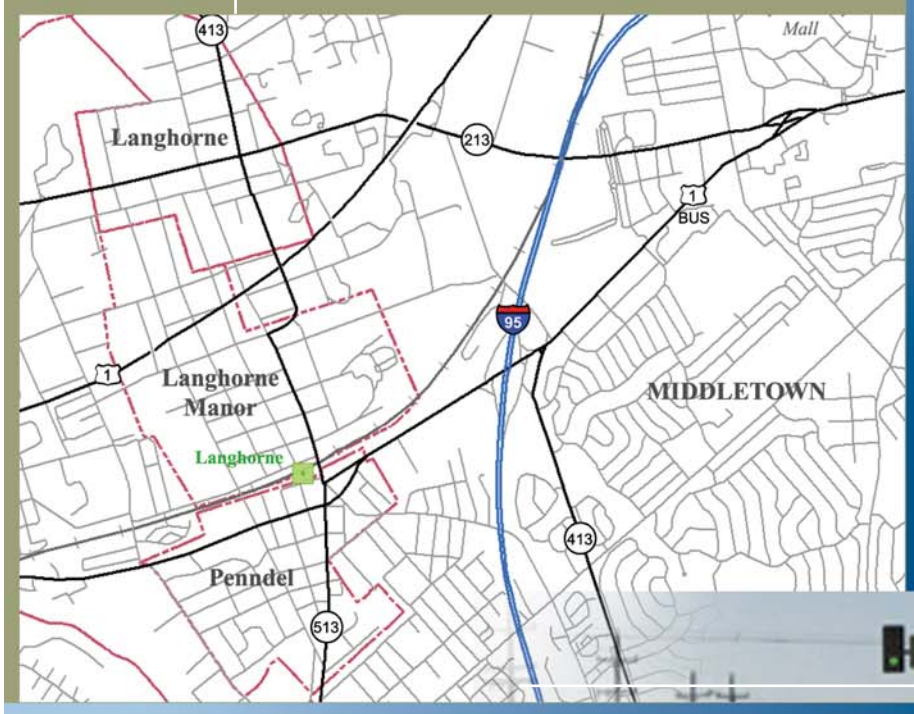
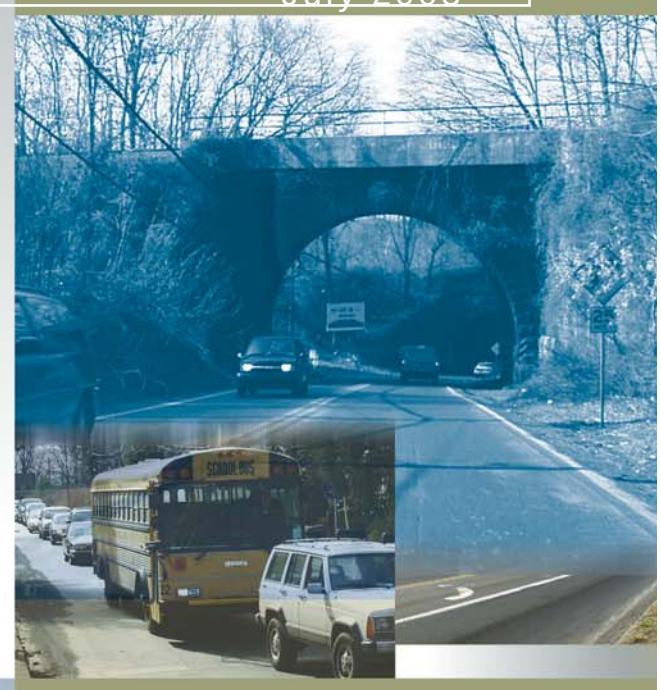
Pennsylvania Congestion Management System - PA 413 Corridor

July 2003





DELAWARE VALLEY REGIONAL
PLANNING COMMISSION

Pennsylvania Congestion Management System - PA 413 Corridor

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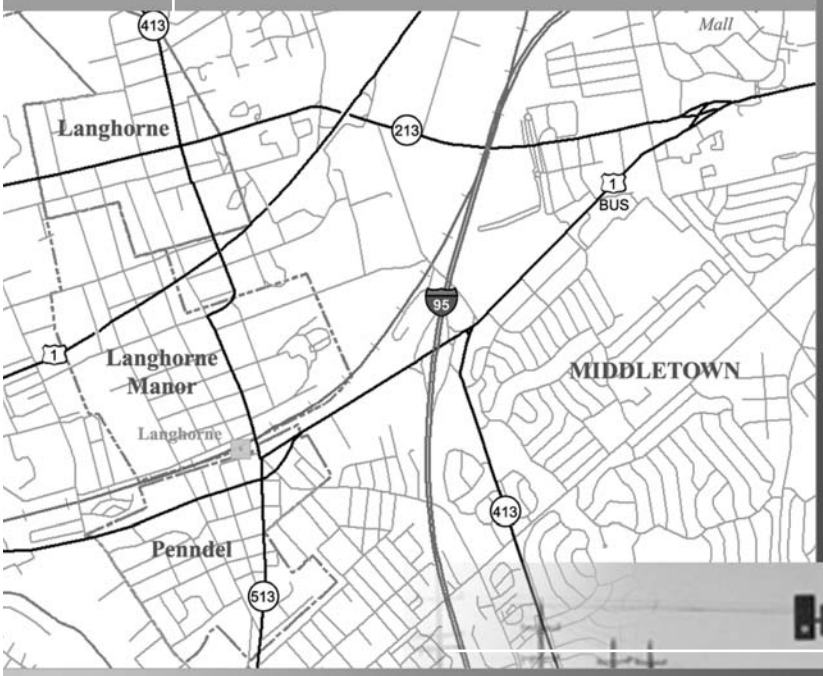

DELAWARE VALLEY REGIONAL
PLANNING COMMISSION

Created in 1965, the Delaware Valley Regional Planning Commission (DVRPC) is an interstate, intercounty and intercity agency that provides continuing, comprehensive and coordinated planning to shape a vision for the future growth of the Delaware Valley region. The region includes Bucks, Chester, Delaware, and Montgomery counties, as well as the City of Philadelphia, in Pennsylvania; and Burlington, Camden, Gloucester and Mercer counties in New Jersey. DVRPC provides technical assistance and services; conducts high priority studies that respond to the requests and demands of member state and local governments; fosters cooperation among various constituents to forge a consensus on diverse regional issues; determines and meets the needs of the private sector; and practices public outreach efforts to promote two-way communication and public awareness of regional issues and the Commission.

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

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

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I. EXECUTIVE SUMMARY

This report examines congestion along the road network within the PA 413 corridor in Bucks County, Pennsylvania. The corridor covers an area of approximately 44 square miles located within an area that varies from urban in the eastern section, first generation suburbs in the west, to rural in the far west. The CMS study area includes many parallel, adjacent, and intersecting arterials that are connected to PA 413. This study evaluated congested areas and developed improvement strategies which would improve the mobility of goods and people.

By way of travel time surveys, travel conditions at all intersections within the study network were evaluated during the peak periods. A total of eight approaches at seven intersections experienced 100 seconds or more of delay during the peak periods. The most congested intersections based on approach delay were examined in detail, and improvement measures to reduce congestion and delay were identified. These measures included adjusting traffic signal timing and coordination, installing protected left turn signals, constructing pedestrian facilities, incorporating additional turning lanes, upgrading poor pavement conditions, and restriping pavement markings.

Within the study area, there are five intersection approaches with more than 120 seconds of average delay. The highest delay was experienced on the southbound approach on PA 413 at the Winchester Avenue intersection with a delay of 230 seconds. This is followed by the northbound approach on Durham Road at the Trenton Road intersection with 225 seconds of delay, and the southbound approach on Woodbourne Road (Edgeley Road) at the New Falls Road intersection with 191 seconds of delay.

In addition to the intersection analysis, ten arterial sections were identified and analyzed based on their congested speed vs. the free-flow speed. This analysis included a Level of Service determination for all arterial sections by direction within the AM and PM peak traffic flow. Five of the arterial sections performed at a Level of Service F in either the AM or PM peak, while two performed at Level of Service E. Recommendations for reducing congestion on the arterial sections include traffic signal coordination, road widening, shoulder improvements, and Travel Demand Management measures.

The study area is served by two regional rail lines, SEPTA's R-3 and R-7. These lines are oriented towards Center City Philadelphia and by themselves, are not suited for suburb to suburb commuting patterns, which is the dominant trip pattern in the area. The feasibility of a circulatory bus service for all types of development in the study area should be explored. Timely and appropriate headways, convenient routing for buses, along with better coordination with regional rail service, could result in increased transit usage.

Based on DVRPC's 2025 forecast, Journey-To-Work travel patterns indicate several major destinations for highway person trips within the study area. Eastern Middletown, Northern Middletown, Falls, Newtown and Bristol Townships were the primary destinations. Based on the same forecast, transit person trips are primarily concentrated in areas in close proximity to commuter rail lines.

While no single strategy will be the panacea for congestion within the study area, the combination of strategies will have an impact on congestion reduction. Travel Demand Management (TDM) is a group of actions which, when combined together, can have a marked affect. An increasingly popular TDM measure is TransitChek . This is a commuter benefit program that enables employers of any size to offer financial vouchers for use on all modes of public transportation. Another effective TDM measure is the Mobility Alternatives Program (MAP). This is an outreach program that provides commuters with information on Share-a-Ride, car and vanpools, and flexible work hours. Other initiatives that can reduce emissions and relieve congestion are telecommuting (telework), park and ride facilities, compressed work weeks, subscription buses, and improvements to pedestrian and bicycle facilities.

II. PURPOSE

A Congestion Management System (CMS) is a systematic process that provides information on transportation system performance and alternative strategies to alleviate congestion and enhance the mobility of persons and goods. The CMS, developed by the Delaware Valley Regional Planning Commission (DVRPC) for the Pennsylvania portion of its region, (*Pennsylvania Congestion Management System - Phase 2 Report, July 1997*), represents a comprehensively planned regional approach to managing the area's transportation infrastructure and improving the efficiency of the transportation system.

Three goals have been established for the CMS. The CMS seeks to: (1) ease traffic congestion through the reduction of single occupant vehicles (SOV's), (2) optimize the efficiency of existing transportation systems by reducing traffic congestion along travel corridors and at critical intersections through incident management, access control, needed highway improvements, and advanced technology systems, and (3) improve access and proficiency of the transportation network to improve mobility.

The CMS consists of five components: (1) performance measures, (2) data collection and system monitoring, (3) identification and evaluation of proposed strategies, (4) implementation of strategies, and (5) evaluation of implemented strategies. In Transportation Management Areas (urban areas of over 200,000), no significant widening project can be implemented unless it is part of an approved CMS study.

DVRPC's *Year 2020 Long Range Plan* identifies individual CMS studies from the region's major travel corridors that serve as connectors for major activity centers. Creating a corridor specific CMS is an effective extension of the regional CMS. The *Year 2020 Transportation Plan* presents an extensive list of policies and strategies, as well as the actions required by each agency to carry them out. The *Year 2025 Transportation Plan* incorporates most of these policies but makes some additions and modifications consistent with the vision statements. These include congestion reduction policies that would (1) implement a coherent strategy for delivering more transit options for commuters, and (2) use transportation demand management techniques for corridor and system planning.

The PA 413 Corridor was chosen from those corridors in the *Year 2020 Long Range Plan* and the Pennsylvania CMS. The corridor is particularly suitable for a CMS study, due to recurring traffic congestion, future growth pressures on the traffic system, and the potential for improved public transportation.

The PA 413 Corridor CMS study is designed to:

- Identify locations that experience traffic congestion and document the severity and duration
- Identify causes of congestion
- Identify, document, and analyze alternatives to manage traffic congestion including:
  - traffic operations
  - transit service and related elements
  - programs and policies that reduce traffic within the corridor
- Develop a program of recommended improvements to reduce traffic congestion

The PA 413 Corridor CMS allows transportation projects in a given area to be developed according to a cohesive plan and programmed in a prioritized manner.

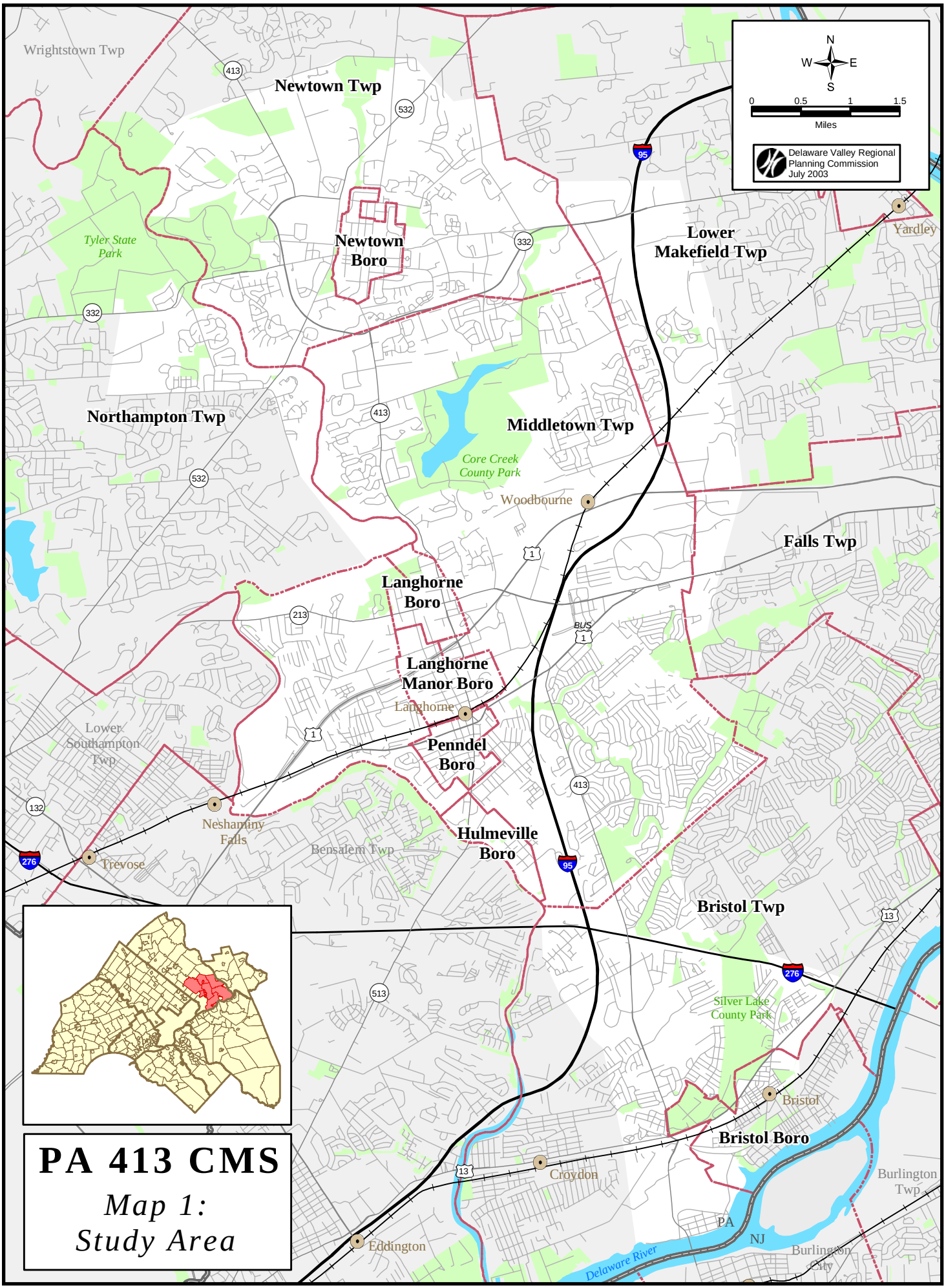
III. STUDY AREA DESCRIPTION

PA 413 is an arterial highway which forms the east-west spine of Bucks County from the Bristol Bridge at the New Jersey border to the northwestern reaches of the county. Land use along the corridor varies from urban in the eastern section, first generation suburbs in the west, to rural in the far west. Much of the rural areas have in recent years been converted to low density suburban development, consisting of single family housing and office parks. In general, the area to the east of US 1 is more densely developed than the area to the west. With the exception of Newtown and Langhorne Boroughs, the western area has low density development.

The CMS study area includes PA 413 and the many parallel, adjacent, and intersecting arterials that are connected to PA 413 (see **Map 1**). The study area extends from Bristol Township in the southeast to Newtown Township in the northwest, while Lower Makefield and Middletown Townships form the northern and southern limits, respectively. The area includes major highway facilities such as the Pennsylvania Turnpike, I-95, and US 1. Arterial facilities include US 13, PA 413, Oxford Valley Road, PA 213, PA 332, Woodbourne Road, PA 532, and US 1 Business. The study area includes all or part of the following municipalities: Bristol Borough, Bristol Township, Middletown Township, Hulmeville, Penndel Borough, Langhorne Borough, the Borough of Langhorne Manor, Falls Township, Newtown Township, Newtown Borough, Lower Makefield Township and Northampton Township.

Map 2 shows the current and forecasted 2025 land use patterns for the study area. Large sections of the study area are already developed or are expected to grow in the future. This is particularly evident in areas adjacent to the transportation arteries of I-95, US 1, and PA 532 (Newtown By-Pass), where large tracts of commercial and office development are proposed. Large residential developments are proposed for the northern reaches of PA 413 and PA 532 in Newtown Township.

The PA 413 area is served by several public transportation services. The SEPTA R3 and R7 are the commuter rail lines that link southeastern Bucks County to Center City Philadelphia and Trenton, New Jersey. Several SEPTA bus routes also serve the area, including Routes 14, 127, 128, 129, and 130.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Lower Makefield Twp
Yardley
Northampton Twp
Middletown Twp
Core Creek County Park
Woodbourne
Falls Twp
Langhorne Boro
Langhorne Manor Boro
Langhorne
Penndel Boro
Lower Southampton Twp
Neshaminy Falls
Trevose
Bensalem Twp
Hulmeville Boro
Bristol Twp
Silver Lake County Park
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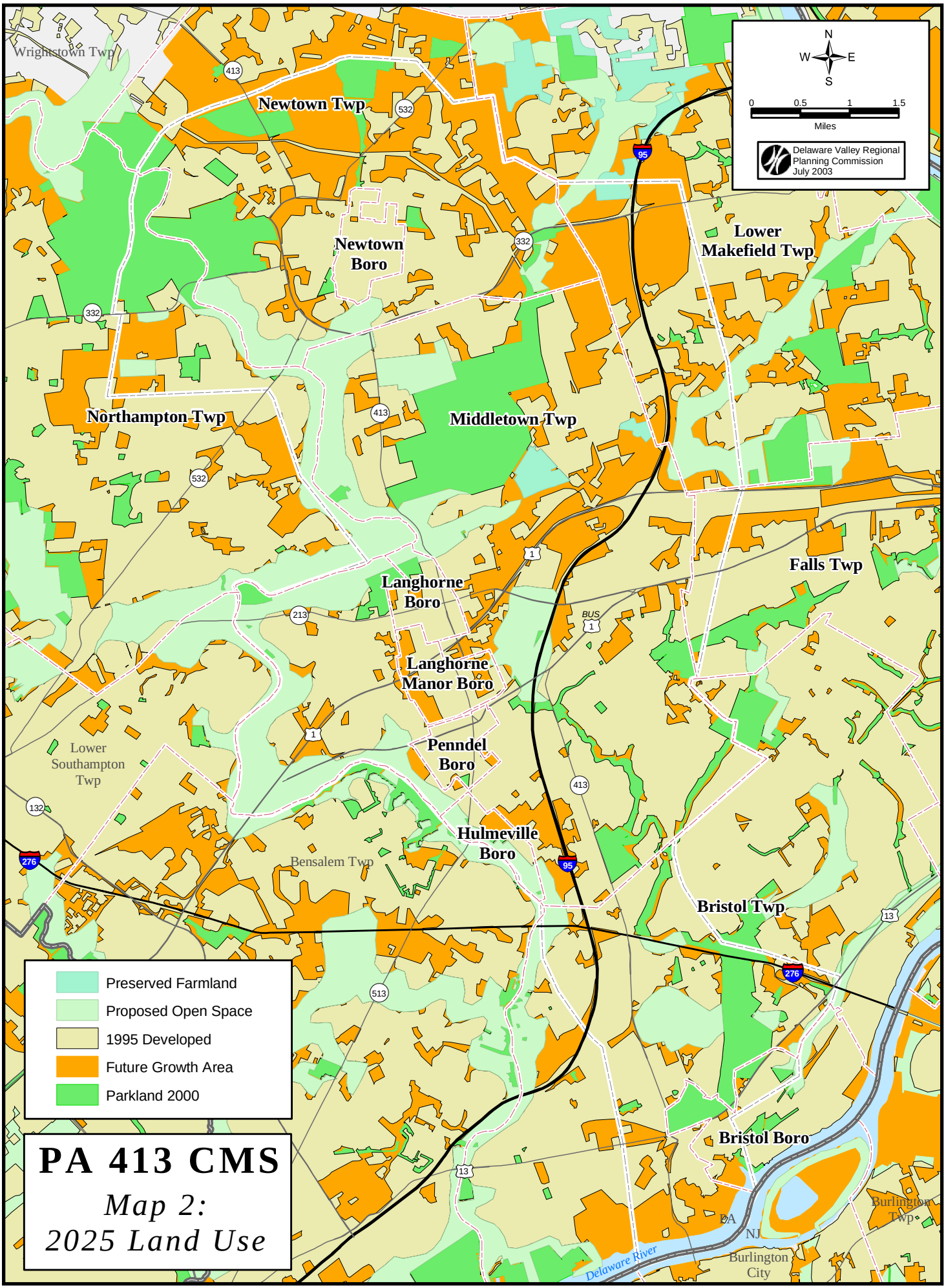
Delaware Valley Regional Planning Commission
July 2003
PA 413 CMS
Map 1:
Study Area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Delaware Valley Regional Planning Commission
July 2003
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Langhorne Manor Boro
Lower Southampton Twp
Penndel Boro
Hulmeville Boro
Bensalem Twp
Bristol Twp
Bristol Boro
Burlington Twp
Burlington City
PA
NJ
Delaware River
Preserved Farmland
Proposed Open Space
1995 Developed
Future Growth Area
Parkland 2000
PA 413 CMS
Map 2:
2025 Land Use

IV. HIGHWAY NETWORK

Designation of Arterial Sections

The PA 413 study area is served by an intricate and extensive network of interstate highways, freeways, and arterials, which provide mobility and access to both freight and vehicular traffic traveling through the area. The highway network where travel times were conducted for the study area is comprised of approximately 50 miles of roadway. **Map 3** shows the PA 413 study area highway network with the Federal Functional Classification. Below is a listing of the primary highways within the study area with a brief description of their function.

Pennsylvania Turnpike (I-76)

The Turnpike is an interstate highway that spans the length of Pennsylvania, from New Jersey to the Ohio border. It is a four-lane, limited-access toll road, with the Bristol / US 13 interchange being the only point of ingress or egress within the study area. The Turnpike cuts across the south end of the study area, providing direct access to the New Jersey Turnpike and to points west. It is not used for travel inside the study area.

I-95

I-95 is an interstate highway which parallels the Delaware River from New Jersey. It extends across Bucks, Philadelphia, and Delaware Counties in Pennsylvania, and then into Delaware. Where it traverses the study area, it is primarily a four-lane divided highway. It is a major access road for suburban commuters traveling to Center City Philadelphia. There are four I-95 interchanges in the study area: PA 413 near several industrial parks in Bristol, US 1, US 1 Business (Levittown / Penndel), and PA 332 (Newtown / Yardley). The I-95 / US 1 interchange is a significant highway intersection within the study area because of high volumes and regional importance of both facilities.

US 1

US 1 is a multi-lane limited access freeway that runs from Trenton to Philadelphia and across Delaware County into the State of Delaware. It is the primary east-west facility through the center of the study area, and provides access to major employment centers along its route. There is an interchange with I-95 within the study area, and another with the Turnpike just outside the study area. Therefore, US 1 provides direct access between I-95 and the Pennsylvania Turnpike. In addition, the Bellevue Avenue (PA 413) exit of US 1 (southbound only) provides access to the Langhorne Train Station.

US 1 Business (Lincoln Highway)

US 1 (Lincoln Highway) is the alternate or business route of US 1 which cuts across the center of the study area on an east-west axis. It splits from US 1 at the western edge of the study area near the I-276/US 1 interchange and rejoins US 1 several miles east of the study area in Falls Township. It

is a principal arterial facility, mostly four lanes with no shoulder, and has many access and egress points that carries local traffic within Bucks County. It is the main street through Penndel Borough and many businesses border its route. The Langhorne Train Station in Penndel can also be accessed from US 1 Business. In the west, it provides a connection to Old Lincoln Highway and, via Old Lincoln Highway, to Bristol Road and the Neshaminy Falls Station.

US 13

US 13 is a four-lane divided roadway that traverses the south end of the study area, running parallel to the Delaware River. It is a well-traveled principal arterial roadway. Furthermore, a number of industrial parks are located along US 13 and benefit from its access to major facilities. It provides direct access to I-95 (from a ramp just south of the study area) and to the Pennsylvania Turnpike (from a ramp in the southeastern section of the study area). US 13 provides access to PA 413, and to SEPTA's R7 Croydon and Bristol Regional Rail Stations.

PA 413

This is a principal arterial with a predominantly north-south orientation which forms the spine of the study area. From Durham Road to points southward, it is a four-lane facility which provides direct access to the Bristol Bridge. PA 413 is a two-lane roadway serving mostly residential areas through Middletown Township and Langhorne Borough in the heart of the study area. In the northern section of the study area, PA 413 becomes the Newtown By-Pass, a high-speed four-lane divided highway. In combination with US 13, PA 413 provides direct access between the Pennsylvania Turnpike and I-95. It is also the primary access road to SEPTA's R-3 Langhorne Regional Rail Station.

PA 432 (Old Lincoln Highway)

PA 432 is an urban collector that cuts across Middletown Township on the west side of the study area. It also provides access between two important east-west facilities: US 1 and PA 213. It originates at PA 213 in the north, parallels US 1, then parallels Neshaminy High School, and terminates at the SEPTA R-3 railroad right-of-way.

PA 213

PA 213 (Maple Avenue and Old Lincoln Highway) is a minor arterial that cuts through the center of the study area on an east-west axis. It originates at US 1 to the east and terminates at PA 532 in Lower Southampton to the west. The PA 213 / US 1 interchange connects a number of Middletown Township commercial, business, and residential areas to US 1 and I-95. The eastern section of PA 213 is a four-lane undivided highway, while much of the western half is a two-lane arterial.

PA 332

PA 332 (Newtown By-Pass) is a principal arterial that cut through the north end of the study area. This divided highway sweeps south and then east around Newtown Borough. It is a major access route to I-95 at the interchange in Lower Makefield. The roads that feed into PA 332 include PA 413, PA 532, and Woodbourne Road. Throughout the Newtown By-Pass corridor, PA 332 has four travel lanes with a shoulder.

PA 532

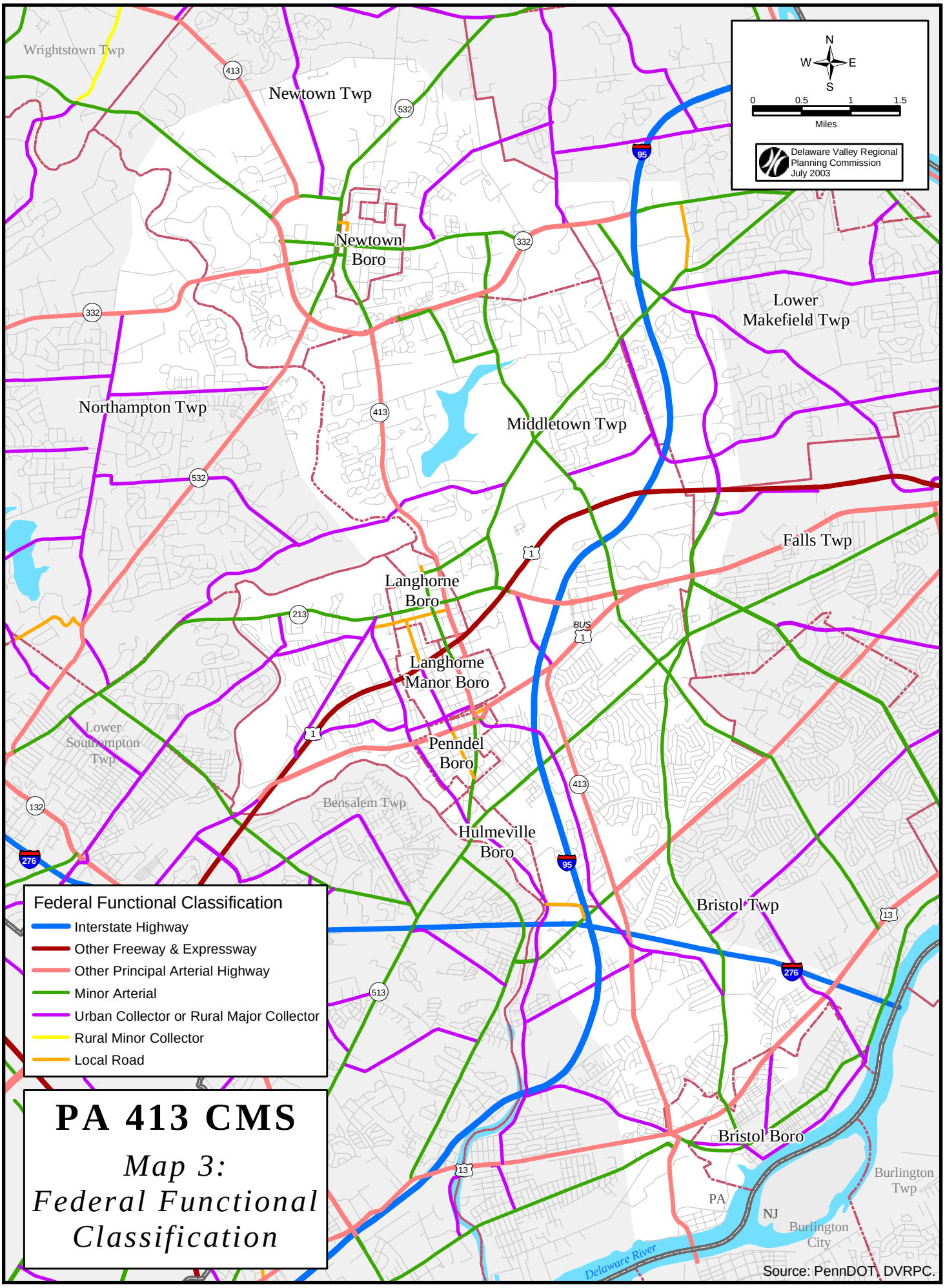
PA 532 extends from Philadelphia to Washington Crossing on the Delaware River. It cuts across the north end of the study area on a southwest-northeast axis, and it is the only arterial that provides access to / from large sections of Northampton, Newtown, and Upper Makefield Townships. It is a principal arterial through Newtown and becomes a minor arterial from just north of Newtown to Washington Crossing. It is also a major access road for the Newtown By-Pass and to Newtown Borough. Within the study area, PA 532 is primarily a two-lane roadway with either a turf shoulder or no shoulder.

Durham Road

This as an urban collector which extends from PA 413 in Bristol Township to US 1 Business (Lincoln Highway) in Penndel Borough. Durham Road runs parallel to PA 413 through much of Middletown Township. It is a major access road to SEPTA's R-3 Regional Rail Langhorne Station.

Woodbourne Road

This is a two-lane principal arterial that runs on a north-south axis through the eastern half of the study area, providing access to nearby business parks and shopping centers. There is direct access from Woodbourne Road to SEPTA's R3 Regional Rail Woodbourne Station. Within the study area, Woodbourne Road extends from PA 332 (Newtown By-Pass) in the north to New Falls Road in the south.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July 2003
Federal Functional Classification
Interstate Highway
Other Freeway & Expressway
Other Principal Arterial Highway
Minor Arterial
Urban Collector or Rural Major Collector
Rural Minor Collector
Local Road
PA 413 CMS
Map 3:
Federal Functional Classification
Source: PennDOT, DVRPC.

Transportation Improvement Projects (TIP) in the PA 413 Study Area

The TIP is the regionally agreed upon list of priority projects, as required by federal law. The TIP document must list all projects that intend to use federal funds, along with non-federally funded projects that are regionally significant. The TIP also includes all other State funded capital projects. The projects are multi-modal. They include bicycle, pedestrian, freight related projects, innovative air quality projects, as well as traditional highway and public transit projects.

The following is a list of the regionally significant Transportation Improvement Projects to the PA 413 Congestion Management Study, derived from *DVRPC FY 2003 Transportation Improvement Program for New Jersey and Pennsylvania*.

TIP #5020 PA 413, New Rogers Road- This project involves reconstructing the PA 413 / US 13 intersection with jughandles, widening PA 413 to five lanes between US 13 and I-95 spur, and widening to four lanes between I-95 spur and Ford Road.

TIP #5533 PA 332, Richboro Road Bridge Replacement- The existing two lane bridge will be replaced over Neshaminy Creek.

TIP #5582 Woodbourne Road- At Langhorne-Yardley Road, add left turn lanes to all approaches.

TIP #5615 Stoney Hill Road, Heacock Road to Oxford Valley Road- This project will eliminate a substandard curve. It involves widening to eight feet wide minimum shoulders on both sides of the street, right turn lanes as needed, and a sidewalk / bikeway on the north side of the street.

TIP #5669 I-95 Delaware Expressway Interchange- Interchange upgrade: A new ramp will be constructed from PA 332 eastbound to I-95 northbound and relocate the existing I-95 northbound off-ramp to PA 332.

TIP #5651 PA 413, New Rogers Road- Widen four feet on each side to accommodate a center lane between Lincoln Highway and Bath Road.

TIP #5699 US 13, Bristol Pike- This project involves installing a closed loop traffic signal system for approximately 16 intersections. The improvement is intended to accommodate the additional traffic anticipated during the rehabilitation of I-95.

TIP #5726 US 1 Business- Closed loop traffic signal interconnection between Hulmeville Road and Oxford Valley Road.

TIP #5740 Pedestrian Bikeway Interconnect Project- This project consists of road improvements for bicycle facilities on Newtown-Yardley Road (PA 332).

TIP #5753 Woodbourne Road and East Lincoln / Old Lincoln Highway- Widening of both intersections to provide additional through lanes on Woodbourne Road, dual left turn lanes on East Lincoln Highway, right turns on Old Lincoln Highway, and traffic signal upgrades.

TIP #5757 Sycamore Street- Reconstruct Sycamore Street from Newtown By-Pass to Durham Road to include new drainage, pavement, signals, and curbing.

TIP #5783 Sycamore Street Streetscape in Newtown- Enhancements include trees, pedestrian facilities, ornamental lighting, street banners, benches, waste receptacles, bike racks, planters, hanging baskets, bollards, and ornamental traffic signal poles.

TIP #B11 Swamp Road Corridor- Between PA 413 and Rushland Road, minor roadway widening, horizontal and vertical curve realignment, shoulder rehabilitation, and associated drainage improvements.

Traffic Volume Analysis 1999 - 2002

By observing traffic volumes over time, trends become evident which reflect increases or decreases which are directly related to changes in Vehicle Miles Traveled (VMT). **Map 4** illustrates the Average Daily Traffic counts for various highways within the study area over the period 1999 - 2002.

While I-95 recorded the highest volumes (53,088), other highway sections with high volumes included portions of PA 332 in Newtown Township (29,000), PA 413 in Middletown Township (21,482), and Trenton Road, also in Middletown Township (20,864).

The highways with the greatest volumes are those that function as conduits to the major thoroughfares in the area: I-95, I-295, and US 1. PA 332 (Newtown By-Pass) in Lower Makefield Township connects directly with I-95. PA 413 and PA 213 in Langhorne and Middletown Townships experience high volumes largely because their proximity provides easy access to the US 1 interchange. Volumes on US 13 in Bristol Township increase on the approach to the I-276 (Pennsylvania Turnpike) ramps.

Traffic Accidents 2000 - 2001

There are many causes of highway accidents. These include equipment failure, driver behavior (primarily through excessive speeding, inattention, or driving while impaired), and inadequate maintenance and roadway design. One measure of highway safety is the number and severity of accidents that occur at specific locations over time. Within this section of Bucks County, the occurrence of accidents over the years 2000 - 2001 is generally evenly dispersed along the primary road network. Accident clusters generally occurs at intersections and links where volumes are particularly heavy. The most severe accidents are fatal and major injury accidents. These are concentrated in pockets in the central and south-eastern section of the study area. **Map 5** shows all accidents designated as fatal or major injury accidents in the study area in the years 2000-2001.

The highest concentration of fatal accidents in 2000 and 2001 occurred at or approaching the intersection of Oxford Valley Road and New Falls Road in Bristol Township. Over the period, a total of 54 accidents occurred at this intersection. Of this total, three were fatal accidents and four were major injury accidents. The intersection of New Falls Road and PA 413 in Bristol Township recorded three major injury accidents over the same period.

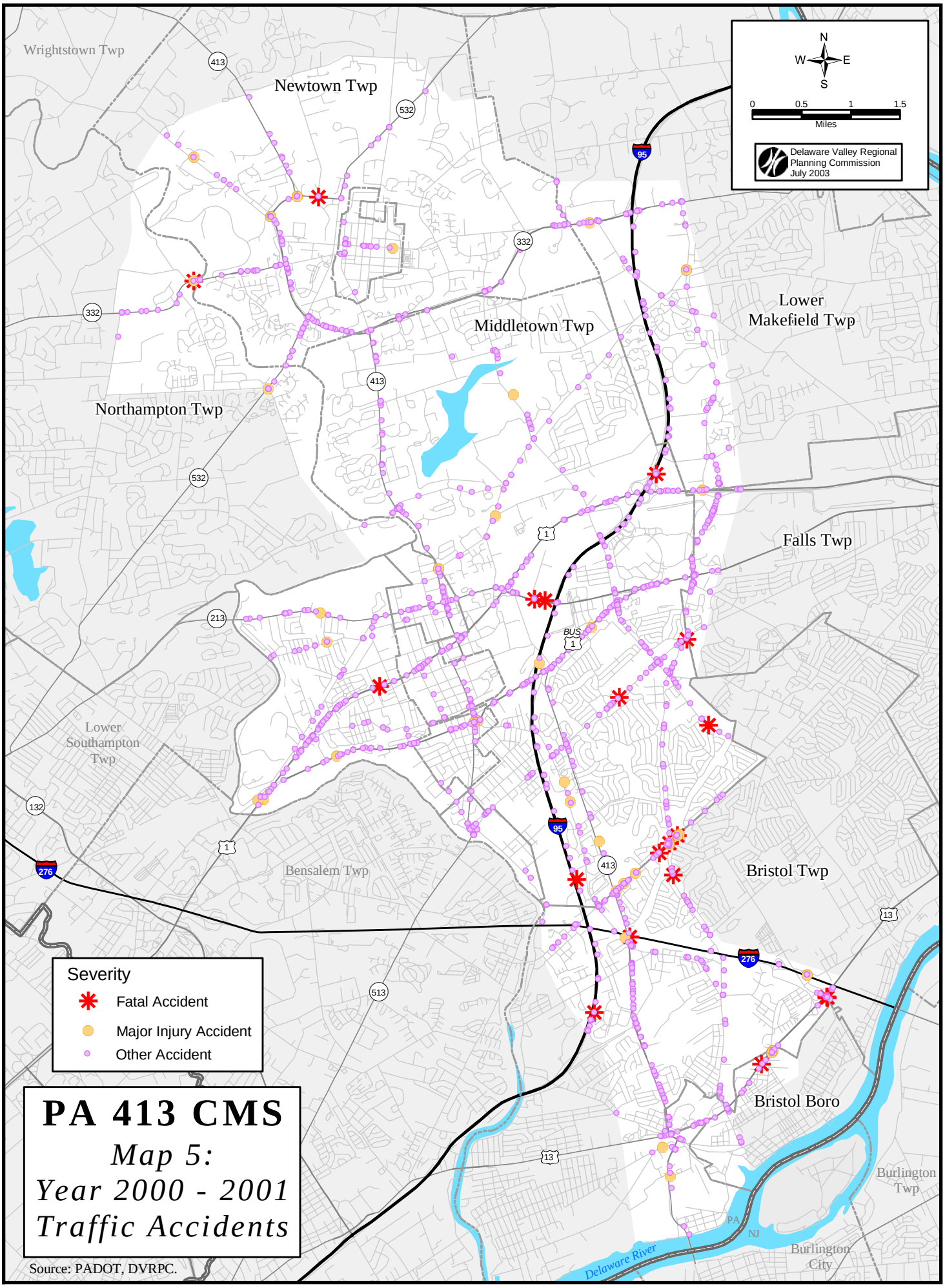
The heavily commercial and often congested section of US 1 Business, extending from its intersection with PA 213 through its intersection with US 1 (Freeway), experienced numerous accidents over the period. This segment experienced seven major injury accidents. The intersection of US 1 Business and PA 513 in Penndel Borough is a peak accident area where a total of 16 accidents occurred, two of which were major injury accidents.

Another peak accident area is the intersection of PA 413 and PA 213 in Langhorne. A total of 17 accidents were recorded at this intersection which is a critical confluence of east-west and north-south traffic.

Several accidents occurred on the approach to the Pennsylvania Turnpike underpass at PA 413 including one fatal and one major injury accident. There is a lane drop from two lanes to one lane for northbound traffic which requires merging at this location.

<u>Recommendation</u>

Improving highway safety will involve changing attitudes such as reducing excessive speed on roadways, and understanding and obeying traffic control devices. Innovative solutions, both passive and active, should be explored and targeted at these critical locations.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Delaware Valley Regional Planning Commission
July 2003
Severity
Fatal Accident
Major Injury Accident
Other Accident
PA 413 CMS
Map 5:
Year 2000 - 2001
Traffic Accidents
Source: PADOT, DVRPC.

Measures of Performance

The basic unit of the arterial is the *segment*, which is the one-directional distance from one signalized intersection to the next. If two or more consecutive segments are comparable in arterial classification, segment length, speed limit, and general land use activity, then the segments were aggregated into *arterial sections*.

Based on comprehensive data collection and analysis of both the segment and each arterial section as a whole, several criteria were used to measure traffic performance. A travel time study was conducted on the most congested arterials within the study area. There were several measures of performance used to interpret the amount of congestion on an arterial section. It should be noted that the gathered information was based on field observations, and represent a snapshot of roadway conditions at that time. Because this is a growing section of Bucks County, traffic conditions change quickly, due mainly to increases in person trips and vehicle miles traveled (VMT).

- Travel Time Study - For the purpose of this analysis, travel time studies were conducted to measure actual travel speeds on arterials within the study area. *Travel time studies* are used specifically to evaluate the extent and causes of congestion. The travel time information can be used to identify problem locations on facilities by virtue of high travel times and delays, and to measure arterial Level of Service.

- Average Car Technique - To ensure uniformity of data, a method called the *average car technique* was used. In this procedure, the driver approximates the average conditions by maintaining a similar position within the traffic stream.

Measurements of time travel were taken at each intersection of the travel area. Travel runs were conducted during the AM and PM peak periods. A single travel run took an average of ten to fifteen minutes to complete. This allowed adequate time for three travel runs in each direction to be conducted for each peak period. Through the use of this technique, a representative sample of traffic conditions throughout the peak period was documented to assure that the duration and variation of congestion throughout the period was taken into account. Directional variations in traffic flow were also noted.

The AM and PM peak periods were conducted during same time frame each day that travel times were performed. The AM peak period generally ranged from 7:00 am to 8:30 am. The PM peak was generally from 4:00 pm to 6:30 pm. Travel runs were conducted on Tuesdays, Wednesdays, and Thursdays of non-holiday weeks, while school was in session. This technique was used to capture typical weekday traffic conditions. The *travel speed*, or average speed of a traffic stream computed as the length of a roadway segment divided by the average travel time of a vehicle traversing the segment, was calculated for each segment on the arterial.

- Free-Flow Speed - The *free-flow speed* (FFS) is defined by the *2000 Highway Capacity Manual* (HCM) as the theoretical speed of traffic when density is zero. This can be interpreted in practical terms as the average speed vehicles tend to drive when they are not constrained by control delay. The free-flow runs were conducted during times of unimpeded travel, typically between 9:30 am and 10:30 am in the morning. Two travel runs were performed in each direction and an average free-flow speed was computed. It should be noted that the free-flow speed is an ideal speed that serves as a benchmark by which the effect of traffic congestion and other impediments to normal traffic flow can be gauged.

- Travel Time Speed versus Free-Flow Speed - This is the relationship between average travel speed and free-flow speed. This is calculated by simply dividing the congested travel time speed with the free-flow speed, which yields a certain percentage. The top ten arterial sections are ranked based on travel speed as a percentage of ideal speed and are listed by direction. The peak period and the corresponding Highway Capacity Manual Level of Service are also given. Additional variations in peak period and direction of the top ten arterial sections are listed, providing that the travel speed to free-flow speed ratio is less than fifty percent.

In general, the Level of Service is consistent with the percentage of free-flow speed. However, since the travel speeds and free-flow speeds were recorded from field research, a straightforward comparison between the two speeds is more precise than Level of Service.

- Level of Service (LOS) - Arterial Level of Service is based on average through-vehicle travel speed for the segment or arterial section under consideration. *Level of Service* is defined in terms of the average travel speed of all through vehicles on the arterial. On a given facility, such factors as inappropriate signal timing, poor progression, traffic signal density, increasing traffic flow, turning vehicles, and average intersection control delay can influence Level of Service.

The arterial sections are categorized based on a combination of average travel speed and street classification. Determining the street classification is established from direct field measurements of the free-flow speed and on an assessment of the street's functional and design categories. Functional categories are based on mobility, access, connectivity, and predominant trip type. Design is based on a variety of criteria, including driveway density, arterial type, parking, speed limit, pedestrian activity, and roadside development. Once the arterial sections have been properly classified, the appropriate Level of Service can be determined based on average travel speed.
The Level of Service (LOS) analysis is used extensively in this report. A general description taken from the *2000 Highway Capacity Manual* of the different LOS follows:

LOS A- describes primarily free-flow operations at average travel speeds. Vehicles are completely unimpeded in their ability to maneuver within the traffic stream. Control delay at signalized intersections is minimal.

LOS B- describes reasonably unimpeded operations at average travel speeds. The ability to maneuver within the traffic stream is only slightly restricted, and control delays at signalized intersections are not significant.

LOS C- describes stable operations; however, ability to maneuver and change lanes in midblock locations may be more restricted than at LOS B. Longer queues, adverse signal coordination, or both may contribute to lower average travel speeds of about 50 percent of the free-flow speed (FFS) for the street class.

LOS D- borders on a range in which small increases in flow may cause substantial increases in delay and decreases in travel speeds. LOS D may be due to adverse signal progression, high signal densities, high volumes, or a combination of these factors.

LOS E- is characterized by significant delays. Such operations are caused by a combination of adverse progression, high signal density, high volumes, extensive delays at critical intersections, and inappropriate signal timing.

LOS F- is characterized by traffic flow at extremely low speeds, typically one-third to one-fourth of the FFS. Intersection congestion is likely at critical signalized locations, with high delays, high volumes, and extensive queuing.

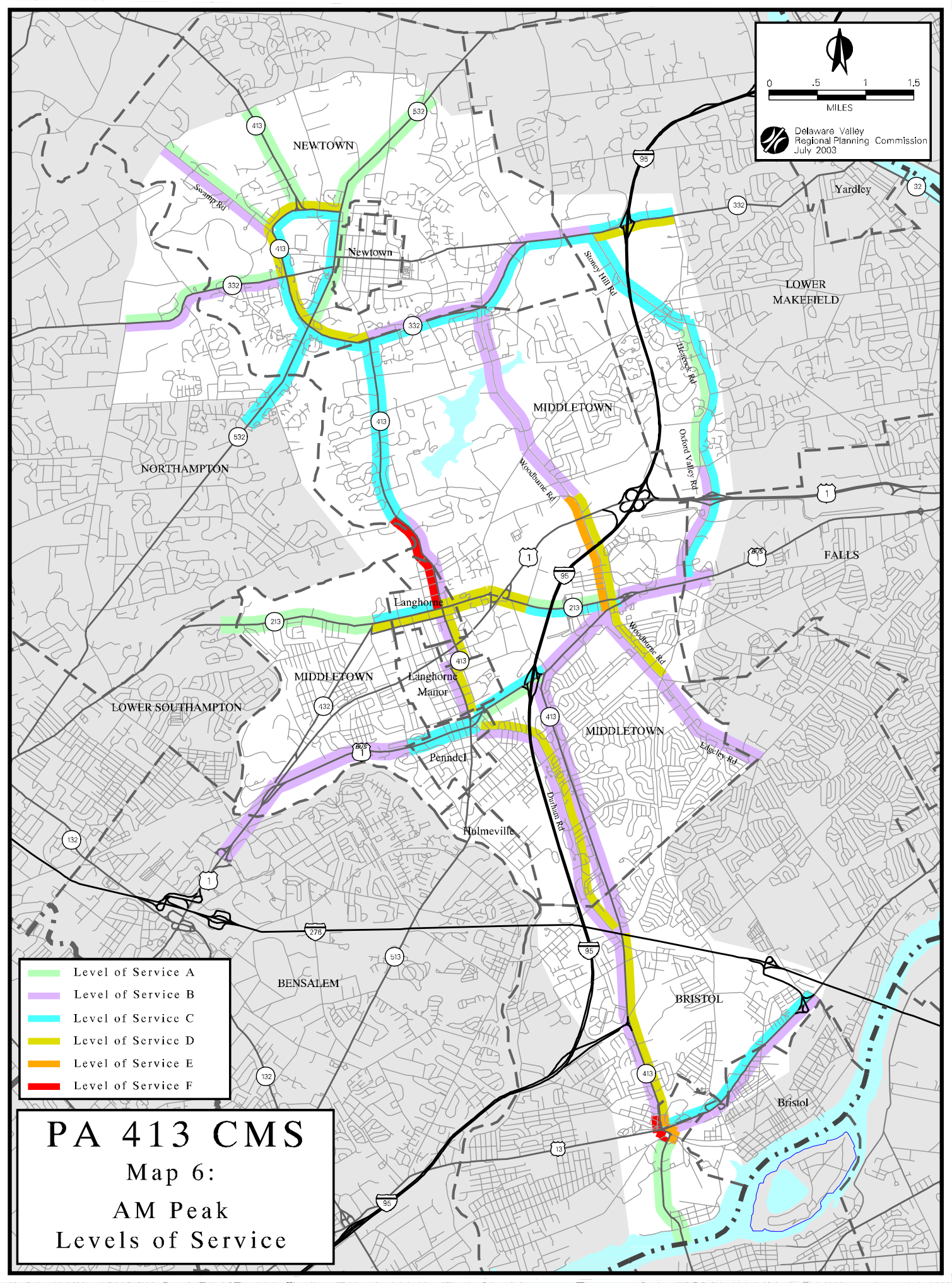
There is some subjectivity in determining the road classification in the Level of Service analysis. Arterial roads in any given area can change capacity and geometry very rapidly; generalizing an urban street may be difficult. There may be instances where an arterial falls into multiple categories, or may be so unique that it does not fall into any distinct, individual category. When this occurred, the free-flow speed was used to aid in this determination, because each arterial classification has a characteristic range of free-flow speeds. Although there is some subjectivity, it is important to remember that the Level of Service is a widely accepted and valid indicator of traffic performance.

Map 6 shows the AM peak Levels of Service for the study area observed through travel time surveys conducted during the hours of 7:00 am to 8:30 am on a typical weekday. The most congested areas under the Level of Service analysis are PA 413 and PA 213 in the Langhorne Borough area, the Newtown By-Pass to the east of Newtown Borough, PA 413 through the US 13 intersection, and Woodbourne Road between Oxford Valley Road and Woodlane Road. Most of these sections of roadway experienced Levels of Service of D or lower.

Most of the US 1 Business Corridor performs a Level of Service C or better during the AM peak. As a highly retail and commercial area, most of the business open after the end of the AM peak. As a result, much of the US 1 Business Corridor was did not experience high levels of congestion during the AM peak.

Map 7 shows the PM Level of Service for the study area observed through travel time surveys conducted during the hours of 4:00 pm to 6:30 pm on a typical weekday. The most congested areas during the PM peak occur on Woodbourne Road, where Level of Service E and F are experienced. The PA 213 corridor sees Level of Service F through sections of Langhorne Borough. Other congested areas include PA 413 through the US 13 intersection, US 1 Business through Penndel Borough, Oxford Valley Road, and sections of the Newtown By-Pass.

While conducting travel time runs during the PM peak, it was observed at several locations that the left turn bays exceeded capacity and spilled back into the through travel lanes. Most notably, this occurred on the Newtown By-Pass at the PA 532 intersection. This condition was also observed at the PA 322 and I-95 intersection. Because travel times were only conducted in the through movement, the Level of Service for a particular arterial section does not reflect delay incurred by left turning vehicles. The Level of Service was only calculated for the through movements. However, the delay caused by left turning vehicles impeding the progress of through traffic is reflected in the Level of Service for that particular arterial section.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Delaware Valley Regional Planning Commission
July 2003
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Swamp Rd
Yardley
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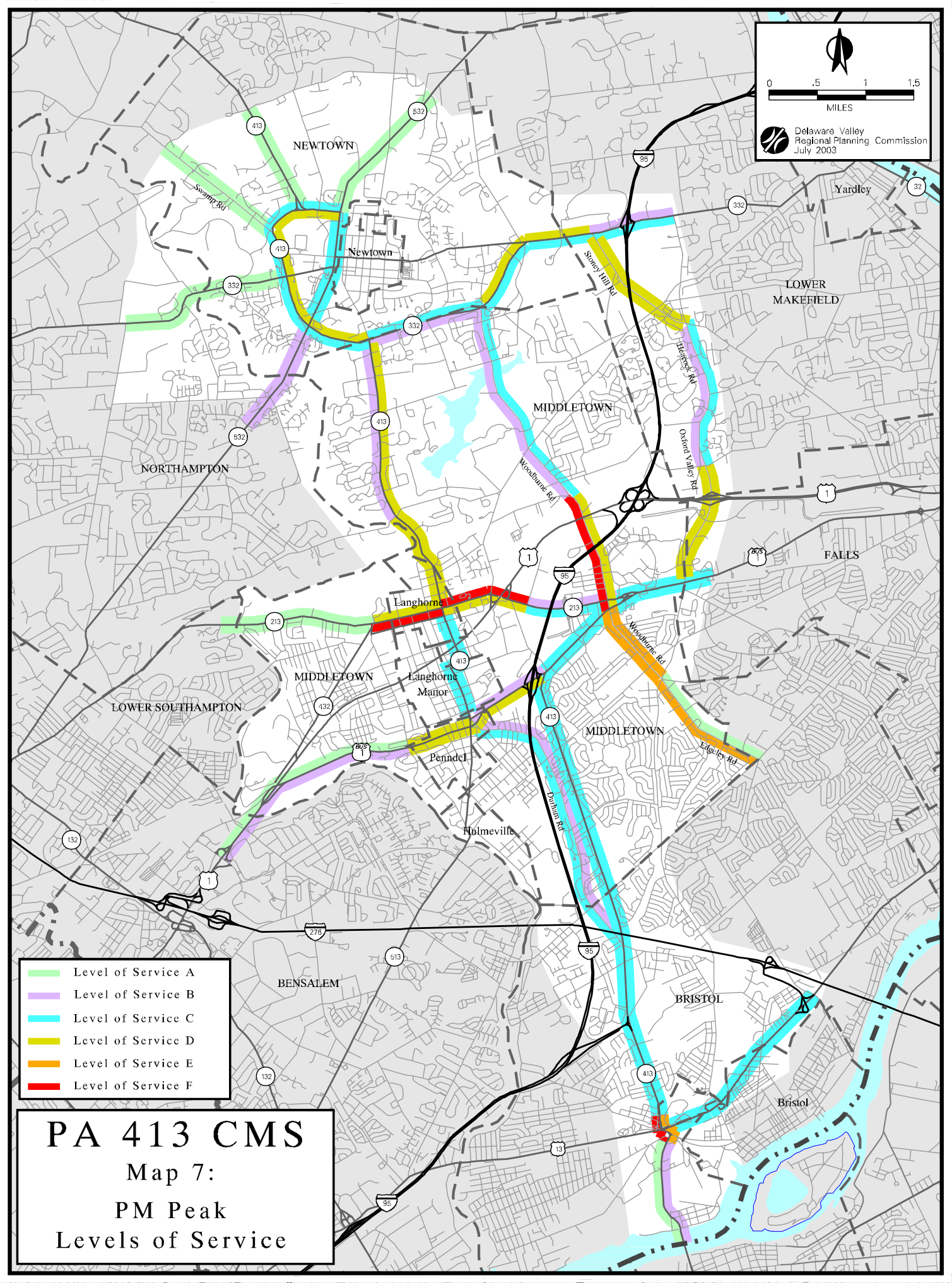
Hilltop Rd
MIDDLETOWN
Oxford Valley Rd
Woodbourne Rd
NORTHAMPTON
FALLS
Langhorne
Langhorne Manor
MIDDLETOWN
LOWER SOUTHAMPTON
Penndel
Edgeley Rd
Durham Rd
Hulmeville
BENSALEM
BRISTOL
Bristol
Level of Service A
Level of Service B
Level of Service C
Level of Service D
Level of Service E
Level of Service F
PA 413 CMS
Map 6:
AM Peak
Levels of Service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MILES
Delaware Valley Regional Planning Commission
July 2003
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Oxford Valley Rd
Woodbourne Rd
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FALLS
Langhorne
Langhorne Manor
MIDDLETOWN
LOWER SOUTHAMPTON
Edgeley Rd
Penndel
Durham Rd
Hulmeville
BENSALEM
BRISTOL
Bristol
Level of Service A
Level of Service B
Level of Service C
Level of Service D
Level of Service E
Level of Service F
PA 413 CMS
Map 7:
PM Peak
Levels of Service

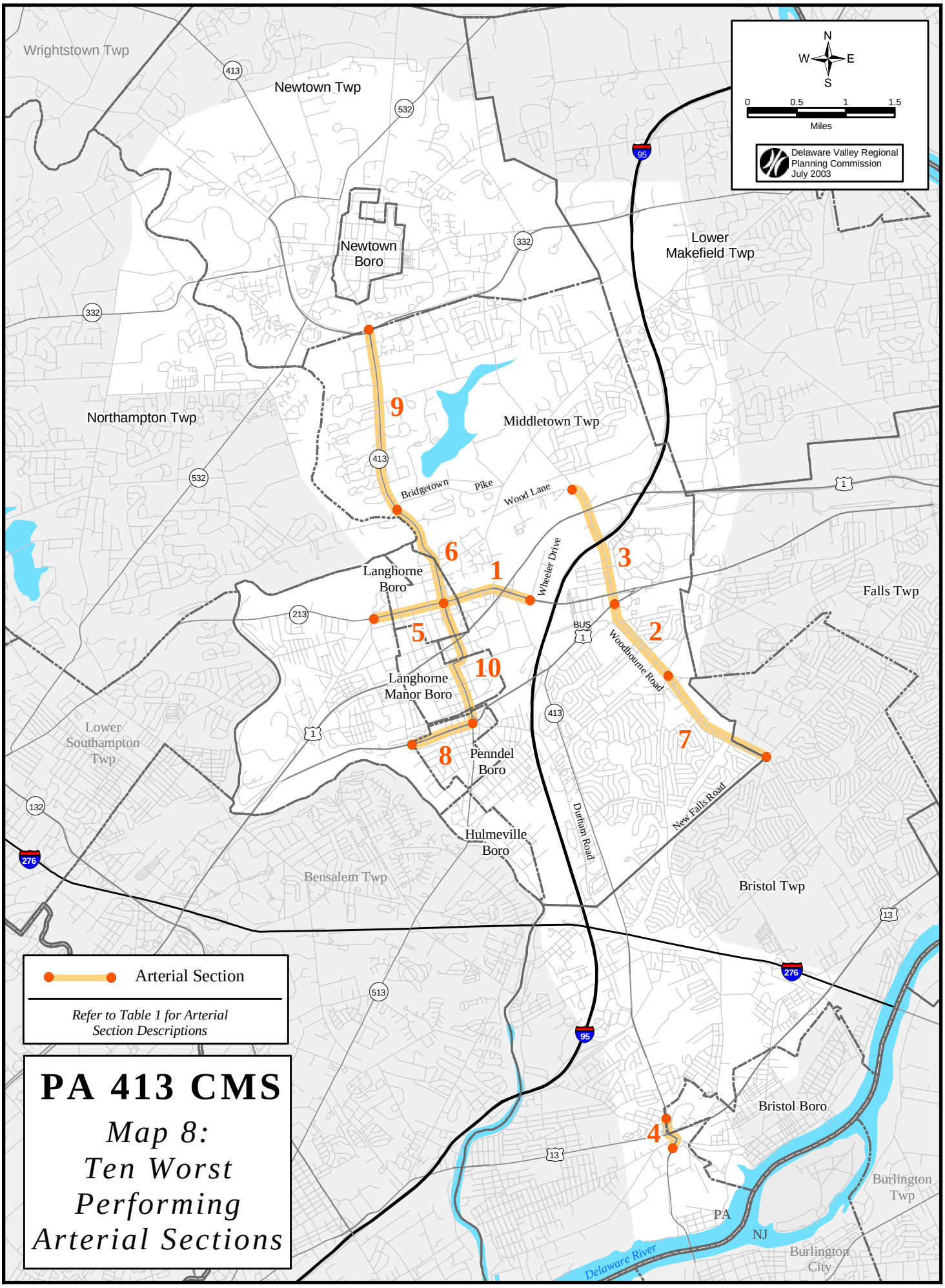
V. MOST CONGESTED ARTERIAL SECTIONS

The ten most congested arterial sections are listed based on the travel speed as a percentage of free-flow speed as identified in **Table 1** and are shown in **Map 8**. The arterial sections were examined based on the existing conditions of the arterial section and immediate vicinity. It should be noted that the Level of Service is a composite of all the individual arterial segments that make up an arterial section. There are variations in congestion within each section which may be greater or less than the average depending on the length of the segments. Therefore, the resulting Level of Service is based on average travel speeds for the entire section.

TABLE 1

Ten Worst Performing Arterial Sections

	Arterial Section	Direction	Peak Period	Average Travel Speed (mph)	Percentage of Free-Flow Speed (mph)	HCM Level of Service
1.	PA 213: Wheeler Dr to PA 413	WB	PM	11.0	25.8	F
2.	Woodbourne Rd: US 1 Business to Oxford Valley Rd	NB	PM	14.9	33.4	E
3.	Woodbourne Rd: Woodlane Rd to US 1Business	SB	PM	12.3	33.5	F
4.	PA 413: Western Ave to State Rd	SB	PM	12.2	34.4	F
5.	PA 213: Golf Club Dr to PA 413	EB	PM	11.8	35.1	F
6.	PA 413: Bridgetown Pike to PA 213	SB	AM	12.2	36.9	F
7.	Woodbourne Rd: Oxford Valley Rd to New Falls Rd	SB	PM	16.0	40.5	E
8.	US 1 Business: Durham Rd to Hulmeville Rd	WB	PM	18.2	42.8	D
9.	PA 413: Bridgetown Pike to the Newtown By-Pass	NB	PM	18.0	43.1	D
10.	PA 413: US 1 Business to PA 213	NB	AM	18.9	45.9	D


Wrightstown Twp
Newtown Twp
Newtown Boro
Lower Makefield Twp
Northampton Twp
Middletown Twp
Langhorne Boro
Langhorne Manor Boro
Penndel Boro
Hulmeville Boro
Falls Twp
Bristol Twp
Bristol Boro
Bensalem Twp
Lower Southampton Twp
Burlington Twp
Burlington City
PA
NJ
Delaware River
Bridgetown Pike
Wood Lane
Wheeler Drive
Woodbourne Road
New Falls Road
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Delaware Valley Regional Planning Commission
July 2003
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Arterial Section
Refer to Table 1 for Arterial Section Descriptions
PA 413 CMS
Map 8:
Ten Worst Performing Arterial Sections

A comprehensive evaluation was made on each of the ten worst performing arterial sections. Current problems were examined and improvement strategies were made regarding the policies and actions necessary for reducing current and future congestion. The recommended improvements are consistent with local, state, and federal construction projects. These improvements include signal timings, closed loop signal systems, shoulder and roadway upgrades, pavement markings, better signage, adding capacity, and incorporating recommendations with existing TIP projects.

1. PA 213: Wheeler Drive to PA 413
Middletown Township, Langhorne Borough

Existing Conditions

This arterial section extends from the Bucks County Business Center at Wheeler Drive in Middletown Township, through the US 1 interchange, to the central business district in Langhorne Borough. PA 213 is generally a high-speed, four lane arterial serving commercial and industrial areas from Wheeler Drive through the US 1 interchange. Between North Flowers Mill Road and PA 413, it serves residential areas. Just west of the US 1 Interchange, PA 213 narrows to two lanes and speeds are reduced.

This section experienced significant congestion in both the eastbound and westbound directions during the PM peak period. In the westbound direction, the average travel speed for the entire section was eleven miles per hour, performing at Level of Service F. The average travel speed for the eastbound direction was just under twenty miles per hour, a Level of Service D. During the AM peak period, the arterial section performed at Level of Service D in both directions.

The major causes of congestion are the consecutive signalized intersections through the US 1 interchange area and long backups at the PA 413 intersection. The US 1 interchange generates high traffic volumes entering and exiting US 1. Vehicles also use Flowers Mill Road to access I-95 and the Middletown Township area. Just west of the US 1 South exit (North Flowers Mill Road), PA 213 narrows from four to two lanes. This also causes slowdowns as vehicles in the westbound direction must merge into a single lane. At the PA 413 intersection on PA 213, vehicles are backed up over a tenth of a mile, past Cherry Street in the PM peak, due to high volumes of vehicles approaching from the US 1 interchange area. This includes through vehicles on PA 213, vehicles exiting US 1, and traffic turning from North Flowers Mill Road onto westbound PA 213. All the traffic funnels onto PA 213 in Langhorne Borough, and as a result, vehicles often have to wait two or three cycles to clear the through movement of the PA 413 intersection during the PM peak.

The traffic signal at the PA 413 and PA 213 intersection also contributes to delay. There are high volumes on each approach during the peak periods, and adjusting the signal timing to favor one

approach will only increase delay for other approaches.

It was observed that vehicles used local roads in Langhorne Borough to avoid the PA 413 intersection. Westbound traffic made a right turn onto National Avenue, cut through a residential area, and then proceeded onto PA 413.

Recommended Improvements

a) There are three signalized intersections within a quarter mile vicinity at the US 1 interchange on PA 213. Due to the close proximity of traffic signals, the signals at Wheeler Drive, South Flowers Mill Road, US 1 south exit, and US 1 North Exit should be coordinated together to ensure an unimpeded flow of traffic.
b) Prevent vehicles from cutting through the residential neighborhoods via National Avenue. This can be accomplished by installing signs that either prevent right turns during certain peak hours, or by making National Avenue a one-way street.
c) Evaluate the feasibility of incorporating a separate right turn lane on the PA 213 westbound approach at the PA 413 intersection. This will reduce delay and provide relief from vehicles from using side streets to cut through residential areas.
d) Evaluate the signal timing of the PA 413 / PA 213 intersection. Significant delay is experienced at multiple approaches. Since large-scale intersection expansion is not feasible, optimizing the signal time may help to reduce congestion.

2. Woodbourne Road: US 1 Business to Oxford Valley Road
Middletown Township

This section of Woodbourne Road, located in Middletown Township, is a heavily utilized corridor, linking large commercial establishments including the Oxford Valley Mall and the Langhorne Square Shopping Center. It serves numerous auto dealerships on the north end and large residential areas of Middletown and Bristol Townships at the southern end. This arterial section includes the intersections of US 1 Business, Harmony Road, Trenton Road, and Oxford Valley Road. Between the Harmony Road and US 1 Business intersection, Woodbourne narrows from four lanes down to two.

Both the northbound and southbound traffic experience significant delay on this arterial section in the PM peak period. Each direction experienced a Level of Service E in the PM peak. The average northbound travel speed was fifteen miles per hour, while the southbound average travel speed was just over thirteen miles per hour. The AM faired better; the northbound received a Level of Service D, while the southbound recorded a Level of Service B. The southbound approach to Trenton Road was particularly congested. During the PM peak, an average of 98 seconds of delay was experienced

for travel along this section.

Much of the congestion and significantly low travel speeds throughout this section of Woodbourne Road can be attributed to high volumes. In the southbound direction, just past the US 1 Business intersection, Woodbourne Road narrows from two lanes to one. This problem is compounded in the peak hours, as high volumes cause slowdowns. The lane drop forces vehicles to merge into a single lane. In the northbound direction, significant delay is experienced at the approach to US 1 Business. This is a result of the long signal cycles at the US 1 Business / Woodbourne Road intersection. Additional delay on this arterial section is a result of close proximity of traffic signals at the Harmony Road, Trenton Road, and Oxford Valley Road intersections. During the PM peak in the southbound direction, traffic was congested the entire segment from Trenton Road through the Harmony Road intersection.

The combination of heavy volumes and consecutive signalized intersections at Harmony Road, Trenton Avenue, and Oxford Valley Road result in jam conditions. Significant improvements through this section of Woodbourne Road cannot be achieved without increased roadway capacity.

Recommended Improvements

a) Because of their close proximity, the Harmony Road, Trenton Road, and Oxford Valley Road traffic signals should be timed so their offset can allow for a north-south progression of traffic.
b) The Woodbourne Road / US 1 Business intersection will be widened as a result of TIP #5753. This should alleviate some of the congestion at the northbound approach to US 1 Business.
c) Evaluate the feasibility of expanding Woodbourne Road from two to four lanes between US 1 Business and Oxford Valley Road.

3. Woodbourne Road: Woodlane Road to US 1 Business

Middletown Township

This arterial section, located in Middletown Township, extends from the Woodlane Road intersection, through the Fourth Street and PA 213 intersections, down to US 1 Business. The northern end of the section provides access to the Woodbourne Rail Station (SEPTA R3). Access to the Oxford Valley Mall is provided at the Fourth Street intersection. The southern section includes the PA 213 and US 1 Business intersections. Woodbourne Road serves as an alternate to PA 413 between US 1 Business and the Newtown By-Pass.

The worst congestion occurs in the southbound direction during the PM peak. The southbound traffic

performed at Level of Service F, with an average travel speed of twelve miles per hour for the section. The worst individual segment was southbound between PA 213 and US 1 Business. This short segment averaged a travel speed of under four miles per hour during the PM peak. In the northbound direction of the PM peak, Woodbourne Road experiences a Level of Service D. During the AM peak, the southbound average travel speed was just under fifteen miles per hour, and the northbound average speed was nineteen miles per hour, receiving a Level of Service E and D, respectively.

There are several contributing factors to the excessive congestion on this arterial section. The first major cause is the Conrail / SEPTA R3 rail crossing located near the Woodlane Road intersection. The rail crossing causes major delays when the gates are closed to allow for the passage of trains. The vehicles are backed up through the Woodlane intersection on the north side of the crossing. On the south side, vehicles are queued over a quarter-mile during the peak periods. When a train passes and the gates are raised, there is a long, continuous platoon of vehicles. In the southbound direction, the downstream intersection of Fourth Street and PA 213 quickly reach capacity. This results in not only long delays while waiting for trains to clear, but additional delays at downstream intersections. These conditions are compounded during the peak periods when traffic volumes are higher.

Delay was also incurred near the Fourth Street intersection. This intersection has a protected left turn phase into the Oxford Valley Mall on the southbound approach. Between Fourth Street and PA 213 on Woodbourne Road, the northbound traffic has two travel lanes, while the southbound side only has one travel lane. This results in significantly more delay per vehicle in the southbound direction as the roadway capacity is half the northbound direction.

At the PA 213 and US 1 Business intersections on Woodbourne Road, significant delays were observed. During the PM peak, vehicles experienced 147 seconds of delay on the southbound approach to the PA 213 intersection. Both the traffic signals at US 1 Business and PA 213 have long signal cycle lengths. The problem in the southbound direction is exacerbated by heavy volumes of right turning vehicles from PA 213 onto Woodbourne Road. This adds numerous vehicles to the queue at the US 1 Business intersection because of its close proximity. The vehicles are then backed up continuously from US 1 Business to PA 213. When queued through movement vehicles at PA 213 on the southbound approach receive a green light, the vehicles block the entire intersection.

Recommended Improvements

a) Evaluate the stopping location of the SEPTA R3 trains. The position of the trains, especially inbound trains to Philadelphia should have minimal impact on Woodbourne Road by stopping further away from the roadway crossing.
b) Due to heavy volumes of traffic on US 1 Business and PA 213, the green time favors these arterials at the Woodbourne intersections. This results in longer delays for the through traffic

on Woodbourne Road. However, because of the close proximity of the two intersections, it is important that they are coordinated in the north and southbound directions to prevent traffic from backing up and blocking subsequent intersections.

c) TIP #5753 includes plans to widen both the US 1 Business and PA 213 intersections on Woodbourne Road to create additional through lanes on Woodbourne Road and other capacity improvements. These improvements should help alleviate delay through the arterial section.

4. PA 413: Western Avenue to State Road
Bristol Township, Bristol Borough

The US 13 and PA 413 juncture comprises this section of PA 413 located in Bristol Township. To the south of State Road on PA 413 is the Burlington-Bristol Bridge, to the north of Western Avenue is the interchange with I-95, while a short distance to the east on US 13 is a connection to the Pennsylvania Turnpike. The intersection of US 13 and PA 413 is part of the signed link between I-95 and the Pennsylvania Turnpike. As a result, a large number of connecting traffic and heavy vehicles use this arterial section. PA 413, between I-95 and US 13, has recently undergone a major upgrade process that included intersection improvements, resurfacing, widening, and streetscaping.

This section performed at a Level of Service F in the southbound direction in both the AM and PM peak periods. Travel speeds for the southbound direction were thirteen miles per hour in the AM, and twelve miles per hour in the PM. In the northbound direction, the Level of Service for the AM and PM peak periods was E. Most of the delay and congestion was experienced through the US 13 and New Rogers Road intersections. PA 413 has recently been upgraded north of the US 13 intersection. As a result, no significant delay was experienced at the Western Avenue intersection.

The main cause of congestion through this section was a combination of consecutive signalized intersections and a cumbersome roadway geometry. In addition to heavy volumes that add to vehicular delay, the PA 413 and US 13 intersection does not align in the northbound / southbound direction. Traversing through the intersection in the southbound direction, the through traffic must make a gradual left turn through the intersection. Vehicles proceed under the narrow Amtrak / SEPTA bridge, then make a free right turn at the New Rogers Road intersection.

In the northbound direction on PA 413 at the approach to US 13, there is one left / through shared lane and one right / through shared lane. Since a significant number of vehicles in the right lane turn right, opposing left turning traffic is under the impression that the lane is a right turn only, and vehicles frequently turn in front of the opposing through traffic. In addition, since the intersection in the northbound direction is offset, vehicles tend to drift over into other lanes, cutting off vehicles.

Recommended Improvements

a) Restripe the pavement markings on the PA 413 northbound approach and US 13 westbound approach. This will identify turning movements and reduce driver confusion.
b) Install pavement marking extensions through the US 13 / PA 413 intersection in the north and southbound directions to help guide vehicles through the intersection.
c) Improve the lighting under the SEPTA / Amtrak bridge. Lighting is poor, and seeing the lane and pavement markings is difficult.
d) Improvements to this intersection should be consistent with TIP #5020. This project involves reconstructing the PA 413 / US 13 intersection with jughandles.

5. PA 213: Golf Club Drive to PA 413
Middletown Township, Langhorne Borough

This generally two lane arterial section contains the Golf Club Drive, Bellvue Avenue, and the PA 413 intersections along PA 213. Most of the section is in the central business district of Langhorne Borough. There is parking on both sides of PA 213 through most of Langhorne Borough.

The eastbound direction performed worse than the westbound direction in both the AM and PM peak periods. In the eastbound direction, the section performed at Level of Service D in the AM peak and Level of Service F in the PM peak. The westbound direction faired slightly better, receiving a Level of Service C in the AM and Level of Service D during the PM peak. During the PM peak in the eastbound direction, the average travel speed was just under twelve miles per hour. The worst performing segment was eastbound between Bellevue Avenue and PA 413 in the PM peak where the congested travel speed for the segment was four miles per hour.

A major source of delay for this section of PA 213 is the Bellevue Avenue intersection. The east and westbound approaches on PA 213 have only one lane for all turning movements. The westbound approach has a leading protected left turn, while the eastbound direction has no only permitted left turns. If the first vehicle in the queue on the eastbound approach on Bellevue Avenue is making a left turn, all vehicles in the queue had to wait until the first vehicle made the left turn. During peak periods, gaps in oncoming traffic are reduced, and left turning vehicles must wait until the end of the green phase to turn. In addition, parked vehicles along PA 213 hamper efforts for vehicles to traverse around left turning vehicles.

Significant delays at the PA 413 intersection also contributed to congestion on this arterial segment. In the eastbound direction on PA 213 during the PM peak, traffic was queued from PA 413 through the Bellevue Avenue intersection.

Recommended Improvements

a) Extend the no parking zones on the approaches to the Bellevue Avenue intersection on PA 213 in Langhorne Borough at to allow more capacity for through vehicles to maneuver around left turning vehicles.
b) Incorporate striped no parking zones at the PA 213 / Bellevue Avenue intersection to increase driver awareness.
c) Incorporate time-restricted left turns at the Bellevue Avenue intersection on PA 213 in the eastbound and westbound directions. Prohibiting left turns during the peak periods would significantly reduce delay for through traffic.
d) Coordinate the signal timings of the PA 413 and Bellevue Avenue intersections on PA 213. Due to the close proximity of the two intersections, coordinated signal timings would improve the progression of traffic through the section.

6. PA 413: Bridgetown Pike to PA 213

Middletown Township

This section of PA 413 extends from Bridgetown Pike in Middletown Township, southward through the Winchester Avenue intersection, to the PA 213 intersection in Langhorne Borough. Between Bridgetown Pike and Winchester Avenue, PA 413 is a two lane arterial with few curb cuts, traversing through predominantly rural and wooded areas. Between Winchester Avenue and PA 213, the landscape changes to a more residential and commercial area. This is a heavily traveled corridor, linking the Newtown area in the north to Langhorne Borough and the US 1 interchange in the south. This arterial section also serves many schools along the PA 413 corridor in this area including the George School, Newtown Friends School, Neshaminy Junior High, Oliver Heckman Elementary, and Woods School. As a result, there are numerous school busses utilizing this section of PA 413 during the AM peak period and during the afternoon hours.

There was a significant directional difference in congestion during the AM peak on this section of PA 413. The northbound direction received a Level of Service B, while the southbound direction received a Level of Service F. Much of the southbound delay of this arterial section was experienced at the Winchester Avenue intersection. During the AM peak in the southbound direction on PA 413, vehicles experienced an average of 230 seconds of delay at the Winchester Avenue intersection. This translates into a travel speed of just over twelve miles per hour for the entire southbound section during the AM peak. During the PM peak, the arterial section performed at Level of Service D in both directions.

Several factors contribute to severe congestion along this section of PA 413. Between Winchester Avenue and Bridgetown Pike, there are two narrow rail bridge underpasses where vehicles must slow

down in order to navigate safely. If there is a large truck nearing either approach to the underpasses, vehicles in the opposite direction must give way before entering. This section is located on a fairly steep grade, which significantly reduces the speed of the northbound traffic. In addition, there are several sharp curves in both directions where warning signs dictate lower speeds. Finally, the pavement through this section is in very poor condition, especially between Winchester Avenue and Old Mill Drive, with ruts and potholes hindering the progression of traffic.

The Winchester Avenue intersection also contributes to delay in this section. All of approaches have only one lane to make all turns. The signal cycle length is inadequate, as vehicles must wait several cycles to traverse the intersection. Left turning vehicles add significant delay to the through vehicles. The traffic signals need to be upgraded, there are no overhead street name signs, and there are variations in grade through the intersection.

Recommended Improvements

a) Upgrade the PA 413 and Winchester Avenue intersection. There is enough available capacity to accommodate left turn lanes on all approaches, although the north and southbound approaches would be the priority. Additional upgrades include new traffic signals, pavement markings, and overhead street name signs.

b) Install a flashing yellow warning sign in both directions in advance of the narrow underpasses to alert drivers of the upcoming hazard.

c) Lower the speed limit between Bridgetown Pike and Winchester Avenue. The posted speed limit is 45 miles per hour. However, there are two curves on this segment where the warning signs are posted 35 mph and 25 mph, respectively. The average free flow speed in both directions was found to be 35 mph. The current conditions consisting of poor pavement, steep grades, sharp curves, and narrow underpasses require speeds lower than the current speed limit in order to navigate the segment safely.

d) Improve the pavement conditions between Bridgetown Pike and Winchester Avenue. This could reduce congestion, improve drainage, and eliminate roadway hazards created by poor pavement.

7. Woodbourne Road: Oxford Valley Road to New Falls Road
Middletown Township

This section of Woodbourne Road is on the southern edge of the PA 413 study. Woodbourne Road is the only major north-south arterial in central Middletown Township, linking the US 1 Business area in the north with large residential tracts of Middletown and Bristol Townships in the south. Between Oxford Valley Road and Cobalt Drive, the land use is primarily commercial, with many business and curb cuts. There is a middle turn lane through most of this section, helping to reduce delay incurred by turning vehicles. The southern half of the section, between Cobalt Drive and New Falls there are few curb cuts, as the environment becomes more residential. In this section, there are wide shoulders but no sidewalks.

Both the north and southbound directions performed at Level of Service B during the AM peak periods on this section of Woodbourne Road . Although there was almost 60 seconds of delay at the New Falls Road intersection in the southbound direction, the long length of the section dilutes the overall travel speed. There was also minor congestion during the PM peak in the northbound direction. However, in the southbound direction during the PM peak, a Level of Service E was recorded. An average of 191 seconds of delay was experienced in the northbound direction during the PM peak on this section of Woodbourne Road.

The major cause of delay on Woodbourne Road on this section is the signalized intersection at New Falls Road. The speed limit throughout the area on Woodbourne Road is generally 45 miles per hour. Through most of the section in both directions, the free flow speed is achieved, even during the peak periods. The only major congestion is the long delays on the southbound approach to the New Falls Road intersection.

<u>Recommended Improvements</u>

a) Add a left turn lane and a protected phase to the southbound approach. This would eliminate the shared through / left lane and create a through only lane. As a result, traffic flow would significantly increase for the through movements.
b) Eliminate the permitted left turns in both the north and southbound approaches. This is a safety issue with vehicles having to cross multiple lanes of traffic to complete the turns. Vehicles also become ‘stranded’ in the middle of the intersection when vehicles are unable to make a left turn during the green and yellow phase.

8. US 1 Business: Durham Road to Hulmeville Road
Penndel Borough

This arterial section of US 1 Business extends from the Durham Road intersection in Penndel Borough westward to Hulmeville Road in Middletown Township. It contains the Durham Road, Bellevue Avenue, Hulmeville Avenue, Neshaminy Street, and Hulmeville Road intersections. The roadway is two lanes in each direction with a posted 35 mile per hour speed limit. Most of the corridor is highly urbanized, traversing through the Penndel central business district. There are a high number of curb cuts that access the numerous businesses along this section. Just past Hulmeville Road, US 1 Business merges into US 1, providing access to the nearby Neshaminy Mall, Eastern State Hospital, and points beyond.

Travel speeds were fairly consistent during the AM and PM peak periods. During the AM peak, the average travel speed for the arterial section of US 1 Business in the westbound direction was 27 miles per hour. The average travel speed for the eastbound direction during the AM peak was 25 miles per hour. Both directions performed at Level of Service C for the AM peak. During the PM peak, travel speeds were reduced to 18 miles per hour in the westbound direction and 20 miles per hour in the eastbound direction. For the PM peak, both directions received Level of Service D.

A major source of delay in travel speeds along this section of US 1 Business is a lack of left turn lanes throughout the corridor. At the Hulmeville Avenue, Bellevue Avenue, and Hulmeville Avenue intersections, there are two through lanes. The left lane is shared left / through, while the right lane is a shared right / through. During congested periods, this condition contributes to delay. If the first vehicle in the queue is making a left turn, all other vehicles in the queue must either wait for the vehicle to turn or merge over to the right lane and drive around the turning vehicle. This creates a hazard of multiple vehicles trying to merge into the right lane at the same time. Waiting through multiple cycles due to left turning vehicles was experienced at these intersections. In addition, when opposing vehicles are making left turns, it is difficult for drivers to see the oncoming traffic in the far shared through / right turn lane.

There is a lack of pedestrian facilities on the US 1 Business corridor in throughout Penndel Borough. There are no crosswalks and no pedestrian signals at the Durham Road and Bellevue Avenue intersections. Because of the high urban density, this area should be a priority for pedestrian facilities.

<u>Recommended Improvements</u>

a) There should be better advanced warning that the left turn lane is a shared lane to prepare drivers to make the appropriate decision when approaching the Durham Avenue, Bellevue Avenue, and Hulmeville Avenue intersections. This can be achieved through the use of

pavement markings, intersection lane control signs, or a combination of both.

b) Evaluate the feasibility of incorporating a middle turn lane on US 1 Business through the Penndel central business district. Due to physical constrains, it may be necessary to reduce US 1 from two travel lanes to one in each direction. This would reduce delay for the through traffic and create a safer environment for left turning vehicles.

c) Introduce pedestrian facilities to include crosswalks, signals, and if necessary, pedestrian islands throughout the US 1 Business corridor.

d) TIP #5726 include plans to install a Closed Loop Signal Interconnection between Hulmeville Road and Oxford Valley Road on US 1 Business. This project includes several traffic signals in this arterial section and will help the progression of vehicles through the US 1 Business corridor.

9. PA 413: Bridgetown Pike to the Newtown By-Pass

Middletown Township, Langhorne Borough

This section of PA 413 connects the heavily traveled Newtown By-Pass and Newtown Township on the northern end with Langhorne Borough and close connections to I-95 and US-1 in the southern end. The section includes the signalized intersections of Bridgetown Pike, St. Mary Boulevard, Pennswood Village, and the Newtown By-Pass. There are several schools located along this section of PA 413 including the George School, Newtown Friends School, and Neshaminy Junior High School. Other major trip generators located along this corridor are St. Mary Medical Center and Core Creek County Park. There is generally one travel lane in each direction, while the speed limit is 45 miles per hour throughout the section.

During the AM peak period in both the north and southbound directions, this section of PA 413 experienced moderate levels of delay. Both directions performed at Level of Service C. The worst congestion of the AM peak was found between the Pennswood Village and the Newtown By-Pass intersection in the northbound direction, where drivers experienced an average of 89 seconds of delay. The southbound direction during the PM peak received a Level of Service B. In the northbound direction during the PM peak, this section of PA 413 experienced a Level of Service D.

The most significant source of delay on this arterial section occurred at the northbound approach to the signalized intersection at the Newtown By-Pass. In the northbound direction on PA 413 at the approach to the Newtown By-Pass, drivers experienced 89 seconds of delay in the AM peak and 77 seconds of delay during the PM peak. The main reason for the excessive delays on the this approach is the long cycle lengths at the PA 413 / Newtown By-Pass intersection. Due to heavier volumes, the cycle length allows more green time for the By-Pass. This produces long queues on the northbound approach on PA 413, and not all the queued vehicles can traverse the intersection during

the green phase. Vehicles during the PM peak were backed up to Summit Trace Drive on the northbound approach. The left turn lane exceeded capacity and spilled into the through lane. There is no dedicated right turn lane, and drivers used the shoulder to make right turns.

Throughout the this section of PA 413, there were other sources of delay. During the AM peak, there are a large number of school busses that use this corridor. Busses tend to drive slower and make frequent stops. There is also a school zone speed limit of 15 miles per hour near the Neshaminy Junior High School on PA 413 during the AM peak. There was also significant delay experienced at the St. Mary Boulevard intersection due to heavy volumes of traffic leaving the medical center during the PM peak.

There is limited shoulder area and poor pavement conditions throughout this section. It was observed that drivers were unable or unwilling to pass left turning vehicles at non-signalized intersections due to insufficient shoulder space. This created long queues, especially during peak periods. Poor pavement conditions near the George School and in the Bridgetown area of PA 413 also resulted in vehicles having to slow down or swerve in order to avoid potholes.

Recommended Improvements

a) Add capacity to the PA 413 / Newtown By-Pass intersection on the northbound approach. Extend the left turn lane to accommodate additional left turning vehicles that queue during the red phase. Upgrade the shoulder by adding a designated right turn lane to better manage the peak hour volumes.
b) Adjust the signal timing at the St. Mary Boulevard intersection during the peak periods to better facilitate the flow of traffic on PA 413.
c) Improve the pavement quality and establish a minimum shoulder width throughout the corridor. This will reduce delay caused by uneven or poor pavement conditions and allow for vehicles to pass left turning vehicles using the shoulder.

10. PA 413: US 1 Business to PA 213

Middletown Township, Langhorne Borough

This arterial section extends from the central business district of Penndel Borough, through Langhorne Manor Borough, to Langhorne Borough. It contains the US 1 Business intersection, the flashing traffic control signal at Highland Avenue, and the signalized intersection at PA 213. This section of PA 413 provides direct access to SEPTA's R3 Langhorne Station. The section is largely residential, and also serves the Philadelphia College of the Bible, Woods School, and Oliver Heckman Elementary School.

During the AM peak, there was a directional variance in the delay experienced on this section. In the southbound direction on PA 413 between PA 213 and US 1 Business, the section performed at Level of Service B. However, in the northbound direction, the section performed at Level of Service D. During the PM peak, both the north and southbound directions experienced Level of Service C. The worst segment for delay was the northbound approach to the PA 213 intersection on PA 413. This segment experienced an average delay of 95 seconds during the AM peak period.

There are two major sources of delay on this section of PA 413. The first is the Conrail / SEPTA R3 rail line that intersect PA 413 just north of LeGrande Avenue. Stopped time at the rail intersection accounted for significant delays. Delay is compounded during the peak periods, when both train frequency and vehicular volumes are greater. Queued vehicles on the northbound approach to the rail crossing extended back through PA 413 / Durham road split. After the train passes and the gates are lifted, a continuous traffic stream would hamper turning vehicles. The second is the signalized intersection at PA 213 / PA 413. Long queues in the northbound direction extended back to Richardson Avenue. This intersection has significant delays on all approaches.

The PA 413 and Highland Avenue intersection presented a hazard to motorists. At the westbound approach, drivers have a flashing yellow light. All other approaches have a flashing red light, and must yield other vehicles. However, it was observed that many vehicles on the westbound approach were unaware that the other approaches have a flashing red, assuming the entire intersection is flashing yellow. Vehicles in this situation would stop at the intersection, unsure which vehicles have the right-of-way. On the contrary, a few vehicles would not stop at all, believing they have the right-of-way.

Recommended Improvements

a) There are currently two studies that proposes to improve PA 413 through Penndel Borough and Langhorne Manor Borough: *Comprehensive Plan for Penndel Borough* and *Penndel Revitalization Plan*. These studies will investigate in detail the economic and transportation improvements needed to improve the PA 413 corridor.
b) Evaluate the signal timing of the PA 413 / PA 213 intersection. Significant delay is experienced at multiple approaches. Since large-scale intersection expansion is not feasible, optimizing the signal time may help to reduce congestion.
c) Further evaluate the PA 413 / Highland Avenue intersection for a traffic signal warrant analysis. If a traffic signal is not warranted, improve driver awareness to intersection procedure with better signs and pavement markings.
d) Introduce a bus pullout on PA 413 at the Langhorne Rail Station at the location of the existing stop. Upgrade the bus stop environment by installing benches and a shelter. This will improve intermodal travel and provide a better environment to encourage transit trips.

TABLE 2

Summary of Arterial Section Improvement Strategies

	Location	Signal Timing/ Coord.	Coord. with TIP Project	Intersection Capacity	Roadway Capacity	Shoulder/ Pavement Improv.	Right Turn Lane	Left Turn Lane	Left Turn Signal	Pavement Markings	Parking Improv.	Sign Improv.
1.	PA 213: Wheeler Dr to PA 413	X					X	X				X
2.	Woodbourne Rd: US 1 Business to Oxford Valley Rd	X	X		X							
3.	Woodbourne Rd: Woodlane Rd to US 1 Business	X	X									
4.	PA 413: Western Ave to State Rd		X							X		
5.	PA 213: Golf Club Dr to PA 413	X									X	X
6.	PA 413: Bridgetown Pike to PA 213	X				X		X		X		X
7.	Woodbourne Rd: Oxford Valley Rd to New Falls Rd							X	X			
8.	US 1 Business: Durham Rd to Hulmeville Rd		X		X							X
9.	PA 413: Bridgetown Pike to the Newtown By-Pass	X		X		X						
10.	PA 413: US 1 Business to PA 213	X			X							X

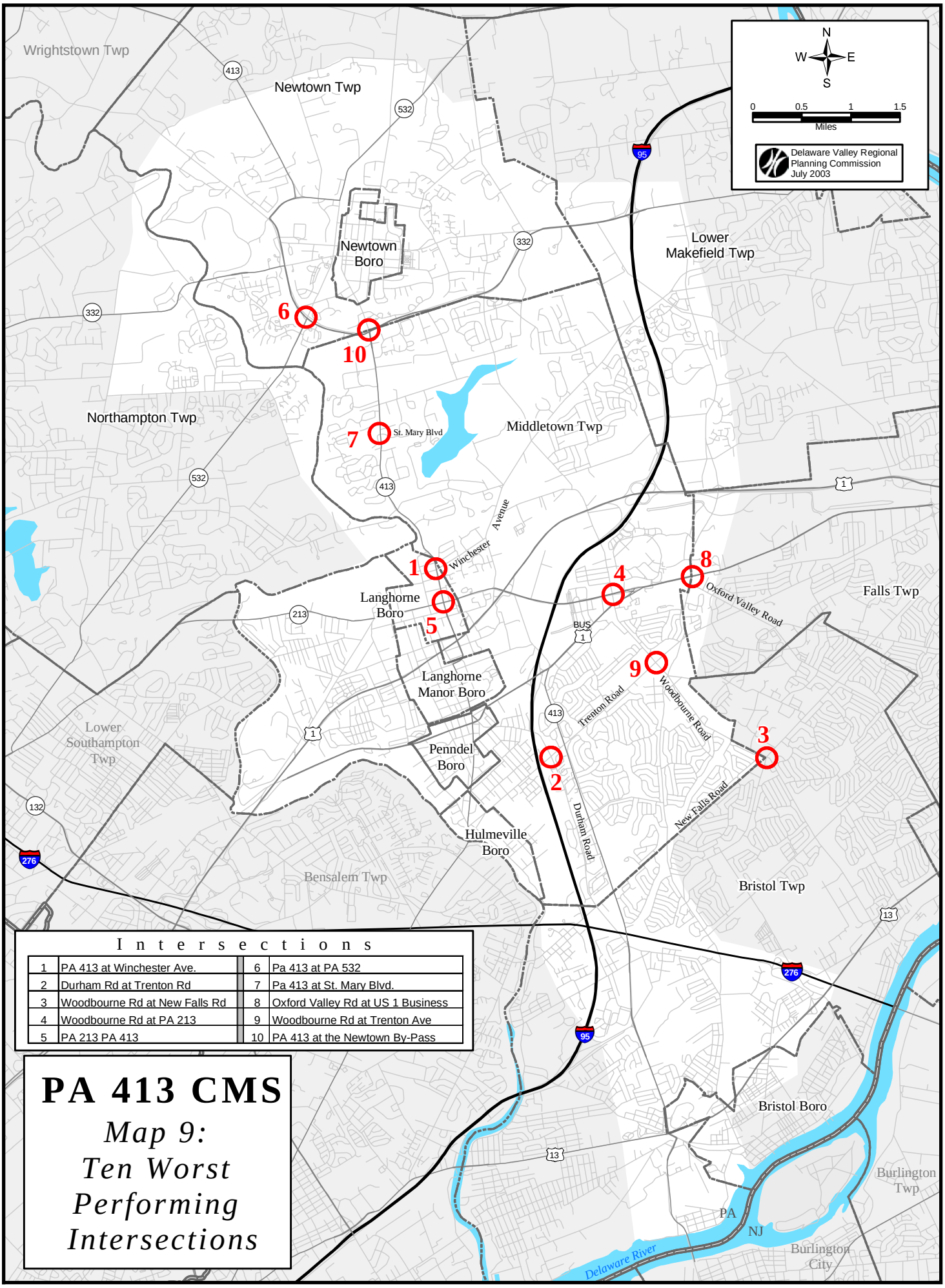
VI. WORST PERFORMING INTERSECTIONS

All of the intersections were analyzed based on peak period approach delay in seconds. The ten worst performing intersections are listed in **Table 3**. Locations of the ten worst performing intersections are shown in **Map 9.** In the table, *Approach delay* includes stopped time and time lost when a vehicle decelerates from its ambient speed. The delay time is displayed with the direction of traffic flow, the peak period in which the delay occurs, and the total delay in seconds. In several cases, more than one approach to the same intersection incurred significant delay. However, a single intersection is listed in the top ten worst only once, regardless of how the other approaches performed. The cumulative effect of the existing congestion and the proposed developments will necessitate improvement of intersections and highway segments, some of which have already been programmed on the TIP.

TABLE 3

Ten Worst Performing Intersections

	Intersection	Approach	Peak Period	Approach Delay (sec)
1.	PA 413 at Winchester Ave	SB	AM	230
2.	Durham Rd at Trenton Rd	NB	AM	225
3.	Woodbourne Rd at New Falls Rd	SB	PM	191
4.	Woodbourne Rd at PA 213	SB	PM	143
5.	PA 213 at PA 413	EB	PM	123
6.	PA 413 at PA 532	SB	PM	102
7.	PA 413 at St. Mary Blvd	NB	PM	99
8.	Oxford Valley Rd at US 1 Business	SB	PM	99
9.	Woodbourne Rd at Trenton Ave	SB	PM	98
10.	PA 413 at the Newtown By-Pass	NB	PM	89



Intersections

1	PA 413 at Winchester Ave.	6	Pa 413 at PA 532
2	Durham Rd at Trenton Rd	7	Pa 413 at St. Mary Blvd.
3	Woodbourne Rd at New Falls Rd	8	Oxford Valley Rd at US 1 Business
4	Woodbourne Rd at PA 213	9	Woodbourne Rd at Trenton Ave
5	PA 213 PA 413	10	PA 413 at the Newtown By-Pass

PA 413 CMS

Map 9:
Ten Worst Performing Intersections

An analysis was completed on the ten most congested intersections as listed in **Table 3** to identify improvement strategies. Existing conditions were evaluated and recommendations were made to alleviate current and future congestion. The improvements are coordinated with local, state, and federal construction projects. These improvements include TIP projects, adding capacity, safety improvements, and operational improvements.

1. PA 413 at Winchester Avenue
Langhorne Borough

This intersection is located in a residential area of Langhorne Borough. There are homes located at three corners, with the Attleboro Retirement Village on the southeast corner. Each approach has a single lane from which all turns must be made. This intersection is also within close proximity to many schools along the PA 413 corridor in this area including the George School, Newtown Friends School, Neshaminy Junior High, Oliver Heckman Elementary, and Woods School. As a result, there are numerous school busses traversing the intersection during the AM peak period and during the afternoon hours.

The greatest delay at this intersection was on the southbound approach during the AM peak period, where the average approach delay was 230 seconds. Vehicles were queued from the Conrail Bridge up to the intersection and would have to wait several cycles to traverse the intersection. The average travel speed between Bridgetown Pike and Winchester Avenue on PA 413 in the southbound direction was eleven miles per hour. Other approaches to the Winchester Avenue intersection also experienced significant delay. The southbound approach during the PM Peak averaged a delay of 118 seconds, while the northbound approach during the PM peak averaged 91 seconds.

The delay at this intersection is a result of heavy volumes during peak hours, a short signal cycle, and vehicles queued behind left turning vehicles. It was observed that vehicles, especially on the north and southbound approaches had to wait several signal cycles before they were able to traverse the intersection. If a large vehicle, such as a truck or school bus, was making a left turn at the intersection on any approach, queued vehicles were unable to proceed. In addition, there are no pedestrian signals and no striped crosswalks. Pedestrian facilities are important to intersections located in residential areas. The traffic signals need to be upgraded, there are no overhead street name signs, and there are variations in grade through the intersection.

There is enough right-of-way to expand the intersection by adding left turn lanes on all approaches, while having little impact on the adjacent properties. The approach lanes are currently wide enough to accommodate smaller vehicles making a left turn while not significantly impacting through traffic. Therefore, only several feet of right-of-way would be needed to incorporate left turn lanes.

Recommended Improvements

a) Add left turn lanes on all approaches to this intersection. This would create a safer and more efficient intersection, reduce overall delay, and significantly aid the flow of through traffic.
b) Upgrade the overall intersection to include new traffic signals, overhead street name signs, pedestrian signals and crosswalks, and pavement markings. These features combined can increase safety and visibility, increase driver awareness, and help to reduce congestion and delay.
c) Reconstruct the intersection to level uneven pavement at and on approaches to the intersection.
d) Further analyze the traffic signal cycle for optimization. Extending the green times for the predominate north and southbound traffic flow could reduce overall intersection delay.

2. Durham Road at Trenton Road
Middletown Township

The Durham Road / Trenton Road is located in a residential area of Middletown Township. Durham Road runs parallel to PA 413 in this area and is used as alternative road during times of peak congestion. Both Durham Road and Trenton Road are two lane arterials. The east and westbound approaches on Trenton Road each have a through / right shared lane and a left turn lane. The westbound approach has a leading left turn phase. The northbound approach on Durham Road has a through / right lane and a left turn lane. However, southbound approach has only one lane for all movements. As a result, the north and southbound approaches are on a split phasing cycle. All of the approaches have recently been repaved.

During the AM peak, the northbound approach on Durham Road experienced an average of 225 seconds of delay. The average travel speed between New Falls Road and Trenton Road during the AM peak was just over seventeen miles per hour. The southbound approach did not experience any major delay during the AM peak. During the PM peak, the northbound approach saw an average delay of 86 seconds, while the southbound approach experienced an average of 57 seconds of delay.

The split phasing on the north and southbound approaches shorten the overall green time for the cycle. As a result, there is increased delay to all approaches to the intersection. In the AM peak on the northbound approach, vehicles entering at the end of the queue had to wait several cycles before traversing through the intersection. This also occurred in the PM peak on the southbound approach. There are businesses within close proximity on both sides of the northbound approach which limit adding capacity. There are no pedestrian signals and the crosswalks are faded.

Recommended Improvements

a) Evaluate the signal timing to eliminate the split phase on the north and southbound approaches. This would extend the green time for the north and southbound approaches and reduce overall intersection delay.

b) Install overhead street name signs on the crossbar for better visibility and to assist unfamiliar drivers.

3. Woodbourne Road at New Falls Road
Middletown Township, Bristol Township

This intersection is located on the border of Middletown Township and Bristol Township. Because this it is situated at the edge of the PA 413 study area, only the southbound approach on Woodbourne Road was analyzed. During the AM period, the southbound approach to the New Falls Road intersection experienced 58 seconds of delay. However, during the PM peak the average delay was 192 seconds.

Several factors contribute to significant delays on the southbound approach at the New Falls Road intersection. This is an intersection with five approaches, and the longer signal cycles contribute to long delays. The northbound approach has a leading left turn, further increasing the southbound delay. During the PM peak, queued vehicles had to wait several cycles before traversing through the intersection.

The southbound approach has two lanes: one shared through / left and one shared through / right. However, there is no protected left turn from the southbound approach. This results in long delays when a vehicle must wait for a gap in oncoming traffic to make a left turn. In addition, if the first vehicle in the queue is making a left turn, all other vehicles in the queue must either wait for the vehicle to turn or merge over to the right lane and drive around the turning vehicle. There are no pedestrian crossing signals, and the pedestrian crosswalks are badly faded.

Recommended Improvements

a) Add a left turn lane and a protected left turn phase to the north and southbound approach. This would eliminate the shared through / left lane, creating an additional through lane and a left turn lane. As a result, traffic flow would significantly increase for the through movements. Eliminate the permitted left turns in both the north and southbound approaches. This is a safety issue, as vehicles have to cross multiple lanes of traffic to complete the turn. Vehicles also become ‘stranded’ in the middle of the intersection when vehicles are unable to make a left turn during the green and yellow phase.

b) Minor upgrades to the intersection should include installing pedestrian crossing signals,

restripe the crosswalks and stop bar, and erecting overhead street name signs on the crossbars.

c) Further study this intersection to achieve better Level of Service and reduce overall intersection delay. Because there are five approaches, the complex traffic patterns require additional analysis. Improvements may include intersection realignment or creating a one-way approach.

4. Woodbourne Road at PA 213
Middletown Township

This intersection is located in a highly commercial area, with close proximity to the Oxford Valley Mall, Langhorne Square Shopping Center, and numerous automotive dealerships along PA 213 and US 1 Business. It is also near the Woodbourne Road and US 1 Business intersection, located approximately less than a tenth of a mile to the south.

The Woodbourne Road intersection at PA 213 experienced only moderate congestion during the AM peak for the north and southbound approaches. The southbound approach had an average of 48 seconds of delay, while the northbound approach saw minimal delay. In the PM peak, the northbound approach also performed well, with only an average delay of 18 seconds. The southbound approach, however, was very congested during the PM peak, experiencing an average of 143 seconds of delay.

The east and westbound approaches were also analyzed as part of the PA 213 corridor. During the AM peak, the eastbound approach had an average delay of 33 seconds, while the westbound approach had an average delay of 12 seconds. The PM peak showed slightly more average delay, with the eastbound approach experiencing 29 seconds, and the westbound approach having 43.

The major source of delay at this intersection are the heavy volumes of traffic on the southbound approach. Between the Fourth Street and PA 213 intersection on Woodbourne Road, there is one lane in the southbound approach and two lanes in the northbound direction. Assuming traffic volumes are equal in both directions, the southbound traffic is operating on half the capacity of the northbound direction, and therefore more likely to experience more significant congestion and delay.

At the intersection, the southbound approach has one left turn lane, one through lane, and one right turn lane. There is no left turn signal, and thus, no protected left turns on the southbound approach. The lack of a left turn signal severely restricts the number of left turns that can be made during the green phase. There are few gaps in the two lanes of oncoming traffic during peak periods. This problem is exacerbated by the fact that there are no left turns permitted at the next southbound

intersection, US 1 Business. Vehicles on Woodbourne Road needing to turn onto eastbound US 1 Business must do so at the PA 213 intersection by making a left turn.

Recommended Improvements

a) Evaluate the feasibility of expanding the southbound capacity on Woodbourne Road from one lane to two travel lanes. There are currently two receiving lanes in the southbound direction but only one through lane at the Woodbourne Road / PA 213 intersection. This would expedite the flow of southbound traffic.
b) Incorporate a left turn signal on the southbound approach. Few vehicles can currently make a left turn during the green phase. Many vehicles also become stranded in the middle of the intersection when the green phase ends.
c) Coordinate the signal timings of the US 1 Business and PA 213 intersections on Woodbourne Road. Due to their close proximity, the through traffic from the US 1 intersection often spills back into the PA 213 intersection.
d) TIP #5753 includes plans to widen both the US 1 Business and PA 213 intersections on Woodbourne Road to create additional through lanes on Woodbourne Road and other capacity improvements. These improvements should help alleviate delay through the Woodbourne Road corridor.

5. PA 213 at PA 413
Langhorne Borough

This intersection is located in the heart of Langhorne Borough. There are commercial developments on three corners, including two gas stations. Each approach has left turn lane and one through / right shared lane. Only the southbound approach has a protected left turn, all other approaches have permitted left turns.

All four approaches of this intersection were evaluated for approach delay. During the AM peak, the eastbound approach had an average delay of 44 seconds, while the westbound approach had 50 seconds. The northbound approach experienced an average delay of 95 seconds, and the southbound approach experienced 57 seconds. The east and westbound approach both had significant congestion during the PM peak. The eastbound approach saw an average delay of 123 seconds, while the westbound approach saw an average delay of 113 seconds. The average delay for the northbound approach was 59 seconds, while the southbound approach did not experience significant delay during the PM peak

The PA 213 / PA 413 intersection experiences congestion on all approaches during the peak periods. Expansion of the intersection is not feasible. Adding capacity would require property acquisition

and significant capital outlay.

Recommended Improvements

a) Evaluate the possibility of adding left turn signals to all approaches, which would allow for protected left turns.
b) Upgrade the intersection to include overhead street name signs, pedestrian signals and crosswalks, and pavement markings. Currently, the crosswalks, stop bars, and pavement markings are faded or nonexistent on some of the approaches.
c) Poor pavement conditions can be found on the northbound receiving lane, where vehicles have worn 'grooves' into the pavement. This condition can create a hazard for drivers and contribute to drainage problems.

6. PA 413 at PA 532
Newtown Township

This intersection is located on the Newtown By-Pass just south of Newtown Borough. The By-Pass is a high-speed, high-volume arterial that functions like a suburban highway. The east and westbound approaches on the Newtown By-Pass each have two through lanes and a left turn lane. The eastbound approach has a right turn lane, while the westbound approach does not. The north and southbound approaches on PA 532 have one left turn lane, one through lane. The northbound approach has a right turn lane, while the southbound approach does not have an official right turn lane, although the shoulder functions as such.

This intersection was evaluated on all approaches. During the AM peak, the eastbound approach on PA 413 experienced an average delay of 48 seconds. The westbound approach did not experience significant delay during the AM peak. On PA 532, the northbound approach experienced an average of 21 seconds of delay, while the southbound approach recorded 48 seconds of average delay. During the PM peak, the eastbound approach on the Newtown By-Pass had an average delay of 73 seconds. The westbound approach saw an average delay of 20 seconds. The northbound approach on PA 532 experienced an average delay of 28 seconds while the southbound approach had 63 seconds of average delay.

Due to high volumes, the traffic signal cycle favors the Newtown By-Pass, which result in longer delays on PA 532. However, there are several other conditions that can be addressed to decrease overall intersection delay and create a safer environment. On the north and southbound approaches on PA 532, there are no left turn signals, only permitted turns. Because of the expanse of the intersection, vehicles must pull out a considerable distance to make a left turn. Other drivers are hesitant to pull out, especially during peak hours when the gaps in oncoming traffic are limited.

During the PM peak, left turning vehicles would queue in both directions, creating a hazardous situation. Only a few vehicles would be able to make the left turn per cycle, and vehicles would get caught in the intersection when the green phase ended. The southbound approach also has no right turn lane, and vehicles used the shoulder to make right turns.

On the northbound approach on PA 532, it was observed that a significant number of vehicles made a right turn onto the Newtown By-Pass. During the peak periods, the right turn lane exceeded capacity of queued vehicles. In addition, although there are no posted *No Turn on Red* signs, some vehicles would wait for the green phase to make a right turn. On the westbound approach on the Newtown By-Pass, there is also no right turn lane. Again, vehicles use the shoulder to make right turns.

In the westbound direction during the PM peak, the left turn lane exceeded capacity with queued vehicles. Vehicles at the end of the queue spilled back into the through travel lanes, and not all queued vehicles were able to traverse the intersection during the protected left turn phase. This impacted vehicles approaching the intersection from the westbound direction, as approaching vehicles had to merge into the right travel lane to avoid queued left turning vehicles that had spilled back into the left through travel lane.

There are general improvements to the intersection that can improve overall safety, visibility, and vehicles delay. The traffic signals at the PA 413 / PA 532 intersection are old and should be upgraded. There are no overhead street name signs, which are needed to assist unfamiliar drivers and give advanced notice of the upcoming intersection.

Recommended Improvements

a) Add right turn lanes on the westbound and southbound approaches. The shoulder already functions as a right turn lane. Adding a few feet of capacity to the shoulder to create a designated right turn lane would reduce driver confusion, improve safety, and create a more efficient intersection.
b) Introduce a right turn signal on the northbound approach on PA 532. This would significantly expedite the right turning vehicles, reduce delay, and help prevent right turn queues from exceeding capacity in the storage lane and impacting the through traffic.
c) Incorporate a protected left turn signal into the north and southbound approaches.
d) Evaluate the need for a dual left turn lane on the westbound approach. During peak hours, the left turn lane exceeds present storage.
e) Upgrade the traffic signals and incorporate overhead street name signs. Reduce the amount of signs or simplify signage on the approaches to the By-Pass on PA 532. Currently, there is an excessive number of road signs that drivers do not have time to decipher when approaching the intersection.

f) Because of the heavy volumes and proximity of traffic signals throughout the corridor, there may be a need for improvements to the closed loop traffic signal system on the Newtown By-Pass. This would include the PA 532 intersection to expedite By-Pass traffic during peak hours.

g) TIP #5757 will reconstruct PA 532 through Newtown Township, between the Newtown By-Pass to Durham Road. This will improve traffic flow on PA 532 and increase capacity on the PA 532 approach to the Newtown By-Pass.

7. PA 413 at St. Mary Boulevard
Middletown Township

This intersection is located in Middletown Township along a stretch of PA 413 containing low-density residential developments. The western leg of the intersection provides access to St. Mary Medical Center, while the eastern leg provides access to Neshaminy Junior High School. The speed limit on PA 413 throughout the area is generally 45 mph. However, this intersection is located in part of a school zone, and during certain times travel speeds are reduced.

During the AM peak, the north and southbound approaches did not experience significant delays, although overall travel speeds were lower due to the school zone. For the PM peak in the southbound direction, an average delay of 21 seconds was experienced. However, in the northbound direction, an average of 99 seconds of delay was experienced.

The main source of congestion and delay at this intersection is the high northbound volumes during the PM peak and vehicles turning in and out of the St. Mary Medical Center. During the peak periods, green time is extended to accommodate the high number of vehicles exiting the hospital, which adds delay for the traffic on PA 413.

<u>Recommended Improvements</u>

a) Evaluate the signal timing and phasing of the intersection to optimize traffic flow.

8. Oxford Valley Road at US 1 Business
Middletown Township

This intersection is at the crux of many large commercial establishments. It has nearby access to the Oxford Valley Mall, Sesame Place, The Courts at Oxford Valley, Frankford Hospital of Bucks County, and extensive commercial development along US 1 Business. This is an expansive intersection, with each approach having two through lanes, a left turn lane, and a right turn lane with

a island merge. Many of the retail and commercial businesses located on US 1 Business open after the end of the AM peak. As expected, the AM peak is much less congested than the PM peak at this location. Because this intersection is located at the edge of the study area, it was only evaluated on the eastbound and southbound approaches.

During the AM peak in the southbound direction, this approach experienced an average of only six seconds of delay. This is mainly due to the free progression of traffic from US 1 to US 1 Business on Oxford Valley Road during uncongested periods. On the eastbound approach, drivers experienced an average of 41 seconds of delay. During the PM peak, the southbound approach has an average delay of 99 seconds. The average travel speed between South Buckstown Avenue and US 1 Business is under six miles per hour. The progression of southbound traffic between US 1 and US 1 Business on Oxford Valley Road floundered at the US 1 Business intersection. The eastbound approach experienced an average of 39 seconds of delay during the PM peak.

Due to the large volumes of vehicles on all approaches, decreasing overall intersection delay is difficult. Favoring the green time for the US 1 Business approaches will increase delay on the Oxford Valley Road approaches and vice versa.

Although the northbound approach was not a part of the PA 413 CMS Study, the segment of roadway at the Oxford Valley Road / South Oxford Valley Road split posed a hazard for drivers. The roadway between US 1 Business and South Oxford Valley Road exceeded capacity, especially during the PM peak.

Recommended Improvements

a) Evaluate the signal timing to extend the green time for the left turn signal at the eastbound approach. It was observed that this approach exceeded capacity during the PM peak period.
b) Evaluate the Oxford Valley Road and South Oxford Valley Road intersection for the warrants to upgrade to a signalized intersection. Improving this intersection would better alleviate congestion at the Oxford Valley Road / US 1 Business intersection.
c) TIP #5726 include plans to install a Closed Loop Signal Interconnection between Hulmeville Road and Oxford Valley Road on US 1 Business. This project includes several traffic signals in this arterial section and will help the progression of vehicles through the US 1 Business corridor.
d) Incorporate overhead street name signs to assist unfamiliar drivers. Use pavement marking extensions to aid drivers making left turns through the intersection.
e) Improve the pavement conditions on the northbound approach.

9. Woodbourne Road at Trenton Avenue
Middletown Township

This intersection is sandwiched between the nearby Harmony Road and Oxford Valley Road intersection. There are commercial businesses on three sides of the intersection. All approaches have a through / right shared lane and a left turn lane. The pavement on Trenton Ave has recently been improved. There are pedestrian signals on three sides of the intersection, and the crosswalks are clearly marked.

This intersection showed moderate delay during the AM peak periods. The northbound approach experienced an average of 29 seconds of delay, while the southbound had an average of 36 seconds. Because of the close proximity of the adjacent signalized intersections, even minor delays greatly reduce travel speeds, and result in low Levels of Service on the arterial segments through this intersection. The PM peak delay was more significant. The northbound approach had an average delay of 64 seconds, and the southbound approach experienced a average delay of 98 seconds.

The major source of delay at this intersection is excess volumes with limited capacity. Minor adjustments in signal timings or roadside improvements would not significantly decrease intersection delay. Adding a middle turn lane would have only minor impacts, as the majority of the flow is through traffic.

Recommended Improvements

a) Examine the feasibility of expanding Woodbourne Road from two to four lanes between US 1 Business to just south of the Oxford Valley Road intersection to reduce current and future delay throughout the Woodbourne Road corridor.
b) Adjust the signal timings of the Harmony Road, Trenton Avenue, and Oxford Valley Road intersections to assist the north and southbound traffic on Woodbourne Road during the peak hours. This would help the progression of traffic and reduce delay along Woodbourne Road.

10. PA 413 at the Newtown By-Pass
Middletown Township, Newtown Township

This intersection is located at the border of Newtown and Middletown Townships, just south of Newtown Borough. The Newtown By-Pass is a high speed arterial road, serving many industrial and corporate campuses in the area.

The most congested approach that was evaluated at this intersection was the northbound section between Pennswood Village and the Newtown By-Pass. This approach experienced an average

delay of 89 seconds during the AM peak and 77 seconds during the PM peak. The northbound approach has a left turn lane, and one through / right lane.

Much of the delay on the north and southbound approaches can be attributed to long cycle lengths, of which the green time favors the heavier volumes on the Newtown By-Pass. During the PM peak, the traffic on the northbound approach was queued to Summit Trace Road. The left turn lane exceeded capacity and was stacked into the through travel lane. In addition, right turning vehicles used the shoulder to make right turns. During the red phase on the northbound approach, vehicles would drive on the shoulder, around the queued vehicles in the through / right lane, and make their right turn when the green phase began. However, this sometimes caused conflict with the vehicles who used the through / right turn lane. Two vehicles would try to make a right turn at the same time, one from the shoulder, and one from the through / right turn.

Recommended Improvements

a) Expand the northbound approach to include more capacity for the left turn lane. This would create additional storage for left turning vehicles and help prevent queued vehicles from adversely impacting the through movement.
b) Expand and repave the shoulder to create an official right turn lane.

TABLE 4

Summary of Intersection Improvement Strategies

	Location	Signal Timing/ Coord.	Coord. with TIP Project	Intersection Capacity	Upgrade Traffic Signals	Shoulder/ Pavement Improv.	Right Turn Lane	Left Turn Lane	Left Turn Signal	Pavement Markings	Pedestrian Facilities	Sign Improv.
1.	PA 413 at Winchester Ave	X						X		X	X	X
2.	Durham Rd at Trenton Rd	X										X
3.	Woodbourne Rd at New Falls Rd							X	X	X	X	X
4.	Woodbourne Rd at PA 213	X	X	X					X			
5.	PA 213 at PA 413					X			X	X	X	
6.	PA 413 at PA 532	X	X	X			X		X			X
7.	PA 413 at St. Mary Blvd	X										
8.	Oxford Valley Rd at US 1 Business	X	X		X	X				X		X
9.	Woodbourne Rd at Trenton Ave	X		X								
10.	PA 413 at the Newtown By-Pass			X			X					

VII. TRANSIT SERVICE

Regional Rail Service

Two SEPTA commuter rail lines, the R3 and R7, bisect the study area. Within the study area the R3 line parallels US 1 and the R7 line parallels US 13. The R3 and R7 lines pass through Lower Bucks County. Both the R3 and R7 rail lines connect Trenton, New Jersey with Center City Philadelphia. The areas of the county to the far northwest are not accessible to rail transit.

The SEPTA R3 Regional Rail provides commuter rail service through the PA 413 study area. The rail line bisects the county in a northeast to southwest direction. The Langhorne and Woodbourne stations are the two stations that are within the study area. Neshaminy Falls station lies just outside the study area to the southwest. There are a total of 27 outbound trains that serve all three stations during the weekdays. They depart from Neshaminy Falls station between 6:15 am and 12:25 am. Of the 27 outbound trains, 7 of them arrive at their final destination before noon. There are a total of 26 inbound trains that serve all three stations during the weekdays. They depart from Woodbourne station between 5:21 am and 11:15 pm. Of the 26 inbound trains, 12 of them arrive at their final destination before noon.

Neshaminy Falls station is accessible from Bristol Road at Linden Street. Bristol Road is a local arterial that in the southern limits connects with Old Lincoln Highway where it deviates from US 1. To the north it connects with PA 213. According to SEPTA's Stations/Parking Inventory from November 2002, there are 186 daily parking spaces at the station. They are SEPTA owned and they cost a fee. All 186 parking spaces were utilized at the time of the November 2002 survey. Based on a March 2001 SEPTA survey, there were 239 passenger boardings at this station during the hours of 5:30 am to 8:30 am.

Langhorne Station is accessible from Bellevue and Station Avenues. Langhorne Station is located between Penndel Borough and Langhorne Manor Borough, with the train tracks as the border. Bellevue Avenue is PA 513 south of US 1 Business , and PA 413 north of US 1 Business . US 1 Business is just south of Langhorne Station and is the main access route to the station. Bellevue Avenue connects with US 1 Business south of the station and with Highway US 1 north of the station. There are 361 parking spaces with 346 of them being utilized based on the November 2002 survey. All of the spaces cost a fee and are owned by SEPTA. According to the November 2002 survey, of the 361 total parking spaces, 235 are daily spaces and 126 are permit spaces. Of the 235 daily spaces, 229 are utilized, while 117 of the126 permit spaces are utilized. Based on a March 2001 SEPTA survey, there were 398 passenger boardings at this station during the hours of 5:25 am to 8:30 am. There is a climate controlled indoor waiting area where tickets can be purchased. The building is open weekdays from 5:15 am until 12:20 pm. The station is directly accessible by

SEPTA bus routes 129 and 130. Route 127 stops at Lincoln Highway (US 1) and Durham Road, which is a five minute walk from Langhorne Station.

Woodbourne Station is accessible directly from Woodbourne Road. Woodbourne Road is a minor arterial that connects with US 1 Business to the south near the Oxford Valley Mall, and with PA 332 to the north. Based on the November 2002 survey, there are 558 parking spaces with only 268 of them being utilized. All of the spaces are free and are owned by SEPTA. Of the 558 parking spaces 178 of them are on the east side of the road, which is the older parking lot, and only 49 of these spaces are utilized according to the November 2002 survey. On the opposite side of the road, which is the newer lot, there are 380 spaces and 219 are utilized according to the November 2002 survey. Based on a March 2001 SEPTA survey, there were 254 passenger boardings at this station during the hours of 5:20 am to 8:25 am. There is an outdoor shelter at the station.

The SEPTA R7 Regional Rail provides commuter rail service through the lower portion of the study area as it travels from Center City, Philadelphia to Trenton, New Jersey and vice versa. The rail line generally runs along the US 13 corridor in the study area. The Trenton station has connecting service to New York City via NJ Transit Rail and Amtrak. While there are no stations within the boundaries of the study area, there are two stations located just outside of it. Croydon station lies southwest of the study area and Bristol station lies southeast of the study area. There are a total of 29 outbound trains that serve both stations during the weekdays. Trains depart from Croydon station between 5:32 am and 12:23 am. Of the 29 outbound trains, 9 of them arrive at their final destination before noon. There are a total of 29 inbound trains that serve both stations during the weekdays. They depart from Bristol station between 5:57 am and 12:31 am. Of the 29 inbound trains, 10 of them arrive at their final destination before noon.

Croydon Station is accessible from Bristol Pike (US 13) and Cedar Avenue. Bristol Pike is a main route and the main thoroughfare through Croydon. Along Bristol Pike in Croydon there are a lot of small businesses and the station is located alongside these businesses. There are 85 parking spaces and all spaces are utilized according to the November 2002 survey. All of the spaces are owned and operated by SEPTA. Of the 85 spaces, 16 of them are free and the remaining 69 cost a daily fee. SEPTA bus route 128 stops at Bristol Pike and Newportville Road, which is a 5-minute walk from Croydon Station.

Bristol Station is accessible from Beaver Street and Garden Street in Bristol Borough. Both streets are residential streets in the borough. To the north, Beaver Street connects with Bristol Pike (US 13), which is a main route and a business highway. There are 294 parking spaces and 136 of them are utilized based on the November 2002 survey. All of the spaces are owned and operated by SEPTA and they are free. The station is directly accessible by SEPTA bus routes 129 and 304.

There is a climate controlled indoor waiting area where tickets can be purchased. The building is open weekdays from 5:45 am until 5:00 pm.

Bus Service

Bus transit service within the corridor centers around the Neshaminy Mall in Bensalem and Oxford Valley Mall in Langhorne. Most of the bus routes have the Frankford Transportation Center as their point of origin or destination. Bus services are offered more widely in the lower portion of the corridor, along the Route 1 corridor and areas south of it.

SEPTA Route 14 serves the area from the Frankford Transportation Center to the Oxford Valley Mall, via the Neshaminy Mall. The primary thoroughfare is US 1. In between Neshaminy Mall and Oxford Valley Mall, the bus stops at Richardson Avenue and Pine Street (PA 413) in Langhorne. This bus runs 24 hours a day from Frankford Transportation Center. However, from 1:00 am until 4:00 am, bus service ends at Neshaminy Mall. From 5:00 am until 6:00 pm the bus runs 5 to 15 times an hour. From 7:00 pm to 12:00 am, a bus leaves two to three times an hour. There is hourly service to Oxford Valley Mall with the first stop at the mall being 5:55 am and the last being 10:53 pm. The bus runs 24 hours a day in the opposite direction. However, from 1:00 am until 4:00 am the route begins at Neshaminy Mall. From 5:00 am until 9:00 pm, the bus runs 5 to 15 times an hour. From 10:00 pm to 12:00 am there are two to three buses per hour. The bus leaves Oxford Valley Mall only once an hour with the first departure at 6:20 am and the last departure at 11:06 pm.

SEPTA Route 127 serves the area from Neshaminy Mall to Trenton, New Jersey. It stops at several locations throughout the lower portion of the corridor. After the Neshaminy Mall stop it then stops at Lincoln Highway (US 1) and Durham Road in Penndel. This stop is a five minute walk to the Langhorne Train Station. Then it travels along US 1 to the Oxford Valley Mall and Sesame Place, then heads east to Morrisville Borough before arriving at the Trenton Railroad Station. There is hourly bus service, with the first departure at 4:50 am and the last departure at 6:30 pm from Neshaminy Mall. In the opposite direction, the first departure is at 6:25 am and the last departure is at 8:00 pm from the Trenton Railroad Station.

SEPTA Route 128 serves a number of locations throughout Bristol and Middletown Townships while traveling between the Oxford Valley Mall and Neshaminy Mall. One of the stops is Bristol Pike (US 13) and Newportville Road in Croydon, which is only a five minute walk to the Croydon Train Station. There is hourly bus service, with the first departure at 6:30 am and the last departure at 6:30 pm from Oxford Valley Mall. In the opposite direction the first departure is at 6:00 am and the last departure is at 6:00 pm from the Neshaminy Mall.

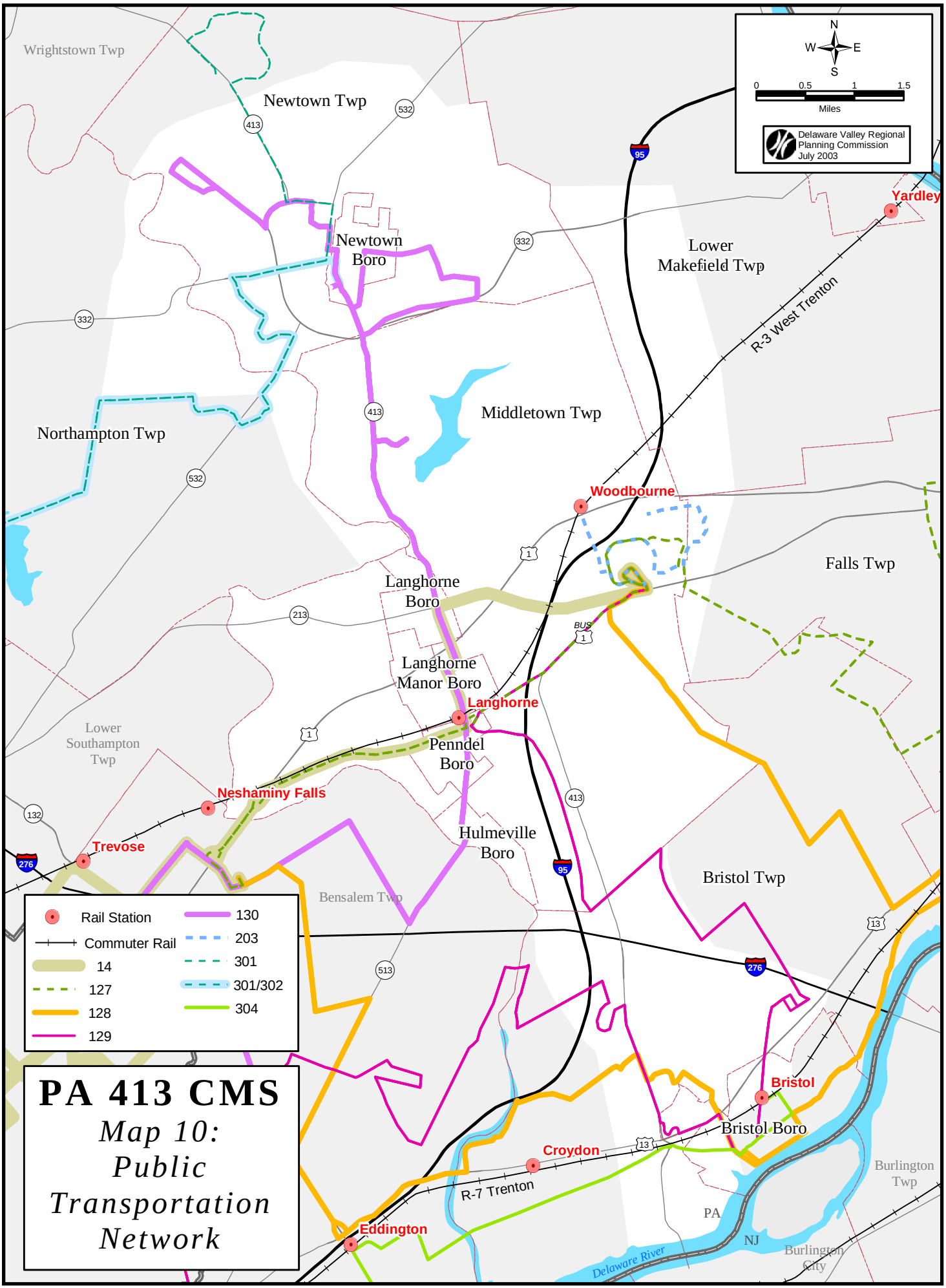
SEPTA Route 129 serves Bensalem and Bristol Townships between Oxford Valley Mall and Torresdale in Philadelphia. Stops include the Langhorne Train Station, Bristol Train Station, and

at the Keystone Industrial Park in Bristol. The bus stops directly at the Bristol Train Station and it stops at Lincoln Highway (US 1) and Durham Road, which is a 5-minute walk to the Langhorne Train Station. There is hourly bus service, with the first departure at 6:30 am and the last departure at 9:45 pm from the Oxford Valley Mall. In the opposite direction the first departure is at 6:00 am and the last departure is at 10:00 pm from Frankford Avenue and City Line Loop.

SEPTA Route 130 is the only route that serves the PA 413 study area on a north-south axis. It begins at the Franklin Mills Mall and terminates at the Bucks County Community College in Newtown. One of the stops is Neshaminy Mall and from there it heads to the Langhorne Train Station. From the Station, it proceeds up PA 413, stopping at several locations including Saint Mary's Hospital. There is hourly bus service, with the first departure at 5:50 am and the last departure at 9:35 pm from the Franklin Mills Mall. The last stop at the Bucks County Community College is at 7:08 pm. In the opposite direction the first departure is at 7:10 am and the last departure is at 7:30 pm from Bucks County Community College.

SEPTA Route 304 travels from Frankford and the City Line Loop to the Bristol Train Station along the US 13 corridor. Of the four stops before the Bristol Train Station, two are at industrial parks. There is hourly bus service, with the first departure at 6:30 am and the last departure at 5:30 pm from Frankford Avenue and City Line Loop. In the opposite direction the first departure is at 6:55 am and the last departure is at 5:55 pm from Bristol Train Station.

The Public Transportation Network for the PA 413 Study Area is identified in **Map 10**.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Delaware Valley Regional Planning Commission
July 2003
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Newtown Twp
Newtown Boro
Lower Makefield Twp
Yardley
R-3 West Trenton
Middletown Twp
Northampton Twp
Woodbourne
Falls Twp
Langhorne Boro
Langhorne Manor Boro
Langhorne
Penndel Boro
Lower Southampton Twp
Neshaminy Falls
Trevose
Hulmeville Boro
Bensalem Twp
Bristol Twp
Bristol
Bristol Boro
Croydon
R-7 Trenton
Eddington
PA
NJ
Delaware River
Burlington Twp
Burlington City
Rail Station
Commuter Rail
14
127
128
129
130
203
301
301/302
304
PA 413 CMS
Map 10:
Public Transportation Network

CMS Benefits of Transit Service Improvements

New or improved transit service is only a valid CMS strategy so far as it attracts travelers, particularly commuters, who would otherwise drive. To manage traffic congestion by transit service improvements or transit use incentives, it is necessary to identify elements that may convert travelers who choose to drive to become transit passengers. An analysis of such factors is as follows:

- Travel Time - Although there are express trains during the AM and PM peaks to and from Philadelphia, travel time on the regional rail lines are significantly slower than travel by auto. Because suburban employment centers are dispersed, bus transit is the only viable transit option. Slow bus traffic, due to congestion and frequent stops, negatively affects travel times. The delays in transit travel time is further exacerbated by the time spent accessing and waiting for transit, and making connections before reaching the final destination.

- Cost - For commuters that currently drive, it is reasonable to assume that they have already taken steps, intentionally or by economic necessity, to minimize their costs associated with driving. Employer paid transit vouchers are the most direct incentive to encourage transit use, particularly if the employer does not offer parking compensation or other payment options. Parking restrictions and price increases at driver destinations may also swing the financial advantage to transit.

- Frequency of Service - The fact that a car is available whenever the driver wants it is a transit-use deterrent for many commuters. Transit, on the other hand, forces passengers to conform their schedule to transit service times. Frequency is constrained by the demand for service and the resources of the transit operator, but can often be improved within these constraints by measures such as smaller, more frequent buses or trains to a point where infrequent service is not a reason to avoid transit. If service is every 40-minutes, the employee who has to work 10-minutes later than planned is unlikely to view transit as a satisfactory alternative to driving. If the headway is every 15-minutes, it is unlikely that frequency would deter anyone not wholly opposed to taking transit.

- Comfort and Convenience - These subjective lifestyle issues play a significant role in transportation mode choice and should be integral to all services. Recognizing the lack of potential to capture new transit riders by travel time improvement or cost, and, usually the lack of demand or funding to increase frequency, comfort and convenience become pivotal factors for improvement.

Transit must become competitive in terms of travel time, convenience, and lifestyle, if it is to be a viable option for those currently commuting by automobile. Several deficiencies exist which, if addressed, could increase the transit share in the region and therefore have a positive impact in mitigating congestion.

Recommended Improvements

A. Immediate

- Trailblazer Signs - Erect "trailblazer" signs at strategic locations to increase the visibility of transit as a travel mode. An area where these signs are most needed is the area along US 13 in Bristol where they could be used to indicate the direction to or the most convenient point of access for SEPTA's Bristol R-7 rail station. It is recommended that the trailblazer assembly be designed to include the appropriate SEPTA train symbol and a single-headed, directional arrow pointed along the route leading to the facility.

- Improve Station Access - Improve approaches to station area by providing adequate lighting, as well as safe and unimpeded accessways for pedestrian traffic. This need is especially critical at stations where parking utilization is at capacity.
  - The Langhorne Station's primary access is from PA 413 in Langhorne Manor. Pedestrian access to the station is inadequate due to an absence of sidewalks on the southern side of PA 413. Adequate sidewalks, along with a bus loading bay should be constructed adjacent to the station.
  - The Neshaminy Falls Station, located to the south-west of the study area, is in need of adequate sidewalks, crosswalks, pedestrian actuation where appropriate, and other pedestrian improvements to provide safe pedestrian access.

- Station Environment - Improve waiting areas at transit stations by providing adequate shelter such as canopies, benches, and comfort facilities designed for customer comfort. Since the value of transit as a congestion reduction measure is to serve commuters who could otherwise drive, such measures must compete with comfort and convenience of a private vehicle. Most stations along the R-3 and R-7 lines within the study area line have been renovated over the past few years and are in need of only minor improvement. The main exception is the Langhorne Station where the station building is unattractive and should be renovated. In addition, the general landscaping of the station area and adjacent parking area should be improved. Because this station is situated in close proximity to the commercial center of Penndel Borough, this station should be considered for accommodating retail activities which could be patronized by commuters. By realizing the commercial potential

of this area, secondary trips by commuters for non-work purposes would be minimized, resulting in a reduction in vehicle miles traveled.

- Bus Stop Shelters - Erect shelters at existing bus stops, where appropriate, along the major bus corridors such as PA 413 and US1 (Business). These shelters should be made accessible by having paved walkways on their approach and having appropriate seating and glass windscreens to enhance customer comfort. A current bus schedule should be posted at each bus stop for each route as well as transfer points for intersecting buses and trains. This will increase the attractiveness of transit and could result in a corresponding decrease in auto travel.

- Location of Bus Stops - For several stops, parking bays or bus pull-outs, that remove buses from the traffic stream while loading and unloading, should be constructed. This will encourage bus use by making the service more attractive and safe and reduce delay for other vehicles on the roadway. Along the US 1 arterial and the PA 413 arterial there are preferred areas where the parking bays should be constructed. Along the US 1 arterial four parking bays should be constructed in the Penndel area. Traveling north the first bay should be at Neshaminy Street on the northbound side, at Glen Street on the northbound side, at Hulmeville Avenue on the northbound side, and lastly at Noland Avenue on the northbound side. Along the PA 413 arterial, four parking bays should be constructed in the Langhorne area. Traveling north, the first bay should be at the parking lot for the Langhorne Train Station on the southbound side (the side adjacent to the station and its parking lot), at the Woods School entrance on the northbound and southbound sides, at Richardson Avenue on the southbound side followed by a parking bay on the northbound side one block up PA 413 at PA 213, and lastly at Old Mill Drive on the northbound and southbound sides.

- Bicycle Parking - Covered bike racks that are functional and secure should be provided at all railroad stations. In addition, amenities such as rental lockers and repair shops for bicycles should be located at targeted rail stations.

B. Long Term

- Parking - Provide adequate parking at transit stations to accommodate current demand and projected future growth in transit ridership.

  SEPTA operates and maintains park-and-ride lots at the Woodbourne (R-3), Langhorne (R-3) and Bristol (R-7) rail stations within the study area. To the southwest of the study area, the Neshaminy Falls station also has a SEPTA operated park and ride lot for R-3 rail users. In most locations, there are no alternatives to park near the station other than in the SEPTA lot.

The 100 percent utilization at the Neshaminy Falls station and 96 percent utilization at the Langhorne station makes commuting by train unavailable, or at best an unreliable choice for an unknown number of commuters who comprise a latent demand. Additional parking areas should be explored to accommodate future growth.

- Increased Travel Speeds - Travel time by express train from Langhorne Station to Center City is approximately 40 minutes. By local train it is approximately 47 minutes. The feasibility of increasing the number and speed of express trains that serve the heavy loading stations, particularly the Langhorne station, during the peak period should be explored. By minimizing the number of stops, travel times can be minimized which will make transit more competitive with auto travel.

- Circulator Bus Service - Study the feasibility of circulator bus service for all types of development in the study area. A special effort should be made to connect residential areas to commercial development within the corridor. Of particular need is service from large residential development such as Levittown to large employment sites such as the Oxford Valley and Neshaminy Malls and major educational institutions such as Bucks County Community College and Philadelphia College of the Bible. Shuttle service to commuter rail stations should also be explored.

Table 5 provides a summary of the transit strategies and station enhancements that should be employed at or close to regional rail stations within the corridor that will facilitate increased rail ridership.

TABLE 5

Summary of Transit Improvement Strategies

Regional Rail Station	Trailblazer Signs on Approach Roads	Station Facade Rehab.	Improve Pedestrian Access	Improve Station Amenities	Bike Racks	Additional Parking*
Woodbourne	X		X	X	X	
Langhorne	X	X	X	X	X	X
Bristol	X			X	X	
Neshaminy Falls	X		X	X	X	X

* Parking lots at these stations may have a few empty general spaces, or unused permit spaces or handicap spaces. However, full utilization of outlying spaces and the presence of illegally parked vehicles indicate that commuters can not rely on finding a space; the lots are effectively beyond capacity.

VIII. 2025 JOURNEY-TO-WORK TRAVEL PATTERNS

The DVRPC travel demand forecasting model of the nine-county Delaware Valley region was run to determine future trip patterns and volumes. The region was divided into 50 traffic analysis zones (TAZ's). All or part of Zones 1 through 10 falls in the study area. Highway person trips and transit person trips were run separately in the forecast model. Most trips were internal trips (trips starting and ending in the same Zone). Trip patterns indicate a trend of trips from many origins to many destinations. To better analyze these trends, 11 Superzones (a combination of several traffic analysis zones outside of the study area) were created. Travel to and from these Superzones to the study area was evaluated, as was travel between the Zones within the study area.

As can be seen in the following series of maps, there are many points of origins and destination for trips originating inside and outside the study area from each of the Zones. Below is a detailed description of the trends and the most logical corridors for these trips based on the existing highway network.

Zone 5

Zone 5 is wholly contained within the boundaries of Middletown Township. It is primarily served by two highways, PA 413 and US 1. These provide connections to the major transportation arteries in the region and as such, functions as conduits for regional as well as local traffic. As can be seen from **Appendix A** and **Maps 11** and **12**, the year 2025 forecast show a total of 164,174 highway person trips terminating in this Zone and 122,724 highway person trips originating in this Zone. These figures include a total of 47,016 internal trips. While the north-eastern half of this Zone is primarily residential (Levittown), the south-western end has a substantial amount of retail commercial activity.

Within the study area, Zone 9 (Northern Bristol) receives the most trips from Zone 5 (12,673) while Zone 9 also sends the most trips to Zone 5, (14,323). Outside the study area, Superzone A (Falls Township) to the northeast, generates 28,365 or 17.3% of the highway trips ending in Zone 5.

Zone 5 is not only well served by PA 413 and US 1, it also provides a direct connection to I-95. Drivers also use PA 413 as an access route to the Pennsylvania Turnpike.

Zone 6

Zone 6 is the part of Middletown Township that is generally to the north of US 1. Major trip generators include St. Mary Medical Center, Philadelphia College of the Bible, Neshaminy Junior High and Woods School. PA 413 forms the spine of this Zone and is the major connector between PA 322 and PA 213. This route is used to access both US 1 as well as I-95. **Appendix A** and **Maps 13** and **14** shows a 2025 forecast of 143,731 highway person trips terminating in the Zone and 126,700 trips originating in the Zone. A total of 47,587 of these trips are internal trips.

Within the study area, Zone 5 (Middletown East) receives the most trips from Zone 6 (12,235), while Zone 8 (Newtown) receives the second most with 8,513 trips. Outside the study area, the primary destination from Zone 6 is Superzone A (Falls) with 10,100 trips. While Superzone B (Lower Makefield) (9,340) and Superzone D (the Bensalem-Warminster area) (8,453) also receive a significant number of trips.

Zone 8 (Newtown) sends the largest number of trips to Zone 6 with 14,938 trips. Superzone A (Falls) and Superzone B (Lower Makefield) are the largest senders of trips from outside the study area with 14,313 and 13,061 trips respectively.

Zone 8

Zone 8 encompasses Newtown Township and Newtown Borough which are in the northwestern limits of the study area. The primary artery in this Zone is the Newtown By-Pass which collects and disperses traffic to and from several arterials and acts as a major access route to I-95. Apart from the more urban center of Newtown Borough, the area is typically suburban in nature with low intensity residential development and office parks.

Appendix A and **Maps 15** and **16** show a 2025 forecast of 112,501 highway person trips terminating in the Zone and 143,670 trips originating in the Zone. A total of 59,512 of these trips are internal trips. Within the study area, Zone 6 (Middletown North) is the primary destination for trips originating in Zone 8. 14,938 trips went to Middletown North while the next largest receiver Zone was Superzone D (Bensalem-Warminster) with 10,668 trips. Also of note is Superzone L (Mercer) which ranked third with 10,400 trips.

Of trips terminating in Zone 8, 12,591 are from Superzone C (Central Bucks) followed by 11,144 and 8,513 from Zone 7 (Northampton) and Zone 6 (Middletown North) respectively.

Transit Trips

The DVRPC travel demand forecasting model was used to forecast transit person trips in the study area to the year 2025. In total, 7,988 transit person trips originated within the boundaries of the study area. 88.91% of these trips ultimately terminated outside of the study area. This compares with 704,645 highway person trips that originated in the study area, of which 39.59% ultimately terminated outside of the study area. These lesser volumes for transit than those for highway person trips reflect a greater reliance on the automobile in the region than transit. The high percentage of transit trips that terminated outside of the study area compared to the moderate percentage of highway person trips indicates that transit is more heavily used for long distance trips.

On close examination as detailed in **Appendix B**, Zones 5 (Middletown East), 6 (Middletown North), 8 (Newtown), 9 (Bristol North), and 10 (Bristol South) are the Zones with the highest transit use. These Zones covers the entire east-west length of the corridor. This is also the route of some of the primary bus routes in the corridor. These Zones are also bisected by two of SEPTA's commuter rail lines, the R-3 and R-7 lines.

Zone 5 trips primary destinations are Philadelphia (61.4%) and Montgomery County (6%). Secondary destinations include Bensalem-Warminster (5.5%), Falls Township (4.9%), and Mercer County, NJ (4.2%).

Zone 6 trips primary destinations are Philadelphia (53.1%), Mercer County (14%) and Montgomery County (11.8%). The secondary destination is the Bensalem-Warminster area (4%). The transit trips to Philadelphia from this Zone is primarily along the R-3 regional rail line with the Langhorne Station being the likely boarding station.

Zone 8 has the largest percentage of trips destined to Philadelphia (72.2%), with Mercer County (8.3%) and Montgomery County (6.6%) being secondary destinations.

Zone 9 originates the largest amount of transit person trips within the study area (1,485 trips). While the primary destination from this Zone is Philadelphia (63.3%). Other important destinations include: Mercer County (9.2%), Bristol South (5.4%), Falls (3.9 %), Bensalem-Warminster (3.6%), and Middletown East (3.6%).

Zone 10 principal trip destination is Philadelphia (59.3%). Secondary destinations include Mercer County (11.1%), Bristol South (8.9%), and Bristol North (5.2%). A logical assumption can be made that the Mercer County destination is the Trenton area, which is most accessible to this area by bus and rail transit.

IX. AREA-WIDE CMS STRATEGIES

In addition to transit service, there are a number of programs that support the reduction of single occupancy vehicle trips that could be effective to reduce congestion in the PA 413 study area. These include:

- TransitChek is a public transportation commuter benefit program that is tax-free to employees and tax-deductible to employers. TransitChek enables employers of any size to help reduce the cost of employees' commutes on public transit or vanpools with a voucher. Federal tax laws allow employers to offer up to $100 / month or $1,200 / year per employee, either as a company paid benefit or a pre-tax payroll deduction. TransitChek is accepted by major transit systems such as SEPTA, PATCO, NJ Transit, DART-First State, and third-party vanpool companies.

- Mobility Alternatives Program (MAP) is a PennDOT-funded, DVRPC- managed program, which provides employers in Southeastern Pennsylvania with alternatives to driving to work alone. Administered through a network of seven subcontractors (five Transportation Management Associations (TMA's), The City of Philadelphia Mayor's Office of Transportation, and SEPTA), MAP is an outreach and education program that provides information on a variety of options available to commuters, including transit, car or van pools, and flexible work hours. Share-A-Ride, a component of the MAP program, is a computerized match service that provides commuters with the most convenient transit options. The service also offers a listing of other commuters who live and work nearby. (Bucks County TMA is one of the seven MAP subcontractors.)

- Transportation Management Association - The Bucks County TMA should be supported in its efforts to promote non-traditional transportation, such as carpools, vanpools, demand responsive paratransit, subscription buses, telecommuting, and compressed work week. Since the role of these programs is, in part, to support transit, recommendations depend on specific transit services and programs that are studied or implemented. An integral part of any ridesharing program is the Guaranteed Ride Home program. This program, which is usually operated by a TMA, acts as a safety net for employees who use transit, carpool, or vanpool. It provides an emergency ride home, usually by taxi, for employees ridesharing who have an emergency during the day or are required to work late.

- Ridesharing
  Carpool -This is a method used to reduce Single Occupancy Vehicle (SOV) trips. Individuals with similar commuting patterns travel to work in the same vehicle rather than each person in a separate vehicle. Commuting can be more relaxing as individuals are not

responsible for driving vehicles. Other benefits to individuals include reduced vehicle miles traveled and thus reduced wear and tear on automobiles. This can lead to lower insurance rates for some policies, less depreciation, and lower maintenance costs for the individual. Various incentives can be provided by both the public and private sector. Through the Share-A -Ride program, the TMA helps match individuals with similar commuting patterns. Private employers can also help facilitate the process by disseminating a list of where employees live. Generally, carpools are recommended when the one-way commute is at least 10 miles.

Vanpool -Vanpools are similar to carpools except that a van is used and it can often be sponsored by an employer. Again, individuals with similar commuting patterns all ride in one van instead of many SOVs. If there are a large number of employees (typically six or more) of a single company who live in close proximity to each other, a corporate-sponsored vanpool is good option to reduce SOV trips. More frequently however, vanpools are formed by groups of employees that contract with a service provider that provides the vehicle and related maintenance. Generally, vanpools are most cost effective when the one-way commute distance is at least 20 miles.

- Telecommuting is a useful technique in reducing journey to work trips. When it is not necessary that an employee performs tasks at a specific location, they can work at another location other than their usual office, thus eliminating or shortening the journey to work trip. This is known as telecommuting or teleworking. Employees can telecommute from home, a satellite work center, or a neighborhood work center. A satellite work center is for employees of one company. A neighborhood work center is for employees of multiple companies and is ideally located within walking or biking distance of a large number of residents. Individuals can telecommute full-time or part-time, or sometimes, just for a few hours.

- Compressed Work Week - Roads become congested at peak periods due to the fact that a majority of work trips are performed at the same times in the morning and evening. One way to combat this problem is through a compressed work week. Many employers are allowing employees to work the expected 40-hour week in a four day period. Adjusting schedules so that trips are made before or after the peak periods is another method of reducing congestion. Additionally, a compressed work schedule reduces the number of weekly trips overall. A compressed work week differs from flextime in that the start and end times of the work day are still set by the employer.

- Flexible Work Hours has the effect of spreading the demand for travel over a wider band of time through alternative work hours. Staggered work hours is one such technique where

different groups of employees are assigned different start times. Flex time is a technique where individual employees can choose a flexible start time within a prescribed window, usually between 7:00 am and 9:30 am. This works well for office workers who work independently.

- Subscription Bus can be a useful link between a main transit line and a residential area or a corporate campus. Subscription buses, often known as shuttle buses, are usually small buses that help reduce short car trips. This can help mitigate congestion by reducing the number of SOVs on the roads. There are several opportunities for subscription bus within the study area. The Bucks County TMA will be conducting two separate feasibility studies to determine the potential for municipal shuttle bus service in Newton Township, Newton Borough and Bristol Township. The studies will determine the need as well as operating routes and times.

- Parking Cash Out is an option given to employees to choose cash in lieu of non-taxable parking subsidies. Since employers can provide tax-free parking of up to $170 per month, employees have an incentive to drive. However, if employers provide cash instead of parking, employees can see a direct benefit and are more inclined to find an alternative to driving alone.

- Park and Ride facilities can provide a number of benefits in terms of air quality and improving commuting. They serve as points where individuals can transfer to high occupancy vehicles, reducing the number of single occupancy vehicles on the road. This, in turn, reduces emissions and congestion. Commuting time can be reduced, especially with express transit services from Park and Ride lots. Park and Ride lots are generally free or charge a nominal fee to attract potential users. Park and Ride locations at the three rail stations within the study area act as collection points for travelers near the origin point of their trip. Woodbourne Station has a total of 558 SEPTA provided parking spaces, Langhorne Station has 361parking spaces, while Bristol Station has 294 parking spaces.

- Pedestrian and Bicycle trips can be an effective method of reducing vehicle trips, especially for short-distance trips. Most bike trips are less than five miles and most pedestrian trips are less than one-half mile. In order to make bicycling and walking a viable alternative to driving, there must be safe facilities, including sidewalks and bike lanes. Employers should provide bicycle racks where employees can store their bikes securely. Safe crossing areas at intersections, including marked crosswalks, are necessary to encourage pedestrian traffic.

X. IMPACT OF HEAVY VEHICLES IN WRIGHTSTOWN TOWNSHIP

To the north of the study area in Wrightstown Township, there are four quarries where stone aggregate is mined and transported out by trucks daily. There are local concerns of truck traffic from these quarries being diverted onto local residential roads in Newtown Township due to weight restrictions over culverts on Swamp Road. The four quarries are in the Rushland-area of Wrightstown, located just off of Swamp Road. A two mile stretch of Swamp Road has been restricted for use by heavy trucks due to a 15-ton weight limitation of two culverts on the road. This two mile stretch of Swamp Road is between the quarries and the Newtown By-Pass, which is a four-lane, limited access divided highway. The Newtown By-Pass leads to an I-95 interchange, which is often the destination of loaded quarry trucks. On their way to the quarries, most of the empty quarry trucks come via I-95. The unloaded trucks use Swamp Road and thus the Newtown By-Pass, since they do not exceed the weight limitation.

However, loaded quarry trucks are forced to turn off Swamp Road. The trucks are diverted onto a 9.7-mile alternative route that ends at the Newtown By-Pass, just ¼ of a mile from I-95. According to Residents for Regional Traffic Solutions, Inc., the residential route encompasses Worthington Mill Road, Stoopville Road, and Lindenhurst Road with 155 access points (driveways), compared to 16 access points on the two mile restricted portion of Swamp Road. Residents of the area strongly prefer that the necessary improvements be made along Swamp Road to prevent trucks from driving this route.

Currently, in the present *FY 2003 TIP for Pennsylvania* there are two projects that will affect the area. TIP # B13 is Phase I of a two-phase project to provide improvements to the entire Swamp Road corridor and calls for replacing the culvert south of Worthington Mill Road in Wrightstown Township. TIP # B11 calls for improvement to the entire Swamp Road corridor from Route 413 to Rushland Road in Newtown and Wrightstown Townships. The improvements would include minor roadway widening, horizontal and vertical curve realignment, shoulder rehabilitation, and associated drainage improvements.

A preferable solution to the problem would be to have the necessary improvements made to Swamp Road, as outlined in the TIP, which would make it accessible to the loaded quarry trucks. This solution would suit the truck drivers and the residents. For the truck drivers the Swamp Road route is more direct and faster since the Newtown By-Pass was built to handle heavy commercial traffic. The residents would benefit by not having the quarry trucks use the residential alternative route because the roads would be safer for drivers and residents.

XI. PLAN IMPLEMENTATION

The *Pennsylvania Congestion Management System - PA 413 Corridor* can be used as a dynamic long range tool for the systematic selection of projects to create a significantly improved transportation system within the study area. This document can serve as a *punch list* for the government agencies with a stake in the implementation of improvements. Municipal governments are key players in this process. Even though a highways may be maintained by the county or state, it is the welfare of the local residents which are most affected. Safety and mobility benefits are realized more by those who use the highway frequently. Therefore, the local municipality should ensure that the improvements are advanced expediently by being involved in the process regardless of which agency has the lead role.

Characteristics

In choosing which projects should advance first, stakeholders can be guided by the information presented in **Table 6** and **Table 7** (page 114 and 115). This matrix suggests the relative importance to stakeholders of the various attributes of each problem location. Each improvement scenario identified is evaluated in terms of project priority, cost range, and project benefits. The stakeholders necessary to implement the plan are also identified.

Priority

Priorities are estimated in terms of three categories: high, moderate, and low. Priorities are assigned based on the perception of the extent of the problems for drivers. Safety is the most important, with congestion (or time delay) and mobility also being considered. A higher degree of priority is also assigned if there is an urgency to complete the improvement due to the imminent completion of a nearby investment (development or transportation improvement). If there is concern that a section of right-of-way needed to complete an improvement is in danger of being developed or used for another use, the priority to act on that improvement is also heightened. If a project is relatively small scale and low cost, yet offers a high benefit, it receives a higher priority ranking.

Cost Range

Costs are also assigned to categories of high, moderate, and low. High cost projects usually involve a major commitment from one or more funding source, lengthy public involvement, and several years lead time in programming. They are typically large scale, complex, or multi-phased improvements that can entail the construction of new facilities. In general, a project in this category is estimated to cost between $5 and $35 million, however some major projects have been known to cost in the hundreds of millions of dollars. An improvement estimated to have a moderate cost could involve a major reconstruction of an intersection, construction of a short connector road, or a widening of an existing road. In general, a project in this category is estimated to cost between $2 and $5 million. Low cost projects can often be fast-tracked with maintenance or pool funding. They

are often operational-type improvements at isolated locations and typically cost less than $2 million. These cost ranges are generalized estimates and could be significantly changed for a specific location due to environmental, right-of-way, or other factors uncovered during project design.

Benefits

Benefits describe the kind of impact the improvement will yield, such as enhancing safety, lessening congestion, improving mobility, or encouraging economic development. Economic development benefits are derived from a transportation improvement generally through an increase in the accessibility of individual properties or areas. The location and magnitude of the improvement determines the extent of the benefits received by the affected properties. The increased level of access to a property may make it attractive enough to induce new commercial or residential development or entice existing land uses to expand. Increased accessibility can also have a positive effect on property values.

Roles of Agencies

In terms of a hierarchy of agencies, the Pennsylvania Department of Transportation (PennDOT) is primary, both in terms of maintaining PA 413 as well as providing much of the design, right-of-way, and construction funding for major improvements. Municipalities make land use decisions in the corridor, which ultimately affect traffic levels on PA 413. In addition, many of the cross streets are designed, built, and maintained by local government, also affecting how well PA 413 functions. Lastly, developers build the housing, commercial, and industrial projects which generate trips that must be accommodated by a publicly-owned transportation infrastructure. In some instances, the transportation improvements themselves are designed and financed by developers.

Pennsylvania Department of Transportation

PennDOT has jurisdiction over the state highways in the corridor. These include I-95, US 1 and US 13. Improvements to these highways are typically financed by state and/or federal funds. Occasionally, developer contributions are also a source of funding if the project has special impact by a development. The State ultimately makes the decision on what improvements are done to their facilities, but often coordinates with the county or local municipalities when the improvements include facilities under their jurisdiction.

Bucks County

The County's role is to prioritize improvement projects and secure federal and state funds via the TIP. It also provides oversight in coordinating area-wide improvements.

Metropolitan Planning Organization (MPO)

DVRPC, serving as the MPO for this region, is required to coordinate a comprehensive and continuing transportation planning process. This process results in the development of a Transportation Improvement Program (TIP) which identifies all priority projects for which federal funds will be sought. The TIP represents a consensus among state and regional officials as to what regional improvements are to be made. In addition to the TIP, the MPO is required by federal legislation to develop a long range plan (LRP) to help direct region-wide transportation decision making for the next 20 years. Long range plans do not specify the design of actual projects. Rather, they identify future needs to address transportation deficiencies.

Municipalities

Local governments not only have jurisdiction over their local road system, they also control local land use decisions. The decisions made at the local level can effect the traffic on roads. Therefore, local officials must understand the traffic impacts which are generated from a particular development, and understand the synergy that exists between land use decisions and transportation improvements. Local officials need to be involved in the transportation planning process for all levels of transportation improvements to ensure that the concerns of their residents are addressed. The Master Plan is an important tool for municipalities to use in addressing their circulation needs. Municipal officials need to make use of the circulation element of their Master Plan to identify important missing links in their highway network and begin to preserve space for these links to be built.

Developers

As properties are developed or redeveloped, transportation needs can change, sometimes drastically. Providing proper transportation access to a new development is often critical to the success of that development. Therefore, developers must work with the transportation providers to assure that the necessary changes are beneficial to both the development and the existing transportation infrastructure. Developers frequently design and construct improvements for traffic attributable to their developments or to provide enhanced access to their site.

TABLE 6

Transportation Improvement Implementation Matrix - Arterial Sections

	Location	*Priority*	*Cost Range*	*Benefits*	*Lead Role*	*Assisting Role*
1	PA 213: Wheeler Drive to PA 413	M	M	Mobility, Congestion	DOT	MCD, Co
2	Woodbourne Rd: US 1 Business to Oxford Valley Rd	H	H	Mobility	MCD	Co
3	Woodbourne Rd: Woodlane Rd to US 1 Business	L	L	Mobility, Congestion	MCD	Co
4	PA 413: Western Ave to State Rd	M	L	Safety, Congestion	DOT	MCD, Co
5	PA 213 Golf Club Dr to PA 413	L	L	Safety, Congestion	DOT	MCD, Co
6	PA 413: Bridgetown Pike to PA 213	H	M	Mobility, Safety, Congestion	DOT	MCD, Co
7	Woodbourne Rd: Oxford Valley Rd to New Falls Rd	L	M	Safety	MCD	Co
8	US 1 Business: Durham Rd to Hulmeville Rd	H	H	Mobility, Safety, Congestion	DOT	MCD, Co
9	PA 413: Bridgetown Pike to the Newtown By-Pass	L	M	Mobility, Congestion	DOT	MCD, Co
10	PA 413: US 1 Business to PA 213	H	M	Mobility, Safety, Congestion	DOT	MCD, Co

Key:

Priority: H = High, M = Moderate, L = Low
Cost Range: H = High, M = Moderate, L = Low
Role: MCD = municipality
Co = county
DOT = Pennsylvania Department of Transportation

TABLE 7

Transportation Improvement Implementation Matrix - Intersections

Location		*Priority*	*Cost Range*	*Benefits*	*Lead Role*	*Assisting Role*
1	PA 413 at Winchester Ave	H	H	Safety, Congestion	DOT	MCD, Co
2	Durham Rd at Trenton Rd	L	L	Congestion	MCD	Co
3	Woodbourne Rd at New Falls Rd	M	M	Mobility, Safety, Congestion	MCD	Co
4	Woodbourne Rd at PA 213	H	H	Mobility, Safety, Congestion	DOT	MCD, Co
5	PA 213 at PA 413	H	L	Safety	DOT	MCD, Co
6	PA 413 at PA 532	M	H	Mobility, Congestion	DOT	MCD, Co
7	PA 413 at St. Mary Blvd	L	L	Congestion	DOT	MCD, Co
8	Oxford Valley Rd at US 1 Business	H	L	Mobility, Safety, Congestion	DOT	MCD, Co
9	Woodbourne Rd at Trenton Ave	M	H	Mobility	MCD	Co
10	PA 413 at the Newtown By-Pass	M	L	Mobility, Congestion	DOT	MCD, Co

Key:

Priority: H = High, M = Moderate, L = Low
Cost Range: H = High, M = Moderate, L = Low
Role: MCD = municipality
Co = county
DOT = Pennsylvania Department of Transportation

Appendix A

Table 1: Zone 1 Total Highway Person Trips

	Destination Zone	Trips Originating in Zone 1	Percent	Origin Zone	Trips Terminating in Zone 1	Percent
Langhorne Boro	1	1,053	12.0	1	1,053	10.3
Langhorne Manor	2	487	5.5	2	236	2.3
Penndel	3	208	2.4	3	164	1.6
Hulmeville/Middletown West	4	434	4.9	4	591	5.8
Middletown East	5	998	11.4	5	700	6.8
Middletown North	6	1,450	16.5	6	1,395	13.6
Northampton	7	76	0.9	7	513	5.0
Newtown	8	293	3.3	8	884	8.6
Bristol North	9	304	3.5	9	275	2.7
Bristol South	10	93	1.1	10	82	0.8
Falls	A*	475	5.4	A*	635	6.2
Lower Makefield	B*	205	2.3	B*	618	6.0
Central Bucks	C*	126	1.4	C*	438	4.3
Bensalem-Warminster	D*	1,297	14.8	D*	1,259	12.3
Upper Bucks	E*	21	0.2	E*	84	0.8
Montgomery	F*	201	2.3	F*	246	2.4
Northeast Philadelphia	G*	276	3.1	G*	318	3.1
Rest of Philadelphia	H*	272	3.1	H*	220	2.1
Delaware/Chester	I*	59	0.7	I*	46	0.4
Gloucester/Camden	J*	50	0.6	J*	48	0.5
Burlington	K*	110	1.3	K*	222	2.2
Mercer	L*	298	3.4	L*	241	2.3
	TOTAL	8,786	100	TOTAL	10,268	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 2: Zone 2 Total Highway Person Trips

	Destination Zone	Trips Originating in Zone 2	Percent	Origin Zone	Trips Terminating in Zone 2	Percent
Langhorne Boro	1	236	3.4	1	487	2.9
Langhorne Manor	2	1,090	15.7	2	1,090	6.6
Penndel	3	264	3.8	3	439	2.7
Hulmeville/Middletown West	4	263	3.8	4	785	4.7
Middletown East	5	1,051	15.2	5	1,792	10.8
Middletown North	6	984	14.2	6	1,832	11.1
Northampton	7	43	0.6	7	563	3.4
Newtown	8	165	2.4	8	1,121	6.8
Bristol North	9	323	4.7	9	674	4.1
Bristol South	10	85	1.2	10	193	1.2
Falls	A*	367	5.3	A*	1,118	6.8
Lower Makefield	B*	159	2.3	B*	1,010	6.1
Central Bucks	C*	74	1.1	C*	590	3.6
Bensalem-Warminster	D*	974	14.1	D*	2,233	13.5
Upper Bucks	E*	14	0.2	E*	122	0.7
Montgomery	F*	126	1.8	F*	422	2.5
Northeast Philadelphia	G*	186	2.7	G*	626	3.8
Rest of Philadelphia	H*	180	2.6	H*	396	2.4
Delaware/Chester	I*	37	0.5	I*	77	0.5
Gloucester/Camden	J*	33	0.5	J*	83	0.5
Burlington	K*	87	1.3	K*	463	2.8
Mercer	L*	185	2.7	L*	443	2.7
	TOTAL	6,926	100	TOTAL	16,559	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 3: Zone 3 Total Highway Person Trips

	Destination Zone	Trips Originating in Zone 3	Percent	Origin Zone	Trips Terminating in Zone 3	Percent
Langhorne Boro	1	164	1.8	1	208	1.8
Langhorne Manor	2	439	4.9	2	264	2.3
Penndel	3	791	8.9	3	791	7.0
Hulmeville/Middletown West	4	320	3.6	4	562	5.0
Middletown East	5	1,710	19.2	5	1,609	14.2
Middletown North	6	871	9.8	6	859	7.6
Northampton	7	32	0.4	7	263	2.3
Newtown	8	136	1.5	8	555	4.9
Bristol North	9	555	6.2	9	634	5.6
Bristol South	10	150	1.7	10	174	1.5
Falls	A*	476	5.4	A*	808	7.2
Lower Makefield	B*	177	2.0	B*	575	5.1
Central Bucks	C*	76	0.9	C*	314	2.8
Bensalem-Warminster	D*	1,634	18.4	D*	1,866	16.5
Upper Bucks	E*	17	0.2	E*	61	0.5
Montgomery	F*	206	2.3	F*	284	2.5
Northeast Philadelphia	G*	305	3.4	G*	494	4.4
Rest of Philadelphia	H*	320	3.6	H*	265	2.3
Delaware/Chester	I*	57	0.6	I*	59	0.5
Gloucester/Camden	J*	50	0.6	J*	70	0.6
Burlington	K*	134	1.5	K*	317	2.8
Mercer	L*	267	3.0	L*	264	2.3
	TOTAL	8,887	100	TOTAL	11,296	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 4: Zone 4 Total Highway Person Trips

	Destination Zone	Trips Originating in Zone 4	Percent	Origin Zone	Trips Terminating in Zone 4	Percent
Langhorne Boro	1	591	1.5	1	434	1.2
Langhorne Manor	2	785	2.0	2	263	0.8
Penndel	3	562	1.5	3	320	0.9
Hulmeville/Middletown West	4	11,903	31.1	4	11,903	34.0
Middletown East	5	2,836	7.4	5	1,695	4.8
Middletown North	6	2,199	5.7	6	1,701	4.9
Northampton	7	327	0.9	7	1,713	4.9
Newtown	8	492	1.3	8	1,219	3.5
Bristol North	9	1,227	3.2	9	855	2.4
Bristol South	10	354	0.9	10	251	0.7
Falls	A*	1,129	2.9	A*	1,219	3.5
Lower Makefield	B*	438	1.1	B*	1,003	2.9
Central Bucks	C*	467	1.2	C*	1,211	3.5
Bensalem-Warminster	D*	8,739	22.8	D*	6,377	18.2
Upper Bucks	E*	80	0.2	E*	237	0.7
Montgomery	F*	1,133	3.0	F*	1,057	3.0
Northeast Philadelphia	G*	1,531	4.0	G*	1,191	3.4
Rest of Philadelphia	H*	1,608	4.2	H*	734	2.1
Delaware/Chester	I*	274	0.7	I*	177	0.5
Gloucester/Camden	J*	234	0.6	J*	153	0.4
Burlington	K*	428	1.1	K*	666	1.9
Mercer	L*	959	2.5	L*	599	1.7
	TOTAL	38,296	100	TOTAL	34,978	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 5: Zone 5 Total Highway Person Trips

	Destination Zone	Trips Originating in Zone 5	Percent	Origin Zone	Trips Terminating in Zone 5	Percent
Langhorne Boro	1	700	0.6	1	998	0.6
Langhorne Manor	2	1,792	1.5	2	1,051	0.6
Penndel	3	1,609	1.3	3	1,710	1.0
Hulmeville/Middletown West	4	1,695	1.4	4	2,836	1.7
Middletown East	5	47,016	38.3	5	47,016	28.6
Middletown North	6	10,561	8.6	6	12,235	7.5
Northampton	7	232	0.2	7	1,960	1.2
Newtown	8	1,277	1.0	8	5,911	3.6
Bristol North	9	12,673	10.3	9	14,323	8.7
Bristol South	10	2,856	2.3	10	3,268	2.0
Falls	A*	13,227	10.8	A*	28,363	17.3
Lower Makefield	B*	2,624	2.1	B*	9,467	5.8
Central Bucks	C*	624	0.5	C*	3,066	1.9
Bensalem-Warminster	D*	11,807	9.6	D*	12,707	7.7
Upper Bucks	E*	159	0.1	E*	750	0.5
Montgomery	F*	1,660	1.4	F*	2,576	1.6
Northeast Philadelphia	G*	2,268	1.8	G*	3,656	2.2
Rest of Philadelphia	H*	3,440	2.8	H*	2,697	1.6
Delaware/Chester	I*	596	0.5	I*	721	0.4
Gloucester/Camden	J*	650	0.5	J*	836	0.5
Burlington	K*	1,761	1.4	K*	4,278	2.6
Mercer	L*	3,497	2.8	L*	3,749	2.3
	TOTAL	122,724	100	TOTAL	164,174	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 6: Zone 6 Total Highway Person Trips

	Destination Zone	Trips Originating in Zone 6	Percent	Origin Zone	Trips Terminating in Zone 6	Percent
Langhorne Boro	1	1,395	1.1	1	1,450	1.0
Langhorne Manor	2	1,832	1.4	2	984	0.7
Penndel	3	859	0.7	3	871	0.6
Hulmeville/Middletown West	4	1,701	1.3	4	2,199	1.5
Middletown East	5	12,235	9.7	5	10,561	7.3
Middletown North	6	47,587	37.6	6	47,587	33.1
Northampton	7	991	0.8	7	4,611	3.2
Newtown	8	8,513	6.7	8	14,938	10.4
Bristol North	9	3,121	2.5	9	3,216	2.2
Bristol South	10	1,110	0.9	10	901	0.6
Falls	A*	10,100	8.0	A*	14,313	10.0
Lower Makefield	B*	9,340	7.4	B*	13,061	9.1
Central Bucks	C*	2,087	1.6	C*	5,044	3.5
Bensalem-Warminster	D*	8,453	6.7	D*	7,602	5.3
Upper Bucks	E*	363	0.3	E*	859	0.6
Montgomery	F*	2,060	1.6	F*	2,014	1.4
Northeast Philadelphia	G*	2,118	1.7	G*	2,406	1.7
Rest of Philadelphia	H*	3,212	2.5	H*	1,756	1.2
Delaware/Chester	I*	647	0.5	I*	489	0.3
Gloucester/Camden	J*	621	0.5	J*	4,480	3.1
Burlington	K*	1,456	1.1	K*	1,148	0.8
Mercer	L*	6,899	5.4	L*	3,241	2.3
	TOTAL	126,700	100	TOTAL	143,731	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 7: Zone 7 Total Highway Person Trips

	Destination Zone	Trips Originating in Zone 7	Percent	Origin Zone	Trips Terminating in Zone 7	Percent
Langhorne Boro	1	513	0.7	1	76	0.3
Langhorne Manor	2	563	0.8	2	43	0.2
Penndel	3	263	0.4	3	32	0.1
Hulmeville/Middletown West	4	1,713	2.3	4	327	1.2
Middletown East	5	1,960	2.6	5	232	0.8
Middletown North	6	4,611	6.2	6	991	3.6
Northampton	7	14,616	19.7	7	14,616	52.9
Newtown	8	11,144	15.0	8	2,911	10.5
Bristol North	9	814	1.1	9	122	0.4
Bristol South	10	326	0.4	10	41	0.1
Falls	A*	1,205	1.6	A*	248	0.9
Lower Makefield	B*	837	1.1	B*	350	1.3
Central Bucks	C*	7,266	9.8	C*	3,156	11.4
Bensalem-Warminster	D*	15,188	20.5	D*	2,250	8.1
Upper Bucks	E*	471	0.6	E*	239	0.9
Montgomery	F*	3,776	5.1	F*	682	2.5
Northeast Philadelphia	G*	2,037	2.7	G*	461	1.7
Rest of Philadelphia	H*	2,608	3.5	H*	303	1.1
Delaware/Chester	I*	523	0.7	I*	78	0.3
Gloucester/Camden	J*	419	0.6	J*	85	0.3
Burlington	K*	698	0.9	K*	178	0.6
Mercer	L*	2,583	3.5	L*	195	0.7
	TOTAL	74,134	100	TOTAL	27,616	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 8: Zone 8 Total Highway Person Trips

	Destination Zone	Trips Originating in Zone 8	Percent	Origin Zone	Trips Terminating in Zone 8	Percent
Langhorne Boro	1	884	0.6	1	293	0.3
Langhorne Manor	2	1,121	0.8	2	165	0.1
Penndel	3	555	0.4	3	136	0.1
Hulmeville/Middletown West	4	1,219	0.8	4	492	0.4
Middletown East	5	5,911	4.1	5	1,277	1.1
Middletown North	6	14,938	10.4	6	8,513	7.6
Northampton	7	2,911	2.0	7	11,144	9.9
Newtown	8	59,512	41.4	8	59,512	52.9
Bristol North	9	2,055	1.4	9	666	0.6
Bristol South	10	842	0.6	10	228	0.2
Falls	A*	4,441	3.1	A*	1,693	1.5
Lower Makefield	B*	5,706	4.0	B*	3,552	3.2
Central Bucks	C*	8,446	5.9	C*	12,591	11.2
Bensalem-Warminster	D*	10,668	7.4	D*	3,701	3.3
Upper Bucks	E*	977	0.7	E*	1,302	1.2
Montgomery	F*	3,930	2.7	F*	1,889	1.7
Northeast Philadelphia	G*	2,183	1.5	G*	981	0.9
Rest of Philadelphia	H*	3,797	2.6	H*	923	0.8
Delaware/Chester	I*	856	0.6	I*	324	0.3
Gloucester/Camden	J*	725	0.5	J*	277	0.2
Burlington	K*	1,593	1.1	K*	901	0.8
Mercer	L*	10,400	7.2	L*	1,941	1.7
	TOTAL	143,670	100	TOTAL	112,501	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 9: Zone 9 Total Highway Person Trips

	Destination Zone	Trips Originating in Zone 9	Percent	Origin Zone	Trips Terminating in Zone 9	Percent
Langhorne Boro	1	275	0.2	1	304	0.2
Langhorne Manor	2	674	0.6	2	323	0.3
Penndel	3	634	0.5	3	555	0.4
Hulmeville/Middletown West	4	855	0.7	4	1,227	1.0
Middletown East	5	14,323	11.8	5	12,673	9.9
Middletown North	6	3,216	2.7	6	3,121	2.4
Northampton	7	122	0.1	7	814	0.6
Newtown	8	666	0.5	8	2,055	1.6
Bristol North	9	41,466	34.2	9	41,466	32.4
Bristol South	10	10,564	8.7	10	9,982	7.8
Falls	A*	12,756	10.5	A*	17,388	13.6
Lower Makefield	B*	1,919	1.6	B*	4,207	3.3
Central Bucks	C*	469	0.4	C*	1,591	1.2
Bensalem-Warminster	D*	14,533	12.0	D*	12,861	10.1
Upper Bucks	E*	145	0.1	E*	499	0.4
Montgomery	F*	1,812	1.5	F*	2,131	1.7
Northeast Philadelphia	G*	3,234	2.7	G*	4,024	3.1
Rest of Philadelphia	H*	5,452	4.5	H*	3,128	2.4
Delaware/Chester	I*	766	0.6	I*	696	0.5
Gloucester/Camden	J*	988	0.8	J*	952	0.7
Burlington	K*	3,186	2.6	K*	5,551	4.3
Mercer	L*	3,292	2.7	L*	2,301	1.8
	TOTAL	121,347	100	TOTAL	127,849	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 10: Zone 10 Total Highway Person Trips

	Destination Zone	Trips Originating in Zone 10	Percent	Origin Zone	Trips Terminating in Zone 10	Percent
Langhorne Boro	1	82	0.2	1	93	0.2
Langhorne Manor	2	193	0.4	2	85	0.1
Penndel	3	174	0.3	3	150	0.2
Hulmeville/Middletown West	4	251	0.5	4	354	0.6
Middletown East	5	3,268	6.1	5	2,856	4.7
Middletown North	6	901	1.7	6	1,110	1.8
Northampton	7	41	0.1	7	326	0.5
Newtown	8	228	0.4	8	842	1.4
Bristol North	9	9,982	18.8	9	10,564	17.3
Bristol South	10	15,223	28.6	10	15,223	24.9
Falls	A*	5,101	9.6	A*	8,085	13.2
Lower Makefield	B*	867	1.6	B*	2,422	4.0
Central Bucks	C*	200	0.4	C*	834	1.4
Bensalem-Warminster	D*	6,373	12.0	D*	5,062	8.3
Upper Bucks	E*	74	0.1	E*	296	0.5
Montgomery	F*	960	1.8	F*	1,328	2.2
Northeast Philadelphia	G*	1,768	3.3	G*	2,264	3.7
Rest of Philadelphia	H*	2,773	5.2	H*	1,881	3.1
Delaware/Chester	I*	395	0.7	I*	436	0.7
Gloucester/Camden	J*	599	1.1	J*	727	1.2
Burlington	K*	2,140	4.0	K*	4,644	7.6
Mercer	L*	1,582	3.0	L*	1,571	2.6
	TOTAL	53,175	100	TOTAL	61,153	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 11: Superzone A Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone A	Percent	Origin Zone	Trips Terminating in Superzone A	Percent
Langhorne Boro	1	635	0.3	1	475	0.3
Langhorne Manor	2	1,118	0.5	2	367	0.2
Penndel	3	808	0.4	3	476	0.3
Hulmeville/Middletown West	4	1,219	0.6	4	1,129	0.6
Middletown East	5	28,363	13.5	5	13,227	7.2
Middletown North	6	14,313	6.8	6	10,100	5.5
Northampton	7	248	0.1	7	1,205	0.7
Newtown	8	1,693	0.8	8	4,441	2.4
Bristol North	9	17,388	8.3	9	12,756	6.9
Bristol South	10	8,085	3.9	10	5,101	2.8
Falls	A*	80,997	38.6	A*	80,997	44.0
Lower Makefield	B*	14,161	6.8	B*	24,928	13.5
Central Bucks	C*	997	0.5	C*	2,915	1.6
Bensalem-Warminster	D*	10,093	4.8	D*	5,897	3.2
Upper Bucks	E*	266	0.1	E*	717	0.4
Montgomery	F*	2,458	1.2	F*	2,090	1.1
Northeast Philadelphia	G*	2,759	1.3	G*	2,184	1.2
Rest of Philadelphia	H*	5,791	2.8	H*	2,123	1.2
Delaware/Chester	I*	1,033	0.5	I*	613	0.3
Gloucester/Camden	J*	1,214	0.6	J*	847	0.5
Burlington	K*	3,667	1.7	K*	4,805	2.6
Mercer	L*	12,347	5.9	L*	6,873	3.7
	TOTAL	209,653	100	TOTAL	184,266	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 12: Superzone B Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone B	Percent	Origin Zone	Trips Terminating in Superzone B	Percent
Langhorne Boro	1	618	0.4	1	205	0.2
Langhorne Manor	2	1,010	0.6	2	159	0.1
Penndel	3	575	0.4	3	177	0.2
Hulmeville/Middletown West	4	1,003	0.6	4	438	0.4
Middletown East	5	9,467	5.9	5	2,624	2.4
Middletown North	6	13,061	8.2	6	9,340	8.5
Northampton	7	350	0.2	7	837	0.8
Newtown	8	3,552	2.2	8	5,706	5.2
Bristol North	9	4,207	2.6	9	1,919	1.7
Bristol South	10	2,422	1.5	10	867	0.8
Falls	A*	24,928	15.6	A*	14,161	12.8
Lower Makefield	B*	55,235	34.6	B*	55,235	50.1
Central Bucks	C*	1,643	1.0	C*	3,285	3.0
Bensalem-Warminster	D*	6,288	3.9	D*	2,082	1.9
Upper Bucks	E*	346	0.2	E*	538	0.5
Montgomery	F*	2,069	1.3	F*	977	0.9
Northeast Philadelphia	G*	1,958	1.2	G*	853	0.8
Rest of Philadelphia	H*	3,924	2.5	H*	889	0.8
Delaware/Chester	I*	823	0.5	I*	315	0.3
Gloucester/Camden	J*	882	0.6	J*	331	0.3
Burlington	K*	2,716	1.7	K*	2,145	1.9
Mercer	L*	22,579	14.1	L*	7,242	6.6
	TOTAL	159,656	100	TOTAL	110,325	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 13: Superzone C Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone C	Percent	Origin Zone	Trips Terminating in Superzone C	Percent
Langhorne Boro	1	438	0.1	1	126	0.0
Langhorne Manor	2	590	0.1	2	74	0.0
Penndel	3	314	0.1	3	76	0.0
Hulmeville/Middletown West	4	1,211	0.2	4	467	0.1
Middletown East	5	3,066	0.6	5	624	0.2
Middletown North	6	5,044	0.9	6	2,087	0.5
Northampton	7	3,156	0.6	7	7,266	1.8
Newtown	8	12,591	2.3	8	8,446	2.1
Bristol North	9	1,591	0.3	9	469	0.1
Bristol South	10	834	0.2	10	200	0.0
Falls	A*	2,915	0.5	A*	997	0.2
Lower Makefield	B*	3,285	0.6	B*	1,643	0.4
Central Bucks	C*	279,525	50.7	C*	279,525	69.0
Bensalem-Warminster	D*	74,989	13.6	D*	29,212	7.2
Upper Bucks	E*	46,364	8.4	E*	36,539	9.0
Montgomery	F*	74,642	13.5	F*	25,810	6.4
Northeast Philadelphia	G*	5,135	0.9	G*	2,430	0.6
Rest of Philadelphia	H*	12,874	2.3	H*	3,271	0.8
Delaware/Chester	I*	5,348	1.0	I*	1,636	0.4
Gloucester/Camden	J*	1,869	0.3	J*	705	0.2
Burlington	K*	2,747	0.5	K*	1,379	0.3
Mercer	L*	13,229	2.4	L*	2,065	0.5
	TOTAL	551,757	100	TOTAL	405,047	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 14: Superzone D Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone D	Percent	Origin Zone	Trips Terminating in Superzone D	Percent
Langhorne Boro	1	1,259	0.2	1	1,297	0.2
Langhorne Manor	2	2,233	0.4	2	974	0.1
Penndel	3	1,866	0.3	3	1,634	0.2
Hulmeville/Middletown West	4	6,377	1.1	4	8,739	1.2
Middletown East	5	12,707	2.2	5	11,807	1.6
Middletown North	6	7,602	1.3	6	8,453	1.2
Northampton	7	2,250	0.4	7	15,188	2.1
Newtown	8	3,701	0.6	8	10,668	1.5
Bristol North	9	12,861	2.2	9	14,533	2.0
Bristol South	10	5,062	0.9	10	6,373	0.9
Falls	A*	5,897	1.0	A*	10,093	1.4
Lower Makefield	B*	2,082	0.4	B*	6,288	0.9
Central Bucks	C*	29,212	5.0	C*	74,989	10.4
Bensalem-Warminster	D*	339,461	57.7	D*	339,461	47.3
Upper Bucks	E*	3,939	0.7	E*	11,029	1.5
Montgomery	F*	68,484	11.6	F*	76,239	10.6
Northeast Philadelphia	G*	35,938	6.1	G*	64,388	9.0
Rest of Philadelphia	H*	27,895	4.7	H*	28,950	4.0
Delaware/Chester	I*	4,670	0.8	I*	5,025	0.7
Gloucester/Camden	J*	3,669	0.6	J*	4,657	0.6
Burlington	K*	5,204	0.9	K*	11,394	1.6
Mercer	L*	5,971	1.0	L*	5,458	0.8
	TOTAL	588,340	100	TOTAL	717,637	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 15: Superzone E Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone E	Percent	Origin Zone	Trips Terminating in Superzone E	Percent
Langhorne Boro	1	84	0.0	1	21	0.0
Langhorne Manor	2	122	0.0	2	14	0.0
Penndel	3	61	0.0	3	17	0.0
Hulmeville/Middletown West	4	237	0.0	4	80	0.0
Middletown East	5	750	0.1	5	159	0.0
Middletown North	6	859	0.1	6	363	0.1
Northampton	7	239	0.0	7	471	0.1
Newtown	8	1,302	0.2	8	977	0.2
Bristol North	9	499	0.1	9	145	0.0
Bristol South	10	296	0.0	10	74	0.0
Falls	A*	717	0.1	A*	266	0.0
Lower Makefield	B*	538	0.1	B*	346	0.1
Central Bucks	C*	36,539	5.4	C*	46,364	7.5
Bensalem-Warminster	D*	11,029	1.6	D*	3,939	0.6
Upper Bucks	E*	491,725	72.3	E*	491,725	79.9
Montgomery	F*	104,083	15.3	F*	62,597	10.2
Northeast Philadelphia	G*	1,963	0.3	G*	745	0.1
Rest of Philadelphia	H*	11,601	1.7	H*	2,271	0.4
Delaware/Chester	I*	10,455	1.5	I*	2,901	0.5
Gloucester/Camden	J*	1,353	0.2	J*	521	0.1
Burlington	K*	1,381	0.2	K*	605	0.1
Mercer	L*	3,937	0.6	L*	700	0.1
	TOTAL	679,770	100	TOTAL	615,301	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 16: Superzone F Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone F	Percent	Origin Zone	Trips Terminating in Superzone F	Percent
Langhorne Boro	1	246	0.0	1	201	0.0
Langhorne Manor	2	422	0.0	2	126	0.0
Penndel	3	284	0.0	3	206	0.0
Hulmeville/Middletown West	4	1,057	0.0	4	1,133	0.1
Middletown East	5	2,576	0.1	5	1,660	0.1
Middletown North	6	2,014	0.1	6	2,060	0.1
Northampton	7	682	0.0	7	3,776	0.2
Newtown	8	1,889	0.1	8	3,930	0.2
Bristol North	9	2,131	0.1	9	1,812	0.1
Bristol South	10	1,328	0.1	10	960	0.0
Falls	A*	2,090	0.1	A*	2,458	0.1
Lower Makefield	B*	977	0.0	B*	2,069	0.1
Central Bucks	C*	25,810	1.1	C*	74,642	3.5
Bensalem-Warminster	D*	76,239	3.3	D*	68,484	3.2
Upper Bucks	E*	62,597	2.7	E*	104,083	4.8
Montgomery	F*	1,640,007	70.2	F*	1,640,007	75.9
Northeast Philadelphia	G*	24,206	1.0	G*	29,552	1.4
Rest of Philadelphia	H*	208,729	8.9	H*	113,600	5.3
Delaware/Chester	I*	256,966	11.0	I*	90,491	4.2
Gloucester/Camden	J*	13,741	0.6	J*	8,149	0.4
Burlington	K*	8,613	0.4	K*	8,957	0.4
Mercer	L*	5,191	0.2	L*	3,414	0.2
	TOTAL	2,337,795	100	TOTAL	2,161,770	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 17: Superzone G Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone G	Percent	Origin Zone	Trips Terminating in Superzone G	Percent
Langhorne Boro	1	318	0.1	1	276	0.1
Langhorne Manor	2	626	0.1	2	186	0.0
Penndel	3	494	0.1	3	305	0.1
Hulmeville/Middletown West	4	1,191	0.2	4	1,531	0.3
Middletown East	5	3,656	0.8	5	2,268	0.5
Middletown North	6	2,406	0.5	6	2,118	0.5
Northampton	7	461	0.1	7	2,037	0.5
Newtown	8	981	0.2	8	2,183	0.5
Bristol North	9	4,024	0.8	9	3,234	0.7
Bristol South	10	2,264	0.5	10	1,768	0.4
Falls	A*	2,184	0.5	A*	2,759	0.6
Lower Makefield	B*	853	0.2	B*	1,958	0.4
Central Bucks	C*	2,430	0.5	C*	5,135	1.1
Bensalem-Warminster	D*	64,388	13.4	D*	35,938	8.0
Upper Bucks	E*	745	0.2	E*	1,963	0.4
Montgomery	F*	29,552	6.1	F*	24,206	5.4
Northeast Philadelphia	G*	252,348	52.4	G*	252,348	56.3
Rest of Philadelphia	H*	91,520	19.0	H*	86,798	19.3
Delaware/Chester	I*	4,456	0.9	I*	3,737	0.8
Gloucester/Camden	J*	6,342	1.3	J*	5,791	1.3
Burlington	K*	6,468	1.3	K*	9,210	2.1
Mercer	L*	3,970	0.8	L*	2,866	0.6
	TOTAL	481,677	100	TOTAL	448,615	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 18: Superzone H Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone H	Percent	Origin Zone	Trips Terminating in Superzone H	Percent
Langhorne Boro	1	220	0.0	1	272	0.0
Langhorne Manor	2	396	0.0	2	180	0.0
Penndel	3	265	0.0	3	320	0.0
Hulmeville/Middletown West	4	734	0.0	4	1,608	0.1
Middletown East	5	2,697	0.1	5	3,440	0.1
Middletown North	6	1,756	0.1	6	3,212	0.1
Northampton	7	303	0.0	7	2,608	0.1
Newtown	8	923	0.0	8	3,797	0.2
Bristol North	9	3,128	0.2	9	5,452	0.2
Bristol South	10	1,881	0.1	10	2,773	0.1
Falls	A*	2,123	0.1	A*	5,791	0.2
Lower Makefield	B*	889	0.0	B*	3,924	0.2
Central Bucks	C*	3,271	0.2	C*	12,874	0.5
Bensalem-Warminster	D*	28,950	1.4	D*	27,895	1.2
Upper Bucks	E*	2,271	0.1	E*	11,601	0.5
Montgomery	F*	113,600	5.6	F*	208,729	8.7
Northeast Philadelphia	G*	86,798	4.3	G*	91,520	3.8
Rest of Philadelphia	H*	1,602,105	78.6	H*	1,602,105	66.5
Delaware/Chester	I*	105,679	5.2	I*	221,678	9.2
Gloucester/Camden	J*	50,338	2.5	J*	131,722	5.5
Burlington	K*	24,069	1.2	K*	59,867	2.5
Mercer	L*	5,368	0.3	L*	7,646	0.3
	TOTAL	2,037,764	100	TOTAL	2,409,014	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 19: Superzone I Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone I	Percent	Origin Zone	Trips Terminating in Superzone I	Percent
Langhorne Boro	1	46	0.0	1	59	0.0
Langhorne Manor	2	77	0.0	2	37	0.0
Penndel	3	59	0.0	3	57	0.0
Hulmeville/Middletown West	4	177	0.0	4	274	0.0
Middletown East	5	721	0.0	5	596	0.0
Middletown North	6	489	0.0	6	647	0.0
Northampton	7	78	0.0	7	523	0.0
Newtown	8	324	0.0	8	856	0.0
Bristol North	9	696	0.0	9	766	0.0
Bristol South	10	436	0.0	10	395	0.0
Falls	A*	613	0.0	A*	1,033	0.0
Lower Makefield	B*	315	0.0	B*	823	0.0
Central Bucks	C*	1,636	0.0	C*	5,348	0.1
Bensalem-Warminster	D*	5,025	0.1	D*	4,670	0.1
Upper Bucks	E*	2,901	0.1	E*	10,455	0.3
Montgomery	F*	90,491	2.5	F*	256,966	6.9
Northeast Philadelphia	G*	3,737	0.1	G*	4,456	0.1
Rest of Philadelphia	H*	221,678	6.1	H*	105,679	2.8
Delaware/Chester	I*	3,285,205	90.0	I*	3,285,205	88.1
Gloucester/Camden	J*	26,767	0.7	J*	37,472	1.0
Burlington	K*	6,564	0.2	K*	9,155	0.2
Mercer	L*	1,705	0.0	L*	1,469	0.0
	TOTAL	3,649,740	100	TOTAL	3,726,941	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 20: Superzone J Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone J	Percent	Origin Zone	Trips Terminating in Superzone J	Percent
Langhorne Boro	1	48	0.0	1	50	0.0
Langhorne Manor	2	83	0.0	2	33	0.0
Penndel	3	70	0.0	3	50	0.0
Hulmeville/Middletown West	4	153	0.0	4	234	0.0
Middletown East	5	836	0.0	5	650	0.0
Middletown North	6	480	0.0	6	621	0.0
Northampton	7	85	0.0	7	419	0.0
Newtown	8	277	0.0	8	725	0.0
Bristol North	9	952	0.0	9	988	0.0
Bristol South	10	727	0.0	10	599	0.0
Falls	A*	847	0.0	A*	1,214	0.0
Lower Makefield	B*	331	0.0	B*	882	0.0
Central Bucks	C*	705	0.0	C*	1,869	0.1
Bensalem-Warminster	D*	4,657	0.1	D*	3,669	0.1
Upper Bucks	E*	521	0.0	E*	1,353	0.0
Montgomery	F*	8,149	0.3	F*	13,741	0.4
Northeast Philadelphia	G*	5,791	0.2	G*	6,342	0.2
Rest of Philadelphia	H*	131,722	4.2	H*	50,338	1.6
Delaware/Chester	I*	37,472	1.2	I*	26,767	0.9
Gloucester/Camden	J*	2,707,496	86.7	J*	2,707,496	87.6
Burlington	K*	212,038	6.8	K*	266,365	8.6
Mercer	L*	9,352	0.3	L*	8,076	0.3
	TOTAL	3,122,792	100	TOTAL	3,092,481	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 21: Superzone K Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone K	Percent	Origin Zone	Trips Terminating in Superzone K	Percent
Langhorne Boro	1	222	0.0	1	110	0.0
Langhorne Manor	2	463	0.0	2	87	0.0
Penndel	3	317	0.0	3	134	0.0
Hulmeville/Middletown West	4	666	0.0	4	428	0.0
Middletown East	5	4,278	0.2	5	1,761	0.1
Middletown North	6	2,148	0.1	6	1,456	0.1
Northampton	7	178	0.0	7	698	0.0
Newtown	8	901	0.0	8	1,593	0.1
Bristol North	9	5,551	0.3	9	3,186	0.2
Bristol South	10	4,644	0.2	10	2,140	0.1
Falls	A*	4,805	0.2	A*	3,667	0.2
Lower Makefield	B*	2,145	0.1	B*	2,716	0.1
Central Bucks	C*	1,379	0.1	C*	2,747	0.1
Bensalem-Warminster	D*	11,394	0.5	D*	5,204	0.3
Upper Bucks	E*	605	0.0	E*	1,381	0.1
Montgomery	F*	8,957	0.4	F*	8,613	0.4
Northeast Philadelphia	G*	9,210	0.4	G*	6,468	0.3
Rest of Philadelphia	H*	59,867	2.8	H*	24,069	1.2
Delaware/Chester	I*	9,155	0.4	I*	6,564	0.3
Gloucester/Camden	J*	266,365	12.5	J*	212,038	10.7
Burlington	K*	1,643,441	77.2	K*	1,643,441	83.0
Mercer	L*	90,894	4.3	L*	52,058	2.6
	TOTAL	2,127,585	100	TOTAL	1,980,559	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 22: Superzone L Total Highway Person Trips

	Destination Zone	Trips Originating in Superzone L	Percent	Origin Zone	Trips Terminating in Superzone L	Percent
Langhorne Boro	1	241	0.0	1	298	0.0
Langhorne Manor	2	443	0.0	2	185	0.0
Penndel	3	264	0.0	3	267	0.0
Hulmeville/Middletown West	4	599	0.0	4	959	0.1
Middletown East	5	3,749	0.2	5	3,497	0.2
Middletown North	6	3,241	0.2	6	6,899	0.4
Northampton	7	195	0.0	7	2,583	0.2
Newtown	8	1,941	0.1	8	10,400	0.6
Bristol North	9	2,301	0.2	9	3,292	0.2
Bristol South	10	1,571	0.1	10	1,582	0.1
Falls	A*	6,873	0.5	A*	12,347	0.8
Lower Makefield	B*	7,242	0.5	B*	22,579	1.4
Central Bucks	C*	2,065	0.1	C*	13,229	0.8
Bensalem-Warminster	D*	5,458	0.4	D*	5,971	0.4
Upper Bucks	E*	700	0.0	E*	3,937	0.2
Montgomery	F*	3,414	0.2	F*	5,191	0.3
Northeast Philadelphia	G*	2,866	0.2	G*	3,970	0.2
Rest of Philadelphia	H*	7,646	0.5	H*	5,368	0.3
Delaware/Chester	I*	1,469	0.1	I*	1,705	0.1
Gloucester/Camden	J*	8,076	0.5	J*	9,352	0.6
Burlington	K*	52,058	3.5	K*	90,894	5.7
Mercer	L*	1,395,882	92.5	L*	1,395,882	87.2
	TOTAL	1,508,294	100	TOTAL	1,600,387	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Appendix B

Table 1: Zone 1 Total Transit Person Trips

	Destination Zone	Trips Originating in Zone 1	Percent	Origin Zone	Trips Terminating in Zone 1	Percent
Langhorne Boro	1	0	0.0	1	0	0.0
Langhorne Manor	2	3	2.0	2	1	2.2
Penndel	3	2	1.3	3	2	4.3
Hulmeville/Middletown West	4	0	0.0	4	0	0.0
Middletown East	5	6	3.9	5	5	10.9
Middletown North	6	6	3.9	6	8	17.4
Northampton	7	0	0.0	7	1	2.2
Newtown	8	0	0.0	8	1	2.2
Bristol North	9	0	0.0	9	1	2.2
Bristol South	10	2	1.3	10	0	0.0
Falls	A*	1	0.7	A*	1	2.2
Lower Makefield	B*	1	0.7	B*	0	0.0
Central Bucks	C*	0	0.0	C*	0	0.0
Bensalem-Warminster	D*	9	5.9	D*	7	15.2
Upper Bucks	E*	0	0.0	E*	0	0.0
Montgomery	F*	13	8.5	F*	2	4.3
Northeast Philadelphia	G*	2	1.3	G*	3	6.5
Rest of Philadelphia	H*	96	62.7	H*	9	19.6
Delaware/Chester	I*	2	1.3	I*	1	2.2
Gloucester/Camden	J*	2	1.3	J*	1	2.2
Burlington	K*	0	0.0	K*	0	0.0
Mercer	L*	8	5.2	L*	3	6.5
	TOTAL	153	100	TOTAL	46	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 2: Zone 2 Total Transit Person Trips

	Destination Zone	Trips Originating in Zone 2	Percent	Origin Zone	Trips Terminating in Zone 2	Percent
Langhorne Boro	1	1	1.5	1	3	2.6
Langhorne Manor	2	0	0.0	2	0	0.0
Penndel	3	0	0.0	3	0	0.0
Hulmeville/Middletown West	4	0	0.0	4	0	0.0
Middletown East	5	5	7.5	5	5	4.3
Middletown North	6	3	4.5	6	5	4.3
Northampton	7	0	0.0	7	2	1.7
Newtown	8	0	0.0	8	4	3.5
Bristol North	9	0	0.0	9	2	1.7
Bristol South	10	0	0.0	10	0	0.0
Falls	A*	2	3.0	A*	8	7.0
Lower Makefield	B*	1	1.5	B*	7	6.1
Central Bucks	C*	0	0.0	C*	1	0.9
Bensalem-Warminster	D*	5	7.5	D*	16	13.9
Upper Bucks	E*	1	1.5	E*	0	0.0
Montgomery	F*	2	3.0	F*	11	9.6
Northeast Philadelphia	G*	3	4.5	G*	12	10.4
Rest of Philadelphia	H*	40	59.7	H*	29	25.2
Delaware/Chester	I*	0	0.0	I*	1	0.9
Gloucester/Camden	J*	0	0.0	J*	0	0.0
Burlington	K*	0	0.0	K*	1	0.9
Mercer	L*	4	6.0	L*	8	7.0
	TOTAL	67	100	TOTAL	115	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 3: Zone 3 Total Transit Person Trips

	Destination Zone	Trips Originating in Zone 3	Percent	Origin Zone	Trips Terminating in Zone 3	Percent
Langhorne Boro	1	2	1.6	1	2	2.8
Langhorne Manor	2	0	0.0	2	0	0.0
Penndel	3	0	0.0	3	0	0.0
Hulmeville/Middletown West	4	0	0.0	4	1	1.4
Middletown East	5	7	5.5	5	4	5.6
Middletown North	6	6	4.7	6	3	4.2
Northampton	7	0	0.0	7	1	1.4
Newtown	8	0	0.0	8	1	1.4
Bristol North	9	1	0.8	9	5	7.0
Bristol South	10	1	0.8	10	0	0.0
Falls	A*	1	0.8	A*	4	5.6
Lower Makefield	B*	0	0.0	B*	9	12.7
Central Bucks	C*	0	0.0	C*	1	1.4
Bensalem-Warminster	D*	13	10.2	D*	11	15.5
Upper Bucks	E*	0	0.0	E*	0	0.0
Montgomery	F*	6	4.7	F*	12	16.9
Northeast Philadelphia	G*	5	3.9	G*	4	5.6
Rest of Philadelphia	H*	79	61.7	H*	6	8.5
Delaware/Chester	I*	1	0.8	I*	2	2.8
Gloucester/Camden	J*	0	0.0	J*	1	1.4
Burlington	K*	0	0.0	K*	1	1.4
Mercer	L*	6	4.7	L*	3	4.2
	TOTAL	128	100	TOTAL	71	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 4: Zone 4 Total Transit Person Trips

	Destination Zone	Trips Originating in Zone 4	Percent	Origin Zone	Trips Terminating in Zone 4	Percent
Langhorne Boro	1	0	0.0	1	0	0.0
Langhorne Manor	2	0	0.0	2	0	0.0
Penndel	3	1	0.2	3	0	0.0
Hulmeville/Middletown West	4	0	0.0	4	0	0.0
Middletown East	5	11	2.6	5	2	3.4
Middletown North	6	7	1.6	6	5	8.6
Northampton	7	0	0.0	7	2	3.4
Newtown	8	0	0.0	8	4	6.9
Bristol North	9	5	1.2	9	1	1.7
Bristol South	10	1	0.2	10	0	0.0
Falls	A*	2	0.5	A*	4	6.9
Lower Makefield	B*	3	0.7	B*	11	19.0
Central Bucks	C*	0	0.0	C*	2	3.4
Bensalem-Warminster	D*	24	5.6	D*	12	20.7
Upper Bucks	E*	1	0.2	E*	0	0.0
Montgomery	F*	32	7.5	F*	5	8.6
Northeast Philadelphia	G*	7	1.6	G*	0	0.0
Rest of Philadelphia	H*	302	70.7	H*	2	3.4
Delaware/Chester	I*	7	1.6	I*	3	5.2
Gloucester/Camden	J*	2	0.5	J*	1	1.7
Burlington	K*	1	0.2	K*	1	1.7
Mercer	L*	21	4.9	L*	3	5.2
	TOTAL	427	100	TOTAL	58	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 5: Zone 5 Total Transit Person Trips

	Destination Zone	Trips Originating in Zone 5	Percent	Origin Zone	Trips Terminating in Zone 5	Percent
Langhorne Boro	1	5	0.4	1	6	1.1
Langhorne Manor	2	5	0.4	2	5	0.9
Penndel	3	4	0.3	3	7	1.2
Hulmeville/Middletown West	4	2	0.2	4	11	1.9
Middletown East	5	64	5.3	5	64	11.3
Middletown North	6	34	2.8	6	29	5.1
Northampton	7	0	0.0	7	3	0.5
Newtown	8	3	0.2	8	11	1.9
Bristol North	9	44	3.7	9	54	9.6
Bristol South	10	21	1.7	10	17	3.0
Falls	A*	59	4.9	A*	122	21.6
Lower Makefield	B*	9	0.7	B*	31	5.5
Central Bucks	C*	1	0.1	C*	9	1.6
Bensalem-Warminster	D*	66	5.5	D*	60	10.6
Upper Bucks	E*	2	0.2	E*	1	0.2
Montgomery	F*	72	6.0	F*	28	5.0
Northeast Philadelphia	G*	21	1.7	G*	17	3.0
Rest of Philadelphia	H*	718	59.7	H*	46	8.1
Delaware/Chester	I*	12	1.0	I*	10	1.8
Gloucester/Camden	J*	3	0.2	J*	3	0.5
Burlington	K*	6	0.5	K*	8	1.4
Mercer	L*	51	4.2	L*	23	4.1
	TOTAL	1,202	100	TOTAL	565	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 6: Zone 6 Total Transit Person Trips

	Destination Zone	Trips Originating in Zone 6	Percent	Origin Zone	Trips Terminating in Zone 6	Percent
Langhorne Boro	1	8	0.5	1	6	1.6
Langhorne Manor	2	5	0.3	2	3	0.8
Penndel	3	3	0.2	3	6	1.6
Hulmeville/Middletown West	4	5	0.3	4	7	1.8
Middletown East	5	29	2.0	5	34	8.8
Middletown North	6	36	2.5	6	36	9.3
Northampton	7	1	0.1	7	6	1.6
Newtown	8	9	0.6	8	13	3.4
Bristol North	9	15	1.0	9	15	3.9
Bristol South	10	26	1.8	10	10	2.6
Falls	A*	46	3.2	A*	56	14.5
Lower Makefield	B*	15	1.0	B*	20	5.2
Central Bucks	C*	6	0.4	C*	19	4.9
Bensalem-Warminster	D*	58	4.0	D*	37	9.6
Upper Bucks	E*	6	0.4	E*	1	0.3
Montgomery	F*	172	11.8	F*	34	8.8
Northeast Philadelphia	G*	25	1.7	G*	19	4.9
Rest of Philadelphia	H*	751	51.4	H*	32	8.3
Delaware/Chester	I*	27	1.8	I*	3	0.8
Gloucester/Camden	J*	5	0.3	J*	0	0.0
Burlington	K*	8	0.5	K*	8	2.1
Mercer	L*	204	14.0	L*	21	5.4
	TOTAL	1,460	100	TOTAL	386	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 7: Zone 7 Total Transit Person Trips

	Destination Zone	Trips Originating in Zone 7	Percent	Origin Zone	Trips Terminating in Zone 7	Percent
Langhorne Boro	1	1	0.1	1	0	0.0
Langhorne Manor	2	2	0.3	2	0	0.0
Penndel	3	1	0.1	3	0	0.0
Hulmeville/Middletown West	4	2	0.3	4	0	0.0
Middletown East	5	3	0.4	5	0	0.0
Middletown North	6	6	0.8	6	1	8.3
Northampton	7	3	0.4	7	3	25.0
Newtown	8	33	4.4	8	1	8.3
Bristol North	9	2	0.3	9	0	0.0
Bristol South	10	1	0.1	10	0	0.0
Falls	A*	0	0.0	A*	1	8.3
Lower Makefield	B*	3	0.4	B*	0	0.0
Central Bucks	C*	11	1.5	C*	2	16.7
Bensalem-Warminster	D*	32	4.2	D*	2	16.7
Upper Bucks	E*	1	0.1	E*	0	0.0
Montgomery	F*	48	6.3	F*	1	8.3
Northeast Philadelphia	G*	5	0.7	G*	0	0.0
Rest of Philadelphia	H*	576	76.1	H*	0	0.0
Delaware/Chester	I*	10	1.3	I*	1	8.3
Gloucester/Camden	J*	7	0.9	J*	0	0.0
Burlington	K*	1	0.1	K*	0	0.0
Mercer	L*	9	1.2	L*	0	0.0
	TOTAL	757	100	TOTAL	12	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 8: Zone 8 Total Transit Person Trips

	Destination Zone	Trips Originating in Zone 8	Percent	Origin Zone	Trips Terminating in Zone 8	Percent
Langhorne Boro	1	1	0.1	1	0	0.0
Langhorne Manor	2	4	0.3	2	0	0.0
Penndel	3	1	0.1	3	0	0.0
Hulmeville/Middletown West	4	4	0.3	4	0	0.0
Middletown East	5	11	0.9	5	3	1.6
Middletown North	6	13	1.0	6	9	4.7
Northampton	7	1	0.1	7	33	17.3
Newtown	8	10	0.8	8	10	5.2
Bristol North	9	5	0.4	9	3	1.6
Bristol South	10	3	0.2	10	1	0.5
Falls	A*	7	0.6	A*	4	2.1
Lower Makefield	B*	9	0.7	B*	4	2.1
Central Bucks	C*	15	1.2	C*	54	28.3
Bensalem-Warminster	D*	45	3.6	D*	22	11.5
Upper Bucks	E*	2	0.2	E*	0	0.0
Montgomery	F*	82	6.6	F*	12	6.3
Northeast Philadelphia	G*	12	1.0	G*	5	2.6
Rest of Philadelphia	H*	886	71.2	H*	13	6.8
Delaware/Chester	I*	17	1.4	I*	3	1.6
Gloucester/Camden	J*	11	0.9	J*	0	0.0
Burlington	K*	3	0.2	K*	4	2.1
Mercer	L*	103	8.3	L*	11	5.8
	TOTAL	1,245	100	TOTAL	191	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 9: Zone 9 Total Transit Person Trips

	Destination Zone	Trips Originating in Zone 9	Percent	Origin Zone	Trips Terminating in Zone 9	Percent
Langhorne Boro	1	1	0.1	1	0	0.0
Langhorne Manor	2	2	0.1	2	0	0.0
Penndel	3	5	0.3	3	1	0.3
Hulmeville/Middletown West	4	1	0.1	4	5	1.4
Middletown East	5	54	3.6	5	44	12.1
Middletown North	6	15	1.0	6	15	4.1
Northampton	7	0	0.0	7	2	0.6
Newtown	8	3	0.2	8	5	1.4
Bristol North	9	51	3.4	9	51	14.0
Bristol South	10	80	5.4	10	55	15.2
Falls	A*	58	3.9	A*	60	16.5
Lower Makefield	B*	10	0.7	B*	18	5.0
Central Bucks	C*	0	0.0	C*	1	0.3
Bensalem-Warminster	D*	54	3.6	D*	31	8.5
Upper Bucks	E*	0	0.0	E*	0	0.0
Montgomery	F*	40	2.7	F*	11	3.0
Northeast Philadelphia	G*	34	2.3	G*	19	5.2
Rest of Philadelphia	H*	906	61.0	H*	13	3.6
Delaware/Chester	I*	16	1.1	I*	0	0.0
Gloucester/Camden	J*	10	0.7	J*	3	0.8
Burlington	K*	9	0.6	K*	13	3.6
Mercer	L*	136	9.2	L*	16	4.4
	TOTAL	1,485	100	TOTAL	363	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 10: Zone 10 Total Transit Person Trips

	Destination Zone	Trips Originating in Zone 10	Percent	Origin Zone	Trips Terminating in Zone 10	Percent
Langhorne Boro	1	0	0.0	1	2	0.3
Langhorne Manor	2	0	0.0	2	0	0.0
Penndel	3	0	0.0	3	1	0.1
Hulmeville/Middletown West	4	0	0.0	4	1	0.1
Middletown East	5	17	1.6	5	21	3.0
Middletown North	6	10	0.9	6	26	3.7
Northampton	7	0	0.0	7	1	0.1
Newtown	8	1	0.1	8	3	0.4
Bristol North	9	55	5.2	9	80	11.3
Bristol South	10	95	8.9	10	95	13.5
Falls	A*	43	4.0	A*	116	16.4
Lower Makefield	B*	4	0.4	B*	52	7.4
Central Bucks	C*	0	0.0	C*	7	1.0
Bensalem-Warminster	D*	38	3.6	D*	57	8.1
Upper Bucks	E*	0	0.0	E*	4	0.6
Montgomery	F*	28	2.6	F*	29	4.1
Northeast Philadelphia	G*	21	2.0	G*	49	6.9
Rest of Philadelphia	H*	610	57.3	H*	65	9.2
Delaware/Chester	I*	13	1.2	I*	9	1.3
Gloucester/Camden	J*	6	0.6	J*	10	1.4
Burlington	K*	5	0.5	K*	17	2.4
Mercer	L*	118	11.1	L*	61	8.6
	TOTAL	1,064	100	TOTAL	706	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 11: Superzone A Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone A	Percent	Origin Zone	Trips Terminating in Superzone A	Percent
Langhorne Boro	1	1	0.0	1	1	0.2
Langhorne Manor	2	8	0.4	2	2	0.3
Penndel	3	4	0.2	3	1	0.2
Hulmeville/Middletown West	4	4	0.2	4	2	0.3
Middletown East	5	122	5.6	5	59	9.4
Middletown North	6	56	2.6	6	46	7.3
Northampton	7	1	0.0	7	0	0.0
Newtown	8	4	0.2	8	7	1.1
Bristol North	9	60	2.7	9	58	9.3
Bristol South	10	116	5.3	10	43	6.9
Falls	A*	157	7.2	A*	157	25.1
Lower Makefield	B*	41	1.9	B*	68	10.9
Central Bucks	C*	2	0.1	C*	9	1.4
Bensalem-Warminster	D*	56	2.6	D*	37	5.9
Upper Bucks	E*	2	0.1	E*	0	0.0
Montgomery	F*	86	3.9	F*	17	2.7
Northeast Philadelphia	G*	31	1.4	G*	17	2.7
Rest of Philadelphia	H*	1,024	46.8	H*	23	3.7
Delaware/Chester	I*	22	1.0	I*	5	0.8
Gloucester/Camden	J*	12	0.5	J*	1	0.2
Burlington	K*	11	0.5	K*	16	2.6
Mercer	L*	366	16.7	L*	57	9.1
	TOTAL	2,186	100	TOTAL	626	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 12: Superzone B Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone B	Percent	Origin Zone	Trips Terminating in Superzone B	Percent
Langhorne Boro	1	0	0.0	1	1	0.4
Langhorne Manor	2	7	0.4	2	1	0.4
Penndel	3	9	0.5	3	0	0.0
Hulmeville/Middletown West	4	11	0.6	4	3	1.1
Middletown East	5	31	1.7	5	9	3.4
Middletown North	6	20	1.1	6	15	5.6
Northampton	7	0	0.0	7	3	1.1
Newtown	8	4	0.2	8	9	3.4
Bristol North	9	18	1.0	9	10	3.7
Bristol South	10	52	2.9	10	4	1.5
Falls	A*	68	3.8	A*	41	15.3
Lower Makefield	B*	69	3.9	B*	69	25.7
Central Bucks	C*	3	0.2	C*	1	0.4
Bensalem-Warminster	D*	51	2.9	D*	19	7.1
Upper Bucks	E*	2	0.1	E*	3	1.1
Montgomery	F*	162	9.1	F*	21	7.8
Northeast Philadelphia	G*	19	1.1	G*	2	0.7
Rest of Philadelphia	H*	835	47.0	H*	7	2.6
Delaware/Chester	I*	25	1.4	I*	3	1.1
Gloucester/Camden	J*	8	0.4	J*	1	0.4
Burlington	K*	9	0.5	K*	4	1.5
Mercer	L*	375	21.1	L*	42	15.7
	TOTAL	1,778	100	TOTAL	268	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 13: Superzone C Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone C	Percent	Origin Zone	Trips Terminating in Superzone C	Percent
Langhorne Boro	1	0	0.0	1	0	0.0
Langhorne Manor	2	1	0.0	2	0	0.0
Penndel	3	1	0.0	3	0	0.0
Hulmeville/Middletown West	4	2	0.1	4	0	0.0
Middletown East	5	9	0.3	5	1	0.2
Middletown North	6	19	0.6	6	6	1.5
Northampton	7	2	0.1	7	11	2.7
Newtown	8	54	1.8	8	15	3.7
Bristol North	9	1	0.0	9	0	0.0
Bristol South	10	7	0.2	10	0	0.0
Falls	A*	9	0.3	A*	2	0.5
Lower Makefield	B*	1	0.0	B*	3	0.7
Central Bucks	C*	139	4.7	C*	139	34.6
Bensalem-Warminster	D*	99	3.4	D*	47	11.7
Upper Bucks	E*	166	5.7	E*	55	13.7
Montgomery	F*	783	26.7	F*	95	23.6
Northeast Philadelphia	G*	26	0.9	G*	3	0.7
Rest of Philadelphia	H*	1,470	50.1	H*	18	4.5
Delaware/Chester	I*	62	2.1	I*	3	0.7
Gloucester/Camden	J*	18	0.6	J*	3	0.7
Burlington	K*	3	0.1	K*	0	0.0
Mercer	L*	64	2.2	L*	1	0.2
	TOTAL	2,936	100	TOTAL	402	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 14: Superzone D Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone D	Percent	Origin Zone	Trips Terminating in Superzone D	Percent
Langhorne Boro	1	7	0.1	1	9	0.4
Langhorne Manor	2	16	0.2	2	5	0.2
Penndel	3	11	0.1	3	13	0.6
Hulmeville/Middletown West	4	12	0.1	4	24	1.1
Middletown East	5	60	0.7	5	66	2.9
Middletown North	6	37	0.4	6	58	2.6
Northampton	7	2	0.0	7	32	1.4
Newtown	8	22	0.3	8	45	2.0
Bristol North	9	31	0.4	9	54	2.4
Bristol South	10	57	0.7	10	38	1.7
Falls	A*	37	0.4	A*	56	2.5
Lower Makefield	B*	19	0.2	B*	51	2.2
Central Bucks	C*	47	0.6	C*	99	4.4
Bensalem-Warminster	D*	500	5.9	D*	500	22.0
Upper Bucks	E*	14	0.2	E*	16	0.7
Montgomery	F*	546	6.4	F*	250	11.0
Northeast Philadelphia	G*	294	3.5	G*	328	14.5
Rest of Philadelphia	H*	6,485	76.1	H*	531	23.4
Delaware/Chester	I*	79	0.9	I*	19	0.8
Gloucester/Camden	J*	49	0.6	J*	18	0.8
Burlington	K*	12	0.1	K*	20	0.9
Mercer	L*	181	2.1	L*	37	1.6
	TOTAL	8,518	100	TOTAL	2,269	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 15: Superzone E Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone E	Percent	Origin Zone	Trips Terminating in Superzone E	Percent
Langhorne Boro	1	0	0.0	1	0	0.0
Langhorne Manor	2	0	0.0	2	1	0.2
Penndel	3	0	0.0	3	0	0.0
Hulmeville/Middletown West	4	0	0.0	4	1	0.2
Middletown East	5	1	0.1	5	2	0.3
Middletown North	6	1	0.1	6	6	1.0
Northampton	7	0	0.0	7	1	0.2
Newtown	8	0	0.0	8	2	0.3
Bristol North	9	0	0.0	9	0	0.0
Bristol South	10	4	0.3	10	0	0.0
Falls	A*	0	0.0	A*	2	0.3
Lower Makefield	B*	3	0.2	B*	2	0.3
Central Bucks	C*	55	4.4	C*	166	28.2
Bensalem-Warminster	D*	16	1.3	D*	14	2.4
Upper Bucks	E*	107	8.5	E*	107	18.2
Montgomery	F*	579	45.8	F*	248	42.2
Northeast Philadelphia	G*	4	0.3	G*	5	0.9
Rest of Philadelphia	H*	455	36.0	H*	21	3.6
Delaware/Chester	I*	20	1.6	I*	8	1.4
Gloucester/Camden	J*	4	0.3	J*	0	0.0
Burlington	K*	1	0.1	K*	1	0.2
Mercer	L*	13	1.0	L*	1	0.2
	TOTAL	1,263	100	TOTAL	588	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 16: Superzone F Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone F	Percent	Origin Zone	Trips Terminating in Superzone F	Percent
Langhorne Boro	1	2	0.0	1	13	0.0
Langhorne Manor	2	11	0.0	2	2	0.0
Penndel	3	12	0.0	3	6	0.0
Hulmeville/Middletown West	4	5	0.0	4	32	0.1
Middletown East	5	28	0.1	5	72	0.2
Middletown North	6	34	0.1	6	172	0.6
Northampton	7	1	0.0	7	48	0.2
Newtown	8	12	0.0	8	82	0.3
Bristol North	9	11	0.0	9	40	0.1
Bristol South	10	29	0.1	10	28	0.1
Falls	A*	17	0.0	A*	86	0.3
Lower Makefield	B*	21	0.0	B*	162	0.5
Central Bucks	C*	95	0.2	C*	783	2.5
Bensalem-Warminster	D*	250	0.5	D*	546	1.8
Upper Bucks	E*	248	0.5	E*	579	1.9
Montgomery	F*	14,040	28.9	F*	14,040	45.1
Northeast Philadelphia	G*	184	0.4	G*	318	1.0
Rest of Philadelphia	H*	30,804	63.3	H*	9,431	30.3
Delaware/Chester	I*	2,441	5.0	I*	4,078	13.1
Gloucester/Camden	J*	186	0.4	J*	337	1.1
Burlington	K*	38	0.1	K*	99	0.3
Mercer	L*	164	0.3	L*	149	0.5
	TOTAL	48,633	100	TOTAL	31,103	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 17: Superzone G Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone G	Percent	Origin Zone	Trips Terminating in Superzone G	Percent
Langhorne Boro	1	3	0.0	1	2	0.0
Langhorne Manor	2	12	0.0	2	3	0.0
Penndel	3	4	0.0	3	5	0.0
Hulmeville/Middletown West	4	0	0.0	4	7	0.0
Middletown East	5	17	0.0	5	21	0.1
Middletown North	6	19	0.0	6	25	0.1
Northampton	7	0	0.0	7	5	0.0
Newtown	8	5	0.0	8	12	0.0
Bristol North	9	19	0.0	9	34	0.1
Bristol South	10	49	0.1	10	21	0.1
Falls	A*	17	0.0	A*	31	0.1
Lower Makefield	B*	2	0.0	B*	19	0.1
Central Bucks	C*	3	0.0	C*	26	0.1
Bensalem-Warminster	D*	328	0.8	D*	294	1.2
Upper Bucks	E*	5	0.0	E*	4	0.0
Montgomery	F*	318	0.8	F*	184	0.8
Northeast Philadelphia	G*	9,924	24.6	G*	9,924	41.0
Rest of Philadelphia	H*	29,344	72.6	H*	13,303	55.0
Delaware/Chester	I*	130	0.3	I*	101	0.4
Gloucester/Camden	J*	90	0.2	J*	124	0.5
Burlington	K*	18	0.0	K*	34	0.1
Mercer	L*	101	0.2	L*	21	0.1
	TOTAL	40,408	100	TOTAL	24,200	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 18: Superzone H Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone H	Percent	Origin Zone	Trips Terminating in Superzone H	Percent
Langhorne Boro	1	9	0.0	1	96	0.0
Langhorne Manor	2	29	0.0	2	40	0.0
Penndel	3	6	0.0	3	79	0.0
Hulmeville/Middletown West	4	2	0.0	4	302	0.0
Middletown East	5	46	0.0	5	718	0.1
Middletown North	6	32	0.0	6	751	0.1
Northampton	7	0	0.0	7	576	0.1
Newtown	8	13	0.0	8	886	0.1
Bristol North	9	13	0.0	9	906	0.1
Bristol South	10	65	0.0	10	610	0.1
Falls	A*	23	0.0	A*	1024	0.1
Lower Makefield	B*	7	0.0	B*	835	0.1
Central Bucks	C*	18	0.0	C*	1,470	0.2
Bensalem-Warminster	D*	531	0.1	D*	6,485	0.8
Upper Bucks	E*	21	0.0	E*	455	0.1
Montgomery	F*	9,431	1.5	F*	30,804	4.0
Northeast Philadelphia	G*	13,303	2.1	G*	29,344	3.8
Rest of Philadelphia	H*	604,900	95.0	H*	604,900	77.6
Delaware/Chester	I*	5,896	0.9	I*	48,802	6.3
Gloucester/Camden	J*	2,077	0.3	J*	37,815	4.8
Burlington	K*	240	0.0	K*	11,188	1.4
Mercer	L*	194	0.0	L*	1,667	0.2
	TOTAL	636,856	100	TOTAL	779,753	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 19: Superzone I Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone I	Percent	Origin Zone	Trips Terminating in Superzone I	Percent
Langhorne Boro	1	1	0.0	1	2	0.0
Langhorne Manor	2	1	0.0	2	0	0.0
Penndel	3	2	0.0	3	1	0.0
Hulmeville/Middletown West	4	3	0.0	4	7	0.0
Middletown East	5	10	0.0	5	12	0.0
Middletown North	6	3	0.0	6	27	0.1
Northampton	7	1	0.0	7	10	0.0
Newtown	8	3	0.0	8	17	0.1
Bristol North	9	0	0.0	9	16	0.1
Bristol South	10	9	0.0	10	13	0.0
Falls	A*	5	0.0	A*	22	0.1
Lower Makefield	B*	3	0.0	B*	25	0.1
Central Bucks	C*	3	0.0	C*	62	0.2
Bensalem-Warminster	D*	19	0.0	D*	79	0.3
Upper Bucks	E*	8	0.0	E*	20	0.1
Montgomery	F*	4,078	5.8	F*	2,441	9.4
Northeast Philadelphia	G*	101	0.1	G*	130	0.5
Rest of Philadelphia	H*	48,802	69.6	H*	5,896	22.7
Delaware/Chester	I*	16,781	23.9	I*	16,781	64.5
Gloucester/Camden	J*	220	0.3	J*	354	1.4
Burlington	K*	17	0.0	K*	81	0.3
Mercer	L*	59	0.1	L*	30	0.1
	TOTAL	70,129	100	TOTAL	26,026	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 20: Superzone J Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone J	Percent	Origin Zone	Trips Terminating in Superzone J	Percent
Langhorne Boro	1	1	0.0	1	2	0.0
Langhorne Manor	2	0	0.0	2	0	0.0
Penndel	3	1	0.0	3	0	0.0
Hulmeville/Middletown West	4	1	0.0	4	2	0.0
Middletown East	5	3	0.0	5	3	0.0
Middletown North	6	0	0.0	6	5	0.0
Northampton	7	0	0.0	7	7	0.0
Newtown	8	0	0.0	8	11	0.0
Bristol North	9	3	0.0	9	10	0.0
Bristol South	10	10	0.0	10	6	0.0
Falls	A*	1	0.0	A*	12	0.0
Lower Makefield	B*	1	0.0	B*	8	0.0
Central Bucks	C*	3	0.0	C*	18	0.1
Bensalem-Warminster	D*	18	0.0	D*	49	0.2
Upper Bucks	E*	0	0.0	E*	4	0.0
Montgomery	F*	337	0.6	F*	186	0.7
Northeast Philadelphia	G*	124	0.2	G*	90	0.3
Rest of Philadelphia	H*	37,815	61.7	H*	2,077	7.9
Delaware/Chester	I*	354	0.6	I*	220	0.8
Gloucester/Camden	J*	20,929	34.2	J*	20,929	80.1
Burlington	K*	1,491	2.4	K*	2,386	9.1
Mercer	L*	159	0.3	L*	104	0.4
	TOTAL	61,251	100	TOTAL	26,129	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 21: Superzone K Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone K	Percent	Origin Zone	Trips Terminating in Superzone K	Percent
Langhorne Boro	1	0	0.0	1	0	0.0
Langhorne Manor	2	1	0.0	2	0	0.0
Penndel	3	1	0.0	3	0	0.0
Hulmeville/Middletown West	4	1	0.0	4	1	0.0
Middletown East	5	8	0.0	5	6	0.1
Middletown North	6	8	0.0	6	8	0.1
Northampton	7	0	0.0	7	1	0.0
Newtown	8	4	0.0	8	3	0.1
Bristol North	9	13	0.1	9	9	0.2
Bristol South	10	17	0.1	10	5	0.1
Falls	A*	16	0.1	A*	11	0.2
Lower Makefield	B*	4	0.0	B*	9	0.2
Central Bucks	C*	0	0.0	C*	3	0.1
Bensalem-Warminster	D*	20	0.1	D*	12	0.2
Upper Bucks	E*	1	0.0	E*	1	0.0
Montgomery	F*	99	0.5	F*	38	0.7
Northeast Philadelphia	G*	34	0.2	G*	18	0.3
Rest of Philadelphia	H*	11,188	60.0	H*	240	4.1
Delaware/Chester	I*	81	0.4	I*	17	0.3
Gloucester/Camden	J*	2,386	12.8	J*	1,491	25.6
Burlington	K*	3,711	19.9	K*	3,711	63.6
Mercer	L*	1,062	5.7	L*	249	4.3
	TOTAL	18,655	100	TOTAL	5,833	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Table 22: Superzone L Total Transit Person Trips

	Destination Zone	Trips Originating in Superzone L	Percent	Origin Zone	Trips Terminating in Superzone L	Percent
Langhorne Boro	1	3	0.0	1	8	0.0
Langhorne Manor	2	8	0.0	2	4	0.0
Penndel	3	3	0.0	3	6	0.0
Hulmeville/Middletown West	4	3	0.0	4	21	0.1
Middletown East	5	23	0.1	5	51	0.2
Middletown North	6	21	0.1	6	204	1.0
Northampton	7	0	0.0	7	9	0.0
Newtown	8	11	0.1	8	103	0.5
Bristol North	9	16	0.1	9	136	0.6
Bristol South	10	61	0.3	10	118	0.6
Falls	A*	57	0.3	A*	366	1.7
Lower Makefield	B*	42	0.2	B*	375	1.8
Central Bucks	C*	1	0.0	C*	64	0.3
Bensalem-Warminster	D*	37	0.2	D*	181	0.9
Upper Bucks	E*	1	0.0	E*	13	0.1
Montgomery	F*	149	0.7	F*	164	0.8
Northeast Philadelphia	G*	21	0.1	G*	101	0.5
Rest of Philadelphia	H*	1,667	8.2	H*	194	0.9
Delaware/Chester	I*	30	0.1	I*	59	0.3
Gloucester/Camden	J*	104	0.5	J*	159	0.8
Burlington	K*	249	1.2	K*	1,062	5.0
Mercer	L*	17,733	87.6	L*	17,733	83.9
	TOTAL	20,240	100	TOTAL	21,131	100

*These are Superzones consisting of combinations of zones as follows:

	Superzone	Zones
Falls	A	15,16
Lower Makefield	B	17,18,19
Central Bucks	C	20-21,25-27
Bensalem-Warminster	D	22-24
Upper Bucks	E	28-31
Montgomery	F	32-35
Northeast Philadelphia	G	36
Rest of Philadelphia	H	37- 41
Delaware/Chester	I	42, 43
Gloucester/Camden	J	44,45
Burlington	K	46-48
Mercer	L	49-50

Title of Report: *Pennsylvania Congestion Management System - PA 413 Corridor*

Publication No.: 03016

Date Published: July 2003

Geographic Area Covered:
The study area consists of an area of Bucks County that is directly or indirectly impacted by traffic traveling along PA 413. It includes or is adjacent to the following Bucks County municipalities: Newtown Township, Newtown Borough, Northampton Township, Falls Township, Middletown Township, Bristol Township, Bristol Borough, Penndel Borough, Langhhorne Manor, Langhorne, Humeville, and Lower Makefield Township

Key Words:
congestion, levels of service, intersection analysis, improvement options, traffic counts, station access, park and ride, trip generators, transit, journey-to-work, functional classification, average car technique, highway person trips, transit person trips, regional rail service, incentives

ABSTRACT:
This report is part of the Pennsylvania Congestion Management System (CMS) and provides an analysis of the PA 413 corridor in Bucks County, Pennsylvania. Through travel time surveys, conditions at intersections and arterial sections within the study network were evaluated during the peak periods. The most congested intersections and arterial sections were examined in detail and improvement measures to reduce congestion and delay were identified. Transit service was evaluated and changes were recommended to improve the attractiveness of this mode. Several Travel Demand Management (TDM) measures such as TransitChek and Mobility Alternative Programs were suggested as additional methods of reducing single occupant vehicle trips. Based on DVRPCís 2025 forecast of Journey-To-Work travel patterns, the major destinations for highway person trips within the study area were determined. Based on the same forecast, origins and destinations of transit person trips were also determined.

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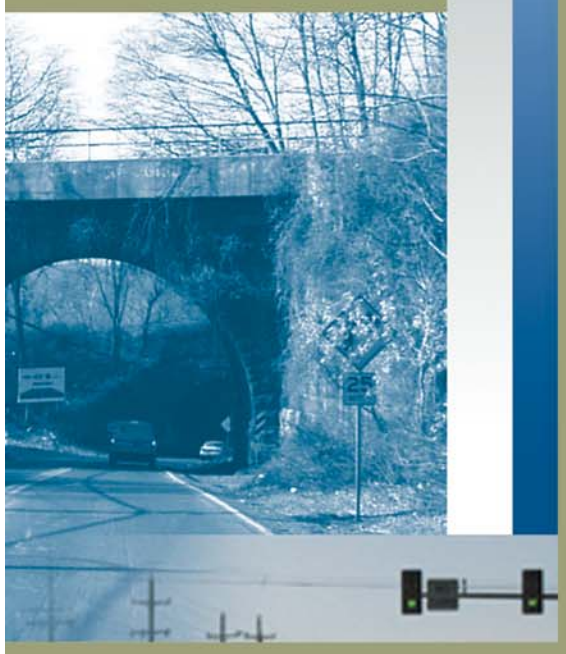

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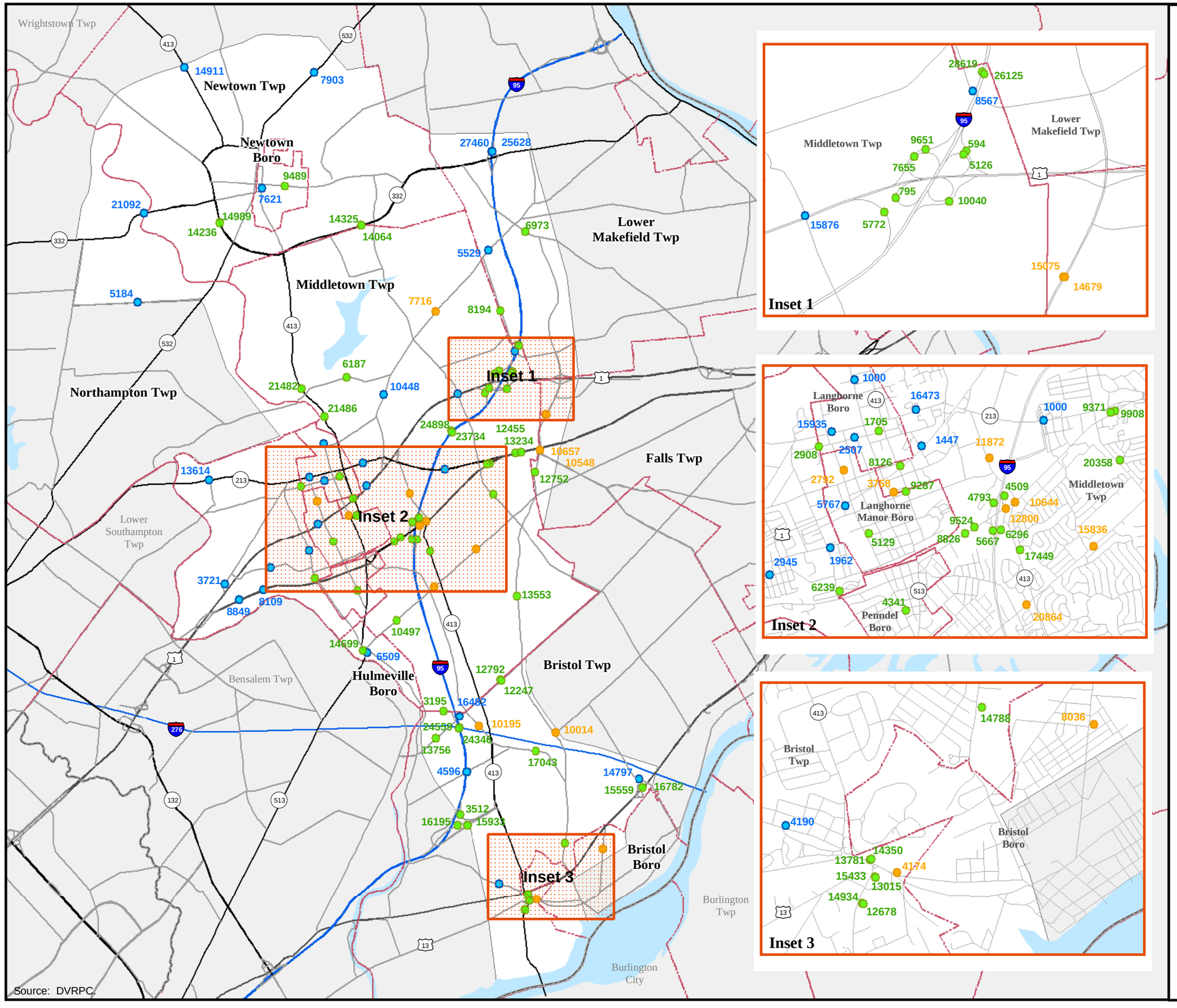
PA 413 CMS

Map 4:
Traffic Counts
1999 - 2002



1999
2001
2002

N
W E
S

0 0.5 1 1.5 2
Miles

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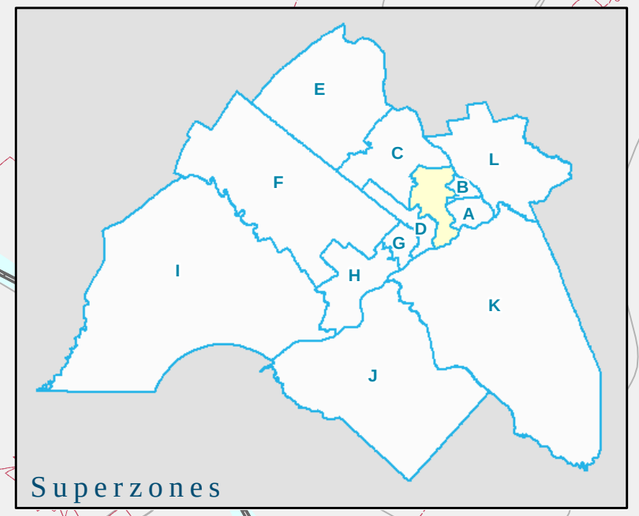
Map 11:
2025 Person Trips Forecast
Trips from Zone 5



Greater than 10%

3% to 10%

1% to 2.9%

Less than 1%

N
W E
S

0 1 2 3
Miles

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Note: Destination/ Origin zone and superzone number can be found within arrowhead.

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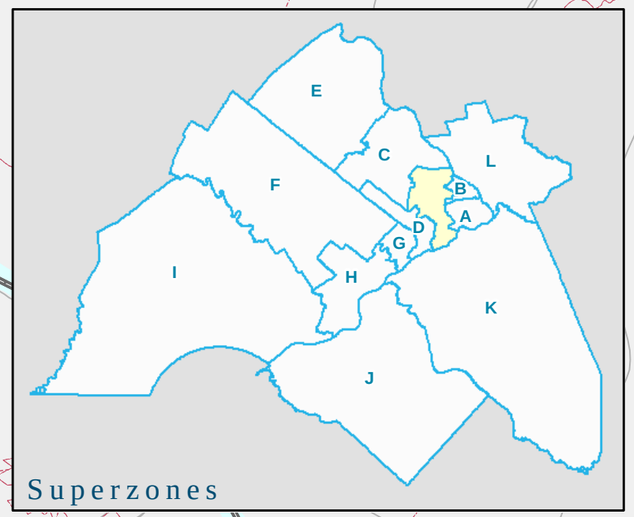
Map 12:
2025 Person Trips
Forecast
Trips to Zone 5



Greater than 10%

3% to 10%

1% to 2.9%

Less than 1%

N
W E
S

0 1 2 3
Miles

Note: Destination/ Origin zone and superzone number can be found within arrowhead.

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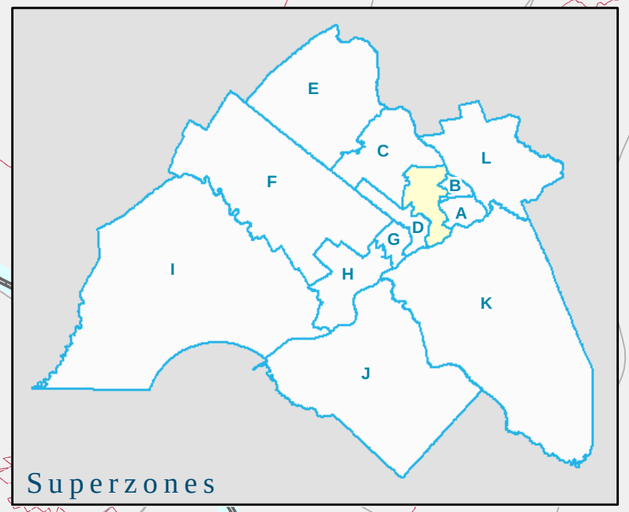
Map 13:
2025 Person Trips
Forecast
Trips from Zone 6



Greater than 10%

3% to 10%

1% to 2.9%

Less than 1%

N
W E
S

0 1 2 3
Miles

Note: Destination/ Origin zone and superzone number can be found within arrowhead.

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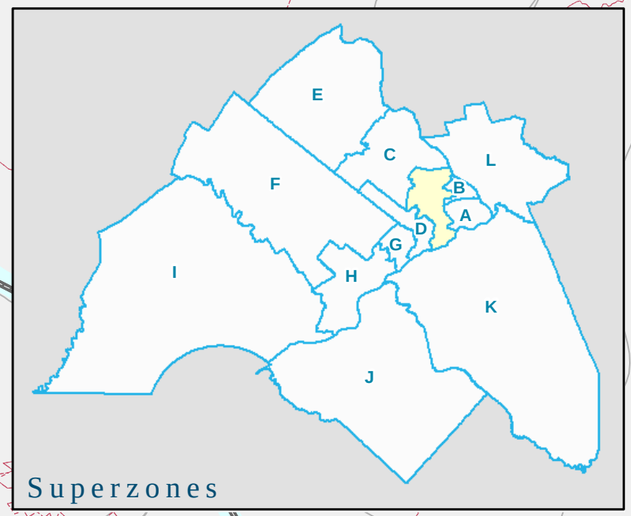
Map 14:
2025 Person Trips
Forecast
Trips to Zone 6



Greater than 10%

3% to 10%

1% to 2.9%

Less than 1%

N
W E
S

0 1 2 3
Miles

Note: Destination/ Origin zone and superzone number can be found within arrowhead.

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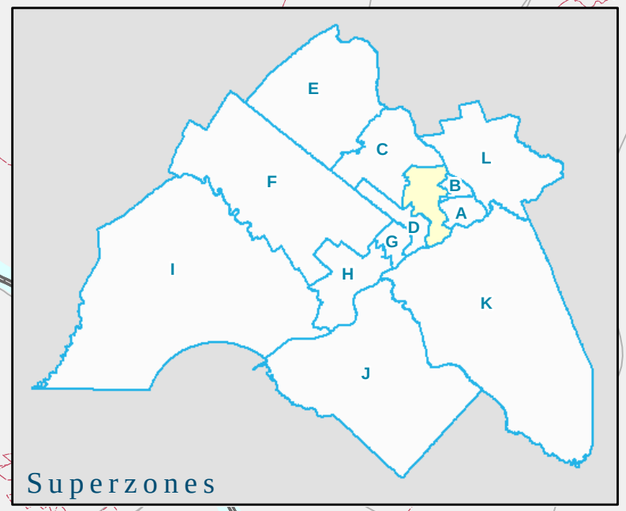
Map 15:
2025 Person Trips Forecast
Trips from Zone 8



Greater than 10%

3% to 10%

1% to 2.9%

Less than 1%

N
W E
S

0 1 2 3
Miles

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July 2003

Note: Destination/ Origin zone and superzone number can be found within arrowhead.

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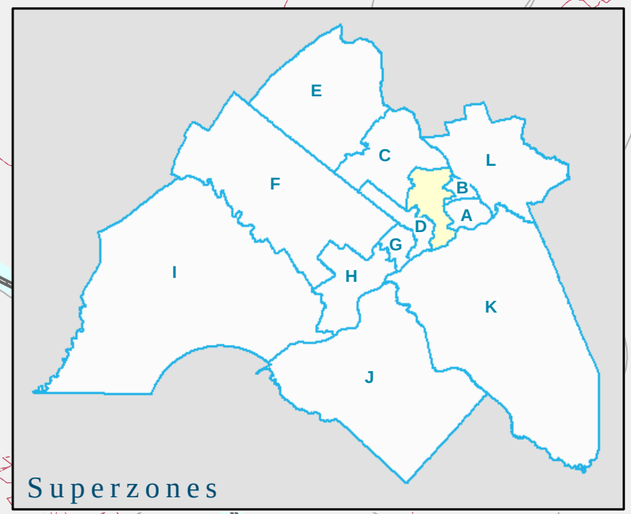
Map 16:
2025 Person Trips
Forecast
Trips to Zone 8



Greater than 10%

3% to 10%

1% to 2.9%

Less than 1%

N
W E
S

0 1 2 3
Miles

Note: Destination/ Origin zone and superzone number can be found within arrowhead.

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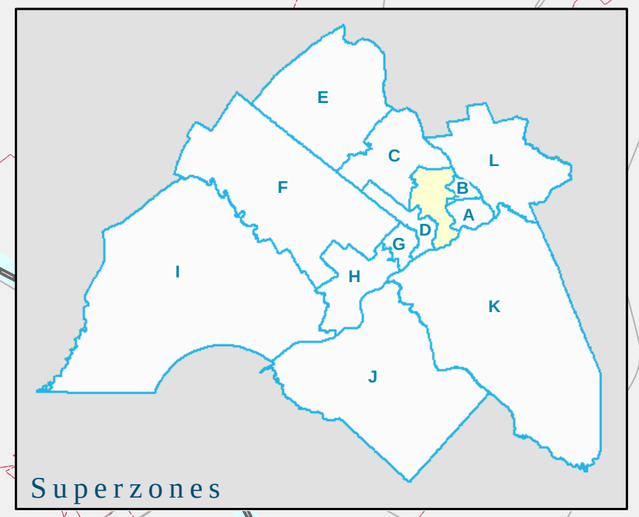
Map 17:
2025 Person Trips Forecast
Trips from Zone 9



Greater than 10%

3% to 10%

1% to 2.9%

Less than 1%

N
W E
S

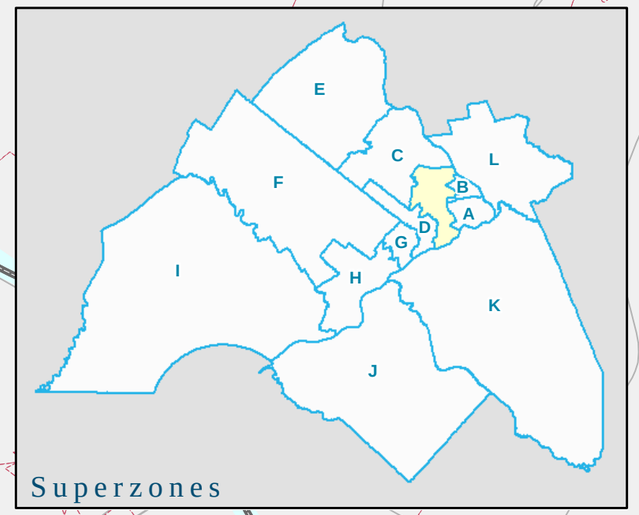
0 1 2 3
Miles

Delaware Valley Regional Planning Commission
July 2003

Note: Destination/ Origin zone and superzone number can be found within arrowhead.

PA 413 CMS

Map 18:
2025 Person Trips Forecast
Trips to Zone 9



Greater than 10%

3% to 10%

1% to 2.9%

Less than 1%

N
W E
S

0 1 2 3
Miles

Note: Destination/ Origin zone and superzone number can be found within arrowhead.

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