US 202 Section 100 Operations Analysis

August 2019

DELAWARE VALLEY REGIONAL PLANNING COMMISSION (dvrpc)

The Delaware Valley Regional Planning Commission is the federally designated Metropolitan Planning Organization for a diverse nine-county region in two states: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey.

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

DVRPC's vision for the Greater Philadelphia Region is a prosperous, innovative, equitable, resilient, and sustainable region that increases mobility choices by investing in a safe and modern transportation system; that protects and preserves our natural resources while creating healthy communities; and that fosters greater opportunities for all.

DVRPC's mission is to achieve this vision by convening the widest array of partners to inform and facilitate data-driven decision-making. We are engaged across the region, and strive to be leaders and innovators, exploring new ideas and creating best practices.

DVRPC is funded through 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.

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Introduction

PURPOSE AND NEED

US Route 202 is a major interstate route that runs from Delaware to Maine. The 59-mile stretch in Pennsylvania connects the four suburban Pennsylvania counties in the Delaware Valley Regional Planning Commission (DVRPC) region. US 202 Section 100 traverses Chester and Delaware counties, and it serves as a local arterial and vital link to the State of Delaware.

This part of the region has experienced considerable growth in recent decades. Chester County specifically continues to grow at a much faster rate than the other Pennsylvania counties in the DVRPC region. The county's population and employment are both projected to increase by 28.4 percent between 2015 and 2045. The resulting potential increase in traffic volumes on US 202 is expected to exacerbate congestion and increase safety concerns.

Improvements to US 202 Section 100 from West Chester to the Delaware state line are listed as an unfunded Major Regional Roadway System Expansion Project in the DVRPC *2045 Long-Range Plan*. US 202 Section 100 was identified as a Priority Subcorridor in the DVRPC 2015 Congestion Management Process (CMP): www.dvrpc.org/webmaps/CMP2015. Operational improvements on US 202 Section 100 are needed, but budget restraints make large-scale capital improvements difficult to realize. As a result, DVRPC worked with the Chester County Planning Commission (CCPC), West Goshen Township, Westtown Township, and PennDOT to develop operational improvement scenarios for US 202 Section 100 between Matlack Street and Skiles Boulevard/Stetson School Drive.

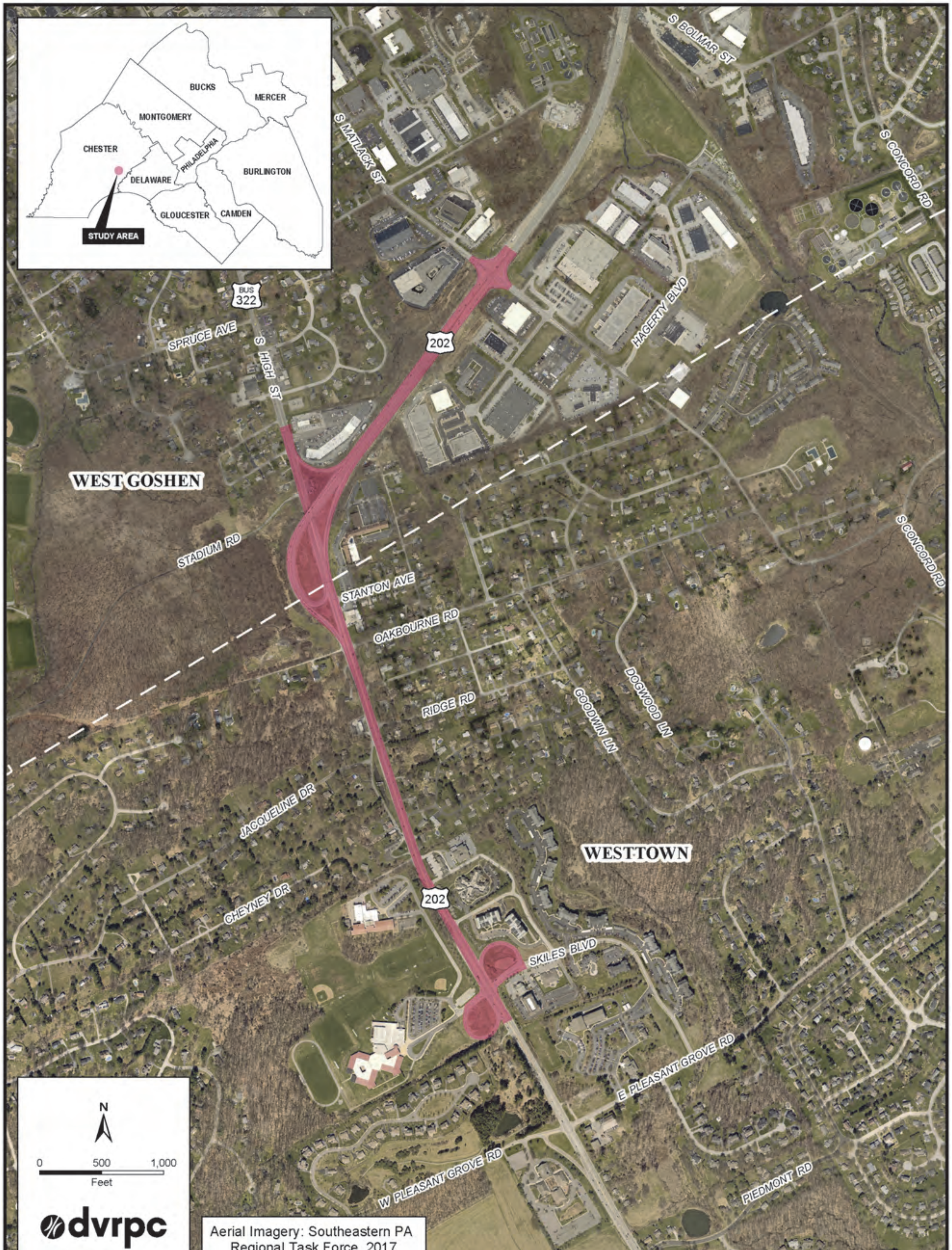
OBJECTIVE

This study supports one main transportation objective: **to improve the operational efficiency of US 202 Section 100 through West Goshen and Westtown Townships**. The facility functions as both an interstate freeway and local arterial in these municipalities. Therefore, this study identifies highway design alternatives that would benefit local residents and commuters by improving safety and maximizing the efficiency of existing transportation infrastructure.

STUDY AREA

The identified study area is located on US 202 Section 100 from Matlack Street to Skiles Boulevard/Stetson School Drive, and it includes the intersection of US 322 Business and the Parkway Shopping Center. This route runs through West Goshen and Westtown Townships in Chester County. The study area is shown in **Figure 1** on the following page.

Figure 1: Study Area



PLANNING PROCESS

This report summarizes the findings of the second phase of a three-year project. The project work program is summarized below.

Phase I (Fiscal Year 2018)

- DVRPC worked with CCPC to collect data on existing conditions along the US 202 corridor, including crash data and historical speeds and travel times.

Phase II (Fiscal Year 2019)

- DVRPC used traffic microsimulation models to evaluate the Existing Conditions (Year 2018) and future No Build (Year 2045) scenarios on US 202 Section 100 from Matlack Street to Skiles Boulevard/Stetson School Drive.
- The project team also developed three Build (Year 2045) scenarios, which tested distinct versions of a variety of alternatives. These alternatives include improvements at the US 202 intersection with Matlack Street and the northbound and southbound ramps at the interchange with US 322 Business/High Street.

Phase III (Fiscal Year 2020)

- DVRPC will evaluate current and future traffic conditions on US 202 Section 200 between the northbound West Chester Pike on-ramp and the PA 100 exit.

DOCUMENT OVERVIEW

This report provides a summary of existing traffic conditions, and it includes an evaluation of No Build (Year 2045), or without improvement, traffic conditions. The study also details the highway performance results of three distinct Build (Year 2045), or improvement, scenarios. Finally, the document outlines next steps and includes planning-level cost estimates.

CHAPTER 1:

Existing Conditions (Year 2018)

TRAVEL TIME

Travel time data from the Probe Data Analytics (PDA)[1] was evaluated for northbound (NB) and southbound (SB) US 202, from Street Road (PA 926) to the overpass of Bolmar Street. This approximately **2.5-mile stretch** of US 202 includes the 1.5-mile study area. The data summarized below is for a longer extent because the vehicle probe data available through PDA is collected through Traffic Message Channel (TMC)[2] segments. The information below summarizes travel time data analyzed for all weekdays over the five-year period between 2013 and 2017.

Northbound

NB **free flow travel time** is 3.5 minutes. It is important to note that there are two traffic signals along this segment of US 202 so free flow can vary as a result of traffic signal timing. NB travel times increase steadily from 6:00 AM to 9:00 AM. Travel time decreases to near-free flow travel time between 9:00 AM and 10:00 AM. There was a nonlinear increase in travel times between 2013 and 2017 (**Table 1**).

Free flow travel time: the duration it takes a motorist to travel a defined route without any congestion or adverse weather conditions.

In 2013, the average travel time between 6:00 AM and 10:00 AM was 4.2 minutes. The average travel time for the AM period reached 4.8 minutes in 2016, and it was 4.6 minutes in 2017. This change represents a 10 percent increase in travel time during the AM period over five years.

Table 1: NB Travel Times (Minutes): Street Road (PA 926) to Bolmar Street Overpass

	2013	2014	2015	2016	2017
6:00-7:00 AM	3.7	3.7	3.7	3.7	3.7
7:00-8:00 AM	4.3	4.7	5.0	5.1	4.8
8:00-9:00 AM	4.8	5.4	5.4	5.7	5.5
9:00-10:00 AM	4.1	4.3	4.4	4.5	4.2
Average 6:00-10:00 AM	4.2	4.5	4.6	4.8	4.6

Sources: INRIX, 2018; DVRPC, 2018

NB PM Travel Times

There was little change in NB travel time in the PM period between 3:00 PM and 7:00 PM. The average travel times in 2013 and 2017 were 4.1 minutes and 4.3 minutes, respectively. This represents an increase of 5 percent over the five-year period. The NB travel time was highest in 2016: 4.5 minutes.

Southbound

The SB free flow travel time is also about 3.5 minutes. Once again, the two traffic signals may affect travel time at all times of day. Overall, the SB AM travel times decreased in the five-year period. In 2013 the

[1] PDA is an analytics platform that provides third party probe data that supports agencies in transportation planning.
[2] TMC is a technology for delivering traffic information to motor vehicle drivers. A TMC covers a specific highway segment.

average travel time was 4.7 minutes, and in 2017 the average travel time was 4.5 minutes. The AM travel times were higher between 2014 and 2016 (**Table 2**).

PM travel times were highest during the 5:00 PM to 6:00 PM hour. Between 2013 and 2017, the average travel time increased from 5.8 minutes to 6.2 minutes (7 percent increase).

Table 2: SB Travel Times (Minutes): Bolmar Street Overpass to Street Road (PA 926)

	2013	2014	2015	2016	2017
6:00-7:00 AM	3.6	3.7	3.6	3.6	3.6
7:00-8:00 AM	4.8	5.1	5.0	5.2	4.8
8:00-9:00 AM	5.6	6.2	5.9	6.3	5.2
9:00-10:00 AM	4.7	5.0	5.1	4.9	4.5
Average 6:00-10:00 AM	4.7	5.0	4.9	5.0	4.5
3:00-4:00 PM	5.2	5.8	5.7	6.0	5.5
4:00-5:00 PM	6.3	7.0	6.7	7.3	6.8
5:00-6:00 PM	6.5	7.1	7.1	7.5	6.9
6:00-7:00 PM	5.3	5.9	5.7	6.0	5.6
Average 3:00-7:00 PM	5.8	6.5	6.3	6.7	6.2

Sources: INRIX, 2018; DVRPC, 2018

CRASH ANALYSIS

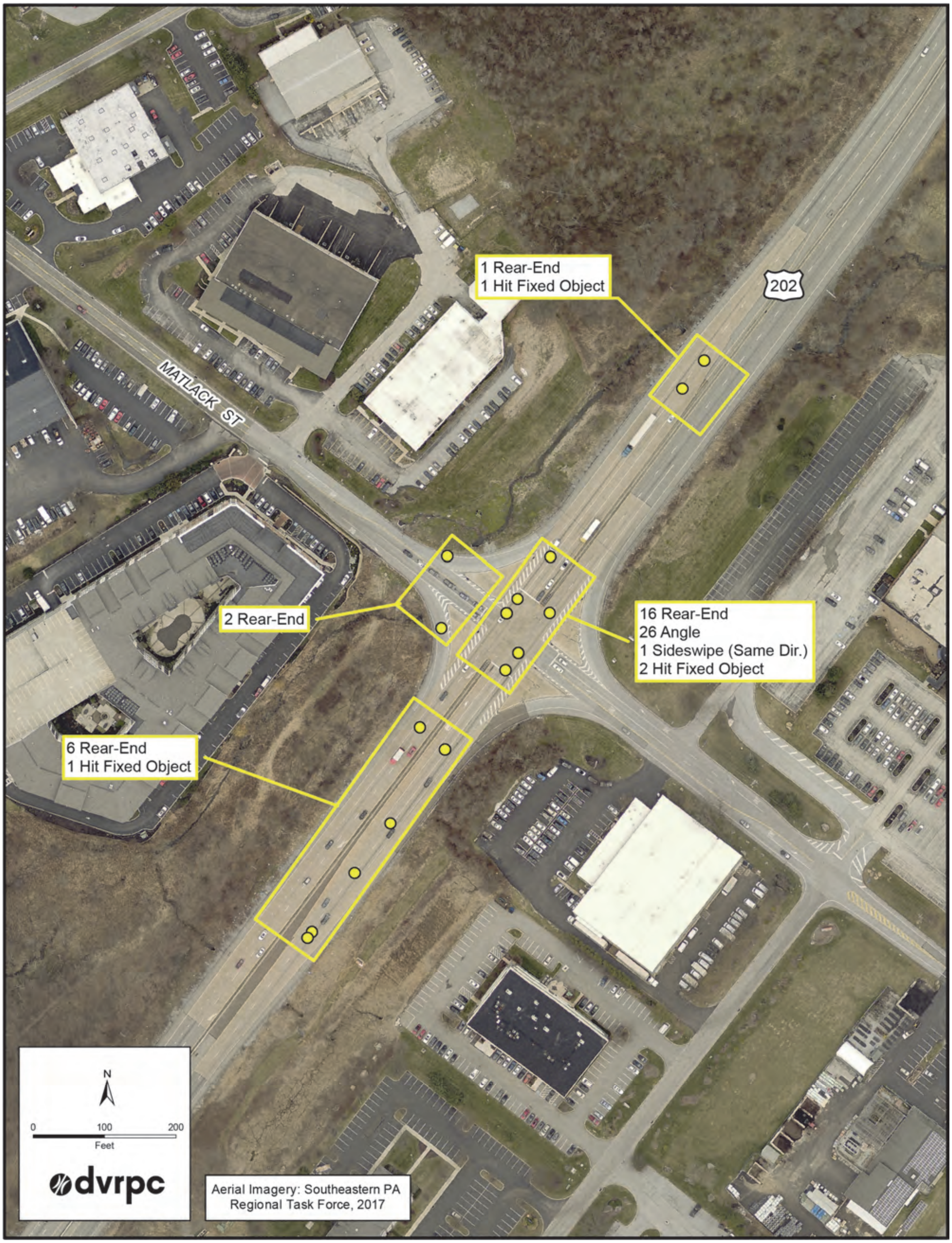
The following crash summaries were prepared using data from the PennDOT Crash Data Analysis and Retrieval Tool (CDART). 2013 through 2017 crash data was analyzed for the 1.5-mile study area from Matlack Street to Skiles Boulevard. The data is summarized by study area segment: 1) US 202 and Matlack Street intersection, 2) US 202/High Street (US 322 Business) Interchange, and 3) the US 202 and Skiles Boulevard intersection.

US 202 and Matlack Street Intersection

A total of 56 crashes were reported on US 202 within 500 feet of Matlack Street in the five-year period (**Figure 2**). The highest occurrence of crashes took place in 2017: 17 crashes—30 percent of the total—were reported that year. The two most prevalent crash types at this location were angle and rear-end crashes. Twenty-six angle crashes (46 percent of all crash types) and 25 rear-end crashes (45 percent of all crash types) were reported. There was one fatal crash that resulted in one death, two crashes of moderate severity that resulted in three moderate injuries, and 15 crashes that resulted in 23 minor injuries.

The majority of crashes occurred under dry roadway conditions (89 percent), no adverse weather conditions (93 percent), and during daylight hours (76 percent). There was a relatively even distribution of crashes throughout the year; August had the highest number of crashes (16 percent). The most common day for crashes (23 percent) was Tuesday. Neither the morning nor afternoon peaks showed a significant spike in crashes.

Figure 2: US 202 and Matlack Street Intersection Crash Summary



US 202 and High Street (US 322 Business) Interchange

According to the PennDOT crash database, a total of 71 reportable crashes occurred near the US 202 interchange during the five-year study period from 2013 through 2017 (**Figure 3**). This included crashes on the ramps and High Street, directly north of the US 202 / US 322 Business interchange; 2015 and 2017 saw the highest number of crashes, with 17 (24 percent) and 16 crashes (22 percent) respectively. The fewest occurred in 2013, when 11 crashes (15 percent) took place.

Of the 72 crashes at this location, 36 (50 percent) were rear-end collision types. This was followed by 14 angled crashes (19 percent) and 12 hit fixed object crashes (17 percent). In terms of severity, there was a single fatal crash at this location which resulted in a single fatality. Of the total injury crashes, two resulted in major injury, four in moderate injury, and 12 in minor injury. Forty-five crashes (63 percent) resulted in no injury.

Road conditions were dry for the majority of crashes (62 crashes, 86 percent); most occurred without adverse weather conditions (66 crashes, 92 percent), and during daylight hours (50 crashes, 69 percent). Though the majority of crashes within this area did occur during daylight hours, 15 crashes (21 percent) took place under dark conditions, without the presence of streetlights. A deeper examination of the crash data reveals a number of drivers unable to navigate the turns on the ramps, which could be the result of poor visibility.

The frequency of crashes did not vary drastically from month to month, with 12 crashes (17 percent) occurring in November, nine in June, and eight in April. The fewest crashes occurred in February and March, with two in each of those months. Tuesday and Friday both experienced 14 crashes (19 percent) followed by Wednesday and Thursday, with 13 and 12 crashes, respectively. In terms of time of day, there was a fairly even distribution of crashes, though the morning and afternoon commute did experience a slight increase in crash occurrence. Only the hour of 4:00 PM to 5:00 PM was an outlier, with 11 crashes (15 percent) taking place during that period of time.

US 202 and Skiles Boulevard Intersection

According to the PennDOT crash database, there were 61 reportable crashes on US 202 within 1,600 feet of the Skiles Boulevard Intersection between 2013 and 2017 (**Figure 4**). 2016 had the highest number of crashes with 18 (30 percent), while 2013 had the fewest with 7 crashes (11 percent). Though it represents only a five-year span, the overall trend is one of increasing crashes at this location.

The majority of the crashes were rear-end, with 38 crashes (62 percent), followed by 9 hit-fixed object crashes (15 percent), and 6 angled crashes (10 percent). Of the total crashes, none of them were fatal or resulted in major injury, though 3 resulted in moderate injuries and in 5 crashes there was a minor injury.

There was a relatively even distribution of crashes by month, except for June, which experienced the highest with 13 crashes (21 percent), followed by April with 7 crashes (11 percent), and May, July, and August each with 6 crashes (10 percent). The fewest crashes occurred in March (1). Thursday and Tuesday had the highest number of crashes, with 13 (21 percent) and 12 (20 percent), respectively, followed by Friday with 10 (16 percent). The fewest crashes occurred on Sunday, with 3 (5 percent).

The morning peak accounted for the highest number of crashes for time of day, with 9 crashes (15 percent) taking place between 8:00 and 9:00 AM and 5 crashes between 7:00 and 8:00 AM and again between 9:00 and 10:00 AM. This was followed by 6 crashes during each hour between 3:00 and 5:00 PM.

Figure 3: US 202 and High Street (US 322 Business) Interchange Crash Summary

Figure 4: US 202 and Skiles Boulevard Intersection Crash Summary

TRAFFIC VOLUMES

The AM peak hour for this analysis is 7:00 AM to 8:00 AM, and the PM peak hour is 4:30 PM to 5:30 PM. In the AM peak hour, US 202 NB volumes are higher than SB volumes by about 200 vehicles. In the PM peak hour, SB volumes are higher than NB volumes by about 200 vehicles. These commuting flows suggest a local commuting pattern toward workplaces in Pennsylvania, as opposed to Delaware. Truck volume percentages on the US 202 and High Street (US 322 Business) interchange ramps fluctuate between 3 percent and 8 percent. Truck volumes are higher in the AM than in the PM.

AM peak hour: the morning hour during which traffic volumes are the highest based on traffic counts collected by DVRPC in 2018.

PM peak hour: the evening hour during which traffic volumes are the highest based on traffic counts collected by DVRPC in 2018.

Figures 5 and 6 on pages 14 and 15 summarize the turning movement counts (TMCs) at the intersections and highway ramps in the study area. DVRPC collected the traffic counts in the study area in 2018. Additional traffic counts for US 202 can be accessed on the DVRPC traffic counts web map: www.dvrpc.org/webmaps/TrafficCounts.

At the US 202 and Matlack Street intersection, 66 percent of EB vehicles make a left-turn onto US 202 NB in the AM peak hour, and 61 percent of EB vehicles make this same movement in the PM peak hour. There is a 200-foot dedicated left-turn lane, but there is no protected left-turn signal phasing. As a result, there is significant queuing at this approach in both the AM and PM peak hours. Left-turning vehicles also block vehicles from entering the through lane and crossing the intersection.

EB queue on Matlack Street during the AM peak hour. Source: DVRPC, 2018

At the US 202 SB ramp, only 8 percent of vehicles take the exit to High Street in both the AM and PM peak hours. 92 percent of vehicles continue straight on US 202 SB. One lane is dedicated to each of these movements; the facility provides the same capacity for the 143 vehicles taking the exit as it does for the 1,706 vehicles continuing SB on US 202. This may point to an inefficient use of space on this stretch of US 202.

US 202 SB ramp over High Street. Source: DVRPC, 2018

US 202 SB exit at High Street. Source: DVRPC, 2018

78 percent of vehicles take the NB ramp to continue onto US 202 NB in the AM peak hour, and 80 percent of vehicles make this movement in the PM peak hour. The facility continues as two lanes as it becomes High Street (US 322 Business), though only a few hundred vehicles make this movement. 1,778 vehicles in the AM peak hour and 1,696 vehicles in the PM peak hour must merge into one lane to continue on US 202 NB.

The highway diverges, and NB traffic continuing on US 202 must exit at the ramp. Source: DVRPC, 2018

At the top of the ramp, US 202 NB traffic flows freely into the right lane, and traffic merging from High Street flows freely into the left lane. Only about 250 to 300 vehicles merge from High Street, compared to almost 2,000 vehicles that are continuing NB from US 202. Nevertheless, both movements are currently given the same priority. Source: DVRPC, 2018

Figure 5: DVRPC Traffic Counts – AM Peak Hour (7:00 AM to 8:00 AM)

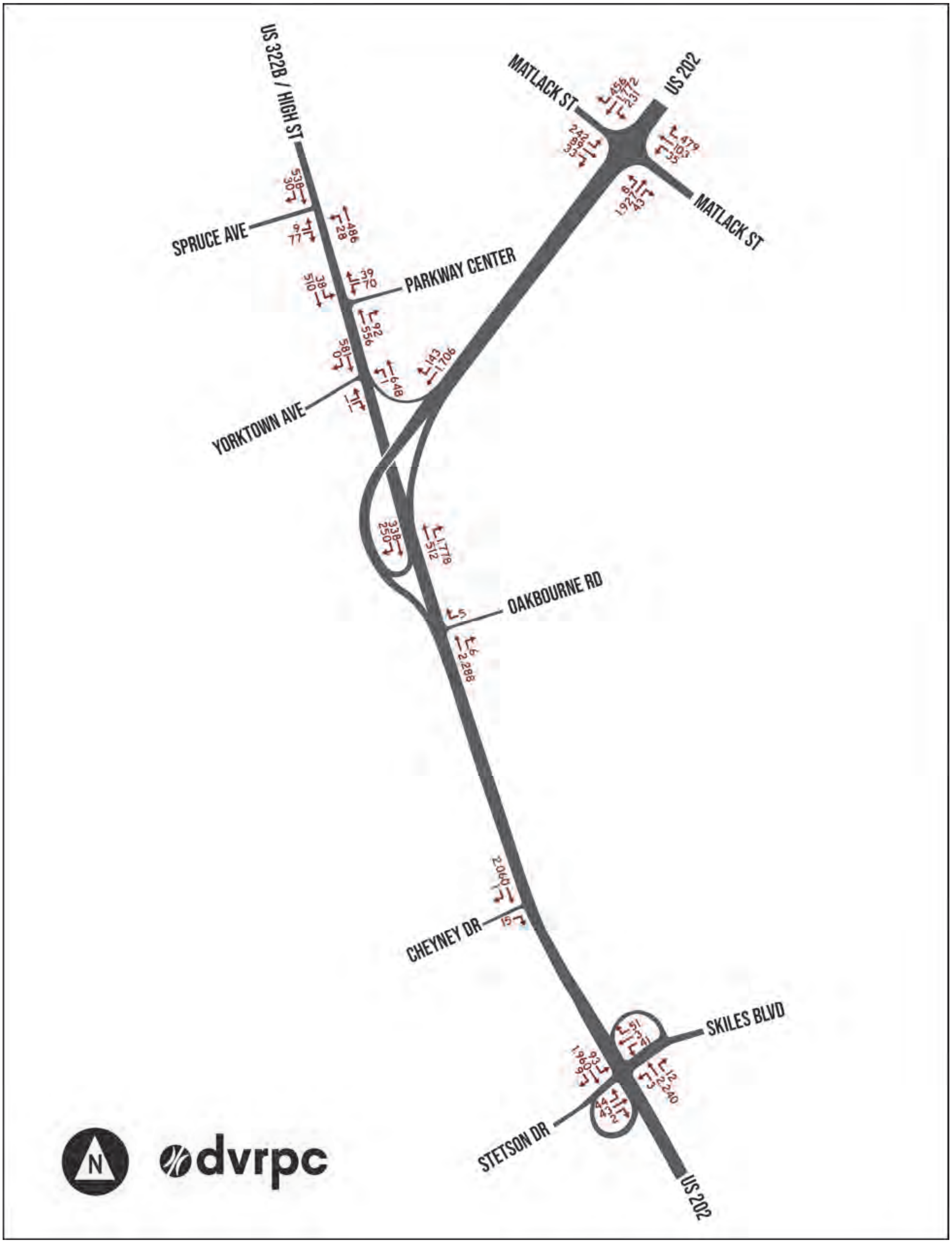
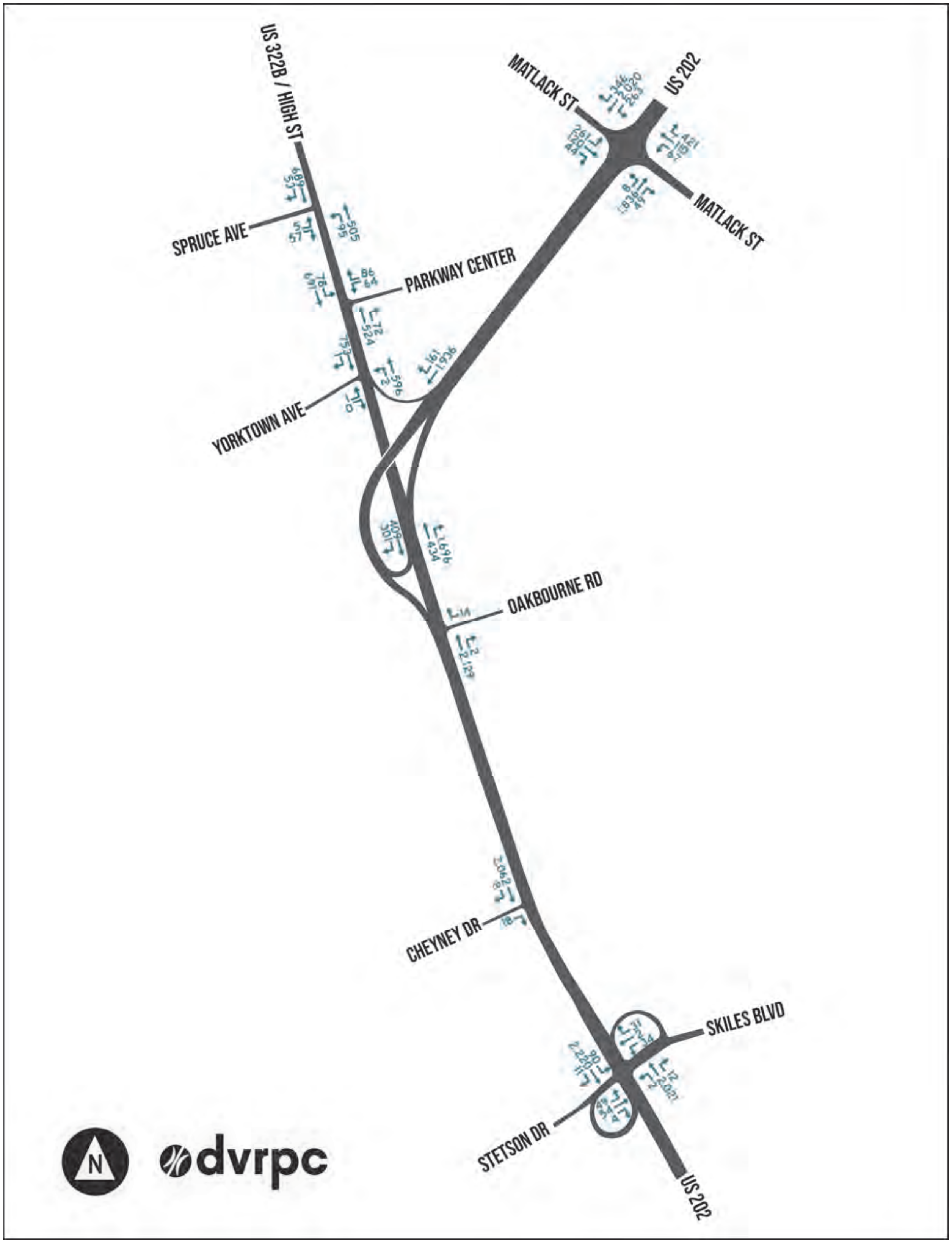


Figure 6: DVRPC Traffic Counts – PM Peak Hour (4:30 PM to 5:30 PM)



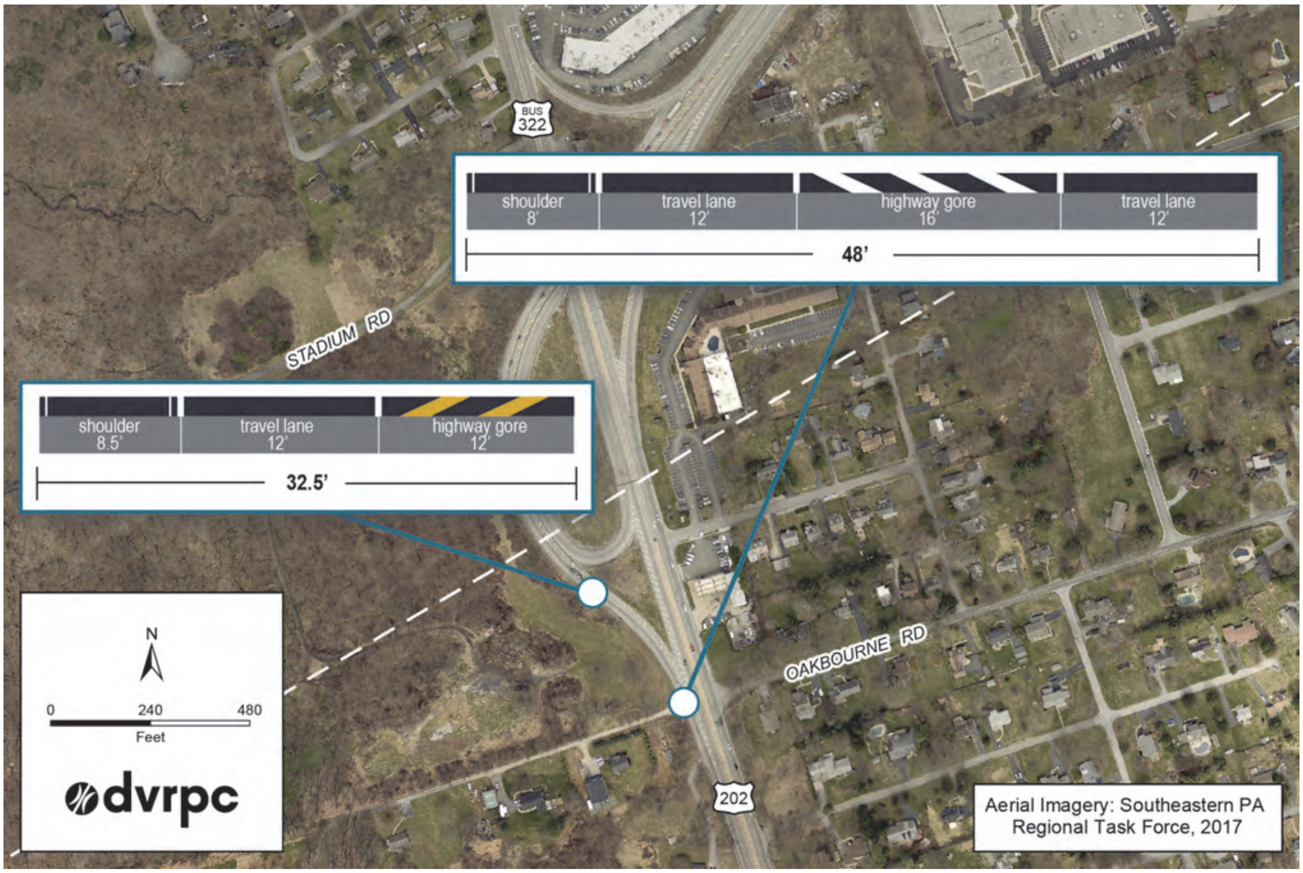
RAMP CHARACTERISTICS

This study focuses on evaluating potential improvements to the US 202 NB and SB ramps. Therefore, the existing characteristics of these ramps were documented in detail through field investigation and the use of available LiDAR[3] data.

Cross Sections

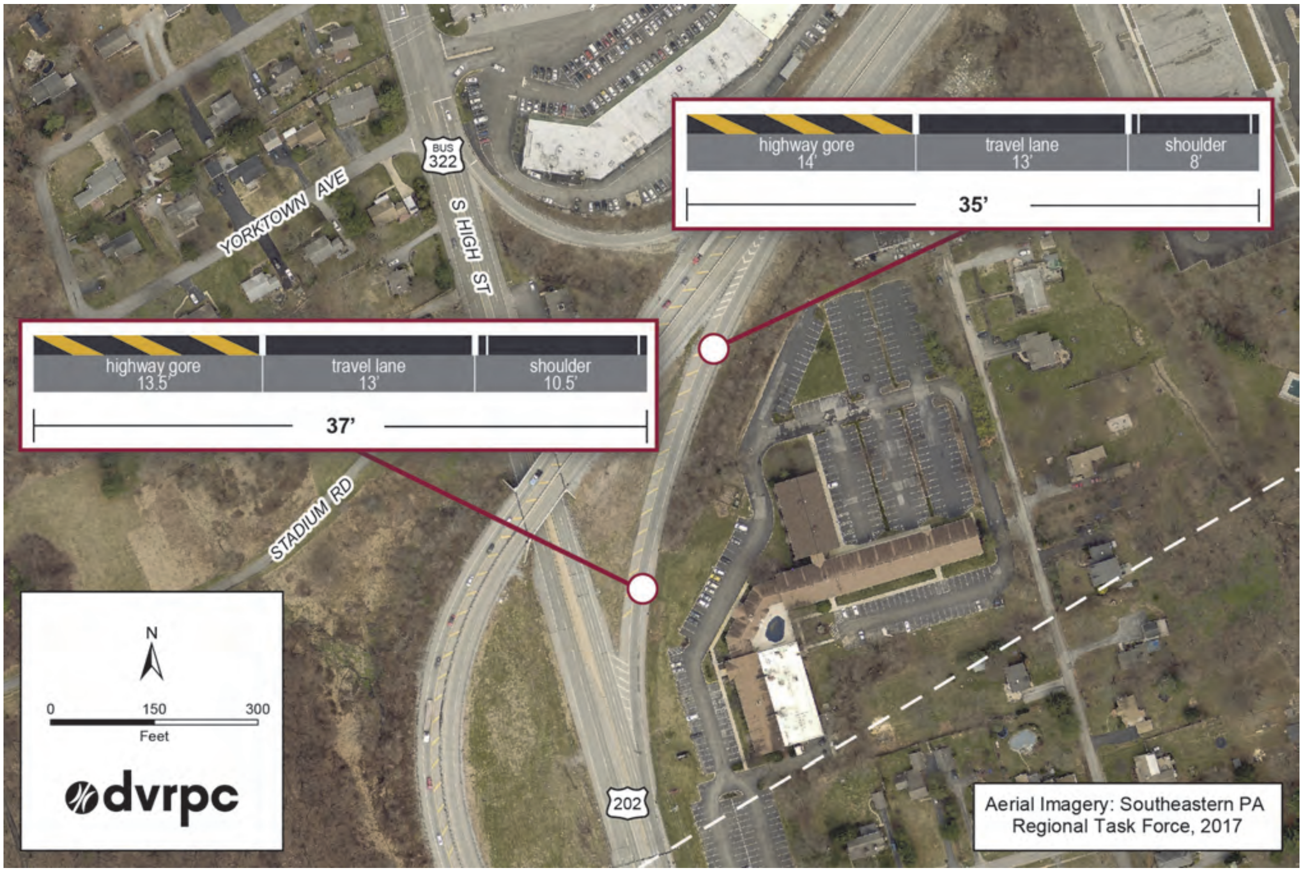
Figures 7 and 8 show cross sections at specific points on the US 202 ramps. Both ramps have a minimum shoulder width of 8 feet and a wide highway gore area that is the same width or wider than the travel lanes (minimum 12 feet).

Figure 7: US 202 SB Ramp Cross Sections



[3] LiDAR is a detection system that uses light from a laser; it can be used as a surveying technology to measure elevation.

Figure 8: US 202 NB Ramp Cross Sections



SB Ramp Superelevation

A preliminary, planning-level analysis of the superelevation and curve radius was conducted using available applications and data (i.e., Google Earth, ArcMap, and USGS LiDAR). The purpose of this analysis was to gauge the feasibility of adding a lane within the existing cartway on the SB ramp. **With the new lane configuration, the US 202 ramps would require a design exception as the design characteristics would be below the minimum values defined in PennDOT Publication 13M: *Design Manual Part 2 Highway Design*.**

This study assumes that a new lane added within the gore area on both the NB and SB ramps would have adequate curve radius to support cars traveling 30 mph with the current superelevation conditions.[4] **Figures 9 and 10** provide information about ramp elevations and slopes that can be used as a baseline for further study. The darker red shades in **Figure 9** indicate lower elevations, while the lighter shades denote higher elevations.

[4] The determination of design feasibility must be made with the support of a licensed engineer in coordination with PennDOT.

Figure 9: US 202 SB Ramp Elevations

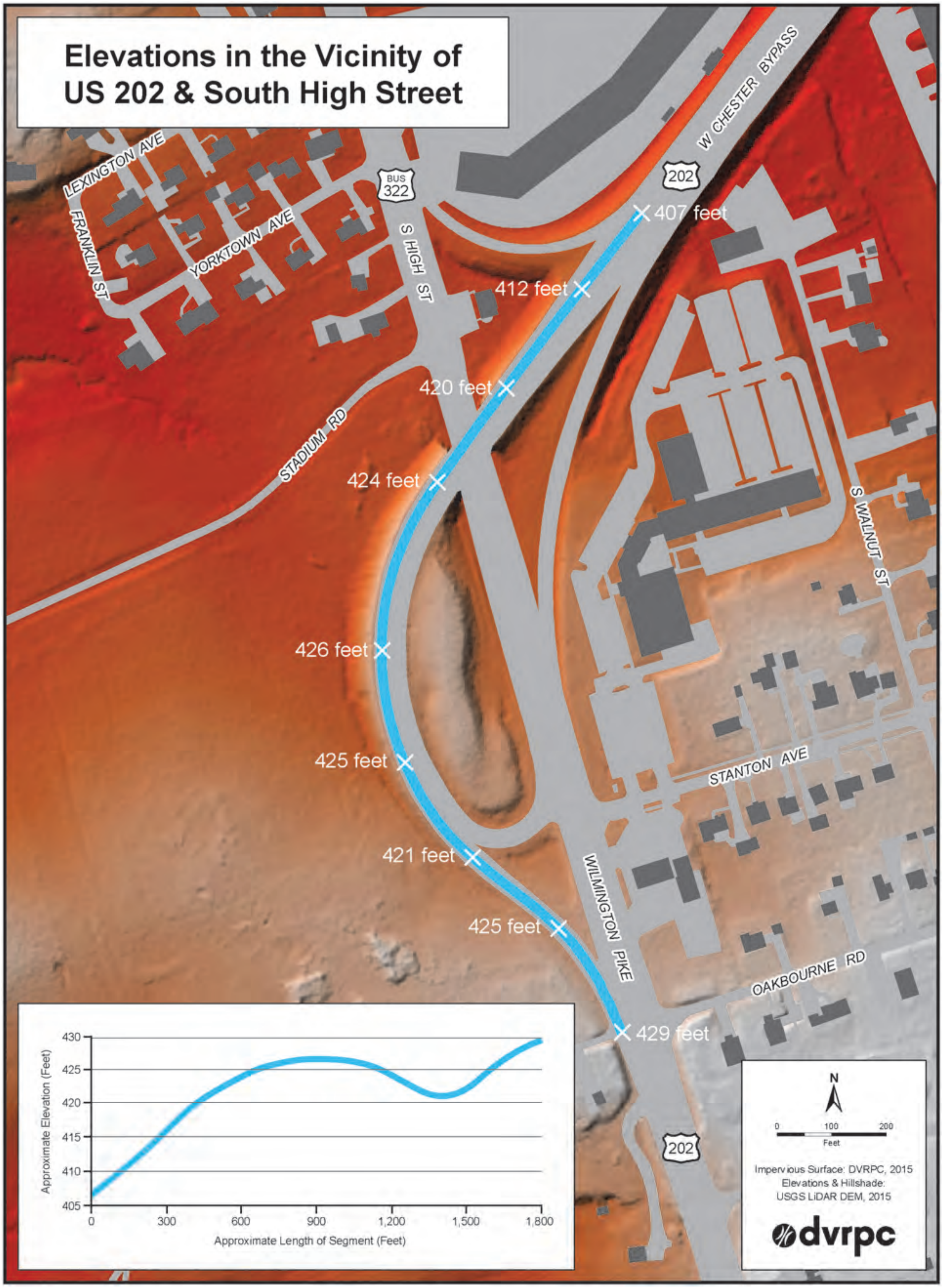
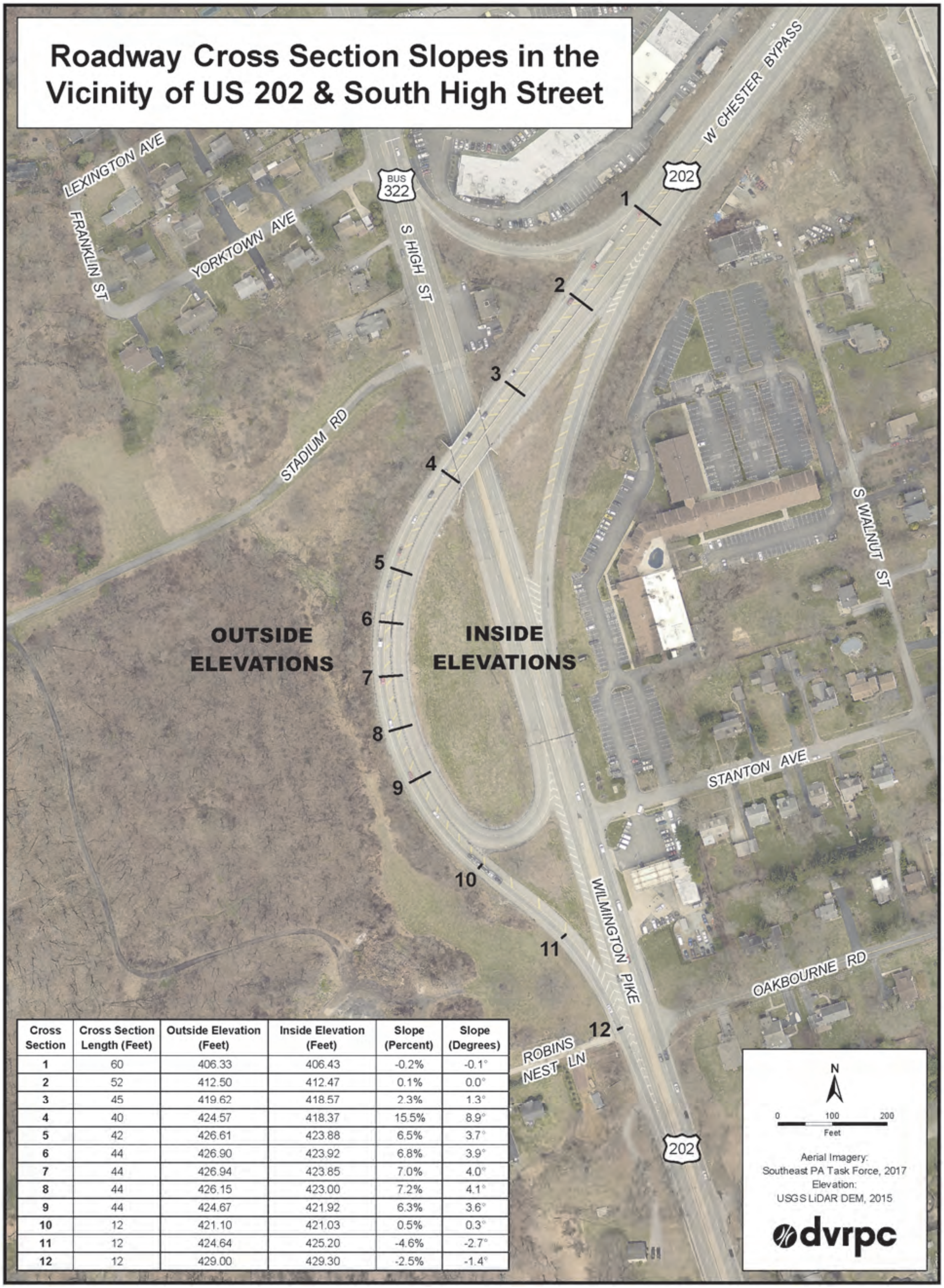


Figure 10: US 202 SB Ramp Superelevations



Cross Section	Cross Section Length (Feet)	Outside Elevation (Feet)	Inside Elevation (Feet)	Slope (Percent)	Slope (Degrees)
1	60	406.33	406.43	-0.2%	-0.1°
2	52	412.50	412.47	0.1%	0.0°
3	45	419.62	418.57	2.3%	1.3°
4	40	424.57	418.37	15.5%	8.9°
5	42	426.61	423.88	6.5%	3.7°
6	44	426.90	423.92	6.8%	3.9°
7	44	426.94	423.85	7.0%	4.0°
8	44	426.15	423.00	7.2%	4.1°
9	44	424.67	421.92	6.3%	3.6°
10	12	421.10	421.03	0.5%	0.3°
11	12	424.64	425.20	-4.6%	-2.7°
12	12	429.00	429.30	-2.5%	-1.4°

CHAPTER 2:

Assessment of Peak Hour Traffic Operations

MICROSIMULATION MODELING

Manual turning movement counts (MTMCs) and Automatic Traffic Recorder (ATR) counts were conducted throughout the study area. The motor vehicular peak hour volumes were determined to be 7:00 AM to 8:00 AM and 4:30 PM to 5:30 PM. PTV Vissim traffic simulation software was used to analyze traffic operations for these peak hours. PTV Vissim is a microsimulation tool, and it was used to quantify four highway performance measures: delay, level of service (LOS), queue length, and travel time. DVRPC developed traffic models and reported performance measures for Existing (Year 2018), No Build (Year 2045), and Build (Year 2045) conditions.

An Existing (Year 2018) microsimulation model was prepared for the AM and PM peak hours. The models were calibrated using TMCs, ATRs, INRIX speed data,[5] and PennDOT traffic signal plans to accurately reflect current traffic conditions.

A No Build (Year 2045) model was also prepared for both peak hours. The No Build (Year 2045) scenario incorporates a number of programmed operational improvements in the study area that are expected to be completed by 2045. In addition, this scenario reflects projected 2045 traffic volumes and new trip volumes and origin-destination pairs generated by the development at 956 Matlack Street.

Three Build (Year 2045) scenarios are presented in this report. The three scenarios include the same improvement alternatives for the NB US 202 ramp and the US 202 and Matlack Street intersection. However, the three scenarios test three distinct improvement alternatives for the SB US 202 ramp. No preferred alternative is identified because all three scenarios yielded similar operational results.

Delay: the average amount of additional time–beyond free flow travel time–that it takes a vehicle to traverse an intersection. This value is given in seconds, and it is an average for all vehicles completing the movement.

LOS: a letter grade A through F assigned to an intersection or approach based on the delay. LOS “A” indicates near free flow conditions, while LOS “F” indicates that an intersection is operating at–or above–capacity.

Queue Length: the distance between the intersection and the farthest vehicle waiting to enter. The value given is the average queue length approaching an intersection across a series of time intervals.

Travel Time: the time, in minutes, that it takes a vehicle to travel a specified distance using a particular route.

[5] Vehicle speed data from INRIX, a private company that provides location-based data and analytics, obtained through the PDA Suite.

EXISTING CONDITIONS

The intersection volumes, delay, LOS, and queues for the AM and PM peak hours, respectively, are shown in **Tables 3 and 4** below. The reported results represent the 95th percentile of 12 simulation runs.

Table 3: Existing (Year 2018) AM Peak Hour Intersection Performance Results

7:00-8:00 AM	Approach	Approach Volume	Approach Delay	Approach LOS	Approach Queue	Intersection Volume	Intersection Delay	Intersection LOS
US 202 & Matlack	US 202 NB	2113	35.7	D	197.4	5709	28.4	C
	Matlack EB	387	74.4	E	125.0			
	Matlack WB	679	17.7	B	10.4			
	US 202 SB	2530	18.1	B	58.5			
High Street & Parkway Shopping Center	Parkway Center WB	128	20.7	C	7.1	1496	14.8	B
	High Street SB	605	10.9	B	16.3			
	US 322 NB	763	16.9	B	39.3			
US 202 & Skiles Boulevard	Stetson Drive EB	139	44.8	D	10.8	4600	8.7	A
	Skiles Blvd WB	106	47.5	D	10.5			
	US 202 SB	2080	6.5	A	26.1			
	US 202 NB	2275	6.7	A	30.0			

Source: DVRPC, 2019

Table 4: Existing (Year 2018) PM Peak Hour Intersection Performance Results

4:30-5:30 PM	Approach	Approach Volume	Approach Delay	Approach LOS	Approach Queue	Intersection Volume	Intersection Delay	Intersection LOS
US 202 & Matlack	US 202 NB	1977	42.1	D	228.2	5808	44.5	D
	Matlack EB	467	168.1	F	485.4			
	Matlack WB	635	19.4	B	12.2			
	US 202 SB	2729	31	C	114.7			
High Street & Parkway Shopping Center	Parkway Center WB	182	20.3	C	10.7	1697	15.7	B
	High Street SB	812	12.3	B	23.1			
	US 322 NB	703	18.4	B	47.1			
US 202 & Skiles Boulevard	Stetson Drive EB	147	43	D	16.4	4732	9.4	A
	Skiles Blvd WB	84	48.3	D	7.6			
	US 202 SB	2371	7.8	A	51.0			
	US 202 NB	2130	7.3	A	33.0			

Source: DVRPC, 2019

The 95th percentile vehicle travel time, also known as planning time, is a measure of performance reliability. Planning time was calculated using the Existing (Year 2018) PTV Vissim microsimulation model for the distance **between north of Matlack Street and south of Skiles Boulevard—1.5 miles in the southbound direction and 1.4 miles in the northbound direction**. **Table 5** shows the calibrated base year PTV Vissim model existing planning times.

Planning Time: the total travel time, which includes buffer time (calculated as the 95th percentile travel time).

Buffer Time: the extra time required to complete a trip (calculated as the difference between the 95th percentile travel time and the average travel time).

Table 5: Existing (Year 2018) Planning Times (Minutes)

	AM	PM
SB US 202 (1.5 mi)	2.7	3.3
NB US 202 (1.4 mi)	2.8	3.3
EB Matlack (0.3 mi)	2.1	4.3

Sources: DVRPC 2019

The number of lanes on US 202 drops from two lanes to one at the NB and SB ramps, creating a bottleneck at both locations. In the SB direction, most vehicles travel in the right lane from the US 202 and Matlack Street intersection, where the left merge lane begins, to the SB ramp. This distance is approximately 0.3-mile. In the NB direction, the two through lanes continue on High Street past the ramp, but most vehicles take the ramp from the right lane to continue on US 202 NB. Therefore, they merge to the right lane shortly past the US 202 and Skiles Boulevard/Stetson School Drive intersection. The primary use of one lane approaching the ramps in both directions results in considerable queueing at these points in the peak hours and causes delays through the study corridor.

NO BUILD (YEAR 2045)

The 2045 No Build Scenario incorporates a number of identified operational improvements, projected 2045 traffic volumes, and new trips generated by the development at 956 Matlack Street.

Operational Improvements

The following operational improvements are included in the 2045 No Build Scenario.

- **US 202 and Matlack Street:** Updated signal timing plan (Sources: Traffic Signal Design Study prepared by Traffic Planning and Design, Inc. [TPD], 2018; PennDOT Drawings for Construction of Transportation Management System, 2017).

- **US 202 and Skiles Boulevard/Stetson School Drive:** Redesign of the southbound left-turn jughandle and eastbound Stetson School Drive approach. Most notably, the eastbound approach lane configuration changes from one left-turn and one right-turn/through lane to one left-turn lane, one through lane, and one right-turn lane.

- **Projected 2045 Traffic Volumes:** A background growth rate was applied to links within the roadway network to capture traffic increase in the study area. The growth factors used represent average values based on county and federal functional classification. They were developed from the DVRPC travel model and *2045 Long-Range Plan* and are consistent with the DVRPC population and employment forecasts. There are four federal functional classes represented in the study area; the average annual growth rate for each is presented in **Table 6**.

Table 6: Average Annual Growth Factor by Federal Functional Class

Federal Functional Class	Average Annual Growth Factor
Other Freeway and Expressway	1.57%
Other Principal Arterial	
Major Collector	1.25%
Local Road	

Sources: DVRPC 2019

Other Adjustments

- **956 Matlack Street Trip Generation:** The new trips for 956 Matlack Street in West Goshen Township are included in the 2045 No Build Scenario. The trip generation and trip distribution identified in the Transportation Impact Study prepared by TPD in July 2018 informed adjustments to the model. These modifications are detailed below.
    - *AM and PM Trip Generation:* 94 additional vehicle trips during the weekday AM peak hour; 100 additional vehicle trips during the weekday PM peak hour (Source: 956 Matlack Street TIS prepared by TPD, July 2018).
    - *Trip distribution Percentages:* 46 percent to/from north (via US 202), 36 percent to/from south (via US 202), 9 percent to/from west (via Matlack Street), and 9 percent to/from east (via Matlack Street) (Source: 956 Matlack Street TIS prepared by TPD, July 2018).
- **PTV Vissim Driving Behavior Changes:** The high volumes in the future (Year 2045) conditions made it difficult for vehicles to enter the simulated network. As a result, default driving behavior on US 202 was modified in the future scenario models to account for increased aggressiveness due to longer queues and delays. Standstill Distance, Headway Time, Following Variation, Maximum Deceleration (Own), Maximum Deceleration (Trailing), and Safety Distance Reduction Factor were adjusted using the range of values recommended in Wisconsin DOT's *Vissim Calibration Parameters* (2018). The PTV Vissim 9 Manual was also used as a supporting document to determine reasonable values for these parameters.

Results

The intersection volumes, delay, LOS, and queues for the No Build (Year 2045) AM and PM peak hours, respectively, are shown in **Tables 7 and 8** on the following pages. The reported results represent the 95th percentile of 12 simulation runs.

Table 7: No Build (Year 2045) AM Peak Hour Intersection Performance Results

7:00-8:00 AM	Approach	Approach Volume	Approach Delay	Approach LOS	Approach Queue	Intersection Volume	Intersection Delay	Intersection LOS
US 202 & Matlack	US 202 NB	2930	61.8	E	997.9	7843	89.3	F
	Matlack EB	491	199.8	F	825.0			
	Matlack WB	951	65.1	E	143.4			
	US 202 SB	3471	103.5	F	925.6			
High Street & Parkway Shopping Center	Parkway Center WB	192	20.9	C	9.9	1998	15.6	B
	High Street SB	850	11.8	B	25.0			
	US 322 NB	956	17.9	B	49.1			
US 202 & Skiles Boulevard	Stetson Drive EB	172	49.1	D	15.0	6363	23.6	C
	Skiles Blvd WB	144	51.7	D	15.0			
	US 202 SB	2837	9	A	60.6			
	US 202 NB	3210	33.9	C	335.1			

Source: DVRPC, 2019

Table 8: No Build (Year 2045) PM Peak Hour Intersection Performance Results

4:30-5:30 PM	Approach	Approach Volume	Approach Delay	Approach LOS	Approach Queue	Intersection Volume	Intersection Delay	Intersection LOS
US 202 & Matlack	US 202 NB	2779	68.6	E	1048.6	7869	80	E
	Matlack EB	600	109.8	F	430.0			
	Matlack WB	854	157.9	F	475.6			
	US 202 SB	3636	65.6	E	558.2			
High Street & Parkway Shopping Center	Parkway Center WB	260	21.7	C	15.9	2359	17.3	B
	High Street SB	1156	14.3	B	41.8			
	US 322 NB	943	19.8	B	63.0			
US 202 & Skiles Boulevard	Stetson Drive EB	181	50.3	D	16.7	6607	12.1	B
	Skiles Blvd WB	119	46	D	10.8			
	US 202 SB	3311	11.7	B	67.7			
	US 202 NB	2996	8.9	A	55.3			

Source: DVRPC, 2019

Planning time was measured using the No Build (Year 2045) PTV Vissim microsimulation model for the distance **between north of Matlack Street and south of Skiles Boulevard—approximately 1.5 miles in the southbound direction and 1.4 miles in the northbound direction**. **Table 9** shows the No Build (Year 2045) PTV Vissim model future planning times.

Table 9: No Build (Year 2045) Planning Times (Minutes)

	AM (7:00-8:00 AM)	PM (4:30-5:30 PM)
SB US 202 (1.5 mi)	5.8	3.8
NB US 202 (1.4 mi)	6.3	5.2
EB Matlack (0.3 mi)	5.6	2.9

Sources: DVRPC 2019

The same operational issues–intersection delays and queueing at the ramps–emerged in the No Build (Year 2045) model that occur under current conditions. These problems would be exacerbated with the projected future increase in traffic volumes. The US 202 and Matlack Street intersection is the most affected by the increase in traffic volumes. It experiences much longer queues on the major approaches due to spillback from the SB lane drop. The addition of a protected left-turn phasing on the Matlack Street approaches reduces the vehicle delay of these movements in the PM. Because the EB left-turning volumes are much higher in the AM, this specific movement experiences more delays in the AM No Build (Year 2045) scenario.

The US 202 and Skiles Boulevard/Stetson School Drive and High Street (US 322 Business) and Parkway Shopping Center intersections do not appear to be especially affected by the volume increase. High Street has comparatively low traffic volumes in this area, and the distance between the nearest intersection and the ramp is greater in the NB direction.

BUILD (YEAR 2045)

As mentioned previously, three Build (Year 2045) scenarios were developed and evaluated through this project. The three scenarios include the same improvement alternatives for the NB US 202 ramp and the US 202 and Matlack Street intersection. However, the scenarios test three distinct improvement alternatives for the SB US 202 ramp. No preferred alternative is identified because all three scenarios yielded similar operational results.

Description of Alternatives

Each alternative refers to a roadway improvement in a distinct part of the study area. These are described below. Please note that no recommendations were developed or tested for the intersection of High Street (US 322 Business) and Parkway Shopping Center. This intersection operates at LOS B; the findings of this operations analysis indicated that conditions would remain stable in the future (Year 2045). Conceptual diagrams for each alternative are shown on the following pages.

- **1:** Addition of one lane on the inside of the US 202 NB ramp. US 202 NB traffic in the right-lane is able to turn onto either ramp lane at the exit. Traffic merging from High Street is stop-controlled.

- **2A:** The addition of one lane on the inside of the US 202 SB ramp. The existing center median is converted to an auxiliary merge lane to Old Wilmington Pike so that traffic on SB High Street has more time to merge. The roadway is slightly realigned, but no additional right-of-way is needed.

- **2B:** The addition of a new T-intersection where the High Street ramp to NB US 202 and the US 202 SB ramp currently run adjacent to one another. All SB High Street traffic is forced to turn right onto the existing ramp. High Street traffic bound for US 202 NB continues unimpeded in the right lane, while High Street traffic bound for US 202 SB reaches a signal-controlled intersection at the US 202 SB ramp.

- **2C:** The redesign of the High Street SB merge to create a parallel type ramp entrance to US 202 SB. An additional lane would be added on the inside of the US 202 SB ramp, and High Street SB traffic would yield to US 202 SB traffic.

    - The development of this alternative involved the identification of the origin of vehicles making a SB right-turn at Old Wilmington Pike. Video data was processed to determine that 9% of vehicles traveling SB in the left lane make a SB right-turn onto Old Wilmington Pike in both peak hours. This equates to approximately 30 vehicles in Existing (Year 2018) conditions and approximately 40 vehicles in No Build (Year 2045) conditions. If the vehicle volumes for this movement were high, this alternative may not be appropriate. However, the number of vehicles making a SB right-turn from the left lane is low. Please note that the following assumptions were made about the feasibility of this alternative: **initial velocity (High**

Street)=40 mph; US 202 SB design speed=55 mph; curve radius=approximately 1000 feet; and curve length=200 feet. [6]

- **3:** The addition of a left-turn lane (40 feet with a 145-foot taper) from EB Matlack Street to NB US 202.

The composition of each scenario is summarized in **Table 10** below, and the alternatives are shown in **Figures 11 through 15**.

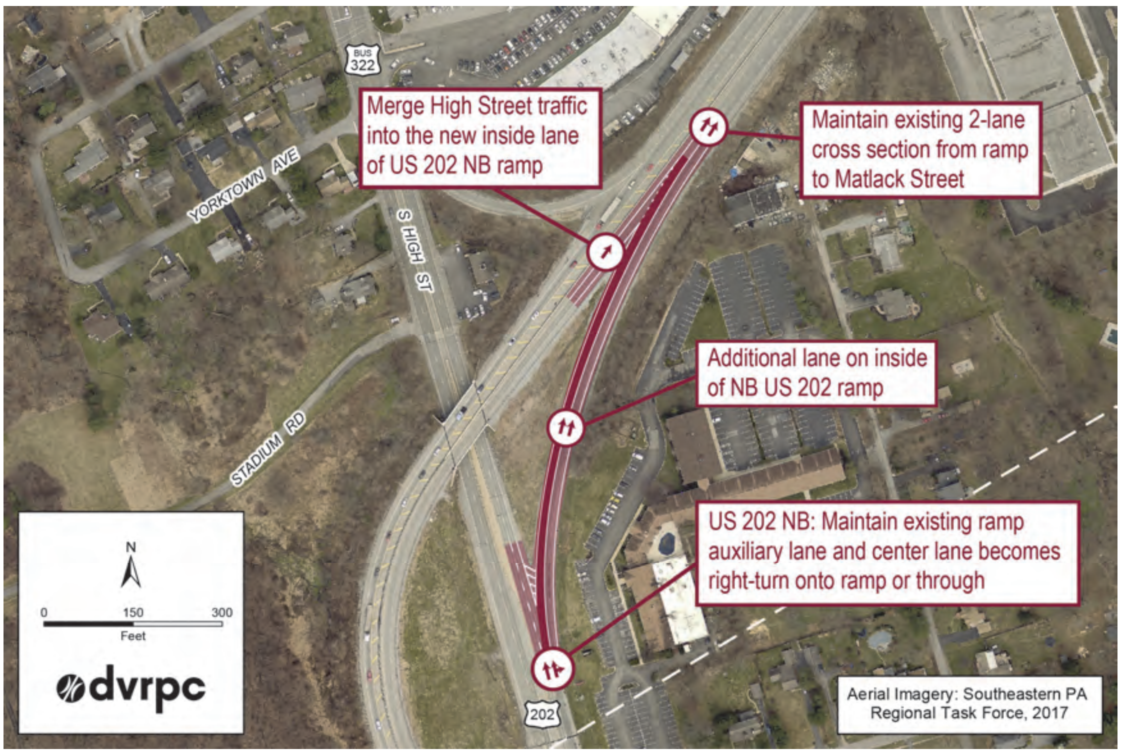
Table 10: Relationship between Build Scenarios and Improvement Alternatives

Build 1	Build 2	Build 3
1, 2A, 3	1, 2B, 3	1, 2C, 3

Sources: DVRPC 2019

Alternative 1

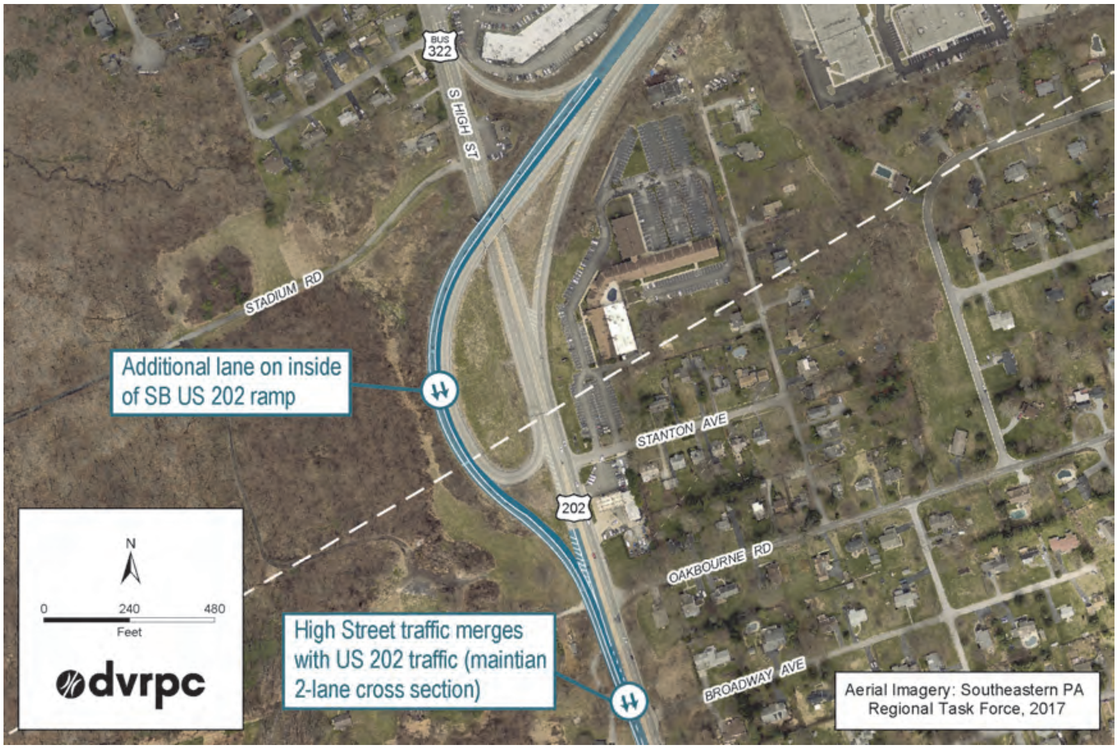
Figure 11: Diagram of NB Ramp Alternative 1 Recommendations



[6] The determination of design feasibility must be made with the support of a licensed engineer in coordination with PennDOT.

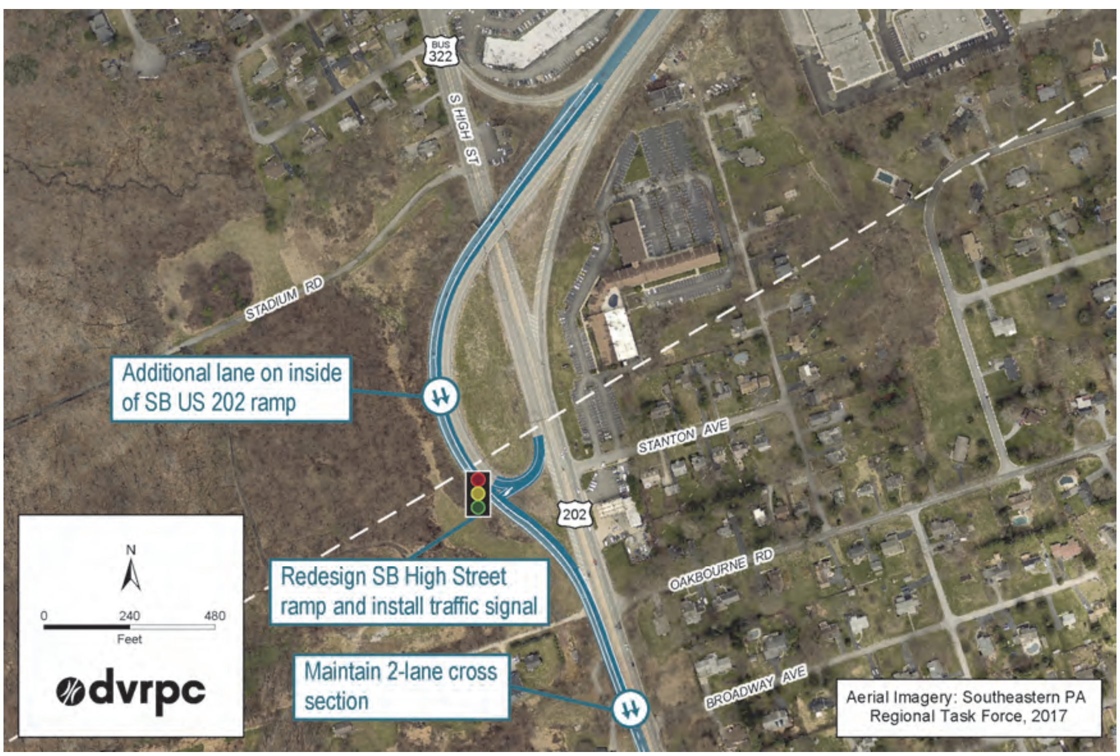
Alternative 2A

Figure 12: Diagram of SB Ramp Alternative 2A Recommendations



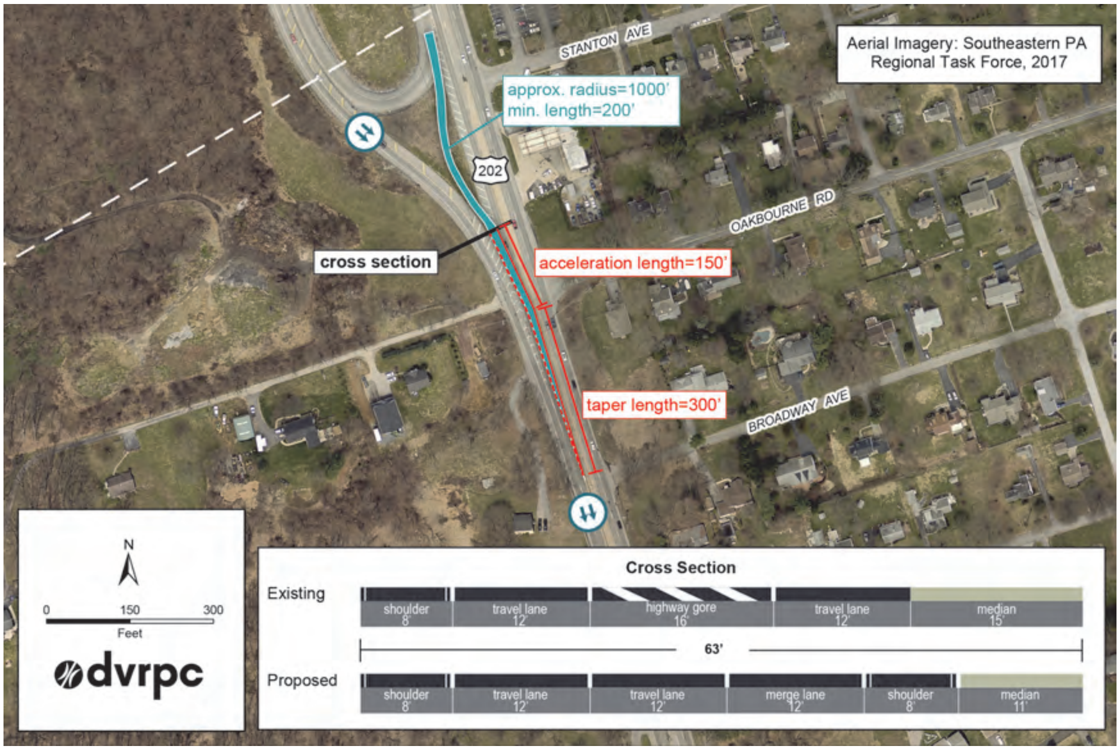
Alternative 2B

Figure 13: Diagram of SB Ramp Alternative 2B Recommendations



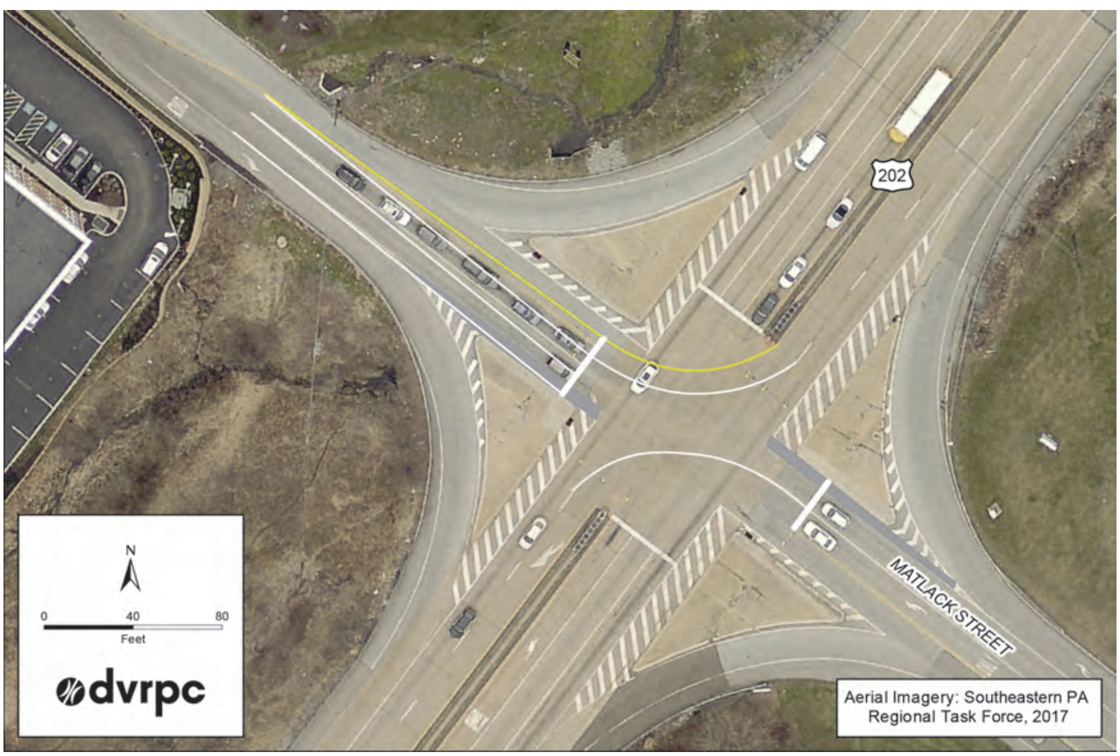
Alternative 2C

Figure 14: Diagram of SB Ramp Alternative 2C Recommendations



Alternative 3

Figure 15: Diagram of US 202 and Matlack Street EB Left-Turn Recommendations



Build 1 (includes Alternatives 1, 2A, 3)

The intersection volumes, delay, LOS, and queues for the AM and PM peak hours, respectively, are shown in **Tables 11 and 12**. The reported results represent the 95th percentile of 12 simulation runs.

Table 11: Build 1 AM Peak Hour Intersection Performance Results

7:00-8:00 AM	Approach	Approach Volume	Approach Delay	Approach LOS	Approach Queue	Intersection Volume	Intersection Delay	Intersection LOS
US 202 & Matlack	US 202 NB	2896	52.9	D	858.5	7961	49.5	D
	Matlack EB	522	56.5	E	70.3			
	Matlack WB	956	55.1	E	94.6			
	US 202 SB	3587	44.3	D	181.6			
High Street & Parkway Shopping Center	Parkway Center WB	192	21	C	10.3	2009	15.5	B
	High Street SB	849	11.9	B	25.5			
	US 322 NB	968	17.6	B	53.5			
US 202 & Skiles Boulevard	Stetson Drive EB	171	48.7	D	14.9	6495	12.6	B
	Skiles Blvd WB	144	45.9	D	14.6			
	US 202 SB	2965	11.4	B	115.5			
	US 202 NB	3215	10.2	B	69.4			

Source: DVRPC, 2019

Table 12: Build 1 PM Peak Hour Intersection Performance Results

4:30-5:30 PM	Approach	Approach Volume	Approach Delay	Approach LOS	Approach Queue	Intersection Volume	Intersection Delay	Intersection LOS
US 202 & Matlack	US 202 NB	2815	51.5	D	621.8	7960	52.2	D
	Matlack EB	630	65.3	E	118.5			
	Matlack WB	882	36.3	D	37.0			
	US 202 SB	3633	54.4	D	324.7			
High Street & Parkway Shopping Center	Parkway Center WB	260	22	C	17.2	2338	17.3	B
	High Street SB	1142	13.3	B	37.1			
	US 322 NB	936	20.8	C	71.9			
US 202 & Skiles Boulevard	Stetson Drive EB	188	52.8	D	18.2	6631	15.8	B
	Skiles Blvd WB	116	46.9	D	10.9			
	US 202 SB	3330	18.9	B	238.2			
	US 202 NB	2997	8.8	A	55.5			

Source: DVRPC, 2019

Build 2 (includes Alternatives 1, 2B, 3)

The intersection volumes, delay, LOS, and queues for the AM and PM peak hours, respectively, are shown in **Tables 13 and 14**. The reported results represent the 95th percentile of 12 simulation runs.

Table 13: Build 2 AM Peak Hour Intersection Performance Results

7:00-8:00 AM	Approach	Approach Volume	Approach Delay	Approach LOS	Approach Queue	Intersection Volume	Intersection Delay	Intersection LOS
US 202 & Matlack	2900	54.1	D	834.4	2900	7972	49.5	D
	522	56.7	E	70.3	522			
	957	55.7	E	101.3	957			
	3593	43.1	D	182.8	3593			
High Street & Parkway Shopping Center	192	20.9	C	10.3	192	2008	15.7	B
	848	12	B	25.9	848			
	968	17.9	B	57.0	968			
US 202 & Skiles Boulevard	172	49.8	D	15.1	172	6525	13.4	B
	144	45.2	D	15.0	144			
	2999	11.6	B	96.8	2999			
	3210	11.7	B	89.6	3210			

Source: DVRPC, 2019

Table 14: Build 2 PM Peak Hour Intersection Performance Results

4:30-5:30 PM	Approach	Approach Volume	Approach Delay	Approach LOS	Approach Queue	Intersection Volume	Intersection Delay	Intersection LOS
US 202 & Matlack	US 202 NB	2806	49.1	D	681.9	7905	51.7	D
	Matlack EB	631	64.3	E	117.2			
	Matlack WB	882	35.1	D	37.4			
	US 202 SB	3586	55.7	E	330.9			
High Street & Parkway Shopping Center	Parkway Center WB	262	21.8	C	16.1	2347	17.5	B
	High Street SB	1143	13.8	B	39.0			
	US 322 NB	942	20.9	C	69.5			
US 202 & Skiles Boulevard	Stetson Drive EB	182	55.5	E	20.4	6584	12.2	B
	Skiles Blvd WB	117	48.3	D	11.4			
	US 202 SB	3295	11.5	B	109.3			
	US 202 NB	2990	9	A	57.4			

Source: DVRPC, 2019

Build 3 (includes Alternatives 1, 2C, 3)

The intersection volumes, delay, LOS, and queues for the AM and PM peak hours, respectively, are shown in **Tables 15 and 16**. The reported results represent the 95th percentile of 12 simulation runs.

Table 15: Build 3 AM Peak Hour Intersection Performance Results

7:00-8:00 AM	Approach	Approach Volume	Approach Delay	Approach LOS	Approach Queue	Intersection Volume	Intersection Delay	Intersection LOS
US 202 & Matlack	US 202 NB	2929	56.2	E	898.2	7998	51.2	D
	Matlack EB	522	56.7	E	69.8			
	Matlack WB	957	54.3	D	93.7			
	US 202 SB	3590	45.4	D	203.7			
High Street & Parkway Shopping Center	Parkway Center WB	192	21.1	C	10.7	2009	15.2	B
	High Street SB	849	12	B	25.5			
	US 322 NB	968	16.8	B	50.8			
US 202 & Skiles Boulevard	Stetson Drive EB	171	50.1	D	15.8	6522	13.2	B
	Skiles Blvd WB	144	47.2	D	14.5			
	US 202 SB	2992	12.5	B	132.9			
	US 202 NB	3215	10.3	B	70.2			

Source: DVRPC, 2019

Table 16: Build 3 PM Peak Hour Intersection Performance Results

4:30-5:30 PM	Approach	Approach Volume	Approach Delay	Approach LOS	Approach Queue	Intersection Volume	Intersection Delay	Intersection LOS
US 202 & Matlack	US 202 NB	2801	51.2	D	738.2	7972	52.1	D
	Matlack EB	631	68.5	E	131.9			
	Matlack WB	882	36.7	D	37.4			
	US 202 SB	3658	53.7	D	337.5			
High Street & Parkway Shopping Center	Parkway Center WB	262	21.2	C	15.8	2353	17.4	B
	High Street SB	1145	15.1	B	47.6			
	US 322 NB	946	19.1	B	63.1			
US 202 & Skiles Boulevard	Stetson Drive EB	185	51	D	18.5	6642	15.7	B
	Skiles Blvd WB	116	47.4	D	10.1			
	US 202 SB	3354	17.5	B	182.2			
	US 202 NB	2987	10.3	B	91.2			

Source: DVRPC, 2019

Comparison of Planning Times

Planning time was measured using the Build 1, 2, and 3 PTV Vissim microsimulation models for the distance **between north of Matlack Street and south of Skiles Boulevard—approximately 1.5 miles in the southbound direction and 1.4 miles in the northbound direction** (**Table 17**).

Table 17: Build 1, 2, 3 Planning Times (minutes)

	No Build (Year 2045)		Build 1		Build 2		Build 3	
	AM	PM	AM	PM	AM	PM	AM	PM
SB US 202 (1.5 mi)	5.8	3.8	2.4	2.6	2.6	2.6	2.4	2.8
NB US 202 (1.4 mi)	6.3	5.2	3.9	3.4	3.7	3.4	3.8	3.3
EB Matlack (0.3 mi)	5.6	2.9	1.6	1.8	1.6	1.8	1.6	1.8

Source: DVRPC, 2019

CHAPTER 3:

Summary of Findings

FINDINGS

The microsimulation analysis suggests that all three recommended scenarios may improve traffic operations along the corridor. The three build scenarios yielded very similar results. In the AM and PM Build Scenario simulations, the addition of a lane on the NB ramp reduced queueing at this location, thereby improving traffic flow through the corridor. There were sufficient gaps for High Street traffic to merge onto US 202 NB from a stopped position. This improvement would also allow the more efficient utilization of the NB travel lanes because vehicles could also use the left lane to proceed on NB US 202. The addition of a double left-turn lane on EB Matlack Street, coupled with protected left-turn phasing, proved to drastically decrease delay (by about 50 seconds).

In the SB direction, the addition of another lane on the ramp helped decrease congestion and reduce conflict at the lane drop. With vehicles flowing freely, queue spillback to Matlack Street was no longer an issue. Slight queueing occurred on SB High Street in Scenarios 1 and 3, which employed free-flowing merge geometry for traffic merging onto US 202 SB from High Street. However, these queues were shorter and less frequent than those experienced farther upstream on US 202 in the Existing (Year 2018) and No Build (Year 2045) scenarios. Scenario 2, which tested the installation of a traffic signal on the US 202 SB ramp, only resulted in a slight increase in SB AM and PM travel times. The traffic signal slightly lowered delay at the downstream US 202 and Skiles Boulevard intersection, possibly due to inadvertent platooning caused by traffic signal control upstream of the intersection.

Ultimately, cost may be an important factor in determining the preferred alternative. **Based on the planning-level cost estimates presented in this report, Scenario 1 is the most cost-effective alternative (estimated final cost between $1,170,000 and $1,580,000).** This scenario involves the least amount of construction, and it would not require modifications to overhead lane control on SB US 202. DVRPC recommends an engineering study to deliver a well-informed project bid. The implementation of one of the proposed scenarios would need to be made with the support of a licensed engineer in coordination with PennDOT.

OTHER SAFETY RECOMMENDATIONS

A number of additional safety measures are recommended for implementation throughout the study area, and they are listed below. These improvements were not tested as part of the operational analysis; therefore, cost estimates were not prepared for these items.

- Install a raised median at High Street and Yorktown Avenue to improve the safety of left-turns onto Yorktown Avenue from the US 202 SB exit and High Street NB. The median would ensure that U-turns are made at the intersection, and make Yorktown Avenue right-in.

- Install crosswalks and sidewalks at the US 202 and Matlack Street intersection if the northeast and northwest quadrants are developed with residential or mixed uses.

- Install overhead lane control on EB Matlack Street approach (WB overhead lane control was recommended in the TPD assessment).

- Add dotted white and yellow line extensions through the intersection for EB left-turns from Matlack Street onto US 202.
- Install “Left on Green Arrow Only” (R10-5) signs on the US 202 approaches at the intersection with Matlack Street.
- Install or replace raised pavement markers (RPMs) on US 202 to the north and south of the ramps. The study area is not well lit at night, and the highway is not at grade. RPMs can help prevent lane departure, especially at dusk and at night.
- Add gore line markings at the SB ramp exit to High Street to increase the visibility of the exit, particularly in dark conditions.
- Add gore line markings and a W2-3 (Side Road symbol) sign on SB US 202 at Old Wilmington Pike. These safety measures would provide drivers with advance warning of the intersection and make the side street more visible to highway traffic.
- Move the No U-turn (R3-4) sign in the median facing NB traffic at Old Wilmington Pike; this obstructs drivers’ view of oncoming traffic when waiting to turn from the left-turn lane.

COST ESTIMATES

Planning-level cost estimates were prepared for the three Build Scenarios. They are parametrically estimated, which means that the unit cost was multiplied by the unit volume to estimate a cost per line item. The estimates are informed by item price histories from PennDOT’s Engineering and Construction Management System (ECMS). Academic publications, external cost databases, completed project cost reports, and product retailer websites were used to supplement this data. Material furnishing and installation costs were marked up 30 percent (10 percent for mitigation: runoff, traffic control, and so on, and 20 percent for construction, surveying, and mobilization). The scaled cost was then marked up an additional 20 percent to account for engineering design costs.

These planning-level cost estimates are designed to give local officials an idea of the projected cost of specified improvements. Maintenance costs, including pavement markings, will be an ongoing expense for the municipalities. Detailed engineering analyses that are necessary before construction, such as hydrogeological surveying and pavement evaluation, were not performed as part of this assessment. As a result, assumptions were made about soil conditions, roadway drainage, and existing pavement cross-sections. Therefore, these estimates will not equal the exact future bid prices for an infrastructure project at the respective location.

The Material and Total Costs reported in **Table 18** are rounded to the nearest thousand. The final estimates are reported as a range (plus or minus 15 percent) to reflect the inherent uncertainty that accompanies a planning-level cost estimate given the aforementioned assumptions. DVRPC recommends an engineering study be performed at each intersection that will provide an adequate level of detail of the study area to deliver a well-informed project bid. The list of line items included in the costs for each improvement alternative can be found in **Appendix A**.

Table 18: Planning-Level Cost Estimates for Build Scenarios

Costs by Alternative	
Alternative 1	$272,000
Alternative 2A	$587,000
Alternative 2B	$793,000
Alternative 2C	$637,000
Alternative 3	$18,000
Total Costs (Material, Construction, and Mitigation Costs—30 percent mark-up)	
Scenario 1 (Alternatives 1, 2A, 3)	$1,139,000
Scenario 2 (Alternatives 1, 2B, 3)	$1,407,000
Scenario 3 (Alternatives 1, 2C, 3)	$1,205,000
Final Costs (Includes Engineering Design—20 percent mark-up, plus or minus 15 percent)	
Scenario 1 (Alternatives 1, 2A, 3)	$1,170,000-$1,580,000
Scenario 2 (Alternatives 1, 2B, 3)	$1,440,000-$1,950,000
Scenario 3 (Alternatives 1, 2C, 3)	$1,240,000-$1,670,000

Sources: PennDOT ECMS; DVRPC, 2019

NEXT STEPS

Securing funding is a crucial step toward project implementation. There are a number of competitive grant programs available in the DVRPC region to help municipalities cover the cost of the transportation improvements described in this report. Municipalities can coordinate with other municipalities, school districts, the county, and PennDOT to prepare and submit grant applications. Possible funding sources for the improvements identified in this study are detailed below.

Transportation Improvement Program (TIP)

The TIP is the regionally agreed-upon list of priority transportation projects, as required by federal law (ISTEA, TEA-21, SAFETEA LU, MAP-21, and the FAST Act). The TIP document must list all projects that intend to use federal funds, along with all non-federally funded projects that are regionally significant. We also include all other State funded capital projects. The projects are multimodal; that is, they include bicycle, pedestrian, ITS, and freight related projects, as well as the more traditional highway and public transit projects.

Act 89 Multimodal Transportation Fund (MTF)

The Act 89 MTF program provides grants to encourage economic development and ensure that a safe and reliable system of transportation is available to the residents of the commonwealth. The program is administered by PennDOT and the Department of Community and Economic Development (DCED) under the direction of the Commonwealth Financing Authority (CFA).

MTF–PennDOT

Eligible projects for PennDOT's MTF program include projects related to streetscape, bicycle and pedestrian facilities, improved signage, and improvements to an integrated transportation corridor in order to improve the productivity, efficiency, and security of goods movement to and from PA ports.

MTF–DCED/CFA

On behalf of the CFA, the DCED accepts applications every year between March 1 and July 31 for multimodal projects. Project eligibility for this funding source is similar to the PennDOT MTF.

CMAQ

The DVRPC Competitive CMAQ Program funds transportation projects that will improve air quality and reduce traffic congestion in the DVRPC region. CMAQ-eligible projects demonstrably reduce air pollution emissions and help the region meet the federal health-based air quality standards. Congestion reduction and traffic flow improvement projects are eligible for CMAQ funding.

Automated Red Light Enforcement (ARLE)

The ARLE program was established in 2010 as a PennDOT-administered competitive grant program. Funding for the program is generated from the net revenue of fines collected through ARLE Enforcement Systems, a technological tool used to automatically monitor signalized intersections for red-light-running violators on a 24/7 basis. The intent of the program is to improve intersection safety by reducing vehicle crashes and injuries due to red-light-running. The system helps to enforce traffic laws and improve safety. Eligible projects include the retiming of existing traffic control signals, installation of new or improved detection systems for traffic control signals, and roadway capacity upgrades such as auxiliary turning lanes.

Green Light-Go

Green Light-Go, Pennsylvania's Municipal Signal Partnership Program, provides state funds for the operation and maintenance of traffic signals along critical and designated corridors on state highways. It is a reimbursement grant program, and applicants are required to provide a minimum 20 percent match. Eligible projects include the replacement of existing incandescent or LED bulbs with new LED bulbs for vehicular and/or pedestrian signal indications, traffic signal retiming, and modernization upgrades.

Appendix A

Cost Estimate Line Items

DELAWARE VALLEY REGIONAL PLANNING COMMISSION

Appendix A: Cost Estimate Line Items

ALTERNATIVE 1

Table A-1: Line Items Included in the Cost Estimate Determination for Alternative 1

202 NB Adjustment	Pavement Markings	Signage and Delineators
Mill Ramp	Remove Edgelines/Centerlines/Lane Lines	R1-1 Sign (STOP) (1)
Binder Course	Remove Gore Lines	Sign Post
Wearing Course	Stop Bar (1)	R3-8 Sign (Right/Through, Right Only) (2)
Joint and Transition Sealing	Dotted (Auxilliary) Lane Line	Adjust US 322 NB Overhead Sign
Shoulder Rumble Strip	Pavement Marking, Thru/Right Arrow	
Replace White Chevron Gore Marking	Pavement Marking, Right Arrow	
Replace Yellow Chevron Gore Marking		
Replace Centerline		
Replace Edgeline		

Source: DVRPC, 2019

ALTERNATIVE 2A

Table A-2: Line Items Included in the Cost Estimate Determination for Alternative 2A

202/322 SB Merge Alignment	202 SB Adjustment	Pavement Markings	Signage and Delineators
Mill Concrete Median	Mill Roadway	Remove Edgelines/Centerlines/Lane Lines	Raised Pavement Marker (Add Through Curve)
Remove Guide Rail	Subbase	Remove Gore Lines	Guide Rail Mounted Delineator, Type D
Replace Guide Rail	Binder Course	Remove Lane Reduction Transition Arrow	W4-2L Sign (Left Lane Ends) (1)
Re-Construct Median Curb	Wearing Course	White Edge Line	W9-2 Sign (Lane Ends Merge Right) (1)
Add Pavement in Former Median Footprint	Shoulder Rumble Strip	White Dashed Lane Line	Sign Post
Excavation (Class 1) and Backfill	Replace Yellow Chevron Gore Marking	Yellow Center Line	Guide Rail Mounted Delineator, Type A/B
Subbase	Replace Centerline	Lane Reduction Transition Arrow, 202/322 Merge	Remove "Form Single Lane" Sign
Base Course	Replace Edgeline	White Dotted Lane Line	Remove "Left Lane Ends" Sign
Binder Course	Replace Dashed Lane Line		Remove "Lane Ends Merge Right" Sign
Wearing Course			
Joint and Transition Sealing			

Source: DVRPC, 2019

ALTERNATIVE 2B

Table A-3: Line Items Included in the Cost Estimate Determination for Alternative 2B

202 SB Adjustment	322/202 Signal and Roadway Adjustment	Pavement Markings	Signage and Delineators
Mill Roadway	Sitework, Clearing, Grubbing	Remove Edgelines/Centerlines/Lane Lines	Raised Pavement Marker (Add Through Curve)
Subbase	Excavation (Class 1) and Backfill	Remove Gore Lines	Guide Rail Mounted Delineator, Type D
Binder Course	Subbase	Remove Lane Reduction Transition Arrow	Remove "Form Single Lane" Sign
Wearing Course	Base Course	White Edge Line	Remove "Left Lane Ends" Sign
Shoulder Rumble Strip	Binder Course	Yellow Center Line	Remove "Lane Ends Merge Right" Sign
Replace Yellow Chevron Gore Marking	Wearing Course	Stop Bar (4)	Remove US 322 Exit Sign
Replace Centerline	Joint and Transition Sealing	Intersection Turn Guide, Dotted Lane Line	Adjust US 322 SB Overhead Sign
Replace Edgeline	Asphalt Shoulder, Type 4	White Hot Thermoplastic Legend, "ONLY," 8'	W3-3 Sign (Signal Ahead) (3)
Replace Dashed Lane Line	Tree Removal	White Hot Thermoplastic Legend, "LEFT ARROW," 12'x3'	Sign Post
	Concrete Median	White Hot Thermoplastic Legend, "SIGNAL," 8'	
	Remove Guide Rail	White Hot Thermoplastic Legend, "AHEAD," 8'	
	Guide Rail		
	Grass Median		
	Traffic Signal Support, 30' Mast Arm		
	NEMA TS-2; Type 1 Controller Assembly		
	2" Conduit		
	Trench and Backfill, Type 1		
	Signal Cable, 14 AWG, 3 Conductor		
	Junction Box, JB-27		
	Electrical Service, Type C		
	Uninterrupted Power Supply		

202 SB Adjustment	322/202 Signal and Roadway Adjustment	Pavement Markings	Signage and Delineators
	Signal Head, Three 12" Sections		
	Emergency Preemption System		
	Traffic Signal Timing		
	Loop Sensor Installation (4)		
	Mill Wearing Course		
	Re-Pave Wearing Course		

Source: DVRPC, 2019

ALTERNATIVE 2C

Table A-4: Line Items Included in the Cost Estimate Determination for Alternative 2C

202 SB Outside Shoulder Adjustment	322 SB Alignment Adjustment	Pavement Markings	Signage and Delineators
Mill Roadway	Add Pavement	Remove Edgelines/Centerlines/Lane Lines	Raised Pavement Marker (Add Through Curve)
Subbase	Excavation (Class 1) and Backfill	Remove Gore Lines	Guide Rail Mounted Delineator, Type D
Binder Course	Subbase	Remove Lane Reduction Transition Arrow	Remove "Form Single Lane" Sign
Wearing Course	Base Course	White Edge Line	Remove "Left Lane Ends" Sign
Shoulder Rumble Strip	Binder Course	White Dashed Lane Line	Remove "Lane Ends Merge Right" Sign
Replace Yellow Chevron Gore Marking	Wearing Course	Yellow Center Line	W9-2 Sign (Lane Ends Merge Right) (1)
Replace Centerline	Joint and Transition Sealing		Sign Post
Replace Edgeline	Concrete Median		Guide Rail Mounted Delineator, Type A/B
Replace Dashed Lane Line	Grass Median		
	Mill Concrete Median		
	Remove Guide Rail		
	Replace Guide Rail		
	Re-Construct Median Curb		
	Add Pavement in Former Median Footprint		
	Excavation (Class 1) and Backfill		
	Subbase		
	Base Course		
	Binder Course		
	Wearing Course		
	Joint and Transition Sealing		

Source: DVRPC, 2019

ALTERNATIVE 3

Table A-5: Line Items Included in the Cost Estimate Determination for Alternative 3

Pavement Markings	Signage	Traffic Signal Updates
Pavement Marking Removal, Centerlines/Edgelines/Lane Lines	Remove Post-Mounted Sign, Type B	Mill Wearing Course (1.5" depth)
Pavement Marking Removal, Gore Lines/Stop Bars	Install Post-Mounted Sign, Type B	Loop Sensor Installation (3)
Pavement Marking Removal, Legends and Symbols	Install Structure Mounted Flat Sheet Aluminum Signs	Re-Pave Wearing Course
White Chevron Gore Marking		Vehicular Signal Head, Three 12" Sections
Edge Line		
Center Line (1)		
Stop Bar		
Dotted Extension Line		
White Hot Thermoplastic Legend, "ONLY"		
White Hot Thermoplastic Legend, "LEFT ARROW," 12'x3'		

Source: DVRPC, 2019

US 202 Section 100 Operations Analysis

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Geographic Area Covered:
West Goshen Township, Westtown Township, Chester County

Key Words:
Highway Operations, Level of Service, Travel Time, Safety, Ramps, US 202

Abstract:
This study supports one main transportation objective: to improve the operational efficiency of US 202 Section 100 through West Goshen and Westtown Townships. The facility functions as both an interstate freeway and local arterial in these municipalities. Therefore, this study identifies highway design alternatives that would benefit local residents and commuters by improving safety and maximizing the efficiency of existing transportation infrastructure.

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