COMPREHENSIVE TRAFFIC STUDY OF DOWNTOWN CARLISLE

Prepared for:

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September 2008

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1. EXECUTIVE SUMMARY

Dewberry-Goodkind, Inc., a consulting engineering firm located in Carlisle, PA has been commissioned by the Borough of Carlisle to a conduct a Comprehensive Traffic Study of Downtown Carlisle. The primary objective of the Study is to make recommendations for traffic pattern changes that will accomplish the following goals:

- Calm traffic and enhance Carlisle's small town feeling
- Reduce accidents and enhance safety
- Promote walking and bicycling
- Reduce air and noise pollution
- Maximize downtown business success
- Improve parking access and safety
- Reduce truck traffic in Downtown Carlisle

Carlisle's downtown is currently troubled by excessive vehicle speeds and long crosswalks. The two four-lane highways that intersect at the Square create an auto-dominance that makes it difficult for bicyclists and pedestrians to navigate through town. This project will be an excellent opportunity for Carlisle to recreate the thriving, walkable downtown that it once had. Today, transportation engineers are planning and designing roadways that meet the needs of all users and modes of transportation including pedestrians, bicyclists, and motor vehicles.

The primary recommendation of the Study calls for a traffic calming "Road Diet" for High and Hanover Streets. Road Diets have been proven to reduce vehicle speeds by up to five mph and to significantly reduce the number of accidents at intersections. The primary features of the Road Diet lane configuration are a conversion from four lanes to three lanes with the addition of a five feet wide bike lane in each direction. A dedicated left turn lane will be provided for High and Hanover Streets at each intersection in the Downtown to improve traffic flow. A traversable stamped asphalt median will be created to calm traffic and improve the appearance of the downtown. Significant upgrades to the existing traffic signals are planned and include emergency vehicle preemption, video detection to detect vehicles on the side streets, and pedestrian pushbuttons and pedestrian countdown signals to better serve pedestrians. A Truck Mitigation Signing Plan is also included to direct trucks away from Carlisle's downtown. Curb extensions at intersections are planned to shorten the crossing distance for pedestrians to reduce their exposure to vehicles. The existing parallel parking spaces will remain as they currently are. The proposed bike lanes will also serve as a buffer to make parallel parking easier and make entering and exiting your vehicle safer.

Under the proposed configuration, it will not be possible for delivery trucks to double park in order to make deliveries or to pick up items as they frequently do now. To alleviate this situation, we are proposing several options for deliveries:

- Provide all day dedicated delivery zones, one per block along High and Hanover Streets, which would require 3 or 4 parking spaces for the entire day.
- Provide time of day restricted delivery zones, one per block along High and Hanover Streets, which would require 3 or 4 parking spaces prior to 11:00 AM when parking demand is not at its peak.
- Encourage deliveries be made from side streets and alleys behind businesses where available.

The recommendations detailed in this report are the most effective method of meeting the objectives set by the project stakeholders and were made with the best interests of Carlisle Borough in mind.

2. INTRODUCTION AND PROJECT DESCRIPTION

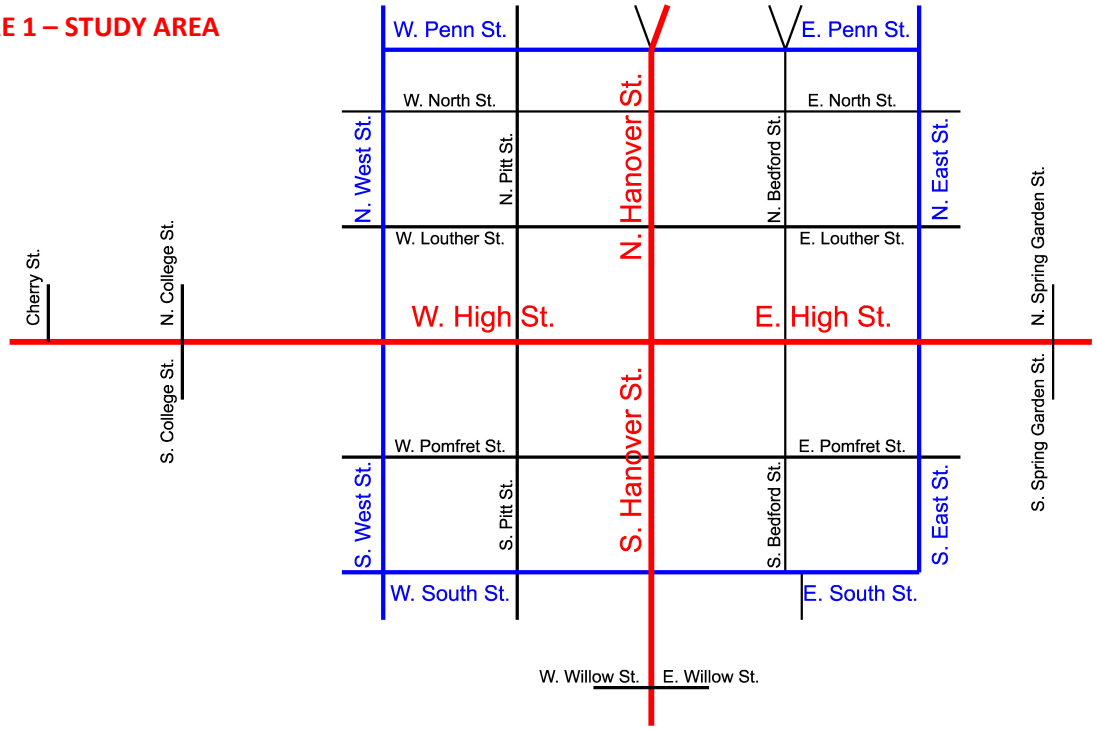
This Comprehensive Traffic Study of Downtown Carlisle was undertaken by the Borough of Carlisle at the request of representatives of the Clean Air Board, the Downtown Carlisle Association, Dickinson College, the Letort Regional Authority, and the Redevelopment Authority of Cumberland County. The purpose of the Study is to preserve and enhance the long-term viability of the downtown area. Dewberry-Goodkind, Inc. (Dewberry) was retained by the Borough of Carlisle to conduct the appropriate traffic studies and analyses to identify strategies to address the following objectives:

- Determine a flow of traffic that enhances an intimate, small-town feeling by calming traffic.
- Promote walking by making it easier for pedestrians to cross roadways.
- Promote bicycling by providing bicycle access through the downtown to employment and recreation areas.
- Provide a reduction in vehicle accidents.
- Provide a reduction in pollutants and noise.
- Maximize downtown business success.
- Improve the accessibility and safety of parking.
- Reduce truck traffic in the downtown.

The objectives listed above are consistent with the Borough's adopted Comprehensive Plan and are crucial to the success of the Borough's efforts to revitalize the downtown area of Carlisle. The downtown is currently not very pedestrian friendly with crosswalks commonly exceeding fifty feet in length which deter people from crossing the streets. In their current lane configuration, High and Hanover Streets are not conducive for bicyclists as there are no dedicated bike lanes forcing them to mix with vehicular traffic.

The Study Area, as shown in Figure 1, includes the downtown area bounded by West Street, South Street, East Street, and Penn Street. Also included in the Study Area are the Hanover Street corridor from Penn Street to Willow Street and the High Street corridor from Cherry Street to Spring Garden Street.

FIGURE 1 – STUDY AREA



3. EXISTING CONDITIONS

Hanover Street and High Street carry four lanes apiece with a 25 mph speed limit and intersect in the heart of the Borough in the area known locally as the 'Square'. Both corridors feature metered parking on both sides and are lined with a variety of businesses, restaurants, churches, and Cumberland County government buildings. Traffic signals control the flow of traffic along both corridors and pedestrians are numerous. Congestion commonly occurs in the inside travel lanes at the signalized intersections as left-turning vehicles waiting for a gap in oncoming traffic cause through-moving vehicles to queue behind them. Often, the through-moving vehicles queued behind a left-turning vehicle will make a sudden lane change near the intersection which raises the likelihood of accidents.

High Street is State Routes 11/74/641 west of the Square and is State Routes 74/641 east of the Square. South of the Square, Hanover Street is State Route 34 and North of the Square, Hanover Street is State Routes 11/34.

Signalized Intersections

There are 15 signalized intersections within the Study Area. Of this total, 13 are located along the High Street and Hanover Street corridors. The two remaining signalized intersections are located along North Street where it intersects with the one-way street pairing of Bedford and East Streets. Currently, all 15 signalized intersections operate on a pretimed basis without regard to time of day or changes in the volume of traffic. All 15 have some form of pedestrian signals including 8 inch Red/Yellow/Green, Walk/Don't Walk, Man/Hand, or Man/Hand with countdown timers. The 15 signalized intersections in the Study Area include:

- West High Street and Cherry Street
- West High Street and College Street
- West High Street and West Street
- West High Street and Pitt Street
- High Street and Hanover Street (also known as the 'Square')
- East High Street and Bedford Street (one-way)
- East High Street and East Street (one-way)
- East High Street and Spring Garden Street
- South Hanover Street and Willow Street
- South Hanover Street and South Street
- South Hanover Street and Pomfret Street
- North Hanover Street and Louther Street
- North Hanover Street and North Street
- East North Street and North Bedford Street (one-way)
- East North Street and North East Street (one-way)

Unsignalized Intersections

There are 13 unsignalized intersections (Stop Sign Controlled) within the Study Area. All of the unsignalized intersections are all way stop sign controlled with the exception of North Hanover Street and Penn Street as North Hanover Street does not have stop signs. The 13 unsignalized intersections within the Study Area include:

- South West Street and West South Street
- South West Street and West Pomfret Street
- North West Street and West Louther Street

- North West Street and West North Street
- South Pitt Street and West South Street
- South Pitt Street and West Pomfret Street
- North Pitt Street and West Louther Street
- North Pitt Street and West North Street
- South Bedford Street and East Pomfret Street
- North Bedford Street and East Louther Street
- South East Street and East Pomfret Street
- North East Street and East Louther Street
- North Hanover Street and Penn Street

Traffic Counts

Manual peak hour turning movement counts at the intersections listed above as well as seven day, 24 hour automatic traffic recorder counts were conducted in April and May of 2008. The timing of the traffic counts was chosen to ensure that the local schools (Carlisle Area School District, Dickinson College, and the Penn State Dickinson School of Law) were in session and no car shows were occurring. The peak hour volumes obtained through the data collection were used to determine the effectiveness of the proposed recommendations and serve as the basis for our traffic analyses.

The manual turning movement counts were done during the Weekday AM Peak Period (7:00 AM to 9:00 AM), Weekday Mid-Day Peak Period (11:00 AM to 1:00 PM), and Weekday PM Peak Period (4:00 PM to 6:00 PM). Passenger vehicles, trucks, pedestrians, and bicycles were all counted separately. The results of the manual turning movement counts are shown in Appendix A.

Automatic traffic recorder (ATR) counts were done during the first week of May 2008 to obtain average daily traffic (ADT) volumes, 85th percentile speeds, and vehicle classifications. The ATR counts were conducted at the following 4 locations:

- West High Street between Cherry Street and College Street
- East High Street between Bedford Street and East Street
- North Hanover Street between Penn Street and Spring Road (State Route 34)
- South Hanover Street between South Street and Willow Street

The locations were chosen based on the availability of objects to secure the traffic counters to and to eliminate the possibility of vehicles parking on the traffic counting tubes. The results of ATR counts are summarized in the following table. The automatic traffic count summaries can be found in Appendix B.

The 85th percentile speed is the speed at which 85 percent of all traffic is traveling at or lower and is generally accepted as the speed that best represents the normal traveling speed of vehicles on a given section of roadway. As shown in the following table, all four sections of High and Hanover Streets are operating well above the posted speed of 25 mph. This excessive speed is detrimental to the quality of life for residents and businesses alike in downtown Carlisle.

TABLE 1 - AUTOMATIC TRAFFIC RECORDER SUMMARY

Location	Average Daily Traffic (vehicles per day)	85th Percentile Speed (mph)	Trucks per Day
West High Street	10,976	32	763
East High Street	12,999	32	482
North Hanover Street	15,247	30	694
South Hanover Street	15,991	38	1184

Accident Analysis

Crash data was obtained from PennDOT's CDART system and from the Borough of Carlisle Accident Forms for intersections and roadways within the project area for the five-year period between 2003 and 2007. This data was analyzed to determine the number of accidents that occurred at each intersection in the Study Area as well as the number of accidents that occurred in mid-block areas. The mid-block accidents were not numerous enough to warrant further investigation but there were a significant number of accidents that occurred at intersections.

When performing an accident analysis, the intersection crash rate is a better measure of crash risk than the raw numbers of accidents because it takes into account the difference in traffic volume at each intersection. The crash rate is based on the number of accidents per million entering vehicles. The following table ranks the intersections in the Study Area based on their respective crash rates.

TABLE 2 – INTERSECTION CRASH RATES

Rank	Intersection	Total # of Crashes	Million Entering Vehicles (MEV)	Crash Rate (/MEV)
1.	East North St. & North East St.	14	14.40	0.97
2.	West North St. & North West St.	7	9.24	0.76
3.	West North St. & North Pitt St.	8	10.82	0.74
4.	East North St. & North Bedford St.	7	11.90	0.59
5.	West Louther St. & North Pitt St.	7	13.29	0.53

6.	East Louther St. & North East St.	6	11.50	0.52
7.	West Louther St. & North West St.	7	14.49	0.48
8.	East Louther St. & North Bedford St.	6	12.58	0.48
9.	West South St. & South West St.	6	13.87	0.43
10.	Pomfret St. & South Hanover St.	11	28.97	0.38
11.	East High St. & East St.	10	27.18	0.37
12.	South West St. & West Pomfret St.	3	8.50	0.35
13.	South Pitt St. & West South St.	3	8.65	0.35
14.	East High St. & Bedford St.	9	26.81	0.34
15.	South Bedford St. & East Pomfret St.	4	12.33	0.32
16.	West High St. & West St.	6	22.07	0.27
17.	South Pitt St. & West Pomfret St.	3	11.03	0.27
18.	North Hanover St. & North St.	7	28.59	0.24
19.	West High St. & Pitt St.	5	22.07	0.23
20.	South East St. & East Pomfret St.	4	17.37	0.23
21.	South St. & South Hanover St.	5	23.96	0.21
22.	High St. & Hanover St.	7	34.29	0.20
23.	West High St. & College St.	4	29.93	0.13
24.	North Hanover St. & Louther St.	3	25.12	0.12
25.	West High St. & Cherry St.	0	21.37	0.00
26.	North Hanover St. & Penn St.	0	18.90	0.00

Upon further review of the accident data, several trends appeared at the following locations:

- South Hanover Street and Pomfret Street - Two accidents occurred in one year that consisted of a bicycle vs. vehicle.
- West High Street and West Street - There were three pedestrian or bicyclist vs. vehicle accidents in three years.
- East North Street and North East Street - There were three instances where a northbound vehicle sideswiped another northbound vehicle. Also at this intersection, there were seven accidents due to drivers running the red light.
- East North Street and North Bedford Street - There were three accidents where a westbound vehicle on North Street ran the red light.
- East High Street and East Street - There were six accidents where drivers ran the red light and of those five (5) were eastbound on High Street.

Field Observations

During our field visits completed for this Study, the following notable observations were made in regards to existing traffic issues in Downtown Carlisle:

- Tractor trailers have an extremely difficult time making right turns at the intersection of High and Hanover Streets. To complete the maneuver without running over the curb and sidewalk, the trucks are forced to either make the right turn from the through travel lane or swing out into the opposing street's left turn lane. The Borough has been forced to replace and relocate several traffic signal supports recently due to damage caused by tractor trailers.
- Currently, the only approach to the intersection of High and Hanover Streets that has protected left turn phasing is the Eastbound High Street approach. Drivers desiring to turn left from the other three approaches must wait for a gap in the opposing traffic stream to complete the left turn. Oftentimes, the drivers of left-turning vehicles enter the intersection on the yellow and red indications after the opposing traffic has stopped. This creates an unsafe condition which increases the likelihood of right angle collisions.
- There are no dedicated left turn lanes at the signalized intersections along High and Hanover Streets other than the Square itself. Left turning vehicles use the inside through lane to complete left turns. Through moving vehicles are commonly blocked in the inside through lane by vehicles waiting to turn left causing unnecessary congestion.
- The exclusive pedestrian phases present at some intersections are detrimental to achieving progressive traffic flow through the coordinated signal systems on High and Hanover Streets. Pedestrians also become impatient waiting for the exclusive pedestrian phase to occur and will cross against the 'Hand' (Do Not Walk) indication. Pedestrians frequently traverse the Square diagonally and must rush to complete the crossing before the vehicular green phase begins.
- The current four lane configurations for High and Hanover Streets encourage motorists to exceed the 25 mph posted speed limit. Motorists frequently make lane changes and pass slower vehicles in an attempt to jockey for position as they approach the signalized intersections.
- Two closures of Interstate 81 have occurred during the development of this Study. On both occasions, Dewberry staff observed the flow of traffic along High and Hanover Streets while Interstate 81 traffic was detoured through the downtown. Due to the width and sheer number of tractor trailers on High and Hanover Streets during the detours, motorists and truck drivers formed a single line of traffic that progressed slowly through the downtown. Tractor trailers would frequently stop in the middle of intersections and thus block side street traffic from entering the intersections.

4. CONCEPTUAL SOLUTIONS

The primary purpose of this Comprehensive Traffic Study was to recommend improvements to the local transportation network that met the objectives set forth by the project stakeholders. The following section will list each of the study objectives and Dewberry's recommendation for improvements that meet each objective.

1. Devise a traffic flow that calms traffic and enhances an intimate, small-town feeling.

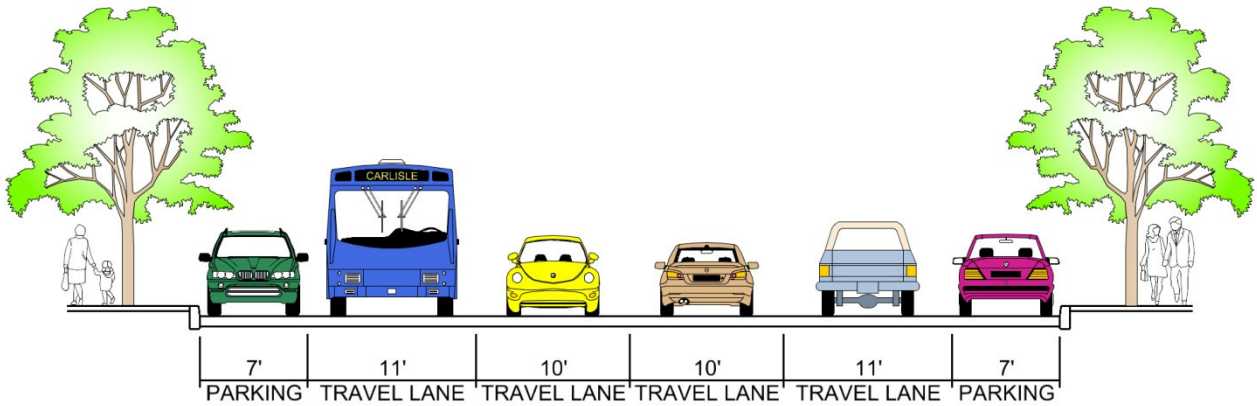
According to the Institute of Transportation Engineers (ITE), the definition of traffic calming is *the combination of mainly physical features that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized users*. Dewberry's recommendation to meet the Study's main objective and one that fits within the ITE definition of traffic calming is the implementation of a Road Diet for the High and Hanover Street corridors. A Road Diet is the removal of travel lanes from a roadway and converting that space for other uses such as bike lanes, parking, and landscaping. A common Road Diet application is the conversion of a four lane arterial to three lanes. The new three lane configuration would feature one through lane per direction with left turn lanes at all signalized intersections.

The Road Diet concept is supported by PennDOT's Smart Transportation Guidebook which states that "the desire to go 'through' a place must be balanced with the desire to go 'to' a place." The Guidebook is based on the premise that roadways are meant for all users and modes of transportation including vehicles, pedestrians, bicyclists, and mass transit. As such, the Guidebook goes on to state "if a roadway is designed to discourage vehicular speeding, it can be comfortably used by pedestrians and bicyclists alike" which fits perfectly with the objectives of this Study.

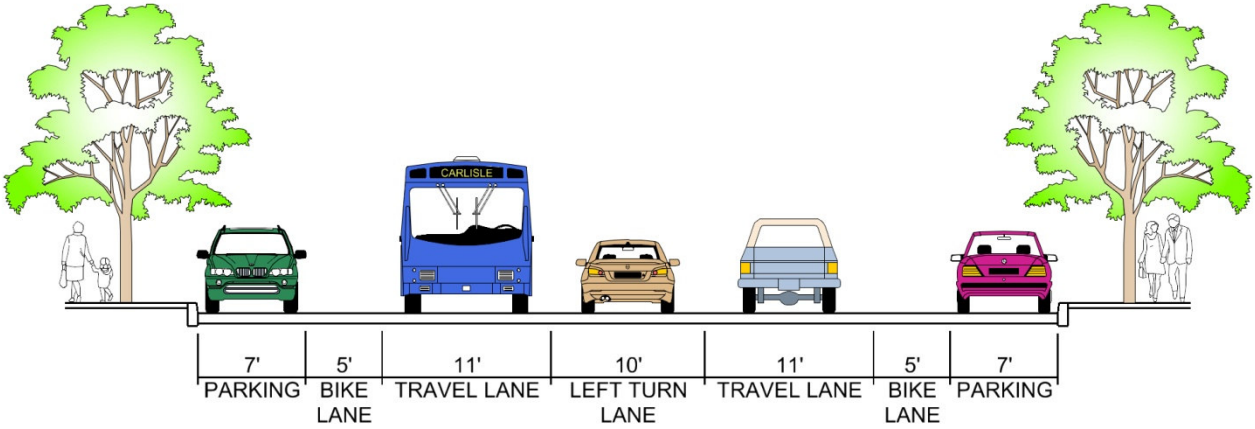
Currently, both High and Hanover Streets feature four 10 feet wide travel lanes with 7 feet wide parallel parking lanes on each side. After a Road Diet transformation, High and Hanover streets would feature one 11 feet wide travel lane per direction with a 10 feet wide dedicated left turn lane at each signalized intersection. A five feet wide bike lane would be created for each direction of travel. The existing parallel parking would be maintained in its current locations.

The following illustrations show what the typical section of both High Streets and Hanover Streets currently looks like as well as what it would look like after the application of a Road Diet.

EXISTING TYPICAL SECTION OF HIGH STREET AND HANOVER STREET



TYPICAL SECTION OF HIGH STREET AND HANOVER STREET AT INTERSECTIONS WITH ROAD DIET



The primary benefit of the Road Diet concept is that it places vehicles in a single lane to regulate driver behavior. With a four lane roadway, drivers tend to speed and jockey for position which encourages other drivers to do the same. With traffic in one lane, the most prudent driver sets the pace for other motorists to follow. Road Diet studies have shown an average speed reduction of 5 mph after the implementation of the lane reconfiguration. The provision of left turn lanes at each signalized intersection helps to maintain capacity where it is needed most, at intersections.

The following illustration depicts what a typical section of High and Hanover Street would look like after the implementation of the Road Diet concept.

FIGURE 2 - PROPOSED ROAD DIET CONDITIONS

According to Parson Brinkerhoff's *Road Diet Handbook: Setting Trends for Livable Streets* and *Road Diets – Fixing the Big Roads* by Dan Burden and Peter Lagerwey, Road Diets are best introduced on roadways with an Average Daily Traffic (ADT) ranging between 12,000 and 18,000 vehicles per day (vpd). The upper limit of ADT for Road Diets is generally between 20,000 and 25,000 vpd. As shown previously in Table 1, the ADT's on High and Hanover Streets range from approximately 10,600 vpd to 16,000 vpd which make these two corridors ideal candidates for a Road Diet conversion. The following is a partial list of other cities that have successfully completed Road Diet conversions on roadways with similar characteristics to High and Hanover Streets in Carlisle:

- Pottstown, PA
- Lewistown, PA
- West Chester, PA
- Philadelphia, PA

The Borough of Pottstown was contacted to discuss their experiences with their Road Diet conversion. Pottstown noted that they did not experience an increase in congestion along the reconfigured corridor nor did they witness any increase in traffic on parallel routes. The use of the bike lanes is increasing and they expect that trend to continue. They have not had an issue with delivery truck parking as the trucks have found places to park on side streets, available curb side parking, or in the painted median. The Borough initially tried to use cones to delineate the revised lane configuration but quickly realized that the cones were a major distraction as the cones confused drivers and caused congestion.

Studies have shown that as ADT's exceed 20,000 vpd, some diversion of traffic to parallel alternate routes can be expected. This diversion is usually in the range of two to fifteen percent. Given an average annual growth rate of one percent, no section of High or Hanover Streets would be expected to carry over 20,000 vpd for the next 23 years. However, if some diversion of traffic does occur onto the parallel street system, we recommend the placement of speed cushions along these streets to act as a disincentive for traffic to leave High and Hanover Streets. The following figures illustrate a typical speed cushion.

FIGURE 3 - SPEED CUSHION FRONT VIEW

FIGURE 4 -SPEED CUSHION SIDE VIEW

Some advantages of the speed cushions are their ability to allow wide axle emergency service providers such as the fire truck shown in Figure 3 to pass without slowing down. Passenger vehicles would still need to pass over a portion of the speed cushion which produces the traffic calming benefit of reduced speeds in residential areas. The speed cushions can also be removed in the winter time to allow for snow plowing operations and can be moved from one area to another as the need arises. The dimensions of speed cushions are typically six feet wide by seven feet long and three inches high.

In conjunction with the reconfiguration of travel lanes, upgrades to the existing traffic signals will be required. The timings of the traffic signals will need to be updated to reflect current traffic volumes and side street video vehicle detection should be implemented to help maintain Levels of Service as close to the existing conditions as possible. A common traffic signal cycle length will be utilized with appropriate offsets to establish a progressive traffic flow along the High and Hanover Street corridors. The purpose of the side street video vehicle detection is to allow unused side street green time to be allocated back to the main streets and to avoid having the side street phases occur if there are no vehicles waiting there. Video detection is also much better suited for detecting bicycles and motorcycles than the traditional in-pavement loop detectors.

Traffic Operations – Level of Service

The analysis of existing and proposed traffic flow conditions was conducted utilizing Synchro/SimTraffic Version 6 traffic analysis software. The operational conditions or quality of flow is commonly expressed in terms of Level of Service (LOS). Level of Service describes the delay experienced by the average vehicle at an intersection or section of highway. LOS varies from A to F with LOS A representing free-flow conditions with virtually no delay. LOS F represents an over capacity condition with very unstable traffic flow and possible gridlock. Because of differences in driver expectations at signalized and unsignalized intersections, the basis for assigning a LOS to those types of intersections varies as shown in the table below.

TABLE 3 - INTERSECTION LEVEL OF SERVICE CRITERIA

UNSIGNALIZED LOS CRITERIA		SIGNALIZED LOS CRITERIA	
Level of Service	Avg. Total Delay (sec/veh)	Level of Service	Control or Signal Delay (sec/veh)
A	≤10.0	A	≤10.0
B	>10.0 and ≤15.0	B	>10.0 and ≤20.0
C	>15.0 and <25.0	C	>20.0 and <35.0
D	>25.0 and <35.0	D	>35.0 and <55.0
E	>35.0 and <50.0	E	>55.0 and <80.0
F	>50.0	F	>80.0

At signalized intersections, the delay is referred to as “control delay” and is the total delay experienced by an approaching vehicle as it passes through the intersection. A LOS can be computed for each movement on an approach, for the entire approach, or for the entire intersection.

At unsignalized intersections, the delay is calculated based on the time spent waiting to turn left from the main street or the time spent waiting at the Stop Sign of the minor street approach. For unsignalized intersections, the LOS is computed for each approach that is controlled by a Stop Sign.

Our analysis included a comparison of the existing 2008 LOS under the four-lane intersection configuration and the Road Diet configuration for AM, Mid-Day, and PM peak hours. We also analyzed the LOS for each intersection under its current configuration but with optimized signal timings (No-Build) against the Road Diet configuration (Build) for the Design Year of 2018. A background growth rate of 0.8 percent was utilized to obtain the expected 2018 peak hour volumes. A summary of these comparisons is detailed in the following

tables. The Synchro reports related to this information are included in Appendix C. Copies of the Traffic Signal Permit Plans that detail the existing traffic signal phasing and timing are included in Appendix J.

TABLE 4 - 2008 LEVEL OF SERVICE AND DELAY (SEC/VEH)

	2008 EXISTING INTERSECTION LOS			2008 PROPOSED INTERSECTION LOS		
INTERSECTION	**AM**	**MID**	**PM**	**AM**	**MID**	**PM**
West High St. and Cherry St.	A (7.4)	A (7.3)	B (12.5)	A (7.6)	A (7.0)	A (8.4)
West High St. and College St.	B (16.8)	B (15.9)	C (23.8)	B (15.5)	A (9.7)	B (19.0)
West High St. and West St.	C (30.7)	D (43.7)	F (94.3)	B (16.4)	B (16.9)	C (22.3)
West High St. and Pitt St.	B (12.4)	B (17.1)	B (16.9)	B (10.6)	B (12.9)	B (14.4)
High St. and Hanover St.	B (19.8)	C (22.6)	C (22.1)	C (24.2)	C (20.7)	C (32.2)
East High St. and Bedford St.	B (10.2)	B (11.0)	B (12.7)	B (11.4)	B (12.4)	B (15.6)
East High St. and East St.	A (8.2)	A (7.6)	A (9.0)	A (7.5)	A (7.6)	B (12.9)
E. High St. and Spring Garden St.	B (15.2)	B (18.8)	C (32.4)	C (24.1)	C (28.5)	D (47.2)
S. Hanover St. and Willow St.	A (8.5)	A (9.5)	B (11.1)	B (12.9)	B (15.1)	B (19.4)
S. Hanover St. and South St.	A (8.2)	A (9.5)	B (10.8)	B (12.1)	B (14.0)	B (18.3)
S. Hanover St. and Pomfret St.	B (14.6)	B (15.2)	C (22.7)	B (16.7)	C (21.1)	C (31.8)
N. Hanover St. and Louther St.	B (14.6)	B (14.4)	B (15.6)	B (11.5)	B (12.7)	B (15.0)
N. Hanover St. and North St.	B (16.4)	B (19.3)	C (21.8)	B (17.3)	B (15.0)	C (22.0)
E. North St. and N. Bedford St.	B (11.5)	B (11.8)	B (13.2)	A (7.3)	A (7.5)	A (8.5)
E. North St. and N. East St.	A (9.8)	B (12.5)	B (14.1)	A (6.9)	A (7.0)	A (9.3)
S. West St. and W. South St.	A (9.4)	B (11.2)	B (13.5)	A (9.4)	B (11.2)	B (13.5)
S. West St. and W. Pomfret St.	A (8.7)	A (9.2)	A (9.7)	A (8.7)	A (9.2)	A (9.7)
N. West St. and W. Louther St.	B (13.6)	B (11.2)	B (14.1)	B (12.5)	B (11.2)	B (14.1)
N. West St. and W. North St.	B (11.0)	A (9.1)	B (10.2)	B (11.0)	A (9.1)	B (10.2)
S. Pitt St. and W. South St.	A (8.8)	A (8.9)	A (9.4)	A (8.8)	A (8.9)	A (9.4)
S. Pitt St. and W. Pomfret St.	A (9.5)	A (9.8)	B (11.1)	A (9.5)	A (9.8)	B (11.1)

N. Pitt St. and W. Louther St.	B (11.2)	B (11.0)	B (12.8)	B (11.2)	B (11.0)	B (12.8)
N. Pitt St. and W. North St.	B (10.4)	A (9.8)	B (11.5)	B (10.4)	A (9.8)	B (11.5)
S. Bedford St. and E. Pomfret St.	B (10.5)	B (10.8)	B (13.7)	B (10.5)	B (10.8)	B (13.7)
N. Bedford St. and E. Louther St.	B (10.7)	B (10.5)	B (12.7)	B (10.7)	B (10.5)	B (12.7)
S. East St. and E. Pomfret St.	B (12.1)	B (14.4)	C (19.8)	B (12.1)	B (14.4)	C (19.8)
N. East St. and E. Louther St.	A (9.6)	A (9.7)	B (11.5)	A (9.6)	A (9.7)	B (11.5)
N. Hanover St. and Penn St.	F (52.3)	A (1.6)	A (8.1)	F (46.8)	A (1.6)	A (5.3)

TABLE 5 - 2018 LEVEL OF SERVICE AND DELAY (SEC/VEH)

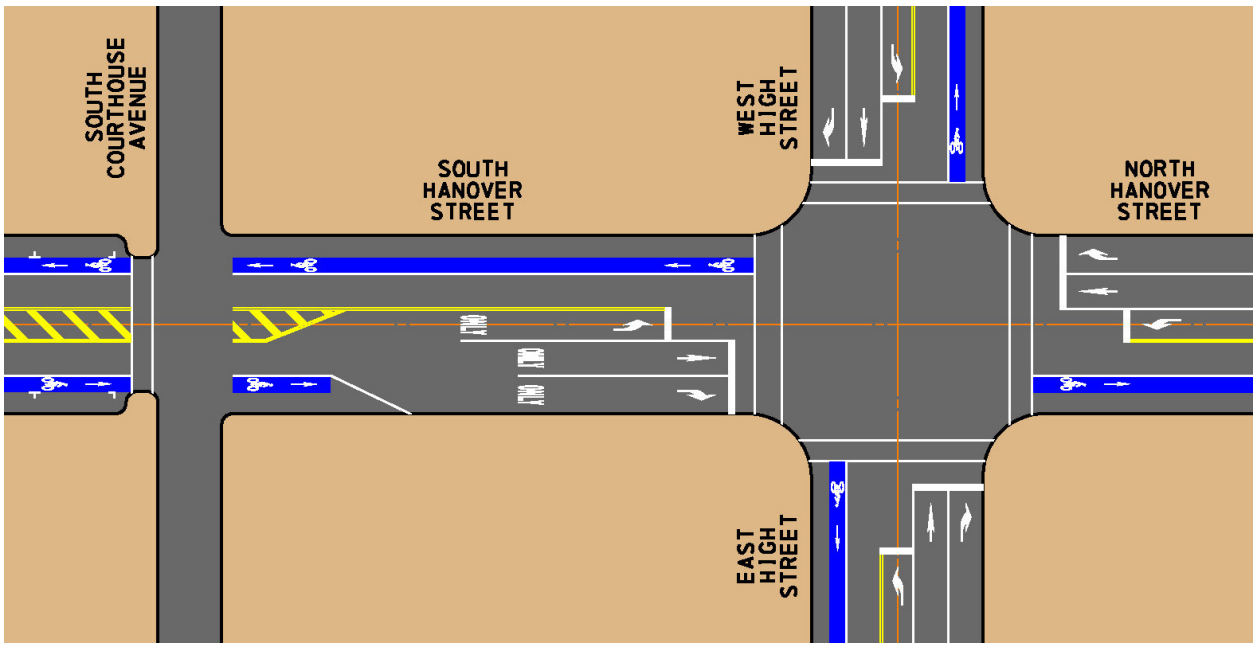
	2018 NO-BUILD INTERSECTION LOS			**2018 BUILD INTERSECTION LOS**		
INTERSECTION	**AM**	**MID**	**PM**	**AM**	**MID**	**PM**
West High St. and Cherry St.	A (8.0)	A (7.8)	B (12.4)	A (8.0)	A (7.0)	A (8.4)
West High St. and College St.	B (17.4)	B (16.2)	C (25.2)	B (15.7)	B (11.1)	B (18.9)
West High St. and West St.	C (32.9)	B (18.3)	C (26.7)	B (17.3)	B (18.7)	C (22.3)
West High St. and Pitt St.	B (12.8)	B (17.0)	B (17.1)	B (10.8)	B (15.4)	B (14.4)
High St. and Hanover St.	C (20.8)	C (23.6)	C (23.6)	C (28.8)	B (19.9)	C (31.6)
East High St. and Bedford St.	B (10.1)	B (11.0)	B (12.4)	B (11.6)	B (14.5)	B (15.6)
East High St. and East St.	A (8.4)	A (7.9)	A (9.4)	A (8.6)	B (10.2)	B (13.2)
E. High St. and Spring Garden St.	B (15.2)	C (20.3)	D (38.4)	C (28.4)	C (34.0)	D (47.0)
S. Hanover St. and Willow St.	A (8.9)	B (11.1)	B (11.9)	B (13.5)	B (16.1)	B (19.5)
S. Hanover St. and South St.	A (8.8)	B (10.4)	B (11.6)	B (14.0)	B (16.8)	B (18.5)
S. Hanover St. and Pomfret St.	B (16.4)	B (17.4)	C (24.3)	B (19.6)	C (26.2)	C (32.0)
N. Hanover St. and Louther St.	B (14.9)	B (14.7)	B (16.0)	B (11.8)	B (13.8)	B (15.0)
N. Hanover St. and North St.	B (17.1)	C (20.2)	C (23.9)	B (18.6)	B (17.6)	C (21.9)
E. North St. and N. Bedford St.	B (11.7)	B (12.1)	B (13.5)	A (7.4)	A (7.6)	A (9.0)

E. North St. and N. East St.	A (10.0)	B (12.8)	B (14.6)	A (7.6)	A (7.1)	A (10.0)
S. West St. and W. South St.	A (9.8)	B (12.1)	C (15.5)	A (9.8)	B (12.1)	C (15.5)
S. West St. and W. Pomfret St.	A (9.0)	A (9.5)	B (10.2)	A (9.0)	A (9.5)	B (10.2)
N. West St. and W. Louther St.	B (13.9)	B (12.0)	C (16.2)	B (13.9)	B (12.0)	C (16.2)
N. West St. and W. North St.	B (11.7)	A (9.4)	B (10.8)	B (11.7)	A (9.4)	B (10.8)
S. Pitt St. and W. South St.	A (9.1)	A (9.2)	A (9.8)	A (9.1)	A (9.2)	A (9.8)
S. Pitt St. and W. Pomfret St.	A (9.9)	B (10.3)	B (11.9)	A (9.9)	B (10.3)	B (11.9)
N. Pitt St. and W. Louther St.	B (12.0)	B (11.8)	B (14.4)	B (12.0)	B (11.8)	B (14.4)
N. Pitt St. and W. North St.	B (11.0)	B (10.3)	B (12.5)	B (11.0)	B (10.3)	B (12.5)
S. Bedford St. and E. Pomfret St.	B (11.1)	B (11.5)	C (15.6)	B (11.1)	B (11.5)	C (15.6)
N. Bedford St. and E. Louther St.	B (11.4)	B (11.1)	B (14.0)	B (11.4)	B (11.1)	B (14.0)
S. East St. and E. Pomfret St.	B (13.3)	C (16.5)	D (25.9)	B (13.3)	C (16.5)	D (25.9)
N. East St. and E. Louther St.	A (9.9)	B (10.1)	B (12.4)	A (9.9)	B (10.1)	B (12.4)
N. Hanover St. and Penn St.	F (87.8)	A (1.9)	B (16.2)	F (85.7)	A (1.8)	B (12.0)

As evidenced in the tables above, the Road Diet lane configuration maintains the same LOS as the four-lane configuration for the vast majority of intersections for the AM, Mid-Day, and PM peak hours. The intersection capacity is maintained by the provision of dedicated left turn lanes, optimized/coordinated signal timings, and the removal of the all pedestrian signal phases which is discussed in more detail on page 18. Based on these results, a significant increase in traffic congestion is not anticipated after the implementation of the Road Diet.

The intersection of High Street and Hanover Street would be reconfigured to have a dedicated left turn lane, a through lane, and a dedicated right turn lane on each approach as shown in the following figure. The proposed bike lanes markings are interrupted at the beginning of the dedicated right turn lanes in accordance with PennDOT's Smart Transportation Guidebook and AASHTO's Guide for the Development of Bicycle Facilities Figure 12 which can be found in Appendix D. As bicyclists approach intersections, they must weave with motorized traffic at a safe opportunity and position themselves in the appropriate lane to complete their trip through the intersection whether they are turning left, right or going straight.

FIGURE 5 - PROPOSED CONFIGURATION OF HIGH STREET/HANOVER STREET INTERSECTION



Project Limits of the Road Diet

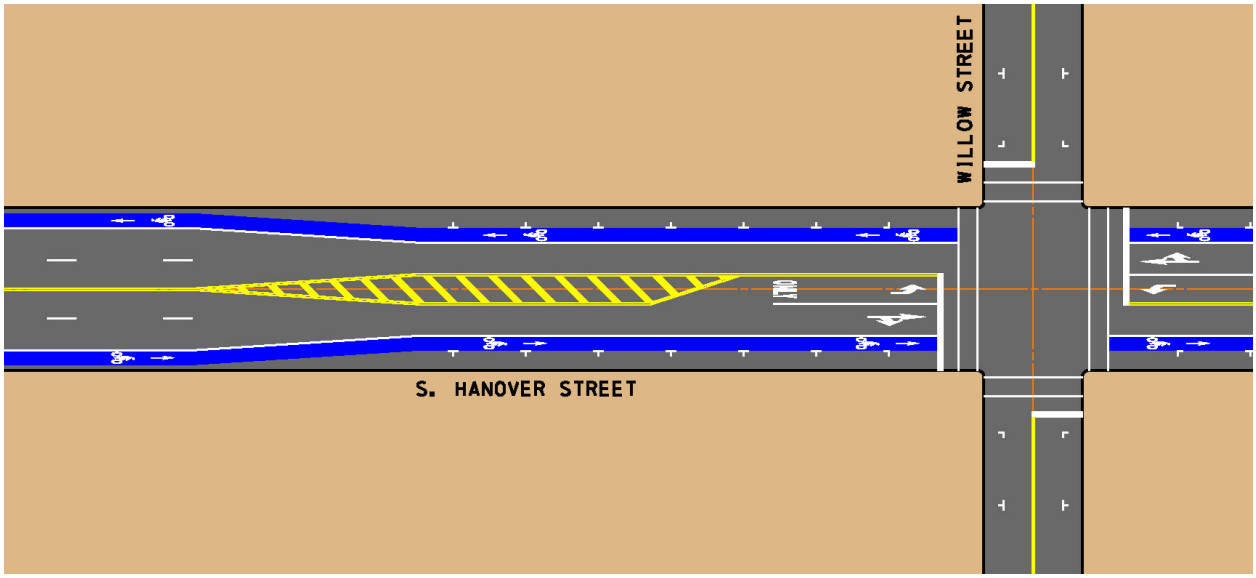
The limits of the Road Diet reconfiguration for High and Hanover Streets were chosen based on locations that could provide the most effective transitions. The western limit on West High Street will be its intersection with Cherry Street. The eastbound High Street approach to this intersection currently features a dedicated left turn lane and a through lane and would not require any modifications.

The northern limit of the improvements will be the intersection of North Hanover Street and Penn Street. North Hanover Street is already one lane in each direction north of Penn Street. As vehicles enter the Study Area from the north they will encounter the Road Diet pavement marking pattern shown in Figure 2 above rather than the existing four lane configuration.

The eastern limit will be the intersection of East High Street and Spring Garden Street. At this location, the westbound High Street approach currently features two lanes (a shared left/through lane and a shared through/right lane) with a protected left turn phase for traffic heading to South Spring Garden Street. With through traffic mixed together with left turning traffic in the inside lane on this approach, the full benefit of the protected left turn phase is not realized. By converting this approach to a dedicated left turn lane and a shared through/right lane, the transition to the Road Diet can be easily achieved.

The southern limit of the Road Diet will occur in the section of South Hanover Street between Noble Boulevard and Willow Street. In this location, the four lane section will tapered down to three lanes as shown in the detail below.

FIGURE 6 - TRANSITION TO ROAD DIET AT SOUTHERN LIMIT



Impact of Road Diet on Interstate 81 Detours

When accidents occur on Interstate 81 in the Carlisle area that require the closure of the Interstate, PennDOT incident management procedures call for interstate traffic to be routed through Carlisle via Routes 11, 34, 74, and 641 (High and Hanover Streets). When these detours occur, major traffic congestion in Carlisle is common. It is important to note that High Street west of Cherry Street and east of Route 74 is already one lane per direction. The same is true for Hanover Street south of Interstate 81 and north of Penn Street. During the completion of this Study, two such Interstate 81 closures have occurred with resulting detours through Carlisle. During each closure Dewberry staff observed the traffic flow patterns along High and Hanover Streets. As noted previously, the width and sheer number of tractor trailers on High and Hanover Streets forced motorists and truck drivers to form a single line of traffic that progressed slowly through the downtown. Tractor trailers would frequently stop in the middle of intersections and thus block side street traffic from entering the intersections. The revised pavement marking pattern of the Road Diet should have little effect on the flow of traffic during I-81 detours as traffic will already be in one lane as it enters the Road Diet areas and will continue through town in such a manner.

The Borough should consider implementing an I-81 detour traffic signal timing plan via its existing closed loop system. The detour timing plan would give greater priority to the High and Hanover Street movements to keep them moving through town. It will be critical for Carlisle Police and the local Fire Police to ensure that tractor trailers do not block the intersections when the High and Hanover Street approaches receive the red signal indication. This will ensure that the side street movements will be able to travel through the intersections in a timely manner and not cause unnecessary delays to the side streets.

Traffic Restrictions for Alleys

In the interest of safety and traffic operations, we recommend that left turns from High and Hanover Streets into the alleys be eliminated. As such, the alleys would be subject to Right-In/Right-Out operations. Eliminating left turns into the alleys from High and Hanover Streets will improve traffic flow along the main routes. We do

not recommend changing any of the One-Way traffic restrictions that currently govern the alley system around the Square.

Proposed Median along High and Hanover Streets

As shown on the rendering in Figure 2, the Road Diet will produce a median along High and Hanover Streets in the areas between the dedicated left turn lanes at the signalized intersections. Early in the Study process, we had proposed a curbed landscaped median to separate the opposing traffic flows and serve as an additional traffic calming device. However, the curbed landscaped median has been removed from our recommendations due to comments received from the public at large as well as the emergency service providers in Carlisle. The main concerns with the curbed landscaped median dealt with decreased mobility of emergency vehicles and the inability of vehicles to get around double-parked delivery trucks.

Additional input from the project stakeholders has led us to recommend a stamped asphalt treatment for the median areas. The stamped asphalt would be a different color from the travel lanes to distinguish this area as a 'non-travel' area. However, the median could still be driven on by emergency vehicles and by motorists bypassing stopped delivery trucks if the need arises. The final choice of color and pattern of the median areas can be made by the Borough when final construction documents are prepared.

Angle Parking

PennDOT's Publication 46, Traffic Engineering Manual covers the issue of Angle Parking. Exhibit 11.6-A, *Diagonal Parking Minimum Maneuver Area*, states that a minimum of 26 feet is required between the face of the curb and the edge of the nearest travel lane. If both proposed 5 foot bike lanes were to be removed it would produce 10 feet in addition to the existing 7 foot parking lane for a total of 17 feet of available maneuver area. This is still 9 feet short of the required maneuver distance of 26 feet for a 30 degree parking angle. As such it will not be possible to provide angle parking along High and Hanover Streets in conjunction with this project.

*2. **Promote walking by making it easier for pedestrians to cross roadways.***

Another benefit of the proposed Road Diet is improved pedestrian safety. With lower speeds and fewer lanes to cross, pedestrian crossings are made safer.

To further achieve the objective of making it easier for people to cross the streets in downtown Carlisle, we also recommend the construction of curb extensions at the downtown intersections along High and Hanover Streets. The purpose of the curb extensions is to shorten the required crossing distance for pedestrians. The less time they spend in the travel way the safer they will be. Curb extensions also increase safety by placing a waiting pedestrian out in the line of sight motorists as they are not hidden behind parked cars. Another advantage of curb extensions is they reduce the required "Walk" indication of the pedestrian signals, that unused portion of the traffic signal cycle can be given back to the vehicular green times and thus improve traffic flow. Curb extensions by the very presence also serve as a traffic calming device as they tend to slow down vehicular traffic. We recommend that the layouts of the curb extensions are first delineated with cones or similar devices while emergency vehicles test the design in the field. The results of the emergency vehicle tests will dictate the final design (location and size) of the curb extensions. Please see Figure 7 below for a typical curb extension in Ephrata, Pennsylvania.

FIGURE 7 - TYPICAL CURB EXTENSION LAYOUT

FIGURE 8 - TYPICAL COUNTDOWN PEDESTRIAN SIGNAL

The expanded use of the countdown style pedestrian signals at all signalized intersections within the Study Area along High and Hanover Streets is also recommended. This form of pedestrian signal provides the crossing pedestrian with the amount of time they have to safely complete the crossing maneuver.

In conjunction with the countdown pedestrian signals, we also recommend the removal of the exclusive pedestrian phases that are currently present at the following intersections:

- West High Street and College Street
- West High Street and West Street
- West High Street and Pitt Street
- High Street and Hanover Street
- North Hanover Street and Louther Street
- North Hanover Street and North Street

The elimination of the exclusive pedestrian phases at these locations will improve vehicle progression within the coordinated traffic signal system. Pedestrians at these intersections would receive a standard "Man" (Walk equivalent) indication followed by a flashing "Hand" (Don't Walk equivalent) along with the adjacent vehicular movement as they currently do at the other signalized intersection within the Study Area.

A Leading Pedestrian Interval or pedestrian head start interval is recommended for the High Street/Hanover Street intersection since it will not be possible to construct curb extensions at this intersection because there is not parking near the intersection. The Leading Pedestrian Interval is usually three seconds and gives the pedestrian an opportunity to enter the crosswalk and establish their presence before a right-turning vehicle has the chance to enter the crosswalk area.

3. Promote bicycling by providing bicycle access through the downtown to employment and recreation areas.

The most effective method of promoting bicycling throughout the downtown is the provision of dedicated bike lanes. We recommend that five feet wide bike lanes in each direction along High and Hanover Streets be provided in conjunction with the Road Diet lane configuration. The benefits of the bike lanes are many and include:

- Reduced vehicular volumes as people choose bikes for short trips
- Increased safety for bicyclists

- Help motorists predict where to expect bikes
- Reduced air and noise pollution
- Reduced fuel consumption
- Promote a healthy activity and exercise.

For safety reasons, the bike lanes should not be placed between the parking lane and the curb. The parked cars block the visibility of the bicyclists and preclude bicyclists from making left turns at intersections. A bicyclist education program is recommended to instruct bicyclists of their responsibilities and to teach safe riding techniques. The program could consist of press releases and brochures distributed at local businesses. According to PennDOT's Smart Transportation Guidebook, "Well-designed bike facilities cannot substitute for good judgment on the part of the cyclist. Even on roads with bike lanes, cyclists are still obliged to follow all prevailing rules of the road." Strict enforcement of the bike lanes will also be required so that vehicles do not treat the bike lanes as de facto right turn lanes at intersections.

The bike lanes should be painted blue to clearly delineate the boundaries of the travel lanes and the bike lanes. It is vitally important that the blue lane markings consist of a textured non-slip surface. Traditional wide pavement markings are notoriously slippery for bicyclists when they are wet.

The blue markings will also serve to notify the passengers of parked cars that they are opening their doors into a bike lane. While the possibility of bicyclist/vehicle door conflicts still exists with the bike lanes, they represent a substantial improvement in safety as bicyclists are separated from vehicular traffic and have their own dedicated space in which to operate.

Bicycle racks should also be installed at strategic locations around the downtown so that bicyclists have a place to conveniently park their bicycles. Some examples of locations where bike racks would be needed are:

- Two locations at the Square
- The Bosler Library
- Northwest corner of Hanover Street and Louther Street.
- Two additional locations each on High and Hanover Streets

The addition of bike lanes along High and Hanover Streets is consistent with the Letort Regional Authority's Greenway Plan which makes the same recommendation for bike lanes. The goal of the Greenway Plan is to create a trail system consisting of marked roadway bike lanes and traditional bike trails that provides connections between municipal parks, schools, and various other attractions. The Greenway Plan is based on a hub and spoke design with Carlisle Borough serving as the central urban hub. The bike lanes and trails would extend outward in a spoke-like pattern to destinations in Middlesex, North Middleton and South Middleton Townships. The Greenway Plan was recently approved by Carlisle Borough Council and serves to provide additional recreational opportunities, provide alternate transportation routes and enhance the quality of life that currently exists in the Study Area.

4. Provide a reduction in vehicle accidents.

Research has consistently shown that arterial road diet conversions of 4-lane to 3-lane can reduce crash rates as well as the number and severity of crashes. The improvement in safety can be attributed to the following factors:

- Reduction in vehicle speeds and speed variability. Most accidents are caused by the variability of vehicle speeds as opposed to the speed itself. Placing traffic in a single through lane will reduce the speed variability along High and Hanover streets.
- Reduction in the number of conflict points at intersections. A conflict point is any spot within an intersection where the travel paths of vehicles can potential cross. With one less through lane per direction, the number of potential conflict points is reduced which reduces the likelihood of crashes.
- Improved intersection sight distance for left turning vehicles. Sight lines are improved for left-turning vehicles because the left turn lanes are aligned providing a clear line of sight for left-turning drivers to the opposing through traffic.
- Improved pedestrian and bicycle environment. The provision of dedicated bike lanes separates bikes from vehicles which greatly reduces the potential for collisions.

5. Provide a reduction in pollutants and noise.

The Carlisle-Harrisburg region has received some rather negative press for its air quality recently as it was ranked 14th worst nationally for particulate matter. Area physicians have noted the recent increase in cases of childhood asthma and local residents are demanding that something be done. Lawmakers in Harrisburg are currently working on legislation (Senate Bill 295) that would ban truck idling at truck stops and warehouses under most conditions.

The traffic calming improvements, truck mitigation signing, and improved traffic signal timings that this Study recommends should produce lower speeds and fewer trucks in Carlisle's downtown. These two factors alone will serve to reduce traffic noise levels. The reduced starting and stopping from improved traffic signal timings will also reduce vehicle emissions, thereby improving air quality.

6. Maximize downtown business success.

As stated previously, Road Diets improve the pedestrian environment and the walkability of a commercial district which improves the economic vitality of the area. By reducing vehicle speeds, traffic noise, and emissions, sidewalk dining and shopping is more enjoyable and will entice patrons to the Downtown. This, in turn, will help the local business climate and facilitate the redevelopment of underutilized or vacant downtown properties.

An issue that surfaced during the public involvement process was the provision of parking for delivery vehicles for the downtown businesses. Currently, most delivery trucks double park in the travel lane adjacent to the curbside parking. The existing four-lane configuration on High and Hanover Streets allows vehicles to pass double-parked delivery vehicles in the spare through lane. This will not be possible under the Road Diet proposal. To alleviate this situation, we recommend that one or more of the following options be implemented by Carlisle Borough:

- All-day dedicated delivery zones. These zones would be provided once per block on each side of High and Hanover Streets in the Downtown. This would require the elimination of three or four parking spaces per block to provide adequate space for delivery trucks to park and maneuver.
- Time of day restricted dedicated delivery zones. This option is identical to the all-day delivery zones except the affected parking spaces would be returned to vehicular parking after a set time such as 11:00 AM. By restricting the delivery zones to the mornings, the existing parking can be restored prior to beginning of the peak parking demand. Local businesses would need to coordinate with their delivery services to have the deliveries made during the times that the delivery zones are in effect and to make sure that the delivery zones are used by the delivery trucks.
- Encourage businesses that have rear alley access to have their deliveries made from the alleys.

- Encourage businesses to have their deliveries made from side streets to avoid having delivery trucks double park on High and Hanover Streets.

In the event that a delivery truck were to attempt to park along High or Hanover Streets, the truck would most likely park in the entirety of the bike lane and a portion of the travel lane. Traffic will still be able to pass by utilizing a portion of the median.

7. Improve the accessibility and safety of parking.

There is currently parallel curbside parking along High and Hanover Streets in the Downtown. Most parking spaces are seven feet wide and are located immediately adjacent to moving traffic. Vehicle passengers must exercise great caution and prudence while opening their doors to avoid having the doors struck by passing vehicles. Many drivers fold in their mirrors to avoid having them hit as well.

The provision of bike lanes along High and Hanover Streets will greatly improve the accessibility and safety of on-street parking. The bike lanes provide a five feet wide buffer area between parking and moving traffic which will make it considerably safer for people to enter and exit parked vehicles.

The accessibility of the parallel parking spaces is also improved by the presence of the bike lanes. The buffer space created by the bike lanes will make it easier and safer to complete the parallel parking maneuver.

8. Reduce truck traffic in the downtown.

The Borough of Carlisle and its surrounding municipalities are strategically located as a hub for the national trucking and warehouse industry. With convenient access to Interstates 81 and 78, Route 15 and the Pennsylvania Turnpike, Carlisle is within a 24 hour drive of nearly seventy percent of the United States population. This location and the availability of large tracts of affordable undeveloped land have made the Carlisle area a magnet for the construction of warehouses and other trucking related businesses. However, this growth has produced large increases in the volume of truck traffic in the Borough of Carlisle which has led to increased traffic congestion, air and water pollution, and noise. These unwelcome side effects have the potential to damage the long-term viability of Carlisle's downtown area and its businesses.

In 1995, the Borough of Carlisle and PennDOT designated US 11, SR 34, SR 641, and SR 74, essentially all of High and Hanover Street, as Access Truck Routes through the Downtown. This designation as Access Truck Routes allowed trucks and 53 feet long trailers to use these roadways. As such, a prohibition of trucks in Carlisle's downtown is not possible. However, the Borough does have the ability to prohibit tractor trailers from using the Borough owned streets which were not designed to handle trucks of that size. Therefore, we recommend that the Borough place R5-2 (No Truck) signs with the supplement R5-2-3 (Except Local Deliveries) sign beneath it at the intersection of all Borough owned streets with High and Hanover Streets. Please refer to Appendix D for details on these signs. This restriction meets the warrant set forth in PennDOT Publication 212, Official Traffic Control Devices, Section 212.117 (c) (2) based on the inadequate turning radii at State Route/local street intersections and Borough street widths.

One of the primary sources of truck traffic in the downtown is the movement of trucks from the PA Turnpike to the warehouses and distribution centers on the west end of Carlisle Borough along the Ritner Highway (US 11) and Newville Road (SR 641). This trip pattern was observed by Dewberry staff on numerous occasions during our field reconnaissance. Trucks utilize West High Street and North Hanover Street to complete this segment of their trips and turn at the Square. The right turn from North Hanover Street to West High Street is very difficult for trucks due to the length of their trailers and the existing corner radius at this location. The Borough has had to relocate traffic signal supports due to them being struck by trucks and damage to the curbs and sidewalk has occurred at this location due to trucks.

Without the ability to prohibit trucks from the State Routes in downtown Carlisle, we must focus on reducing their numbers. The two most effective methods of doing so are the ongoing Trucking Outreach Program and a targeted signing plan to encourage trucks to use Interstate 81 to bypass downtown Carlisle.

Signs directing trucks away from the downtown should be placed at the following locations:

- I-81 Northbound prior to Exit 44 with the message: Trucks to PA Turnpike – Use Exit 52
- I-81 Southbound prior to Exit 52 with the message: Trucks to Carlisle – Use Exit 44
- SR 34 Northbound prior to I-81 with the message: Trucks to PA Turnpike – Use I-81 North
- US 11 Southbound prior to I-81 with the message: Trucks to Carlisle – Use I-81 South
- PA Turnpike after Carlisle Interchange Toll Plaza with the message: Trucks to Carlisle – Use I-81 South

Please refer to the Conceptual Signing Plan in Appendix D for additional details.

The initial meeting of the Trucking Outreach Program was held on June 26, 2008. Representatives from over thirty local trucking companies were invited to attend while ten were in attendance at the meeting. The trucking companies were encouraged to direct their trucks away from the downtown and were generally supportive of the signing recommendations listed above. Please refer to Appendix E for additional details and results of the Trucking Outreach Program. Additional coordination will need to occur after the acceptance and approval of this Study to ensure that the trucking companies are aware of the proposed changes and continue to direct their trucks away from the Downtown.

We also recommend that the signs be placed at the exits of the trucking related businesses at the west end of the Borough directing truck traffic to Interstate 81 via SR 465. A suggested sign message for this application is shown in Appendix D.

5. PUBLIC INVOLVEMENT

A significant public involvement process was undertaken for this Study. Obtaining public input was critical to receive feedback on the Study's proposals as well as to inform the public of the potential changes to downtown Carlisle.

Stakeholder Meetings

A total of four Stakeholder Meetings occurred throughout the development of this Study's recommendations. Minutes from each of the Stakeholder Meetings can be found in Appendix F. The Stakeholder Committee was comprised of representatives of the following organizations:

- Carlisle Borough
- Carlisle Fire Department
- Carlisle Police Department
- Carlisle Area Health and Wellness Foundation
- Clean Air Board
- Cumberland County Planning Commission
- Downtown Carlisle Association
- Dickinson College
- Keen Trucking
- Letort Regional Authority
- PennDOT District 8-0
- Redevelopment Authority of Cumberland County
- State Representative Will Gabig's Office

Trucking Outreach Program

A Trucking Outreach Program Meeting was held on June 26, 2008. A total of 32 trucking related businesses were invited and 10 were in attendance. The companies invited represented trucking terminals, warehouses, distribution centers, manufacturers, and suppliers. The point was made that Carlisle Borough and the project Stakeholders are not anti-truck and everyone fully realizes the trucking industry is a vital part of the local economy. However, because they are part of the Carlisle community, we did ask that they be good neighbors and try to help us achieve our goal of reducing the number of trucks in Downtown Carlisle. An explanation of the Traffic Study and the benefits of the Road Diet concept were presented to the trucking attendees. Proposals to reduce truck traffic in downtown Carlisle through signing on Interstate 81 and the PA Turnpike were also discussed. The trucking companies who were present were supportive of the signing initiative.

Concerns raised by the trucking companies at the meeting included the need for bike lanes along High and Hanover Streets, the limiting of truck turning movements by the proposed curb extensions, the ability of delivery trucks to park under the Road Diet conditions.

Questionnaires were distributed requesting information on the operating characteristics of the local trucking companies. The meeting minutes and completed questionnaires can be found in Appendix E.

Business Outreach Meeting

A Business Outreach Meeting was held on August 26, 2008 to present the Study's recommendations to local businesses in downtown Carlisle. The primary focus of the meeting was to obtain input from the businesses on

the most effective method of handling deliveries. Invitations were sent out by the Downtown Carlisle Association to approximately 200 local businesses. Representative from only four businesses were in attendance. A formal presentation was made to the business representatives highlighting the recommendations of the Traffic Study which was followed by a question and answer period.

Questionnaires were distributed to gather information of how deliveries are currently made to the businesses and to get input from the businesses on which proposed method of deliveries under the Road Diet would best suit them. Questionnaires were also sent out to all businesses that were invited. In all, only six business questionnaires were completed and returned. The completed questionnaires can be found in Appendix G.

Public Meetings

Two Public Meetings were also held to present the Study's findings to the public and to receive feedback on the recommendations from the public. The public meetings occurred on July 24, 2008 and September 9, 2008. The meetings followed a format of a formal presentation followed by a question and answer session. Dewberry representatives were on hand at the conclusion of each public meeting to field additional one-on-one questions from the public. Approximately 60 people were in attendance at each public meeting. A summary of the verbal and written comments received at each public meeting can be found in Appendix H.

Among the comments received from the public were useful suggestions for improving traffic flow and safety in Carlisle Borough. The following list summarizes these suggestions which Carlisle Borough and/or PennDOT District 8-0 should consider for implementation:

- Install a W12-2 "Low Clearance – 12'-10" sign on Newville Road (SR 641) in advance of the Orange Street railroad underpass. It was noted that trucks frequently leave the ProLogis warehouse complex and head east towards Carlisle on Newville. Trucks encounter the low clearance underpass and turn left on Orange Street (Borough owned) and turn around at Carlisle Area High School which creates an undesirable and unsafe condition. Please see Appendix D for a detail of the W12-2 sign.
- The yellow clearance interval and the all-red interval should be re-evaluated and possibly lengthened at the traffic signals in Carlisle to reduce the number of vehicles running red lights. This comment is supported by the accident data that showed a number of red light running accidents at certain locations. This issue should be reevaluated during the design portion of this project.
- A truck traffic pattern on Borough owned streets was observed by a citizen and confirmed by Dewberry as follows. Trucks traveling north on Hanover Street turn left on South Street and then turn right on College Street. The trucks then continue straight through the intersection of High Street and College Street and proceed north to SR 74. The trucks are using South Street and College Street to avoid traveling through the High Street/Hanover Street intersection. As stated previously, we recommend that the Borough place R5-2 (No Truck) signs with the supplemental R5-2-3 (Except Local Deliveries) sign beneath it at the appropriate locations.

6. CONSTRUCTION PHASING AND FUNDING SOURCES

We recommend that this project be constructed in three distinct phases with the following approximate time frames:

- Phase 1 - Short Term (1-2 years)
- Phase 2 – Medium Term (2-3 years)
- Phase 3 – Long Term (3-4 years)

Phase 1 will entail the removal of the existing pavement markings along High and Hanover Streets as well as the application of the Road Diet pavement markings. It should be noted that the stamped asphalt median and blue bike lane markings will be constructed in Phase 2. In the interim, standard yellow transverse median markings and bike lane symbols with directional arrows are recommended as a short term enhancement. Traffic signal timing adjustments including protected left turn phasing at the Square as well as emergency vehicle preemption will be added in Phase 1. The Truck Mitigation Signing will also occur in Phase 1. **The enhancements are expected to cost approximately $456,000 in 2008 dollars.**

Phase 2 will include the more significant improvements to the traffic signals as well as the stamped concrete median treatment and blue bike lane textured markings. The traffic signal upgrades in Phase 2 include:

- Video Detection
- Pedestrian Countdown Signals

The traffic calming speed cushions will also be purchased in Phase 2 and installed at locations deemed necessary by Carlisle Borough. **The Phase 2 improvements are expected to cost approximately $1,121,000 in 2008 dollars.**

Phase 3 of this project will feature the construction of the curb extensions including Americans with Disabilities Act (ADA) compliant curb ramps at all required locations. It may be necessary to relocate certain existing features such as traffic signal supports and utility poles to construct curb ramps that fully comply with the most recent ADA requirements. However, it is impossible to predict how many existing features may need to be relocated until the curb extensions are designed so the costs associated with relocating these items are not included with this estimate. **As such, the Phase 3 portion of this project is expected to cost approximately $504,000 in 2008 dollars.**

The grand total for all three phases is approximately $2,081,000 in 2008 dollars. The cost estimates for all three phases include the actual construction items as well Maintenance and Protection of Traffic during Construction, contractor mobilization costs, construction inspection costs, as well as a ten percent contingency factor. Please refer to Appendix I for detailed breakdown of the items and associated costs for each construction phase.

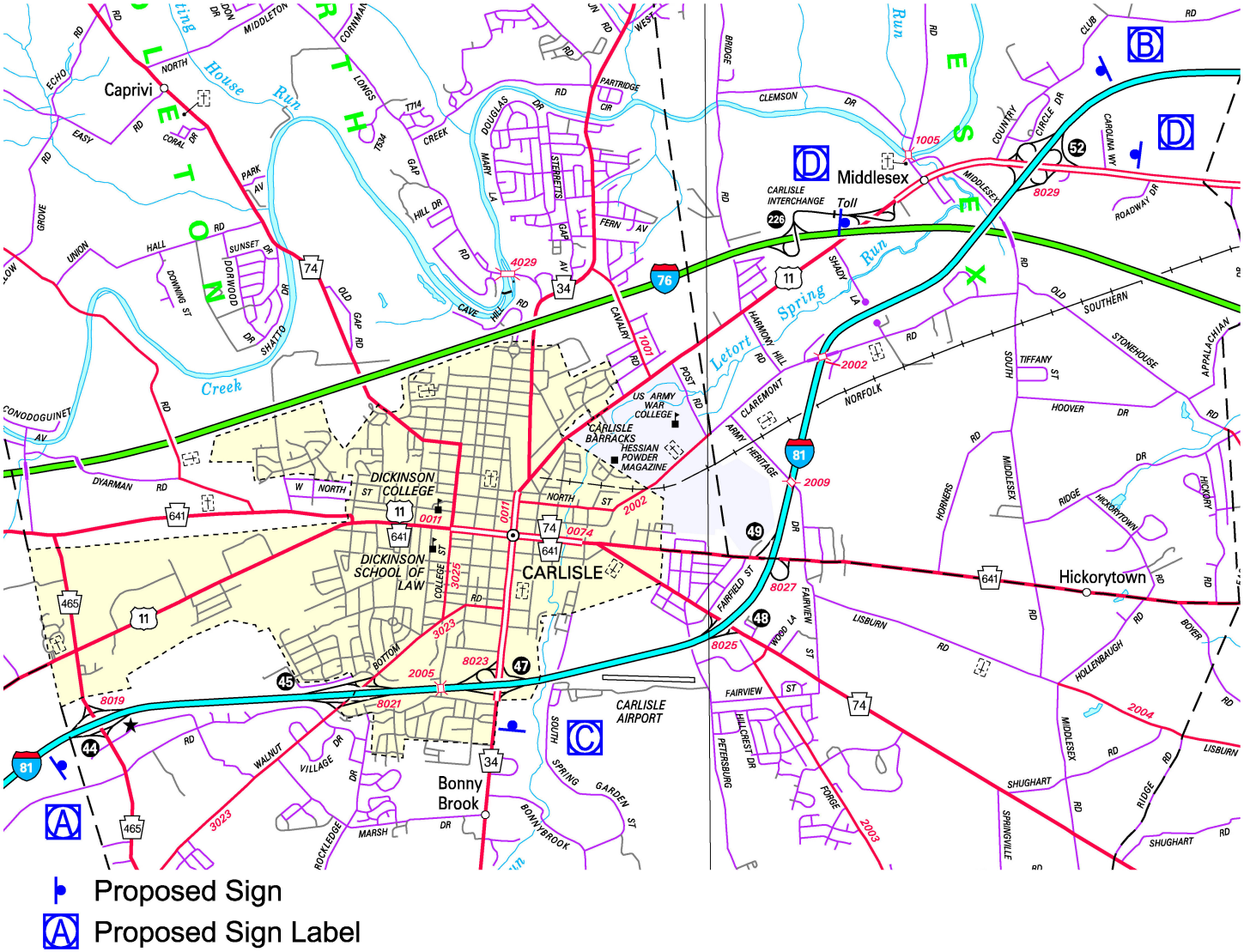
There are a variety of funding sources available to Carlisle Borough. The Borough could petition the Harrisburg Area Transportation Study (HATS) in an attempt to have this project funded with Federal funds through the Transportation Improvement Program (TIP). Should this project be accepted by HATS, it would be placed on the 12-year TIP and would compete with a variety of other projects for placement on the higher priority 4-year TIP. The project would be administered and let by PennDOT and the Borough would have little to no control of the project schedule. The main advantage of attempting to fund this project through the TIP process is that it would minimize the design and construction costs for the Borough.

PennDOT also administers two cost reimbursement programs known as the Hometown Streets Program and the Safe Routes to School Program. These programs provide for reimbursement of construction funds but they are

not grant programs. They are a federal cost reimbursement program. The Borough will not receive a check in advance once the project is approved. Once a project is authorized to advance and begin incurring costs, the borough will receive periodic invoices from the contractor working on the project. The Borough will review and approve these invoices and then submit them to PennDOT for payment. PennDOT will pay the Borough for the amount on the approved invoice and the Borough will then pay the contractor.

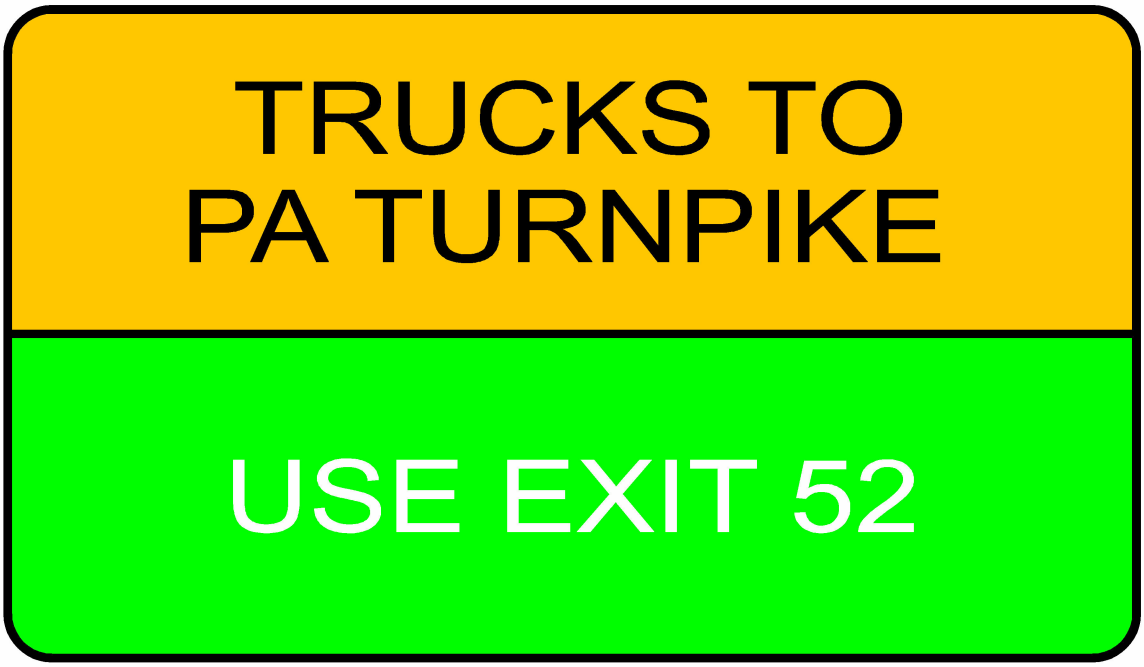
The method of project delivery where the Borough would have the most control of the project scope, costs and schedule would be a local let project. This is a situation where the Borough would solicit bids from qualified engineering firms for the preliminary and final design of the recommendations set forth in this Traffic Study. The engineering firm would prepare construction plans and bid documents. The Borough would advertise the project to contractors and the Borough would select a contractor based on the low bid. Construction could begin shortly after the low bid was verified and a signed construction contract is in place. Funding for the design and construction of the project would need to come from Borough resources, privately raised funds, grants, loans or a combination of these sources.

Low interest loans are available from the Pennsylvania Infrastructure Bank to municipalities for projects such as this. Also, traditional grant programs are available such as Community Development Block Grants that could be used to help fund this project.

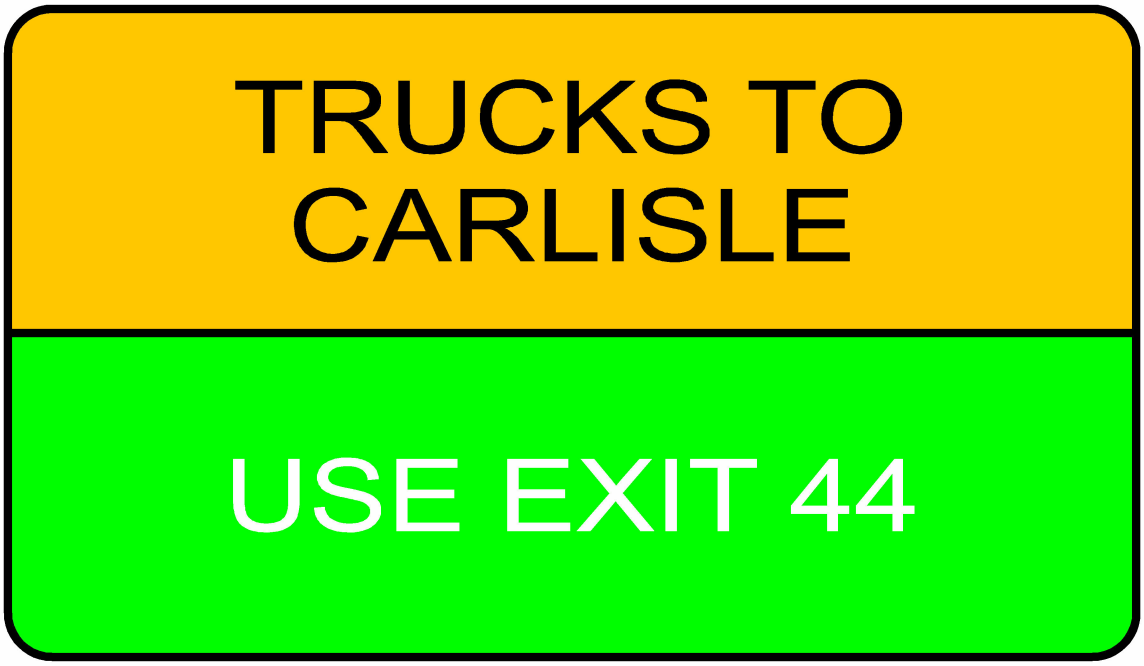


Conceptual Truck Mitigation Signing Plan

Dewberry®



Sign Ⓐ



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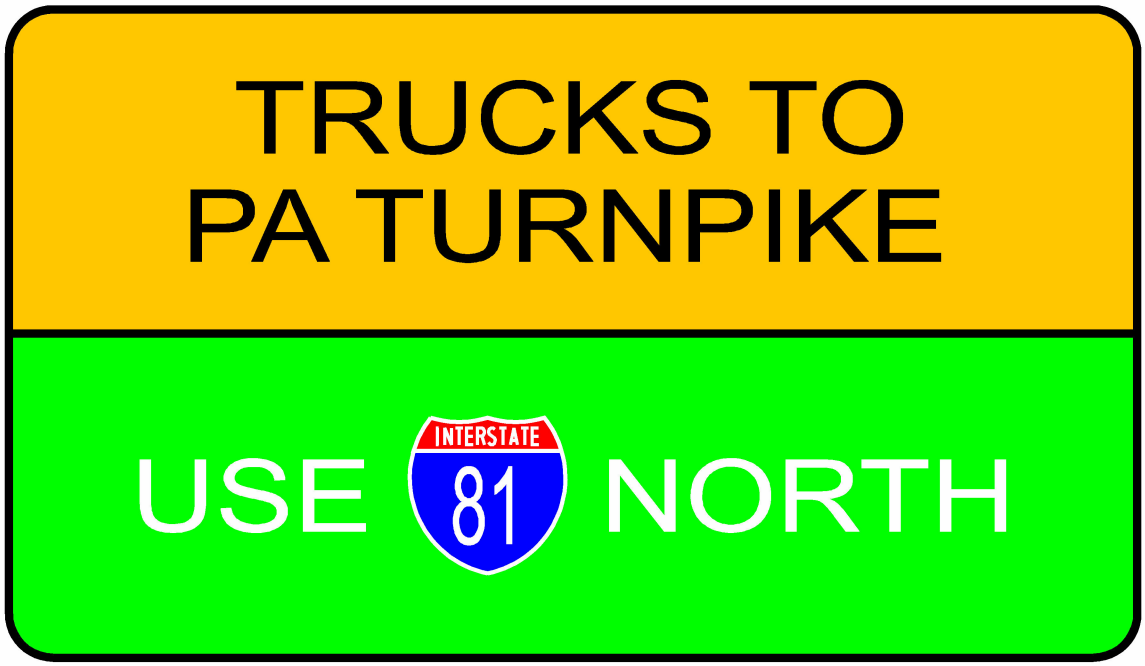
Conceptual Truck Mitigation Sign Details



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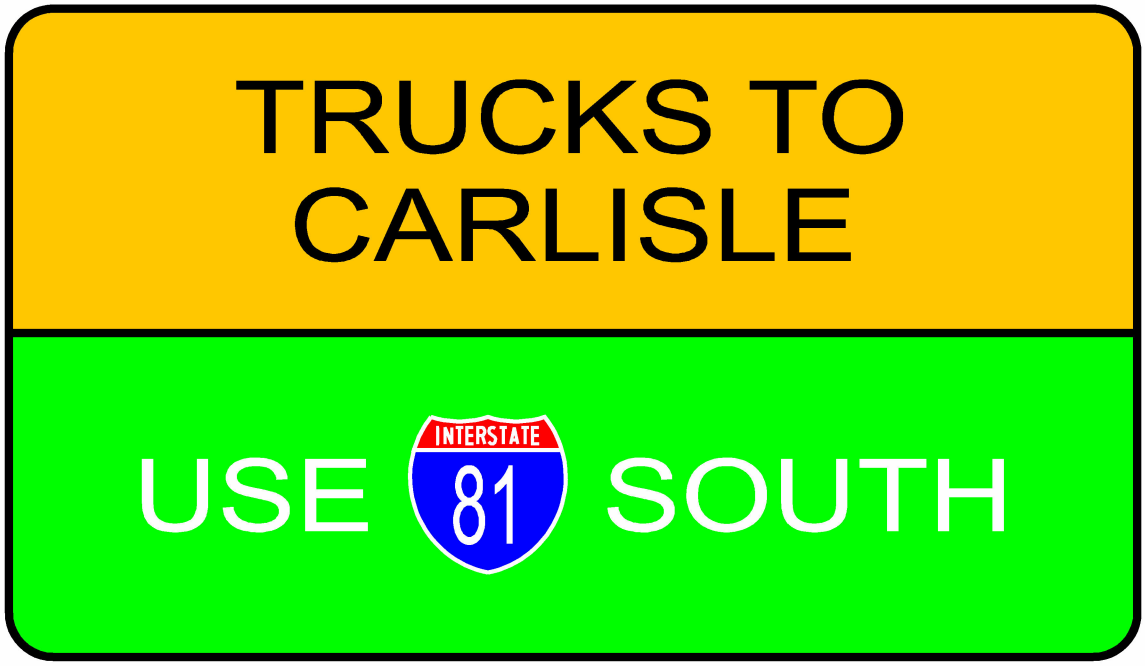

Sign D

Conceptual Truck Mitigation Sign Details

ESTIMATE BY: JRM DATE: 9/23/2008
CHECK BY: CJD DATE: 9/24/2008

COMPREHENSIVE TRAFFIC STUDY OF DOWNTOWN CARLISLE

PHASE 1 PRELIMINARY COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT	QTY.	UNIT PRICE	COST
0608-0001	MOBILIZATION	LS	1	$17,238.38	$17,238.38
0901-0001	MAINTENANCE AND PROTECTION OF TRAFFIC DURING CONSTRUCTION	LS	1	$17,238.38	$17,238.38
0931-0001	POST MOUNTED SIGNS, TYPE B	SF	150	$30.00	$4,500.00
0936-0200	STRUCTURE MOUNTED FLAT SHEET ALUMINUM SIGNS	SF	150	$35.00	$5,250.00
0955-3205	VEHICULAR SIGNAL HEAD, FIVE 12" SECTIONS (LED)	EACH	7	$1,400.00	$9,800.00
0963-0004	4" PAVEMENT MARKING REMOVAL	LF	13696	$1.25	$17,120.00
0963-0006	6" PAVEMENT MARKING REMOVAL	LF	4565	$1.50	$6,847.50
0963-0010	PAVEMENT MARKING REMOVAL (LEGENDS AND SYMBOLS)	EACH	12	$100.00	$1,200.00
0964-0001	4" WHITE EPOXY PAVEMENT MARKINGS	LF	8100	$1.00	$8,100.00
0964-0002	4" YELLOW EPOXY PAVEMENT MARKINGS	LF	17400	$1.00	$17,400.00
0960-0005	6" WHITE HOT THERMOPLASTIC PAVEMENT MARKINGS	LF	21600	$1.50	$32,400.00
0960-0021	24" WHITE HOT THERMOPLASTIC PAVEMENT MARKINGS	LF	1550	$10.00	$15,500.00
0960-0118	WHITE HOT THERMOPLASTIC LEGEND, "BICYCLE WITH RIDER", 8' - 0" X 4' - 0"	EACH	108	$200.00	$21,600.00
0960-0220	WHITE HOT THERMOPLASTIC LEGEND, "STRAIGHT ARROW", 12' - 0" X 3' - 0"	EACH	108	$200.00	$21,600.00
0960-0222	WHITE HOT THERMOPLASTIC LEGEND, "RIGHT ARROW", 12' - 0" X 3' - 0"	EACH	8	$200.00	$1,600.00
0960-0224	WHITE HOT THERMOPLASTIC LEGEND, "LEFT ARROW", 12' - 0" X 3' - 0"	EACH	48	$200.00	$9,600.00
9950-0001	PRIORITY BASED EMERGENCY VEHICLE PREEMPTION SYSTEM-IN CABINET DATA ENCODED PHASE SELECTOR	LS	13	$10,000.00	$130,000.00
9950-0050	SIGNAL TIMING MODIFICATION AT EXISTING TRAFFIC SIGNAL	EACH	15	$750.00	$11,250.00
0930-0004	POST MOUNTED SIGNS, TYPE A ASSUMED 10 SIGNS WITH AVERAGE DIMENSIONS OF 10'x10'	SF	500	$50.00	$25,000.00
N/A	SINGLE-SIDE 8-BIKE COMMERCIAL PARKING RACK	EACH	8	$750.00	$6,000.00

SUB-TOTAL WITHOUT MOBILIZATION & MPT	**$344,767.50**
MOBILIZATION (5%)	**$17,238.38**
MPT (5%)	**$17,238.38**
CONSTRUCTION TOTAL	**$379,244.25**
CONSTR. INSPECT. & CONSULT. (10%)	**$37,924.43**
CONTINGENCY (10%)	**$37,924.43**
PHASE 1 GRAND TOTAL	**$455,093.10**

ESTIMATE BY: JRM DATE: 9/23/2008
CHECK BY: CJD DATE: 9/24/2008

COMPREHENSIVE TRAFFIC STUDY OF DOWNTOWN CARLISLE

PHASE 2 PRELIMINARY COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT	QTY.	UNIT PRICE	COST
0608-0001	MOBILIZATION	LS	1	$42,458.88	$42,458.88
0901-0001	MAINTENANCE AND PROTECTION OF TRAFFIC DURING CONSTRUCTION	LS	1	$42,458.88	$42,458.88
0609-0004	INSPECTOR'S FIELD OFFICE AND INSPECTION FACILITIES, TYPE C	LS	1	$12,000.00	$12,000.00
0609-0009	EQUIPMENT PACKAGE	LS	1	$3,000.00	$3,000.00
0686-0020	CONSTRUCTION SURVEYING, TYPE B	LS	1	$5,000.00	$5,000.00
0954-0201	SIGNAL CABLE, 14 AWG, 3 CONDUCTOR	LF	9750	$1.75	$17,062.50
0954-0202	SIGNAL CABLE, 14 AWG, 5 CONDUCTOR (for Ped Countdowns)	LF	7750	$2.50	$19,375.00
0956-0500	PEDESTRIAN PUSH BUTTON	EACH	49	$130.00	$6,370.00
9950-0050	SIGNAL TIMING MODIFICATION AT EXISTING TRAFFIC SIGNAL	EACH	15	$750.00	$11,250.00
9955-3721	PEDESTRIAN SIGNAL HEAD (LED COUNTDOWN)	EACH	94	$1,000.00	$94,000.00
9956-0001	VIDEO DETECTION SYSTEM (1 CAMERA)	EACH	4	$10,000.00	$40,000.00
9956-0002	VIDEO DETECTION SYSTEM (2 CAMERAS)	EACH	9	$15,000.00	$135,000.00
9956-0004	VIDEO DETECTION SYSTEM (4 CAMERAS)	EACH	1	$25,000.00	$25,000.00
N/A	SPEED CUSHION	EACH	10	$5,000.00	$50,000.00
N/A	STAMPED ASPHALT MEDIAN	SF	25000	$8.00	$200,000.00
N/A	FLINT TRADING PREMARK THERMOPLASTIC BIKE LANE PAINT	SF	57780	$4.00	$231,120.00

SUB-TOTAL WITHOUT MOBILIZATION & MPT	**$849,177.50**
MOBILIZATION (5%)	**$42,458.88**
MPT (5%)	**$42,458.88**
CONSTRUCTION TOTAL	**$934,095.25**
CONSTR. INSPECT. & CONSULT. (10%)	**$93,409.53**
CONTINGENCY (10%)	**$93,409.53**
PHASE 2 GRAND TOTAL	**$1,120,914.30**

ESTIMATE BY: JRM DATE: 9/23/2008
CHECK BY: CJD DATE: 9/24/2008

COMPREHENSIVE TRAFFIC STUDY OF DOWNTOWN CARLISLE

PHASE 3 PRELIMINARY COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT	QTY.	UNIT PRICE	COST
0608-0001	MOBILIZATION	LS	1	$19,087.60	$19,087.60
0901-0001	MAINTENANCE AND PROTECTION OF TRAFFIC DURING CONSTRUCTION	LS	1	$19,087.60	$19,087.60
0686-0020	CONSTRUCTION SURVEYING, TYPE B	LS	1	$5,000.00	$5,000.00
0203-0004	CLASS 1B EXCAVATION	CY	912	$35.00	$31,920.00
0309-0526	SUPERPAVE ASPHALT MIXTURE DESIGN, HMA BASE COARSE, PG 64-22, 3 TO < 10 MILLION ESALS, 25.0 MM MIX, 6" DEPTH	SY	816	$25.00	$20,400.00
0350-0106	SUBBASE 6" DEPTH	SY	816	$25.00	$20,400.00
0409-0582	SUPERPAVE ASPHALT MIXTURE DESIGN, HMA WEARING COARSE, PG 64-22, 3 TO < 10 MILLION ESALS, 9.5 MM MIX, 1 1/2" DEPTH, SRL-H	SY	1200	$30.00	$36,000.00
0409-6550	SUPERPAVE ASPHALT MIXTURE DESIGN, HMA BINDER COARSE, PG 64-22, 3 TO < 10 MILLION ESALS, 19.0 MM MIX, 2 1/2" DEPTH	SY	816	$20.00	$16,320.00
0617-0001	SLOTTED DRAINS	LF	1200	$100.00	$120,000.00
4630-0001	PLAIN CEMENT CONCRETE CURB MODIFIED	LF	3696	$22.00	$81,312.00
0676-0001	CEMENT CONCRETE SIDEWALK	LF	672	$75.00	$50,400.00

SUB-TOTAL WITHOUT MOBILIZATION & MPT	**$381,752.00**
MOBILIZATION (5%)	**$19,087.60**
MPT (5%)	**$19,087.60**
CONSTRUCTION TOTAL	**$419,927.20**
CONSTR. INSPECT. & CONSULT. (10%)	**$41,992.72**
CONTINGENCY (10%)	**$41,992.72**
PHASE 3 GRAND TOTAL	**$503,912.64**