Palmyra as well as White Oak Street and US 422 in Annville. Any connections that can be created to take advantage of alternate routes to divert traffic from US 422 will make the entire development more successful.

Consideration in this development should also be made for the potential connection from Palmyra to Annville to extend or accommodate a potential one-way pair circulation in the future.

The existing traffic signal spacing between the intersections of Shady Lane, Apple Blossom Road, and Wal-Mart Driveway should be considered as new signals and accesses are planned for the Clear Spring Road development. A continuation of the same signal spacing (see below) will allow future signals to be effectively coordinated to facilitate two-way progression along the US 422 Corridor. If signal spacings are not equal or relatively equal, it makes it difficult to coordinate and progress traffic through the signals along an arterial.



Maintain Equal Spacing of New Signals to Enhance Progression



## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

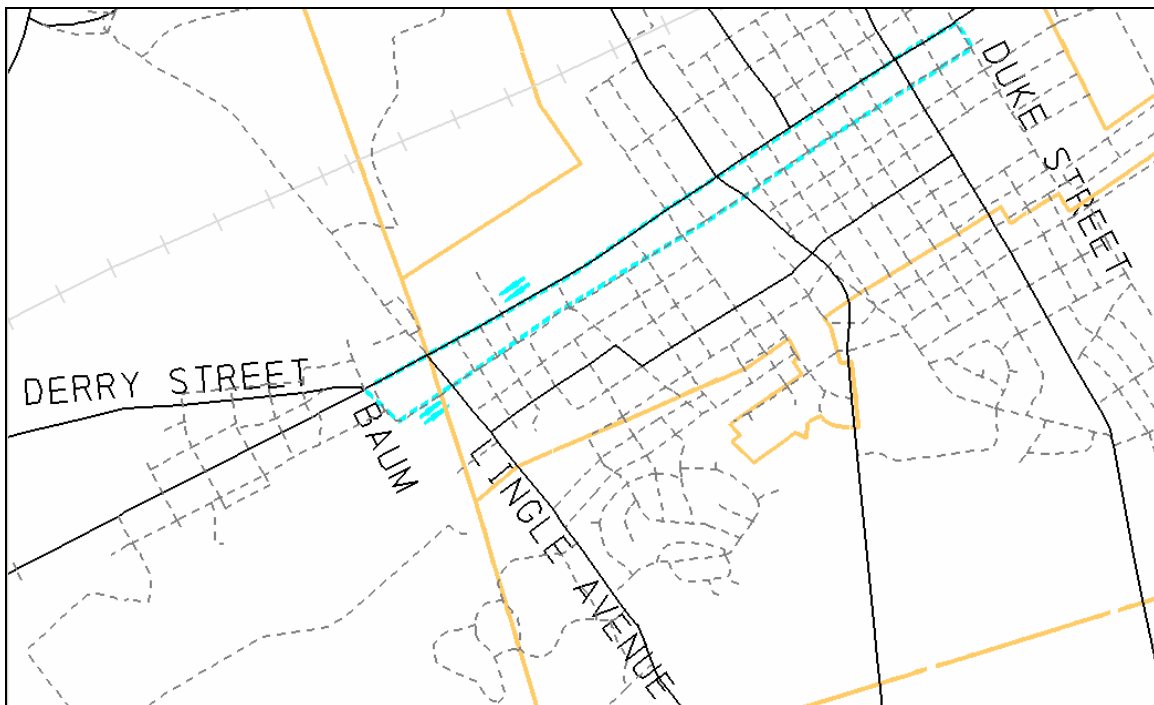
### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

#### Development of a One-way Pair with Cherry Street and US 422

A one-way pair circulation system could be considered with Cherry Street and US 422 being the streets in the couplet. Cherry Street would be one-way eastbound and US 422 would be one-way westbound. This change would improve operations and open up a large area in the cross section for parking and other pedestrian accommodations.

Consideration would need to be made for the length/extent of the system. Obvious termini would be Lingle Avenue on the west and Duke Street on the east. However, to avoid making all turns and beginning the one-way system at Lingle Avenue, the system could start at Baum Street with a re-design and improvement to improve the intersection of Baum Street and US 422 as well as East Derry Road and US 422. This possible configuration is illustrated below with the aqua markings. The system could also be extended beyond Duke Street to take advantage of the Clear Spring Road development and possibly create another east-west parallel connection between Palmyra and Annville through the new development.



One-way Pair through Palmyra



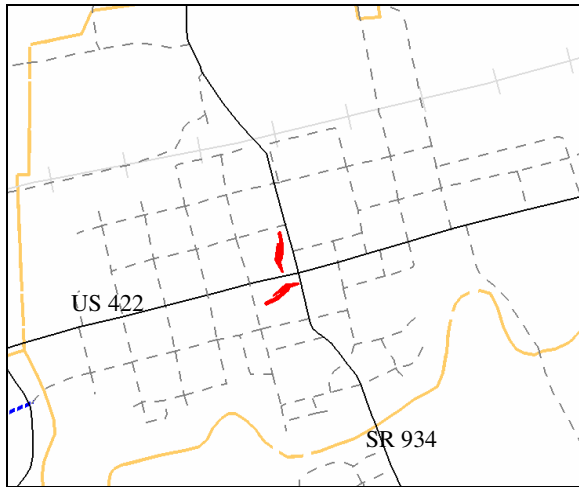
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### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

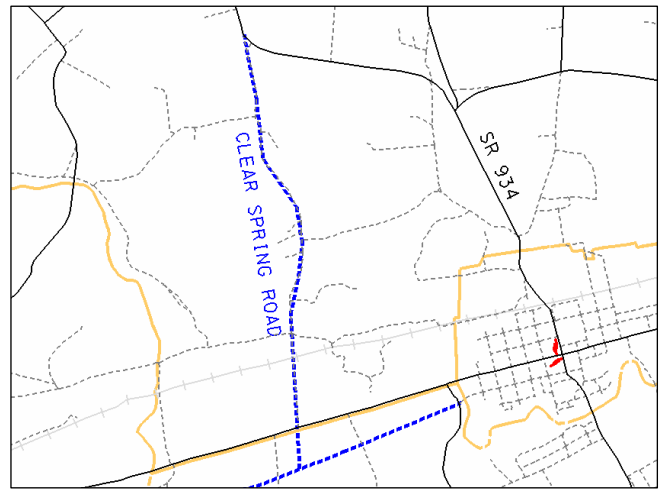
(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

#### Development of Alternate Truck Routes

One of the major operational issues at the intersection of White Oak Street and US 422 in Annville is the truck turning accommodations. Although the operational effects of this cannot be modeled directly using traffic simulation software, the effects in the field are obvious. One possible consideration for the future would be to restrict southbound right turns and eastbound left turns at this intersection (see left photo) and accommodate these turning movements via Clear Spring Road (see right photo).



Turn Restriction in Annville



Alternate Truck Route



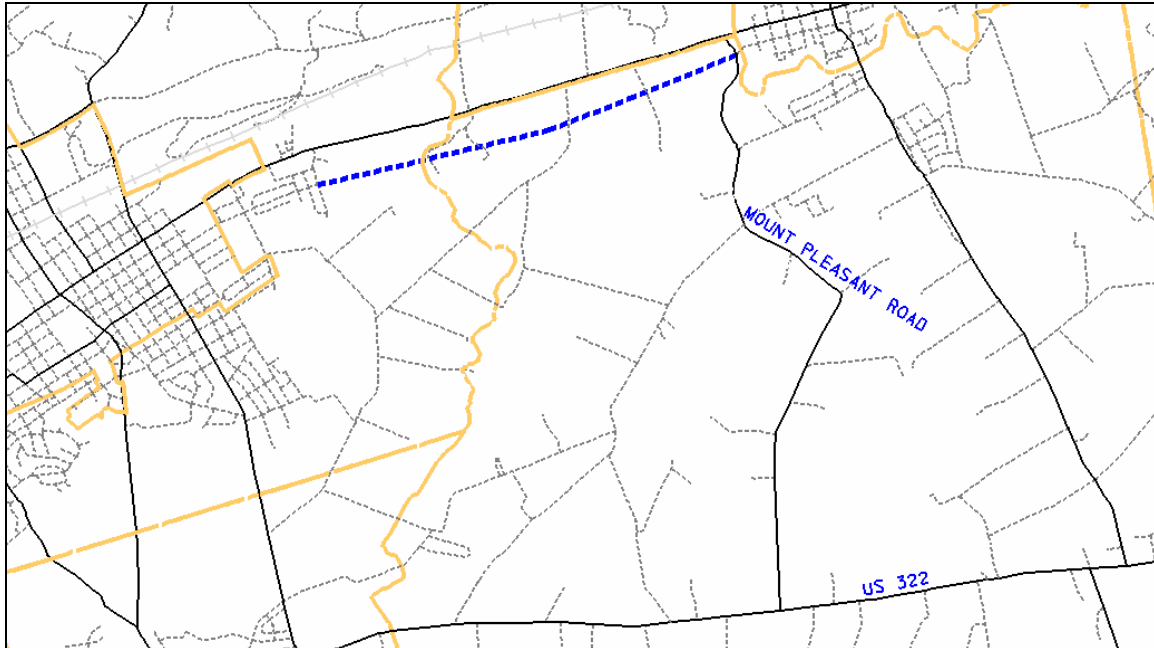
## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

#### Provisions for Additional Network Connections

Reverse or parallel access could also be considered between Apple Blossom Road and Annville via a new facility that would begin at or near Apple Blossom Road and connect through the new Clear Spring Road development to West Queen Street in Annville. There may also be opportunities to connect this roadway to the south via Mount Pleasant Road (see below) to US 322 or a realigned Clear Spring Road and Louser Road.



Additional Network Connections with Clear Spring Road

#### Development of an Act 209 Study or Transportation Impact Fee Ordinance

To address future development and transportation improvements in this region, the Act 209 Transportation Impact Fee ordinance should be considered. A partnership between South Annville Township, North Annville Township and North Londonderry Township to create a Transportation Development District or similar transportation impact fee area would be beneficial and may allow the municipalities and planning agencies to address development issues and concerns between Palmyra and Annville into the future.





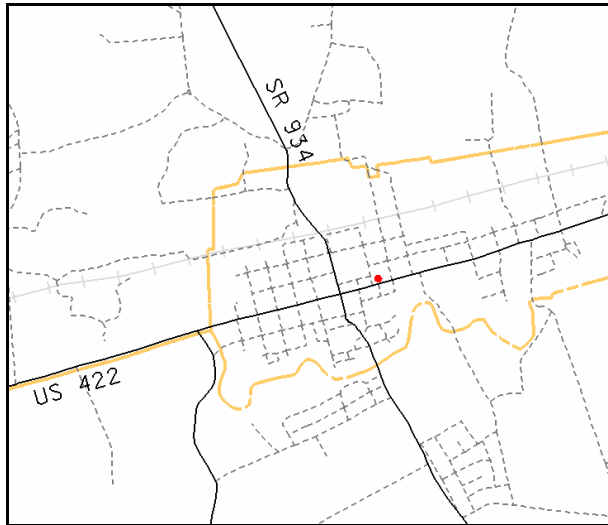
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### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

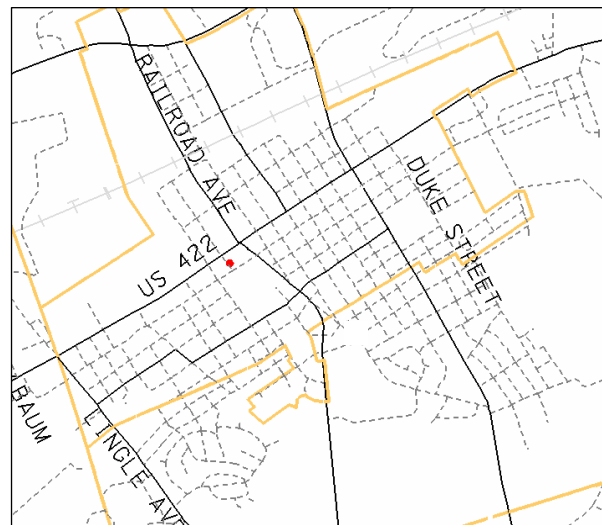
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#### Coordination with Emergency Management Providers

In coordination with the Emergency Management Agencies within the study area, attempts should be made to increase their ability to respond effectively to incidents. Currently three fire station/responder locations exist along the corridor and will continue to be hampered in the future by congestion on US 422. (These locations are designated by red dots in the below graphics.) Consideration should be made for some type of control at the fire stations to prevent blockages of their entrances and allow the fire department to clear vehicle queues in the direction of the response to improve operational efficiency.



EMA Location in Annville



EMA Location in Palmyra



EMA Location in Cleona



## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

### US 422 Corridor – Palmyra/North Londonderry/Annaville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

#### Alternate Pedestrian Accommodations and Transit Improvements

Several alternate solutions could be included to facilitate transit and pedestrian accommodations through Palmyra, Annville and Cleona. The following illustrate a few of the more out of the box ideas for transit and pedestrian accommodation. These should be coupled with more traditional bulb out and traffic calming measures along US 422.

Utilize Cherry Street or other parallel routes for transit vehicles to avoid the congestion along US 422. Relocating stops to side streets would also allow the transit vehicles to stop in an uncongested environment and cross US 422 at perpendicular crossings and reduce the congestion caused by busses stopping along US 422. In many cases, the side street locations would be just as convenient as or more convenient than the current locations and would improve operational efficiency. Creating parallel routes using existing streets north and south of US 422 would facilitate this operation. The MPO and PennDOT should coordinate with COLT to determine the effectiveness of this route alteration and potential for future implementation.

Consider creating a more pedestrian friendly and walkable environment on Cherry Street in Palmyra and on US 422 in Cleona by adding a median or other landscaping that would not only improve aesthetics but would improve pedestrian and transit safety and operations. The following graphics show examples of how these two roadways could be improved.



Potential Changes in Cross-Section on Cherry Street



# CONGESTED CORRIDOR IMPROVEMENT PROGRAM

## US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)



Potential Changes in Cross-Section on US 422 east of White Oak Street



## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

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## VI. Recommendations

The improvement scenarios were categorized by the time frames in which they could be implemented. The first time frame is immediate, occurring in one year or less; the second is short-term, occurring in one to three years; and the third is long-term, occurring in three years or more.

The immediate and short-term improvements can be developed and constructed within the length of this program. The immediate and short-term recommendations are the focus of this study; the long-term improvement alternatives, including the other potential improvements that were discussed will require further and more detailed traffic, engineering, and environmental study, as well as public involvement efforts.

### A. *Immediate Improvements*

The immediate improvement recommendations are relatively low in cost and can be completed within one year. Several of the improvements listed are related to conditions noted in the Summary of Adverse Conditions in Section IV. The improvements include:

- Adjust signal timings.
- Include right turn delay detection at Grant Street, Apple Blossom Road, Shady Lane, and Wal-Mart Driveway.
- Repair loop detector(s) at Center Street.
- Remove nightly flashing signal operations at Railroad Street, Grant Street, Forge Road, and Duke Street.
- Delineate pavement markings at areas noted in the Summary of Adverse Conditions, Section IV.
- Provide crosswalks at Apple Blossom Road and US 422.
- Install missing lane control sign on the eastbound approach of the Grant Street and US 422 Intersection.
- Repair exposed wiring at Forge Road and US 422.
- Eliminate the conflicting signage at Hoffer Street.
- Install luminaires at Shady Lane and US 422.
- Install tether wire for the span wire installations at Mill Street and US 422 and Center Street and US 422.
- Replace burnt signal lenses at Center Street and US 422.

The approximate cost to implement these improvements is \$43,000. The operational benefits of implementing the signal improvements were discussed in the Existing Condition Scenarios, in Section II, Part E. The signal timings utilized for the immediate term analysis are provided in **Technical Files, Section D. Appendix G** provides cost estimate information. It is believed that



## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

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most of these costs will fall under existing maintenance funds and the available staff or contracts within the Boroughs and Townships can perform these improvements. The benefits of this project versus the cost indicate a benefit/cost ratio of 16. Benefit/Cost ratio calculations are also provided in **Appendix G**. **The recommended plan of action is for the Project Team to coordinate with PennDOT District 8-0 and Lebanon County to implement these recommendations.**

#### ***B. Short-Term Improvements***

The short-term improvements can be completed within one to three years and can be completed with minor right-of-way impacts. Two improvement options were presented under the short-term improvements. The Study Team discussed and agreed that Short-Term Improvement Option 2 would be appropriate for the short-term improvement recommendations. In addition to the improvements under Option 2, several of the improvements listed are related to conditions noted in the Summary of Adverse Conditions in Section IV. Where appropriate, the following improvements were included:

- Install new mast arms.
- Install new controller assemblies.
- Install new signal heads with light emitting diode (LED) indications.
- Install emergency vehicle pre-emption.
- Adjust signal timings.
- Coordinate signal operations at Mill Street and Center Street.
- Provide global positioning system (GPS) coordination for the signals in the Borough of Palmyra.
- Include southbound left turn lane at Forge Road and US 422.
- Include northbound left turn lane at Apple Blossom Road (as shown on existing signal plan).
- Include northbound and southbound left turn lane at Mill Street and US 422.
- Include southbound left turn lane at Center Street and US 422.
- Include Walk/Don't Walk pedestrian accommodations.
- Relocate pedestrian push button at Railroad Street and US 422.
- Install pedestrian push buttons for all movements at Mill Street and US 422.
- Install ramps at the intersections of Apple Blossom Road, Shady Lane, Wal-Mart Driveway, and Center Street.
- Replace utility pole span wire installation with mast arm installation at the intersection of Center Street and US 422.
- Reset signal head/mast arm locations to provide 40-ft between the nearest signal head and the stop bar at Grant Street and US 422.
- Re-stripe westbound left turn lane to add length at Forge Road and US 422.



## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

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- Replace head-in angle parking along US 422 west of White Oak Street with back-in angle parking.
- Remove parking along White Oak Street north of the US 422 intersection.

These improvements were included in the short-term recommendations as right-of-way impacts were limited thus minimizing cost and the time frame to complete the project. All of the improvements capable of being captured in the simulation were analyzed under Option 2. The approximate cost to implement these improvements is \$965,000. **Appendix G** provides cost estimate information and benefit/cost ratio calculations. The benefits of this project versus the cost indicate a benefit/cost ratio of 96. The benefit/cost ratio is relatively high as the estimated travel times for the Future No-Build with Phasing Adjustments are lengthy and minor improvements relate to a significant travel time reduction (up to 77 percent in the Midday peak hour).

**The recommended plan of action is for PennDOT and the Lebanon County Planning Department to coordinate and decide on a method for selecting a consultant to pursue the final design of these improvements. This could be done through a new contract, or through one of PennDOT's open-end contracts. The Lebanon County Metropolitan Planning Organization (LEBCO MPO) currently has 2007-2010 Transportation Improvement Program (TIP) funding available for the final design of these improvements. Additionally, it is recommended that the Short-Term Improvements be pursued as a single integrated project and incorporate the effects of Hershey Entertainment, i.e. weekend signal coordination plan.**

#### *C. Long-Term Improvements*

The long-term improvement recommendations have a time frame of three or more years to completion. These recommendations are beyond the scope of this program and should be utilized as a planning tool. Two traffic scenarios were reviewed for long-term improvements; Option 3 involved geometric improvements at specific intersections, and Option 4 widens US 422 to include two travel lanes in each direction from Railroad Street to east of the White Oak Street intersection. Also, other potential improvements including access management, one-way pair option, and other network connections were reviewed and discussed in Alternative Analysis, Other Potential Improvements; Section V, part C. In addition to the improvements outlined in the traffic scenarios and the other potential improvements discussed, improvements related to the conditions noted in the Summary of Adverse Conditions are listed below:

- Implement access management.
- Improve conditions of US 422 pavement.
- Improve intersection turning radii.
- Install sidewalks to be continuous throughout the US 422 Corridor.
- Improve vertical alignments of intersections.



## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

*(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)*

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## VII. Next Steps

The goal of this project is to achieve a reduction of peak hour travel time in the study corridor and to improve overall travel through the corridor. The immediate and short-term improvement recommendations, which are the focus of this study, have the ability to be implemented immediately or within the next three years.

This report identifies some of the needs within the corridor and specific projects that may help to address some of the needs. The projects have been prioritized within the immediate, short-term and long-term time frames. The Project Team will coordinate with PennDOT and the Lebanon County Planning Department to implement the immediate improvements. The short-term improvement recommendations are ready to progress into final design. The extensive traffic data and analysis conducted for this study can be utilized for final design purposes for projects that are undertaken within the next two years.

The long-term improvements, which fully satisfy the 20 percent travel time reduction goals of the study, must be considered further by PennDOT, Lebanon County, and the municipalities, due to their high costs and extensive impacts. If pursuit of these projects is desired, additional and more detailed traffic, engineering, and environmental studies and a public outreach program will need to be completed.



## CONGESTED CORRIDOR IMPROVEMENT PROGRAM

### US 422 Corridor – Palmyra/North Londonderry/Annville/Cleona

(PennDOT Bureau of Highway Safety & Traffic Engineering and PennDOT Engineering District 8-0)

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## VIII. References

Lebanon County website, <http://www.lebcounty.org/lebanon/site/default.asp>.

County of Lebanon Transportation website, <http://www.coltbus.org/>.

PennDOT Bureau of Planning and Research, *2004 Pennsylvania Traffic Data Report*, Harrisburg, PA, 2001.

Institute of Transportation Engineers, *Manual of Transportation Engineering Studies*, Washington, D.C., 1994.

Transportation Research Board, *Highway Capacity Manual*, Washington D.C., 2000.

American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Street*, Washington, D.C. 2004.

Trafficware, *Synchro Version 6.0, Build 614*, Albany, CA, 2001.

Trafficware, *SimTraffic Version 6.0, Build 614*, Albany, CA, 2001.

PennDOT Bureau of Maintenance and Operations, *Traffic Signal Design Handbook, Publication 149*, Harrisburg, PA, 1988.

Institute of Transportation Engineers, *Trip Generation Manual*, 6<sup>th</sup> edition, Washington, D.C., 1997.