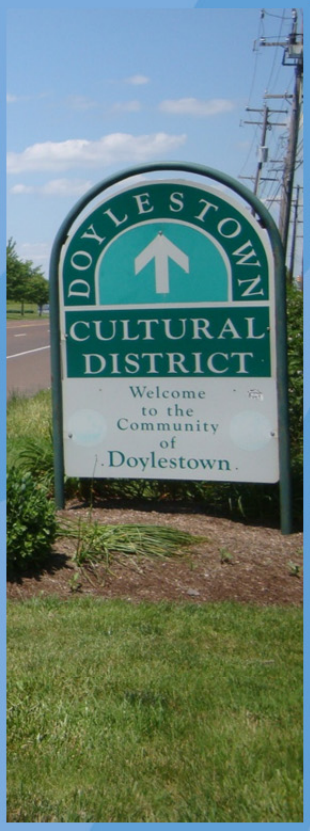
Managing Access along PA 611 in Bucks County



DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

January 2013

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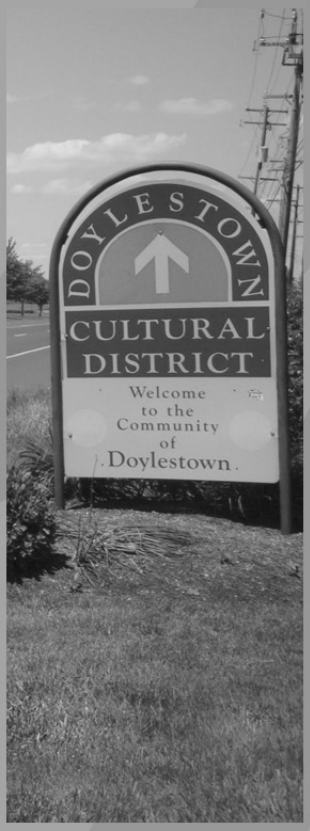

DELAWARE VALLEY
dvrpc
REGIONAL PLANNING COMMISSION

January 2013

The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals, and the public with a common vision of making a great region even greater. Shaping the way we live, work, and play, DVRPC builds consensus on improving transportation, promoting smart growth, protecting the environment, and enhancing the economy. We serve a diverse region of nine counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey. DVRPC is the federally designated Metropolitan Planning Organization for the Greater Philadelphia Region — leading the way to a better future.

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

The symbol in 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 the findings and conclusions herein, which may not represent the official views or policies of the funding agencies.

DVRPC fully complies with Title VI of the Civil Rights Act of 1964 and related statutes and regulations in all programs and activities. DVRPC's website (www.dvrpc.org) may be translated into multiple languages. Publications and other public documents can be made available in alternative languages and formats, if requested. For more information, please call (215) 238-2871.

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Executive Summary

This access management case study addresses an emerging corridor in Bucks County. Municipalities along this study corridor include Warrington and Doylestown townships. PA 611 serves as both a regional arterial and a main street for the corridor's municipalities.

Highway access management techniques were assembled into a conceptual plan for the study corridor to improve safety and mobility, and to prolong highway serviceability in light of ongoing regional growth and development. The work was performed by DVRPC staff in support of PennDOT's effort to promote wider planning for and application of access management procedures within the commonwealth. The procedures are applicable to both state and local highways, and the strategies are most effectively delivered through municipal ordinances that govern the land development design, application, review, and approval process. As such, principal guidance for developing the plan was obtained from PennDOT's publication *Access Management Model Ordinances for Pennsylvania Municipalities Handbook*.

Opportunities to correct access management deficiencies are present during land redevelopments and land use changes, when the proper enabling ordinances are in place. Appropriately designed access for new development is a simpler task to accomplish, but both developed and developing parcels need to be recognized and addressed in the vision to create comprehensive improvements for the study corridor. Regulations need to be adopted by the municipalities in their zoning and subdivision and land use ordinances to ensure that access management strategies continue.

Ultimately, this study sought to accomplish three tasks: **educate** municipal officials to the benefits of access management; **encourage** corridor municipalities to adopt enabling ordinances; and **enable** corridor municipalities with tools and recommendations to identify improvements to proactively shape access along PA 611 to be safe and efficient.

CHAPTER 1

Introduction

In January 2009, an Access Management Task Force meeting was held at DVRPC to select corridors for access management case studies. Representatives of each Pennsylvania county in the DVRPC region, PennDOT Engineering District 6-0, and SEPTA were present for the selection process. The long list of potential corridors was drawn from the region's CMP and from task force participant suggestions. The PA 611 corridor was nominated and agreed upon by all task force members due to high traffic volumes and numerous access points. Members from Bucks County and municipal representatives participated in the planning exercises and were given the opportunity to review and make comments on the draft report.

The access management assessment conducted in this study is comprised of two facets: the geographic-specific assessment and a review of the municipal enabling ordinances. The primary goal of this study, and of the access management program as a whole, is to educate the municipal representatives on the benefits of access management and for access management to be included in future municipal transportation-related decision making.

Highway access management is one of many strategies available to improve the function of a municipal or state roadway. The methods employed in access management seek to identify corridor needs, optimize the existing transportation infrastructure, and accommodate eventual change. Access management strategies generally work toward reducing conflict points, decreasing through-travel interruptions, and making vehicle entrances and exits at driveways and roadways more predictable.

Access management is closely related to land development, and since land use and development are municipal responsibilities, implementation can most effectively be achieved through the practices, plans, and ordinances that guide and support the municipality's land development. This includes design, application, review, and approval processes (e.g., the comprehensive plan, official map, zoning ordinance, and subdivision and land development ordinance). In turn, formal placement and design of new intersecting streets and driveways along important state and local highways within the municipality's jurisdiction can be regulated by the municipality. Where state highways are involved, formalized access management plans can also be supported by PennDOT's highway occupancy permitting process.

If implemented through the land development design and approval process, access management is a relatively low cost means of reducing congestion and increasing both the efficiency and safety of a roadway. Techniques can be introduced on a case-by-case

basis by retrofitting access at individual parcels along developed highway corridors or incrementally along growing corridors. The key is to have a defined plan of approach and the legal basis for requiring compliance.

According to the *Access Management Manual*, the goals of access management are accomplished by applying the following principles.

- Provide a specialized roadway system.
- Limit direct access to major roadways.
- Promote intersection hierarchy.
- Locate traffic signals to favor through movement.
- Preserve the functional areas of intersections and interchanges.
- Limit the number of vehicle conflict points (where vehicle paths intersect).
- Separate vehicle conflict areas.
- Remove turning vehicles from through travel lanes.
- Use nontraversable medians to manage turning movements.
- Provide a supporting street and circulation system.

National studies indicate that where access management techniques are consistently implemented along a highway corridor, collisions can be reduced by as much as 50 percent, capacities increased between 23 and 45 percent, and travel times and delays reduced by as much as 40 to 60 percent versus highway segments with unregulated or under regulated access management practices (*NCHRP Report 420*). Other studies have concluded that increasing driveway interferences (e.g., conflict points) from 10 to 20 per mile can result in a 30 to 40 percent increase in crashes along a highway (*Access Management Manual*).

Highway functional classification is a term that implies the hierarchy and interconnectivity of a highway network. Typically, freeways, expressways, and arterial highways provide through travel and mobility over longer distances. Local travel, composed of shorter trips, is served by collector roads and local streets. More often than not, trips include both local and longer-distance elements, hence the importance of interconnectivity and continuity of the system to serve all highway trips. Functional classification is an important parameter in determining the extent to which access management strategies should be applied. Highways designated in the transportation system may also be eligible for federal funding assistance when transportation improvement projects are contemplated.

A foundation for understanding the hierarchy of roads is represented by the federal aid highway classification system. Typically, functional classification maps and highway designations are also found in municipal comprehensive plans. Highway design standards, contained in PennDOT manuals and municipal ordinances, reinforce the intended function of a highway. PennDOT's *Access Management Model Ordinances for*

Pennsylvania Municipalities Handbook also arranges its guidelines in relation to a highway's functional classification.

DVRPC's access management work program was created to promote and support PennDOT's Model Access Management Ordinance project with the participation of the membership and the municipalities. DVRPC's access management planning methodology draws from the region's federally mandated Congestion Management Process (CMP), which aims to minimize congestion and enhance the mobility of both people and goods along a defined network of highways.

CHAPTER 2

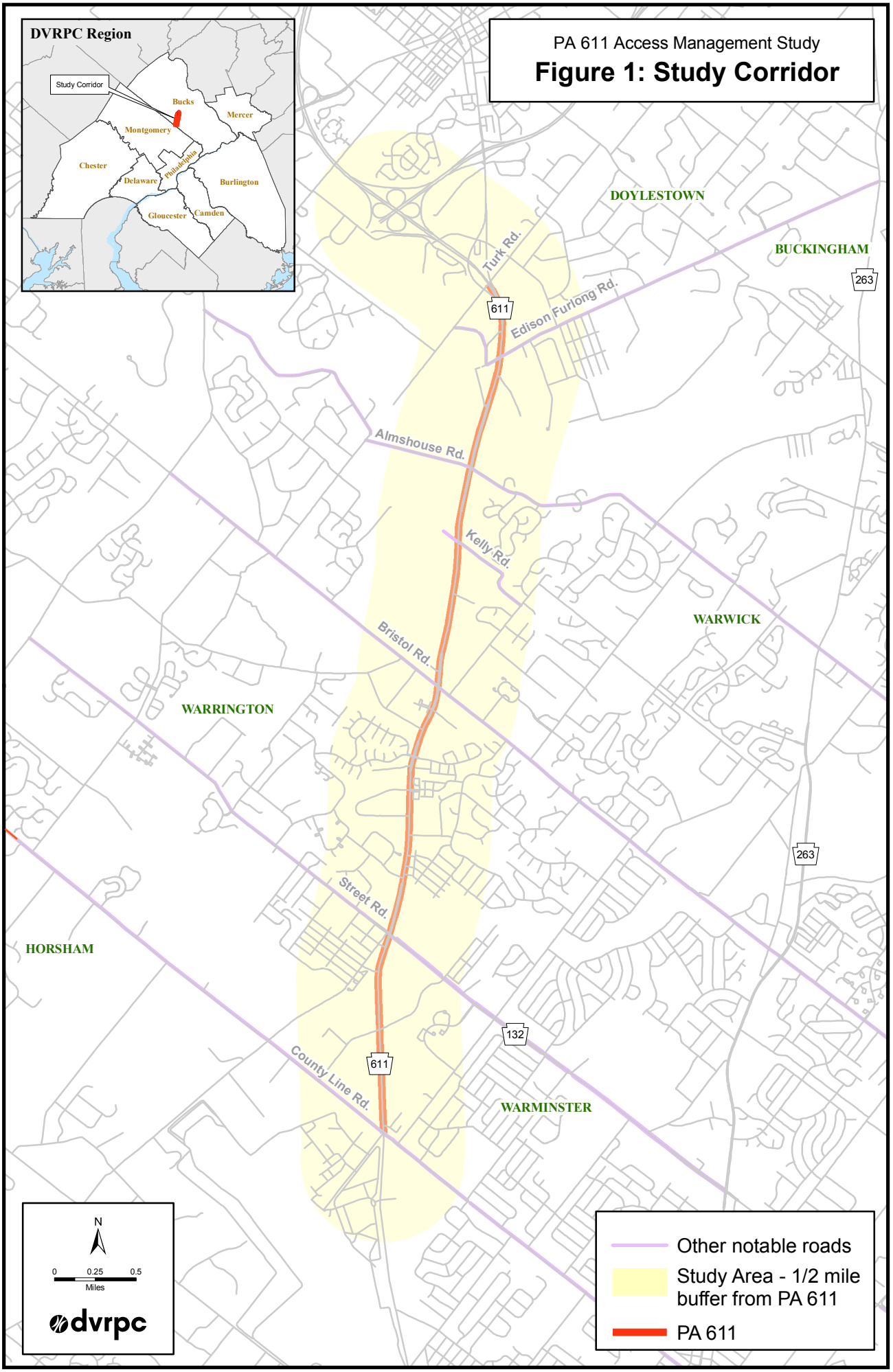
Study Area Transportation Facilities

This study is concerned with PA 611 within the limits of Doylestown and Warrington townships, Bucks County. As illustrated in Figure 1, the southern end of the study area is defined by the County Line Road intersection, and the northern terminus is the Turk Road intersection, where the PA 611/US 202 Bypass begins, a distance of approximately 5.3 miles. The study corridor can be defined by the four-lane PA 611 roadway, abutting commercial land uses that are surrounded by residential land uses. The landscape consists of rolling hills resulting in slight to moderate grade changes.

Existing Conditions

The study corridor is a suburban arterial highway in the Philadelphia metropolitan area. Center City Philadelphia is approximately 18 miles to the south. Trenton, New Jersey, is approximately 20 miles to the east, and Doylestown Borough is roughly two miles north of the study corridor. The Pennsylvania Turnpike is the nearest interstate highway, intersecting PA 611 about four miles south of the study corridor. Due to its proximity to major regional employment centers, residential growth is expected.

No major transportation improvements are planned for the study area in the foreseeable future. However, *Connections 2035*, the regional Long-Range Plan, identifies the widening and reconstruction of County Line Road between PA 309 and PA 611 as a future project. Additionally, US 202 Section 700, the US 202 Parkway, was under construction during the course of this study, and has recently opened. The latter may contribute to slightly lower traffic volumes on PA 611. Access management can be used to improve and/or maintain existing levels of mobility and improve safety along the corridor.


PA 611 Access Management Study
Figure 1: Study Corridor
DVRPC Region
Study Corridor
Bucks
Mercer
Montgomery
Chester
Philadelphia
Delaware
Burlington
Gloucester
Camden
DOYLESTOWN
BUCKINGHAM
263
Turk Rd.
611
Edison Furlong Rd.
Almshouse Rd.
Kelly Rd.
WARWICK
Bristol Rd.
WARRINGTON
263
Street Rd.
HORSHAM
132
611
County Line Rd.
WARMINSTER
N
0 0.25 0.5
Miles
dvrpc
Other notable roads
Study Area - 1/2 mile buffer from PA 611
PA 611

Roadway Characteristics

PA 611 is functionally classified as a principal arterial highway. Traffic volumes range from an annual average of approximately 28,000 vehicles per day on the southern end of the study corridor to 33,300 vehicles per day near the northern end. The study corridor has varying characteristics, including:

- Seventeen traffic signals, averaging roughly three per mile;
- Auxiliary turning lanes are present at many signalized intersections;
- Approximately half of the study corridor has a nontraversable center median;
- There is a two-way left-turn lane (TWTL) where there is no center median;
- There are four through travel lanes consistently along the study corridor;
- Route 611 becomes a limited-access freeway north of the study area;
- The entire study corridor has a posted speed limit of 45 miles per hour; and
- There are inconsistent highway shoulder widths.

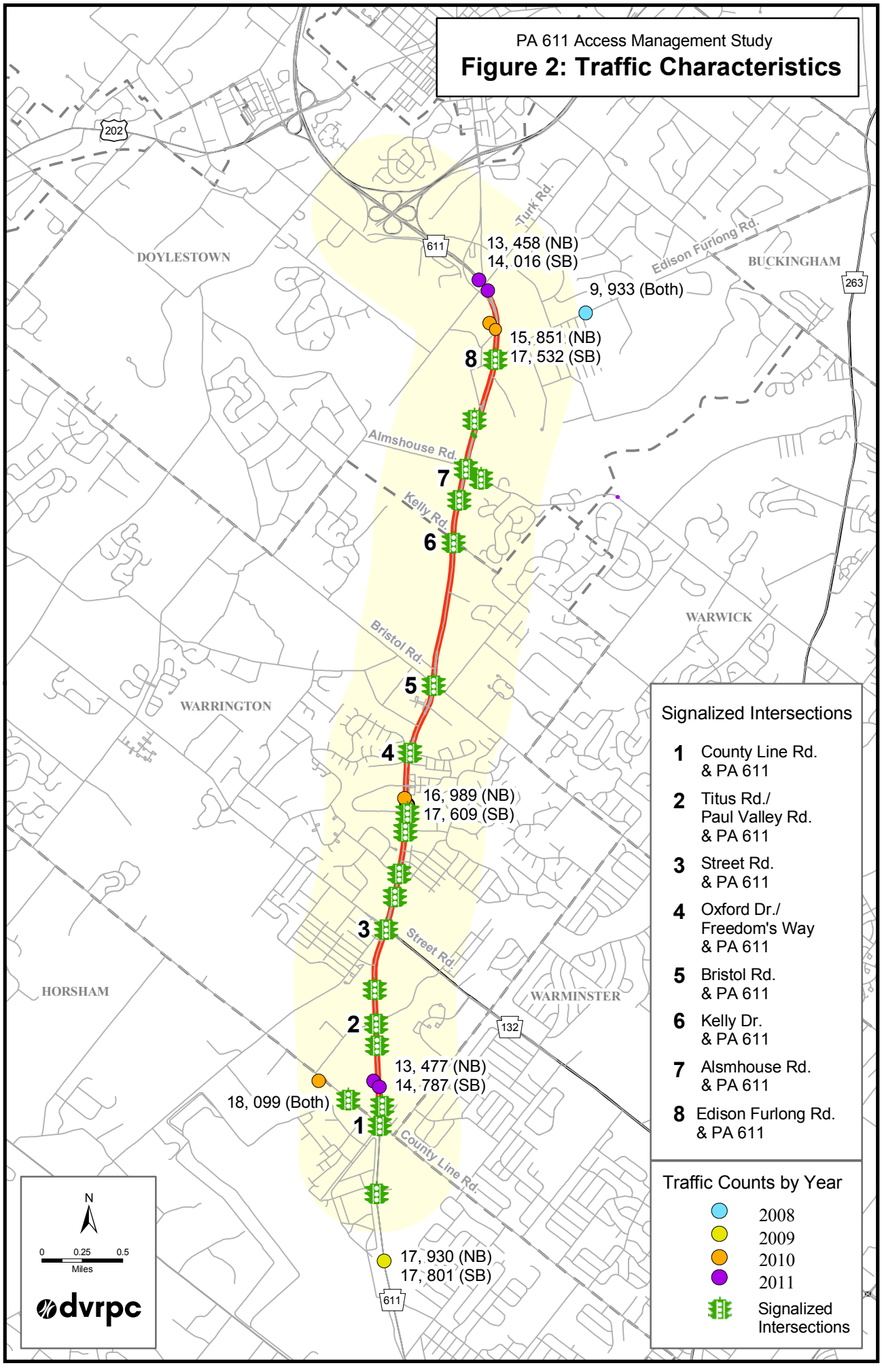
Figure 2 highlights traffic counts collected between 2008 and 2011 along the corridor. The highest traffic volumes are between Almshouse and Edison Furlong roads, while the lowest volumes are in the vicinity of Turk Road. This map also illustrates signalized intersections.

Other Notable Roads in the Study Corridor

- County Line Road – This road is a principal arterial that extends between PA 309 north of Montgomeryville and PA 532, Bustleton Pike, in Northeast Philadelphia. There are two travel lanes east of PA 611 and four travel lanes west of PA 611.
- Street Road (PA 132 and SR 3001) – Extends between Lower State Road and Bensalem. East of PA 611 there are two travel lanes per direction and the route designation changes from PA 132 to SR 3001. It is a minor arterial east of PA 611 and a principal arterial west of the study corridor.
- Bristol Road – This minor arterial roadway extends between US 202 near Chalfont and Bensalem. One travel lane is offered in each direction.
- Kelly Road – Extends between Bristol Road west of PA 611 and Stuckert Road to the east, and it is a local road. West of PA 611, Kelly Road provides access to an office park. One travel lane is offered in each direction.
- Almshouse Road – This major collector extends between Richboro (where it becomes Newtown-Richboro Road) and US 202 in New Britain. One travel lane is offered in each direction.
- Edison Furlong Road – Extends between PA 263, York Road, and west of PA 611. It has one travel lane, and it is a major collector east of PA 611 and a local road to the west.

PA 611 Access Management Study

Figure 2: Traffic Characteristics



Signalized Intersections

1. County Line Rd. & PA 611
2. Titus Rd./ Paul Valley Rd. & PA 611
3. Street Rd. & PA 611
4. Oxford Dr./ Freedom's Way & PA 611
5. Bristol Rd. & PA 611
6. Kelly Dr. & PA 611
7. Alsmhouse Rd. & PA 611
8. Edison Furlong Rd. & PA 611

Traffic Counts by Year

- 2008
- 2009
- 2010
- 2011
- Signalized Intersections

Public Transit Service

Two bus routes operate along PA 611 and two regional rail lines operate in the vicinity.

SEPTA Route 55

- Provides seven-day service along PA 611 between Doylestown and the Olney Transportation Center in North Philadelphia;
- On weekdays there is service roughly 30-minute headways during the day and one hour at night;
- Operates between 4:30 AM and 3:00 AM (22.5 hours/weekday); and
- Offers approximately 90-minute weekend headways.

Doylestown Dart

- Provides service between Neshaminy Manor (Almshouse Road) and points north, including Delaware Valley College, Doylestown Rail Station, and Doylestown Hospital, among others;
- One-hour headways;
- Weekday-only service between 8:00 AM and 6:00 PM; and
- Operated by the Bucks County Transportation Management Association.

SEPTA Doylestown Regional Rail Line

- Provides service between Doylestown Borough and Center City Philadelphia;
- Offers 30-minute peak and one-hour off-peak headways between 5:30 AM and 11:00 PM on weekdays; and
- Offers one-hour weekend headways between 6:30 AM and 11:30 PM.

SEPTA Warminster Regional Rail Line

- Provides service between Warminster and Center City Philadelphia;
- Offers 30-minute peak and one-hour off-peak frequency between 5:30 AM and 1:00 AM on weekdays; and
- Offers one-hour weekend frequency between 5:30 AM and 11:30 PM.

The two bus services are convenient for connecting employees to jobs along the PA 611 corridor, where pedestrian amenities are available. For study area residents utilizing the rail services, a trip by personal vehicle is necessary to reach the stations. Land use patterns along the study corridor are not ideal for supporting transit ridership.

Congestion Management

The Congestion Management Process (CMP) advances the goals of the DVRPC Long-Range Plan and provides strategies to mitigate congestion throughout the region. Regularly updated, it provides information on transportation system performance and

identifies strategies to enhance the mobility of people and goods. In keeping with federal regulations and DVRPC policy, it first seeks to address problems through strategies other than building new single-occupancy vehicle (SOV) capacity. Where additions to SOV capacity are appropriate, the CMP includes supplemental strategies to attain the most long-term value from the investment. Projects that add SOV capacity must be consistent with the CMP to be eligible for federal transportation funding.

The CMP acts as a connection between the region's Long-Range Plan and the region's Transportation Improvement Program (TIP) to ensure that appropriate strategies are applied to improve regional transportation facilities. An initial step in the CMP was to define congested corridors throughout the region. The process then considered characteristics within each corridor and preliminarily identified strategies—including access management techniques—to mitigate congestion. Consequently, with the direct participation of the local municipality or municipalities in the case study evaluation, DVRPC's access management corridor approach provides a more detailed evaluation than the CMP's general recommendation and a sounding board for its acceptance.

The CMP identifies a set of congested corridors for the region. Each is divided into subcorridors, where, at a regional planning scale, similar strategies are appropriate. PA 611 is classified as a congested corridor in the CMP. It is identified as PA Corridor 14, subcorridor 14F.

Identified strategies in the CMP include the following:

- Closed-loop computerized traffic signals;
- Channelization;
- Center turn lanes;
- County and local road connectivity;
- Transit-oriented development (TOD); and
- Extensions or changes in bus routes.

Study Area Transportation Facilities Conclusion

In the study area, PA 611 is perceived to be congested by commuters and identified to be congested by the CMP. No major improvements to the highway are planned. There are few other north-south highways to relieve demand on PA 611. Public transit services are offered along the corridor and in the vicinity, but the land use patterns are not transit supportive. Access management is a means to preserve and/or improve mobility along PA 611 as demand continues to grow.

CHAPTER 3

Land Use, Natural, and Cultural Environments

The relationship between land use and transportation facilities is central to any traffic study. The use of the land–where people live, work, and play–and its intensity is responsible for trip generation and its magnitude. The geographic distribution of uses and the transportation facilities connecting and serving the uses are responsible for how trips are made (e.g., by highway, transit, walking, etc.).

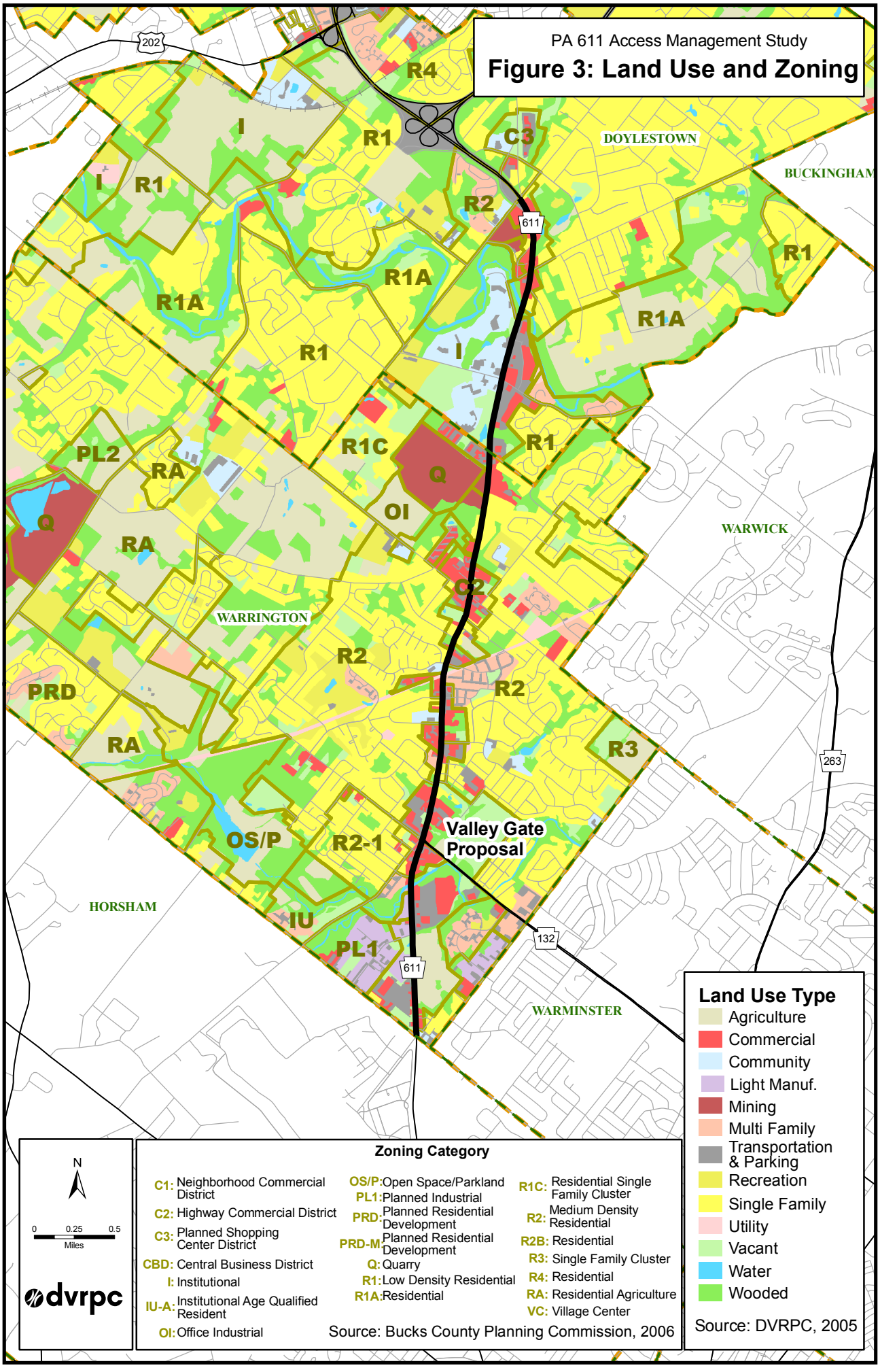
Land Use and Zoning

Land use along the study corridor is varied. Abutting PA 611 are typical commercial land uses, such as gas stations, auto dealerships, shopping centers, and offices. Zoning varies along PA 611. Figure 3 illustrates land use and zoning along the study corridor.

Though development along the corridor has been occurring for many years, the rate of development has accelerated in the past 20 years. Between 1990 and 2005, the following changes have occurred within a half-mile of the corridor: land devoted to residential uses has increased 23 percent to 1,637 acres, land used for commercial purposes has increased 43 percent to 290 acres, agricultural lands have declined 69 percent to 238 acres, and land used for automobile parking has increased by 103 percent to 273 acres. As the study corridor nears a point of full development, the current rate of development cannot be sustained into the future.

Abutting the corridor is one remaining sizable parcel in agricultural use. This parcel, between County Line Road and Street Road, is the proposed Valley Gate development. The 67-acre site is proposed to be developed with a mix of commercial, hotel, and residential land uses. Beyond the Valley Gate development, little undeveloped land exists for new large-scale developments. However, it is important to note that just south of the study area in Horsham Township, preliminary plans are emerging for the redevelopment of the former Willow Grove Naval Air Station. Depending on the size of the redevelopment, mix of land uses, and traffic impact mitigation efforts, PA 611 in Warrington and Doylestown townships may experience increased congestion.

The majority of zoning along PA 611 is dedicated to central business district, highway commercial, institutional (Bucks County offices, parks, and services), and medium-density residential (Valley Square). There are a few areas that are low-density residential, likely land that is yet to be redeveloped. Outside the immediate study corridor are agricultural lands, institutions, low-density residences, open park spaces, and quarries. These zones are lower density than right along the study corridor. Figure 3 illustrates the land uses and zoning along the study corridor and the surrounding area in more detail.


PA 611 Access Management Study
Figure 3: Land Use and Zoning
DOYLESTOWN
BUCKINGHAM
WARWICK
WARRINGTON
HORSHAM
WARMINSTER
Valley Gate Proposal
202
611
263
132
R4
R1
C3
I
R2
R1A
R1C
Q
OI
C2
R3
PRD
PL2
RA
OS/P
R2-1
IU
PL1
Land Use Type
Agriculture
Commercial
Community
Light Manuf.
Mining
Multi Family
Transportation & Parking
Recreation
Single Family
Utility
Vacant
Water
Wooded
Source: DVRPC, 2005
Zoning Category
C1: Neighborhood Commercial District
C2: Highway Commercial District
C3: Planned Shopping Center District
CBD: Central Business District
I: Institutional
IU-A: Institutional Age Qualified Resident
OI: Office Industrial
OS/P: Open Space/Parkland
PL1: Planned Industrial
PRD: Planned Residential Development
PRD-M: Planned Residential Development
Q: Quarry
R1: Low Density Residential
R1A: Residential
R1C: Residential Single Family Cluster
R2: Medium Density Residential
R2B: Residential
R3: Single Family Cluster
R4: Residential
RA: Residential Agriculture
VC: Village Center
Source: Bucks County Planning Commission, 2006
N
0 0.25 0.5
Miles
dvrpc

Demographics

Population and employment growth in the study municipalities has shaped the existing land use patterns. Continued population and employment growth will shape the future land use patterns. Table 1 contains current and forecasted demographics. Each of the municipalities' rates of growth is expected to outpace that of Bucks County and the DVRPC region.

Table 1: Population and Employment

	Population			Employment		
	2010	2040**	Change	2010	2040**	Change
Corridor Municipalities	40,983	52,703	29%	18,028	22,129	23%
Doylestown Township	17,565	21,078	20%	10,083	12,100	20%
Warrington Township	23,418	31,625	35%	7,945	10,029	26%
Abutting Municipalities	153,175	184,261	20%	95,879	113,874	19%
Buckingham Township	20,075	25,448	27%	7,020	8,099	15%
Doylestown Borough	8,380	8,744	4%	9,108	10,204	12%
Horsham Township	26,147	31,611	21%	30,872	37,323	21%
Montgomery Township	24,790	27,266	10%	15,284	18,311	20%
New Britain Borough	3,152	3,355	6%	2,589	2,756	6%
New Britain Township	11,070	13,111	18%	4,543	5,381	18%
Plumstead Township	12,442	17,353	39%	6,315	7,808	24%
Warminster Township	32,682	39,376	20%	14,919	17,975	20%
Warwick Township	14,437	17,997	25%	5,229	6,018	15%
Bucks County	625,249	727,150	16%	293,325	335,747	14%
Nine County DVRPC Region	5,626,186	6,259,422	11%	2,841,765	3,147,126	11%

Source: DVRPC 2012, Forecast **

Human and Natural Environments

Environmental Justice

Advance inventorying work was performed in identifying human and natural environments in the study area. As projects are developed, the information may be helpful in engaging targeted residents, helping identify avoidance steps, and/or preparing for the eventuality of compliance with the requirements of federal mandates.

Federal law, Title VI of the Civil Rights Act of 1964, and the 1994 President's Executive Order on Environmental Justice states that no person or group shall be excluded from participation in, or denied the benefits of, any program or activity utilizing federal funds. Each federal agency is required to identify any disproportionately high and adverse

health or environmental effects of its programs on minority and low-income populations. Metropolitan Planning Organizations (MPO), as part of the United States Department of Transportation's certification requirements, are charged with evaluating their plans and programs for environmental justice sensitivity, including expanding their outreach efforts to low-income, minority, or other disadvantaged population groups.

DVRPC developed a method of analysis in 2001, which has been updated several times since. U.S. Census data is used to access eight Degrees of Disadvantage (DOD): minorities, Hispanics, disabled, carless households, impoverished households, female heads of household with children, and limited English proficiency households. Census tracts with a population that exceeds the Philadelphia metropolitan regional average, or threshold, are considered EJ-sensitive.

DOD was applied to the study municipalities using data from the 2000 Census. The findings indicated that Census tract 42017104603 in Doylestown Township, west of PA 611, houses an elderly population (75 years and older) that exceeds the regional average. This is likely due to the long-term care facility, Neshaminy Manor, in this tract. Planning projects requiring federal funding should reach out to this population.

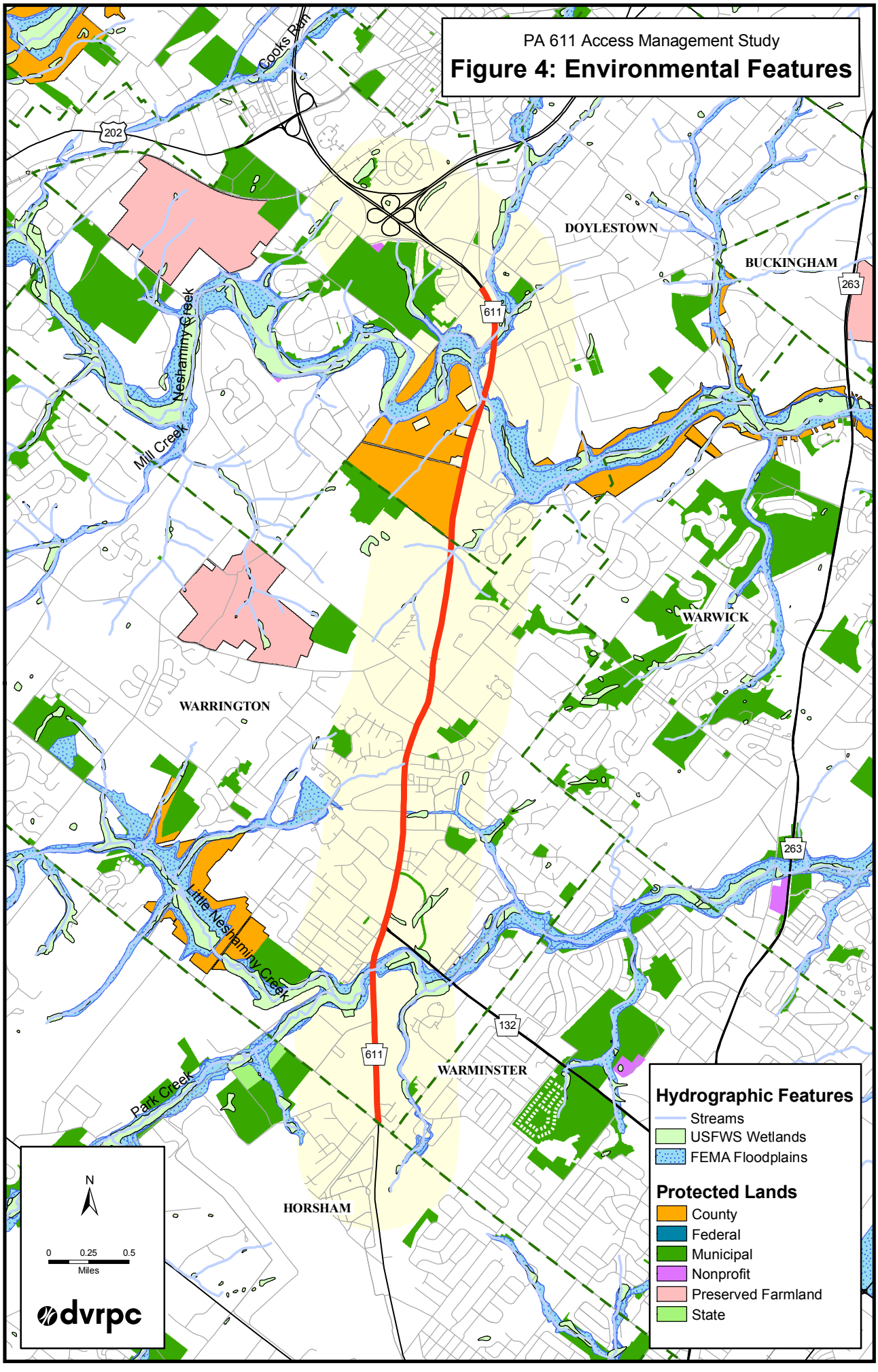
Cultural and Historic Features

Cultural landmarks and historic resources in the study corridor include private and public schools, colleges and universities, historic sites, and parks. Delaware Valley College is located in Doylestown Township, just northwest of the study area. There are multiple sites within the study area on the National Register for Historical Places in Bucks County: Tabor Home for Needy and Destitute Children (Doylestown), Bridge Valley Bridge (Hartsville), Cabin Run Covered Bridge (Point Pleasant), and Moland House (Hartsville). Special consideration may need to be given to transportation and land use projects that impact these locations.

Natural Features

The presence of natural features and protected lands can influence future development patterns. Development often creates more impervious surfaces which can lead to accelerated runoff and flooding. In addition, water quality and the natural habitat can be impaired.

Natural features in the study corridor are illustrated in Figure 4 and include floodplains, protected lands, and wetlands. There are three areas of preserved farmland within one mile of PA 611, highlighted in pink in Figure 4. One section off of Bristol Road is the Warrington Quarry, where Eureka Stone is mined. Throughout the study corridor, there are numerous streams and lakes. Neshaminy Creek runs along Almshouse Road, and Little Neshaminy Creek begins at Street Road and converges with Neshaminy Creek northeast of the intersection of Almshouse Road and PA 611. There are significant floodplain and wetland areas close by PA 611.


PA 611 Access Management Study
Figure 4: Environmental Features
Cooks Run
202
DOYLESTOWN
BUCKINGHAM
263
611
Neshaminy Creek
Mill Creek
WARWICK
WARRINGTON
263
Little Neshaminy Creek
132
611
WARMINSTER
Park Creek
HORSHAM
N
0 0.25 0.5
Miles
dvrpc
Hydrographic Features
Streams
USFWS Wetlands
FEMA Floodplains
Protected Lands
County
Federal
Municipal
Nonprofit
Preserved Farmland
State

CHAPTER 4

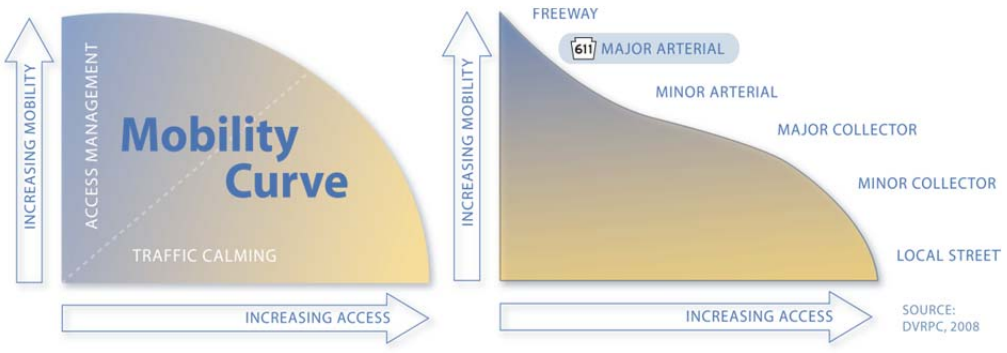
Access Management: Principles, Practices, and Observations

Access Management Principles and Practices

Access management is the lesser known and understood counterpart to traffic calming. The two are related due to their application to roadways–traffic calming to lower-order roadways and access management to higher-order roadways. However, there is one big difference: traffic calming is often reactive, while access management works best when used proactively.

Roadways are commonly classified according to their respective function. In Pennsylvania, PennDOT classifies roadways in accordance with the *American Association of State Highway Transportation Officials' (AASHTO) A Policy on the Geometric Design of Highways and Streets*. These classifications range from principal arterial (PA 611) to local road. Counties and municipalities often build on this with a classification system of their own, usually contained in the comprehensive plan. Limited-access freeways would be classified above principal arterials, and they assist in the understanding of access management. A limited-access freeway has severely restricted access; the only access allowed is at interchanges. No driveways are found on these facilities. This roadway design is used to provide the greatest levels of mobility possible. Conversely, local roads have many driveways. Mobility on local roads is of secondary importance to providing access to abutting commercial and residential properties. In fact, if mobility on local roads is too high, traffic-calming measures may be requested and employed to decrease mobility. Access management works the other way. If access is hampering mobility, highway access management techniques may be appropriate. It is also appropriate to preserve mobility before undue access creates an actual problem. Figure 5 provides a visual representation of the access/mobility relationship.

Figure 5: Mobility Curve



The graphic shows the role that access and mobility play in relation to the various functions and classifications of roadways. Access management and traffic calming become appropriate when roadways begin to stray from their intended function. When skewing occurs, the purple portions of the curve may require access management and the yellow portions may require traffic calming. Again, both access management and traffic calming may be used to prevent the curve from becoming skewed in the first place.

The *Smart Transportation Guidebook: Planning and Designing Highways and Streets that Support Sustainable and Livable Communities* was published in March 2008. The document was a collaborative effort between DVRPC and the Pennsylvania and New Jersey DOTs, and its concepts have since been adopted by PennDOT. According to the guidelines in the *Smart Guidebook*, PA 611 is considered a regional arterial throughout the study area. By distinguishing classifications beyond principal arterial highway, roadway treatments more in line with the surrounding land-use context may be utilized.

Safety is also compromised by a skewed mobility curve. Access points create turbulence on the roadway. When poor access management is in place, too many conflict points (turbulences) are present and are disorderly in nature, resulting in less predictable driver behavior and ultimately increased crashes.

With safety and mobility in mind, the PennDOT Access Management Manual notes that "The purpose of access management is to provide vehicular access to land development in a manner that preserves the safety and efficiency of the transportation system". Access management is not about placing undue requirements on developers and businesses; rather, it is concerned with preserving mobility and improving safety on regional roads.

Access management in Pennsylvania has historically been the responsibility of PennDOT; however, a 1997 legal decision established precedent for municipal-level access management ordinances. The case, Ice v. Cross Roads Borough (York County), found that property developers are required to satisfy the access requirements of both the local municipality and PennDOT, even if the local municipality's requirements are more thorough than those of PennDOT. PennDOT fully supports municipal access management regulations. *Pennsylvania Code, Title 67, Chapter 441*, defines the access management regulations employed by PennDOT. The regulations were developed as a generic set of guidelines that may be applied to the commonwealth as a whole, and by no means reflect the context of any particular municipality. Enacting local access management ordinances is a means to be more fitting to the unique situations of a municipality and to provide access management planning coverage to non-state-owned roads. *Chapter 441* explicitly states that municipalities may enact ordinances that are more stringent than the Pennsylvania Code of Regulations. Essentially, the access management regulations identified in *Chapter 441* act as a default.

Just as there are numerous traffic-calming techniques, there are various methods used to accomplish access management. Municipal ordinances only establish the legal basis for employing the methods. *PennDOT Planning Services and Implementation, Work Order #7, Task #4*, provides a comprehensive list of access management techniques categorized by purpose.

There are many highway access management techniques that can be used to limit conflicts. One example is to install median barriers to control traffic for deceleration, merging, right and left turns, and uncontrolled access along property frontage. In addition, channelizing median openings to restrict left-turn ingress or left-turn egress will reduce conflict points. By offsetting opposing driveways and maintaining spacing requirements, conflict points will be limited.

Regulating the minimum spacing of driveways, the distance between a crossroad intersection and the nearest driveway, and the maximum number of driveways per property frontage are three highway access management techniques to separate basic conflict areas. In addition, techniques to keep conflict areas farther from each other that can be employed include: denying access to small frontages, consolidating existing access for adjacent properties, designating the number of driveways to each existing property and denying additional driveways regardless of future subdivision of that property, and requiring access on a collector street in lieu of driveways on a major highway.

Highway access management techniques to limit deceleration requirements include improving and regulating minimum sight distance and the effective approach width of a driveway. In addition, improving the profile of a driveway, optimizing its location in the permit authorization stage, and increasing the effective approach width are tactics to limit deceleration requirements. Also, by installing right-turn acceleration lanes, lower speeds will not be required along the study corridor because vehicles will have time before merging to increase their speed.

Highway access management techniques to remove turning vehicles from through lanes may include: two-way left-turn lanes, alternating left-turn lanes, isolated medians, deceleration lanes, and medial storage lanes

Observations: The Good, the Bad, and the Ugly

Providing local examples of actual practices in highway access management is helpful in illustrating the benefits.

The Good

Several aspects of the study corridor exhibit well-designed access management. Figure 6 highlights two positive traits—a center median and auxiliary turning lanes at signalized intersections. The center median is present along approximately half of the corridor, and it prevents unprotected left turns. Auxiliary turning lanes are located at all signalized intersections. A majority of these intersections have both right- and left-

Figure 6: Center Median and Auxiliary Turning Lanes

Source: DVRPC 2012

turn lanes, while all have at least left-turn lanes. Auxiliary turn lanes are beneficial for removing turning vehicles from through travel lanes, thus creating a safer driving environment.

Figure 7 highlights a driveway for the Wawa convenience store south of the Street Road intersection. The store's only driveway connecting with PA 611 is channelized and right in, right out only. Additionally, a deceleration lane is associated with the driveway. This driveway design provides a safer and more predictable driving environment.

Figure 7: Channelized Driveway

Source: DVRPC 2012

The Bad

There is an overabundance of signalized intersections along the study corridor. According to the Smart Transportation Guidebook, recommended signal spacing on a highway of PA 611's type (regional arterial, suburban context) is between 1,320 and 1,540 feet. Seven of the 17 signals are spaced less than the minimum recommendation, as near as 615 feet from one another. Six of the 17 signals serve access to/from commercial properties. Ideally, commercial properties would be accessed from intersecting streets rather than dedicated signals on the regional arterial. An analysis of aerial photographs from 1970 to 2010 in 10-year increments was conducted to assess when the signals were installed. The analysis found the following:

- In 1970 there were four signalized intersections.
- In 1980 there were five signalized intersections.
- In 1990 there were eight signalized intersections.
- In 2000 there were 14 signalized intersections.
- In 2010 there were 17 signalized intersections.

The first signal for commercial property access was installed between 1990 and 2000. While providing access to commercial property is important, every effort should be made to design future access without the need for new traffic signals. Additional traffic signals will decrease mobility. This can be controlled by stipulating desired signal spacing by road type in the subdivision and land development ordinance.

The Ugly

Figure 8: Narrow Shoulders

Source: DVRPC 2012

The examples of poor access management are represented by remnants of the past. The first example, Figure 8, shows northbound PA 611 between Bristol and Almshouse roads. There are several residences and a church along this segment. No shoulders are present to remove turning vehicles from the travel lanes. The driveways are narrow and at 90 degrees, which require a slow entry. There are also residences along this stretch where sanitation trucks, school buses, etc. stop and block a travel lane. This creates an unsafe driving environment and limits mobility.

The second example, Figure 9 on the right, shows several commercial properties along the northbound side of PA 611 south of Street Road. These commercial properties appear to be converted residences, likely built when access was neither a problem nor a concern. This uncontrolled access may encourage left turns across traffic. It may also encourage or require unsafe egressing, such as backing onto PA 611.

This final example, Figure 9 on the left, shows the access to the properties along southbound PA 611 near the merge with the Doylestown Bypass. Along this segment there are several driveways and a limited shoulder. The problem is that drivers are paying attention to the southbound bypass traffic with which they will soon merge. A slowing or stopped vehicle in the travel lane is a safety hazard.

Figure 9: Uncontrolled Access

Source: DVRPC 2012

Highway Shoulders

There is congestion throughout the day on PA 611. Shoulders along a suburban highway such as PA 611 are beneficial to remove right-turning and disabled vehicles from travel lanes. By doing so, predictability (safety) is improved, as well as mobility. An inventory of

shoulders along PA 611 was conducted. The assessment as to whether shoulders were available was entirely qualitative and conducted via a windshield survey.

Ideally, eight- to 12-foot-wide shoulders would be available along the entire corridor. In reality, several segments do have adequate shoulder space, while others are physically constrained. Prior to 2000, a two-way center left-turn lane was installed on portions of PA 611, thereby purposely reducing shoulder widths. A means to widen shoulders without major construction efforts is to narrow travel lanes. Many portions of the study corridor have two or four travel lanes that are 13 feet wide. Where lanes are 13 feet, the lanes could be narrowed to 11 feet and provide an additional one or two feet of shoulder space per direction. This is a near-term measure to improve access and safety along the study corridor.

The study team visited US 1 near Kennett Square in Chester County and observed the half-mile stretch prior to the Kennett Oxford Bypass, shown in Figure 10. The photo illustrates that the northbound side of the roadway has a large shoulder, while the southbound side has a third lane for ingress and egress. This corridor has clustered traffic signals and a significant number of access points along both sides of the roadway. Vehicles entering southbound traffic do not interfere with through traffic. Where there are large shoulders and not auxiliary lanes, installing a third lane for a short distance is a concept that could be explored to reduce vehicle conflicts and congestion along PA 611.

Figure 10: US 1 Five-Lane Configuration

Source: DVRPC 2012

Climbing Lane

Stakeholders in both townships are concerned with the heavy vehicle traffic between Kelly Drive and Almshouse Road northbound, and Kelly Drive to Bristol Road southbound. A climbing lane was suggested in these areas and should be considered if it meets the suggested criteria. In this short distance, there are significant grade changes.

Therefore, adding a climbing lane would help keep slow and/or heavy vehicles to the right, which preserves mobility in the other lanes.

A highway section with a climbing lane is not considered a three-lane highway, but a two-lane highway with an added lane for slow moving vehicles. A climbing lane is normally provided as an added lane for the upgrade direction of a two-lane highway where the grade, traffic volume, and heavy vehicle volume combine to degrade traffic operations. In locations with low volumes a climing lane, although desirable, may not be justified economically, even where the critical length of grade is exceeded.

The following three criteria, reflecting economic considerations, should be satisfied to justify a climbing lane:

- Upgrade traffic flow rate in excess of 200 vehicles per hour.
- Upgrade truck flow rate in excess of 20 vehicles per hour.
- One of the following conditions exists:
  - A 15 km/h (10 mph) or greater speed reduction is expected for a typical heavy truck.
  - Level of service of E or F exists on the grade.
  - A reduction of two or more levels of service is experienced when moving from the approach segment to the grade.[1]

If a climbing lane is not warranted after further investigation, then adding an access lane such as on US 1 can be explored.

Principles, Practices, and Observations Conclusion

PA 611, in the study corridor, has roadway access of varying degrees of desirability. These range from good quality access connecting new developments to the roadway and undesirable roadways access associated with the older properties along the corridor. The good news is that better access management techniques have been implemented as new developments have replaced the old. There are several negative factors inhibiting mobility along the corridor, including a high number of closely spaced traffic signals and inconsistent shoulders. The remainder of this report discusses traffic safety, conceptual improvements, and municipal policy means for promoting good access management along the study corridor.

[1] For additional information on the principal determinants of need and the applicable criteria and detailed methodology for the inclusion of climbing lanes, refer to the section "Climbing Lanes" in the 2004 AASHTO Green Book, Chapter 3, and the Highway Capacity Manual.

CHAPTER 5

Traffic Safety Recommendations

An analysis of local crash data along PA 611 is a way to identify problematic intersections. Each new access point introduces conflicts and friction into the traffic stream. With increased conflicts, there is more potential for crashes. Crash data for PA 611 was evaluated for years 2008 to 2010, using PennDOT's database, which includes reportable crashes (bodily injury and/or tow away) occurring on state roads, as well as information conveyed by the project stakeholders.

The PennDOT database identifies nine crash types, six of which are prevalent in this corridor: rear end, head on, angle, sideswipe (same direction), sideswipe (opposite direction), and hitting fixed objects. In this corridor, a majority of the crashes were categorized as angle and rear end.

Nationally, at least 21 percent of all fatalities, 52 percent of injuries, and 45 percent of property-damage crashes occur at or near intersections. Therefore, the crash analysis in this chapter focuses on nine key intersections with the highest percentage of crashes. The following section is organized from south to north. By examining information about the number of crashes and pattern of crashes, related causation factors can be determined and general countermeasures can be identified where concerns exist (Pennsylvania Crash Facts & Statistics, 2010).

Figure 11 displays the spatial distribution of crashes across the study area. The number of identified crashes at each functional intersection, or area that extends both upstream and downstream from the physical intersection area and includes auxiliary lanes and their associated channelization, is within the circle in Figure 13. Of all the intersections, there is a higher percentage of rear-end crashes occurring throughout the corridor than angle crashes. All of the listed intersections are four-way signalized, with the exception of Duane Road, which is an unsignalized "T" intersection.

All crash data presented in this chapter is from 2008, 2009, and 2010.

PA 611 Access Management Study

Figure 13: Key Intersection Crashes 2008 to 2010

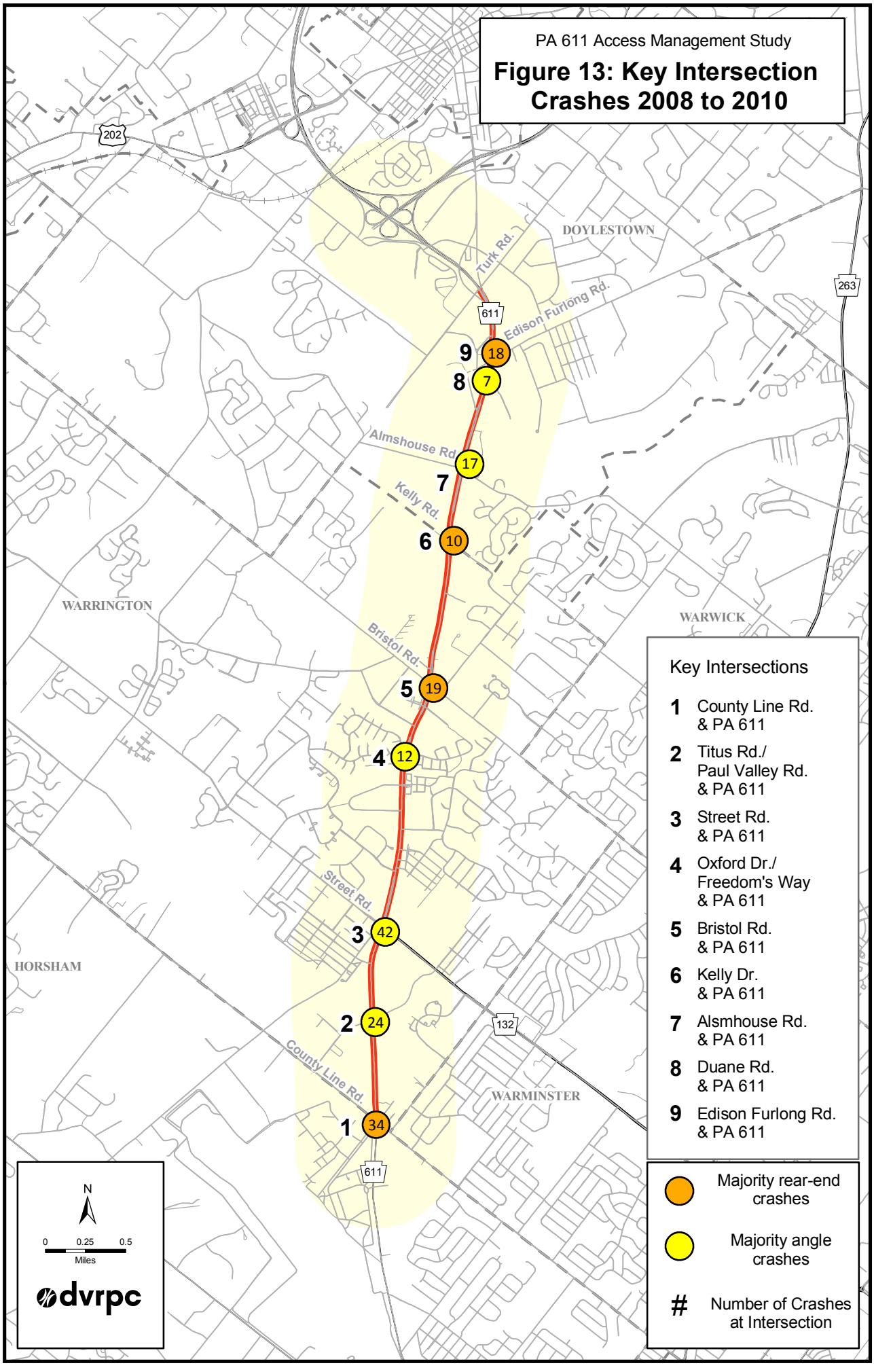


Table 2 identifies the number and percent of crashes at all nine intersections discussed in this chapter. Street Road and County Line Road have the highest amount of crashes along the corridor. Both of these roadways have four travel lanes and are principal arterials that extend further throughout the region.

Table 2: Crash Summary

Intersection	Total Crashes	% of Crashes
County Line Road	34	19%
Titus Avenue/Paul Valley Road	24	13%
Street Road	42	23%
Oxford Road/Freedom's Way	12	7%
Bristol Road	19	10%
Kelly Drive	10	5%
Almshouse Road	17	9%
Duane Road	7	4%
Edison Furlong Road	18	10%
Total	*183*	*100%*

Source: DVRPC 2012

Detailed Intersection Crash Analysis

County Line Road and PA 611

The first intersection in the study corridor is County Line Road and PA 611. Table 3 identifies all of the crashes reported to PennDOT at County Line Road, by type. Over the three-year period, 34 crashes were reported: 29 percent were rear-end crashes and 26 percent were angle crashes. The typical scenario of a rear-end crash at this intersection identified from the reports occurred when one vehicle was traveling north in the left-turn lane turning left on PA 611, while the second vehicle was traveling from an alternate point in the intersection.

Table 3: County Line Road Crashes

Type of Crash	Number of Crashes	% of Crashes at Intersection
Rear End	10	29%
Angle	9	26%
Sideswipe (same direction)	3	9%
Hit Fixed Object	8	24%
Hit Pedestrian	4	12%
Total	*34*	*100%*

Source: DVRPC 2012

Observations

- Eastbound and westbound approaches have protected/permitted left-turn signal phases, which are possibly contributing to some of the angled crashes.
- There is no right-turn lane heading northbound on PA 611, which may be related to the high percentage of rear-end crashes.
- There is a fifth leg at this intersection, Privet Road. This may be causing additional safety concerns and adding to driver confusion. However, there are signal detectors at this leg which results in the green phase being recalled only when a vehicle is present.
- A majority of vehicles using the light at Privet Road are turning out of the retail development on the southwest corner of the intersection.
- Few vehicles are turning right from southbound PA 611 and are likely using Titus Avenue to access the commercial and residential land uses west of PA 611.

Potential Improvement Strategies

- Evaluate installing northbound right-turn lane to remove traffic from through travel lanes prior to channelized area (a rendering can be found on page 48).
- Close Privet Road leg of the intersection when the National Guard access is relocated.

Titus Ave/Paul Valley Road and PA 611

Along PA 611 slightly north of County Line Road is the intersection of Titus Avenue/Paul Valley Road. At this crossing, 24 crashes were reported, and 29 percent of these were angled crashes, as shown in Table 4. The majority of angled crashes were vehicles traveling southbound.

Table 4: Titus Avenue/Paul Valley Road Crashes

Type of Crash	Number of Crashes	% of Crashes at Intersection
Rear End	6	25%
Head On	1	4%
Angle	7	29%
Sideswipe (same direction)	1	4%
Hit Fixed Object	7	29%
Hit Pedestrian	2	8%
Total	*24*	*100%*

Source: DVRPC 2012

Observations

- There are no protected left turns at this intersection, likely contributing to the high percentage of angled crashes.
- On the southeast corner there is a large parcel that has been proposed to be developed. Once this site is developed, it is likely that there will be more traffic on PA 611 and nearby intersections.
- There are not additional traffic signals being added for Valley Gate on PA 611, the proposed development on the southeast corner of this intersection. The existing traffic signals at Titus Avenue/Paul Valley Road and at the entrance to the Century 21 New Horizons Theater are sufficient for the new development.
- There are no striped crosswalks, although there are user-activated pedestrian crossing signals.

Potential Improvement Strategies

- For consistency with the rest of the corridor, protected/permitted left-turn signals with detection should be installed along PA 611 at both approaches, and evaluated for the Titus Avenue and Paul Valley Road approaches.
- Use existing traffic lights on PA 611 and adjacent roadways for access into the new Valley Gate development rather than adding new traffic signals.
- Add striping for crosswalks on the east and north sides of intersection, where there are user-activated pedestrian crossing signals.

Street Road and PA 611

The intersection of Street Road and PA 611 had the highest volume of crashes reported. As illustrated in Table 5, a majority of the crashes, 33 percent, were angled. These crashes involved vehicles traveling north or southbound along PA 611 and making turns onto the cross streets.

Table 5: Street Road Crashes

Type of Crash	Number of Crashes	% of Crashes at Intersection
Rear End	**10**	**24%**
Head On	**3**	**7%**
Angle	**14**	**33%**
Sideswipe (same direction)	**3**	**7%**
Sideswipe (opposite direction)	**2**	**5%**
Hit Fixed Object	**10**	**24%**
Total	***42***	***100%***

Source: DVRPC 2012

Observations

- Three of the four approaches have channelized right-turn lanes.
- Protected and permitted left turns are allowed from all four directions.
- The protected left turn for southbound traffic is lagging, causing vehicles unfamiliar with the intersection to speed through the intersection following the permitted green phase, not realizing that this approach has a protected phase.
- The center median extends northbound to the following intersection, the entrance to Valley Square.
- Pavement markings and crosswalks are faded.

Potential Improvement Strategies

- Evaluate adding a protected only phase for left turns on PA 611 northbound and southbound.
- Evaluate dual left-turn lanes for southbound PA 611 (discussed further in Chapter 6).
- Restripe pavement markings for safety purposes.

Oxford Drive/Freedom's Way and PA 611

At this intersection, 42 percent of the reported crashes were angled, as shown in Table 6. A significant percentage of these crashes were vehicles traveling northbound on PA 611.

Table 6: Oxford Drive/Freedom's Way Crashes

Type of Crash	Number of Crashes	% of Crashes at Intersection
Rear End	**2**	**17%**
Angle	**5**	**42%**
Sideswipe (opposite direction)	**1**	**8%**
Hit Fixed Object	**3**	**25%**
Hit Pedestrian	**1**	**8%**
Total	***12***	***100%***

Source: DVRPC 2012

Observations

- Northbound approaching vehicles have compromised sight distance to the signal due to a horizontal curve in the road and vegetation. A measurement found that all signal heads become visible from the right lane only 500 feet from the intersection.
- The westbound right-turn-on-red looking left visibility is severely restricted–measured at only 250 feet, as illustrated by Figure 12. This is well below the MUTCD-recommended 350 to 400 feet.

- Right turn on red is allowed in all directions, though making a right onto PA 611 from Oxford Drive may be hazardous.
- The pavement markings are faded.

Figure 12: Oxford Drive Sight Distance

Source: DVRPC 2012

Potential Improvement Strategies

- Investigate installing an advance warning flasher for northbound PA 611 approaching the intersection.
- Do not permit right turns on red for westbound traffic.
- Restripe pavement markings for clarity and safety purposes.

Bristol Road and PA 611

At this intersection, 42 percent of the crashes reported were rear end, as exhibited in Table 7. Of the rear-end crashes, many were vehicles traveling northbound turning right.

Table 7: Bristol Road Crashes

Type of Crash	Number of Crashes	% of Crashes at Intersection
Rear End	8	42%
Head On	1	5%
Angle	3	16%
Hit Fixed Object	6	32%
Hit Pedestrian	1	5%
Total	*19*	*100%*

Source: DVRPC 2012

Observations

- This intersection is surrounded by commercial development. Many of these businesses have been granted individual driveway access to PA 611.
- Figure 13 illustrates that vehicles are using the wide shoulder to make right turns. Faded pavement markings show that the shoulder is regularly used, creating turning conflicts at the intersection.
- The crosswalk striping is faded.

Figure 13: Northbound PA 611 at Bristol Road

Source: DVRPC 2012

Potential Improvement Strategies

- Work with property owners to better define driveways.
- Restripe northbound right shoulder or convert into right-turn lane.
- Restripe crosswalk.

Kelly Road and PA 611

Table 8 illustrates that the most frequent type of crash reported at Kelly Road and PA 611 was angled, at approximately 30 percent. A majority of these crashes were vehicles traveling north in the right lane. Kelly Road leads to a large residential population.

Table 8: Kelly Road Crashes

Type of Crash	Number of Crashes	% of Crashes at Intersection
Rear End	**2**	**20%**
Angle	**3**	**30%**
Sideswipe (same direction)	**1**	**10%**
Hit Fixed Object	**3**	**30%**
Hit Pedestrian	**1**	**10%**
Total Crashes	***10***	***100%***

Source: DVRPC 2012

Observations

- On the west side of this intersection there is a large office park.
- There is a right-turn lane for the southbound traffic, but not for the northbound traffic. There is potentially a wide enough shoulder for a northbound right-turn lane.
- Northbound between Kelly and Almshouse roads, there is enough space in the right shoulder to stripe a climbing or access lane.
- Southbound between Kelly and Bristol roads, a significant uphill grade change is present.

Potential Improvement Strategies

- Install right-turn lane on PA 611 for northbound traffic.
- Investigate a climbing or access lane for northbound PA 611 from Kelly Road to Almshouse Road and Bristol Road to Kelly Road southbound.

Almshouse Road and PA 611

This crossing has a significant amount of traffic on the intersecting approaches. To the east there are two major shopping centers that abut PA 611 and a number of residential communities. To the west of PA 611, there are Bucks County Services and a connection to Turk Road that runs to Bristol Road, with connections to collector streets of residential communities. Of the reported crashes, 35 percent were rear end and 35 percent were angled, as shown in Table 9.

Table 9: Almshouse Road Crashes

Type of Crash	Number of Crashes	% of Crashes at Intersection
Rear End	**6**	**35%**
Angle	**6**	**35%**
Sideswipe (same direction)	**1**	**6%**
Hit Fixed Object	**2**	**12%**
Hit Pedestrian	**2**	**12%**
Total	***17***	***100%***

Source: DVRPC 2012

Observations

- Following the intersection there is a grade change for northbound traffic. This may hinder acceleration for heavy vehicles.
- There is not a right-turn lane for westbound traffic, and more than half of the traffic is turning right during peak periods approaching the intersection. Traffic on this approach often spills back through the downstream traffic signal during peak periods. The approach was constructed along a hillside.

- The southbound left-turn lane often spills back into the travel lanes.
- Vehicles are using the southbound right shoulder as a right-turn lane despite signed prohibition.

Potential Improvement Strategies (discussed further in Chapter 6)

- Install a westbound right-turn lane.
- Extend southbound left-turn lane.
- Stripe right shoulder heading southbound with bus-only markings.
- A long-term strategy is to install a southbound right turn lane.

Duane Road and PA 611

Seven crashes were reported at this intersection, as exhibited in Table 10. The intersection is not signalized. The majority of crashes were angled (vehicles turning left traveling southbound and hitting vehicles heading northbound going straight) and northbound rear ends. Duane Road leads to a small residential community.

Table 10: Duane Road Crashes

Type of Crash	Number of Crashes	% of Crashes at Intersection
Rear End	**3**	**43%**
Angle	**3**	**43%**
Hit Fixed Object	**1**	**14%**
Total	***7***	***100%***

Source: DVRPC 2012

Observations

- There is no northbound right-turn lane, despite a greater than 90 degree turn. This is likely a contributor to rear-end crashes.
- Left turns are allowed onto Duane Road, from a center left-turn lane.
- There is a small sign indicating that vehicles should keep the intersection clear; however, through observation, this is not followed during peak periods.

Potential Improvement Strategies

- Investigate new methods for keeping the “box” clear, either with signage or pavement striping.
- Construct a northbound right-turn lane (discussed further in Chapter 6).

Edison Furlong Road and PA 611

There were 22 percent rear-end crashes and 22 percent angled crashes reported at this intersection, as displayed in Table 11. A common conflict was one vehicle traveling southbound turning left in the left lane and crashing into a second vehicle traveling northbound in the left lane. Edison Furlong Road provides connections with residential communities.

Table 11: Edison Furlong Road Crashes

Type of Crash	Number of Crashes	% of Crashes at Intersection
Rear End	**4**	**22%**
Angle	**4**	**22%**
Hit Fixed Object	**7**	**39%**
Hit Pedestrian	**3**	**17%**
Total	***18***	***100%***

Source: DVRPC 2012

Observations

- There is no protected left-turn signal phase for northbound left-turning vehicles.
- Poor sight distance for northbound left turns due to the intersection's location at the crest of a hill, and the vehicles traveling southbound are at highway speeds.
- Northbound left-turning vehicles often avoid the intersection by cutting through the 7-Eleven parking lot; thus, the left turns northbound on PA 611 may be underrepresented.

Potential Improvement Strategies

- Add protected signal phase for northbound left turns.
- Employ additional means to slow southbound bypass traffic.

Summary of Traffic Safety Recommendation

Crashes are primarily rear end and angled throughout the study corridor. Several methods have been identified in this section to improve the nine intersections with high safety concerns.

CHAPTER 6

Access Management Concept Plan Recommendations

PennDOT's publication *Access Management Model Ordinances for Pennsylvania Municipalities Handbook* was the prime resource used in generating recommendations in the study corridor. Access management strategies and applications within the model ordinances are structured in three tiers, in which varying techniques are applied over different physical limits or geographic areas.

This study corridor is approximately 5.3 miles long and abutting lands are largely developed. There are existing accesses that could be improved, though this will come over time through the redevelopment process. The following chapter illustrates detailed concepts for several key locations for access management improvements that will benefit both mobility and safety. Following these concepts, there is a discussion about parking policy improvements. In addition, a discussion of the Gateway/Corridor Study (2005), a study proposing land use and transportation methods to improve the transition between Doylestown Borough and Township, is offered.

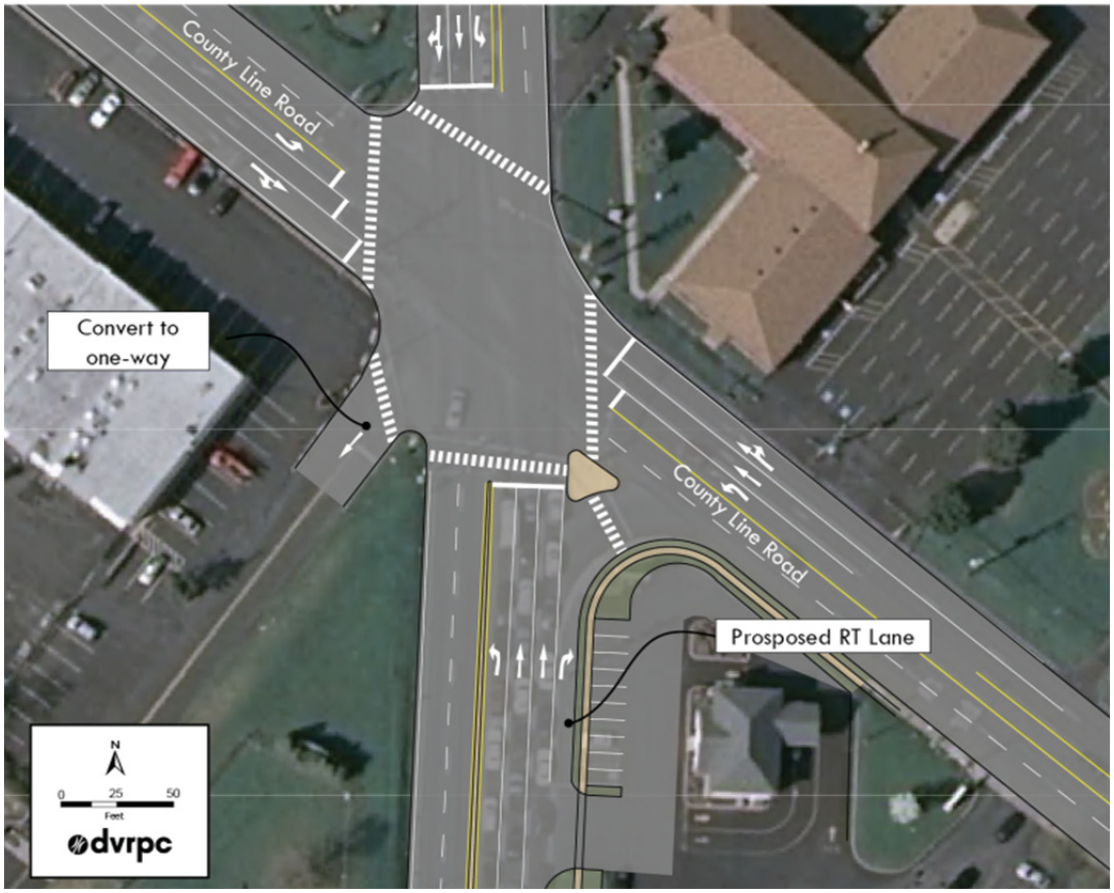
Key Location Concept Plans

Figures 14 to 19 illustrate several locations where there is an opportunity to implement measures that would improve traffic flow and reduce congestion. The suggestions could be used as examples for similar access management problems occurring in the future, or elsewhere along the corridor. The existing condition images of these figures can be found in Appendix B.

PA 611 and County Line Road

Figure 14 shows a channelized right-turn pocket lane for northbound PA 611 traffic, which is appropriate to install due to the acute angle of the intersection. Currently, this space is a grassy landscaped area in front of a bank. Rear-end crashes heading northbound were identified as the majority type, and adding this lane may prevent some of these crashes. The fifth leg, Privet Road, could be changed into a one-way-in roadway; this would still allow access into the shopping center, but would not require the light to have five phases. County Line Road is slated for significant improvements, and county and municipal officials should pursue having this project implemented.

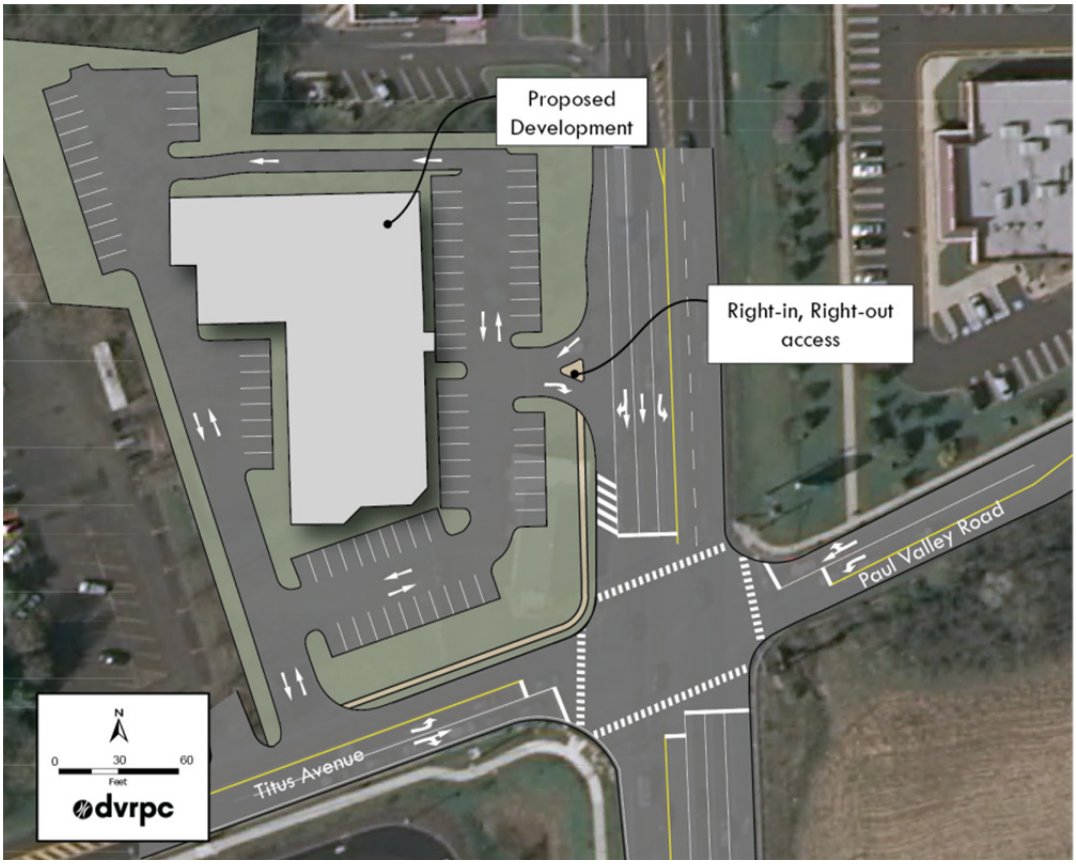
Figure 14: County Line Road Conceptual Redesign



PA 611 and Titus Avenue

PA 611 in both Warrington and Doylestown townships is described as a strategic or principal arterial. Throughout sections of the roadway, full access from PA 611 occurs at various locations due to the traversable two-way left-turn lane. At the intersection of Titus Road and PA 611, Figure 15 shows the planned redevelopment (the site is currently vacant) with a more efficient circulation plan. Driveways from PA 611 southbound are restructured to allow right-in/right-out turn movements. Site layout influences the quality of access design and the ability to respond to traffic changes.

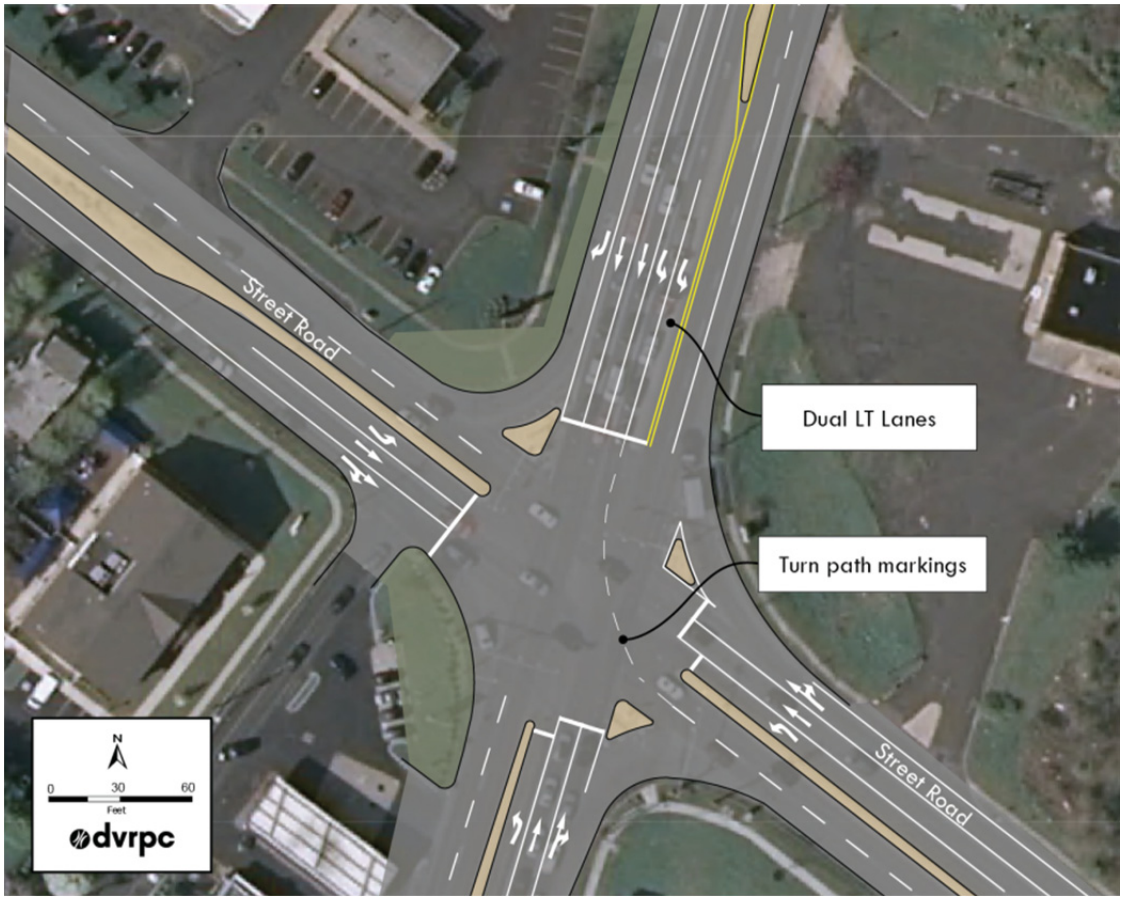
Figure 15: Ideal Access Site Redesign Example



PA 611 and Street Road

As indicated earlier, Street Road is the intersection identified in the crash analysis with the highest number of crashes in the corridor between 2008 and 2010. During observation, the study team noted that there is a significant amount of vehicles making left turns (southbound PA 611 to eastbound Street Road). In addition, many vehicles are rushing through the left-turn permitted phase, not realizing that the protected left-turn phase is lagging. A potential improvement to increase southbound left-turn capacity is to add dual left-turn lanes. This would require that left turns could only occur during a protected signal phase. Figure 16 is a concept plan illustrating this idea. In addition, the signal timing could be revisited.

Figure 16: Street Road Conceptual Redesign



PA 611 and Almshouse Road

Several improvements for this intersection were identified by the study team or suggested by the stakeholders. Included in the improvements are: constructing a westbound Almshouse Road right-turn lane, southbound right-shoulder adjustments, and increasing the storage capacity of the southbound left-turn lane. Each improvement is discussed individually.

Westbound Right-Turn Lane

There is not a right-turn lane heading westbound on Almshouse Road, yet a significant amount of vehicles turn right. In addition, there is a steep slope on the north side of Almshouse Road. The photographs in Figure 17 show this site today and an illustration of how a westbound right-turn lane may look after installation.

Figure 17: Almshouse Road Westbound Approach Conceptual Redesign

Source: DVRPC 2012

Southbound Right-Shoulder Adjustments

A wide shoulder is present along southbound PA 611 at the intersection with Almshouse Road. A bus stop shelter is present. This approach is marked with a “Keep Off Shoulder” sign. The concern is when right-turning vehicles utilize the shoulder and conflict with vehicles making a proper right turn at the intersection. With ample width, a right-turn lane

could theoretically be striped. However, conflict and lane blockage caused by bus service would remain a concern. Therefore, as Figure 18 shows, the DVRPC study team suggests striping the bus shoulder farther north to deter traffic from using it as a right-turn lane. A long term strategy would be acquiring land from Bucks County and installing a southbound right turn lane.

Southbound Left-Turn Lane Storage Capacity Increase

Southbound PA 611 to eastbound Almshouse Road is a high volume left-turn movement. Currently, there is a roughly 230-foot left-turn lane and a 90-foot taper area to accommodate vehicles making this movement. Project stakeholders noted that the left-turn lane often overflows and blocks the left through travel lane. An analysis was conducted to estimate the appropriate length of the left-turn lane. The primary reference for the analysis was the *Institute of Traffic Engineers Traffic Engineering Handbook, 5th Edition (1999)*.

According to engineering principles, the preferred length for the left-turn lane's vehicle storage capacity is 490 feet. This assumes a two percent mix of heavy vehicles. Due to the nature of Almshouse Road east of PA 611 and the fact that trucks tend to avoid peak travel hours, this is a conservative estimate. A 490-foot left-turn lane is possible with the location if the median is removed and the southbound direction is restriped to shift to the right. Also, additional left-turn storage capacity at this location would require retiming the traffic signal, which in turn could positively impact the level of service for the three other approaches. Finally, roadway sensor relocation may need to accompany any improvement. Figure 18 illustrates this improvement.

Figure 18: Almshouse Road Intersection Conceptual Redesign

PA 611 and Duane Road

DVRPC staff learned from the crash data that there was a significant amount of crashes occuring at the intersection of PA 611 and Duane Road. One design change to reduce crashes is to add a channelized northbound right-turn lane, as illustrated in Figure 19. Minimal land acquisition would be necessary, but the concept would remove slowing northbound, right-turning vehicles from the travel lane and potentially have a positive impact, by reducing rear-end crashes.

Figure 19: Duane Road Intersection Conceptual Redesign

Access Management Parking Strategies

Often separating highways from the adjacent built environment are parking facilities and their access driveways. Access to and egress from the abutting properties is influenced by driveway and parking facility design. Retrofitting parking requirements for older commercial properties typically leaves little real estate for appropriately designed driveways. This is common along the PA 611 corridor, where many commercial properties are occupying structures that were never intended for such uses and the parking needs take priority over access. Parking facilities should be designed in a manner that satisfies a property's demand and allows for safe and efficient access.

Perhaps the single most important component of parking design is the size of the parking lot associated with the quantity of parking spaces. Parking requirements are typically

based on national standards, derived from sources such as the Institute of Transportation Engineers and the Urban Land Institute. The standards usually dictate that a set number of parking spots be provided for a certain number of dwellings for residential or square footage for commercial properties. However, this assumes that all trips will be made by car and that destinations will be isolated and single use in character. The standards fail to account for the nuances between various types of commercial land uses and parking needs. They provide little guidance about strategies that recognize that parking should be sensitive to the broader environment rather than being viewed as just a single use. Additionally, the analysis performed to create parking standards does not take into account geographic, demographic, and economic factors that can affect parking demand. Thus, parking requirements are remarkably consistent across different cities and regions, despite varying levels of economic vitality, population size, and development density.

Likewise, municipal parking ordinances, which are typically based on these standards and are applied uniformly to communities with a variety of contexts and land uses, often result in too much parking, or requirements that are not flexible for mixed-use settings. Conventional parking standards usually (and often exclusively) focus on setting a required *minimum* number of parking spaces for various land uses. Requiring more parking than the market demands also adds substantial cost to development and redevelopment. The added cost of parking can prevent development altogether.

There are both institutional and political barriers to modifying outdated parking standards and adopting new ones. Common reasons why there is resistance to change include:

- Limited and/or confusing information in technical resources on parking requirements;
- Political pressures from commercial and development interests to either increase the supply if they perceive a burden to their operations, or to broaden the exemptions, particularly if they only apply to some geographic areas;
- Assuming that since parking has always been provided in certain quantities, this must be the best (or only) way to do it;
- Difficulty in precisely predicting maximum parking amounts;
- Possibility of parking spillover if mitigation, enforcement, and monitoring are lacking;
- Assuming that it is better to have too much parking rather than the right amount;
- Resident opposition if abundant neighborhood parking is desired;
- Overcoming the assumption that society benefits from a maximum supply of free or low-priced parking; and
- Valuing driver convenience at the expense of the overall transportation system.

As developable land becomes scarcer, land devoted to excessive parking is inefficient or even wasteful. With the increasing cost of land, cost per space, and ongoing maintenance, municipalities can encourage development by utilizing techniques that foster more efficient parking or relaxing current parking standards. This can be a significant cost savings for the parking provider and a better way to use finite resources.

The following topics highlight ways to better understand the impacts of the parking supply and ways to lessen the impacts of parking.

Shared Parking: Shared parking is when two or more land uses share the same parking spaces. Shared parking revolves around different land uses having their respective peak demand for parking at different times of the day. Sharing parking spaces typically accommodates 20 to 40 percent more users compared with assigning each space to an individual motorist, since some potential users are usually away at any particular time. Having multiple businesses share parking encourages walking between establishments, while requiring fewer driveways and access points, resulting in better traffic flow.

Facility Design: Through a variety of techniques, the capacity of existing parking facilities can be increased without requiring more land. This can be achieved by reducing the size of the parking spaces, modifying on-street parking orientation from parallel to angled, and providing small spaces for motorcycles and scooters. Using one-way angled parking maximizes the number of parking spaces, while minimizing total lot size. Creating smaller spaces for compact cars can also reduce overall lot size. In addition, municipalities can redesign and consolidate parking lots so one lot can serve several businesses.

Parking Space Size: The typical size of a parking space is eight to 10 feet wide and 18 to 20 feet deep, totaling 180 to 200 square feet. However, for maximum parking efficiency, the size of a parking space should be customized to the needs of the users. It is recommended to have different minimum parking stall widths for different parking characteristics. For low turnover, eight feet six inches is appropriate. For moderate turnover, a width of eight feet six inches to eight feet nine inches is suitable. For high turnover, a stall width of nine feet is appropriate. It is important to note that a smaller stall usually requires a wider aisle to provide an adequate turning movement. Table 12 lists the parking space sizes found in the municipal zoning ordinances.

Table 12: Parking Space Regulations

				Driveway Width	
Doylestown Township	Parking Angle	Stall Width (ft)	Stall Depth (ft)	One-Way (ft)	Two-Way (ft)
	90°	10	20	24	24
	60°	10	20	18	21
	45°	10	20	15	18
				Driveway Width	
Warrington Township	Parking Angle	Stall Width (ft)	Stall Depth (ft)	One-Way (ft)	Two-Way (ft)
	90°	9.5	18.5	22	22
	60°	9.5	18.5	17	18
	45°	9.5	18.5	13	13
	30°	9.5	18.2	12	11

Source: Retrieved from Warrington and Doylestown townships zoning ordinances, 2012

Along the PA 611 corridor, allowing smaller parking spaces could reduce the number of total spaces and use the space for better circulation. In other cases, parking spaces that conflict with or pose a hazard to entering and exiting vehicles within the parking lot could be altered or eliminated.

Flexible Standards: This technique involves working with the developer to find an ideal number of parking spaces for a particular site. Providing an excess of parking spaces can drive up costs, while providing too few can have negative effects on business. Therefore, involving the private sector to participate in optimizing the number of parking spaces can be beneficial for both the developer and the community.

Incorporating flexible standards would be an appropriate strategy for the PA 611 corridor. It is in a developer's best interest to ensure that adequate parking is supplied—it does not need to be over-supplied. It is also recommended to reduce parking requirements for existing businesses on an individual basis if a parking area is unsafe, in order to improve circulation, or if parking is excessive.

Environmental Concerns: The smaller the size of a parking lot, the less impervious cover created. This requires that parking demand be estimated more accurately and municipal standards allow fewer required parking spaces and/or restrict impervious cover levels. Specific measures include:

- Encouraging structured parking rather than large surface lots to reduce the amount of impervious surface consumed, land used, and runoff created;
- Differentiating between primary parking that meets daily needs and spillover parking for times of maximum use;
- Paving requirements, which incorporate alternative surfaces, such as grid pavers, grass, or porous paving, being used for occasional spillover parking at or near a site;
- Increasing natural landscaping that can serve as part of the storm water management system and also enhance the appearance of the parking lot;
- Increasing landscaping that reduces the heat island effects of paved parking lots; and
- Banking land or preserving a landscaped area for future demand and, if needed, for conversion into parking at a later date.

Relation to Gateway/Corridor Study (2005)

Doylestown Township and Borough coordinated a Gateway/Corridor Study of PA 611 between Neshaminy Creek and the township/borough border. The purpose of the study was to conceptualize and plan for improving the transition between PA 611, the regional arterial, and Doylestown Borough. The southern half of the study area overlaps with the PA 611 study area, and provides an excellent conceptual improvement plan for this portion of PA 611. Among its conceptual improvements are the following:

- Construct an access road between the southbound PA 611 bypass merge and Edison Road, including a spur connecting to Turk Road.

- Install a new traffic signal at the southbound PA 611 bypass merge for access road access and egress.
- Construct/connect a pedestrian path or sidewalk between Neshaminy Creek and Doylestown Borough along the western side of PA 611.
- Redesign and aesthetically improve access along the study corridor.

Implementing the recommendations from this study would vastly improve access management along the most troublesome portion of the study corridor in Doylestown Township. Additionally, the traffic signal at the bypass' southern terminus would assist in slowing bypass traffic.

Within this study's overlap, DVRPC recommends two additional improvements:

- Construct a northbound right-turn lane for the approach to Duane Road due to the acute angle of the intersection.
- When a traffic signal is installed, construct a southbound bypass right-turn lane to facilitate cross traffic right turns. The traffic signal should also include a fully actuated phase for this turning movement.

The plan's conceptual figure, South Easton Road Gateway/Corridor Plan Portion A, could be adopted as an official map for the area to preserve right of way and highlight access improvements.

Summary of Concept Plan Recommendations

This chapter discussed specific concepts to improve access management inconsistencies along the study corridor. For this corridor, adding auxiliary lanes and reducing direct driveway access to single land uses will help reduce congestion in high volume areas on PA 611. The key concepts and strategies presented can be applied to similar scenarios throughout the townships. Chapter 8 of this study provides a set of recommendations for Warrington and Doylestown townships.

CHAPTER 7

Access Management Policy Framework

In order to accomplish the physical aspects of access management, the municipal ordinances and comprehensive plan need to be supportive. The role of the comprehensive plan is to highlight the goals, objectives, and policies for the municipality. Access management should be included, and must be for the legal soundness of related ordinances. On the ordinance level, access management regulations need to be included in either the subdivision and land development ordinance, or the zoning ordinance, or both. This chapter discusses these aspects of access management, presents a review of the existing framework, and makes recommendations for consideration. Finally, the benefits of an official map are discussed.

Comprehensive Plans

Municipal comprehensive plans are used to state the goals, objectives, and policies of the municipality. They are a requirement of the Pennsylvania Municipalities Planning Code. In regards to access management, municipal ordinances must be supported by the goals of the municipality, i.e., its comprehensive plan. This support must be demonstrated to ensure the legal soundness of the ordinances.

A review of each township's comprehensive plan was conducted to determine the level of support for access management.

Warrington Township

The Warrington Township comprehensive plan was updated and adopted in 2006. The plan stresses transportation through four major goals, two of these directly relate to access management: minimize congestion and improve safety. Access managment methods are used to emphasize implementation of these two goals. To improve safety, the comprehensive plan provides access-related suggestions.

This study may be adopted as an addendum to the current comprehensive plan to demonstrate support for access management.

Doylestown Township

The Doylestown Township comprehensive plan was adopted in 1989 and was amended in 2008. The comprehensive plan directly acknowledges strategies of access management and specifically mentions a number of access management strategies that

include: avoiding high number of driveway access on a major route, minimum spacing between driveways, encouraging shared driveways, regulating sight distance, and requiring access to lower order streets.

In more detail, the comprehensive plan lists three primary goals and implementation techniques of how these can be achieved. One goal is directly associated with access management and states that the municipality would like to "manage the local road system so it continues to provide safe and convenient access for township residents" and "encourage regional cooperation in regard to state and federal highways". The two goals are addressed in the comprehensive plan through a street hierarchy. In the study area, PA 611 is defined as an arterial or an interregional highway connecting towns with adjoining access, but also has limited driveway access. Therefore, in two different locations in the comprehensive plan, there is discussion about driveway access on the roadways. In addition, corner clearance, safe sight distance, and joint and cross access are listed in techniques for access management in the comprehensive plan, but have not been specifically addressed in the implementation portion.

The comprehensive plan does address the cartways, or the driveway throat length, width, radius, and curb widths, and this is discussed thoroughly.

This study may be adopted as an addendum to the current comprehensive plan to demonstrate support for access management.

Comprehensive Plan Analysis Conclusion

Access management is the union between land use and transportation. Its purpose is to create that union in as organized and mutually beneficial a way as possible. A subsection dedicated to explaining the benefits and methods of access management should be present in the comprehensive plan. Appropriate references to access management should be present in both land use and transportation sections.

Access Management Regulations

Zoning Ordinance or Subdivision and Land-Development Ordinance

Access management regulations may be a part of either a zoning ordinance or a subdivision and land development ordinance (SALDO). Each of the two have benefits, though including access management regulations in the zoning ordinance may be the better fit. Zoning ordinances typically contain regulations that may be complemented by access management regulations, such as parking requirements and setbacks. The downside to placing access management regulations in a zoning ordinance is that the regulations may be granted variances. However, a great benefit of the zoning ordinance is that existing properties may become nonconforming, which enables the future correction of poor access management practice. A compromise may be to place the regulations in the SALDO and have a statement regarding nonconforming access in the zoning ordinance. The location of the access management regulations should ultimately be determined through a discussion among township officials and their solicitor.

Existing Access Management Regulations

A review of the existing ordinances for each township was conducted. Warrington and Doylestown townships' ordinances were available at the townships' websites. Table 13 is a summary of the more basic access management regulations that are highly recommended to be adopted and/or updated in the municipal ordinances. There are three definitions in the table: no regulation – not mentioned in the ordinances at all; adequate – mentioned, but ordinances should add suggested language in the appendix; and ideal – there is no need to supplement the existing language that is in the ordinances.

Table 13: Summary of Existing Township Ordinances

Regulation	Warrington	Doylestown
Purpose	Adequate	Adequate
Applicability	Adequate	Adequate
Nonconforming Driveways	No regulation	No regulation
Relationship to HOP	Adequate	No regulation
Driveway Spacing	Adequate	Adequate
Driveway Alignment	Adequate	Adequate
Corner Clearance	Adequate	Adequate
Joint and Cross Access	No regulation	Ideal
Internal Access to Outparcels	No regulation	No regulation
Auxiliary Lanes	No regulation	No regulation

Source: DVRPC 2012

Additional access management regulations exist. The townships may consider adopting these additional regulations if needed so that they apply to all roads within their borders. They include: safe sight distance, driveway throat length and width, channelizing islands, pedestrian connectivity, signalized intersection spacing, right- and left-turning lanes, driveway radius, and driveway profile. The ordinance review found that many of these regulations are currently covered. The PennDOT publication *Access Management Model Ordinances for Pennsylvania Municipalities Handbook* contains sample language for these regulations. Appendix A, in this document has sample ordinance language pertaining specifically to each municipality.

Warrington Township

Most of the major access management techniques are covered in the existing zoning and subdivision and land development ordinances. More details could be provided regarding corner clearance, number of driveways, driveway alignment, and driveway channelization. Not covered are joint and cross access, or access to out parcels for developments built close to each other. In addition, there are not specifics regarding

driveway design: throat length, width, radius, or spacing. Requiring auxiliary turning lanes where appropriate would also be beneficial in the township.

Goals of access management in Warrington Township should include: auxiliary turning lanes at all high volume driveways, increasing shoulder widths, driveway design, and traffic signal and driveway minimum spacing standards.

Doylestown Township

A majority of the access management techniques are addressed in the existing zoning and subdivision and land use ordinances. However, several core access management regulations are absent: a statement regarding nonconforming driveways, corner clearance, driveway alignment, driveway spacing, internal access to outparcels, and signalization intersection spacing. Similarly, the ordinance does not have any specific regulations for auxiliary turning lanes.

Goals of access management in Doylestown Township should include: developing an auxiliary lane amendment to the ordinance that focuses on the width of lanes and shoulders. The ordinance should also address traffic signal spacing and driveway spacing.

Official Map

Neither municipality has an official map. The *Pennsylvania Municipalities Planning Code* states that an official map may "show appropriate elements or portions of elements of the comprehensive plan . . ." (Section 401). If the comprehensive plan thoroughly addresses access management, an official map is a useful implementation tool.

The official map is an effective tool to visualize programmed or planned projects in the township and to preserve right of way. For this study corridor, the map would be useful for identifying at which locations auxiliary turning lanes should be added to PA 611. The climbing, deceleration, and acceleration lane could also be identified on this map for future study. Finally, an official map would be a useful complement to the Gateway/Corridor Study.

An official map need not cover an entire municipality. It may cover a single corridor, or a combination of corridors.

CHAPTER 8

Recommendations and Implementation

This document can be used as a reference by state, county, and municipal entities; all are the key players in the implementation process. These implementation plans suggest 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, and project benefits. The recommendations of this study are summarized in Tables 14, 15, and 16. Table 14 suggests recommendations based on safety, Table 15 on congestion mitigation, and Table 16 on access management policy improvements.

Each matrix has four columns. The first is the recommendation, or what DVRPC staff suggests should be changed. The second column is the recommendation priority, which is estimated in terms of three categories: high, medium, and low. The priorities are assigned based on the perception of the extent of the problems that they present drivers, with safety being the most important, and congestion, mobility, and policy also being considered. The third column, the cost, is also assigned to categories of high, medium, and low. High-cost projects usually involve a major reconstruction of an intersection. In general, a project in this category is estimated to cost over $1 million. An improvement estimated to have a moderate cost would be striping at intersections or installing signage, and would range from $500,000 to $1 million. Low-cost projects are often policy changes to the current municipal documents or signal phasing changes, costing $500,000 and below. The final column indicates the stakeholder party who should take ownership to implement the recommendation.

Table 14: Safety Recommendations

Safety Improvements			
Corridor-wide Recommendations	**Priority**	**Cost Range**	**Responsible Party**
Assess shoulder width and needs throughout corridor	Medium	Low	Doylestown Township, Warrington Township
Work with property owners to define driveways on PA 611	Medium	Medium	Doylestown Township, Warrington Township, PennDOT
Install bus shelters in near proximity to employment and residential trip generators	Medium	Low	Doylestown Township, Warrington Township
Location Specific Recommendations	**Priority**	**Cost Range**	**Responsible Party**
Close Privet Road (5th) leg at County Line Road intersection or make one-way in, when National Guard access is relocated	Low	Low	Horsham Township, Warrington Township, Mont. County, PennDOT
Install protected left-turn signal phases at all four approaches at the Titus Ave/Paul Valley Road intersection	High	Medium	Warrington Township, PennDOT
Add crosswalk striping on east and north sides of Titus Ave/Paul Valley Road intersection	High	Low	Warrington Township, PennDOT
Restripe pavement markings at Street Road	Medium	Medium	Warrington Township, PennDOT
Install advance warning flasher for northbound PA 611 at Oxford/Freedom's Way	High	Low	Warrington Township, PennDOT
Do not permit red turn on red for westbound traffic at Oxford Drive/Freedom's Way	High	Low	Warrington Township, PennDOT
Restripe crosswalks at Bristol Road	High	Medium	Warrington Township, PennDOT
Stripe right shoulder southbound at Almshouse Road with bus only markings	Medium	Low	Doylestown Township, PennDOT
Investigate new methods for keeping the "box" clear, either with signage or pavement striping at Duane Road	Low	Low	Doylestown Township, PennDOT
Construct northbound right-turn lane at Duane Road	High	Medium	Doylestown Township, PennDOT
Add signal phase for northbound left turns at Edison Furlong Road	High	Medium	Doylestown Township, County, PennDOT
Install additional means to slow down southbound bypass traffic at Edison Furlong Road	Medium	Low	Doylestown Township, County, PennDOT

Source: DVRPC 2012

Table 15: Congestion Mitigation Improvements

Congestion Mitigation Improvements			
Recommendation	**Priority**	**Cost Range**	**Responsible Party**
Install northbound right-turn lane at County Line Road	Medium	High	Horsham Township, Warrington Township Mont. County, PennDOT
Use existing traffic lights on PA 611 and adjacent roadways for access into the new Valley Gate development rather than adding more signals	High	Low	Warrington Township, PennDOT
Install dual left-turn lanes for southbound PA 611 at Street Road	Medium	High	Warrington Township, County, PennDOT
Install right-turn lane where northbound shoulder is currently striped at Bristol Road	Medium	Medium	Warrington Township, PennDOT
Conduct a study for evaluating installation of climbing/acceleration/access lane northbound from Kelly Road to Almshouse Road	Low	Low (study)	Doylestown Township, PennDOT
Install westbound right-turn lane at Almshouse Road	Medium	High	Township, County, PennDOT
Extend southbound left-turn lane at Almshouse Road	High	Medium	Township, County, PennDOT

Source: DVRPC 2012

Table 16: Access Management Policy Improvements

Access Management Policy Improvements			
Recommendation	**Priority**	**Cost Range**	**Responsible Party**
Allow for shared parking, alternative parking facility design, variable parking space size, and flexible parking in zoning ordinances	Medium	Low	Doylestown Township, Warrington Township
Incorporate this study as an addendum to Comprehensive Plan when next updated	Medium	Low	Doylestown Township, Warrington Township
Incorporate this study as an addendum to Zoning Ordinance when next updated	High	Low	Doylestown Township, Warrington Township
Incorporate this study as an addendum to Subdivision and Land Development Ordinance when next updated	High	Low	Doylestown Township, Warrington Township
Adopt an official map as related to identify at which locations auxiliary turning lanes and/or the climbing or acceleration lane could be added	Low	Low	Doylestown Township, Warrington Township

Source: DVRPC 2012

CHAPTER 9

Acknowledgments and References

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- Mr. Roy Rieder – Warrington Township
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APPENDIX A

Appendix A

Sample Ordinance Language

Throughout the previous section, deficiencies were identified with existing access management related regulations in the municipal ordinances. The following is language proposed to be added to zoning and land use and development ordinances for each township. The subsections are based on reviewing the current ordinances in each township and what would be useful to add to achieve an ordinance with superior access management standards. In many cases, text was specified based on municipality; where it is not, both Warrington and Doylestown townships could adopt the additional text. Additional ordinance language is available in the *Access Management Model Ordinances for Pennsylvania Municipalities Handbook* (PennDOT, 2006).

I. Purpose

This ordinance is intended to promote safe and efficient travel within (municipality) by limiting the number of conflict points, providing safe spacing standards between driveways, encouraging shared access between abutting properties, and ensuring safe access by emergency vehicles.

II. Applicability

This ordinance shall pertain to all applications for subdivision and land development approval, or building permits, for lots with frontage along roadways within (municipality).

III. Nonconforming Driveways (locate in SALDO)

Driveways that do not conform to the access management regulations in this ordinance, or in the SALDO Section X.X, and were constructed before the adoption of this ordinance or the SALDO, shall be considered legal nonconforming driveways. However, nonconforming driveway(s) shall be reconstructed to comply with this ordinance, and SALDO Section X.X under all of the following conditions:

- New driveway permits are requested;
- Modifications to an existing driveway permit are requested;
- The property owner or applicant applies for a change in property use and will generate more vehicle trips than the existing use; or
- An expansion of the existing use will result in an increase in trip generation.

IV. Relationship to PennDOT Highway Occupancy Permit

Issuance of a PennDOT Highway Occupancy Permit (HOP) does not guarantee site plan approval by (municipality) nor does it deem the plan in conformance with this ordinance. The HOP submittal to PennDOT should not occur before approval to do so by (municipality). However, upon request of the applicant or request of (municipality), PennDOT may be brought into the review process to reconcile site design and access issues.

V. Number of Driveways

The functional intersection area includes more than the physical intersection (where the two roadways intersect), but also includes all areas where auxiliary lanes, such as right- and left-turn lanes, exist. Ideally driveways should not be located within the functional intersection. When the property frontage is close to the functional intersection, access should only be permitted as far as possible from the functional intersection.

Along PA 611 in both townships, there are closely spaced driveways on opposite sides, and the roadway is undivided (except for in major intersections) and has a continuous two-way left-turn lane. This creates jog maneuvers instead of separate and distinct left-turn and right-turn maneuvers, as well as conflicting left turns.

Adequate driveway spacing allows greater speeds for through traffic, reduces the number of potential conflict points that must be monitored by motorists, and helps preserve capacity on the roadway. The location and design of access affect the ability of drivers to safely respond to the driving environment. When creating access, it is important to consider driver's reaction time (including unfamiliar and elderly drives), thus creating longer driveway spacing. The following are suggestions for the zoning and/or subdivision and land use ordinances by township.

Warrington

- If a mixed or single land use abuts two or more intersecting roadways, access should be given at the one of lower classification.

- Only one access shall be permitted per property. Additional access(es) shall be allowed if the applicant can demonstrate that it is to accommodate traffic from the site and it can be achieved safely.

- The municipality shall restrict access to right-turn-only ingress and egress to a state-maintained or local road if safe and efficient movements cannot be accommodated.

- Minimum offset distance between driveways or intersections on opposite sides of undivided roadways if they are not directly opposite each other.

Warrington and Doylestown

- The following driveway spacing standards are desirable for major roadways.

    i. Principal arterial: 600 feet.
    ii. Minor arterial: 400 feet.
    iii. Major collector: 200 feet.

- If the above driveway standards are not met, a system of joint or cross access driveways, frontage roads, or service roads may be required.

VI. Driveway Alignment

Access driveway approaches used for two-way operation shall be positioned at right angles (90 degrees) to the roadway or as near thereto as site conditions permit.

When two access driveways are constructed on the same property frontage and used for one-way operation, each of these driveways may be placed at an angle less than a right angle, but not less than 45 degrees to the roadway.

VIII. Corner Clearance

Standardizing corner clearance minimizes driveway-intersection conflicts and provides a greater distance for vehicles to merge into through traffic. Corner clearance, at a minimum, should be equal to or greater than driveway spacing standards. On high volume roadways, a longer corner clearance may be necessary to avoid conflicts. The following are suggestions for the zoning and/or subdivision and land use ordinances by township.

Doylestown

- Access shall be provided to the roadway where corner clearance requirements can be achieved.

Warrington and Doylestown

- Corner clearance shall meet the following driveway spacing standards that are desirable for arterial and major collector roads:

    i. Principal arterial: 600 feet.
    ii. Minor arterial: 400 feet.
    iii. Major collector: 200 feet.

- If the minimum driveway spacing standards cannot be achieved due to constraints, the following shall apply in all cases:

i. There shall be a minimum 10-foot tangent distance between the end of the intersecting roadway radius and the beginning radius of a permitted driveway.

ii. The distance from the nearest edge of the cartway of an intersecting roadway to the beginning radius of a permitted driveway shall be a minimum of 30 feet.

iii. Access shall be taken from the intersecting roadway with the lesser functional classification.

- If no other reasonable access to the property is available, and no reasonable alternative is identified, the driveway shall be located the farthest possible distance from the intersecting roadway. In such cases, directional connections (i.e., right in/right out only, right in only or right out only) may be required.
- The municipality shall require restrictions at the driveway if the municipal engineer determines that the location of the driveway and particular ingress or egress movements will create safety or operation problems.

IIX. Joint and Cross Access

Collectors and local streets provide for short trips within a community. When large areas of business (including multiple parcels and multiple ownerships) are grouped together, joint and cross access easements and joint parking circulation effectively serve as collectors and local streets. These private roadway systems, although not public streets in the traditional sense, operationally serve the same purpose of keeping short local trips off the higher-volume and higher-speed arterials (PA 611).

Joint and cross access driveways also reduce the number of driveways accessing the roadways, thus reducing the number of conflict areas along the roadway. They provide safer access to drivers who want to get from one land use to another without having to merge into traffic. In addition, these types of driveways allow maintainable driveway spacing standards.

Doylestown

- Adjacent nonresidential properties shall provide a joint or cross access driveways to allow circulation between sites and land uses.

Warrington and Doylestown

- The municipality may require a joint driveway in order to achieve the following driveway spacing standards that are desirable for arterial and major collector roads:

I. Principal arterial: 600 feet.
II. Minor arterial: 400 feet.
III. Major collector: 200 feet.

- Adjacent nonresidential properties shall provide a joint or cross access driveway to allow circulation between sites wherever feasible along roadways classified as major collectors or arterials in accordance with the functional classification contained in the municipal comprehensive plan. The following shall apply to joint and cross access driveways:

    I. The driveway shall have a design speed of 10 mph and have sufficient width to accommodate two-way traffic, including the largest vehicle expected to frequently access the properties.
    II. A circulation plan that may include coordinated or shared parking shall be required.
    III. Features shall be included in the design to make it visually obvious that abutting properties shall be tied in to provide cross access.

- The property owners along a joint or cross access driveway shall:

    I. Record an easement with the deed allowing cross access to and from other properties served by the driveway.
    II. Record an agreement with the municipality so that future access rights along the driveway shall be granted at the discretion of the municipality and the design shall be approved by the municipal engineer.
    III. Record a joint agreement with the deed defining the maintenance responsibilities of each of the property owners located along the driveway.

IX. Internal Access to Outparcels

For commercial and office developments comprised of more than one building site and under the same ownership at the time of application and consolidated for the purposes of development, (municipality) shall require that the development, including all outparcels, be served by an internal drive that is separated from the main roadway. Outparcel access shall demonstrate safe, efficient ingress and egress and avoid queuing across other driveways and parking aisles.

XI. Auxiliary Lanes

A vehicle turning into a driveway is most likely decelerating a considerable distance upstream from where the driveway entry is to be made. Therefore, there is a difference in speed between a vehicle slowing to make a turn and one that is not. Auxiliary left-turn and right-turn lanes (or bays) are the most effective means of reducing the speed differential between turning vehicles and through traffic on arterial roadways.

Warrington and Doylestown

- At an unsignalized intersection, a right-turn lane shall be considered when any one or a combination of the following conditions exist: 40 or more right

turns during the peak hour, speed in excess of 40 mph, or high average daily traffic on the through road (5,000 vehicles per day or more).

- At an unsignalized intersection, a left-turn lane shall be required if the visibility to the rear of a vehicle stopped to turn left into the proposed access does not meet minimum sight distance requirements and no alternative is available.
- At an intersection, a right-turn or left-turn lane should be installed when the LOS and operation of the intersection can be improved by installing a turning lane.
- It is important for turn bays on roadways of high functional classification to be of sufficient length to store all arriving vehicles most of the time. Auxiliary lanes also reduce the potential for rear-end crashes. Table x defines the correct storage distance based on the speed vehicles are traveling on the roadway.

XI. Signalized Intersection Spacing

As a general rule, spacing requirements apply to new development and redevelopment. They do not have to be consistent with existing access characteristics.

Closely spaced or irregularly spaced traffic signals on arterial roadways result in frequent stops, unnecessary delay, increase fuel consumption, excessive vehicular emissions, and high crash rates. Long and uniform spacing allows timing plans that can efficiently accommodate varying traffic conditions during peak and off-peak periods and traffic changes that occur over time. Each additional traffic signal per mile reduces speed two to three mph.

- New development should coordinate with those signals that are already installed and in use along PA 611.

XII. Signalized Intersection Spacing

Since there are frequent bus stops throughout the corridor and the vehicles are going at speeds between 45 and 50 mph when there is not traffic, the buses may be slowing the traffic at bus stop locations. Throughout the corridor, the bus stop locations are not coupled with crosswalks to provide safe access for pedestrians crossing to the other side of the street. One example is at Valley Square shopping center. This is a safety concern due to the high speeds vehicles are driving along PA 611. In addition, there are few bus stops along the corridor with shelters. In times of bad weather, this is not an encouraging or comfortable environment for bus riders.

- If there is bus rerouting designed in the future, request crosswalks at all bus stop locations.
- Where it is feasible, install bus shelters along the corridor.
- Where it is possible, install bus turnouts.

APPENDIX B

Appendix B

Conceptual Improvement Location Existing Conditions

The following are aerial images of the existing concept plan sites without the concept plan overlaid. These match with the Figures found in Chapter 6.

Figure B-1: County Line Road Existing Conditions

Figure B-2: Route 611 and Titus Ave/Paul Valley Road Existing Conditions

Figure B-3: Route 611 and Street Road Existing Conditions

Figure B-4: Route 611 and Almshouse Road Existing Conditions

Figure B-5: Route 611 and Duane Road Existing Conditions

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Abstract:

The evaluations summarized in this report were performed in support of PennDOT's statewide effort to promote the establishment of formal access management ordinances for state and local highways. A case study of PA 611 in southern Bucks County was conducted and concept plans prepared for the study corridor as tangible illustration of benefits of planning and implementing access management strategies. In addition, improvement strategies were suggested as a means of mitigating congestion and improving traffic safety.

The study also analyzed the existing access management regulation in each of the township comprehensive plan, zoning and subdivision and land development ordinances. Where regulatory gaps were found, recommendations and sample ordinance language were provided.

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