FEBRUARY 2022

DELAWARE VALLEY
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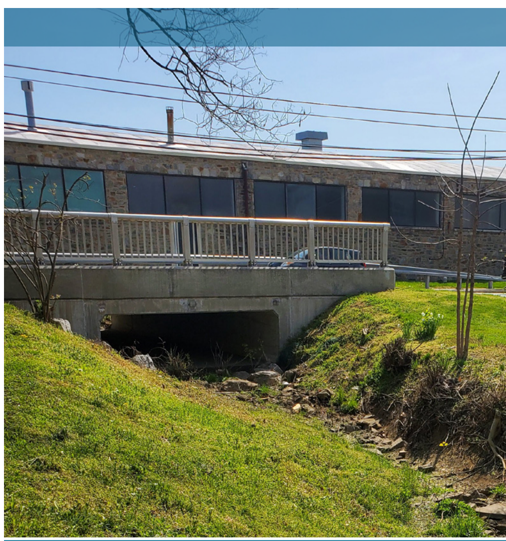
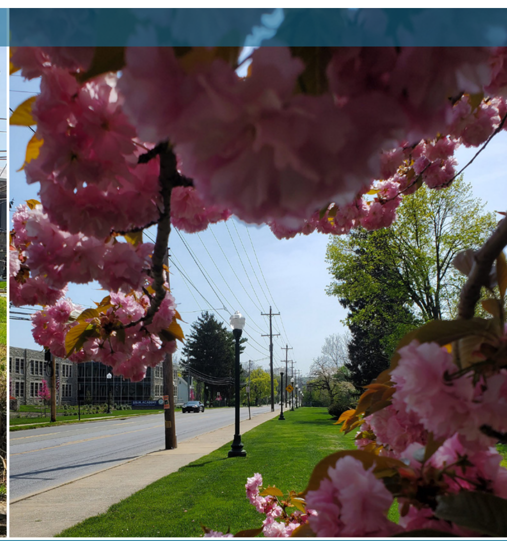
REGIONAL
PLANNING COMMISSION

Downingtown Area Transportation Study

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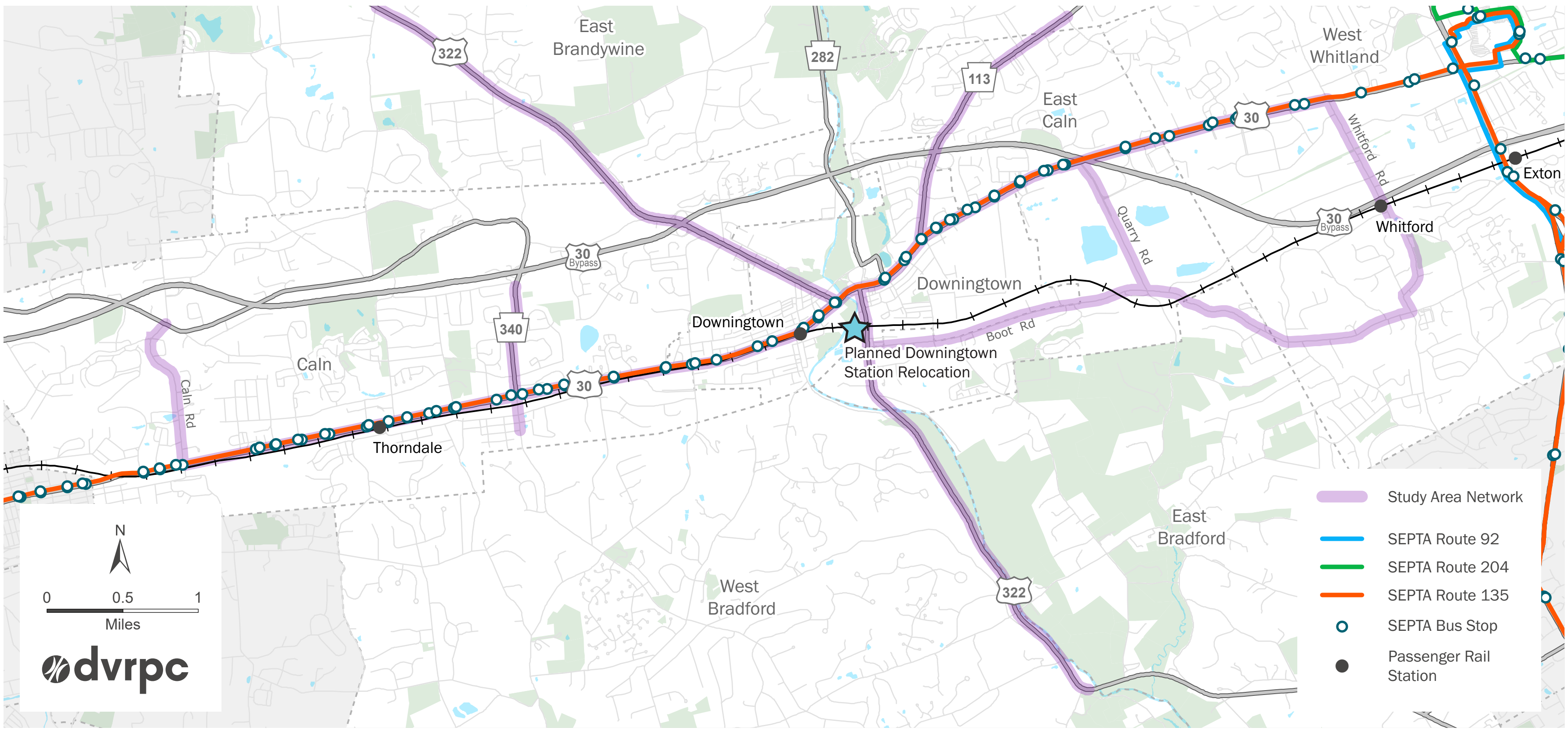
Executive Summary

The Downingtown Area in Central Chester County has experienced significant growth in recent years, along with a corresponding increase in traffic congestion. Several large private developments are planned, which will create additional transportation challenges. Furthermore, the Downingtown Train Station is set to be relocated (see Figure 1), which will impact mobility in the surrounding area.

Figure 1: Existing and Planned Rail Stations



Source: SEPTA, 2021

At the request of the Chester County Planning Commission (CCPC), the Delaware Valley Regional Planning Commission (DVRPC) conducted a two-year study in an effort to:

a. Identify and quantify areas of existing and future transportation bottlenecks within the Downingtown area and Central Chester County;

b. Quantify the impact of new development on traffic circulation and mobility; and
c. Develop the analytical basis for improvements needed to establish a modern transportation system.

The project team examined non-vehicular approaches to mitigate traffic congestion in the Downingtown Area, by improving multimodal accessibility throughout the area and reducing impacts from stormwater runoff.

Figure 2: Introductory Modeling Flowchart

Bicycle network improvements were recommended throughout the Borough of Downingtown to create safer connections to trails and transit, reducing reliance on personal vehicles.

Since stormwater runoff has the potential to negatively impact transportation when it accumulates on roadways and sidewalks, intersections were analyzed for stormwater runoff potential and prioritized for stormwater control recommendations.

Focusing on vehicular issues, the study analyzed four scenarios, as described in Figure 2.

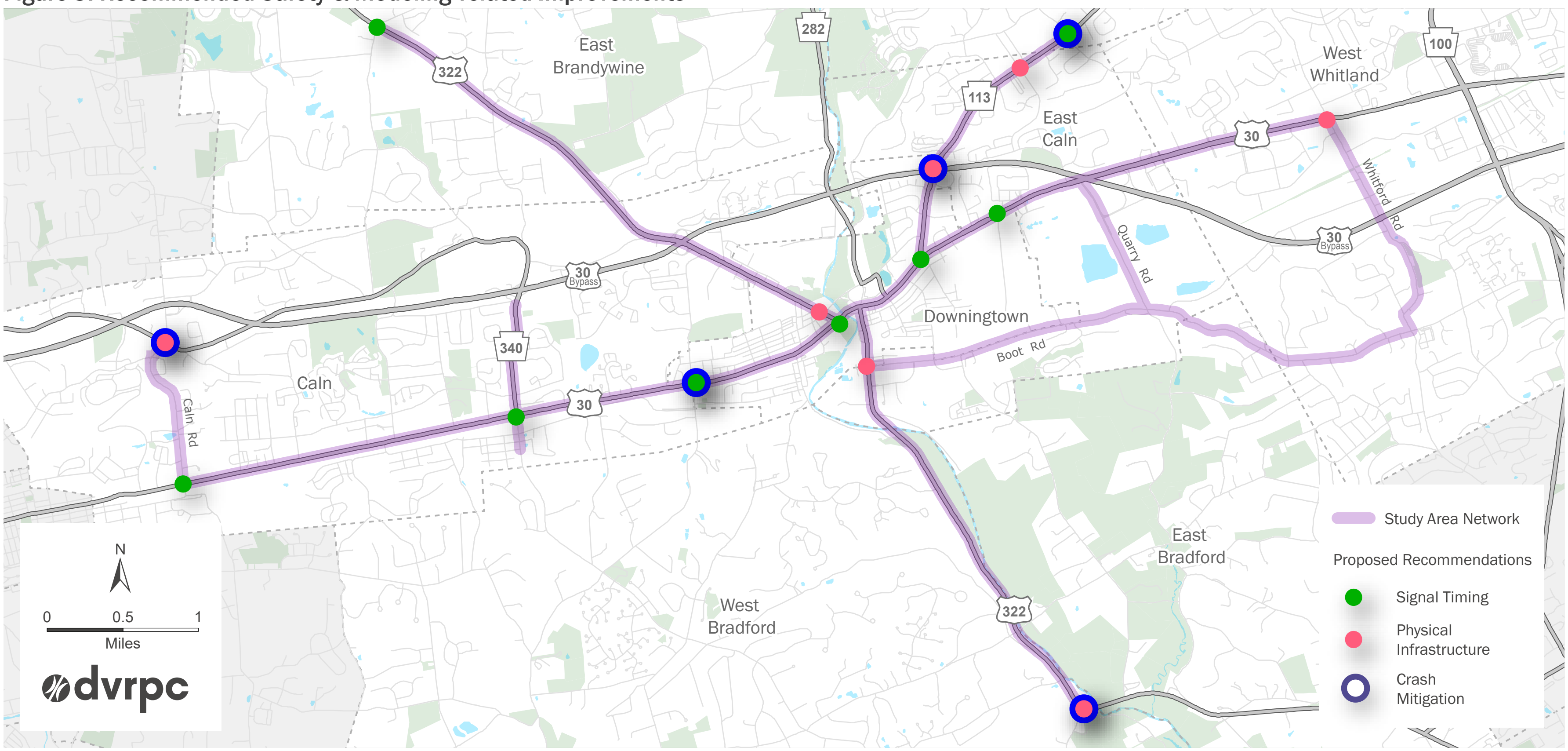
Since safety and congestion are of primary interest to the study's Technical Advisory Committee, the project team developed a set of criteria to identify intersections that experienced the most severe congestion and safety issues. Criteria included failing peak hour intersection LOS, substantial increase in vehicle delay between scenarios, and a high number of reported crash events within a five-year period. If any of the criteria were satisfied, the intersection was considered for improvements in the 2035 Build + Improvements traffic model.

Applying the criteria to the 29 study intersections, highlighted 15 focus intersections. Along with crash mitigation recommendations, the project team recommended signal timing or physical infrastructure improvements to address congestion issues at these 15 intersections, as described in Table 1 and shown in Figure 3

Table 1: Primary Recommendation Locations

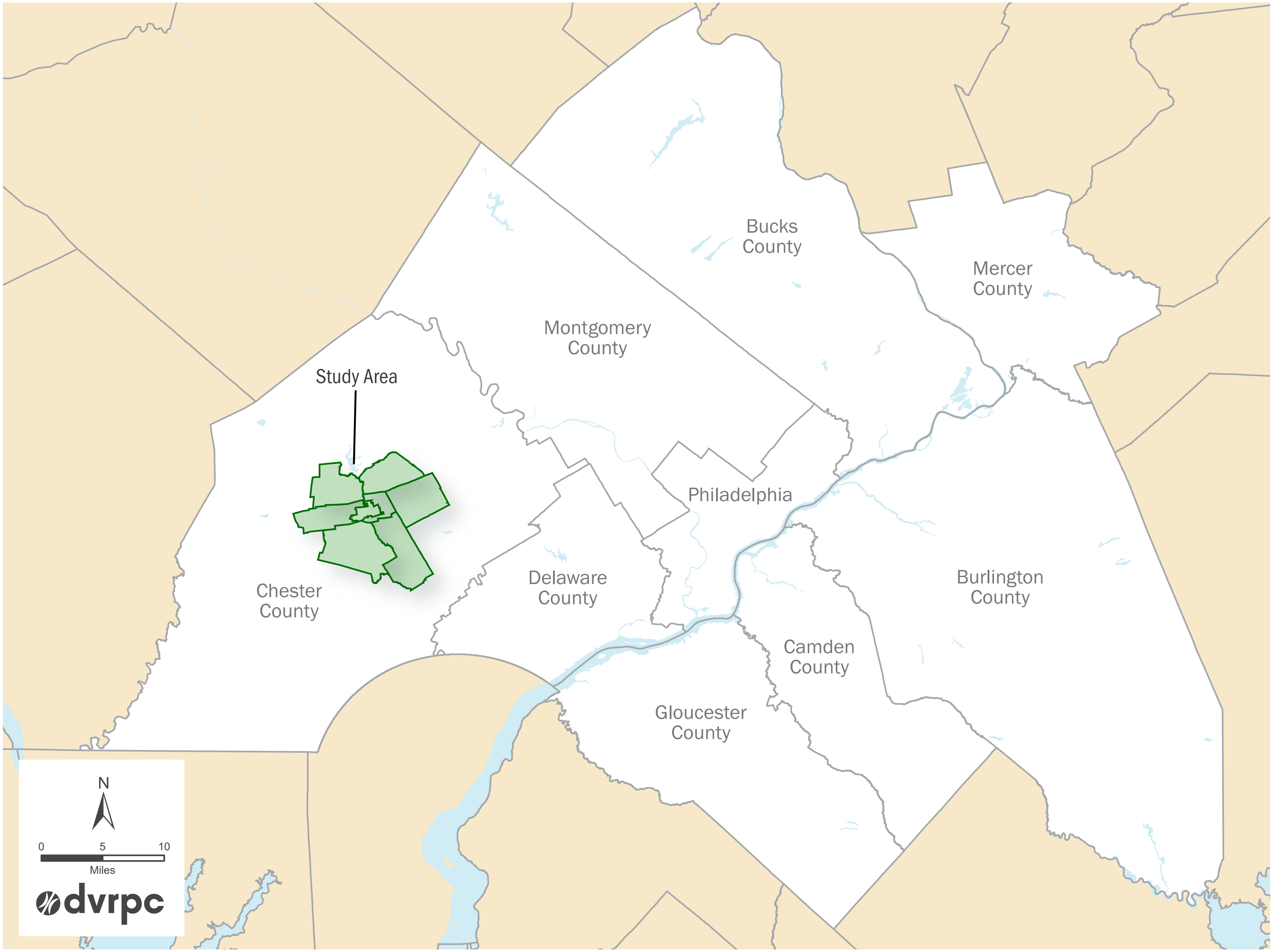
Signal Timing Recommendations	Physical Infrastructure Recommendations
US 30 Business & Caln Road	Manor Avenue & Pennsylvania Avenue
US 30 Business & Bondsville Road	US 322 & Boot Road
US 30 Business & Lloyd Avenue	US 322 & Sugars Bridge Road
US 322 & Hopewell Road	Uwchlan Avenue & Garris Road
US 30 Business & US 322	US 30 Business & US 30 Ramps
US 30 Business & Uwchlan Avenue	US 30 Business & Whitford Road
Uwchlan Avenue & Peck Road	Kings Highway & Caln Road
US 30 Business & Woodbine Road	–

Figure 3: Recommended Safety & Modeling-related Improvements



Source: DVRPC, 2020

Figure 4: Regional Setting



Source: DVRPC, 2020

CHAPTER 1

Introduction

The Borough of Downingtown and surrounding municipalities have experienced significant growth in recent years along with a corresponding increase in traffic congestion. Several large private developments are planned, which will create additional transportation challenges. Furthermore, the Downingtown Train Station is set to be relocated, which will impact mobility in the surrounding area.

At the request of the Chester County Planning Commission (CCPC), the Delaware Valley Regional Planning Commission (DVRPC) conducted a two-year study to evaluate current and future peak hour conditions on major roads in the Downingtown Area in an effort to identify critical locations for further analysis and support capital project development.

Study Objectives

Together with the CCPC and the project's Technical Advisory Committee, the project team developed three main objectives to guide this study:

- Identify and quantify areas of existing and future transportation bottlenecks within the Downingtown Area and Central Chester County;
- Quantify the impact of new development on traffic circulation and mobility; and
- Develop the analytical basis for improvements needed to establish a modern transportation system.

Regional Setting

Population and employment in Chester County are both projected to increase by over 28 percent by 2045, based on 2015 estimates. According to DVRPC's Long-Range Plan, *Connections 2045*, Chester County is expected to gain over 87,000 jobs, which is the largest forecasted absolute increase in DVRPC's nine county region.

From a transportation perspective, the Downingtown Area's location in Central Chester County makes it attractive to new developments. It is situated at the intersection of US 30 (including Business US 30) and US 322. It is served by SEPTA's Paoli/Thorndale Regional Rail line, with connections to Philadelphia, and by Amtrack's Keystone Line, connecting to New York, Lancaster, and Harrisburg.

The study area, shown in Figure 4 includes major roads in Downingtown Borough and the surrounding municipalities of East Brandywine, Caln, East Caln, West Bradford, Uwchlan, West Whiteland, and East Bradford. The analysis focused on those segments and intersections deemed critical by the steering committee, based on local knowledge of traffic issues and congestion data.

Planning Process

The Downingtown Area Transportation Study was conducted over the course of two years. In the first year of the study, the project scope was refined, study locations were selected, and data was collected. In the second year of the study, the traffic model was developed and used to test various alternatives. Qualitative multimodal recommendations were also made in Downingtown Borough and throughout the study area.

Technical Advisory Committee

The participation of stakeholders was essential to the completion of this study. The project Technical Advisory Committee (TAC) was formed in the first months of the study and guided the project team's efforts. The TAC was comprised of members from:

- Chester County Planning Commission (CCPC),
- Downingtown Borough,
- East Brandywine Township,
- Caln Township,
- West Bradford Township,
- East Bradford Township,
- East Caln Township,
- Uwchlan Township,
- West Whiteland Township,
- Southeastern Pennsylvania Transportation Authority (SEPTA),
- Transportation Management Association of Chester County (TMACC),
- Krapf Bus; and
- Pennsylvania Department of Transportation (PennDOT)

Public Meetings

This study held four public meetings. Two public meetings were held in October 2020 to discuss the project purpose and gather input on local priorities on which to focus analysis and recommendations. In May 2021, the project team hosted another set of two meetings to present study findings and recommendations to the public.

Guiding Principles

Selection of Study Locations

The study area extent, including Downingtown Borough and eight surrounding municipalities, was collaboratively selected by the project team and approved by the TAC. The traffic model network and 29 study intersections were selected by the project team as representative locations that would best capture the effects of the changes being analyzed.

Population & Employment Growth

The central Chester County area is projected to sustain population and employment growth in the coming years. The project team inventoried housing and business developments, as well as DVRPC board-adopted municipal level population forecasts. Both of these elements were incorporated into traffic simulation models.

Downingtown Train Station Relocation & Coatesville Regional Rail Extension

The planned Downingtown train station relocation was a major impetus for this study. Study intersection locations and a separate traffic modeling scenario were created to isolate the traffic effects of the station's anticipated move to roughly a half mile east of its current location as shown in Figure 8 found in the following chapter.

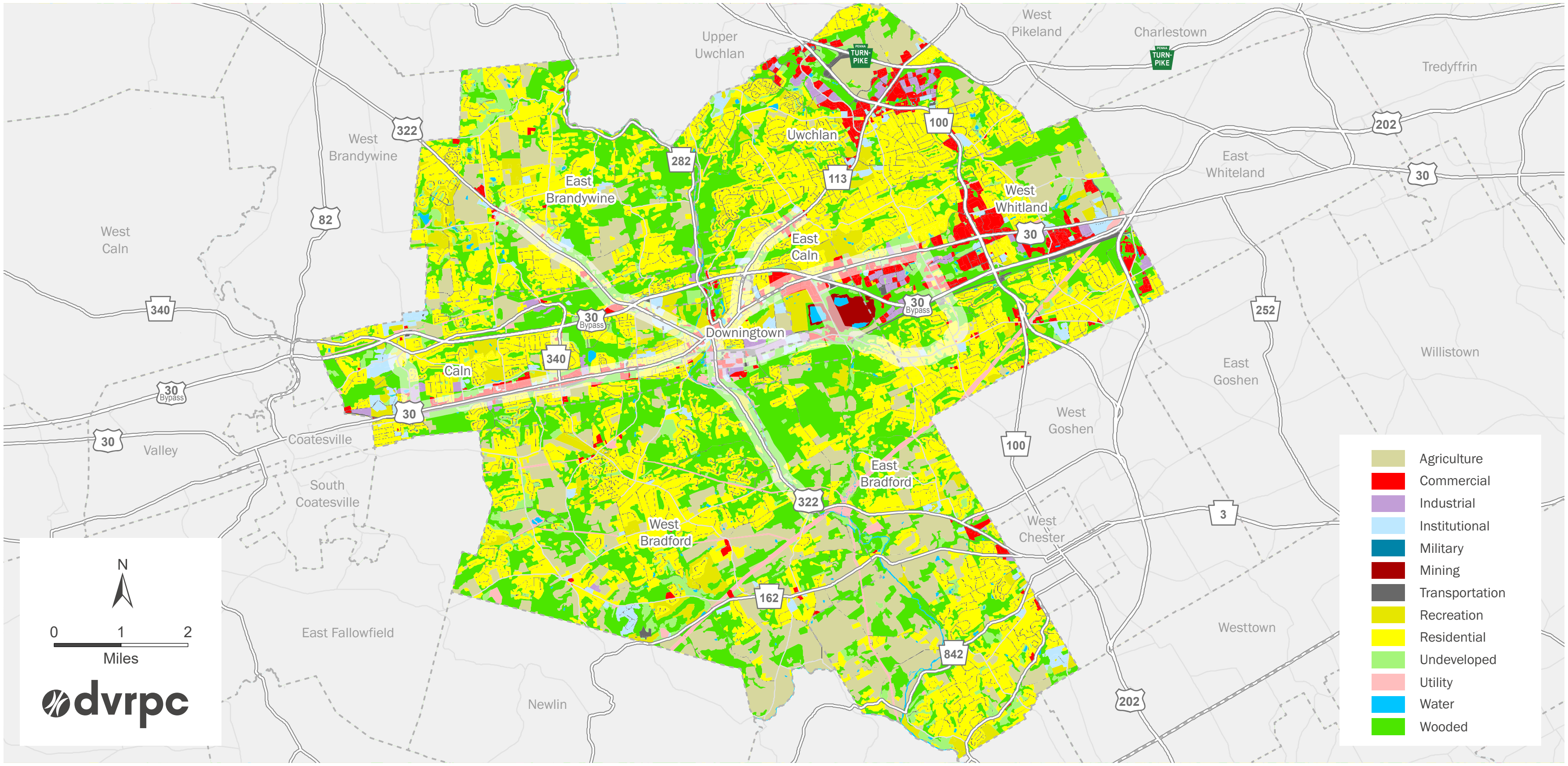
Another anticipated change to the transit network was the extension of service on the SEPTA Paoli/Thorndale line to Coatesville. This change was incorporated into future year traffic models so that its impact on the local road network would be accounted for at study intersections.

CHAPTER 2
Existing Conditions

Land Use and Environment

Understanding land use is critical to modeling transportation behavior, as residential, commercial, and other uses generate different numbers and types of trips. The land uses within the study area are shown in Figure 5. Much of the area around Downingtown is wooded or residential. Along the US 30 Business corridor, there are more commercial land uses. There are also large areas of commercial space in downtown Downingtown, and east in East Caln and West Whiteland Townships. There is also some mining and industrial space in this region. The new train station location provides an opportunity for more mixed-use development. The proposed River Station is a transit-oriented development that will provide both residential and commercial space in close proximity to the new station.

Figure 5: Land Use, 2015



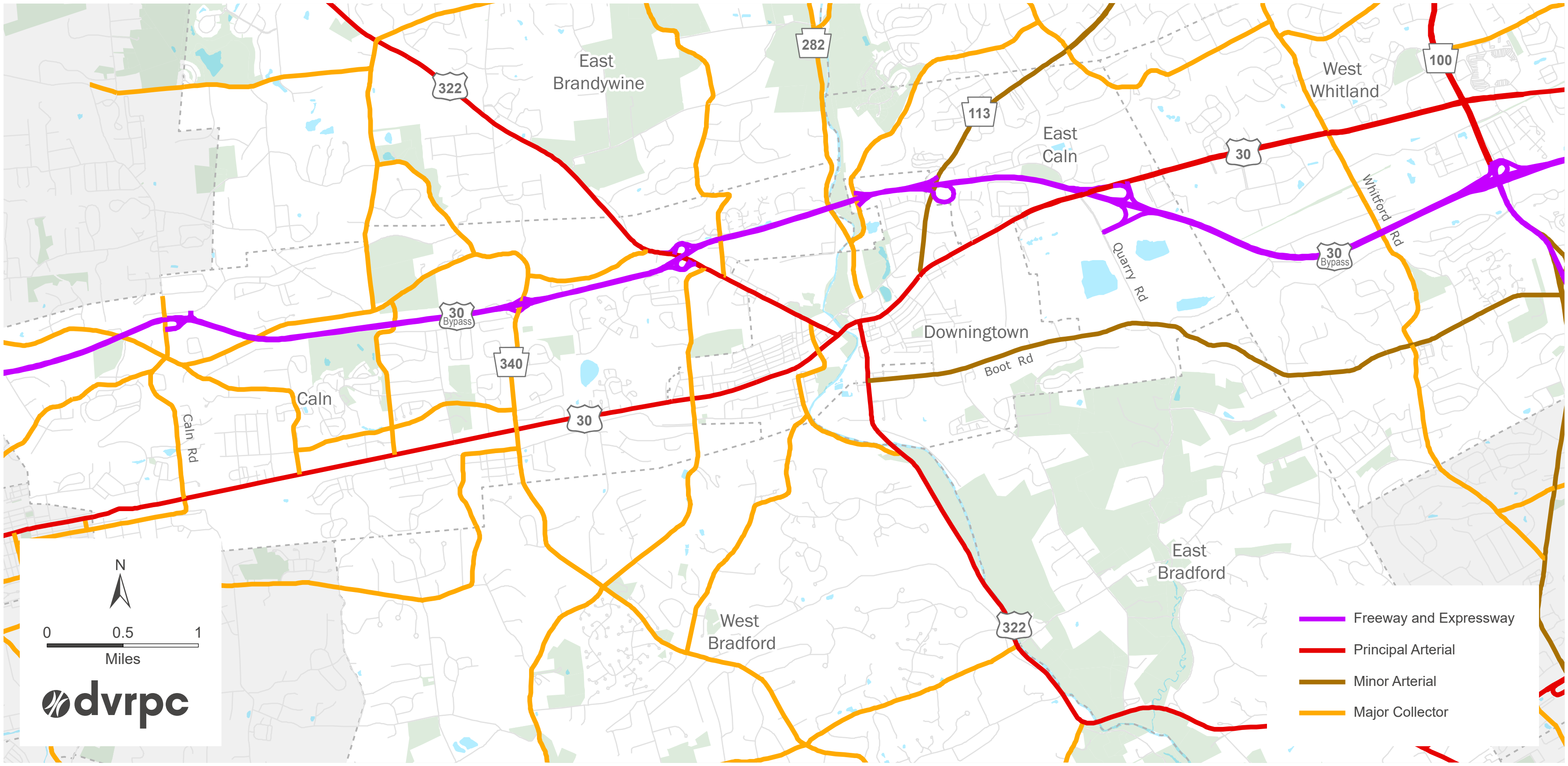
Source: DVRPC, 2015

Transportation Network & Context

Roadways

The modeled network for this study included major roadways and intersections in the Downingtown Area, with the assumption that they would be directly affected by traffic associated with the relocated Downingtown train station. The roadways and intersections are shown in Figure 6 and the intersections analyzed in the microsimulation modeling are listed in Appendix C.

Figure 6: Functional Classification



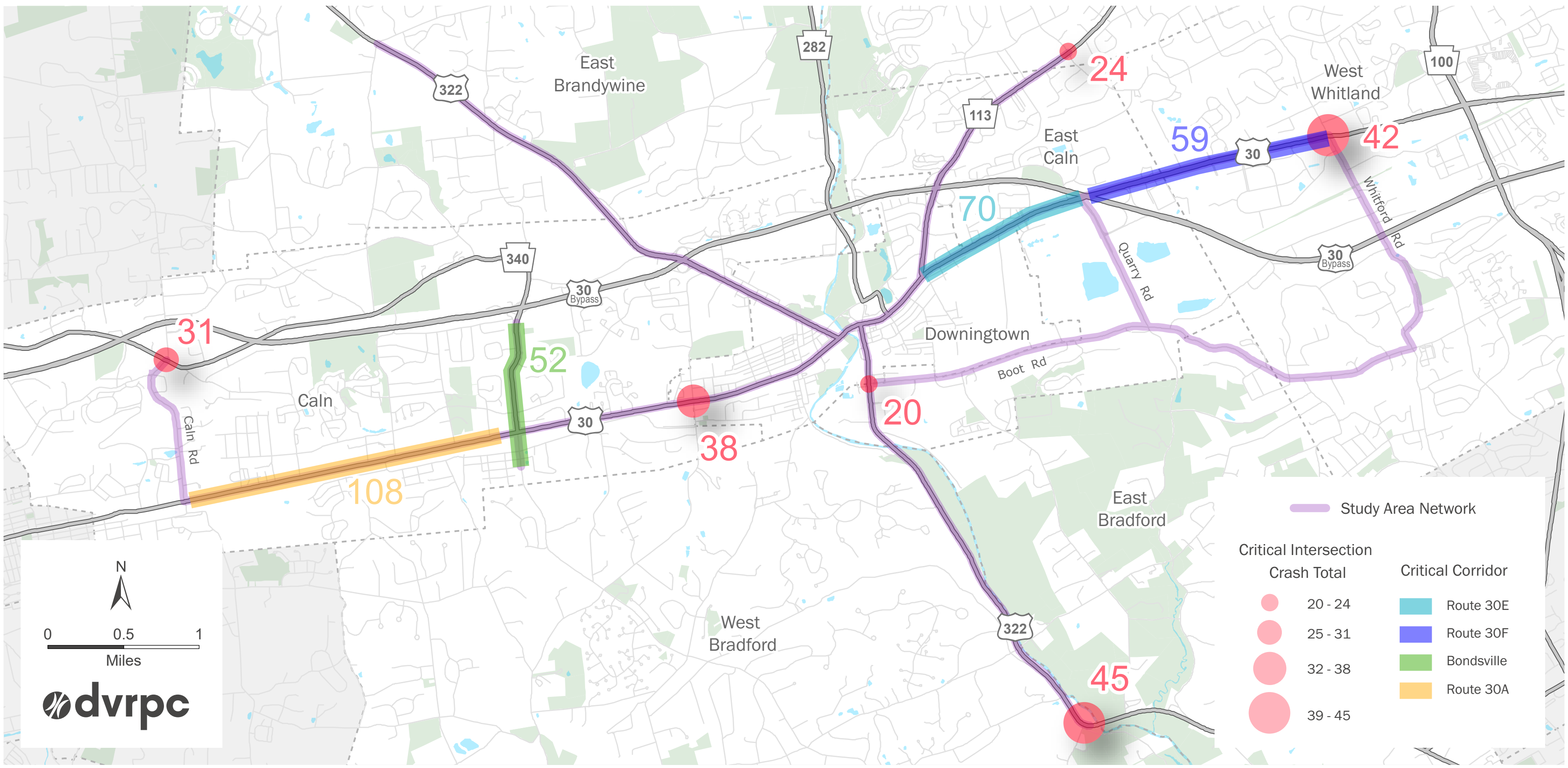
Source: PennDOT, 2021

Crash Analysis

The reported crashes within the study network between 2015 and 2019 were located and analyzed to identify intersections and road segments with high crash rates. The project team used this information to determine recommendations to enhance safety at these locations. A map with the reported crashes at study intersections and along corridor segments is shown in Figure 7. Most of the high-crash locations are outside of downtown Downingtown, which is expected since the downtown area has lower speeds and more narrow roadways, as well as pedestrian amenities which help calm traffic.

Table 2 shows the top four corridors based on crash rate (crashes per mile). The road segments with the highest crash rates were on the western and eastern ends of Route 30 Business as well as along Bondsville Road. There were several crashes involving pedestrians in these areas, indicating a critical need for safety improvements. The most frequent crash type on the three Route 30 Business segments was rear-end crashes. This could be due to queueing along the roadway during peak hours. The most frequent crash type along Bondsville Road was angle crashes, which is likely due to turning vehicles and may involve sight issues related to roadway curvature.

Figure 7: Crashes



Source: PennDOT, 2015–2019

Table 2: Critical Corridor Crashes

Red text indicates the highest value in a column

Corridor	Total Crashes	Crashes Per Mile Per Year	Most Frequent Crash Type			Crashes Involving Pedestrian	Crashes Involving Bicycle	% Crashes Involving Injury	Wet Crashes	Mid-Block Crashes
Route 30F	59	10.2	Rear-end/ Angle	21/21	36%	0	0	41%	14%	58%
Bondsville	52	10.4	Angle	19	37%	2	1	48%	17%	54%
Route 30A	108	11.6	Rear-end	50	46%	4	1	61%	22%	65%
Route 30E	70	14.0	Rear-end	33	47%	3	0	39%	36%	76%

Table 3: Critical Intersection Crashes

Red text indicates the highest value in a column

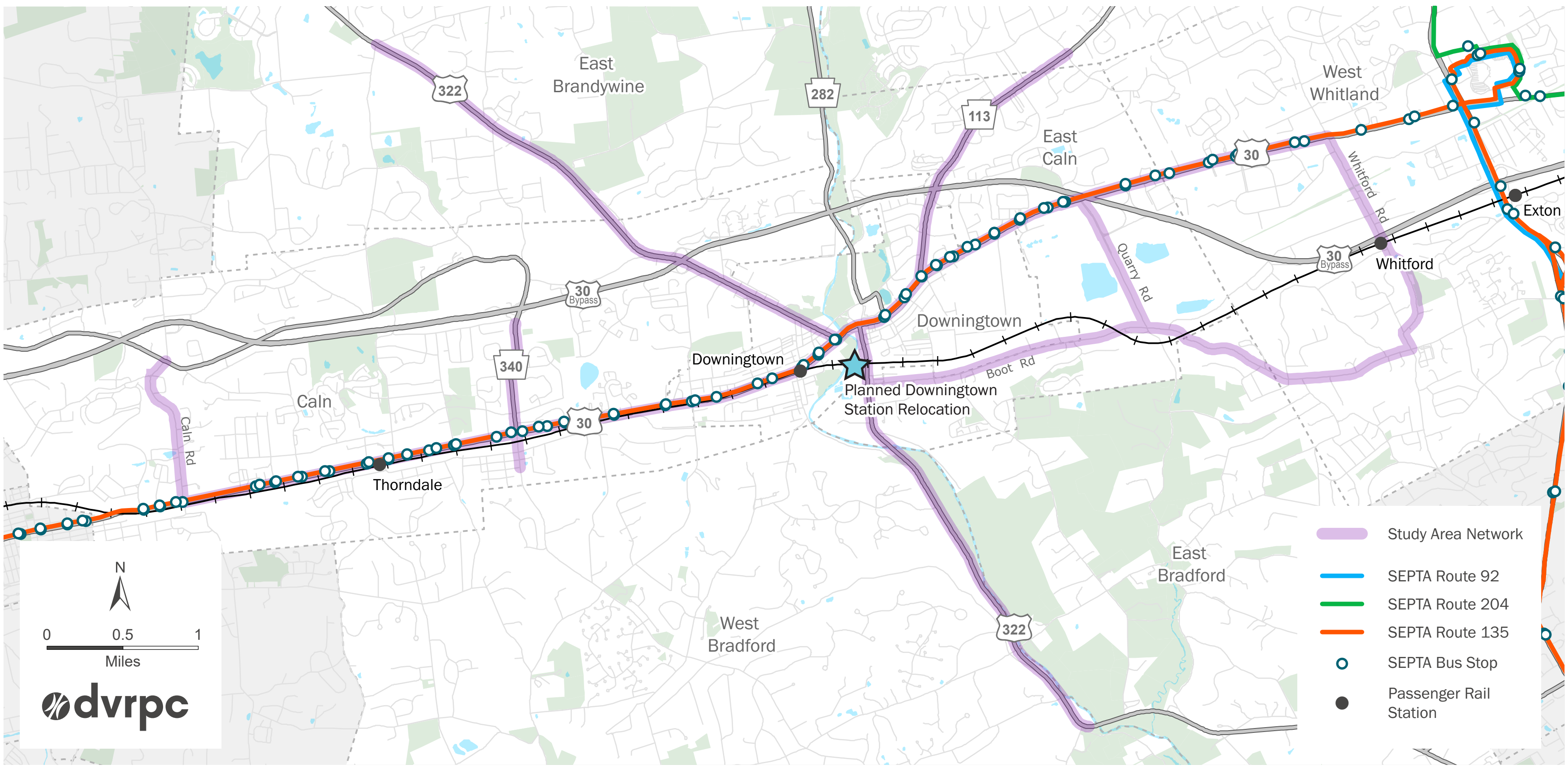
	Intersection	Total Crashes	Crashes per Year	Most Frequent Crash Type			Crashes Involving Pedestrian	Crashes Involving Bicycle	% Crashes Involving Injury	Wet Crashes
13	Downingtown Pike (US 322) & Sugars Bridge Rd	45	9.0	Rear-end	17	38%	1	0	44%	40%
11	US 30 BUS & Whitford Rd	42	8.4	Angle	24	57%	0	0	45%	29%
6	US 30 BUS & Lloyd Ave	38	7.6	Angle	25	66%	0	0	34%	8%
3	Caln Rd & Kings Hwy	31	6.2	Angle	19	61%	0	0	77%	3%
2	Peck Rd & Uwchlan Ave (PA 113)	24	4.8	Angle	13	54%	0	1	54%	13%
12	Brandywine Ave (US 322) & Boot Rd	20	4.0	Angle	8	40%	0	0	55%	25%

The intersections with the most crashes are shown in Table 3. The highest crash rates are found on the edges of the study network. These six intersections have experienced an average of four or more crashes per year based on the most recent data. The intersection of Downingtown Pike (US 322) and Sugars Bridge Road, shown at the bottom of the map in Figure 7, had the most toal crashes with 45 and the highest crash rate with an average of 9 crashes per year. One of the reported crashes during the five-year period involved a pedestrian and most of the crashes were rear-end crashes.

Transit

As shown in Figure 8, bus service in Downingtown is provided by SEPTA routes 92 and 204 (connecting to King of Prussia and Radnor, respectively). At the start of this study, the Krapf A route connected Downingtown to Coatesville and West Chester, and integrated with the Coatesville Link, a service provided by the Transportation Management Association of Chester County (TMACC). As of August 2021, a slightly modified version of the Krapf A route was replaced by the Route 135, operated by SEPTA.

Figure 8: Bus and Rail Transit

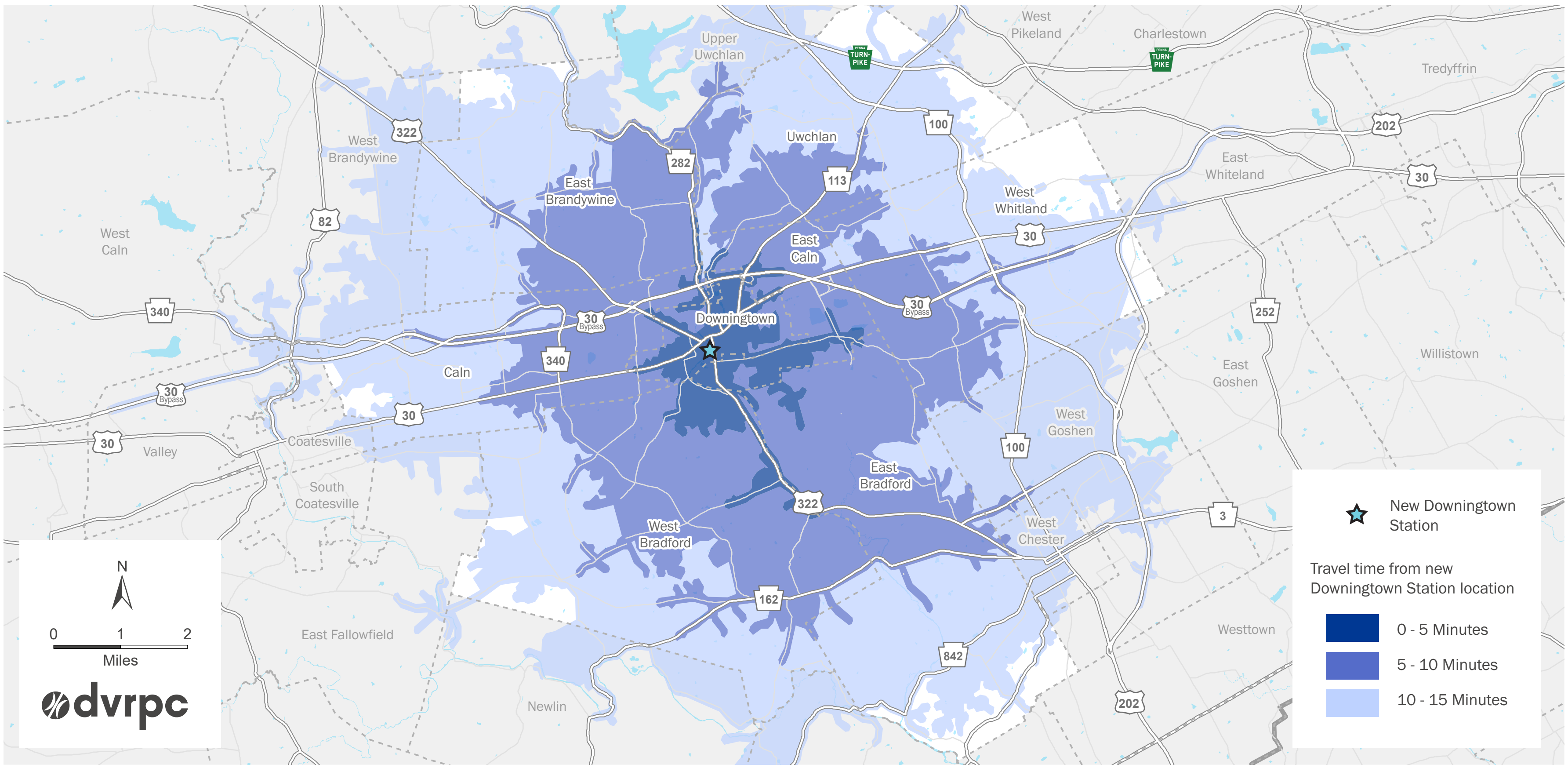


Source: SEPTA, 2021

In addition, Downingtown has two rail service providers: SEPTA's Paoli/Thorndale regional rail line and Amtrak's Keystone line. SEPTA is currently in the middle of a multi-year process to move the regional rail stop roughly half a mile eastward from its current location at W Lancaster Ave & Stuart Ave to its new location on Brandywine Ave just north of Boot Rd.

Figure 9 shows vehicular travel time to the new SEPTA regional rail station on Brandywine Ave near Boot Rd. It shows that the entirety of Downingtown is within a 5 minute car trip to the station, and the surrounding municipalities are all within 15 minutes or less (with portions of each being less than a 10-minute ride away).

Figure 9: Station Sheds

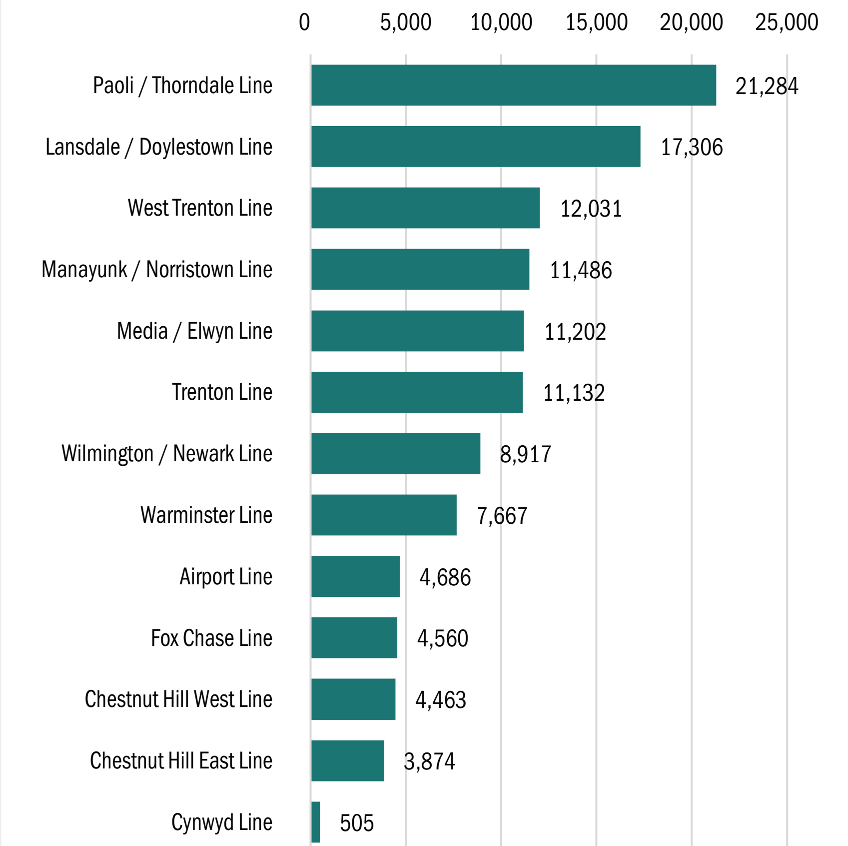


Source (New Station Location): SEPTA, 2021

Figure 10 shows that SEPTA's Paoli/Thorndale regional rail line had the highest ridership volume of all regional rail lines in 2020, with 21,284 riders on a typical weekday. This volume of ridership is greater than the five lowest-volume lines combined (Cynwyd, Chestnut Hill East, Chestnut Hill West, Fox Chase, and Airport lines, which have a combined ridership of 18,088).

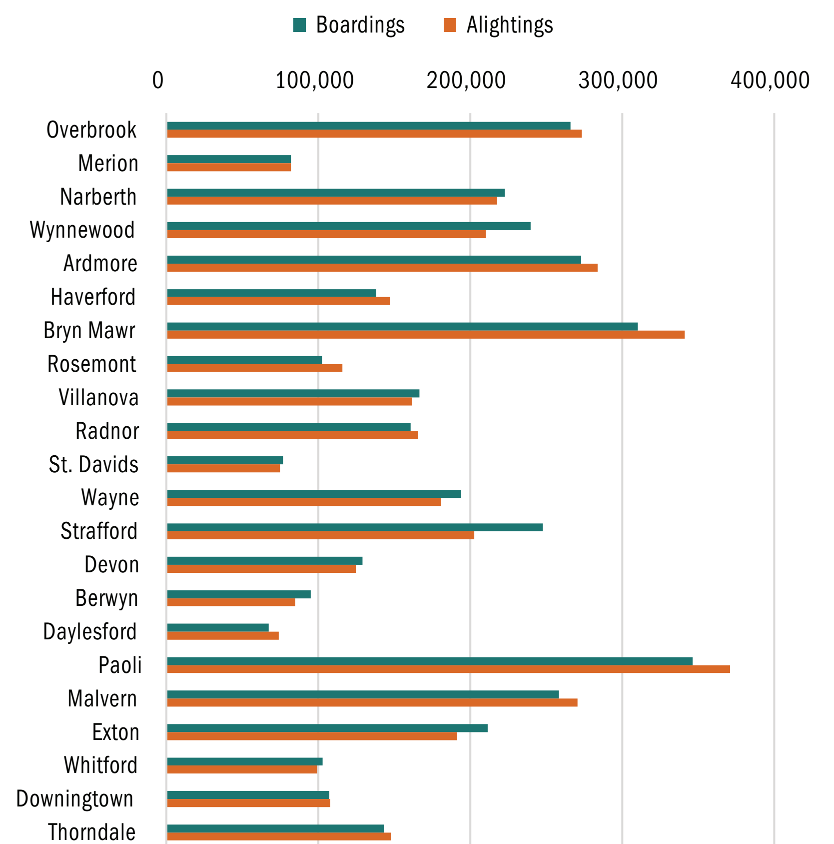
Figure 11 below highlights the total annual boardings and alightings at the stop level (2015) along the Paoli/Thorndale line. At the end of the line, the Whitford, Downingtown, and Thorndale stations all have roughly equal ridership. These three stations combined have almost the same ridership as the Paoli station, the single highest-volume station along the line.

Figure 10: Daily Average Ridership (Weekday)



Source: SEPTA, 2020

Figure 11: Average Boardings and Alights on Paoli/Thorndale Line

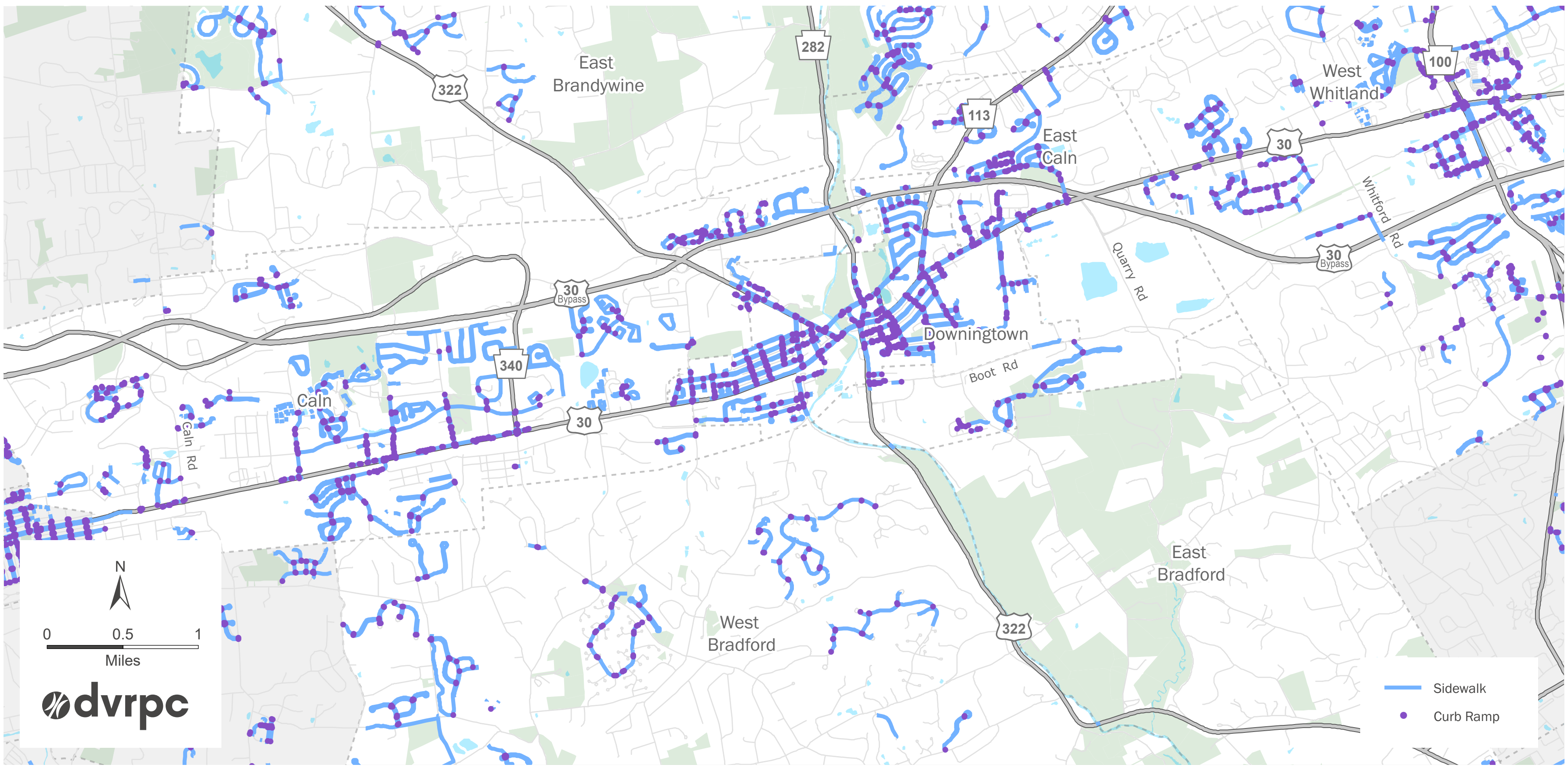


Source: SEPTA, 2015

Pedestrian Facilities

Downingtown is a pedestrian-friendly environment, with most streets in the borough featuring sidewalks on both sides of the street. Figure 12 below highlights the sidewalk coverage of each street in and around Downingtown, showing that many of the adjacent municipalities lack sidewalks and are therefore less conducive to walking than Downingtown borough.

Figure 12: Pedestrian Facilities

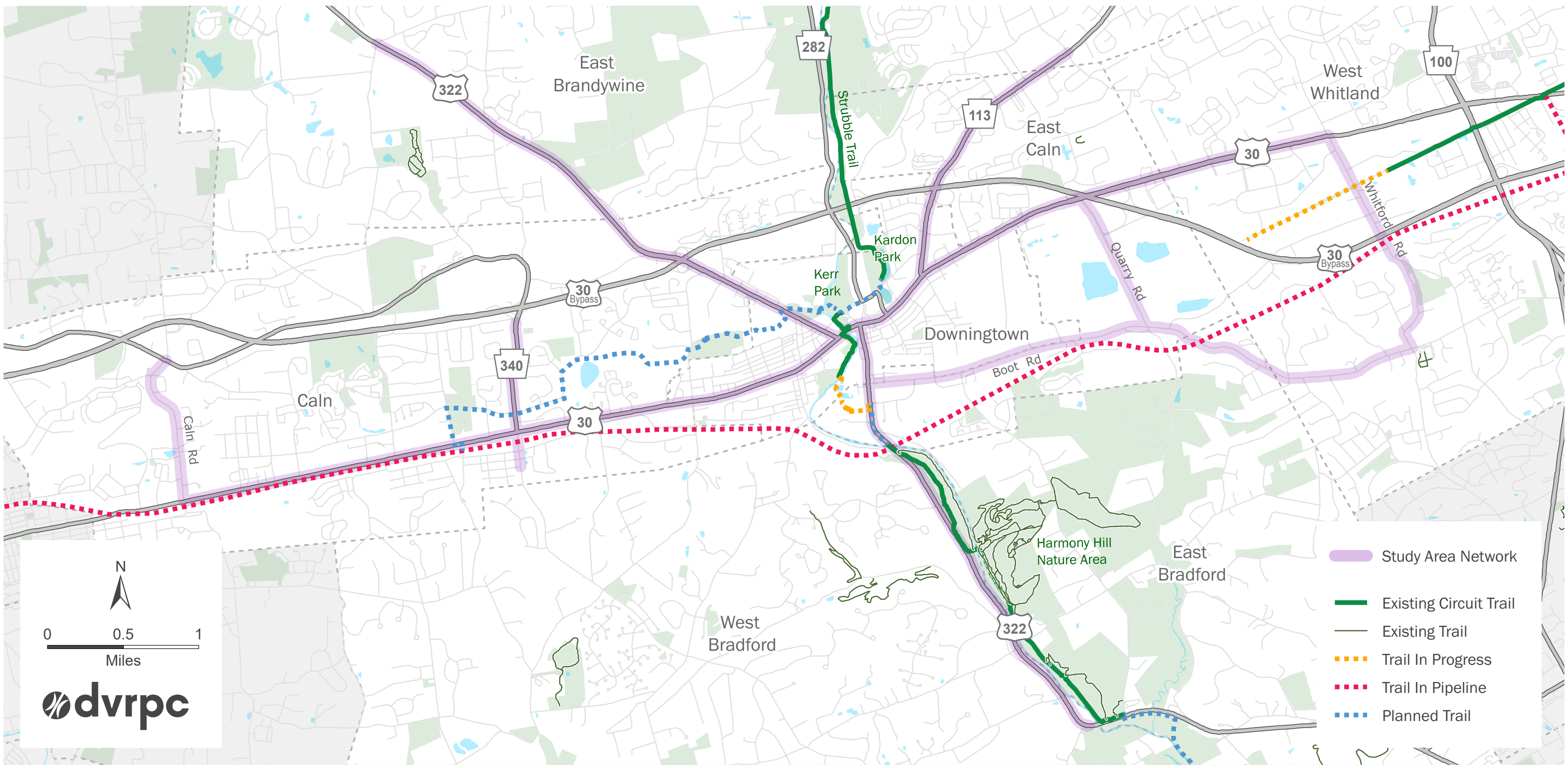


Source: DVRPC, 2020

Bicycle Facilities & Trails

Although Downingtown does not have any on-road bicycle facilities, Figure 13 below shows the existing trails as well as planned trail extensions. The existing trails connect northward from Kardon Park to Marsh Creek State Park, and southward from the East Branch Brandywine Trailhead into the Harmony Hill Nature Area.

Figure 13: Bicycle Facilities and Trails



Source: The Circuit Trails, Open Street Map, 2021

CHAPTER 3

Stormwater

Importance of Stormwater Management

The Downingtown Area lies within the Chester Valley, a west-to-east valley through the center of Chester County. The area's topography causes large portions of the valley to drain into the two branches of the Brandywine Creek. In the case of the Downingtown Area Transportation Study, the eight-municipality study area falls almost completely within the Brandywine Creek East Branch watershed. As developments and transportation projects lead to additional impervious surface area, the speed and amount of stormwater runoff increases. Large amounts of runoff pose a threat to stream health by eroding stream banks and carrying pollutants and excess sediment. It also has the potential to negatively impact the transportation network when runoff accumulates on roadways and sidewalks. Thus, it is important that transportation studies consider the impacts of added impervious surfaces, and that the locations of proposed stormwater control measures are prioritized with these effects in mind.

Screening Overview

This prioritization is intended to consider both the hydrogeologic and transportation setting of the site. The stormwater intersection score reflects the predicted severity of runoff and stormwater-related transportation issues. For example, intersections with substantial ponding of stormwater runoff and a high number of crashes occurring in wet conditions pose a safety risk and should be prioritized for improvement. The highest scoring stormwater study intersections and model network are shown in Figure 14 on page 18, and the scoring equation and full analysis is detailed in Appendix E.

Screening Results

Fifteen intersections within the study area were considered for stormwater analysis and intended to encompass the different geographic locations and land uses found within the study area. The stormwater score for each study intersection reflects the predicted severity of runoff and stormwater-related transportation issues.

The scores can range from zero to one, with one representing an intersection deemed to be most in need of stormwater control measures. The highest scoring intersections, and their respective scores, are shown in Figure 14 and are listed in Table 4 on page 19. A complete encapsulation of the scoring equation and a detailed table of results can be found in Appendix E. Chapter 5: Recommendations, includes stormwater mitigation techniques that can be implemented at these high scoring intersections to address ponding and related safety and transportation issues.

Figure 14: Stormwater Top Ten Scoring Intersections

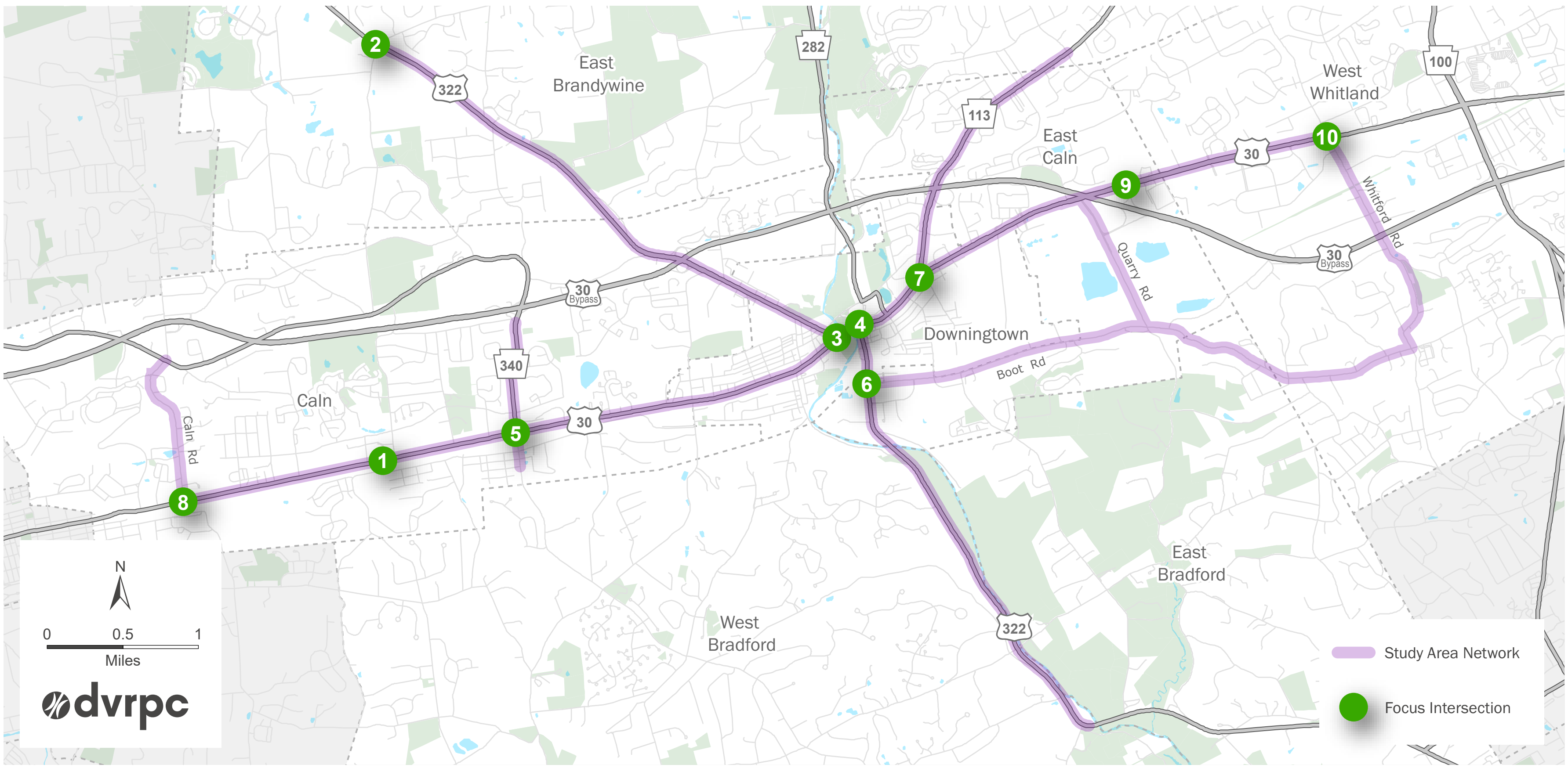


Table 4: Intersection Stormwater Scores

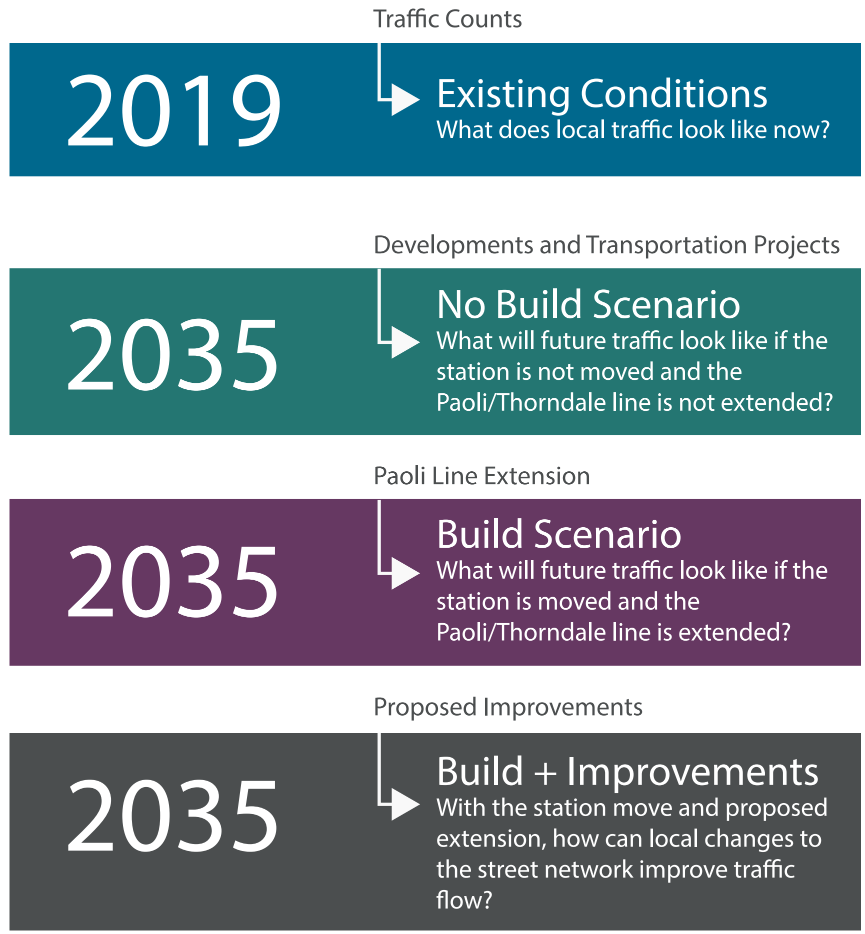
Stormwater Score Rank	Intersection Name	Stormwater Score
1	US 30 Business and S Bailey Rd	0.654
2	US 322 Horseshoe Pk and Hopewell Rd	0.651
3	US 30 Business and US 322 Manor Ave	0.594
4	US 30 Business and US 322 Brandywine Ave/Park Ln/Wallace Ave	0.575
5	US 30 Business and Bondsville/Marshallton Rd	0.574
6	US 322 Brandywine Ave and Boot Rd	0.572
7	US 30 Business and PA 113 Uwchlan Ave/ Whiteland Ave	0.540
8	US 30 Business and Caln Rd	0.534
9	US 30 Business and Exton Bypass WB Exit	0.530
10	US 30 Business and Whitford Rd	0.515

Traffic Modeling

Modeling Approach

Four scenarios, shown in Figure 15, were modeled using DVRPC's regional travel demand model and/or microsimulation. Each scenario was evaluated for Level of Service (LOS) and other performance measures to determine the impact of the proposed new developments, the Downingtown train station relocation, and the Paoli/Thorndale line extension to Coatesville and Parksburg. The Existing Conditions, No Build Scenario, and Build Scenario results discussed in this chapter, were used to identify areas in need of improvements, and develop congestion mitigation strategies. These strategies were applied to the Build + Improvements scenario, discussed in Chapter 5: Recommendations. Additional detail about the modeling approach can be found in Appendix A.

Figure 15: Modeling Diagram



LOS/Delay Definition Table

What LOS is:

Level of Service (LOS) is a transportation engineering method used to quantify motor vehicle traffic conditions. The Highway Capacity Manual uses letter grades, “A” through “F," to describe vehicle congestion and average delay by turning movement, intersection approach, or entire intersections, as outlined in Table 5 (Transportation Research Board 2010).

Agencies often base transportation and development decisions on their impact on LOS, with the intention of maintaining or improving the quality of life for residents and users of the local road network. However, traditional LOS does not paint the entire picture of mobility.

What LOS is not:

Although it uses letter grades, LOS results should not be read like a report card. The goal in traffic operations is not to achieve an LOS of A, but to create conditions that maintain stable traffic flow that is typically achieved within the LOS range of A to C. An entire network of intersections with LOS of A during peak hours often points to a system designed for more capacity than necessary.

The Bigger Picture:

Focusing solely on LOS centers the conversation around vehicle congestion, without considering relationships and conflicts with other modes and skewing recommendations away from designs that create truly complete streets. Transportation improvement projects should prioritize the movement of people and goods, not just the movement of vehicles.

A variety of methods exist for calculating an LOS-like measure for other modes, such as bikes, pedestrians, and transit, and for calculating combined Multimodal LOS (MMLOS) measures. However, it is difficult to quantify the quality of service for non-motorized modes, since the comfort, convenience, and safety of walking, biking, and using transit is often more subjective. Many of these methods require copious amounts of data that may not be reliably available or are not trusted to result in an apples-to-apples comparison between modes.

While this report will provide LOS results, it will also present ideas to support mobility for all road users. LOS should be considered as an important part of a larger picture of mobility.

Table 5: Levels of Service for Signalized and Unsignalized Intersections

LOS	Signalized Intersections Delay (seconds)	Unsignalized Intersections Delay (seconds)	Interpretation
A	≤10	0 - 10	Predictable and stable flow
B	> 10 - 20	> 10 - 15	
C	> 20 - 35	> 15 - 25	
D	> 35 - 55	> 25 - 35	Predictable but approaching unstable
E	> 55 - 80	> 35 - 50	Unstable and unpredictable
F	> 80	> 50	

Developments

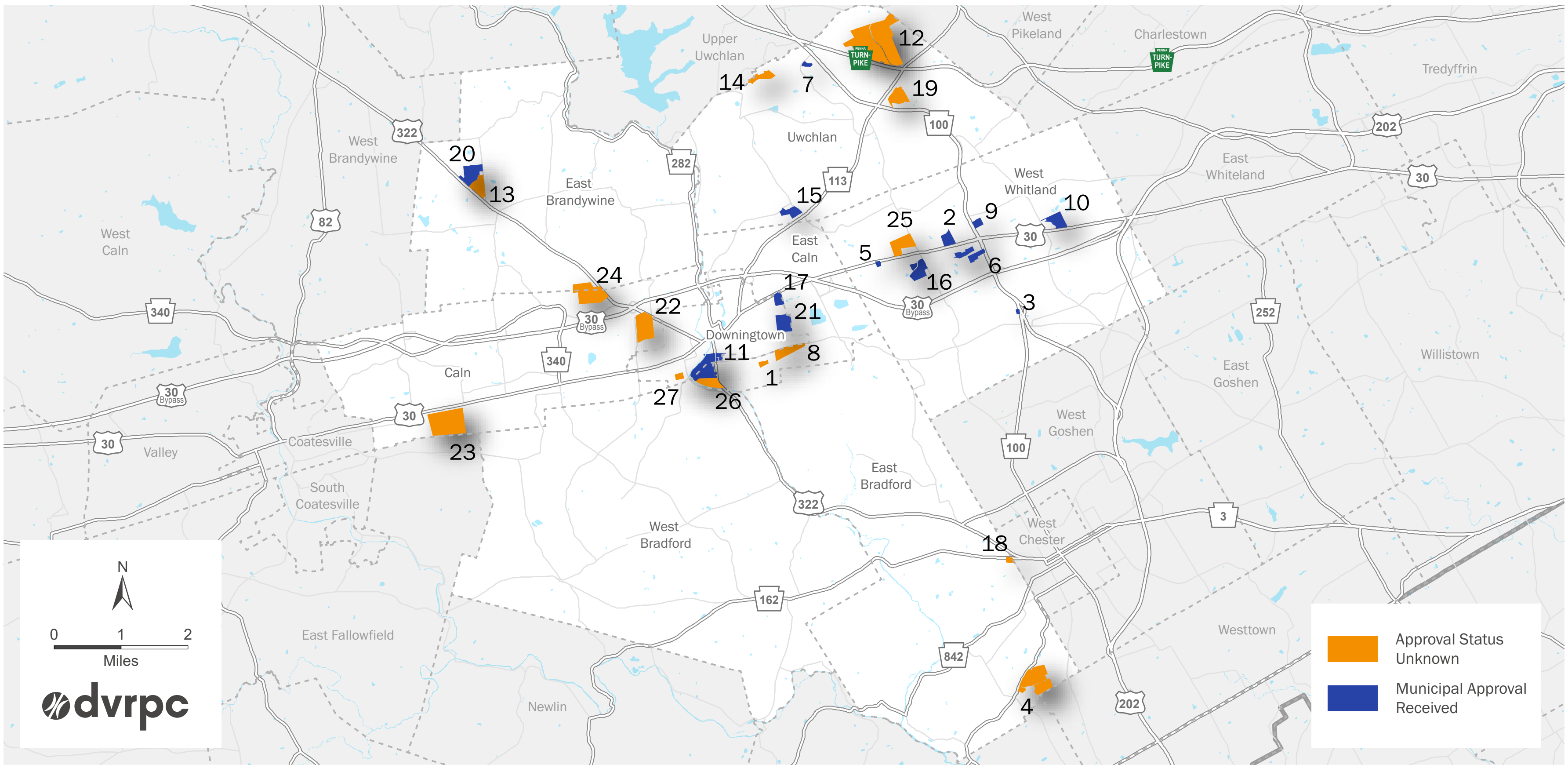
A number of significant developments within the study area have been approved in recent years. To most accurately model the future conditions, recent and upcoming developments with at least 50 residential units, or at least 50,000 sq. ft of commercial space, were included in the No Build, Build, and Build + Improvements scenarios.

These developments are listed in Table 6 on page 24 and shown in Figure 16. Overall, 24 known developments were included in the microsimulation. The most significant development is the River Station (#11 on the map below) which is a proposed mixed-use site adjacent to the new train station location.

Including this information in the future scenarios is important because residents, employees, and customers traveling to and from these new developments would likely use the new train station.

The land use category, number of residential units, and industrial or commercial square feet are used to determine how much new traffic will be added to local streets due to these new developments.

Figure 16: Developments



Source: Chester County, 2020

Table 6: Developments

No.	Plan Title	Description
1	901 Skelp Level Road	50,000 sq. ft warehouse
2	Keva Flats at Exton	240 apartments
3	Proposed Self Storage Facility, 1464 Pottstown Pike	88,000 sq. ft self-storage facility
4	Darlington Ridge at West Chester	106 townhomes
5	CSH Exton, LLC Oaklands Business Park (Lot 1)	99 beds assisted living facility
6	Main Street at Exton, L.P. Residential Development	410 apartments, 8,992 sq. ft retail
7	Eagleview Lot 58	50,000 sq. ft office
8	600 Boot Road	110 townhomes
9	Hanover Exton Square Residential Development	342 apartments
10	Lochiel Farm	140 townhomes
11	River Station	255 apartments, 14,200 sq. ft retail
12	Eagleview East	127 single-family detached, 273 townhomes, 441,000 sq. ft office, 80,000 sq. ft elementary school, 30,000 sq. ft retail
13	East Brandywine Center	65,400 sq. ft supermarket, 4,600 sq. ft retail
14	Eagleview Lot 24	117 senior apartments, 84 beds assisted living facility
15	Uwchlan Hills Elementary School	81,969 sq. ft elementary school
16	Parkview at Oaklands	276 apartments
17	Lot #1 - Woodbine Road	229 apartments
18	West Chester Crossing	56 townhomes
19	101 Gordon Drive	183,717 sq. ft warehouse
20	Appleview	160 townhomes
21	East Village	96 townhomes, 89 single-family detached, 40 apartments
22	Lloyd Farm Development	92 senior apartments, 103 single-family detached
23	Hills at Thorndale Woods	87 single-family detached, 175 townhomes
24	Dwell at Caln	160 townhomes, 240 apartments
25	Waterloo Reserve	86 townhomes
26	5th-6th Grade Center	1200 students
27	236-272 Prospect Ave.	65 townhomes

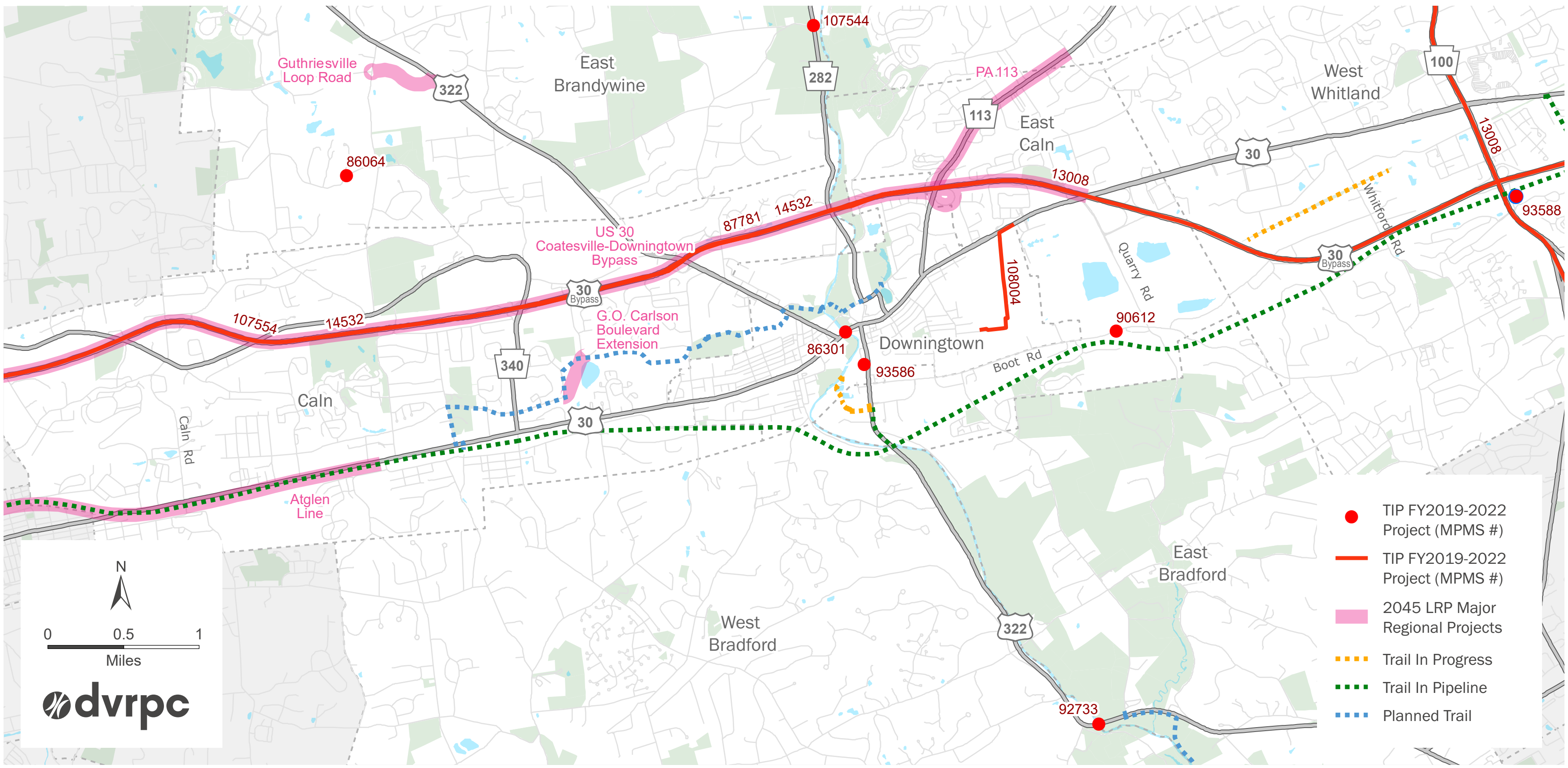
Existing and Planned Roadway Improvements

The new train station is one of many proposed transportation improvements in the study area with the goal of improving traffic flow, safety, and transportation choices. Proposed transportation projects within the study area are shown in Figure 17. The map includes projects listed in the Pennsylvania Transportation Improvement Program (TIP), and their corresponding PennDOT Multimodal Project Management System (MPMS) tracking number. It also highlights major regional projects included in DVRPC's Long Range Plan (LRP), Connections 2045.

The US Route 30 Coatesville-Downingtown Bypass project aims to reduce congestion, accommodate planned growth, improve facility deficiencies, and improve system connectivity. The interchange improvements at the Route 82 and US Route 30 interchange include adjusting ramp geometry to lengthen acceleration and deceleration lanes, as well as widen tight turning radii. Additionally, several bridge reconstruction projects are proposed in the area.

Together with the new train station, these transportation improvements will help provide safe and efficient travel for the Downingtown Area. Figure 17 shows the proposed transportation projects that were incorporated into

Figure 17: Existing and Planned improvements



Source: The Circuit Trails, 2021

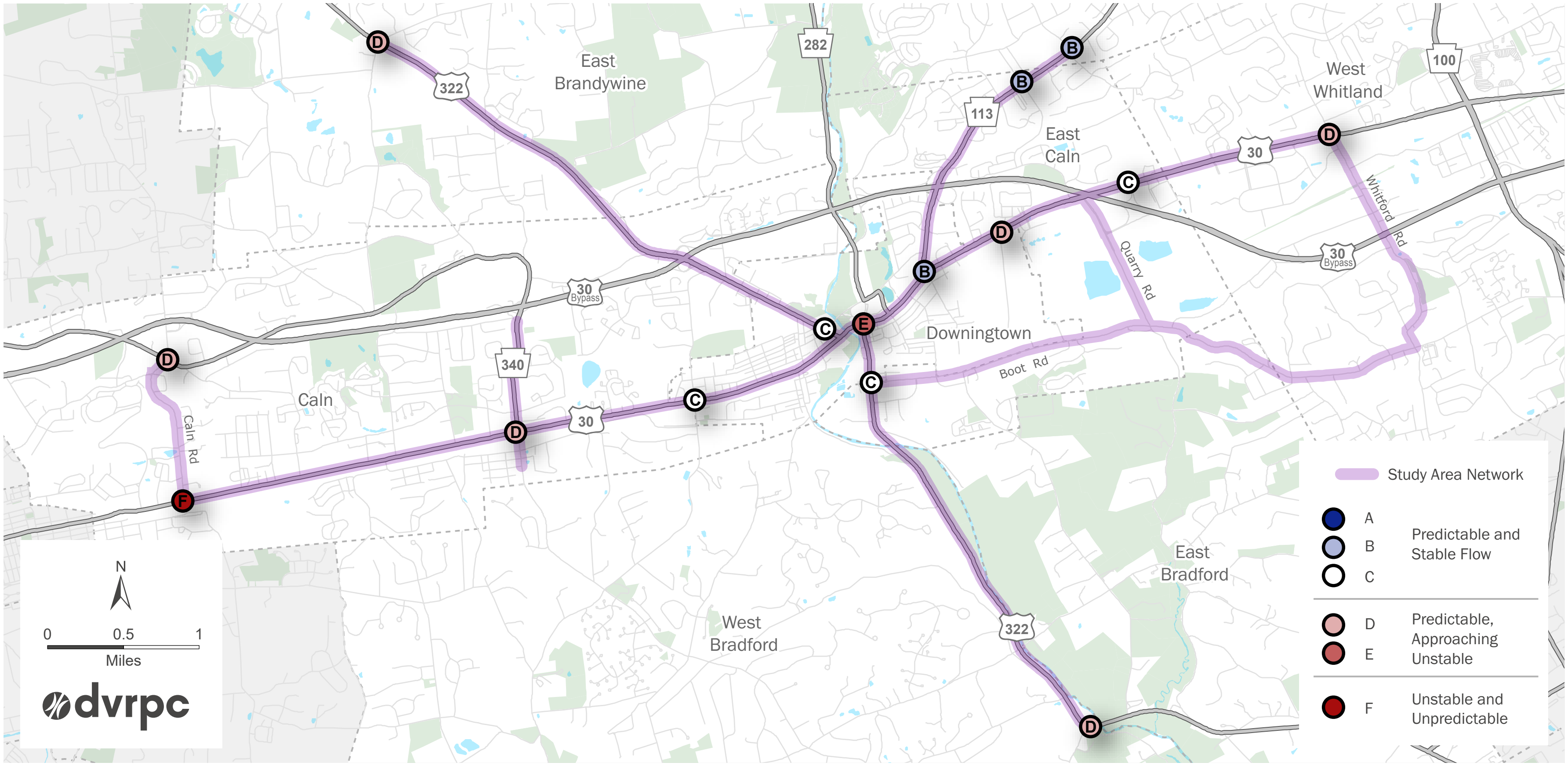
the future modeling scenarios, along with new developments, to better understand how traffic is expected to operate in the future.

Changes Between Scenarios

Each study intersection was evaluated and compared based on delay and LOS under each modeling scenario during the AM and PM peak hours. All modeling results are shown in Appendices A-C.

Under the Existing Conditions shown in Figure 18, the intersection of US 30 Business and Caln Road operates under failing conditions during the AM peak hour and LOS E during the PM peak hour. During both peak hours, the intersection of US 30 Business and US 322 operates at LOS E.

Figure 18: AM Peak Hour Level of Service — Existing Conditions



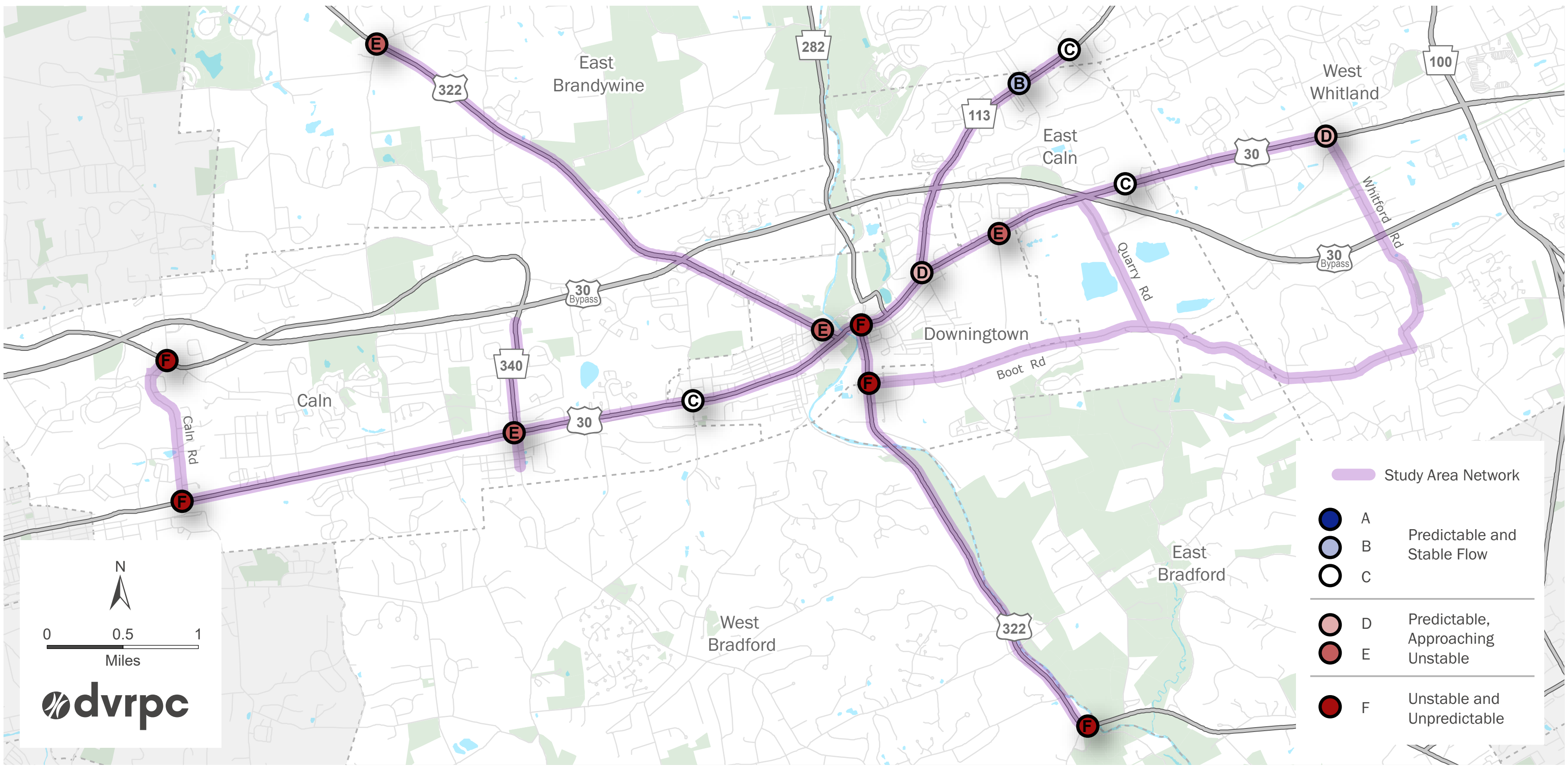
Source: DVRPC, 2020

In the No Build scenario, including proposed developments and transportation projects, several intersections are expected to experience increased delay compared to the existing conditions. During the AM peak hour, six intersections increase by 45 seconds or more per vehicle. These include:

- US 30 Business & Caln Road;
- US 30 Business & Lloyd Avenue;
- US 30 Business & US 322;
- Manor Avenue & Pennsylvania Avenue;
- US 322 & Boot Road; and
- Kings Highway & Caln Road.

During the PM peak hour, the intersections of Manor Avenue & Pennsylvania Avenue and US 30 Business & the US 30 ramps increase in delay by 45 seconds or more per vehicle.

Figure 19: AM Peak Hour Level of Service — No Build

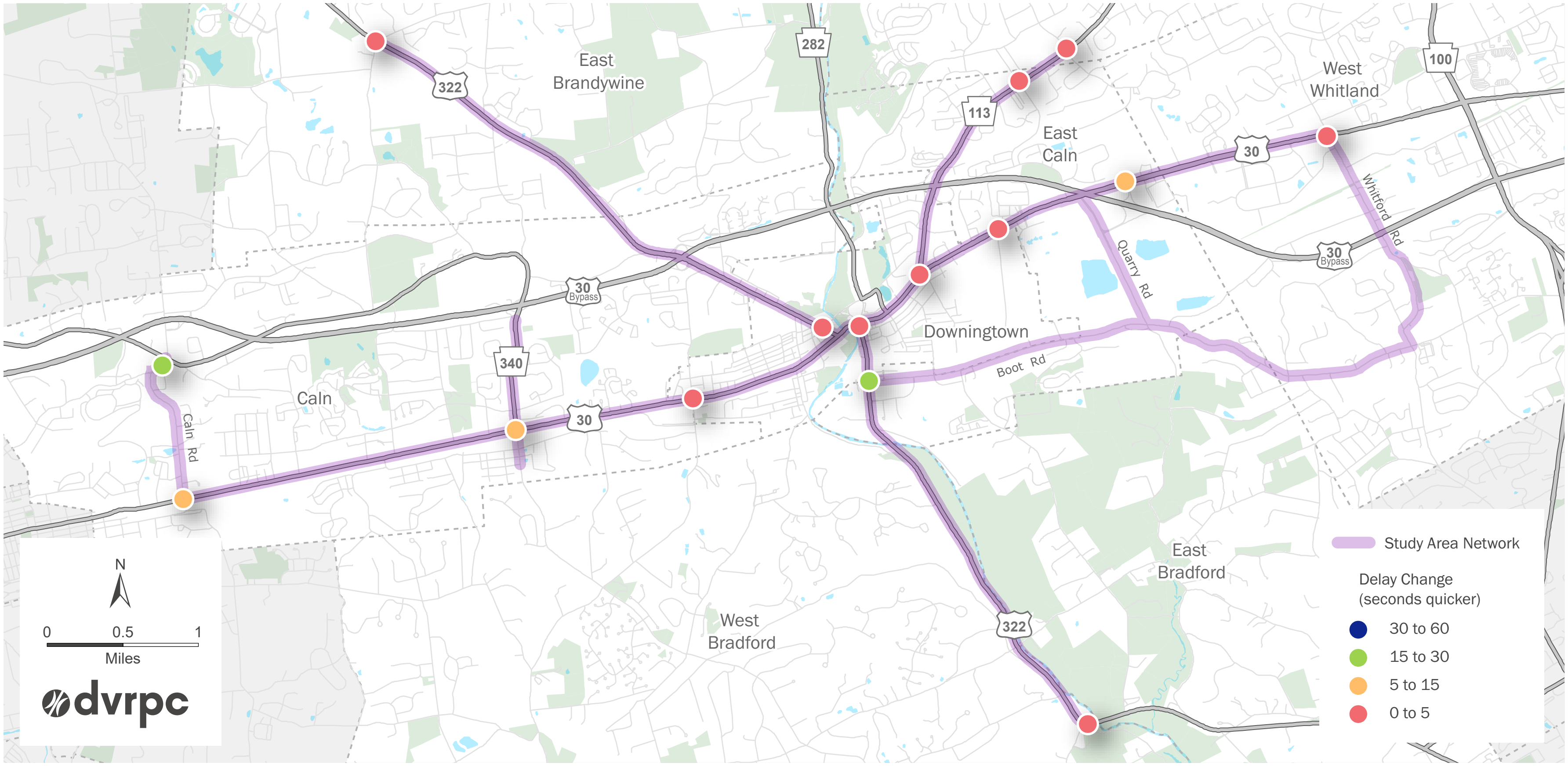


Source: DVRPC, 2020

The Build scenario includes the same future growth, developments, and transportation projects as the No Build scenario, as well as the new train station. Incorporating the new station and its associated traffic increases delay at some intersections and improves delay at others. Figure 20 highlights the change in vehicle delay at study intersections between the No Build and Build scenarios. The red circles indicate that the new train station is expected to have a minimal impact on delay at most study area intersections. However, at some intersections, the new train station is expected to improve traffic conditions by decreasing intersection delay.

Intersections that decrease in average delay significantly during the AM peak hour include US 322 & Boot Road and Kings Highway & Caln Road. During the PM peak hour, most intersections experience negligible change in delay.

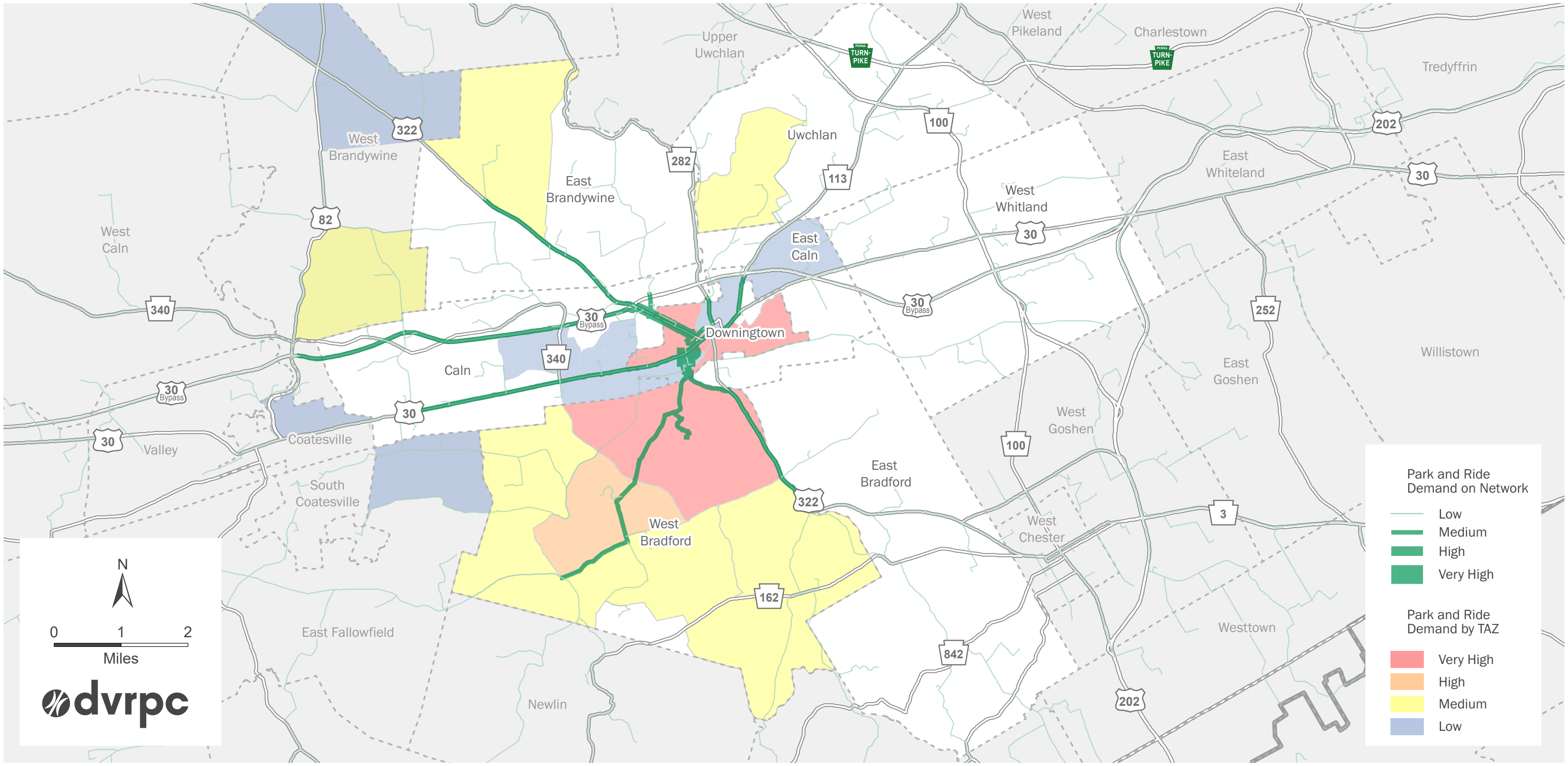
Figure 20: AM Delay Change — No Build Compared to Build



Impact to the Downingtown Train Station

Figure 21 shows the modeled park and ride catchments for the Downingtown Station under the 2035 No Build Scenario. Red and orange highlight areas where large portions of the modeled park and ride demand is coming from. The majority of demand comes from west of the station.

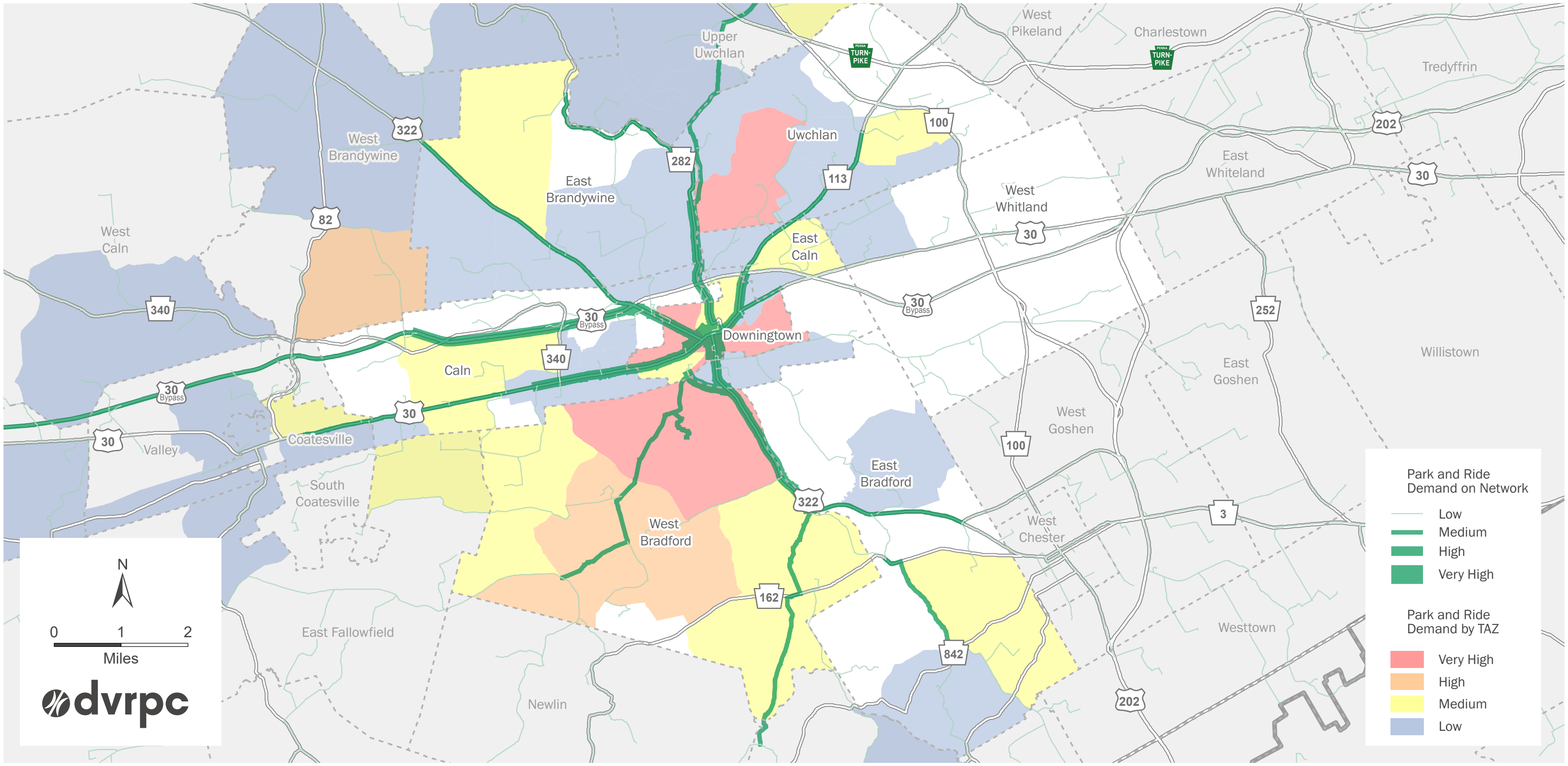
Figure 21: 2035 No Build Modeled Park and Ride Catchment Travel Analysis Zone (TAZ) Demand



Source: DVRPC, 2020

Figure 22 shows the modeled park and ride catchments for the Downingtown Station under the 2035 Build Scenario which includes the station relocation. The combination of increased lot capacity and increased road capacity on the approaches to the station lead to an expansion of the catchment and increasing demand from zones already using the Downingtown Station Park and Ride. Essentially, the new park and ride location is expected to attract more passengers and draw from a larger geographic area. Consistent with expectations regarding traveler behavior, new demand comes primarily from the North, West, and South. Travelers to the East of the station continue to prefer traveling in the in-bound direction, towards Philadelphia, to find their park and ride spaces.

Figure 22: 2035 Build Modeled Park and Ride Catchment TAZ Demand

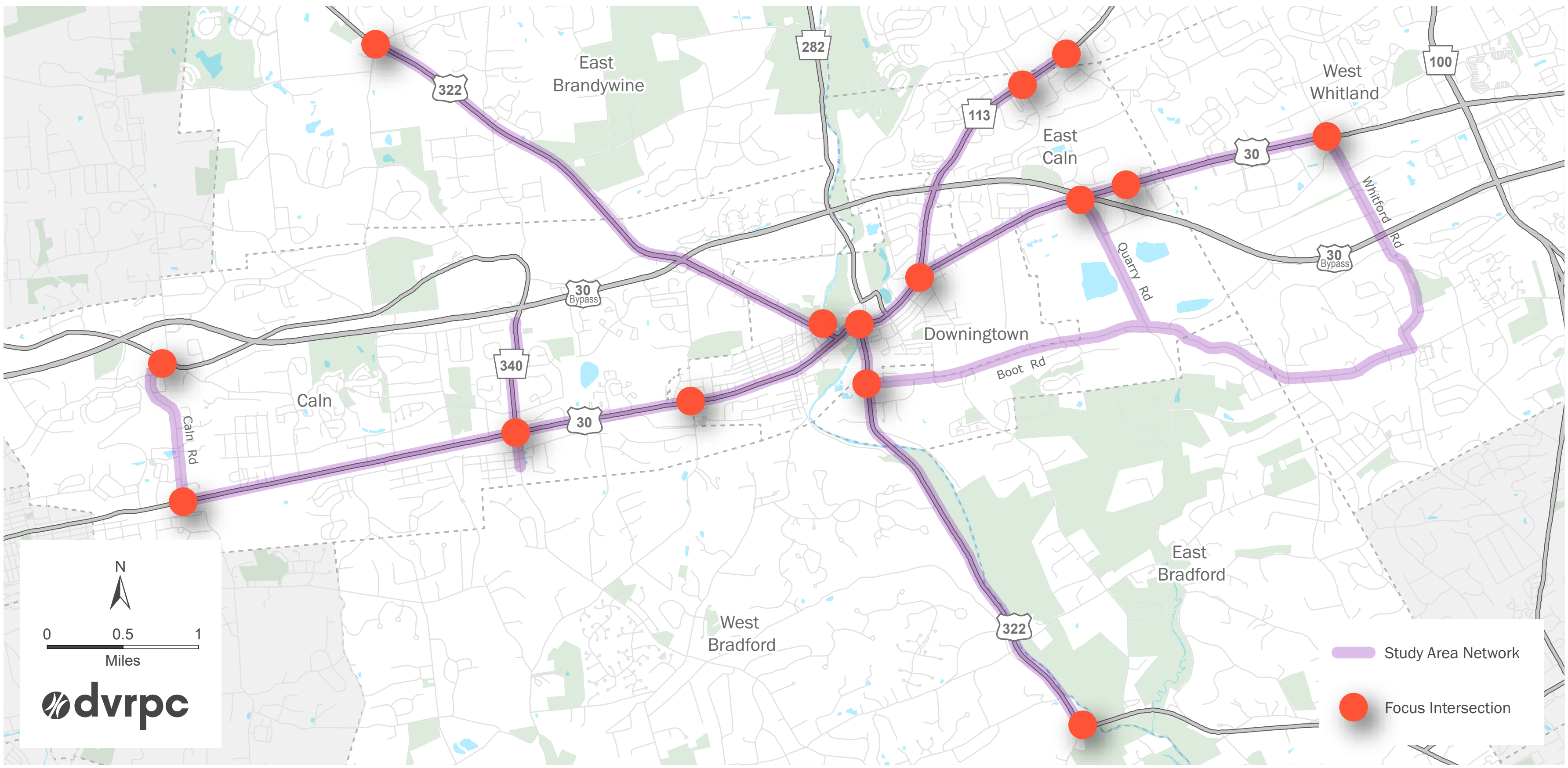


Source: DVRPC, 2020

Focus Intersections

After the 2035 Build model was complete, it became apparent that certain study intersections were more in need of improvements than others. The project team developed a set of criteria to identify intersections that experienced the most severe congestion and safety issues. If any of the criteria were satisfied, the intersection was considered for improvements in the 2035 Build + Improvements traffic model. The criteria are detailed in Table 7 on page 32. Applying the criteria to the 29 study intersections, highlighted 15 focus intersections. Six of these intersections are located within Downingtown Borough, three in Caln Township, two in East Caln Township, and one in each of West Bradford Township, East Brandywine Township, West Whiteland Township, and Uwchlan Township. A detailed table showing the results of the selection criteria is available in Appendix B.

Figure 23: Focus Intersections



Source: DVRPC, 2020

Table 7: Criteria for Intersections

Intersection experiences LOS E or F in AM/PM No Build or Build Scenario
Intersection experiences delay increase of over 15 seconds/vehicle between AM/PM existing to No Build Scenario
Intersection experiences delay increase of over 15 seconds/vehicle between AM/PM No Build to Build Scenario
Twenty or more crash events reported at intersection within five-year study period, 2014–2018

CHAPTER 5

Recommendations

This chapter outlines the project team's recommendations for improvements to the vehicular roadway network, the bicycle network, and to stormwater infrastructure. The recommendations in this chapter, including proposed designs, are conceptual and require engineering design and feasibility analysis. Actual authority for carrying out any planning proposals rest with the governing bodies of the states or local governments that have the primary responsibility to own, manage or maintain the roadways.

Congestion and Crash Mitigation Improvements

Process

Improvements were modeled and recommended at each of the critical intersections in order to mitigate congestion associated with the station move and to increase safety. These improvements, along with the planned projects included in the Build scenario, made up the Build + Improvements Scenario. Recommendations were made on a case-by-case basis, prioritizing low-cost improvements. Where possible, changes to signal timing only were recommended. In cases where congestion was more severe, recommendations included physical adjustments to existing infrastructure. While these physical improvements are associated with higher costs, the future models show that they are necessary to decrease delay.

Proposed Recommendations

Signal Timing Recommendations

Traffic signal timing adjustments are recommended at the following intersections. This means that seconds of green time allocated to certain signal phases can be optimized. These changes do not require physical infrastructure adjustments. The existing and proposed signal timings can be found in Appendix C in the Synchro reports.

- US 30 Business & Caln Road;
- US 30 Business & Bondsville Road;
- US 30 Business & Lloyd Avenue;
- US 322 & Hopewell Road;
- US 30 Business & US 322;
- US 30 Business & Uwchlan Avenue;
- Uwchlan Avenue & Peck Road; and
- US 30 Business & Woodbine Road.

These intersections are all visible in Figure 24.

Physical Infrastructure Recommendations

The following intersections' congestion could not be improved beyond failure with signal timing adjustments alone. Therefore, physical infrastructure adjustments were recommended. These changes are reflected in the Build + Improvements Scenario Synchro reports in Appendix C. A selection of changes are also shown as diagrams in Appendix D.

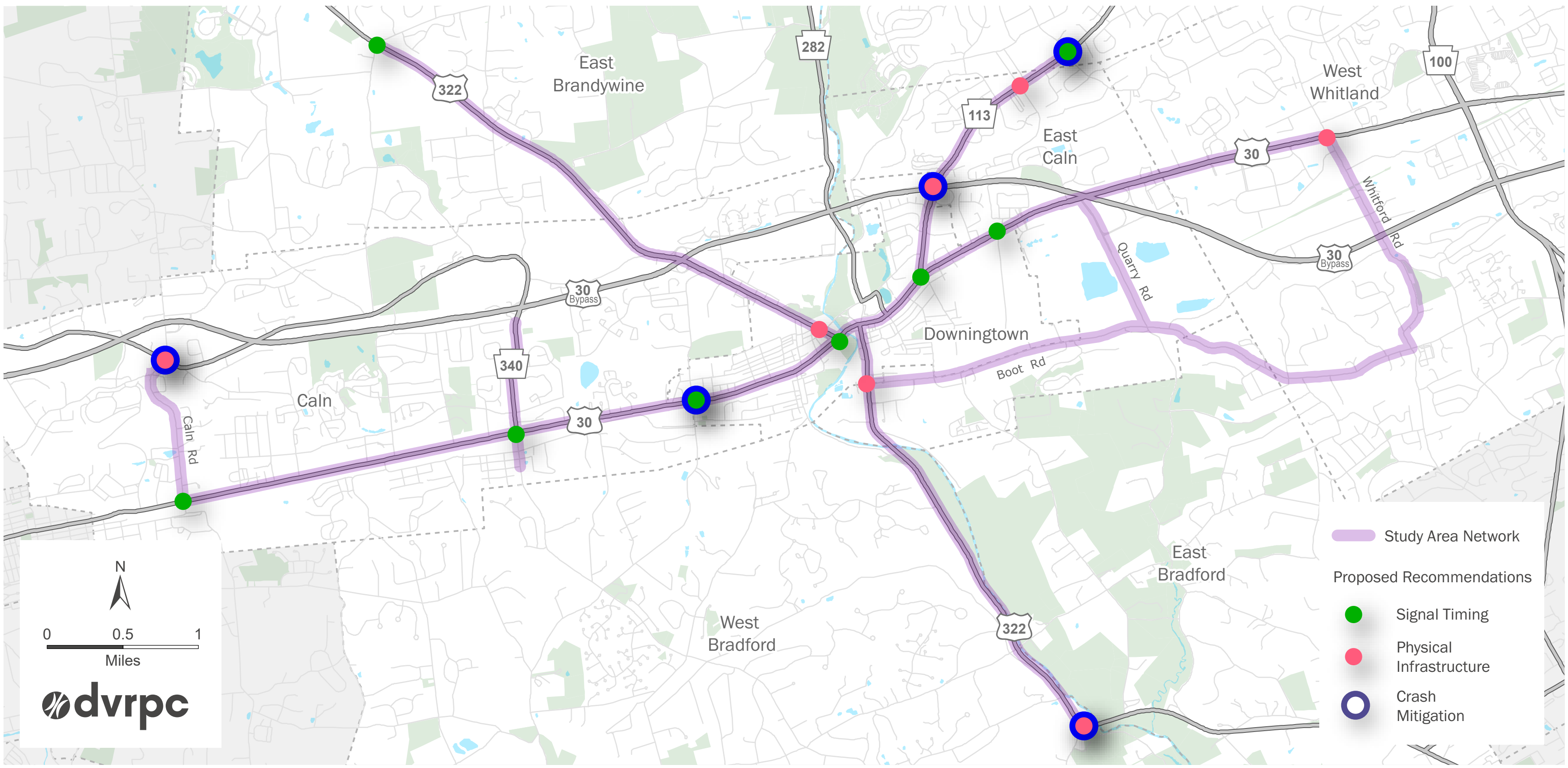
- Manor Avenue & Pennsylvania Avenue: The northbound left-turn storage lane was extended from 125 ft to 200 ft.
- US 322 & Boot Road: Through lanes were added on the northbound and southbound approaches. Permitted/over phases were added to the right-turn lanes on the northbound, southbound, and westbound approaches.
- US 322 & Sugars Bridge Road: Through lanes were added on the northbound and southbound approaches.
- Uwchlan Avenue & Garris Road: Through lanes were added on the eastbound and westbound approaches.
- US 30 Business & US 30 Ramps: The northbound right-turn storage lane was extended from 175 feet to 250 feet. A 200-foot northbound left-turn storage lane was added with signal phasing. Split phasing was incorporated.

- US 30 Business & Whitford Road: Through lanes were added on the northbound and southbound approaches.
- Kings Highway & Caln Road: 150-foot storage lanes were added for the northbound left-turn, northbound right-turn, southbound left-turn, eastbound left-turn, eastbound right-turn, westbound left-turn, and westbound right-turn. Left-turn phasing was added to the new left-turn lanes.

Crash Mitigation Recommendations

- The following intersections feature recommendations made to mitigate crashes.
- US 30 Business & Lloyd Avenue: Brush should be cleared on both sides of the Lloyd Avenue northbound approach in order to improve visibility.
- US 322 & Sugars Bridge Road: Advance signal warning signs should be installed to decrease rear-end crashes.
- Uwchlan Avenue & Peck Road: Brush should be cleared on the right

Figure 24: Recommended Safety & Modeling-Related Improvements



Source: DVRPC, 2020

side of the Peck Road southbound approach to improve visibility.

- US 30 Business & US 30 Ramps: Split phasing and left-turn phasing may reduce crash frequency.
- Kings Highway & Caln Road: Added right-turn lanes and left-turn phasing may reduce crash frequency.

Figure 25 shows the LOS results of the Build + Improvement scenario, which includes the recommendations listed above. There are still quite a few intersections expected to operate with unstable and unpredictable delay (LOS F) in the AM peak hour in the Build + Improvements Scenario.

Figure 25: AM Peak Hour Level of Service — Build + Improvements

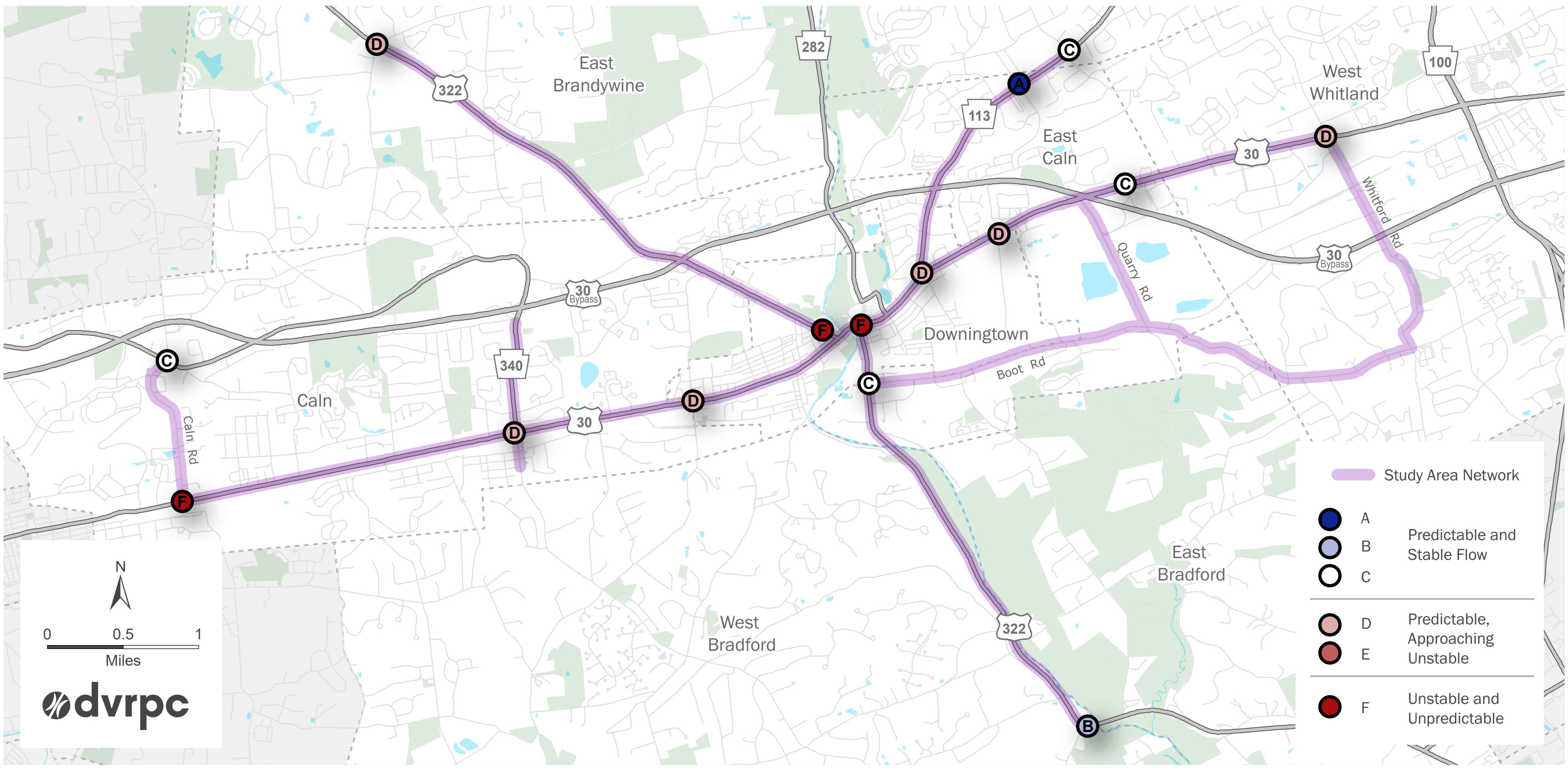
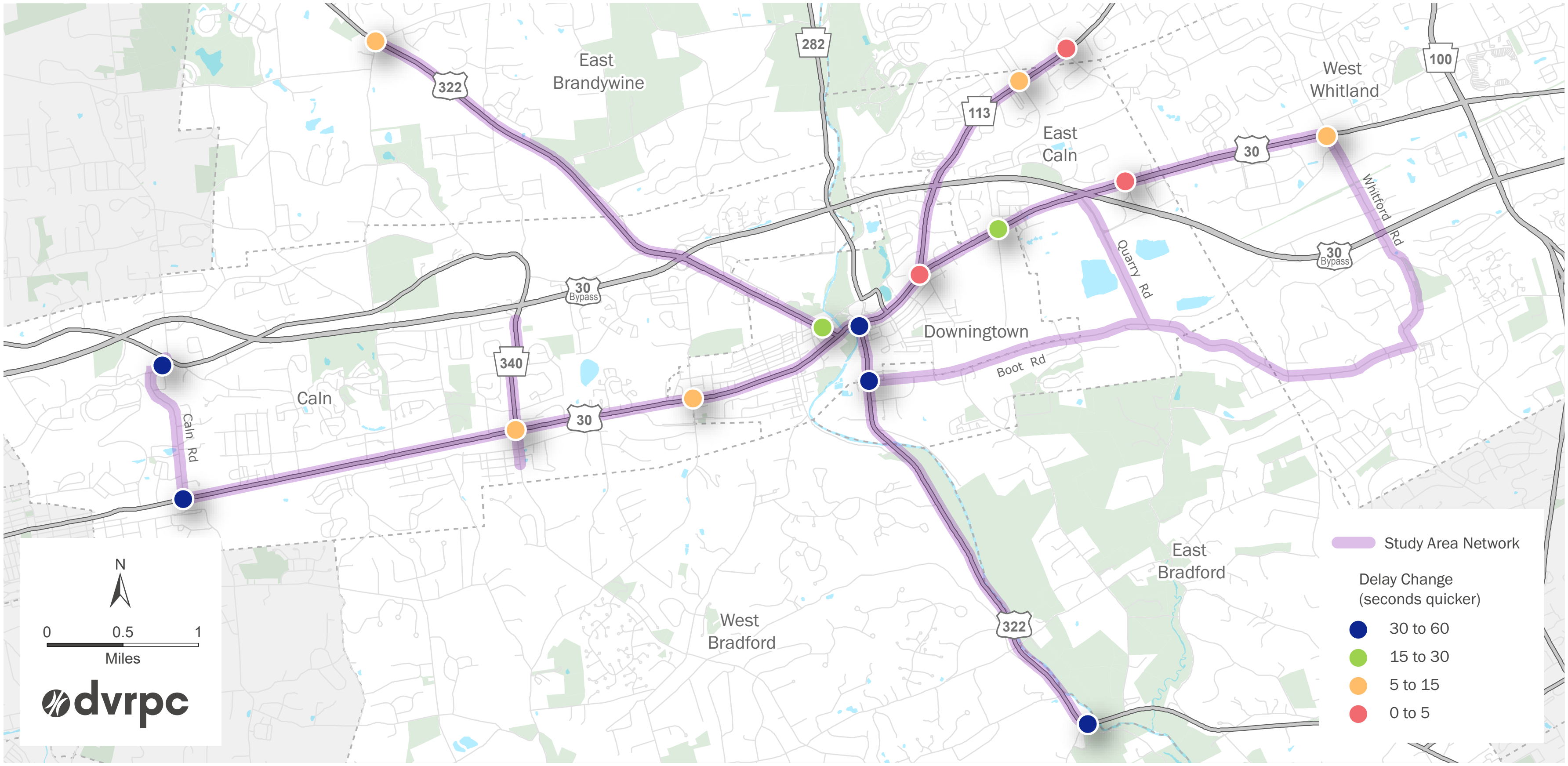


Figure 26 compares the Build and Build + Improvements scenario results, highlighting the fact that the recommended improvements are expected to decrease delay, substantially improving on the expected traffic flow from the Build scenario. The dark blue circles identify the intersections which are expected see the most benefit from the recommended improvements.

Figure 26: AM Delay Change — Build Compared to Build + Improvements



Bicycle Network Improvements

Goals

The proposed bicycle network for Downingtown was developed to achieve the following goals:

1. Connect the new SEPTA station on Brandywine Avenue to the downtown core using both local roads and trails
2. Provide access to local parks and trails
3. Improve the accessibility of Lancaster Avenue for non-motorized road users
4. Facilitate East/West and North/South travel across Downingtown with a gridded network

Design Approach

Excess street space in Downingtown is rare. The roadways tend to be narrow, typically featuring travel lanes in each direction and parking on at least one side. This condition leaves very little space for dedicated bicycle infrastructure. As a result, the proposed network heavily features “bicycle boulevards," which are defined by the National Association of City Transportation Officials (NACTO) as:

> ... streets with low motorized traffic volumes and speeds, designated and designed to give bicycle travel priority. Bicycle Boulevards use signs, pavement markings, and speed and volume management measures to discourage through trips by motor vehicles and create safe, convenient bicycle crossings of busy arterial streets.

In cases where the roadway is wide enough, bicycle lanes are proposed instead of bicycle boulevards. On roadways where it is impossible to discourage through trips, a more traditional “shared lane” approach will be used instead.

In addition to on-street markings, a central feature of a bicycle boulevard-based network is the wayfinding signage that directs users to destinations such as commercial corridors, parks, and transit stops. As shown in the example below, these signs should include approximate travel times in addition to the directional guidance.

In some cases there are corridors that are recommended for inclusion in the bicycle network despite the fact that the roadway is not conducive to bicycle facility markings (due to the confluence of narrow width, high speed limits, and heavy traffic). In these cases, signed routes (without pavement markings) are proposed, as these corridors serve as important functional links between origins and destinations.

Improvement Plan

1. Connect the new SEPTA station to downtown

Downingtown’s SEPTA station is being moved from its current location on Lancaster Ave near Stuart Ave roughly a half-mile East to Brandywine Ave near Logan Ave (see Figure 27). The plan for the new station includes nine bicycle racks in addition to a bicycle and pedestrian bridge over the Brandywine Creek East Branch that connects to Johnsontown Park.

Pennsylvania Ave, a proposed bicycle boulevard, provides connectivity East and West to/from the new SEPTA station by linking to the proposed facilities that connect to Green Street. The road also serves as an important confluence point for a variety of existing and planned off-road trails. In addition to the proposed facility on Pennsylvania Avenue, it is recommended that the number of new bicycle racks be increased to account for additional future demand.

2. Provide access to local parks & trails connections

Downingtown sits between many parks, with Marsh Creek Park to the north and Brandywine Meadows Preserve/Harmony Hill Nature Area to the south. Marsh Creek is accessible via the Struble Trail, which begins in Kardon Park on the eastern side of Downingtown on East Pennsylvania Ave. The parks to the south can be accessed via **Brandywine Avenue** and **Bradford Avenue**, on the east and west sides of the East Branch Brandywine Creek, respectively.

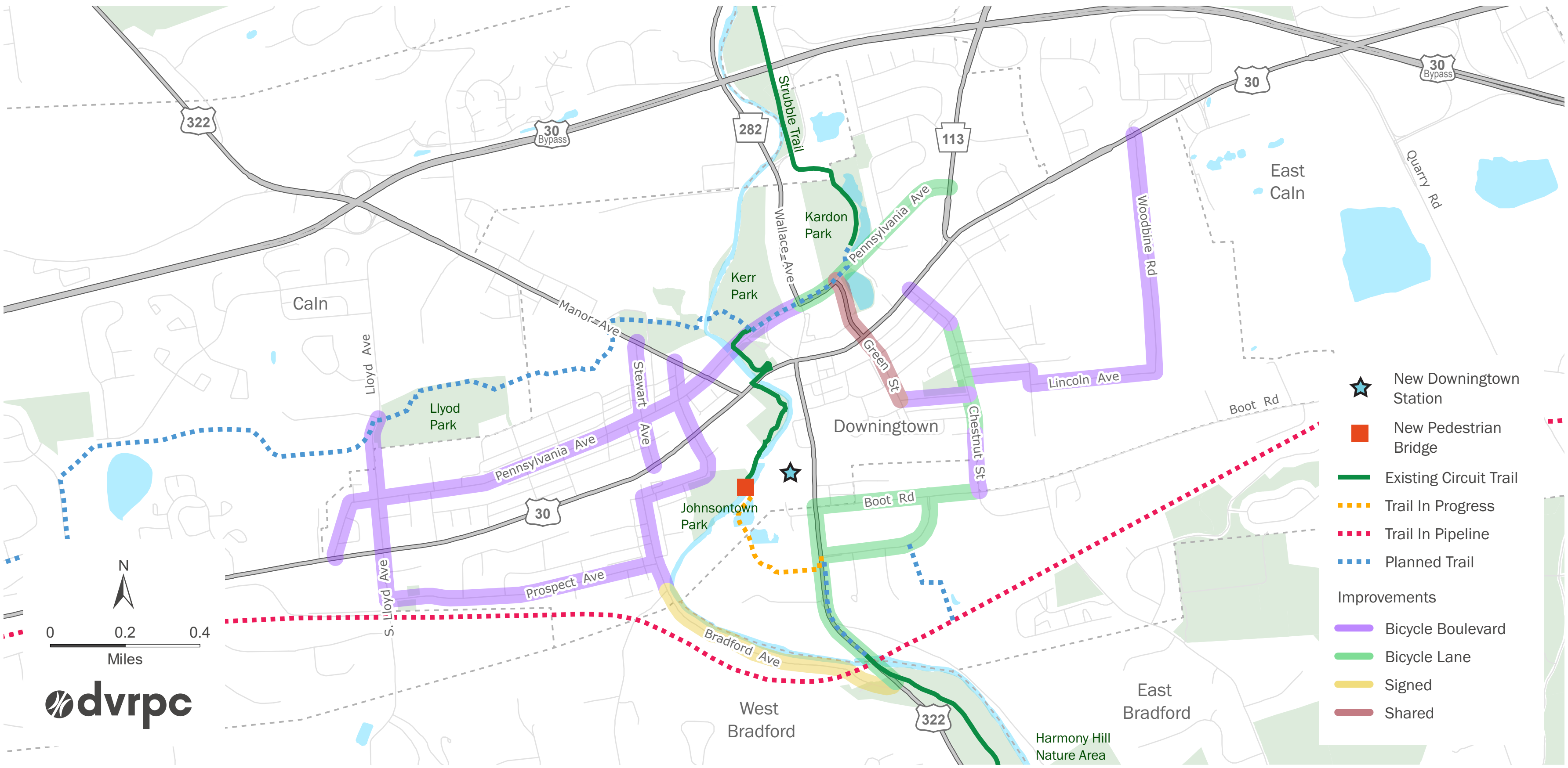
3. Improve the accessibility of Lancaster Avenue for non-motorized road users

Lancaster Ave is not a great candidate for the bicycle boulevard treatment, which works best on streets with few through trips and lower traffic volumes/speeds. It is also not a great candidate for shared lanes, due to the high volume of traffic that uses it daily. However, Lancaster Ave is an important destination within Downingtown, and as a result, additional bicycle parking amenities are recommended, including standard racks on the sidewalk as well as on-street bicycle corrals.

4. Facilitate bicycle trips with a gridded network

In order for bicyclists to effectively traverse Downingtown on two wheels, bicycle routes must exist all throughout the borough, in all directions. To accomplish this, Pennsylvania Ave can serve as the primary east/west corridor, punctuated by corridors that provide north/south connectivity, including (from east to west) Chestnut St, Green St, Downing/Viaduct Ave, and Lloyd Ave. The proposed bicycle/pedestrian bridge over the Brandywine Creek East Branch compliments this grid by providing additional north/south connectivity using existing and in-progress trails.

Figure 27: Recommended Bike Network Improvements



Source: The Circuit Trails, SEPTA, 2021

Final design of any bicycle facility should be informed by a thorough examination of existing conditions, including the collection of new traffic count and vehicle speed data.

BICYCLE CORRALS

"Bicycle corrals" are a single motor vehicle parking space in the roadway that has been converted to parking for 10 to 15 bicycles.

Bicycle Corral in Portland, Oregon
Source: Brad Crawford, PBIC

ADVANCED SIGNAL WARNING SIGNS

These signs alert motorists of the presence of traffic signals ahead.

Advance Signal Warning Sign
Source: Wikipedia Commons

Stormwater Recommendations

Further Evaluation of Study Intersections

After stormwater scores were calculated using the method described in Chapter 3, a subset of study intersections was selected for the development of recommendations. The project TAC deemed the sites with the top three scores to be representative of the study area as a whole. They are: Intersection 8, US 30 Business and US 322, Intersection 1, US 322 and Hopewell Road, and Intersection 4, US 30 Business and S Bailey Road.

The site-specific treatment examples on page 41 account for the intersections' transportation context. Given the diversity of site context and land uses, the techniques recommended for each site provide examples that can be referenced for a variety of other similar intersections throughout the Downingtown Area.

Intersection Best Practices

The project team selected stormwater control measures that would require minimal construction, were located on or near the cartway, and had a positive impact on mobility for any mode of transportation. They are pictured on page 41.

A combination of these treatments was recommended for each focus intersection given the stormwater, land use, and transportation context of the site.

US 30 Business and US 322 Manor Avenue

This intersection is located in Downingtown Borough, near Brandywine Creek, Kerr Park, and Downingtown Borough Hall. Corridor beautification and enhancing the pedestrian experience are priorities here, as the intersection area will likely see a more than average amount of pedestrian traffic.

With limited space for facilities, a tree trench is recommended on the north side of US 30, using existing street trees, as well as permeable pavement in nearby driveways. These treatments do not require additional space, but can help reduce ponding on adjacent sidewalks and roadways.

US 322 Horseshoe Pike and Hopewell Road

This intersection is located in East Brandywine Township, north-west of Downingtown Borough. More space appears to be available for stormwater management at this location. Balancing access to nearby lots, along with pedestrian safety and comfort is a priority. A stormwater planter along the north curb of the east leg could decrease runoff, while also providing a buffer between pedestrians and traffic. A rain garden in the landscaped areas on the street corners would make better use of the green space in the area.

US 30 Business and S Bailey Road

This intersection is located in Caln Township, west of Downingtown Borough. Space is constricted by nearby businesses to the north and the Paoli/Thorndale train line to the south, with the south leg of the intersection passing under the train line. Since runoff will follow the path of least resistance, it is important that treatments prioritize capturing stormwater before it can flow downhill into the underpass. Thus, permeable pavement in the east leg shoulder, a stormwater bump out at the southwest and southeast corners, and stormwater planters in the northwest gore bicycle lane buffer are recommended. The bump outs and planters would also enhance cyclist and pedestrian safety which could benefit rail passengers commuting to the nearby Thorndale station.

STORMWATER TREATMENTS

The project team selected stormwater control measures that would require minimal construction, were located on or near the cartway, and had a positive impact on mobility for any mode of transportation.

Stormwater Tree Pits in Louisville, KY
Source: NACTO

Rain Garden
Source: Environmental Protection Agency (EPA)

Stormwater Bumpout, Philadelphia
Source: Philadelphia Water Department

Permeable Pavement
Source: Philadelphia Water Department

Tree Trench, Mill Creek, Philadelphia
Source: Philadelphia Water Department

CHAPTER 6

Next Steps

This transportation analysis is intended as a tool to identify local transportation project opportunities in the Downingtown Area. Further engineering study may be required prior to the implementation of the recommended improvements. Municipal officials and engineers must obtain the appropriate agreements and permits, and coordination with PennDOT, Chester County, or SEPTA on these efforts is key.

Funding Programs

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 listed below. As funding from the 2021 Infrastructure Investment and Jobs Act becomes available, these sources may change and new funding opportunities may present additional opportunities for implementation.

Federal

Better Utilizing Investments to Leverage Development (BUILD)

The program funds investments in transportation infrastructure, including transit. BUILD Transportation grants replace the Transportation Investment Generating Economic Recovery (TIGER) grant program.

Infrastructure for Rebuilding American Grant Program (INFRA)

INFRA grants fund highway and rail projects of regional and national economic significance. The program prioritizes projects that would improve local economies, create jobs, and meet all statutory requirements, as well as how they would address climate change, environmental justice, and racial equity.

Surface Transportation Block Grant Program (STBG)

The STBG provides flexible funding that may be used by States and localities for projects to preserve and improve the conditions and performance on any Federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects, including intercity bus terminals.

State

Act 89 Multimodal Transportation Fund (MTF)

The design recommendations in this report are multimodal in nature, making these improvements eligible for the Act 89 MTF program. The MTF 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).

Automated Red Light Enforcement (ARLE)

The ARLE program is a state-funded, PennDOT administered competitive grant program established in 2010. The intent of the program is to improve intersection safety by reducing vehicle crashes and injuries due to red-light-running. The program funds the installation of the ARLE system, which is a vehicle sensor that works in conjunction with a traffic control signal and automatically produces images of a vehicle at the time the vehicle is running a red light. The system helps to enforce traffic laws and improve safety. Eligible projects include the installation of a traffic control signal system, improvements to traffic control signals, and roadway capacity upgrades such as auxiliary turning lanes.

DCED Municipal Assistance Program (MAP)

The DCED MAP provides funding to assist local governments to plan for and efficiently implement a variety of services and improvements. Shared service activities and community planning are eligible for MAP funding. Community planning projects that could be funded through MAP include parts of comprehensive plans and land use ordinances.

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 applications 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.

Growing Greener Grants

Growing Greener remains the largest single investment of state funds in Pennsylvania's history to address Pennsylvania's critical environmental concerns of the 21st century. The three programs covered under the Growing Greener Plus Grants Program are:

- Growing Greener Watershed Restoration and Protection
- Surface Mining Conservation and Reclamation Act (SMCRA) Bond Forfeiture
- Abandoned Mine Drainage (AMD) Set-Aside grants.

Pennsylvania Infrastructure Bank (PIB)

The PIB is a PennDOT program that provides low-interest loans to help fund transportation projects within the Commonwealth. The goal of the PIB is to leverage state and federal funds, accelerate priority transportation projects, spur economic development and assist local governments with their transportation needs.

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.

Transportation Alternatives Set-Aside Program (TA)

TA is administered by PennDOT. TA provides federal funds for community based "non-traditional" surface transportation projects designed to strengthen the cultural, aesthetic, and environmental aspects of the nation's intermodal system. Projects must be directly related to surface transportation and be accessible to the public. TA funds are provided on a reimbursement basis. Eligible projects include design and construction of on-road and off-road trail facilities for pedestrians, bicyclists, and other non-motorized forms of transportation. Projects must be authorized for construction within two years of the grant notification, and they must have formal community support.

Regional

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.

Regional Streetlight Procurement Program (RSLPP)

DVRPC's RSLPP assembles the resources needed to design, procure, and finance the transition to light-emitting-diode (LED) street lighting at the municipal level. The RSLPP is designed to help municipalities overcome the barriers of implementing an LED conversion project, such as navigating the conversion process, identifying the best solutions, finding trusted project partners, and paying for the upfront cost of the project. The RSLPP is organized in four phases: 1) Feasibility, 2) Project Development, 3) Construction, and 4) Post Construction Operations and Maintenance. Municipalities are responsible for the project implementation and maintenance costs. However, they benefit from cost savings in all four steps due to the pooling of municipal resources. In addition, DVRPC manages the program and guides municipalities through each step of the process. Please note that the RSLPP has assisted municipalities in installing new LED street lights in certain cases.

Safe Routes to School Program (SRTS)

SRTS is an approach that promotes walking and bicycling to school through infrastructure improvements, enforcement, tools, safety education, and incentives to encourage walking and bicycling to school. SRTS initiatives improve safety and levels of physical activity for students.

Transportation and Community Development Initiative (TCDI)

The TCDI is an opportunity for DVRPC to support growth in individual municipalities of the Delaware Valley through planning initiatives that implement the region's long-range plan. TCDI grants support early stage planning, design, and feasibility studies. Eligible projects reinforce and implement improvements in designated centers and improve the overall character and quality of life within the region. Among the eligible activities are wayfinding plans and mobility elements of master plans.

Transportation Improvement Program (TIP)

The TIP is the regionally agreed-upon list of priority transportation projects, as required by federal law. The TIP document must list all projects that intend to use federal funds, along with all non-federally funded projects that are regionally significant.

Nonprofit Funding Sources

PeopleForBikes Community Grants

The PeopleForBikes Community Grant Program provides funding for important projects that make bicycling better in communities across the U.S. These projects include (but are not limited to) bike paths, lanes and trails; Mountain bike and BMX facilities; Bike parks and pump tracks; Bike racks and bike repair stations; and Large-scale bicycle advocacy initiatives.

Community Transportation Association of America Grant Programs (CTAA)

CTAA administers four active grant programs with a focus on improving the transit for all Americans, regardless of geography, ability, age or income level.

Stormwater Funding Sources

Stormwater projects can take advantage of additional, non-transportation focused funding programs to finance construction and maintenance of stormwater control facilities. Possible funding sources include:

EPA Clean Water State Revolving Fund (CWSRF)

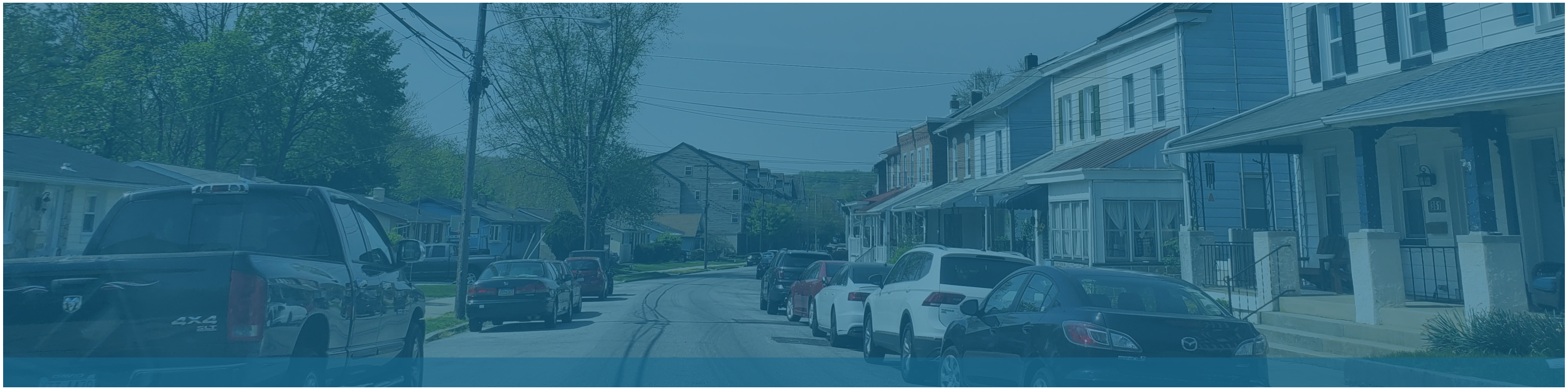
The CWSRF program is a federal-state partnership that provides communities low-cost financing for a wide range of water quality infrastructure projects. In Pennsylvania, this program is administered by the Pennsylvania Infrastructure Investment Authority (PENNVEST).

Section 319 Nonpoint Source Grant Program

State can apply to receive grant money that supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects.

Municipal-level Funding such as:

- General municipal funds;
- Drinking water and wastewater fees;
- Developer fees;
- Special assessment district fees; and
- One-time or connection fees.



Appendices

A: Detailed Modeling Approach

B: Focus Intersection Selection

C: Microsimulation Results

D: Selection of Build + Improvement Concepts

E: Stormwater Intersection Scoring

Photo Credit:
Camden Palvino, DVRPC

DELAWARE VALLEY
dvrpc
REGIONAL
PLANNING COMMISSION

APPENDIX A

Detailed Modeling Approach

The DVRPC Transportation Improvement Model version 2.3 (TIM 2.3) was used to estimate future roadway demand to be used as inputs for the Synchro intersection-level modeling (See Figure A-1). This step-wise process was as follows:

1. A base year regional model was calibrated to ensure that the model represented existing conditions in the Downingtown Area as accurately as possible. This involved checking to ensure that the road network in the model matched what was on the ground, including details such as number of lanes and speed limits, as well as adjusting model variables to better reproduce observed vehicle volumes collected through traffic counts.

2. A submodel of the study area was generated from the TIM 2.3 regional model and a demand balancing algorithm (T-Flow Fuzzy within VISUM) was used to develop a new travel demand matrix of origins and destinations, reflective of the observed travel behaviors in the study area.

3. A 2035 year version of the calibrated regional model was run and a new 2035 submodel was exported. This model included population and employment growth and funded transportation improvement projects, but not the Downingtown train station move or regional rail line extension. The change in travel demand between this model and the unbalanced base year model (from step 1) was used to develop a set of growth factors to be applied to the balanced base model (from step 2).

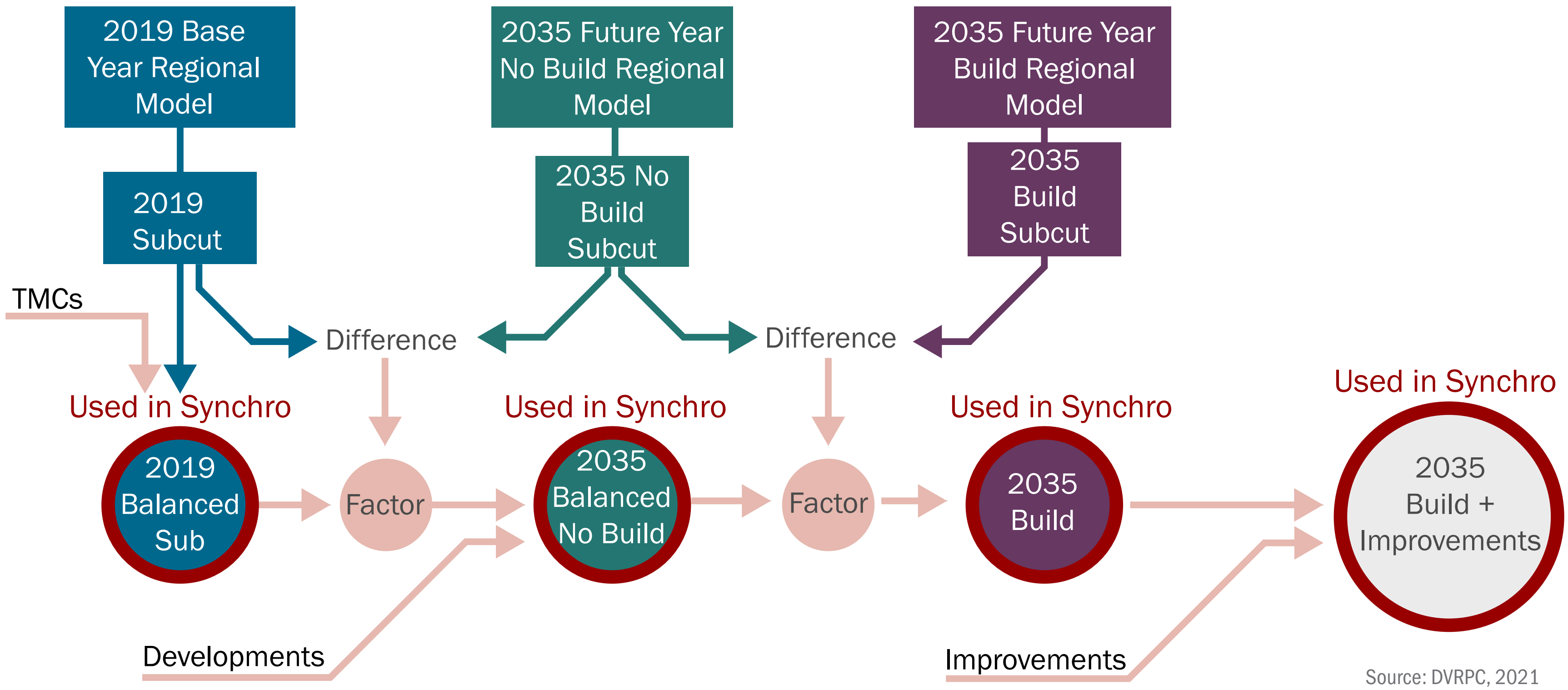
4. The balanced base model demand was factored to 2035 demand, with additional demand added for future developments (see section on new developments explicitly included in modeling). The new development demand was assumed to follow the same distribution as the existing demand for the area (traffic analysis zone) within which the development fell. The resulting new demand matrix was assigned to the study area submodel resulting in a 2035 No Build submodel.

5. The outputs of the base and 2035 No Build models were compared to generate a set of factors for scaling the observed turning movements used in the Synchro intersection-level modeling. These factors were applied to the vehicle count data and resulting values were used to model 2035 No Build intersection performance in Synchro.

6. In order to model 2035 Build scenario conditions, including the train station relocation and rail line extension, a second set of factors were developed based on a prior study model for the proposed Paoli/Thorndale line extension to Coatesville and Parkesburg. The Build version of this study model was modified to reflect the relocation of the Downingtown station and rerun.

7. Outputs from the modified extension Build model were compared to outputs from the extension 2035 No Build model to develop a set of build factors for intersection turning movements reflective of changed travel behavior in response to station relocation. These factors were then applied to the 2035 No Build Synchro volumes to generate 2035 Build values for Synchro modeling.

Figure A-1: Detailed Modeling Diagram



Source: DVRPC, 2021

APPENDIX B

Focus Intersection Selection

The names of focus intersections are highlighted in dark red. In the data columns, LOS results that are unstable and unpredictable, E or F, are highlighted in pink.

Table B-1: Build + Improvement Focus Intersection Selection

Study Intersection		NB AM		Ex -> NB	Build AM		NB -> B	NB PM		Ex -> NB	Build PM		NB -> B	Crash Focus
Number	*Name*	*Delay (s)*	*LOS*	*Delay Change (s)*	*Delay (s)*	*LOS*	*Delay Change (s)*	*Delay (s)*	*LOS*	*Delay Change (s)*	*Delay (s)*	*LOS*	*Delay Change (s)*	*≥20 crash/ 5yr*
1	US 30 Business & Caln Road	176.2	F	82.7	170.9	F	-5.3	99.3	F	41.8	101.8	F	2.5	No
2	US 30 Business & S Bailey Road	23.2	C	5.9	22.1	C	-1.1	30	C	7.5	30.3	C	0.3	No
3	US 30 Business & Bondsville Road	74	E	27.6	66.4	E	-7.6	38.8	D	11	38.3	D	-0.5	No
4	US 30 Business & Lloyd Ave	47.8	D	24.7	50.5	D	2.7	27.8	C	13.6	25.4	C	-2.4	Yes (38)
5	US 30 Business & StuartAve	5.7	A	-0.2	5.6	A	-0.1	6.4	A	0.2	6.3	A	-0.1	No
6	US 30 Business & Downing Ave	24.4	C	5.2	26.6	C	2.2	15.5	B	-4	16.7	B	1.2	No
7	US 30 Business & Manor Ave	16.4	B	-0.4	16.2	B	-0.2	23.3	C	0.8	25.7	C	2.4	No
8	Manor Ave & Pennsylvania Ave	76	E	45.1	118.9	F	42.9	110.4	F	69.7	103.2	F	-7.2	No
9	Manor Ave & Downingtown H.S.	2.9	a	0.8	2.8	a	-0.1	4.7	a	2.2	4.5	a	-0.2	No
10	US 322 (Horseshoe Pike) & Corner Ketch Road	8.8	A	2.5	8.6	A	-0.2	11.7	B	3.8	11.6	B	-0.1	No
11	US 322 (Horseshoe Pike) & Hopewell Road	60.8	E	23.7	59.3	E	-1.5	33.2	C	7.1	33.6	C	0.4	No
12	US 30 Business & US 322 (Brandywine Ave)	145.2	F	70	179.2	F	34	50	D	-8.5	42.8	D	-7.2	No
13	US 322 (Brandywine Ave) & Logan Ave	9.7	a	9.4	8.5	a	-1.2	6	a	5.5	5.1	a	-0.9	No
14	US 322 (Brandywine Ave) & Boot Road	107.6	F	82.1	87.7	F	-19.9	28.3	C	4.6	28	C	-0.3	Yes (20)
15	US 322 (Downingtown Pike) & Sugars Bridge Road	84.8	F	40.1	86.9	F	2.1	14.2	B	1.2	14.2	B	0	Yes (45)
16	US 30 Business & Uwchlan Ave	37.2	D	17.4	35.3	D	-1.9	61.1	E	36.4	69.7	E	8.6	No
17	Uwchlan Ave & Pennsylvania Ave	32.4	C	8.5	33.1	C	0.7	19.1	B	7.9	14.9	B	-4.2	No
18	Uwchlan Ave & Garris Road	14.2	B	4.1	14.4	B	0.2	53.8	D	31.3	60.8	E	7	No
19	Uwchlan Ave & Peck Road	32.9	C	13.9	32.2	C	-0.7	36.4	D	9.5	36.7	D	0.3	Yes (24)
20	US 30 Business & Woodbine Road	76	E	34.7	74.9	E	-1.1	20.4	C	-0.5	20.7	C	0.3	No
21	US 30 Business & Brandywine Square	12.7	B	4.6	12.6	B	-0.1	22.5	C	0.1	22.5	C	0	No
22	Quarry Road & US 30 Ramps	24.2	C	8	32.6	C	8.4	13.3	B	1.5	13.4	B	0.1	No
23	US 30 Business & US 30 Ramps	31.5	C	7.6	31	C	-0.5	96.4	F	49.2	96.1	F	-0.3	No
24	US 30 Business & Woodledge Lane	19.7	B	3.9	19.7	B	0	27.2	C	4.7	27.3	C	0.1	No
25	US 30 Business & Whitford Road	44.3	D	1.1	45.5	D	1.2	87	F	31.8	87.6	F	0.6	Yes (42)
26	Whitford Road & Spackman Lane	1.4	a	0.1	1.5	a	0.1	1.9	a	0.2	2	a	0.1	No
27	Kings Highway & Caln Road	173.5	F	127.9	154	F	-19.5	58.8	E	27.5	58.2	E	-0.6	Yes (31)
28	US 322 (Manor Ave) & EB US 30 Byp Ramps	4.8	a	1.9	4.8	a	0	8.3	a	4.6	7.9	a	-0.4	No
29	US 322 (Manor Ave) & WB US 30 Byp Ramps	21.7	C	0.6	21.8	C	0.1	21.1	C	4.5	20.4	C	-0.7	No

Source: DVRPC, 2021

APPENDIX C

Microsimulation Results

Downingtown Area Transportation Study | 2019 Existing Conditions
1: Caln Road & US 30 Business | AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	100	482	23	49	291	86	35	172	125	98	96	90
Future Volume (veh/h)	100	482	23	49	291	86	35	172	125	98	96	90
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1722	1796	1796	1752	1826	1870	1856	1856	1856	1796	1796	1796
Adj Flow Rate, veh/h	110	530	25	54	320	95	38	189	137	108	105	99
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	12	7	7	10	5	2	3	3	3	7	7	7
Cap, veh/h	380	681	32	224	681	577	24	121	88	118	114	108
Arrive On Green	0.06	0.40	0.40	0.03	0.37	0.37	0.13	0.13	0.13	0.20	0.20	0.20
Sat Flow, veh/h	1640	1699	80	1668	1826	1548	181	898	651	579	563	530
Grp Volume(v), veh/h	110	0	555	54	320	95	364	0	0	312	0	0
Grp Sat Flow(s),veh/h/ln	1640	0	1780	1668	1826	1548	1729	0	0	1672	0	0
Q Serve(g_s), s	4.3	0.0	28.3	2.1	13.9	4.3	14.0	0.0	0.0	19.0	0.0	0.0
Cycle Q Clear(g_c), s	4.3	0.0	28.3	2.1	13.9	4.3	14.0	0.0	0.0	19.0	0.0	0.0
Prop In Lane	1.00		0.05	1.00		1.00	0.10		0.38	0.35		0.32
Lane Grp Cap(c), veh/h	380	0	713	224	681	577	233	0	0	340	0	0
V/C Ratio(X)	0.29	0.00	0.78	0.24	0.47	0.16	1.57	0.00	0.00	0.92	0.00	0.00
Avail Cap(c_a), veh/h	472	0	872	364	894	758	233	0	0	353	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	19.1	0.0	27.2	22.4	24.8	21.8	45.1	0.0	0.0	40.6	0.0	0.0
Incr Delay (d2), s/veh	0.4	0.0	5.2	0.5	1.1	0.3	274.2	0.0	0.0	27.8	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.6	0.0	12.3	0.8	5.9	1.5	23.7	0.0	0.0	10.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.5	0.0	32.3	23.0	25.9	22.1	319.3	0.0	0.0	68.4	0.0	0.0
LnGrp LOS	B	A	C	C	C	C	F	A	A	E	A	A
Approach Vol, veh/h		665			469			364			312	
Approach Delay, s/veh		30.2			24.8			319.3			68.4	
Approach LOS		C			C			F			E	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	12.1	44.8		27.2	9.3	47.7		20.0				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	12.0	51.0		22.0	12.0	51.0		14.0				
Max Q Clear Time (g_c+I1), s	6.3	15.9		21.0	4.1	30.3		16.0				
Green Ext Time (p_c), s	0.1	6.8		0.1	0.1	11.4		0.0				

Intersection Summary			
HCM 6th Ctrl Delay			93.5
HCM 6th LOS			F

Notes

User approved pedestrian interval to be less than phase max green.

Source: DVRPC, 2020

Downingtown Area Transportation Study
1: Caln Road & US 30 Business

2019 Existing Conditions
PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	122	336	33	103	510	89	25	158	86	71	175	83
Future Volume (veh/h)	122	336	33	103	510	89	25	158	86	71	175	83
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1826	1870	1870	1870	1885	1856	1870	1870	1870	1826	1826	1826
Adj Flow Rate, veh/h	126	346	34	106	526	92	26	163	89	73	180	86
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Percent Heavy Veh, %	5	2	2	2	1	3	2	2	2	5	5	5
Cap, veh/h	278	640	63	383	704	574	22	141	77	78	192	92
Arrive On Green	0.06	0.38	0.38	0.05	0.37	0.37	0.14	0.14	0.14	0.21	0.21	0.21
Sat Flow, veh/h	1739	1672	164	1781	1885	1536	165	1032	564	372	918	438
Grp Volume(v), veh/h	126	0	380	106	526	92	278	0	0	339	0	0
Grp Sat Flow(s),veh/h/ln	1739	0	1837	1781	1885	1536	1761	0	0	1728	0	0
Q Serve(g_s), s	4.8	0.0	17.7	4.0	26.7	4.4	15.0	0.0	0.0	21.2	0.0	0.0
Cycle Q Clear(g_c), s	4.8	0.0	17.7	4.0	26.7	4.4	15.0	0.0	0.0	21.2	0.0	0.0
Prop In Lane	1.00		0.09	1.00		1.00	0.09		0.32	0.22		0.25
Lane Grp Cap(c), veh/h	278	0	703	383	704	574	240	0	0	361	0	0
V/C Ratio(X)	0.45	0.00	0.54	0.28	0.75	0.16	1.16	0.00	0.00	0.94	0.00	0.00
Avail Cap(c_a), veh/h	406	0	703	498	704	574	240	0	0	361	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.97	0.00	0.00
Uniform Delay (d), s/veh	22.7	0.0	26.4	20.6	29.9	22.9	47.5	0.0	0.0	42.8	0.0	0.0
Incr Delay (d2), s/veh	1.2	0.0	3.0	0.4	7.1	0.6	107.4	0.0	0.0	31.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.0	0.0	8.0	1.6	12.9	1.6	13.7	0.0	0.0	12.0	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	23.8	0.0	29.4	21.0	37.0	23.5	154.9	0.0	0.0	74.0	0.0	0.0
LnGrp LOS	C	A	C	C	D	C	F	A	A	E	A	A
Approach Vol, veh/h		506			724			278			339	
Approach Delay, s/veh		28.0			33.0			154.9			74.0	
Approach LOS		C			C			F			E	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	12.9	47.1		29.0	11.9	48.1		21.0				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	15.0	33.0		23.0	13.0	35.0		15.0				
Max Q Clear Time (g_c+I1), s	6.8	28.7		23.2	6.0	19.7		17.0				
Green Ext Time (p_c), s	0.2	2.8		0.0	0.1	6.3		0.0				

Intersection Summary			
HCM 6th Ctrl Delay			57.5
HCM 6th LOS			E

Notes

User approved pedestrian interval to be less than phase max green.

Source: DVRPC, 2020

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	137	535	29	66	345	144	45	269	139	120	112	95
Future Volume (veh/h)	137	535	29	66	345	144	45	269	139	120	112	95
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1722	1796	1796	1752	1826	1870	1856	1856	1856	1796	1796	1796
Adj Flow Rate, veh/h	151	588	32	73	379	158	49	296	153	132	123	104
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	12	7	7	10	5	2	3	3	3	7	7	7
Cap, veh/h	363	703	38	211	700	594	22	132	68	123	114	97
Arrive On Green	0.07	0.42	0.42	0.04	0.38	0.38	0.13	0.13	0.13	0.20	0.20	0.20
Sat Flow, veh/h	1640	1685	92	1668	1826	1548	172	1040	538	617	575	486
Grp Volume(v), veh/h	151	0	620	73	379	158	498	0	0	359	0	0
Grp Sat Flow(s),veh/h/ln	1640	0	1777	1668	1826	1548	1750	0	0	1678	0	0
Q Serve(g_s), s	6.1	0.0	34.5	2.9	17.9	7.7	14.0	0.0	0.0	22.0	0.0	0.0
Cycle Q Clear(g_c), s	6.1	0.0	34.5	2.9	17.9	7.7	14.0	0.0	0.0	22.0	0.0	0.0
Prop In Lane	1.00		0.05	1.00		1.00	0.10		0.31	0.37		0.29
Lane Grp Cap(c), veh/h	363	0	741	211	700	594	222	0	0	334	0	0
V/C Ratio(X)	0.42	0.00	0.84	0.35	0.54	0.27	2.25	0.00	0.00	1.08	0.00	0.00
Avail Cap(c_a), veh/h	420	0	820	325	842	714	222	0	0	334	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	19.7	0.0	28.9	23.9	26.5	23.4	48.3	0.0	0.0	44.3	0.0	0.0
Incr Delay (d2), s/veh	0.8	0.0	8.3	1.0	1.4	0.5	575.5	0.0	0.0	70.7	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.3	0.0	15.6	1.1	7.7	2.8	41.5	0.0	0.0	15.5	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.5	0.0	37.1	24.9	27.9	23.9	623.8	0.0	0.0	115.0	0.0	0.0
LnGrp LOS	C	A	D	C	C	C	F	A	A	F	A	A
Approach Vol, veh/h		771			610			498			359	
Approach Delay, s/veh		33.9			26.5			623.8			115.0	
Approach LOS		C			C			F			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	14.2	48.4		28.0	10.5	52.1		20.0				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	12.0	51.0		22.0	12.0	51.0		14.0				
Max Q Clear Time (g_c+I1), s	8.1	19.9		24.0	4.9	36.5		16.0				
Green Ext Time (p_c), s	0.1	7.5		0.0	0.1	9.6		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			176.2									
HCM 6th LOS			F									

Notes

User approved pedestrian interval to be less than phase max green.

Source: DVRPC, 2020

Downingtown Area Transportation Study
1: Caln Road & US 30 Business

2035 No Build
PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	128	402	44	118	574	133	33	190	109	107	228	107
Future Volume (veh/h)	128	402	44	118	574	133	33	190	109	107	228	107
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1826	1870	1870	1870	1885	1856	1870	1870	1870	1826	1826	1826
Adj Flow Rate, veh/h	132	414	45	122	592	137	34	196	112	110	235	110
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Percent Heavy Veh, %	5	2	2	2	1	3	2	2	2	5	5	5
Cap, veh/h	238	622	68	329	700	570	24	137	79	87	187	87
Arrive On Green	0.07	0.38	0.38	0.06	0.37	0.37	0.14	0.14	0.14	0.21	0.21	0.21
Sat Flow, veh/h	1739	1654	180	1781	1885	1536	175	1008	576	418	893	418
Grp Volume(v), veh/h	132	0	459	122	592	137	342	0	0	455	0	0
Grp Sat Flow(s),veh/h/ln	1739	0	1833	1781	1885	1536	1758	0	0	1730	0	0
Q Serve(g_s), s	5.1	0.0	22.9	4.6	31.7	6.8	15.0	0.0	0.0	23.0	0.0	0.0
Cycle Q Clear(g_c), s	5.1	0.0	22.9	4.6	31.7	6.8	15.0	0.0	0.0	23.0	0.0	0.0
Prop In Lane	1.00		0.10	1.00		1.00	0.10		0.33	0.24		0.24
Lane Grp Cap(c), veh/h	238	0	690	329	700	570	240	0	0	362	0	0
V/C Ratio(X)	0.55	0.00	0.67	0.37	0.85	0.24	1.43	0.00	0.00	1.26	0.00	0.00
Avail Cap(c_a), veh/h	362	0	690	433	700	570	240	0	0	362	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.97	0.00	0.00
Uniform Delay (d), s/veh	24.5	0.0	28.5	21.7	31.7	23.9	47.5	0.0	0.0	43.5	0.0	0.0
Incr Delay (d2), s/veh	2.0	0.0	5.0	0.7	12.0	1.0	214.5	0.0	0.0	136.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.1	0.0	10.6	1.9	16.0	2.5	20.8	0.0	0.0	23.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	26.5	0.0	33.5	22.4	43.8	24.9	262.0	0.0	0.0	179.7	0.0	0.0
LnGrp LOS	C	A	C	C	D	C	F	A	A	F	A	A
Approach Vol, veh/h		591			851			342			455	
Approach Delay, s/veh		32.0			37.7			262.0			179.7	
Approach LOS		C			D			F			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	13.2	46.8		29.0	12.6	47.4		21.0
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	15.0	33.0		23.0	13.0	35.0		15.0
Max Q Clear Time (g_c+I1), s	7.1	33.7		25.0	6.6	24.9		17.0
Green Ext Time (p_c), s	0.2	0.0		0.0	0.2	5.5		0.0

Intersection Summary	
HCM 6th Ctrl Delay	99.3
HCM 6th LOS	F

Notes

User approved pedestrian interval to be less than phase max green.

Source: DVRPC, 2020

1: Caln Road & US 30 Business

AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	136	529	29	66	347	144	45	258	144	121	107	94
Future Volume (veh/h)	136	529	29	66	347	144	45	258	144	121	107	94
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1722	1796	1796	1752	1826	1870	1856	1856	1856	1796	1796	1796
Adj Flow Rate, veh/h	149	581	32	73	381	158	49	284	158	133	118	103
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	12	7	7	10	5	2	3	3	3	7	7	7
Cap, veh/h	360	699	38	214	698	592	22	128	71	126	112	97
Arrive On Green	0.07	0.42	0.42	0.04	0.38	0.38	0.13	0.13	0.13	0.20	0.20	0.20
Sat Flow, veh/h	1640	1684	93	1668	1826	1548	174	1010	562	630	559	488
Grp Volume(v), veh/h	149	0	613	73	381	158	491	0	0	354	0	0
Grp Sat Flow(s),veh/h/ln	1640	0	1777	1668	1826	1548	1746	0	0	1677	0	0
Q Serve(g_s), s	6.0	0.0	33.9	2.9	17.9	7.7	14.0	0.0	0.0	22.0	0.0	0.0
Cycle Q Clear(g_c), s	6.0	0.0	33.9	2.9	17.9	7.7	14.0	0.0	0.0	22.0	0.0	0.0
Prop In Lane	1.00		0.05	1.00		1.00	0.10		0.32	0.38		0.29
Lane Grp Cap(c), veh/h	360	0	738	214	698	592	222	0	0	335	0	0
V/C Ratio(X)	0.41	0.00	0.83	0.34	0.55	0.27	2.21	0.00	0.00	1.06	0.00	0.00
Avail Cap(c_a), veh/h	419	0	822	328	845	716	222	0	0	335	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	19.8	0.0	28.8	23.8	26.6	23.4	48.1	0.0	0.0	44.1	0.0	0.0
Incr Delay (d2), s/veh	0.8	0.0	7.9	0.9	1.4	0.5	560.6	0.0	0.0	65.1	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.3	0.0	15.3	1.1	7.8	2.8	40.6	0.0	0.0	15.0	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.5	0.0	36.7	24.8	28.0	23.9	608.7	0.0	0.0	109.2	0.0	0.0
LnGrp LOS	C	A	D	C	C	C	F	A	A	F	A	A
Approach Vol, veh/h		762			612			491			354	
Approach Delay, s/veh		33.5			26.5			608.7			109.2	
Approach LOS		C			C			F			F	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	14.1	48.1		28.0	10.5	51.7		20.0				
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0				
Max Green Setting (Gmax), s	12.0	51.0		22.0	12.0	51.0		14.0				
Max Q Clear Time (g_c+I1), s	8.0	19.9		24.0	4.9	35.9		16.0				
Green Ext Time (p_c), s	0.1	7.6		0.0	0.1	9.8		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			170.9									
HCM 6th LOS			F									

Notes

User approved pedestrian interval to be less than phase max green.

Source: DVRPC, 2020

Table C-6: Synchro Report: Build PM Peak

Downingtown Area Transportation Study — 2035 No Build
1: Caln Road & US 30 Business — PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	127	403	44	116	576	133	33	190	117	107	230	102
Future Volume (veh/h)	127	403	44	116	576	133	33	190	117	107	230	102
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1826	1870	1870	1870	1885	1856	1870	1870	1870	1826	1826	1826
Adj Flow Rate, veh/h	131	415	45	120	594	137	34	196	121	110	237	105
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Percent Heavy Veh, %	5	2	2	2	1	3	2	2	2	5	5	5
Cap, veh/h	236	624	68	328	700	571	23	133	82	88	190	84
Arrive On Green	0.06	0.38	0.38	0.06	0.37	0.37	0.14	0.14	0.14	0.21	0.21	0.21
Sat Flow, veh/h	1739	1654	179	1781	1885	1536	170	979	604	422	908	402
Grp Volume(v), veh/h	131	0	460	120	594	137	351	0	0	452	0	0
Grp Sat Flow(s),veh/h/ln	1739	0	1834	1781	1885	1536	1753	0	0	1732	0	0
Q Serve(g_s), s	5.1	0.0	22.9	4.5	31.8	6.8	15.0	0.0	0.0	23.0	0.0	0.0
Cycle Q Clear(g_c), s	5.1	0.0	22.9	4.5	31.8	6.8	15.0	0.0	0.0	23.0	0.0	0.0
Prop In Lane	1.00		0.10	1.00		1.00	0.10		0.34	0.24		0.23
Lane Grp Cap(c), veh/h	236	0	692	328	700	571	239	0	0	362	0	0
V/C Ratio(X)	0.55	0.00	0.67	0.37	0.85	0.24	1.47	0.00	0.00	1.25	0.00	0.00
Avail Cap(c_a), veh/h	361	0	692	433	700	571	239	0	0	362	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	1.00	1.00	1.00	0.00	0.00	0.97	0.00	0.00
Uniform Delay (d), s/veh	24.5	0.0	28.5	21.7	31.7	23.8	47.5	0.0	0.0	43.5	0.0	0.0
Incr Delay (d2), s/veh	2.0	0.0	5.0	0.7	12.2	1.0	232.1	0.0	0.0	132.0	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.1	0.0	10.6	1.9	16.1	2.5	21.9	0.0	0.0	22.9	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	26.6	0.0	33.5	22.4	43.9	24.8	279.6	0.0	0.0	175.5	0.0	0.0
LnGrp LOS	C	A	C	C	D	C	F	A	A	F	A	A
Approach Vol, veh/h		591			851			351			452	
Approach Delay, s/veh		31.9			37.8			279.6			175.5	
Approach LOS		C			D			F			F	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	13.1	46.9		29.0	12.5	47.5		21.0
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	15.0	33.0		23.0	13.0	35.0		15.0
Max Q Clear Time (g_c+I1), s	7.1	33.8		25.0	6.5	24.9		17.0
Green Ext Time (p_c), s	0.2	0.0		0.0	0.2	5.5		0.0

Intersection Summary	
HCM 6th Ctrl Delay	101.8
HCM 6th LOS	F

Notes

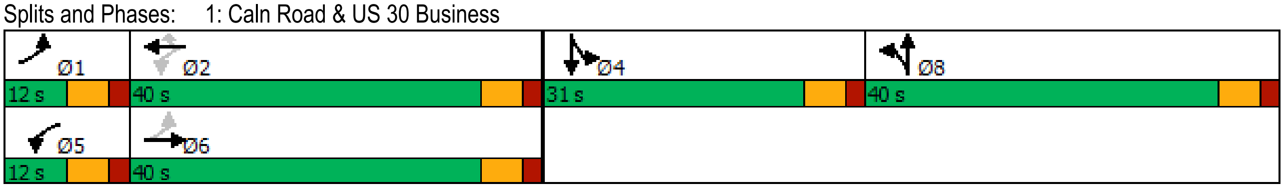
User approved pedestrian interval to be less than phase max green.

Source: DVRPC, 2020

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	SBT
Lane Configurations							
Traffic Volume (vph)	136	529	66	347	144	258	107
Future Volume (vph)	136	529	66	347	144	258	107
Turn Type	pm+pt	NA	pm+pt	NA	Perm	NA	NA
Protected Phases	1	6	5	2		8	4
Permitted Phases	6		2		2		
Detector Phase	1	6	5	2	2	8	4
Switch Phase							
Minimum Initial (s)	3.0	10.0	3.0	10.0	10.0	3.0	3.0
Minimum Split (s)	9.0	16.0	9.0	16.0	16.0	9.0	9.0
Total Split (s)	12.0	40.0	12.0	40.0	40.0	40.0	31.0
Total Split (%)	9.8%	32.5%	9.8%	32.5%	32.5%	32.5%	25.2%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		
Recall Mode	None	Min	None	Min	Min	None	None

Intersection Summary
Cycle Length: 123
Actuated Cycle Length: 120.8
Natural Cycle: 140
Control Type: Actuated-Uncoordinated

Splits and Phases: 1: Caln Road & US 30 Business



Source: DVRPC, 2020

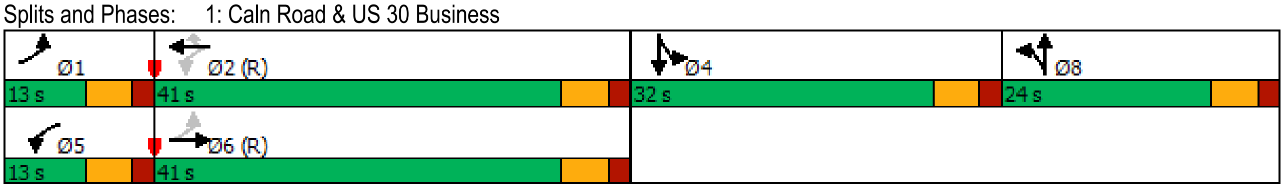
Downingtown Area Transportation Study
1: Caln Road & US 30 Business

2035 Build + Improvements
PM Peak

Lane Group	EBL	EBT	WBL	WBT	WBR	NBT	SBT
Lane Configurations							
Traffic Volume (vph)	127	403	116	576	133	190	230
Future Volume (vph)	127	403	116	576	133	190	230
Turn Type	pm+pt	NA	pm+pt	NA	Perm	NA	NA
Protected Phases	1	6	5	2		8	4
Permitted Phases	6		2		2		
Detector Phase	1	6	5	2	2	8	4
Switch Phase							
Minimum Initial (s)	3.0	10.0	3.0	10.0	10.0	3.0	3.0
Minimum Split (s)	9.0	16.0	9.0	16.0	16.0	9.0	9.0
Total Split (s)	13.0	41.0	13.0	41.0	41.0	24.0	32.0
Total Split (%)	11.8%	37.3%	11.8%	37.3%	37.3%	21.8%	29.1%
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead	Lag	Lead	Lag	Lag		
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		
Recall Mode	None	C-Min	None	C-Min	C-Min	None	None
Act Effct Green (s)	42.0	35.0	42.0	35.0	35.0	18.0	26.0
Actuated g/C Ratio	0.38	0.32	0.38	0.32	0.32	0.16	0.24
v/c Ratio	0.75	0.79	0.50	0.99	0.28	1.21	1.09
Control Delay	47.7	45.6	26.8	73.5	30.1	161.0	111.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.7	45.6	26.8	73.5	30.1	161.0	111.6
LOS	D	D	C	E	C	F	F
Approach Delay		46.1		59.9		161.0	111.6
Approach LOS		D		E		F	F

Intersection Summary	
Cycle Length: 110	
Actuated Cycle Length: 110	
Offset: 74 (67%), Referenced to phase 2:WBTL and 6:EBTL, Start of Green	
Natural Cycle: 120	
Control Type: Actuated-Coordinated	
Maximum v/c Ratio: 1.21	
Intersection Signal Delay: 82.5	Intersection LOS: F
Intersection Capacity Utilization 99.6%	ICU Level of Service F
Analysis Period (min) 15	

Splits and Phases: 1: Caln Road & US 30 Business



APPENDIX D

Selection of Build + Improvement Concepts

The recommendations in this appendix, including proposed designs, are conceptual and require engineering design and feasibility analysis. Actual authority for carrying out any planning proposals rest with the governing bodies of the states or local governments that have the primary responsibility to own, manage or maintain the roadways.

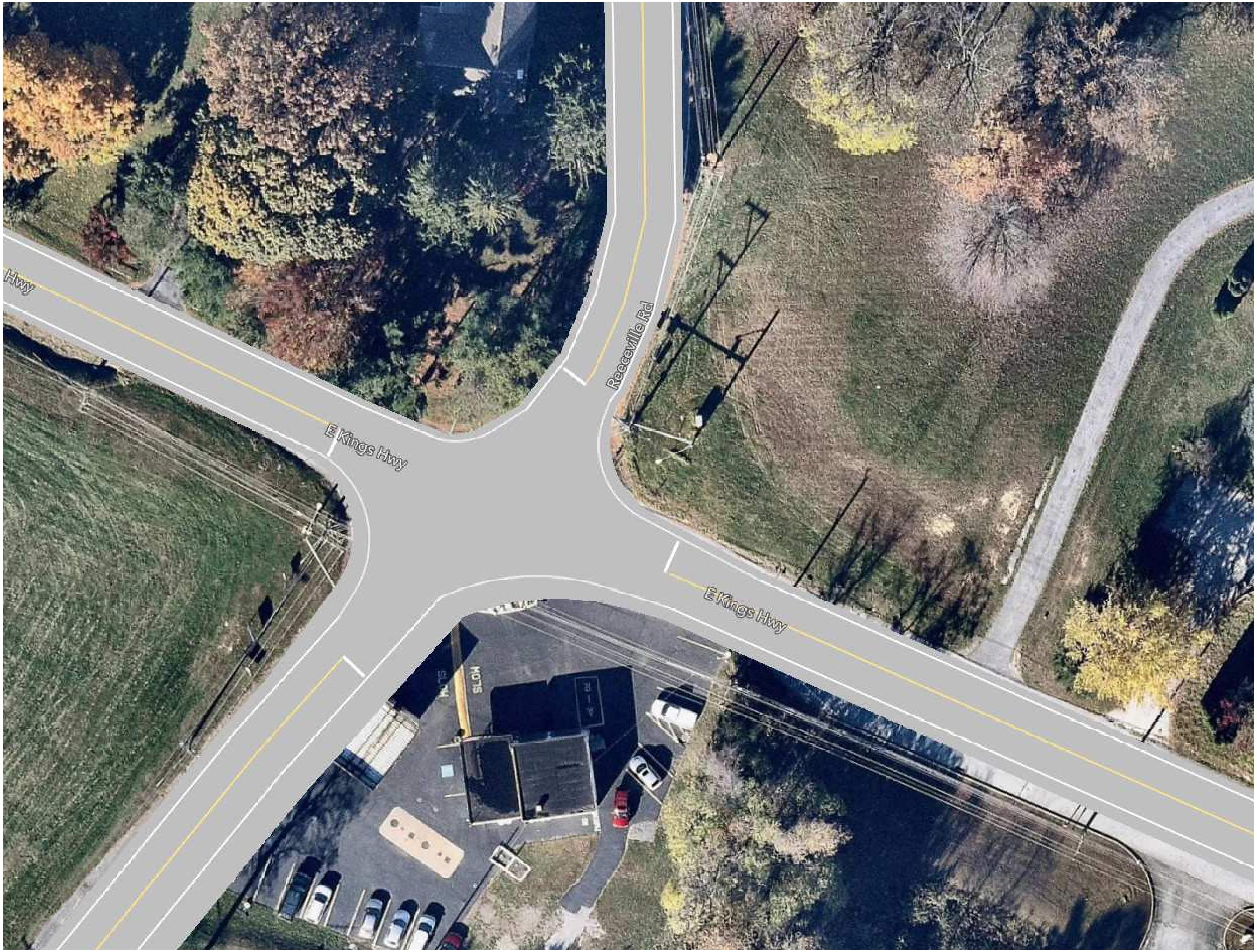
Figure D-1: 30 Ramp / Lancaster Avenue Existing Conditions

Concept Created in Remix, 2021

Figure D-2: 30 Ramp / Lancaster Avenue Proposed Treatment

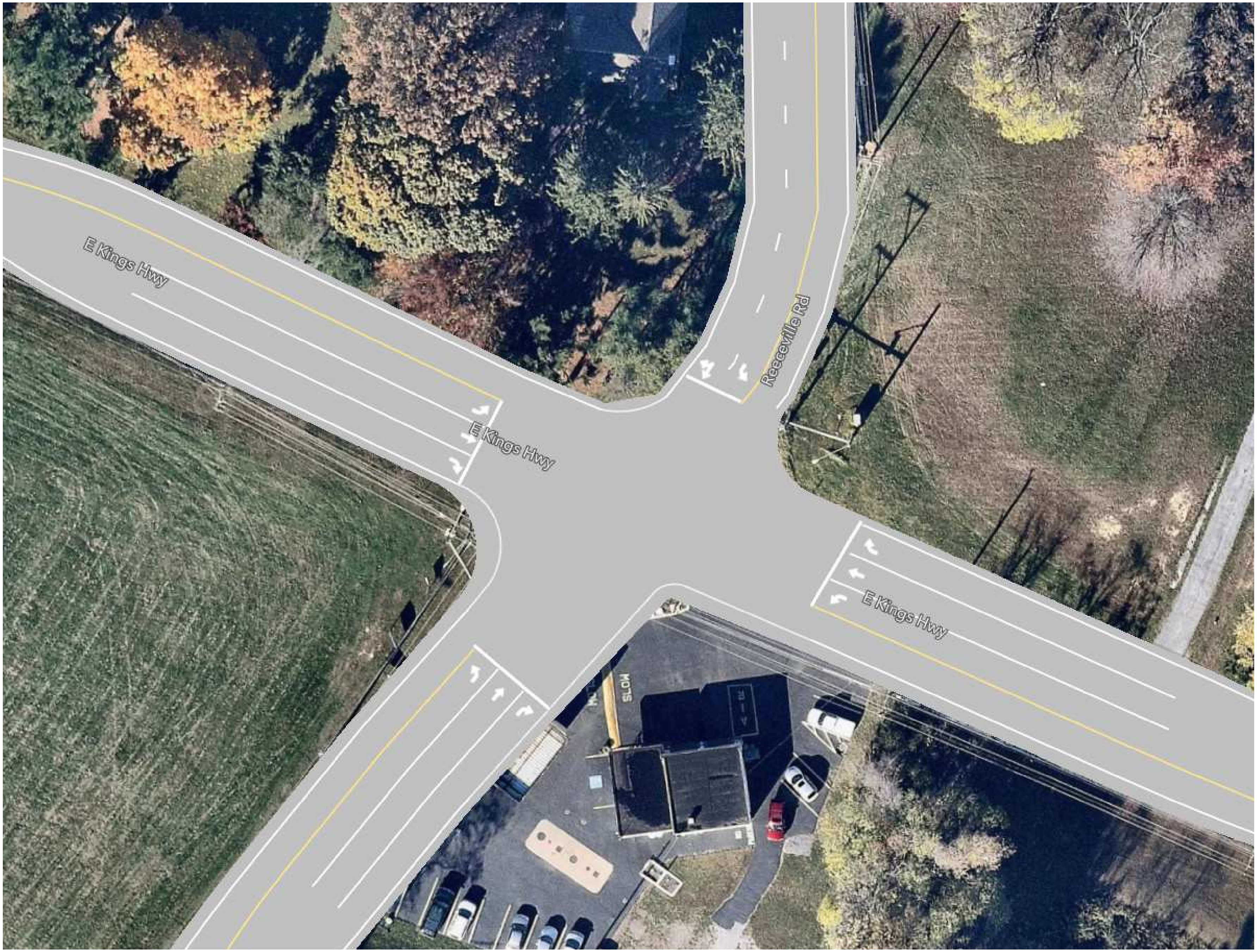
Concept Created in Remix, 2021

Figure D-3: Kings Highway / Caln (Reeceville) Road Existing Conditions



Concept Created in Remix, 2021

Figure D-4: Kings Highway / Caln (Reeceville) Proposed Treatment

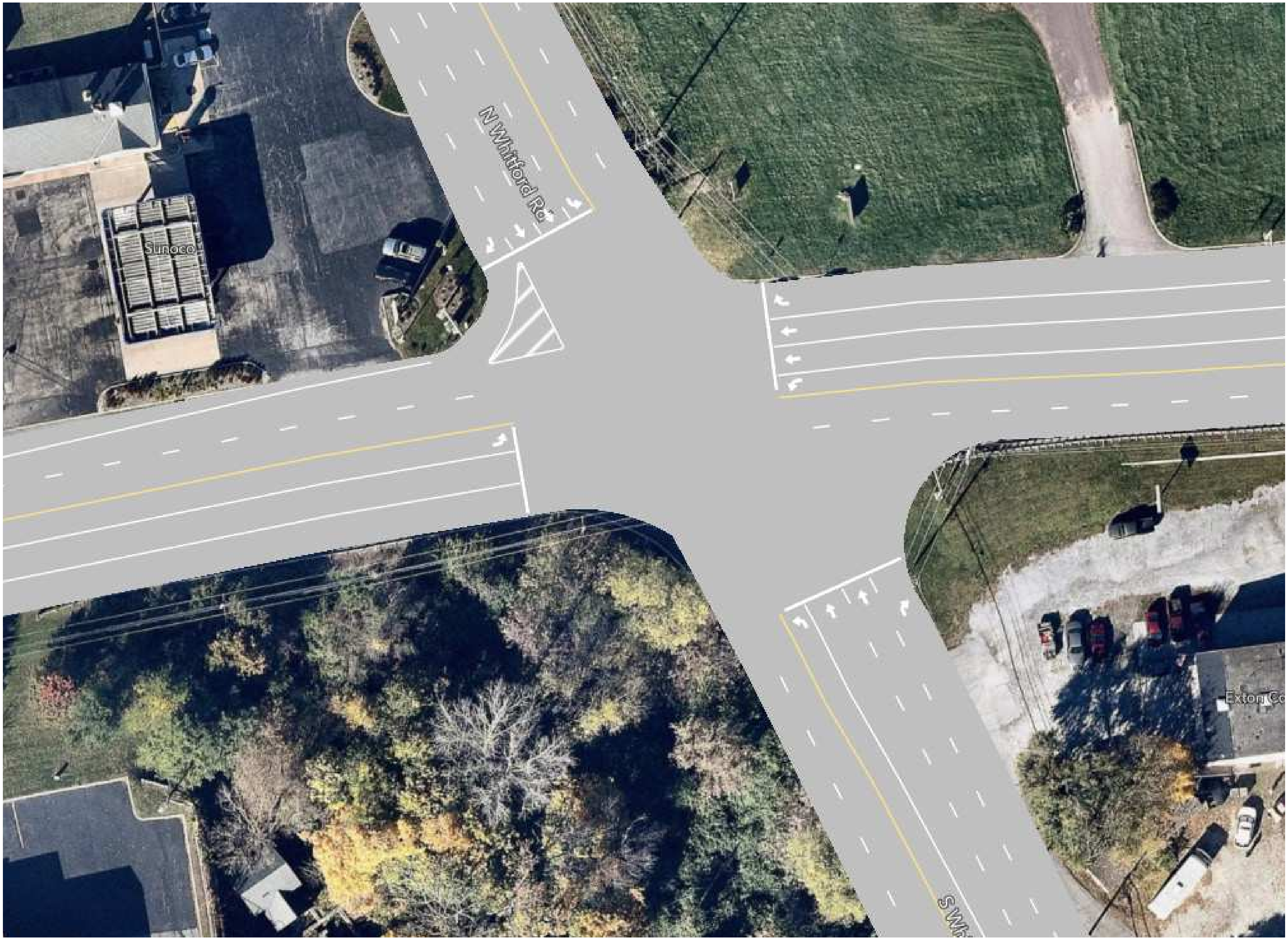


Concept Created in Remix, 2021

Figure D-5: Whitford Road / US 30 Existing Conditions

Concept Created in Remix, 2021

Figure D-6: Whitford Road / US 30 Proposed Treatment



Concept Created in Remix, 2021

Figure D-7: US 322 / Sugars Bridge Road Existing Conditions

Concept Created in Remix, 2021

Figure D-8: US 322 / Sugars Bridge Road Proposed Treatment

Concept Created in Remix, 2021

Figure D-9: Boot Road / Brandywine Avenue Existing Conditions

Concept Created in Remix, 2021

Figure D-10: Boot Road / Brandywine Avenue Proposed Treatment

Concept Created in Remix, 2021

Figure D-11: Manor Avenue / Pennsylvania Avenue Existing Conditions

Concept Created in Remix, 2021

Figure D-12: Manor Avenue / Pennsylvania Avenue Proposed Treatment

Concept Created in Remix, 2021

Figure D-13: Uwchlan Avenue / Bell Tavern Boulevard Existing Conditions

Concept Created in Remix, 2021

Figure D-14: Uwchlan Avenue / Bell Tavern Boulevard Proposed Treatment

Concept Created in Remix, 2021

APPENDIX E

Stormwater Intersection Scoring

Scoring Equation

Intersection Score =

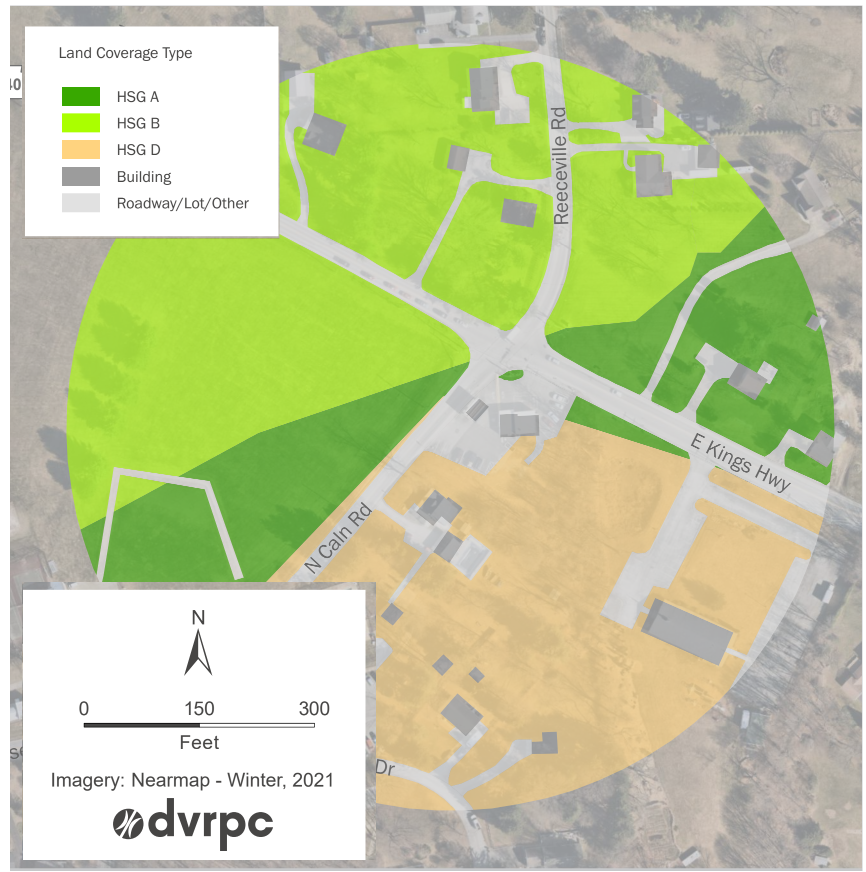
$$\frac{1}{3}\left(0.75\left(\frac{\text{\# ZOI Wet Crashes}}{\text{\# Total Study Area Wet Crashes}}\right) + 0.25\,(\text{AADT Bin Score}) + 1.5\,(\text{ZOI Land Cover Score} + .05\,(\text{ZOI Distance Score})\right)$$

The intersection score (stormwater score) for each intersection was computed based on a number of data inputs. A 500-foot radius was identified around the center of each intersection and the resulting area was defined as the Zone of Influence (ZOI) for analysis purposes. The project team developed a stormwater screening method to provide a framework for the estimation of stormwater runoff resulting from select intersections in the study area, and to prioritize these sites for implementation of stormwater control measures. The score equation was created for this project and is summarized below:

- **Wet crashes** are defined as the number of crash events within a 500-foot radius of the center of the intersection, reported as occurring in wet conditions from 2014 through 2018.
- **Average Annual Daily Traffic (AADT) bin score** is the sum of all approach AADTs at an intersection, divided into bins:
  - AADT ≥ 30,000 = score 1
  - 30,000 > AADT ≥ 25,000 = score 0.875
  - AADT < 25,000 = score 0.65
- **ZOI land cover score** is calculated as a decimal score. It is based on the proportion of impervious area and the type of Hydrologic Soil Group (HSG) as defined in TR-55, Urban Hydrology for Small Watersheds, within the ZOI. Impervious land cover, as well as soil type, were obtained through analysis of GIS datasets. Land cover of a ZOI is illustrated in Figure E-1.
  - Water is counted as impervious area, as rainfall would not be absorbed after falling on it.
- **ZOI distance score** is the shortest distance of the 15 evaluated ZOI's distance downhill to the nearest stream divided by the respective ZOI's distance downhill to the nearest stream.

Coefficients were selected by the DVRPC project team to reflect the relative importance of the respective element in the overall evaluation.

Figure E-1: Land Cover and ZOI



Source: SSURGO, National Cooperative Soil Survey, 2020

Scoring Equation Limitations

While grounded in quantitative data, the equation and its components are ultimately approximations of the hydrogeologic and transportation conditions at a site and should be used for relative comparisons between intersections. The scoring equation does not account for grading within the intersection ZOI or the presence of existing stormwater control facilities at or near study intersections. The equation coefficient scores and bins are also approximations themselves and may artificially adjust the intersection scores. Finally, the equation uses competitive comparison of variables in the calculation of the wet crashes and distance score, which may skew results if this equation is applied to evaluate a very small or very large group of intersections.

Table E-1: Intersection Stormwater Scores

Intersection ID Number	Intersection Name	Stormwater Score
1	US 30 Business and S Bailey Rd	0.654
2	US 322 Horseshoe Pk and Hopewell Rd	0.651
3	US 30 Business and US 322 Manor Ave	0.594
4	US 30 Business and US 322 Brandywine Ave/Park Ln/Wallace Ave	0.575
5	US 30 Business and Bondsville/Marshallton Rd	0.574
6	US 322 Brandywine Ave and Boot Rd	0.572
7	US 30 Business and PA 113 Uwchlan Ave/ Whiteland Ave	0.540
8	US 30 Business and Caln Rd	0.534
9	US 30 Business and Exton Bypass WB Exit	0.530
10	US 30 Business and Whitford Rd	0.515
11	PA 113 Uwchlan Ave and Peck Rd	0.496
12	US 30 Business and Lloyd Ave	0.491
13	US 30 Business and Quarry Rd	0.491
14	US 322 Downingtown Pk and Sugars Bridge Rd	0.461
15	PA 340 E Kings Hwy and Caln Rd	0.422

Downingtown Area Transportation Study

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Development, Downingtown, Mobility, Stormwater, Transit

Abstract:
The Downingtown Area in Central Chester County has experienced significant growth in recent years, along with a corresponding increase in traffic congestion. Several large private developments are planned, which will create additional transportation challenges. Furthermore, the Downingtown Train Station is set to be relocated, which will impact mobility in the surrounding area. The project team examined non-vehicular approaches to mitigate traffic congestion in the Downingtown Area, by improving multimodal accessibility throughout the area and reducing impacts from stormwater runoff. Bicycle network improvements were recommended throughout the Borough of Downingtown to create safer connections to trails and transit, reducing reliance on personal vehicles. Since stormwater runoff has the potential to negatively impact transportation when it accumulates on roadways and sidewalks, intersections were analyzed for stormwater runoff potential and prioritized for stormwater control recommendations.

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