



**TIER 3 - TRANSPORTATION
TECHNICAL MEMORANDUM**

**Prepared for:
Southeastern Pennsylvania Transportation Authority (SEPTA)**



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1.0 Introduction

The Federal Transit Administration (FTA), in cooperation with the Southeastern Pennsylvania Transportation Authority (SEPTA), is preparing a Draft Environmental Impact Statement (DEIS), under the National Environmental Policy Act of 1969 (NEPA), that examines and evaluates a proposed extension of the existing Norristown High Speed Line (NHSL) to the King of Prussia area, known herein as the King of Prussia (KOP) Rail project (Project). King of Prussia is a section of Upper Merion Township, Montgomery County, PA.

This technical memorandum supports the DEIS and examines the potential benefits and impacts of the Action Alternatives and the No Action Alternative on transportation. The areas of focus in this technical memorandum are potential traffic impacts at proposed park-and-ride facilities, potential effects of the Project on pedestrian and bicycle facilities in the Project area, and safety. The technical memorandum provides background information on current and projected traffic volumes. It identifies through modeling and technical analysis the potential effects of each Action Alternative on the transportation facilities that are the focus of this document. This technical memorandum also identifies potential measures that SEPTA could propose to minimize potential negative impacts on transportation, and it discusses potential mitigation strategies that SEPTA may consider as the Project advances.

2.0 Project Description

The DEIS and this technical memorandum examine five Action Alternatives and the No Action Alternative described in the following subsections. The study area for this assessment is the geographic area encompassing the King of Prussia area defined by the NHSL to the east, the Schuylkill River to the north, US Route 422 to the west, and the Schuylkill Expressway to the south.

2.1 No Action Alternative

The No Action Alternative assumes no improvements to the transportation system in the transportation study area other than those contained in the financially constrained element of *Connections 2040 Plan for Greater Philadelphia*, the long-range transportation plan of the Delaware Valley Regional Planning Commission (DVRP). Table 2-1.1 lists the committed No Action Alternative projects within the transportation study area.

Table 2-1.1: Committed Projects within the King of Prussia Area

Project	Type	Description
New US Route 422 Bridge crossing over Schuylkill River	Highway	New 4-lane bridge westbound; replace bridge eastbound.
Widen US Route 422 from US Route 202 to PA 363	Highway	Widen this 2-mile segment from 4 lanes to 6.
Full interchange at US Route 422 and PA 363	Highway	Complete to a full interchange, with movements in both directions.
PA Turnpike widening from Morgantown exit to Valley Forge	Highway	Widen to 6 lanes throughout.
Lafayette Street extension and new Turnpike exit in Norristown	Highway	Construction on extension underway. Construction on Turnpike exit could start in 2018.
1 st Avenue Streetscape and Multi-use Trail (known also as the 1 st Avenue Road Diet project)	Highway	Funded through statewide TAP program. Road Diet, streetscaping and multi-use trail along the length of 1 st Avenue to enhance multi-modal access.
Relocate PA 23/Valley Forge Road and North Gulph Road	Highway	Move roadway 300 feet east of current entrance with Valley Forge National Historical Park to improve operations and reduce traffic impacts with the Park, and create a new Gateway entrance.
Widen Henderson Road and South Gulph Road	Highway	Widen South Gulph Road from Crooked Lane to I-76 intersection at Gulph Mills, and widen Henderson Road from South Gulph to Shoemaker Road.
Chester Valley Trail Extension	Multimodal	Extend the Chester Valley Trail to connect with the Schuylkill River Trail in Norristown, a 3.5 mile extension.

Source: DVRPC, Connections 2040 Plan for Greater Philadelphia.

The committed projects consist primarily of planned capacity and operational improvements to transportation study area roadways, particularly US Route 422 and the PA Turnpike. All but one

roadway project operates at the periphery of the transportation study area; the 1st Avenue “road diet” project is within the Project area. Montgomery County’s Chester Valley Trail Extension is also within the transportation study area. In addition to these committed planned projects, the No Action Alternative consists of highway and transit networks, transit service levels, traffic volumes, and forecasted demographics for the horizon year 2040.

2.2 Action Alternatives

Figures 2-2.1 through 2-2.5 illustrate the Action Alternatives, described as follows:

- **PECO-1st Ave.:** The PECO-1st Ave. Action Alternative would use a portion of the PECO electric utility corridor as its trunk, passing in front of (to the south of) the King of Prussia Mall, turning north to use a portion of the Norfolk Southern Railroad (NS) Industrial Track before turning west along 1st Avenue as its branch and ending near the intersection of 1st Avenue and N. Gulph Road near the Valley Forge Casino Resort (VFCR).
- **PECO/TP-1st Ave.:** The PECO/TP-1st Ave. Action Alternative would use portions of the PECO electric utility corridor and PA Turnpike as its trunk, passing behind (to the north of) the King of Prussia Mall, turning north to use a portion of the NS Industrial Track before turning west along 1st Avenue as its branch and ending near the intersection of 1st Avenue and N. Gulph Road near the VFCR.
- **PECO/TP-N. Gulph:** The PECO/TP-N. Gulph Action Alternative would use portions of the PECO electric utility corridor and PA Turnpike as its trunk, passing behind (to the north of) the King of Prussia Mall, turning south to connect to N. Gulph Road before turning west along the N. Gulph Road as its branch and ending near the intersection of 1st Avenue and N. Gulph Road near the VFCR.
- **US 202-1st Ave.:** The US 202-1st Ave. Action Alternative would use portions of the US Route 202 corridor and the PA Turnpike right-of-way as its trunk, passing behind (to the north of) the King of Prussia Mall, turning north to use a portion of the NS Industrial Track before turning west along 1st Avenue as its branch and ending near the intersection of 1st Avenue and N. Gulph Road near the VFCR.
- **US 202-N. Gulph:** The US 202-N. Gulph Action Alternative would use portions of the US Route 202 corridor as its trunk, passing behind (to the north of) the King of Prussia Mall, turning south to connect to N. Gulph Road before turning west along the N. Gulph Road as its branch and ending near the intersection of 1st Avenue and N. Gulph Road near the VFCR.

As part of each Action Alternative, two tracks would be provided on primarily elevated guideway. However, a short at-grade section would be provided in the turnoffs adjacent to the existing NHSL. In the PECO and PECO/TP Trunks, the tracks would also be at grade on a hilltop area within the PECO corridor a short distance west of Henderson Road.

Figure 2-2.1: PECO – 1st Ave. Action Alternative

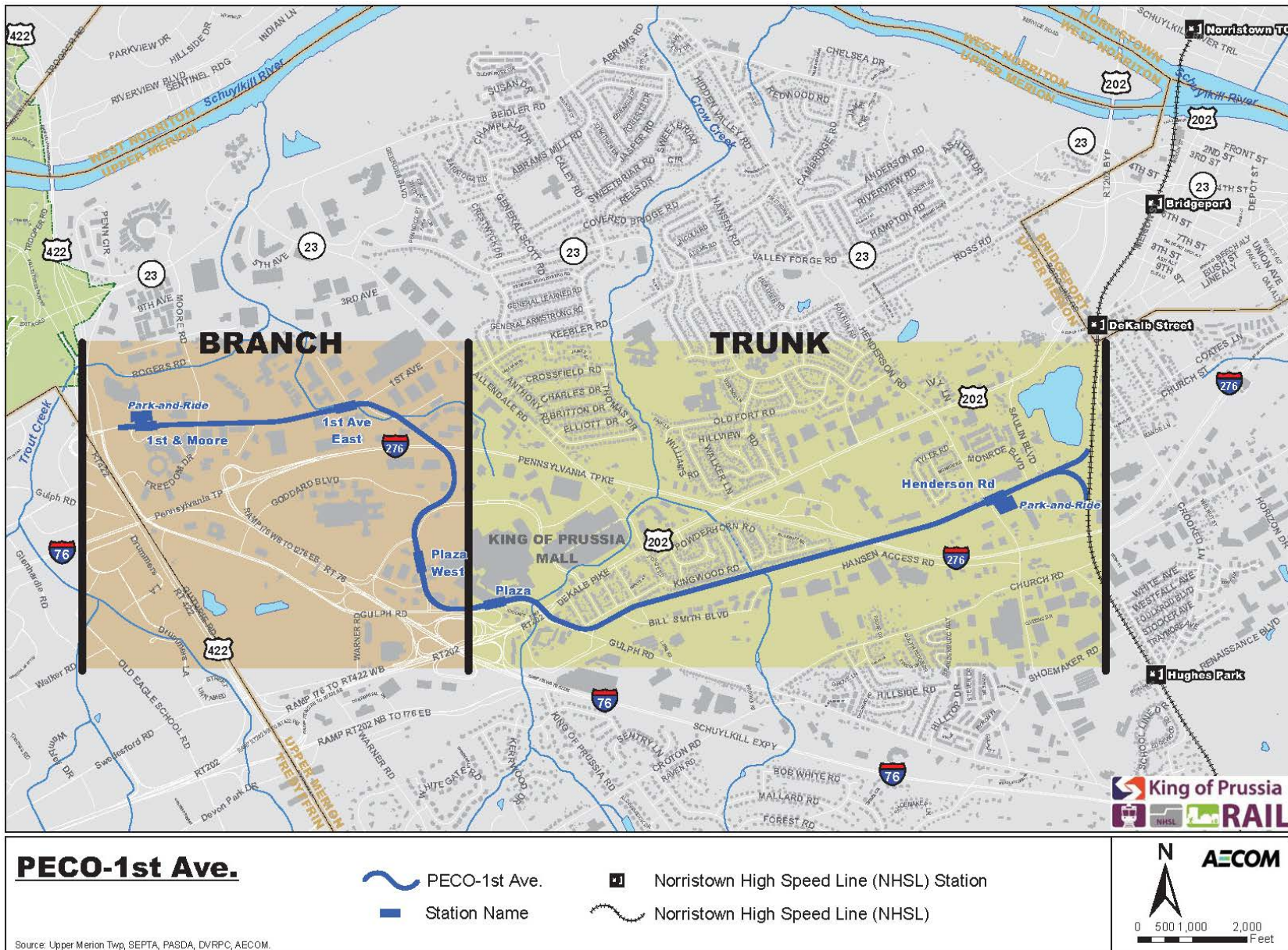


Figure 2-2.2: PECO/TP- 1st Ave. Action Alternative

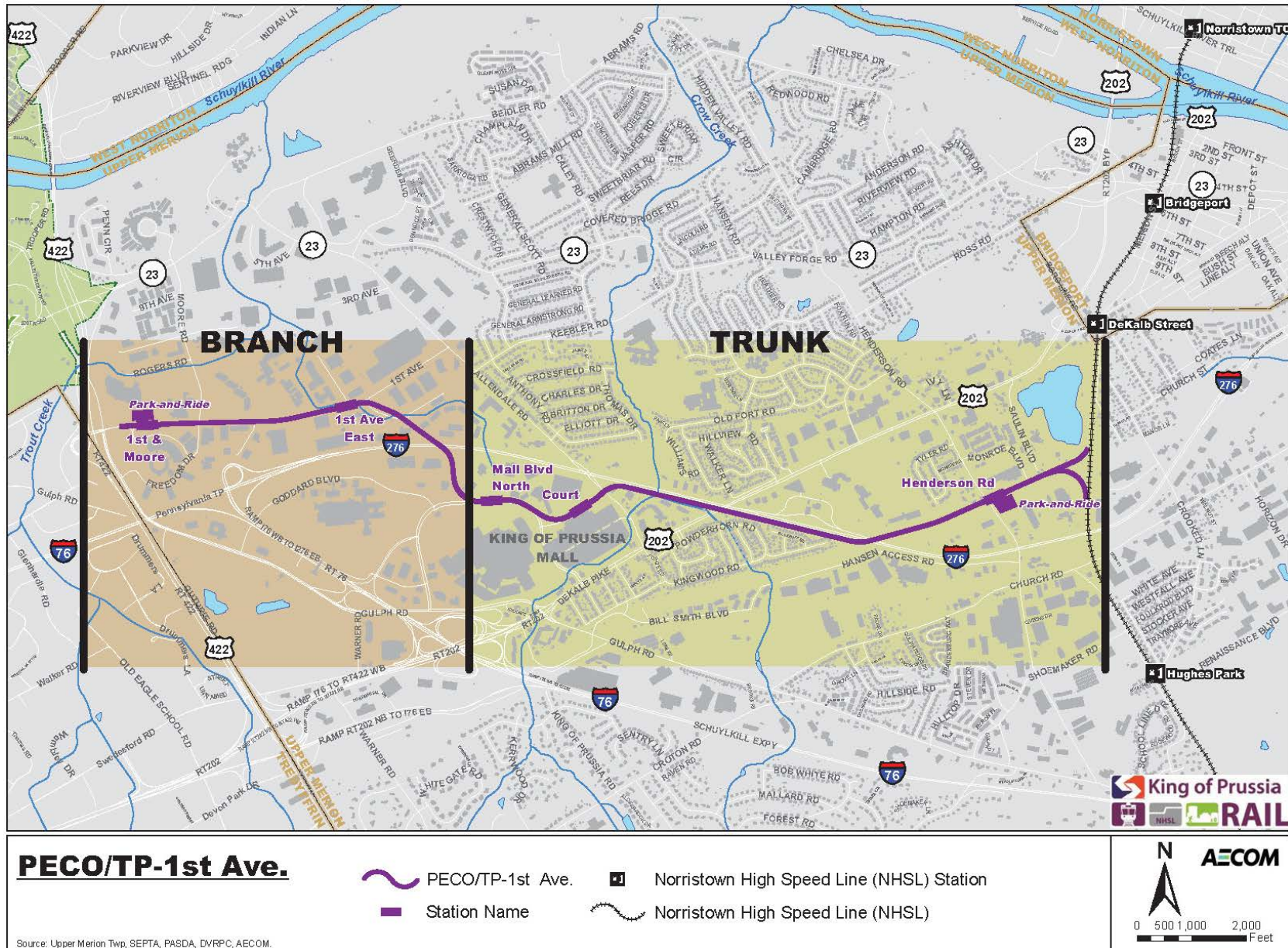
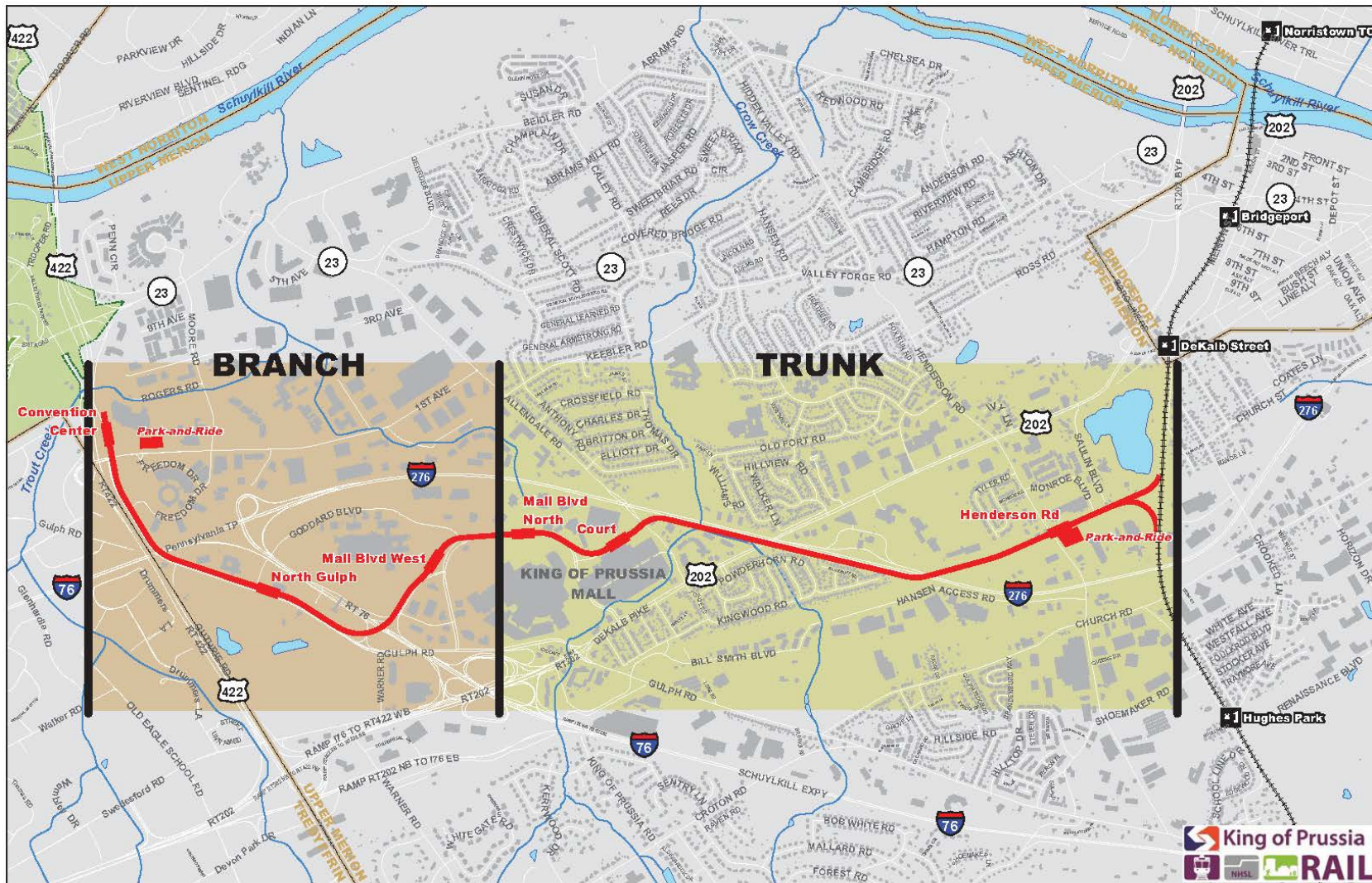


Figure 2-2.3: PECO/TP - N. Gulph Action Alternative



PECO/TP-N. Gulph

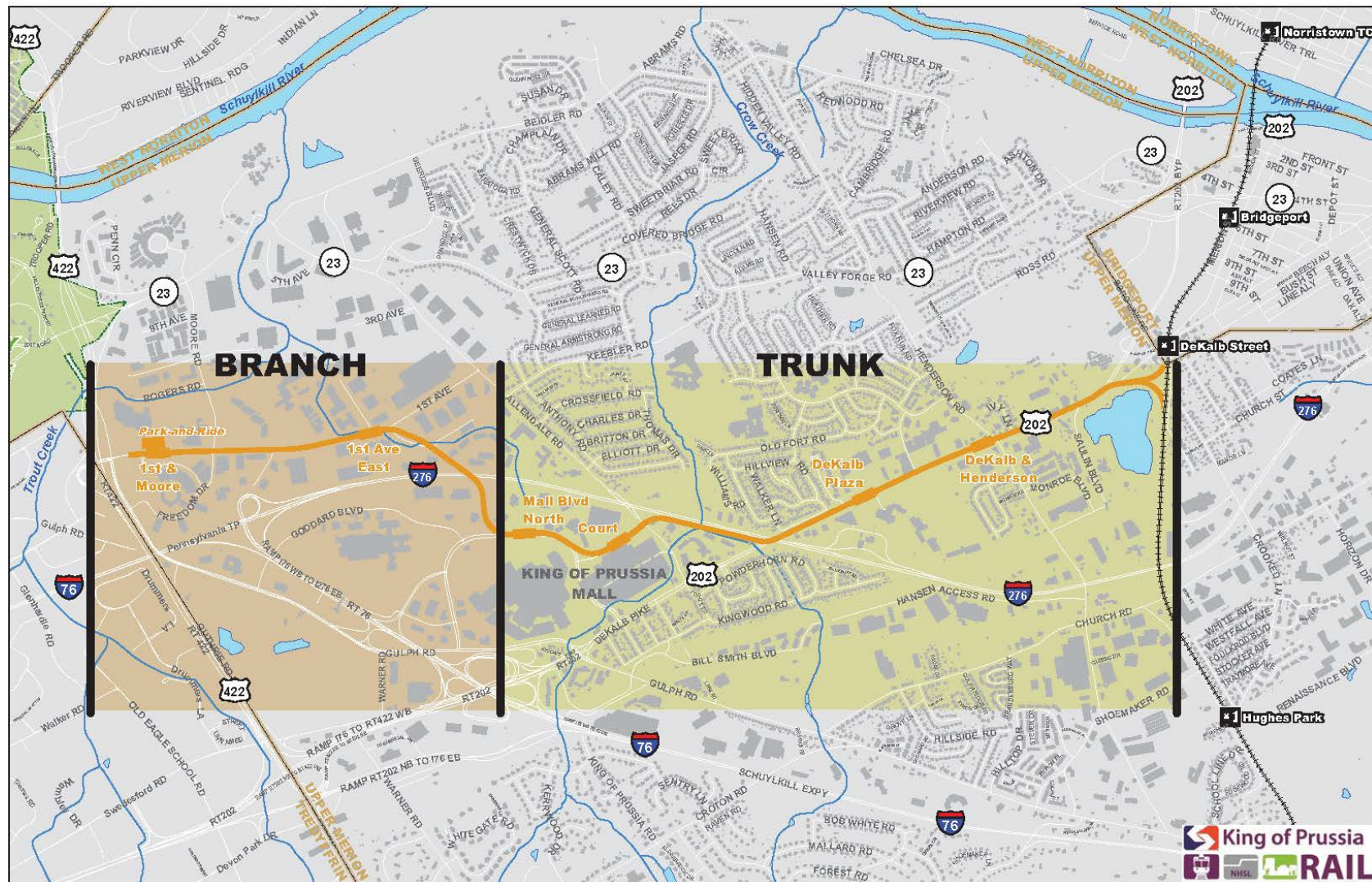
~ PECO/TP-N. Gulph
■ Station Name
 Norristown High Speed Line (NHSL) Station
 Norristown High Speed Line (NHSL)

Source: Upper Merion Twp, SEPTA, PASDA, DV/PC, AECOM.

N **AECOM**

0 500 1,000 2,000 Feet

Figure 2-2.4: US 202 – 1st Ave. Action Alternative



US 202-1st Ave.

US 202-1st Ave.
 Station Name

Norristown High Speed Line (NHSL) Station
 Norristown High Speed Line (NHSL)

King of Prussia RAIL

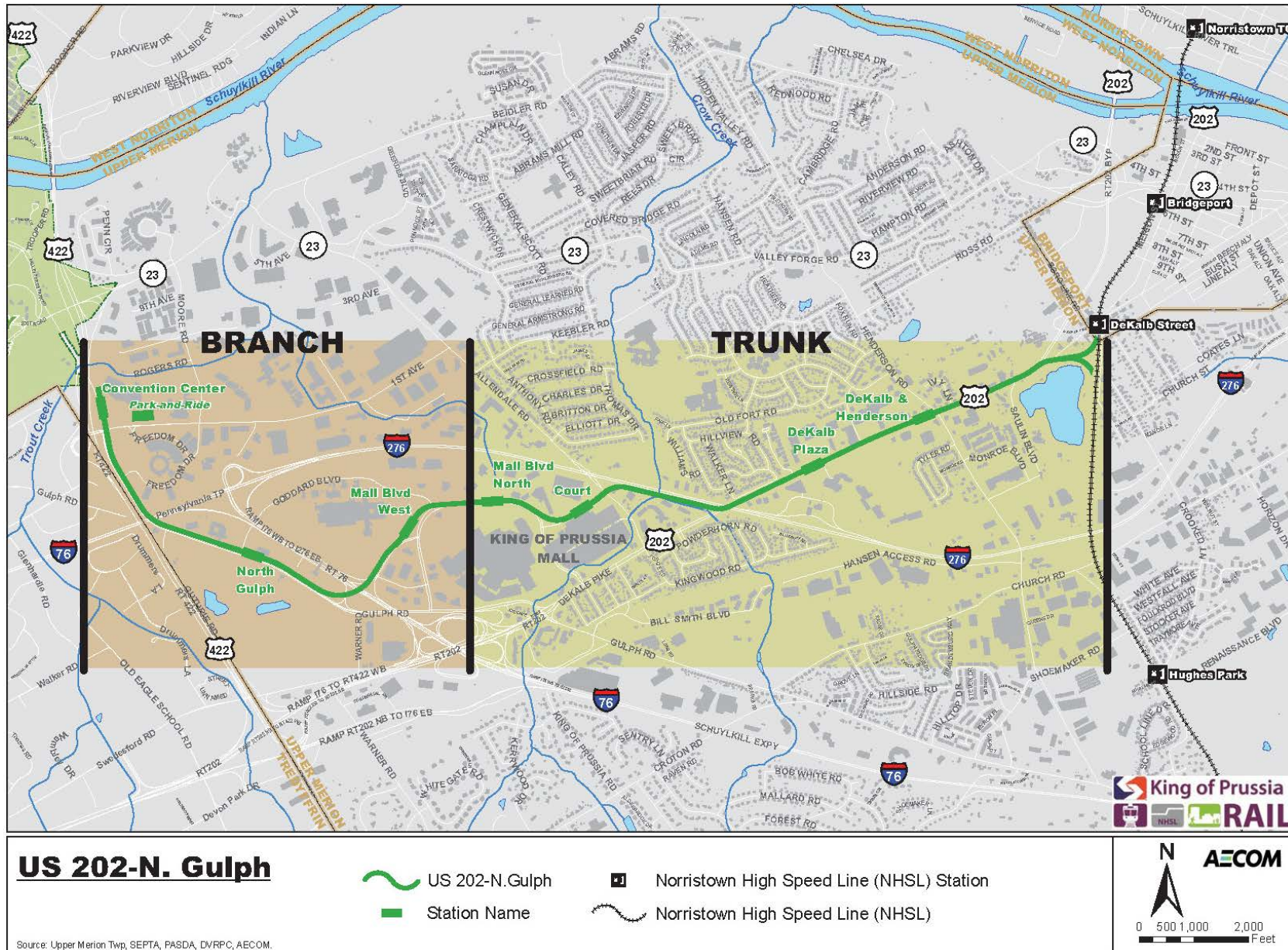
AECOM

N

0 500 1,000 2,000 Feet

Source: Upper Merion Twp, SEPTA, PASDA, DVRPC, AECOM.

Figure 2-2.5: US 202 – N. Gulph Action Alternative



Each Action Alternative includes five to seven proposed station areas depending on the alternative: Henderson Road, Court, Mall Boulevard North, Mall Boulevard West, Plaza, Plaza West, 1st Avenue East, N. Gulph, DeKalb Plaza, DeKalb & Henderson, and the terminal stations 1st & Moore or Convention Center. The Henderson Road and 1st & Moore/Convention Center stations would include park-and-ride facilities, currently configured as a surface lot at the Henderson Road station and a multi-story garage structure at 1st & Moore/Convention Center station. This traffic technical memorandum analyzes the traffic impacts of the proposed park-and-ride facilities. The other stations are proposed as kiss-and-ride facilities only, with drop off areas only for bus, shuttles or car. As such, substantial traffic impacts are not anticipated at these proposed stations.

As the elevated guideway approaches the western terminal stations (1st & Moore or Convention Center), the two-track guideway structure would widen from approximately 34 feet to a three-track cross-section approximately 50 feet wide. In the widened area, the third track would provide SEPTA with the necessary track capacity for efficient train operations at the terminal station and along the alignment in those areas. There are no permanent traffic impacts anticipated due to the need for a third track at terminal stations.

Extending NHSL service into King of Prussia would require SEPTA to add one new station track at SEPTA's 69th Street Transportation Center in Upper Darby Township, Delaware County. The new track would be aligned along the north side of the existing NHSL tracks, stopping at the existing building along the north side of the existing northern platform. The ballast embankment supporting the existing NHSL tracks would be widened to the north to accommodate the new track. Adjacent to the northern platform, the new track would be supported on an elevated guideway structure. The purpose of using structure rather than continuing the embankment up to the building is to avoid impacting the existing bus stop and turnaround area underneath and adjacent to the new track.

The northern platform would be widened to serve the new track. As with the existing NHSL service, the new track and widened platform would be designed to enable level passenger boarding. The existing windbreak wall along the northern edge of the existing platform would be removed and rebuilt along the northern edge of the proposed guideway structure. Elements to be removed include a short section of existing turnout track along the proposed alignment as well as an existing stairway used by passengers exiting from the north platform and by SEPTA personnel. The existing track embankment retaining wall would be relocated to the north edge of the new embankment and the existing track turnout would be replaced. Other portions of the 69th Street Transportation Center would not be affected or changed by the proposed Project. There are no permanent traffic impacts anticipated from the one new station track at SEPTA's 69th Street Transportation Center.

3.0 Methodology

3.1 Traffic

The focus of traffic assessment is in the vicinity of proposed park-and-ride facilities where Project-related traffic generation has the potential to negatively impact local roadway operations. This section describes the analysis methodology applied to assess traffic impacts at proposed park-and-ride facilities. The analysis focuses on specific intersection operations, defined by level of service (LOS) thresholds. Also assessed are significance criteria guidelines and relevant existing factors affecting performance near the studied intersections, such as driveways.

3.1.1 Proposed Stations and Park-and-Rides

Table 3-1.1 summarizes the numbers of stations and park-and-ride facilities proposed for each Action Alternative. The numbers are quantified by numbers with kiss-and-ride and park-and-ride access.

Table 3-1.1: Stations per Action Alternative

Alternative	Kiss-and-Ride Stations	Park-and-Ride Stations
PECO - 1st Ave	3	2
PECO/TP - 1st Ave	3	2
PECO/TP - N. Gulph Rd	4	2
US Route 202 - 1st Ave	5	1
US Route 202 - N. Gulph Rd	6	1

Source: AECOM, 2016.

It should be noted that kiss-and-ride stations allow only passenger drop-off and pick-up, by either passenger cars or by buses and shuttles. Five of the nine proposed kiss-and-ride station areas are along roadways with a center median, where only right-in, right-out access will be permitted. Exits at all kiss-and-ride station areas are proposed to be stop controlled. The following proposed kiss-and-ride station areas are near traffic signals and may require further investigation in subsequent phases of Project development to determine if signal phasing and/or timings need to be adjusted.

- Court Station: Exit approximately 450' east of Mall Boulevard/Wills Boulevard intersection
- Plaza West Station: Exit approximately 220' south of Mall Boulevard/I-76 Ramp intersection
- N. Gulph Station: Exit approximately 100' east of N Gulph Road/Goddard Boulevard intersection
- 1st Avenue East Station: Shared vehicle and bus turnout lanes approximately 100' and 450' west of 1st Avenue/American Avenue intersection
- DeKalb Plaza Station : Exit approximately 150' from US Route 202/King Circle intersection

- DeKalb and Henderson Station: Exits approximately 180' north and west of DeKalb Pike/Henderson Road
- Henderson Road Station: Exits approximately 350' south and 450' east of Henderson Road/Saulin Boulevard intersection

3.1.2 Studied Intersections

Among the five Action Alternatives, the assessment of traffic impacts examined seven signalized intersections near the two proposed park-and-ride facilities. These intersections were selected for study based upon the likelihood of experiencing potential impacts from park-and-ride traffic. The selected intersections are the nearest signalized intersections to park-and-ride facility locations along identified inbound/outbound routes. Table 3-1.2 lists the intersections examined. Figure 3-1.1 identifies the two intersections analyzed for the proposed park-and-ride near the Convention Center and 1st & Moore station areas. Figure 3-1.2 identifies the five intersections analyzed for the proposed park-and-ride facility near the Henderson Road station area.

Table 3-1.2: Studied Signalized Intersections

Intersection	Major Roadway	Minor Roadway
1	1 st Avenue	North Gulph Road
2	1 st Avenue	Moore Road
3	Henderson Road	Saulin Boulevard
4	Henderson Road	Monroe Boulevard/Monroe Road
5	US Route 202	Saulin Boulevard
6	Henderson Road	Church Road
7	Henderson Road	US Route 202

Source: AECOM, 2016.

Figure 3-1.1: Intersections Analyzed: Convention Center/1st & Moore Park-and-Ride

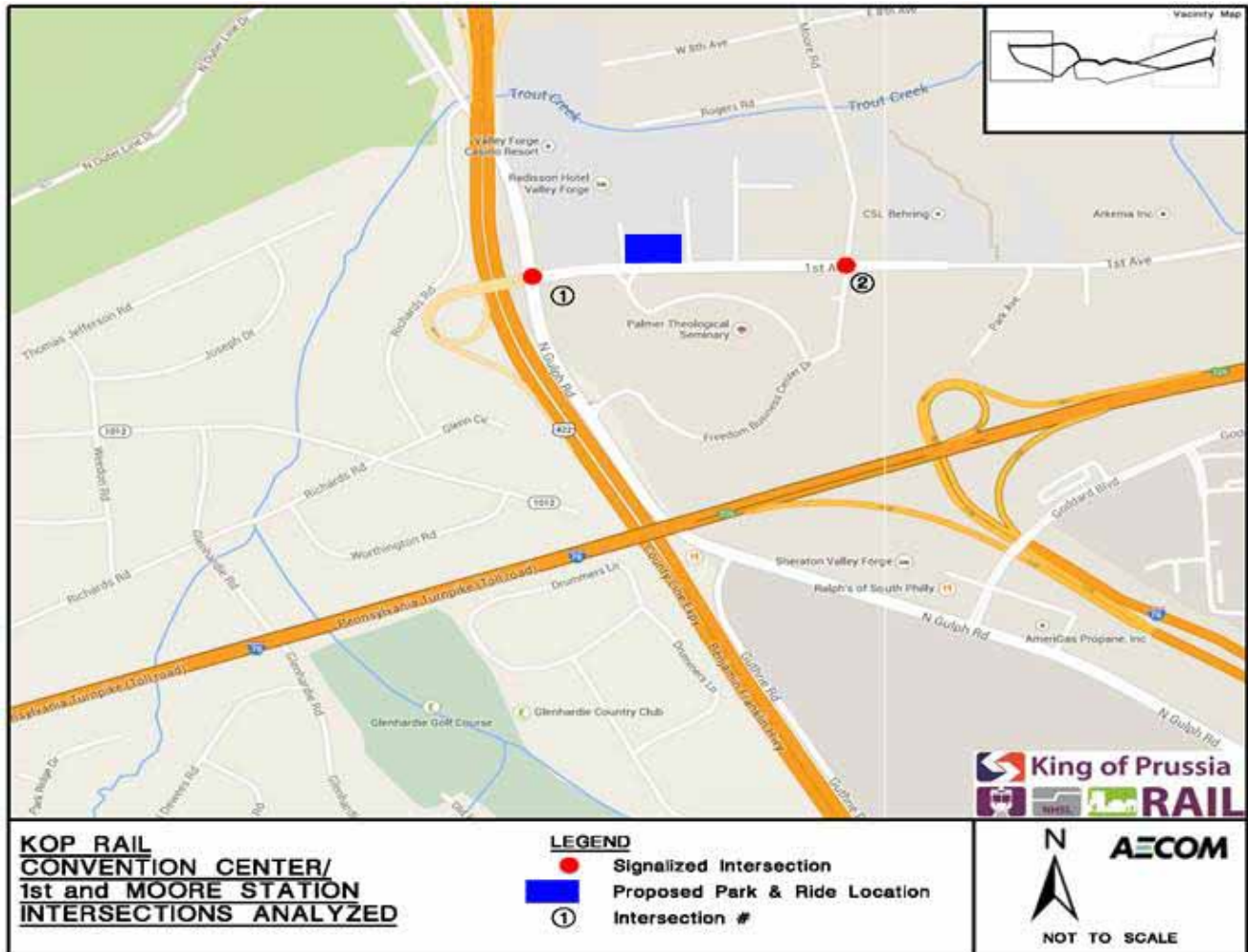
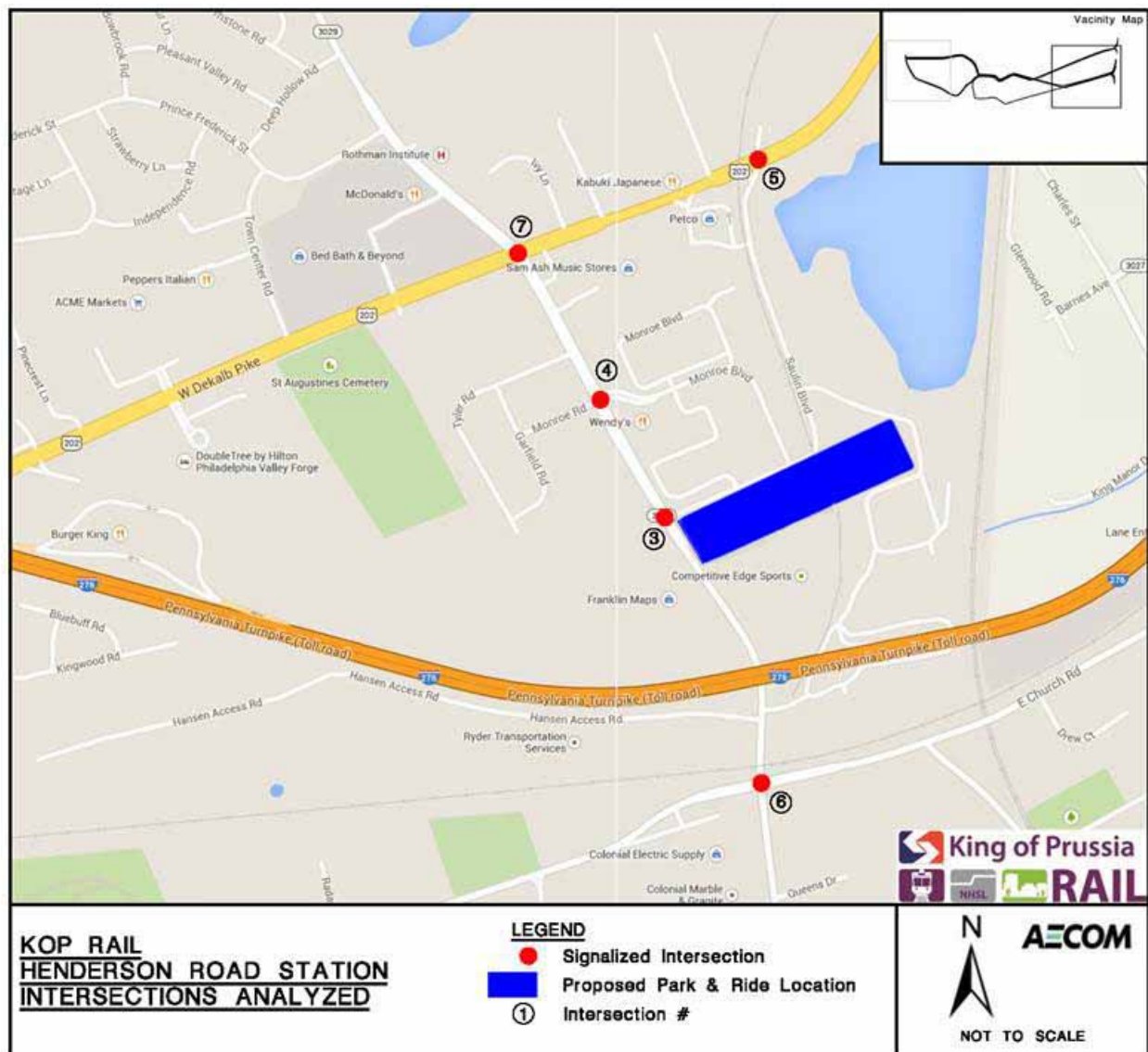


Figure 3-1.2: Intersections Analyzed: Henderson Road Park-and-Ride



3.1.3 Analysis Methodologies

The assessment of the potential effects of the No Action Alternative and each Action Alternative on roadways relies on the results of traffic analyses described in this technical memorandum and regional travel demand modeling and ridership forecasting performed by the Delaware Valley Regional Planning Commission (DVRPC).

Data used to assess the potential effects on roadways included roadway system characteristics, DVRPC forecasted access mode to Project stations with park-and-ride facilities, intersection turning movement volumes, and peak period traffic volumes. Analysis tools included traffic simulation modeling and the DVRPC regional travel demand model. Existing and horizon year 2040 roadway networks and travel patterns were analyzed using the DVRPC travel demand

model. Traffic congestion was quantified using the methodologies of the Highway Capacity Manual, the national standard for evaluating traffic operations.

No potential at-grade rail crossings of streets, roads, or highways would occur under any Action Alternative. Even though the entire lengths of each Action Alternative are not on an aerial structure, the limited portions of the alignments that are at grade or on retained fill do not have potential roadway crossings. As a result, intersection capacity analysis for roadway and rail crossing locations was not warranted or performed.

An analysis of the DVRPC prepared forecasts of mode of access to Project stations was used to determine that potential traffic impacts, in terms of operational performance of intersections, are expected to occur only at park-and-ride facilities and that no operational performance impacts would occur at intersections serving Project kiss-and-ride stations. As proposed, the kiss-and-ride stations have no parking spaces for park-and-ride and offer only a small number of short-duration spaces for the specific purposes of drop-off and pick-up of rail passengers to and from trains.

The predominant modes of access to and from the kiss-and-ride stations are forecasted to be walk access and bus/shuttle access; motor vehicle access to these stations by the kiss-and-ride access mode is forecasted to be low volumes. Table 3.1-3 shows the forecasted 2040 mode of access for riders to proposed kiss-and-ride stations and stations with park-and-ride facilities for each Action Alternative during the PM peak period (a four hour time period from 3pm to 7pm). The PM peak period represents the period of time with the highest roadway traffic volumes affecting intersection operational performance. In all cases during the four hour PM time period, forecasted motor vehicle access to the kiss-and-ride stations by the kiss-and-ride access mode is not greater than 31 riders over that entire four hour time period for any Action Alternative. At all but two kiss-and-ride stations, no more than 20 riders are forecasted to use the kiss-and-ride access mode during the four hour PM time period. Table 3.1-3 summarizes these findings.

Table 3-1.3: 2040 Forecasted Mode of Access to Kiss-and-Ride Stations and Park-and-Ride Stations (PM Time Period (3pm to 7pm))

PLAZA: A Kiss & Ride Station						
TIME PERIOD	2040 MODE OF ACCESS	Action Alternative				
		PECO-1st Ave.	PECO/TP-N. Gulph	PECO/TP-1st Ave. (recommended LPA) (a)	US202-N. Gulph	US202 - 1st Ave.
PM	Park & Ride	-	-	-	-	-
	Kiss & Ride	23	-	-	-	-
	Bus or Shuttle	-	-	-	-	-
	Walk-On	230	-	-	-	-
	NHSL to NHSL	2	-	-	-	-

PLAZA WEST: A Kiss & Ride Station						
TIME PERIOD	2040 MODE OF ACCESS	Action Alternative				
		PECO-1st Ave.	PECO/TP-N.Gulph	PECO/TP-1st Ave.	(recommended LPA) (a)	US202-N.Gulph
PM	Park & Ride	-	-	-	-	-
	Kiss & Ride	16	-	-	-	-
	Bus or Shuttle	307	-	-	-	-
	Walk-On	165	-	-	-	-
	NHSL to NHSL	0	-	-	-	-

1ST AVENUE EAST: A Kiss & Ride Station						
TIME PERIOD	2040 MODE OF ACCESS	Action Alternative				
		PECO-1st Ave.	PECO/TP-N.Gulph	PECO/TP-1st Ave.	(recommended LPA) (a)	US202-N.Gulph
PM	Park & Ride	-	-	-	-	-
	Kiss & Ride	16	-	17	-	16
	Bus or Shuttle	66	-	23	-	51
	Walk-On	159	-	175	-	162
	NHSL to NHSL	1	-	0	-	0

COURT: A Kiss & Ride Station						
TIME PERIOD	2040 MODE OF ACCESS	Action Alternative				
		PECO-1st Ave.	PECO/TP-N.Gulph	PECO/TP-1st Ave.	(recommended LPA) (a)	US202-N.Gulph
PM	Park & Ride	-	-	-	-	-
	Kiss & Ride	-	14	14	13	13
	Bus or Shuttle	-	65	57	23	25
	Walk-On	-	139	140	128	131
	NHSL to NHSL	-	3	3	0	0

MALL BOULEVARD NORTH: A Kiss & Ride Station						
TIME PERIOD	2040 MODE OF ACCESS	Action Alternative				
		PECO-1st Ave.	PECO/TP-N.Gulph	PECO/TP-1st Ave.	(recommended LPA) (a)	US202-N.Gulph
PM	Park & Ride	-	-	-	-	-
	Kiss & Ride	-	18	18	16	17
	Bus or Shuttle	-	366	544	265	465
	Walk-On	-	180	178	164	170
	NHSL to NHSL	-	0	0	0	0

MALL BOULEVARD WEST: A Kiss & Ride Station						
TIME PERIOD	2040 MODE OF ACCESS	Action Alternative				
		PECO-1st Ave.	PECO/TP-N. Gulph	PECO/TP-1st Ave.	(recommended LPA) (a)	US202-N. Gulph
PM	Park & Ride	-	-	-	-	-
	Kiss & Ride	-	4	-	-	2
	Bus or Shuttle	-	18	-	-	13
	Walk-On	-	41	-	-	19
	NHSL to NHSL	-	0	-	-	0
NORTH GULPH: A Kiss & Ride Station						
TIME PERIOD	2040 MODE OF ACCESS	Action Alternative				
		PECO-1st Ave.	PECO/TP-N. Gulph	PECO/TP-1st Ave.	(recommended LPA) (a)	US202-N. Gulph
PM	Park & Ride	-	-	-	-	-
	Kiss & Ride	-	17	-	-	31
	Bus or Shuttle	-	14	-	-	8
	Walk-On	-	175	-	-	312
	NHSL to NHSL	-	0	-	-	0
DEKALB & HENDERSON: A Kiss & Ride Station						
TIME PERIOD	2040 MODE OF ACCESS	Action Alternative				
		PECO-1st Ave.	PECO/TP-N. Gulph	PECO/TP-1st Ave.	(recommended LPA) (a)	US202-N. Gulph
PM	Park & Ride	-	-	-	-	-
	Kiss & Ride	-	-	-	-	4
	Bus or Shuttle	-	-	-	-	25
	Walk-On	-	-	-	-	37
	NHSL to NHSL	-	-	-	-	1
DEKALB PLAZA: A Kiss & Ride Station						
TIME PERIOD	2040 MODE OF ACCESS	Action Alternative				
		PECO-1st Ave.	PECO/TP-N. Gulph	PECO/TP-1st Ave.	(recommended LPA) (a)	US202-N. Gulph
PM	Park & Ride	-	-	-	-	-
	Kiss & Ride	-	-	-	-	8
	Bus or Shuttle	-	-	-	-	22
	Walk-On	-	-	-	-	80
	NHSL to NHSL	-	-	-	-	0

HENDERSON ROAD: A Park & Ride Station						
TIME PERIOD	2040 MODE OF ACCESS	Action Alternative				
		PECO-1st Ave	PECO/TP-Gulph Rd	PECO/TP-First Ave (recommended LPA)(a)	US202-N. Gulph	US202 - 1st Ave.
PM	Park & Ride	232	244	246	-	-
	Kiss & Ride	41	43	43	-	-
	Bus or Shuttle	42	43	37	-	-
	Walk-On	44	43	47	-	-
	NHSL to NHSL	25	27	27	-	-

CONVENTION CENTER/1st & MOORE: A Park & Ride Station						
TIME PERIOD	2040 MODE OF ACCESS	Action Alternative				
		PECO-1st Ave	PECO/TP-Gulph Rd	PECO/TP-First Ave (recommended LPA)(a)	US202-N. Gulph	US202 - 1st Ave.
PM	Park & Ride	172	159	184	101	113
	Kiss & Ride	30	28	32	18	20
	Bus or Shuttle	25	91	41	106	11
	Walk-On	147	168	159	147	152
	NHSL to NHSL	0	0	0	0	0

Source: DVRPC Tier 3 Forecast, Run Dates 4/3/15 and 6/2/15

Impacts to the intersections were evaluated by measuring performance associated with vehicular and pedestrian traffic in the existing, No-Build (for the No Action Alternative) and Build (Action Alternative) conditions. The horizon year has been established by SEPTA and the DVRPC as 2040. Growth rates were provided by DVRPC from the NHSL study model that is developed, maintained, and applied by DVRPC for ridership forecasting purposes for the DEIS. The growth rates are specific to each model link (roadway segment) and accommodate both local and regional development as well as traditional growth metrics (population and employment) and programmed infrastructure improvements.

To establish baseline conditions and determine intersection capacity impacts of the Project near the proposed park-and-ride facilities, traffic analyses were conducted at each studied intersection for existing conditions, conditions that will occur for the No Action Alternative and conditions that would occur for each Action Alternative. Typical quantitative parameters (Measures of Effectiveness or MOE's), including Level of Service (LOS), delay and queue length, were used to indicate the performance of the intersections.

- Delay is the MOE frequently used to analyze performance of signalized intersections. Delay is the additional travel time attributable to the presence of the signal and

conflicting traffic. Delay is measured in seconds per vehicle by intersection movement and for the total intersection.

- LOS is a conversion of delay from seconds to a qualitative, letter-grade system, measuring the operational efficiency of an intersection. Table 3-1.4: Signalized Intersection Level of Service Criteria (Delay per Vehicle(s))
- 3.1-4 summarizes the LOS criteria (Highway Capacity Manual 2010) for signalized intersections.

Table 3-1.4: Signalized Intersection Level of Service Criteria (Delay per Vehicle(s))

LOS	Control Delay
A	≤ 10
B	> 10 and ≤ 20
C	> 20 and ≤ 35
D	> 35 and ≤ 55
E	> 55 and ≤ 80
F	> 80

- Another MOE used to evaluate intersection operation is queue length, which is measured in feet by lane, and generally follows delay trends. Queue length is most useful in evaluating the sufficiency of available storage length and identifying conflicts with access points or starvation (insufficiency) of movements at a downstream signal.

All traffic analyses were conducted utilizing Synchro software, which models operations of systems of adjacent intersections, so that impacts can be identified and solutions or mitigation developed.

3.1.4 Traffic Volumes

3.1.4.1 Data Collection

Traffic data collection was limited to signalized intersections only and relied upon various sources. Previous reports and existing traffic counts were used at Intersections 1 and 7. Traffic counts were conducted on February 4, 2015, at intersections 2 through 6. Previous reports also provided driveway counts for the VFCR. Raw data from all sources is compiled in Appendix A.

3.1.4.2 Network Balancing

Since the traffic data vary by both source and date, volumes between all adjacent intersections do not agree, or have concurrent peak periods. This section describes the methodology used to divide the intersections into networks of impact by station area, and the assumptions used to grow and balance the volumes, and establish peak hours within each network. Supporting calculations for global peak hours and balanced volumes are compiled in Appendix B and Appendix C.

Since the primary, Project-related impacts to the traffic stream would be at the proposed park-and-ride facilities, two analysis networks were created. The first network includes Intersections 1 and 2, which would be impacted by traffic using the park-and-ride facility proposed for the Convention Center and 1st & Moore Stations.

The volumes for Intersections 1 and 2 were not balanced. Variations are attributed to major driveways between them: one for the VFCR along westbound 1st Avenue and a second access to a major commercial building along eastbound 1st Avenue. Based upon the greatest common volumes, peak hours of 8:00 AM – 9:00 AM and 4:30 PM – 5:30 PM were established for the analyses of Intersections 1 and 2.

Intersections 3 through 7 would be impacted by traffic using the park-and-ride facility proposed for the Henderson Road Station. Data was collected along roadways intersecting Henderson Road and one outlying intersection that provides an alternate route to and from the station area.

Three variations were identified in the grown data; since these variations were large enough to impact analysis results, the data were adjusted. 2015 volumes were held at surrounding intersections, and volumes at the US Route 202/Henderson Road intersection were adjusted to correspond. Further, 2011 turning movement percentages were used to assign volumes by approach.

Adjacent signalized intersections within the Henderson Road Station network without commercial driveways between them were also balanced. Based upon the greatest common adjusted volumes, peak hours of 7:30 AM – 8:30 AM and 4:30 PM – 5:30 PM were established.

3.2 Bicycle and Pedestrian Facilities

A qualitative assessment of potential impacts of the Project on bicycle and pedestrian facilities was undertaken using available information from Upper Merion Township, Montgomery County and PennDOT, as well as field observation of existing transportation study area facilities. It identifies the nature and extent of existing facilities and, where present, assesses the potential for changes in circulation. Also identified are potential strategies SEPTA would consider as the Project advances to accommodate bicycle and pedestrian activity in and around proposed station areas and park-and-ride facilities.

3.3 Public Parking Facilities

The potential for impacts of the Action Alternatives on public parking facilities, either during construction or over the long-term, was assessed by identifying public parking facilities within the alignment of each Action Alternative. In terms of public on- and off-street parking facilities, Data sources included field reconnaissance and available mapping. The methodology for assessing potential effects on public parking facilities involved quantifying the number of public parking spaces potentially affected by each Action Alternative.

3.4 Safety

The potential for safety effects of the Action and No Action Alternatives was qualitatively assessed by examining transportation system safety and security and local emergency services. The assessment identifies general safety and security considerations related to the Project.

4.0 Existing Transportation Facilities

4.1 Regional and Local Roadway Network

The system of roadways in the vicinity of and concurrent with the Action Alternative is divided into local and regional networks serving communities and businesses in the transportation study area (see Table 4-1.1). These roadways within the transportation study area include the following:

Table 4-1.1: Transportation Study Area Roadways

Roadway	Jurisdiction	Type	Comments
Church Road	Township / PennDOT	UC	Two lanes, bisects Henderson Road, provides commercial and residential access to east and west.
1 st Avenue	Township	UC	Four lanes, extends between N. Gulph Rd and Allendale Ave, provides commercial access to the north and south.
Henderson Road	PennDOT	PAH	Two lanes, bisects US Route 202, provides residential access to the north and commercial access to the south.
I-276 (PA Turnpike)	PA Turnpike Commission	IS	Six lanes, bisects US Route 202, runs from north of the King of Prussia Mall to south of proposed Henderson Road Station, I-76 Interchange is located west of the King of Prussia Mall.
I-76 (Schuylkill Expressway)	PennDOT	IS	Four lanes, bisects US Route 202, runs mainly southeast of Project area.
Mall Boulevard	Township	LR	Main circulation road around King of Prussia Mall.
Monroe Road / Monroe Blvd	Township / Private	LR	Two lanes, bisects Henderson Road, provides residential access to east and west and serves as minor commercial circulation road to east.
Moore Road / Freedom Drive	Township / Private	UC	Two lanes, bisects 1 st Ave, provides main access from Freedom Business Center to south and commercial access to north.
North Gulph Road	PennDOT	MA	Four lanes, bisects US Route 202, provides residential access to south, primary mall access and convention center/casino access to north, provides main access Children's Hospital of Philadelphia (CHOP) at the Village at Valley Forge.
Saulin Boulevard	Township	LR	Two lanes, provides minor commercial access and bypass around congested Henderson Road/US Route 202 intersection.
US Route 202	PennDOT	PAH	Four lanes, provides primary access to retail and commercial properties and King of Prussia Mall circulation roads.

Legend: LR – Local Road, UC – Urban Collector, MA – Minor Arterial, PAH – Principal Arterial Highway, IS – Interstate.

Source: DVRPC, *Connections 2040 Plan for Greater Philadelphia*.

4.2 Pedestrian and Bicycle Facilities

4.2.1 Existing Conditions

Existing pedestrian facilities are summarized by intersection in Table 4-2.1, and include sidewalks, curb ramps, pedestrian push buttons, pedestrian traffic signals, and crosswalks. An assessment of compliance with current Americans with Disabilities Act (ADA) requirements was not performed.

Table 4-2.1: Intersection Pedestrian Facilities

Intersection	Sidewalk	Curb Ramp	Push Button	Ped Head	Crosswalk
1 ¹	No	No	No	No	No
2 ¹	1 st Avenue – East side	Yes	Yes	No	NB, SB, WB
3 ¹	Saulin Blvd – South side, Henderson Rd – both sides	NE, SE, SW	NE, SE, SW	NE, SE, SW	NB, WB
4	Henderson Rd – East side, Monroe Blvd – both sides	Yes	Yes	Yes	Yes
5 ¹	No	NW, NE, SE	NW, NE, SE	NW, NE, SE	SB, WB
6 ¹	Henderson Rd – West side	NW, SW, SE	NW, SW, SE	NW, SW, SE	NB, EB
7 ¹	Henderson Rd – both sides (north of US Route 202), US Route 202 EB, US Route 202 WB – North Side	NW, NE, SE	NW, NE, SE	NW, NE, SE	SB, WB

¹ - Indicates location where pedestrian movements are prohibited on by existing signage on one or more approaches. Source: Malick & Scherer, 2016.

No designated Class 1, 2 or 3 bicycle facilities exist near the studied intersections (an asphalt path runs for about 750 feet on the south side of Saulin Boulevard). Due to the type and classification of the major roadways and the current land use pattern of the surrounding area, bicycle use is anticipated to be low.

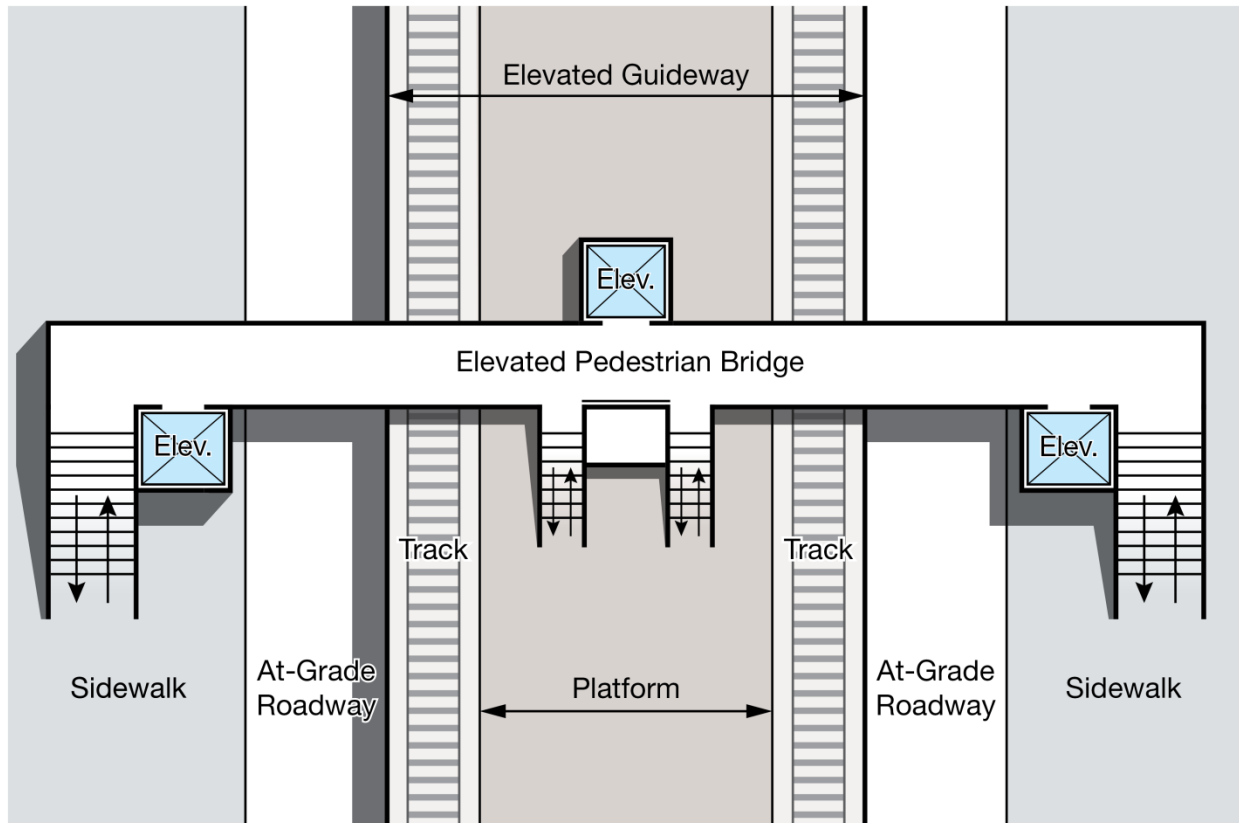
4.2.2 Proposed Project Facilities

Access from existing transportation study area pedestrian infrastructure to each proposed station area was considered as part of the DEIS. A conceptual layout of facilities, including but not limited to sidewalk, ramps, stairs, elevators, and overhead pedestrian bridges is included in each station area concept design (see Figure 4-2.1). All proposed station area and the park-and-ride facility layouts are conceptual in nature and subject to change as continued dialogue and refinement of these layouts occur with property owners and other stakeholders and as station area design advances in subsequent design phases. Design elements of all facilities will need to comply with the design standards set forth in the Public Rights-of-Way Accessibility Guidelines (PROWAG).

4.3 Public Parking Facilities

The inventory of public parking determined that none is present in alignment of each Action Alternative, either in the form of public on-street parking or off-street public parking. Parking areas are private and associated with existing commercial and office land uses.

Figure 4-2.1 Typical Station Layout Plan



Typical Station Layout Plan

Not to Scale

Source: AECOM: 2016.

5.0 Results

This section describes the results of traffic analyses for the existing condition and 2040 future conditions for the No Action (No-Build) and Action (Build) Alternatives.

5.1 Intersection Impacts Overview

This section describes each Action Alternative and the studied intersections that each potentially would impact.

5.1.1 PECO – 1st Ave. Alternative

PECO-1st Ave. is comprised of a 1st Ave. Branch (including intersection 2) and a PECO Trunk (including intersection 3). The performance of intersections 1 through 7 potentially would be impacted by PECO-1st Ave.

5.1.2 PECO/TP – 1st Ave. Alternative

PECO/TP-1st Ave. is comprised of a 1st Ave. Branch (including intersection 2) and a PECO/TP Trunk (including intersection 3). The performance of intersections 1 through 7 potentially would be impacted by PECO/TP-1st Ave.

5.1.3 PECO/TP – N. Gulph Alternative

PECO/TP-N. Gulph is comprised of a N. Gulph Branch (including intersection 1) and a PECO/TP Trunk (including intersection 3). The performance of intersections 1 through 7 potentially would be impacted by PECO/TP-N. Gulph.

5.1.4 US 202 – 1st Ave. Alternative

US 202-1st Ave. is comprised of a 1st Ave. Branch (including intersection 2) and a US 202 Trunk (including intersections 5 and 7). The performance of intersections 1, 2, 5 and 7 potentially would be impacted by US 202-1st Ave.

5.1.5 US 202 – N. Gulph Alternative

US 202-N. Gulph is comprised of a N. Gulph Branch (including intersection 1) and a US 202 Trunk (including intersections 5 and 7). The performance of intersections 1, 2, 5 and 7 potentially would be impacted by US 202-N. Gulph.

5.2 Traffic Impacts

This section reports the results of traffic modeling analyses using the Synchro model by individual location for 2015 existing conditions, 2040 conditions with the No Action Alternative (No-Build), and 2040 conditions with the Action Alternatives (Build). This section compares traffic performance among the five Action Alternatives.

This analysis identified existing deficiencies that should be addressed prior to or concurrent with Project development. Where possible, this analysis applied improvements to optimize operations, in the forms of turning lanes and other operational adjustments. Some deficiencies are already being programmed for mitigation by other regional and local projects. Where Project impacts are identified and SEPTA could potentially address, improvements are included in the analysis of the Action Alternatives (Build) condition to optimize operational results.

5.2.1 2015 Existing Traffic Conditions

The existing lane configurations at the studied, signalized intersections are shown in Figure 5-2.1. Balanced AM and PM peak hour volumes are shown in Figure 5-2.2. Note that the eastbound approach of Intersection 3 is an active driveway.

Peak Hour Factors (PHF) and Percent Heavy Vehicles (% HV) were calculated by intersection. A PHF represents the distribution of volumes across the selected peak hour, and % HV represents the percentage of trucks, buses and other large non-passenger vehicles in the traffic stream. Both are used by Synchro to customize results to existing field conditions. PHF and % HV calculations are included in Appendix A.

Aerial mapping, supplemented by a field survey, established geometric features that provided the basis for setting up the Synchro model. Intersections were first assigned node locations, and corresponding link distances were then developed, along with storage lengths, lane assignments, roadway widths, and other relevant features. Existing signal timing and phasing for traffic signals are usually obtained from as-built signal plans; however, these resources were not available for this analysis. Traffic signal timing and phasing data, therefore, were recorded in the field and formed the basis of the 2015 Existing Condition Synchro timings.

The Synchro model produced LOS, delay, and queue length results for each intersection in both networks. LOS and delay are summarized in Table 5-2.1. Since the main focus of the traffic analyses is the park-and-ride facilities, detailed discussion has been divided by facility and then further subdivided by trunk, branch, and alternative.

Figure 5-2.1: Existing Intersection Turning Movements

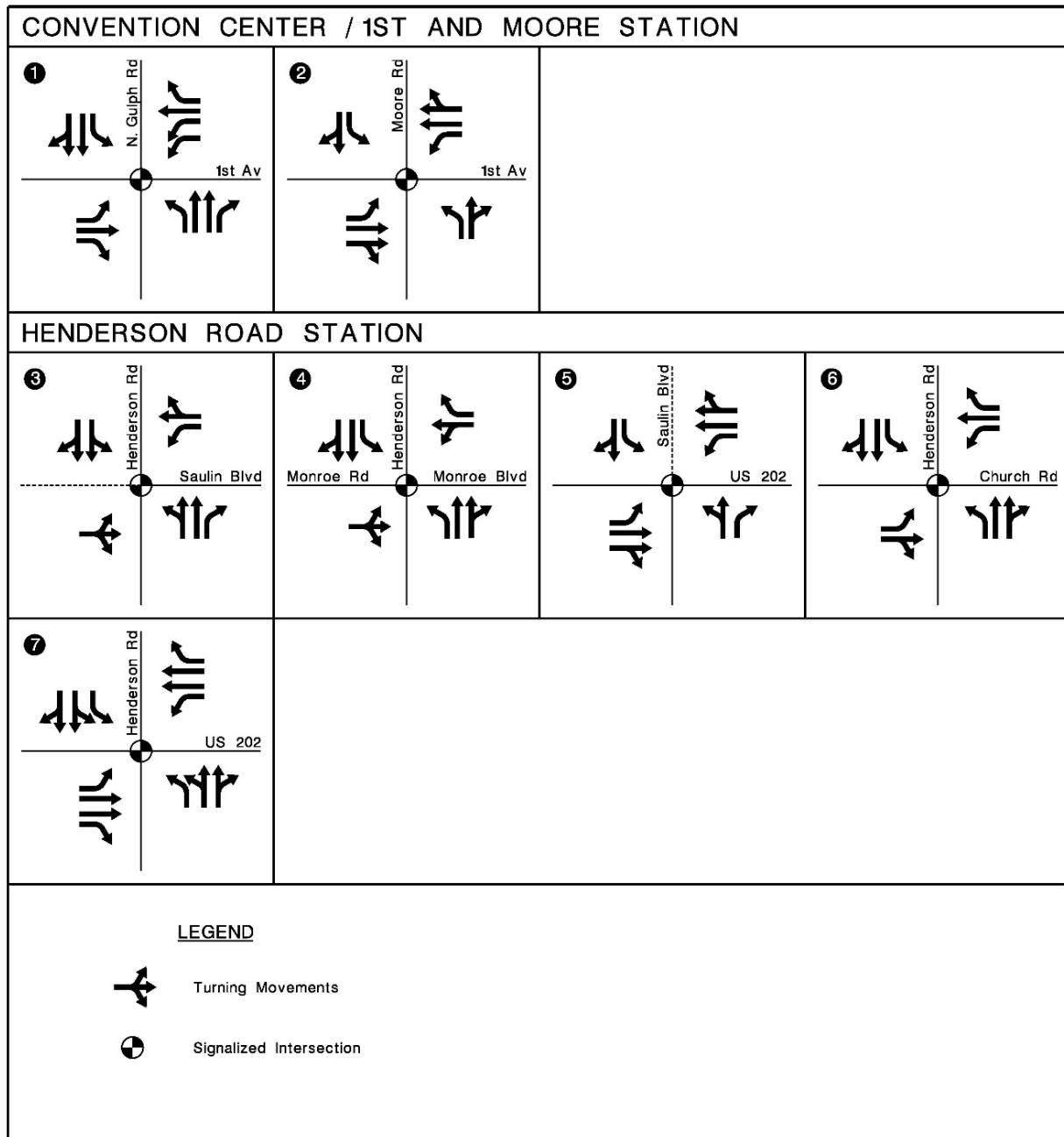
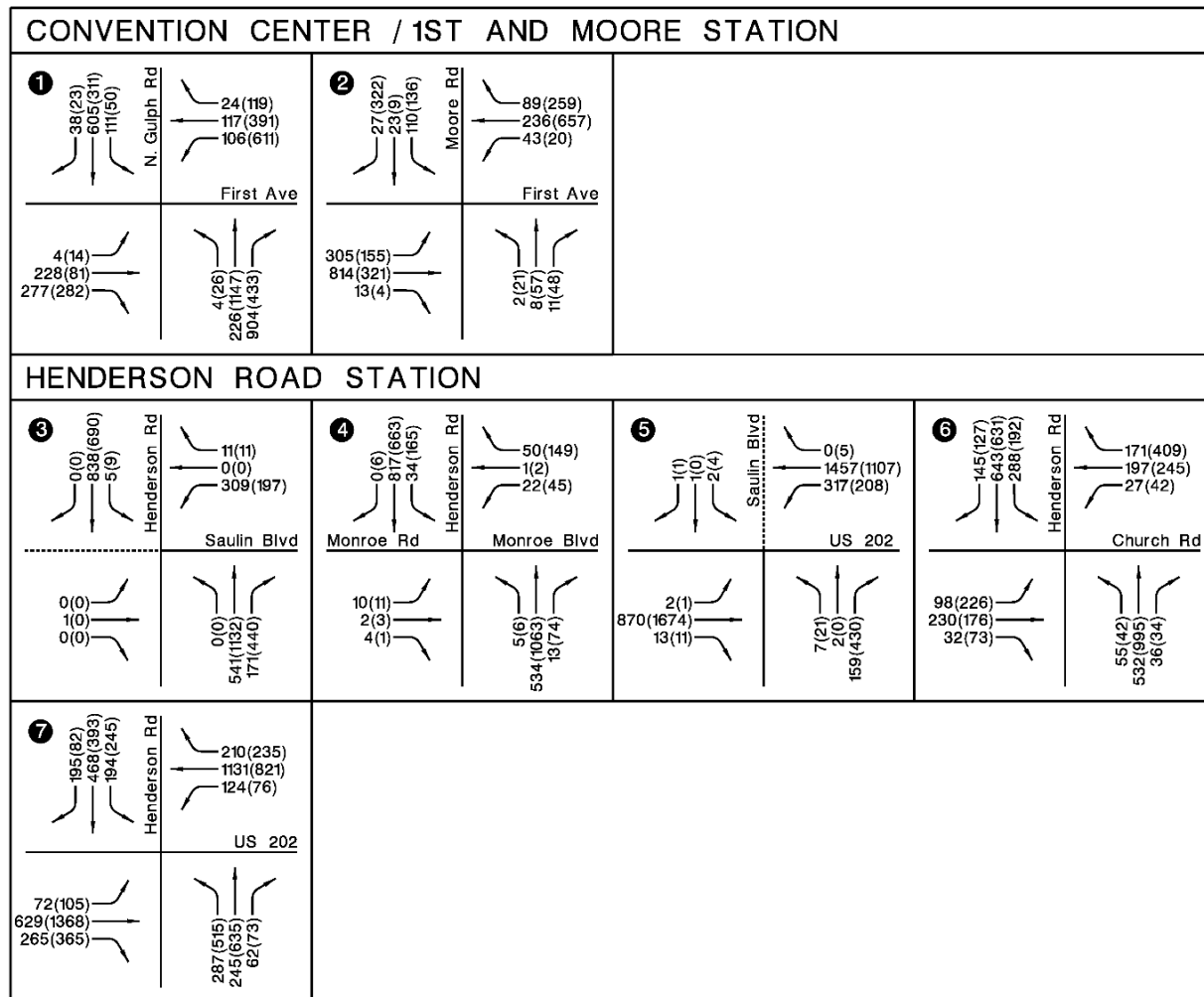


Figure 5-2.2: Balanced Existing Intersection Peak Hour Volumes



XX(XX) - AM(PM) Peak Hour Volumes

Source: AECOM, 2016.

Table 5-2.1: Existing Intersection LOS/Delay

Intersection	Intersection Control	AM Peak Hour		PM Peak Hour	
		LOS	Delay (sec)	LOS	Delay (sec)
1	N. Gulph Rd/1st Ave	D	46.4	D	52.5
2	First Ave/Moore Rd	B	14.4	B	19.1
3	Henderson Rd/Saulin Blvd	B	15.3	B	11.2
4	Henderson Rd/Monroe Blvd	A	6.4	C	20.5
5	US Route 202/Saulin Blvd	A	6.2	C	27.8
6	Henderson Rd/Church Rd	D	37	D	43.1
7	US Route 202/Henderson Rd	E	58.9	F	123.7

Source: AECOM, 2016.

The results in Table 5-2.1 show that some intersections are operating at acceptable overall levels of service in the existing condition, while some are not. Those that are not are: N. Gulph Rd/1st Ave, Henderson Rd/Church Rd, and US Route 202/Henderson Rd, which are operating at LOS D or lower in the AM and/or PM peak hours. The locations of poor operational conditions can be linked to heavy volumes and geometric and operational deficiencies. Traffic patterns at all studied intersections correspond to expected regional travel patterns. Synchro results for Existing Conditions can be found in Appendix D.

5.2.1.1 Intersection 1: N. Gulph Road & 1st Avenue

This intersection serves commuter flow along both 1st Avenue and N. Gulph Road, providing access to commercial buildings to the east and south, the US Route 422 interchange to the west, and the I-76 Schuylkill Expressway interchange to the south. N. Gulph Road is located approximately 1700' west of Moore Road, 1000' north of Freedom Business Center Drive (the main access to that facility), and just over one mile from the I-76 interchange.

The heaviest peak hour flows are over 1100 vehicles per hour (vph) in the AM, northbound (NB), with over 900 vehicles turning right onto 1st Avenue. Another 700 vph proceed outbound (SB) in the AM, and over 500 vph exit from County Line Expressway onto the eastbound (EB) approach. NB continues to be the heaviest approach in the PM, with over 1100 vph moving through and 400 vph turning right onto 1st Avenue. Over 600 westbound (WB) vehicles turn left in the PM and nearly 400 vph are bound for US Route 422. The SB approach mainly serves vehicles bound for the Freedom Business Park or the I-76/I-276 interchange. The EB approach serves traffic to and from the County Line Expressway, and the NB approach delivers traffic to and from 1st Avenue and points north. 1st Avenue operates with protected dual lefts with overlap rights, and a single permitted through phase. N. Gulph Road operates similarly, without the overlap rights.

Due to the heavy PM lefts, the WB approach is equipped with dual left turn lanes. Both EB and WB approaches have dedicated right turn lanes, partially warranted by volume and partially warranted to reduce the phase time necessary to clear vehicles on those approaches.

Although the intersection as a whole operates at a LOS D during both peak periods, the EB and WB approaches fail during the AM and PM peak periods, respectively. Additionally, v/c ratios for movements in the AM EB and NB approaches and the PM WB approach exceed 1.0, indicating the volume of traffic exceeds approach capacity.

Although signal timing was optimized to garner the best performance, this intersection is operating in excess of capacity at two of its approaches. Geometric reevaluation would be necessary in the long term to remedy excessive queuing.

5.2.1.2 Intersection 2: 1st Avenue & Moore Road

This intersection serves mainly commuter flows along 1st Avenue, and provides access to commercial buildings to the north. Moore Road is located approximately 1700' east of N. Gulph Road. The heaviest peak hour flows are over 1100 vph AM EB, and over 900 vph PM WB along 1st Avenue. The SB approach mainly serves vehicles turning onto 1st Avenue, with approach

volumes less than 400 vph at any time. The NB approach is a secondary access point to Freedom Business Park, with approach volumes generally less than 100 vph. 1st Avenue operates with permitted/protected dual lefts and Moore Road operates with a single permitted phase.

This intersection performs well, with an overall LOS B for both AM and PM. No queues exceed available storage length. The EB left turn volume in the AM is 305 vph, above the generally recommended volume of 200 vph per turning lane, but since sufficient green time is available to the left turn movement, the movement operates at a LOS A.

5.2.1.3 Intersection 3: Henderson Road & Saulin Boulevard

At this intersection, Henderson Road is the primary route, with AM traffic generally traveling NB and PM traffic traveling SB. Turning movements reflect the use of Saulin Boulevard as a “cut-through” street to US Route 202, and traffic along Henderson Road is likely destined to and from I-76. In spite of heavy and directionally skewed volumes for some individual movements, this intersection operates well in the existing condition. Delays are at acceptable levels for all movements and no queues exceed available storage space.

5.2.1.4 Intersection 4: Henderson Road & Monroe Boulevard/Road

Monroe Boulevard is 800’ north of Saulin Boulevard, providing access to businesses to the east and residences to the west. Henderson Road traffic patterns are similar to those at Saulin Boulevard. Traffic along the cross streets is light, with the exception of a heavy PM WB right turning movement, attributed to outbound commuter traffic. Delays are acceptable for all movements, and no queues exceed storage space. Timing and phasing reevaluation may garner modest performance improvements of outbound movements at the cross streets during the PM peak.

5.2.1.5 Intersection 5: US Route 202 & Saulin Boulevard

Saulin Boulevard is 1500’ east of Henderson Boulevard along US Route 202 and provides both primary access to and from commercial establishments as well as a cut-through route to Henderson Road that avoids the congested US Route 202 & Henderson Road intersection. US Route 202 volumes exhibit a WB AM peak and an EB PM peak, with moderate variation in other movements between the two peaks. Delays are acceptable for all movements, and no queues exceed storage space. NB traffic is almost exclusively right turning during both peak hours, and minor timing and phasing revisions and/or geometric reevaluation on the NB approach might improve performance.

5.2.1.6 Intersection 6: Henderson Road & Church Road

Church Road is approximately 1800’ south of Saulin Boulevard along Henderson Road. Church Road provides access to both residential and commercial areas to both the east and west. Henderson Road is the primary route, with an AM SB peak and a PM NB peak. The intersection has recently undergone geometric and operational revisions to increase capacity and throughput.

The Church Road approaches operate at a LOS D during both peak periods, with queue lengths for almost all movements exceeding storage during the PM peak. This is attributed to the

timings favoring the heavier volume Henderson Road. The SB left turn queue exceeds the storage length during both peak periods, but an upstream NB left turn lane to Hansen Access Road prevents the addition of storage length. Without ROW acquisition, this intersection cannot be further improved.

5.2.1.7 Intersection 7: US Route 202 & Henderson Road

US Route 202 intersects with Henderson Road approximately 1000' north of Monroe Boulevard. US Route 202 provides primary access to commercial properties, and it carries heavier peak hour volumes than Henderson Road. US Route 202 has an AM WB peak and a PM EB peak. The EB approach of US Route 202 has been recently improved to increase storage, particularly for left turns. Due to the heavy through and turning volumes, all approaches have one or more movements operating at LOS D or worse during both the AM and PM peaks.

5.3 No Action Alternative (2040 No-Build Traffic Conditions)

The traffic conditions as they are forecasted to occur for the No Action Alternative are the basis for comparing the traffic impacts of the Action Alternatives. The No Action Alternative represents the studied intersections as they currently are, along with the implementation of committed transportation programs or projects that are expected to be in place by 2040, the planning horizon. The analysis focused on the seven intersections in the vicinity of the two proposed park-and-ride facilities.

No Action Alternative traffic volumes were projected based upon growth rates derived from data provided by the DVRPC from its travel demand model. The data included directional volumes for each of the links identified in the Synchro network, with a 24 hour period broken down into four periods: AM (6:00 AM – 10:00 AM), MD (10:00 AM – 3:00 PM), PM (3:00 PM – 7:00 PM) and NT (7:00 PM – 6:00 AM). Volume data was provided for the years 2013 and 2040. Since specific information regarding peak hour volumes could not be derived from the time period data, nor were turning movement breakdowns available, the intersection approach volumes from the existing conditions analyses were grown by the growth factors derived for each link for the AM and PM periods, and the grown approach volumes for 2040 were then distributed over the turning movements at each intersection, with adjustments made as needed to maintain adequate balance between intersections and within each network as a whole. Growth rate and volume balancing are summarized in Appendix C.

The traffic volumes for the No Action Alternative were input into the Synchro models, which produced LOS, delay, and queue length results for each intersection in both networks. The LOS and delay are summarized in Table 5-3.1 below. Since the main focus of the traffic analyses are the park-and-ride stations, detailed discussion has been divided by station, and then further subdivided by trunk, branch, and alternative. Synchro results for the No Action Alternative (2040 No-Build traffic conditions) can be found in Appendix E.

Table 5-3.1: No Action Alternative Intersection LOS/Delay

	Intersection	Intersection Control	AM Peak Hour		PM Peak Hour	
			LOS	Delay (sec)	LOS	Delay (sec)
1	N. Gulph Rd/1st Ave	Signalized	D	49.6	D	45.8
2	1st Ave/Moore Rd	Signalized	D	36.9	F	95.0
3	Henderson Rd/Saulin Blvd	Signalized	D	49.9	D	39.1
4	Henderson Rd/Monroe Blvd	Signalized	A	9.2	F	335.1
5	US Route 202/Saulin Blvd	Signalized	B	13.0	D	50.0
6	Henderson Rd/Church Rd	Signalized	E	61.6	F	95.8
7	US Route 202/Henderson Rd	Signalized	F	166.7	F	294.2

Source: AECOM, 2016.

5.3.1 Intersections 1 and 2

Many vehicles accessing the VFCR travel through intersections 1 or 2, which will be impacted by background traffic growth and the implementation of local and regional transportation projects, as discussed in previous sections. While the intersection LOS at N. Gulph Road and 1st Avenue will remain at D during the AM and PM peaks, the implementation of the road diet project will result in the intersection LOS at 1st Avenue and Moore Road decreasing from B to D in the AM peak and from B to F during the PM peak.

5.3.2 Intersections 3 through 7

These intersections are anticipated to see heavier background growth than those studied near the Convention Center/1st & Moore Station park-and-ride facility. Traffic growth along Henderson Road is expected to be robust, at or close to 100% on approaches at several intersections. Impacts will occur at Henderson Road and Saulin Boulevard, where NB and SB No Build queue lengths will increase by about 1000' and SB movement LOS will drop from B to E. A similar deterioration is seen at Monroe Boulevard, where NB and SB movement LOS will drop to F in the PM while queue lengths will increase on NB and SB movements.

The impacts at the intersection of Henderson Road and Church Road are somewhat less dramatic since the intersection is operating poorly in the existing condition. Queues will increase an average of several hundred feet at each approach while LOS will drop to E or F for at least one movement at every approach. Similarly, the intersection of Henderson Road and US Route 202 is already operating poorly, with LOS F for at least one movement on every approach in either the AM or PM peak period. In the No Build condition, LOS will be F on every approach with the exception of the EB AM.

5.4 Action Alternatives (2040 Build Traffic Conditions)

The Action Alternatives in this analysis include traffic conditions at the studied locations as forecasted, with Project traffic effects as well as effects from the committed transportation programs or projects that are expected to be in place by 2040. As mentioned, the analysis

focused on seven intersections in the vicinity of the two proposed park-and-ride facilities. The selected intersections are the nearest signalized intersections to park-and-ride facility locations along identified inbound/outbound routes. The forecasted increases in impacts between the No Action Alternative and the Action Alternatives represent those that would be related to the Project. As Project development continues in later phases, SEPTA will coordinate with PennDOT and Upper Merion Township to provide required traffic impact studies for the Project's opening year and a future planning horizon year.

To perform the most conservative traffic analysis for 2040, Action Alternative volumes were generated under the assumption that all park-and-ride traffic activity would occur during the AM and PM peak hours. Specifically, it was assumed that all park-and-ride patrons would arrive during the AM peak hour, and they would depart during the PM peak hour. Doing so represents the worst case scenario (the most conservative traffic analysis) for traffic volumes at affected intersections.

Arrival and departure volumes associated with the park-and-ride facilities were directionally distributed based upon the No Action Alternative (2040 No-Build) peak hour volume proportions in surrounding intersections. Park-and-ride facility volume assignment and balancing calculations are summarized in Appendix C.

In order to assess and address the impacts to traffic conditions anticipated from the Action Alternatives and to minimize deterioration in operational conditions, geometric and operational improvements are identified at several of the studied intersections. To maximize the performance of the studied signalized intersections under conditions that are forecasted for the Action Alternatives, all signal phases and cycle lengths were optimized at the intersections under study. The Action Alternative traffic volumes were input into the Synchro models, which produced LOS, delay, and queue length results for each studied intersection. The resulting LOS and delay data are summarized in Table 5-4.1 below. Synchro results can be found in Appendix F. Table 5-4.2 at the end of this technical memorandum provides comparative results for LOS and delay by Action Alternative.

Table 5-4.1: Action Alternative (2040 Build Traffic Condition) Intersection LOS/Delay

Intersection	Intersection Control	AM Peak Hour		PM Peak Hour	
		LOS	Delay (sec)	LOS	Delay (sec)
N. Gulph Rd/1st Ave	Signalized	B	18.1	D	50.6
1st Ave/Moore Rd	Signalized	D	41.9	F	127.4
Henderson Rd/Saulin Blvd	Signalized	D	36.5	D	51.4
Henderson Rd/Monroe Blvd	Signalized	B	11.1	F	90.7
US Route 202/Saulin Blvd	Signalized	B	14.7	E	70.5
Henderson Rd/Church Rd	Signalized	E	60.4	F	92.8
US Route 202/Henderson Rd	Signalized	F	155.0	F	257.6

Source: AECOM, 2016.

5.4.1 Intersection 1: N. Gulph Road & 1st Avenue

The N. Gulph Road and 1st Avenue intersection would require several geometric improvements to address the impacts of the Action Alternative traffic volumes as compared to the No Action Alternative. For the Action Alternative condition, geometry for the EB through movement is proposed to increase from one to two lanes (the additional through lane can be a through storage lane). On the receiving side, there would be an additional EB through lane to accommodate the additional through lane from the EB approach. With the exclusive receiving lane on 1st Avenue east of the intersection, the NB right phasing is proposed to be converted from permitted for the No Action Alternative to free for the Action Alternative. Also, the SB left geometry is proposed to increase from one storage left lane to two storage left lanes for the Action Alternative condition.

5.4.2 Intersection 2: 1st Avenue & Moore Road

A minor phasing revision of converting the SB left turn type from Permitted for the No Action Alternative to Permitted + Protected for the Action Alternative condition is identified for the intersection of 1st Avenue & Moore Road. In addition, a signal cycle length update to 90 seconds is required during the AM peak to mitigate impacts from the increase in volumes under the Action Alternative condition.

5.4.3 Intersection 3: Henderson Road & Saulin Boulevard

The Henderson Road & Saulin Boulevard intersection is presumed to be the primary gateway to the proposed Henderson Road Station park-and-ride facility. Although the intersection has undergone improvements within the last four years, which included widening of the NB approach, restriping of the SB approach and the addition of ADA facilities, the current geometry is insufficient to adequately accommodate forecasted future No Action Alternative volumes, and requires improvements to accommodate forecasted Action Alternative volumes.

First, for purposes of analysis, the EB approach (a low-volume driveway with two other access points) was eliminated from the Action Alternative Synchro network so that the analytic logic would be able to more accurately reflect operational conditions. Next, a third NB through lane is proposed, and the NB right turn phase is proposed to be converted from the condition of Permitted in the No Action Alternative to Permitted + Overlap. The SB geometry is proposed to be increased from one left/through and one through combination to one left lane and two through lanes. The SB left turn lane would also require a protected phase to accommodate the flow of the forecasted park-and-ride facility traffic. Also, an additional WB left turn lane is proposed by restriping the lane grouping to one WB left and one WB shared left + through + right lane.

These proposed improvements would enable the Henderson Road & Saulin Boulevard intersection to operate at the same overall levels of service during the AM peak and PM peaks for the Action Alternative as for the No Action Alternative.

5.4.4 Intersection 4: Henderson Road & Monroe Boulevard/Road

Limited geometric improvements are identified at the Henderson Road & Monroe Boulevard intersection to provide adequate capacity for the forecasted Action Alternative volumes traveling between Saulin Boulevard and US Route 202. Accordingly, NB through geometry is proposed to convert the shared NB through + right lane into a through only lane, thus providing two exclusive NB through lanes and a dedicated right turn lane. Revision of the WB right turn phase from Permitted in the No Action Alternative condition to Permitted + Overlap in the Action Alternative condition is also identified, in addition to revising the SB left turn phase from Permitted + Protected to Protected. These above improvements would result in about the same or modestly improved performance over the No Action Alternative condition though certain queueing issues remain.

5.4.5 Intersection 5: Saulin Boulevard & US Route 202

Limited geometric improvements are also identified at the Saulin Boulevard & US Route 202 intersection to provide adequate performance for the forecasted Action Alternative traffic that would use Saulin Boulevard as a “cut-through” to avoid congestion along Henderson Road and US Route 202. For Saulin Boulevard and US Route 202, accordingly, the NB right turn lane is proposed to be converted to a right turn slip ramp in the Action Alternative condition. This slip ramp would involve modifying the intersection with a small island to separate the NB right-turning traffic from signal control and allow it to flow freely or perhaps be yield-controlled. These geometric changes as well as signal phasing revisions would result in a slightly modest deterioration over the No Action Alternative condition in the PM peak, but substantial queue length or delay increases are not anticipated.

5.4.6 Intersection 6: Henderson Road & Church Road

The Henderson Road & Church Road intersection has undergone geometric improvements within the last four years, including widening of the NB approach, restriping of the other approaches, and the addition of ADA facilities. A limiting factor at this intersection is the railroad bridge over the SB approach. In order to mitigate additional SB right turning traffic for the Action Alternative condition, SB right geometry is proposed to include one right turn lane with a Permitted + Overlap phase. The NB approach is proposed to include one right turn lane with a Permitted + Overlap phase. Similarly, the EB approach is proposed to include one right turn lane with a Permitted + Overlap phase. This intersection would be near capacity in the No Action Alternative condition if further improvements are not programmed. The proposed improvements under the Action Alternative condition would enable the intersection to operate at about the same levels of service as under the No Action Alternative.

5.4.7 Intersection 7: Henderson Road & US Route 202

The Henderson Road & US Route 202 intersection is the most congested one in the Henderson Road Station area and operates the poorest in the No Action Alternative condition of the seven intersections studied. Every approach of this intersection is forecasted to be operating at an LOS F in the No Action Alternative condition for the PM peak. Geometric improvements in the form of dedicated right turn storage lanes for the NB and SB approaches are proposed for the

Action Alternative condition. These lanes would serve to segregate the heavy right turn volumes from the through volumes, allowing the remaining through lanes to better absorb the additional volume generated by the proposed park-and-ride facility. The improvements proposed to mitigate impacts of the proposed park-and-ride volumes under the Action Alternative would enable the intersection to operate at about the same levels of service as under the No Action Alternative.

5.4.8 1st Ave. and N. Gulph Branches

Traffic impacts to the 1st Ave. and N. Gulph branches will be viewed together, because they include the proposed park-and-ride facility that would serve either the Convention Center or the 1st & Moore Stations. At the time of the DEIS, the location of the park-and-ride facility was proposed not to vary due to station, and access to the park-and-ride facility would be via existing parking lot access points. Many vehicles accessing the VFCR travel through intersections 1 or 2, which will be impacted by background traffic growth and the implementation of local and regional transportation projects, as discussed in previous sections.

Compared to the traffic impacts anticipated in the vicinity of the Henderson Road Station park-and-ride facility (that would serve the PECO and PECO/TP Trunks), the traffic impacts of the park-and-ride facility at Convention Center / 1st & Moore Stations (that would serve the 1st Ave. and N. Gulph Branches) are fewer, queue lengths show limited deterioration between the No Action and the Action Alternatives, and only two signalized intersections would be directly impacted. Geometric improvements to mitigate impacts of Action Alternative volumes would be provided at the intersection of 1st Avenue & N. Gulph Road.

5.4.9 PECO and PECO/TP Trunks

Traffic impacts to intersection performance by park-and-ride facilities are the same for the PECO and PECO/TP trunks, because each includes the proposed Henderson Road park-and-ride facility. The location of the park-and-ride facility does not vary between the two trunks, and access to the facility would impact intersections 3 through 7.

In terms of traffic, the modeling results for the Henderson Road park-and-ride facility (that would serve the PECO and PECO/TP Trunks) exceed those of the Convention Center / 1st & Moore Station's park-and-ride facility (that would serve the 1st Ave. and N. Gulph Branches). Forecasted traffic volume growth from existing conditions to the No Action Alternative condition along Henderson Road suggests that a corridor study may be warranted to address this growth. Without mitigation, LOS and queue lengths would further deteriorate at every intersection when comparing the No Action and the Action Alternatives. Thus, geometric improvements to mitigate the Action Alternative impacts are proposed at each of the five study network intersections.

5.4.10 PECO-1st Ave, PECO/TP-1st Ave. and PECO/TP-N. Gulph Alternatives

In terms of direct impacts to signalized intersections by park-and-ride facilities, the PECO-1st Ave., PECO/TP-1st Ave. and PECO/TP-N. Gulph Alternatives would have the most traffic impact since all seven signalized intersections potentially would be impacted.

5.4.11 US 202-1st Ave and US 202-N. Gulph Alternatives

In terms of direct traffic impacts to signalized intersections serving park-and-ride facilities, the US 202-1st Ave. and US 202-N. Gulph Alternatives would have the fewest impacts since only two intersections would be impacted.

5.5 Action Alternative Driveway Performance

5.5.1 Convention Center Site Driveway Analysis

There are four existing driveways to the VFCR – one along N. Gulph Road (north of 1st Avenue) and three along 1st Avenue (between N. Gulph Road and Moore Road). Based on the location of the proposed park-and-ride facility, the three driveways along 1st Avenue would be mainly used in the Action Alternative condition by park-and-ride facility users. The driveway along N. Gulph Road would be a primary access to the VFCR via southbound N. Gulph Road and by a small portion (assumed to be 25%) of users traveling along northbound N. Gulph Road during the peak hour, especially due to the heavy right turn movement from northbound N. Gulph Road to eastbound 1st Avenue.

For the No Action Alternative condition analysis, site driveway volumes were determined using the peak hour site access volumes used in the traffic impact study for the VFCR. Due to the developed character of the VFCR site, growth factors were not applied to the driveway volumes in the No Action Alternative condition analysis.

Table 5-4.2: Comparison - Action Alternative Intersection LOS/Delay

Location		AM	PM	Action Alternative				
Int.	St.	AM LOS/Delay	PM LOS/Delay	PECO-1st Ave	PECO/TP -1st Ave	PECO/TP -N. Gulph Rd	US 202-1st Ave	US 202-N. Gulph Rd
1	1st/N. Gulph	B/18.1	D/50.6	✓	✓	✓	✓	✓
2	1st/Moore	C/26.4	C/28.5	✓	✓	✓	✓	✓
3	Henderson/Saulin	D/36.5	D/51.4	✓	✓	✓	NA	NA
4	Henderson/Monroe	B/11.1	F/90.7	✓	✓	✓	NA	NA
5	US Route 202/Saulin	B/14.7	E/70.5	✓	✓	✓	✓	✓
6	Henderson/Church	E/60.4	F/92.8	✓	✓	✓	NA	NA
7	US Route 202/Henders	F/155.0	F/257.6	✓	✓	✓	✓	✓

Source: AECOM, 2016.

For the Action Alternative condition analysis, all traffic arriving at the park-and-ride facility via eastbound 1st Avenue and 75% of traffic arriving via northbound N. Gulph Road were estimated to use access driveways along the 1st Avenue. Approximately 75% of these arrivals were projected to use the primary access driveway as this intersection would be signalized. The remaining 25% arrivals were assumed to use the secondary access driveway as this driveway is further east and would not be signalized. For the arrivals via westbound 1st Avenue, 80% were projected to use the secondary access driveway (due to its vicinity to the proposed park-and-ride facility location) and remaining 20% were projected to use the primary access driveway as this driveway is the farthest approach for users traveling westbound on 1st Avenue. For facility users exiting to eastbound 1st Avenue, all left turns were assumed to occur at the primary access driveway as this intersection would be a signalized intersection ensuring efficient left turn exits. For facility users exiting towards westbound 1st Avenue and southbound N. Gulph Road, 70% were projected to use the primary access driveway (nearest), and 30% would use the secondary access driveway.

These Action Alternative condition driveway usage projections were estimated based on several factors such as the current use of these driveways, location of the proposed park-and-ride facility, proposed intersection control types for driveways, and projected levels of traffic queuing under the Action Alternative condition along 1st Avenue and N. Gulph Road corridors. Table 5-5.1 displays the comparative LOS/delays at driveway intersections as they are forecasted for the No Action Alternative condition and the Action Alternative condition. The primary access driveway is proposed to be signalized in the Build condition in order to handle the additional traffic associated with the park-and-ride facility. The EB right turn lane, which is an additional lane provided between N. Gulph Road and this intersection, would be exit only and would not be continued east of this intersection. The secondary access driveway is proposed to be relocated to about 200 feet east of its existing location. Also, WB 1st Avenue would need to be converted to two lanes between this relocated driveway and Gulph Road.

Table 5-5.1: Comparison - Action Alternative Driveway LOS/Delay

Driveway Intersection	No Action Alternative				Action Alternative			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)
1st Ave & Primary Access Driveway	A	1.6	D	17.0	B	16.1	C	23.3
1st Ave & Secondary Access Driveway	C	0.5	C	2.0	B	1.2	C	2.4
1st Ave & Partial Access Driveway	A	0	A	0.6	NA	NA	NA	NA

Source: AECOM, 2016.

5.5.2 Henderson Road Site Driveway Analysis

The site access driveway for the Henderson Road park-and-ride facility is not present in the No Action Alternative condition and, thus, no analysis was performed for the No Action Alternative

condition. For the Action Alternative condition, since this driveway would be the only site access, entering and exiting driveway turning movement volumes were determined based on the regional movements of arriving and exiting park-and-ride users as well as kiss-and-ride users during the peak hours. Table 5-5.2 displays the Action Alternative LOS/delays for the driveway for the Henderson Road park-and-ride at Saulin Boulevard.

Table 5-5.2: Action Alternative Driveway LOS/Delay

Driveway Intersection	AM Peak Hour LOS	AM Peak Hour Delay (sec)	PM Peak Hour LOS	PM Peak Hour Delay (sec)
Park-and-Ride Driveway & Saulin Boulevard	A	4.3	A	33.5

Source: AECOM, 2016.

The intersection of the park-and-ride facility driveway and Saulin Boulevard is proposed to be signalized to handle park-and-ride related volumes. The EB Saulin Boulevard approach is proposed as two lanes between Henderson Road and this intersection. This approach would be grouped as a left + through lane and a through + right lane; two receiving lanes would be required on the east side of this intersection on Saulin Boulevard, which can then taper down to a single lane before the curve. The westbound Saulin Boulevard approach would need a 200-foot left turn storage lane.

5.6 Bicycle and Pedestrian Facilities

As SEPTA advances the Project, the agency will work with Upper Merion Township to interconnect Project sidewalks with existing pedestrian infrastructure in the vicinity of park-and-ride facilities and station areas. SEPTA will consider existing and future access and circulation patterns, as well as warrants for specific design elements such as sidewalks, curb ramps, pedestrian push buttons, pedestrian traffic signals, and crosswalks. SEPTA's facilities will comply with applicable aspects of the ADA, as well as make accommodations for bicyclists.

Regarding bicycle access and connectivity, SEPTA will coordinate with the Township to identify appropriate accommodation for bicyclists. Considerations could include provision of bicycle lanes where SEPTA commits to making specific intersection improvements and providing hardware (such as bike racks) at stations and park-and-ride facilities.

5.7 Public Parking Facilities

Public parking, either in the forms of public on-street or off-street parking is not present where the No Action Alternative projects are planned. Thus, the No Action Alternative will have no effects to public on-street or off-street parking.

Public parking, either in the forms of public on-street or off-street parking is not present along the alignments of the Action Alternatives. Thus, no long-term operational effects to public on- or off-street parking would occur from the Action Alternatives.

Project impacts to privately held parking would be addressed as part of SEPTA's property acquisitions and displacement processes outlined in Section 4.5. As the Project advances, SEPTA would refine the design with the goals of avoiding or minimizing impacts to private parking and optimizing benefits, including those to privately held, off-street parking.

5.8 Safety

The grade-separated design of the Project is intended to enable the proposed rail transit service to operate on a dedicated guideway without interfering with the at-grade transportation network below it. By separating operations, there is no potential for at-grade crossing conflicts between rail and other modes. Grade-separation also allows SEPTA to use third-rail traction power, which is the power source along the existing NHSL. Separating the vehicle power source from places where people are, is a critically important safety provision. At-grade rail operations would also require that the rail guideway is fenced to separate people and animals from rail operations. Traction power substations would be placed at approximately 1.5 mile intervals along the Project alignment. These small buildings would be fenced.

SEPTA has preliminarily examined the safe accommodation of these movements in its conceptual layout of Project stations and park-and-ride facilities by considering the movement of vehicles (cars, buses and shuttles) as well as pedestrians and bicyclists to and from the these facilities (see Appendix G).

Each Action Alternative would feature safety and security systems and procedures that meet safety requirements that are in effect at the time of Project construction and operation to protect passengers, workers, and adjacent communities. Each of the Action Alternatives would be designed and operated in accordance with SEPTA's rail operations safety and security protocols and procedures for the NHSL, which would be updated to include specific requirements for the Project prior to revenue service. The Project would be designed in accordance with SEPTA's Design Criteria Manual for NHSL at the time of design.

Appendix A
Traffic Count Data

Appendix B
Global Peak Hour Calculation

Appendix C
Balanced 2015 Volumes

Appendix D
SYNCHRO Analysis, Existing Condition, 2015

Appendix E
SYNCHRO Analysis, No-Build Condition, 2040

Appendix F
SYNCHRO Analysis, Build Condition, 2040

Appendix G

Conceptual Station Design Layouts