



**Highway Attachment -Delaware Valley Regional Planning Commission (DVRPC) Darby
Borough Phase I and Phase 2 Grade Crossing Studies**

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Darby, Pennsylvania

(133 pages)

PHASE I

MAY 2013



DARBY BOROUGH

GRADE CROSSING STUDY



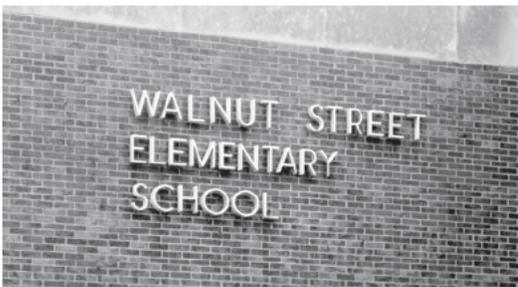
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The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals and the public with a common vision of making a great region even greater. Shaping the way we live, work, and play, DVRPC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



The symbol in our logo is adapted from the official DVRPC seal and is designed as a stylized image of the Delaware

Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

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

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Executive Summary

The Delaware Valley Regional Planning Commission (DVRPC) is the officially designated Metropolitan Planning Organization (MPO) for the nine-county Philadelphia-Camden-Trenton region. The Delaware County Planning Department requested that DVRPC study two highway-railroad grade crossings in Darby Borough. This report represents the summation of Phase I of that effort.

The two grade crossings that are the focus of this study are located in Darby Borough in close proximity to one another, at Main Street (US DOT Crossing # 140641S) and Fifth Street (US DOT Crossing # 140640K), respectively. The two grade crossings are created by the Philadelphia Subdivision, which is owned and operated by CSX, a Class I railroad. The Philadelphia Subdivision runs between Baltimore and Philadelphia, and is a subsection of a main line in the CSX system that runs from Florida to New York. The grade crossing at Main Street has a highly unusual added dimension: the SEPTA Route 11 trolley, which operates in the Main Street right-of-way from 5:00 AM to 2:00 AM daily, also bisects the freight rail line. Additionally, the meeting of the freight line and SEPTA trolley takes place within the intersection of Main Street and Sixth Street.

Darby Borough is located along the eastern edge of Delaware County bordering Philadelphia. According to the U.S. Census information available at the time of this report's publication, Darby Borough has a population of 10,687, a median household income of \$30,938, and a total area of 527 acres. An environmental justice analysis performed for this study shows that there are three Degrees of Disadvantage (DODs) that are found within the borough. They are non-Hispanic minorities, female heads of households with child, and poverty.

An important part of the Phase I work was data collection. DVRPC performed both manual and automated counts at and around the two grade crossings. Below is a summary of the data collected in one calendar day:

- ▶ 11,649 total vehicles were counted on both Main and Sixth streets at the grade crossing
- ▶ 4,146 was determined to be the AADT of Fifth Street at the grade crossing
- ▶ 13 freight trains moved through Darby Borough
- ▶ 763 carloads worth of goods moved through Darby Borough
- ▶ 323 total pedestrians traversed the grade crossing at Main Street between 7:00 AM and 9:00 AM
- ▶ 237 SEPTA Route 11 trolleys were scheduled to cross the Main Street grade crossing on a weekday

This report also lays out a wide array of possible improvements that can be made to highway-railroad grade crossings. This report does not recommend any specific improvements; it merely states possible improvements. Possible improvements include:

- ▶ Upgrades to existing equipment, such as signage, warning devices, and subbase
- ▶ Installation of Secondary Safety Measures, such as four-quadrant gates or channelization devices
- ▶ Changing traffic patterns of vehicles, trolleys, or trains through Darby Borough
- ▶ Fully grade separating the Darby Borough grade crossings
- ▶ Community-based improvements, such as a public education campaigns and improved walking routes

This Phase I report is concluded by discussing Next Steps, which will be undertaken in Phase II. They include conducting walkability studies for the two nearby public schools, developing possible short-, medium-, and long-term initiatives to present to the public, and analyzing the results of public outreach to determine which initiatives should be acted upon immediately and which should be advanced in the longer term.

Introduction

The highway-railroad grade crossing at the intersection of Sixth and Main streets in Darby Borough, Pennsylvania, is the only known location in the country in which an active freight rail line intersects an active trolley line within a state-owned roadway. Because of this, the grade crossing has been on the radar of many agencies for a long time. The unique conditions at this grade crossing pose three major problems: maintenance, traffic flow, and safety. The pounding of the surface and rail where the trolley tracks and train tracks meet has caused substantial continuous pavement degradation, which has forced the grade crossing to be resurfaced many times. Main Street is an active commercial district and a main through road, with over 10,000 vehicles daily. Each train that passes creates a queue of cars and trolleys trying to proceed down Main Street. A high volume of pedestrians, many of whom are students attending one of the two nearby schools, also pass through the grade crossing daily.

While the Main Street grade crossing was the main force driving this study, a grade crossing at Fifth Street has issues of its own, and the proximity of the two grade crossings make it prudent that they be studied together. These are the driving forces behind the Darby Borough Grade Crossing Study. What follows is a Phase I report that focuses on background information and data collection, and lays out a host of possible improvements that will be built upon in the Phase II report.

Previous Technical Work

In 2006, DVRPC published a report, the *Delaware County Highway-Railroad Grade Crossing Study*, which examined 11 highway-railroad grade crossings along the CSX Philadelphia Subdivision in Delaware County. The study contained an inventory of each grade crossing in the corridor, highlighting the existing conditions, such as DOT Identification Number, location, road owner, annual average daily traffic, number of daily trains, warning devices, adjacent land use, and crash data.

The purpose of the study was to identify improvements that might better integrate the rail freight traffic with the goals of the host communities, particularly taking into account the grade crossings. To this end, the report spelled out improvement options for the entire rail corridor and for individual grade crossings, such as supplemental safety measures, grade crossing consolidation, and grade separation.

Steering Committee

Integral to the completion of this report was the steering committee, which met to discuss the report's progress and review completed materials. Members of the steering committee also assisted by sharing data and lessons learned. The following is a

list of organizations that were invited to participate in the steering committee and made invaluable contributions to the contents of this report:

- ▶ CSX;
- ▶ Darby Borough;
- ▶ Delaware County Planning Department;
- ▶ Delaware County Transportation Management Association;
- ▶ Federal Railroad Administration;
- ▶ PennDOT;
- ▶ Pennsylvania Public Utility Commission – Rail Safety Section;
- ▶ SEPTA; and
- ▶ William Penn School District.

Report Organization

The Darby Borough Grade Crossing Study: Phase I is organized as follows:

- ▶ Current Conditions and Background
 - ◆ This section contains extensive background information about the transportation systems and land use, both at the grade crossing and in Darby Borough in general. This section also contains information on Class I Railroads in the DVRPC region, general grade-crossing guidance and laws, Operation Lifesaver, and environmental justice.

▶ Data Collection Endeavor

- ◆ DVRPC collected a large amount of data for the purposes of this study. That data are summarized in this section and categorized by movement type (i.e., pedestrian data, vehicular data, trolley data, and train data).

▶ Possible Improvements

- ◆ This section contains many different ways to improve a highway-railroad grade crossing. For each improvement, three sections are provided: an overview of the improvement, how the improvement would be applicable in Darby Borough, and possible considerations that need to be accounted for before moving forward with the improvement.

▶ Next Steps

- ◆ This section explains what tasks DVRPC will be undertaking as part of Phase II of this study.

Current Conditions and Background

This chapter will provide background on Darby Borough and the study area, specific information about highway-railroad grade crossings, a summary of Class I grade crossings in the region, and additional information about grade crossings in general.

Darby Borough

Darby Borough is located along the eastern edge of Delaware County bordering Philadelphia. Darby Borough is believed to have been founded in 1682 by John Blunston and other Quakers from Darbyshire, England. Traces of Darby's Quaker and colonial roots still remain, with an active Meeting House that was built in 1805, sitting at 1017 Main Street; a half-mile away from the study location. This section covers basic current conditions in Darby Borough, such as land use and demographic data, which are important to consider throughout this study.

Demographics

According to the 2010 Census, Darby Borough has a population of 10,687. The borough is predominately African-American (78.9 percent of residents), with white being the second highest racial group (16.2 percent of residents). There are 3,367 households, 1,403 of which have a child under 18 years of age living in the house. The average household size for the borough is 3.03 occupants. The majority of Darby Borough is made up of single-family homes, with 52.4 percent of households being owner occupied and 47.6 percent of households being renter occupied. There are 521 vacant homes in Darby Borough.

In 2000, Darby Borough had 4,169 residents in the labor force, of which 3,688 were employed and 477 were unemployed. By far the highest sector of employment for borough residents was Educational, Health, and Social Services, with 29.6 percent of employed residents working in the sector. The median household income was \$30,938. In terms of how Darby Borough residents got to work, 2,028 drove alone, 431 drove in a carpool, 854 took public transit, and 215 walked.

W.C. Fields was born William Claude Dukenfield in Darby, Pennsylvania, on January 29, 1880. He was an American comedian, actor, juggler, and writer. He starred in numerous films and Broadway shows, such as Ziegfeld Follies and Poppy.

Land Use

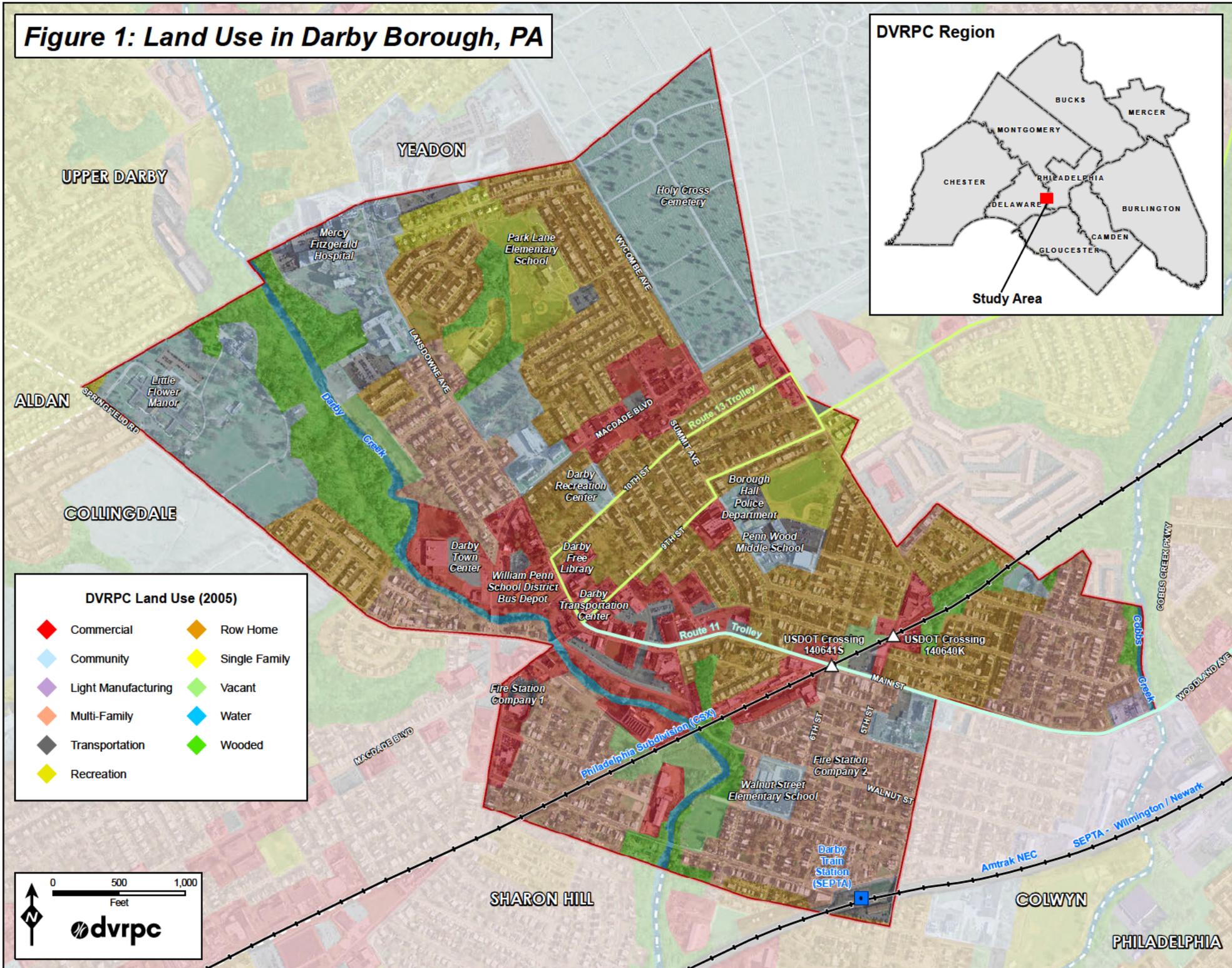
Darby Borough is a small municipality of 527 acres. Eighty-five percent of the land within the borough is made up of five different land use types:

- ▶ Single-family Residential – 21 percent;
- ▶ Multifamily Residential – 16 percent;
- ▶ Transportation – 16 percent;
- ▶ Commercial – 12 percent; and
- ▶ Community Services – 20 percent.

The business district of Darby Borough runs along Main Street, from Fifth Street to MacDade Boulevard, and then continues along MacDade Boulevard in both directions (see Figure 1). The Darby Transportation Center sits in the middle of the commercial area and serves numerous bus and trolley lines. In recent years, there have been some signs of commercial revitalization in Darby Borough. In December 2010, the Save-a-Lot Food Store in the Darby Town Center officially opened, signaling the first time a grocery store existed in Darby Borough in 30 years. The 17,000-plus square foot store will anchor the town center, which will also include other retailers. In total, the new Darby Town Center will be 142,000 square feet of retail and will bring an estimated 200 permanent local jobs to Darby Borough.

As mentioned in the Demographics section above, the sector that employs the most Darby Borough residents is Educational, Health, and Social Services. Not surprisingly, there are a number of facilities in Darby Borough that employ residents in these fields. Darby Borough has two elementary schools, Park Lane Elementary and Walnut Street Elementary, which is closer to the grade crossings. Also close to the study area is the Penn Wood Middle School, which is the only middle school in Darby Borough. There is no high school in Darby Borough, as residents attend Penn Wood High School in Lansdowne. In the health arena is the Mercy Fitzgerald Hospital, which is a 218-bed teaching hospital that has been in existence for 76 years. Little Flower Manor in the extreme western corner of Darby Borough is a nursing care facility that also offers short-term rehabilitation care for senior citizens.

Figure 1: Land Use in Darby Borough, PA



From the perspective of social services, the borough is home to a number of facilities for local government, police, and fire. On April 7, 2011, the new Darby Recreation Center opened. The 11,000-square-foot building has a gymnasium, conference space, and a full-service kitchen. The borough has received an additional \$2,000,000 in funding to expand the recreation center to include a new municipal center, which will include new headquarters for the police force, administration offices, and district court chambers.

Highways and Streets

Much of the street system in Darby Borough is grid-like, with numbered streets (there are 10 numbered streets, First Street through 10th Street) running north to south, and named streets (primarily named after trees) running east to west. Main Street runs through the middle of Darby Borough and connects to roads on either end that link to the surrounding communities and greater highway system.

At the east end of Darby Borough, Main Street intersects with three other roads: Cobbs Creek Parkway, Woodland Avenue, and Island Avenue. Cobbs Creek Parkway carries vehicles north along the Philadelphia city line and becomes 63rd Street north of Market Street in West Philadelphia. Woodland Avenue is the natural extension of Main Street to the east and allows vehicles to travel into the University City area. Island Avenue runs south and connects Darby Borough into both I-95 and the Philadelphia International Airport.

At the west end of Darby Borough, Main Street connects into four major roads: MacDade Boulevard, Chester Pike, Lansdowne Avenue, and Springfield Road. MacDade Boulevard and Chester Pike (US 13) run parallel to each other, south from Darby Borough through Delaware County along the I-95 Corridor. MacDade Boulevard connects to I-476 at Interchange #1 and then turns into 22nd street in Chester, Pennsylvania. Chester Pike (US 13) also extends into Chester, Pennsylvania, turning into Morton Avenue and then Ninth Street (both of which are designated as US 13). Springfield Road allows vehicles to travel west out of Darby Borough and connects into Clifton Heights and Springfield Township before ultimately turning into Sproul Road (PA 320) in Marple Township. Lansdowne Avenue is the most natural extension of Main Street. At the western edge of Darby Borough, it connects into Lansdowne Borough before intersecting West Chester Pike (PA 3).

Public Transit

The Southeastern Pennsylvania Transportation Authority (SEPTA) operates six subway-surface trolleys, which are collectively referred to as the “Green Line.” The subway-surface lines are remnants of the far more extensive streetcar system that developed after the arrival of electric trolleys. Two of these lines terminate at the Darby Transportation Center, the Route 11 and the Route 13 (note, the Route 13 has limited service to Darby Borough).

The Route 11, when running from east to west, starts at the 13th Street station under Market Street in Philadelphia. It stops at multiple underground stations before surfacing near 40th Street and Baltimore Avenue. Once above ground, the trolley runs southwest along Woodland Avenue, making stops at every block for boarding and departing. At the intersection of Island Road and the Cobbs Creek Parkway, the Route 11 moves northwest from Woodland Avenue onto Main Street as it crosses Cobbs Creek and enters Darby Borough. In Darby Borough, the Route 11 travels down Main Street, across the highway-railroad grade crossing at Sixth and Main streets, and terminates at the Darby Transportation Center.

Internet research indicates that the Route 11 was established as the West Philadelphia Passenger Railway Company in Darby Borough in 1858, and ran as horse cars from Ninth and Main Streets in Darby to 49th Street and Woodland Avenue in West Philadelphia. The line was integrated into the subway-surface trolley system in 1906.

The Route 13 primarily terminates at Chester Avenue in Yeadon, just before the Darby Borough border, but there is limited service to the Darby Transportation Center, mostly during rush hour. While the Route 13 uses Ninth and 10th streets to access the transportation center, the Route 13 trolley still occasionally runs down Main Street because those trolleys may be stored in the Island Avenue Trolley Yard when not in operation. The Island Avenue Trolley Yard is located at the intersection of Island and Elmwood avenues, approximately a quarter mile from the intersection of Island Avenue and Main Street.

In addition to trolley service, the Darby Transportation Center acts as a hub for three suburban bus routes. The Route 113 runs from the 69th Street Transportation Center to the Darby Transportation Center, down MacDade Boulevard, through Chester City, and terminates at the Tri-State Mall in Delaware. The Route 114 originates at the Darby Transportation Center, from which it runs down Chester Pike, through Chester City, and out Route 452, terminating at the Granite Run Mall on Baltimore Pike. The Route 115's principal route is between the Darby Transportation Center and the Philadelphia International Airport; however, the line also runs limited service to the Delaware County Community College via Lansdowne Avenue and West Chester Pike.

OcTrolleyFest is an annual event that occurs in Darby, Pennsylvania, in October. This day celebrates the transportation heritage of Darby. Residents and visitors are able to board a historic trolley that will take them to the many events at the festival.

Environmental Justice

Title VI of the Civil Rights Act of 1964 and President Clinton's 1994 Executive Order on Environmental Justice (#12898) state that no person or group shall be excluded from participation in or denied the benefits of any program or activity utilizing federal funds. DVRPC, the Metropolitan Planning Organization (MPO) for the Delaware Valley, is required to evaluate its plans and programs for environmental justice (EJ) sensitivity, including expanding its outreach efforts to low-income, minority, and other disadvantaged populations.

As a result of DVRPC's EJ work, an internal method of analysis was created as a way to identify disadvantaged communities within the region. Using the 2010 U.S. Census data, DVRPC evaluated eight degrees of disadvantage (DOD), which includes poverty, non-Hispanic minorities, Hispanics, elderly (75 years of age and older), carless households, physically disabled, Limited English Proficiency (LEP), and female heads of household with children.

There are three census tracts for Darby Borough. Two of these tracts are most directly linked to this study. The DOD analysis for these two tracts shows that three DODs can be found in both tracts. The DODs that are found within the study area are non-Hispanic minorities, female heads of household with child, and poverty. This analysis indicates that any potential impacts of transportation improvement projects should take into consideration the interests and concerns of these groups.

The Hilldale Daisies, also known as the Darby Daisies, was an African American professional baseball team based in Darby, Pennsylvania. This baseball team was established in 1910 as a boy's club team and later became a professional team in 1916. The team won the Negro League World Series Championship in 1925.

The Study Area: Main Street and Fifth Street Grade Crossings

The two grade crossings that shape the study area are created by the Philadelphia Subdivision rail line, which is owned and operated by CSX, a Class I railroad. The Philadelphia Subdivision runs between Baltimore and Philadelphia, and is a subsection of a main line in the CSX system, which runs from Florida to New York. The Philadelphia Subdivision was built by the Baltimore and Philadelphia Railroad in Pennsylvania as a branch of the B&O Railroad in Delaware and Maryland, and began full operation in 1886.

In Delaware County, the Philadelphia Subdivision has one main track and a series of passing sidings. There are two major facilities that the line serves in Delaware County, an intermodal automobile facility in Twin Oaks and a Transflo bulk facility in Chester. The Philadelphia Subdivision carries mostly through trains and has few, if any, local customers along the line. The line is heavily used, with a range of approximately 15 to 25 trains operating on a daily basis. Freight trains operating on this line haul virtually any substance, including consumer products, bulk commodities, hazardous materials, and even solid waste. Freight trains may be seen carrying various types of rail equipment, such as box cars, tank cars, hopper cars, containers, and trailers on flat cars. These cars travel along the main line until they are shifted to more local lines (shortlines or secondary lines) or handled in an intermodal facility.

USDOT Number

All highway-railroad grade crossings in the United States, public or private, both at-grade and separated, are required by law (Rail Safety Improvement Act of 2008) to have a DOT Crossing Inventory Number. For at-grade crossings, the number should be posted at the crossing. A crossing inventory number contains six digits followed by a letter.

In Darby Borough, the Main Street grade crossing is designated as crossing #140641S and the Fifth Street grade crossing is designated as crossing #140640K. The number is unique to specific location and should be posted, preferably on sign on both sides of the grade crossing. Responsibility for purchasing and displaying the signs is the responsibility of the railroad.

The crossing numbers are useful for reporting an incident or maintenance concern at a grade crossing. Each grade crossing should be equipped with placards that display this number, along with a phone number for the railroad that owns the rail line.

Main Street Grade Crossing

The Main Street grade crossing is the only known grade crossing in the country in which an active freight rail line crosses an active fixed-rail transit line, with vehicular traffic also operating in the grade crossing. The Main Street grade crossing is made even more unique by the fact that the crossing is located within the intersection of Main and Sixth streets. Main Street is one lane in each direction, while Sixth Street is one way southbound to the south of Main Street and two way north of Main Street. There is parking on either side of both Main and Sixth streets. Additionally, there are sidewalks on either side of both Main and



The Crossing ID placard at the Fifth Street grade crossing (#140640K) in Darby, PA. (Source: DVRPC)

Sixth streets at the grade crossing, but the sidewalk on the east side of Sixth Street north of Main Street ends abruptly shortly after the intersection.

The Main Street grade crossing is equipped with warning devices, including: gates, pedestrian gates, flashing lights (over lane and mast mounted), and warning signs. There are three vehicular gates, blocking each of the three lanes that enter the grade crossing/intersection. Sixth Street south of Main Street is one way, away from the crossing; thus, there is no traffic lane that enters the intersection from this direction. Because of this, there is no gate, but there are overhead and mast mounted flashing lights.

Fifth Street Grade Crossing

The Fifth Street grade crossing is located 500 feet northeast of the Main Street grade crossing. This grade crossing is more traditional in nature in that there is no trolley or other roadway bisecting Fifth Street at the grade crossing. The grade crossing is located 350 feet north of the intersection of Fifth and Main streets, which is signaled and has a Route 11 trolley stop, and 125 feet south of the intersection of Greenway Avenue and Fifth Street, which is only a three-way intersection, with Greenway deadending into Fifth Street.

Like Main Street, Fifth Street is equipped with gates, flashing lights (over lane and mast mounted), and warning signs. While the Main Street grade crossing is relatively flat, Fifth Street slopes upward on either side of the rail line. The sidewalks along Fifth Street are not clearly defined through the grade crossing, and there are no pedestrian gates.

Land Use at the Crossings

The crossing at Main Street is surrounded on three sides by commercial development and on one side by a vacant lot owned by CSX. In the northwest quadrant of the Main Street grade crossing is a bar/restaurant. This establishment is set off from the street and has a parking area located between the front door and the Main Street grade crossing. In the southwest corner of the Main Street grade crossing is a business that rents out heavy-duty machinery. This business generates significant truck traffic, some traditional tractor trailers, and some nontraditional oversized commercial vehicles. The business' property line



The gates closing for an oncoming train at the Main Street grade crossing (facing west). (Source: DVRPC)



The Fifth Street grade crossing looking south toward Main Street. (Source: DVRPC)

runs directly along the rail line, and the entrance is directly adjacent to the Main Street grade crossing. Commercial vehicle drivers serving this business occasionally choose to stop in the grade crossing in order to turn into the entrance.

In the southeast corner of the Main Street grade crossing, there is a strip of various commercial operations, mixed with buildings that appear seldom used or vacant. Directly at the intersection is a large building, the use of which is undistinguishable. Following that as the buildings proceed east toward Fifth Street are:

- ▶ An upholstery store;
- ▶ A building that may house apartments;
- ▶ A food market, which created significant foot traffic during morning and evening peak periods during field work;
- ▶ A Chinese restaurant, which created significant foot traffic in the evenings;
- ▶ A Laundromat;
- ▶ A residential-looking property; and
- ▶ A barbershop.

The land use around the Fifth Street grade crossing consists of three industrial buildings and one commercial building. The industrial buildings include two businesses, one of which distributes and serves HVAC and air-filtration products, and the other, which is a metal-recycling facility, as well as a possibly vacant building. The one commercial business at the Fifth Street grade crossing is a bar located in the northwestern quadrant of the grade crossing. There is residential housing in close proximity, along both Fifth Street and Darby Terrace, but not adjacent to the grade crossing.

Sidewalks Adjacent to the Grade Crossings

The Main Street and the Fifth Street grade crossings are subjected to high levels of daily pedestrian activity. This activity is primarily due to the adjacent residential areas, the business district along Main Street, and the elementary and middle schools in the nearby vicinity.

The condition of the sidewalks near the Main Street grade crossing is significant because of the amount of pedestrian activity, as well as for pedestrian safety. Along the north side of Main Street, the sidewalks were recently upgraded by CSX from brick to concrete. The curbs for these portions of sidewalk are in poor condition. In addition, along the east side of Sixth Street north of Main Street, the sidewalk unexpectedly ends soon after the intersection. The section of sidewalk located along the west side of Sixth Street south of Main Street is poorly separated from the roadway. There is no curb to indicate where the roadway begins.

The section of sidewalk along the south end of Main Street west of Sixth Street, as well as the section along the east side of Sixth Street north of Main Street, is interrupted by the location of the CSX tracks.

In the vicinity of the Fifth Street grade crossing, the sidewalks are also in poor condition. First, they are not clearly delineated from the roadway. This can create potential hazards between pedestrians and vehicles. Additionally, there are no pedestrian gates to deter pedestrians from crossing the rail lines when there is an oncoming freight train. Finally, the roadway slopes uphill and downhill before and after the rail lines, respectively. This may cause a difficult situation for any disabled person seeking to cross the rail line.

Class I Grade Crossings in DVRPC Area

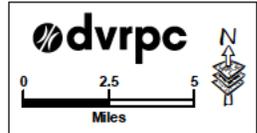
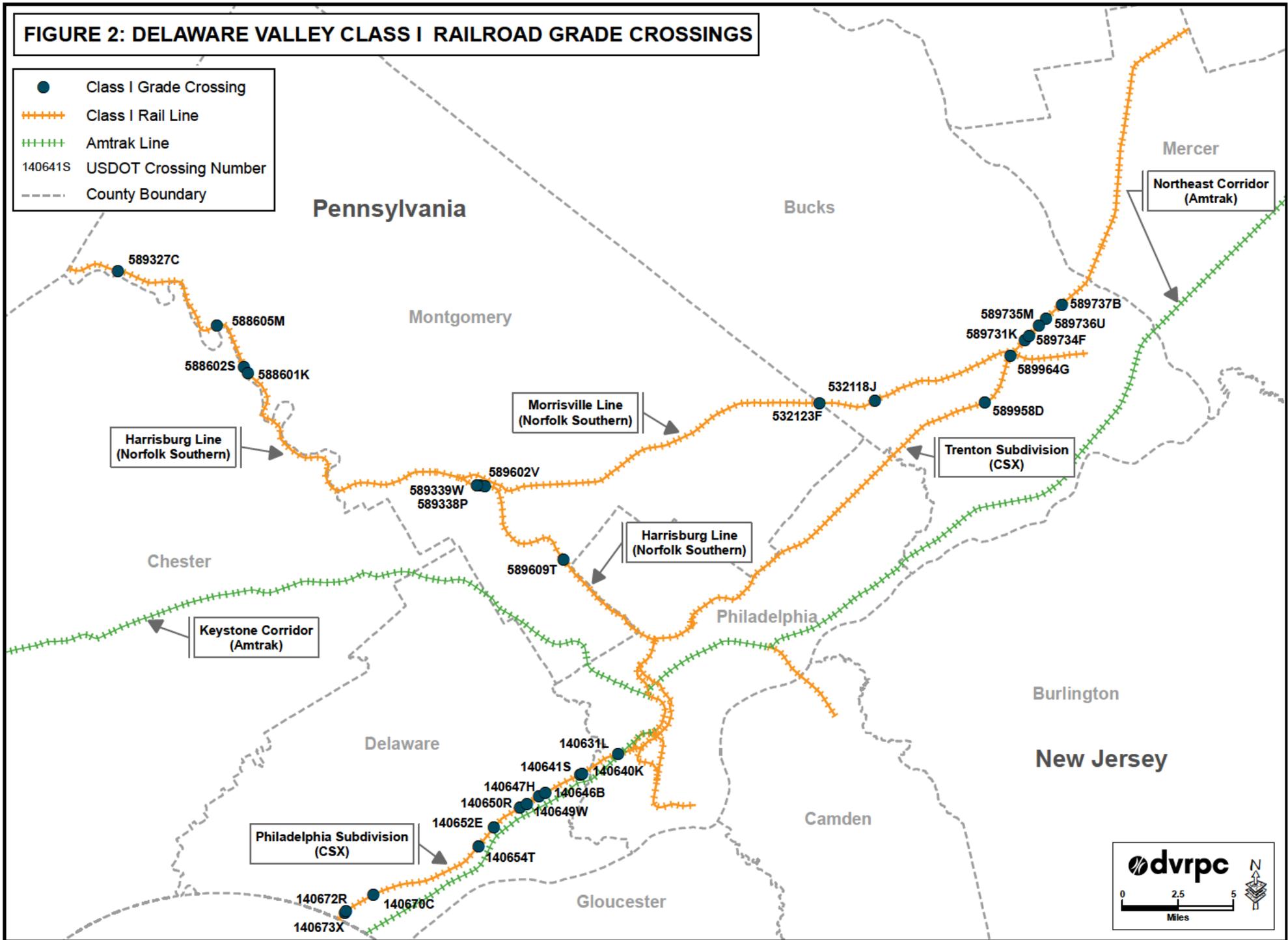
Class I rail lines are comparable to interstate highways in that they have the highest volumes of train traffic, are engineered for the highest speeds, and are better maintained than other rail lines in the region. Trains on these lines are owned and operated by Class I carriers, the nation's highest classification of railroad. Class I railroads are generally defined as those with annual operating revenues of \$250 million or more. The Delaware Valley is uniquely served by three Class I freight railroads: CSX, Norfolk Southern, and the Canadian Pacific (note: Amtrak is also classified as a Class I carrier).

The Class I rail system in the Delaware Valley can be simplified into four primary lines. The Harrisburg Line, owned and operated by Norfolk Southern, connects Philadelphia to Harrisburg and points beyond. The Morrisville Line, also owned and operated by Norfolk Southern, connects an intermodal facility in Morrisville with the Harrisburg Line. The Philadelphia and Trenton subdivisions are owned and operated by CSX, and make up parts of the CSX main line, which runs north-south along the East Coast from Florida to New Jersey (note: the Canadian Pacific is able to serve the region by virtue of trackage rights and agreements that it enjoys on the lines owned by CSX and Norfolk Southern). These lines lead to rail lines in other states, other Class I carriers, and even Canada and Mexico.

In the DVRPC region, there are 29 highway-railroad grade crossings along these Class I rail lines. Because of the high train volumes, speeds, and carloads, these 29 locations are important in terms of safety, pedestrians, and train and vehicular operations. Of the four primary lines, the Philadelphia Subdivision has the most highway-railroad grade crossings, 12, while the Harrisburg Line has eight, the Trenton Subdivision has seven, and the Morrisville Line has two.

FIGURE 2: DELAWARE VALLEY CLASS I RAILROAD GRADE CROSSINGS

- Class I Grade Crossing
- +++++ Class I Rail Line
- +++++ Amtrak Line
- 140641S USDOT Crossing Number
- - - - County Boundary



Grade Crossing Background

This section provides general information regarding grade crossings. The majority of the information is taken from the *Railroad-Highway Grade Crossing Handbook, US Department of Transportation, Revised Second Edition, August 2007*.

Horn Noise

All locomotives are equipped with air-powered horns, which are required by law to be used when approaching a grade crossing. The engineer inside the locomotive will sound the horn in a sequence of two long blasts, followed by a short blast, followed by another long blast, as the train approaches the grade crossing. The federal regulations require that the horn sequence be initiated between 15 and 20 seconds prior to the arrival of the train at the grade crossing; however, most existing state laws and railroad rules require that the horn be sounded beginning at a point a quarter-mile in advance of the grade crossing and continue to be sounded until the grade crossing is occupied by the locomotive. There are a series of exceptions to the train horn rules, the most prevalent and well known of which are quiet zones.

Quiet Zone regulations are intended to maintain a high level of public safety, while providing local communities with relief from unwanted train noise. There is a series of “supplementary safety measures,” “alternative safety measures,” education, and enforcement options that can be used to raise public safety at a grade crossing to the point that a community can seek a quiet zone designation. Once a quiet zone is established, the railroad is barred from sounding the horn at the affected grade crossing, or grade crossings (note: a railroad may still need to initiate the horn in a quiet zone for railroad-operations-related reasons). The local entity (e.g., Darby Borough) tasked with maintenance or enforcement of the roadway at the grade crossing is the only entity that may apply for a quiet zone. Additionally, both the capital and maintenance costs of the added safety measures needed to secure quiet zone statues fall on the applying entity, not the railroad.

Train Detection

In the DVRPC region, 27 of the 29 Class I grade crossings have active warning devices (lights, bells, and/or gates) that notify highway traffic of an oncoming train. An important aspect in the functioning of these systems is the train-detection systems along the rail line. There are multiple technologies that serve this purpose, some that use electricity that the train trips at a certain point, and some that are specially designed to use the motion of the train to activate the warning devices. On tracks where trains operate in excess of 20 MPH (such as the CSX Philadelphia Subdivision), the federal guidelines state that, “The circuits controlling automatic flashing light signals shall provide a minimum operation of 20 seconds before the arrival of any train” (*Railroad-Highway Grade Crossing Handbook, US Department of Transportation, Revised Second Edition, August 2007, Page 114*).

Roles and Responsibilities for Grade Crossings

Many federal, state, local, and private agencies play a role in grade crossing safety and maintenance. Below is a list of the most important agencies and a brief description of their general responsibility.

- ▶ Federal Highway Administration (FHWA). FHWA administers federally funded programs, several of which can be used to fund capital improvements at grade crossings.
- ▶ Federal Railroad Administration (FRA). FRA maintains data about each highway railroad grade crossing in the “National Highway Rail Crossing Inventory,” as well as data about each incident at a crossing in the “Railroad Accident/Incident Reporting System.”
- ▶ Pennsylvania Public Utility Commission (PUC). Jurisdiction over highway-railroad grade and grade-separated crossings falls mostly to each state. In Pennsylvania, the responsible agency is the PUC. Anything regarding improvements, cost allocation, and closings that has to do with grade crossings must be approved by the PUC.
- ▶ Railroads. Railroads are responsible for all installation and maintenance of tracks and roadway within the grade crossing. The railroad is also responsible for the design, construction, operation, and maintenance of highway-railroad grade crossing signals (cross bucks, lights, gates, etc.).
- ▶ State and local government. The enforcement of traffic laws within the grade crossing falls to the local police department (e.g., Darby Borough Police). The roadway owner, be it the state or local entity (e.g. PennDOT), is responsible for making sure that the standards set forth by the federal government are followed by the railroad in regards to the design, construction, operation, and maintenance of railroad grade crossing signals (cross bucks, lights, gates, etc.). These agencies are responsible for all traffic control devices on the approaches to the grade crossing. This includes, but is not limited to, traffic signals (even if interconnected with the railroad warning systems), and passive signs, such as “Do Not Stop on Tracks.”

Traffic Laws at Grade Crossings

In general, the laws of the roadway extend into the grade crossing when no train is in the vicinity. Once the active warning system has been initiated, drivers that enter the grade crossing are subject to heavy fines and suspension of their driver’s license. All buses (such as public transit, tour, and school buses) are legally required to come to a complete stop at every grade crossing, regardless of whether the active train warning devices are in operation. This law also extends to all trucks that are carrying hazardous materials.

Operation Lifesaver

Operation Lifesaver is a nonprofit organization devoted to increasing the safety at highway-railroad grade crossings through public education. The organization was founded in Idaho in 1972, and in 1986, a national office was opened to support the efforts of the state-level programs and raise national awareness. Today, Operation Lifesaver provides a network of certified volunteers to speak to a wide range of groups, including schools, community groups, professional groups, and law enforcement. The national Operation Lifesaver office produces flyers and give-away items intended to raise awareness and make learning about the dangers of grade crossings fun and meaningful.

As part of this study, DVRPC staff and certified Operation Lifesaver volunteers conducted three events in Darby Borough. On the morning of September 14, 2011, an official Operation Lifesaver brochure was distributed to all pedestrians at the Main Street grade crossing. In the evening of that same day, DVRPC staff attended the Walnut Street Elementary School back-to-school night. DVRPC staff was assigned a table from which they handed out a wide array of kid-friendly Operation Lifesaver merchandise, such as erasers, pens, pencils, and coloring books, and safety flyers for the parents. On Thursday, September 15, DVRPC staff and an Operation Lifesaver volunteer attended the Penn Wood Middle School back-to-school night and talked to students and parents about safety, and handed out additional flyers and age-appropriate merchandise.

Data Collection Endeavor

When considering improvement options at a particular grade crossing, having accurate and up-to-date data is essential. Through the study's steering committee, DVRPC coordinated with Delaware County, Darby Borough, SEPTA, PennDOT, and CSX to collect representative data at the two grade crossings in Darby Borough. Multiple varieties of data collection were performed and are organized in this chapter into five categories: pedestrian counts, vehicular counts, trolley counts, train counts and gate closures, and accidents/incidents. The chapter ends with a section that attempts to break down all the different aspects of the grade crossings into a brief summary of the data collected.

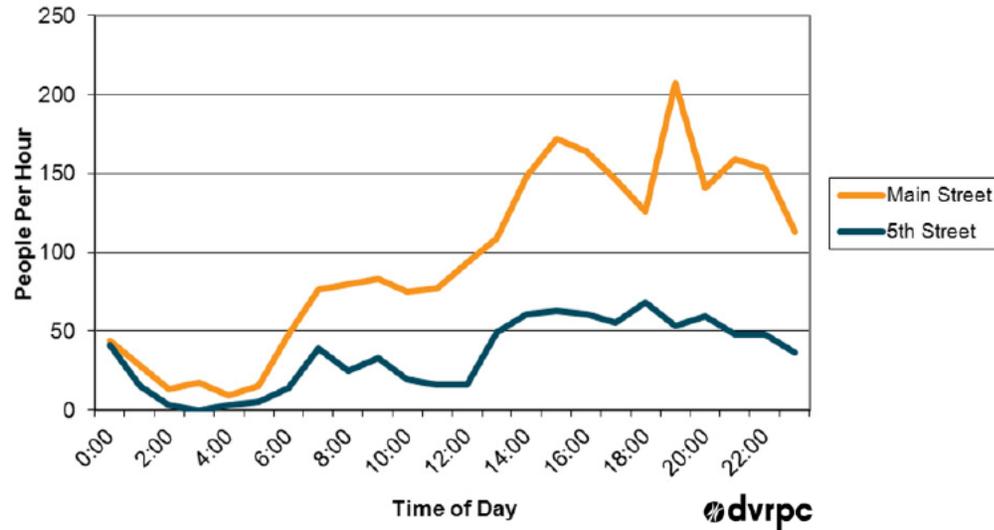
The data collection effort was concentrated into one 24-hour period. Working with the steering committee, a date of April 27, 2011, was selected. DVRPC has augmented the data collected in this intensive one-day effort with other field work, by coordinating with other agencies that have provided data and information contained in this section. The data presented in this chapter leads to a better understanding of operations at the grade crossing and will feed into future applications in Phase II of this study.

Pedestrian Counts

The movement of people at a grade crossing is a key form of activity from a safety perspective. This is especially true in a densely developed community such as Darby Borough. Along Main Street, in direct proximity to the grade crossing, a number of businesses attract significant pedestrian traffic. A sampling of some of the businesses include a food market, a Chinese restaurant, and a barber shop, all located on the south side of Main Street east of the grade crossing, and a bar located in the northwestern corner of the grade crossing. In addition to these businesses, pedestrian traffic is generated by the Route 11 trolley stop, which occurs at the Main Street grade crossing. The amount of pedestrian traffic at this grade crossing is significantly higher than at most Class I grade crossings in the region. Given the amount of traffic and the possible safety concerns, pedestrian counts were important to include in the data collection effort.

DVRPC collected pedestrian counts on both Main Street and Fifth Street near the grade crossings using state-of-the-art automated pedestrian counters. Figure 3 contains a profile of pedestrian activity along both Main Street and Fifth Street that these counters captured.

Figure 3: 24-hour Pedestrian Counts along Main Street and Fifth Street



The counts portrayed in Figure 3 reflect movements (in any direction) on the sidewalks along either side of the roadway. The counters are designed to record each movement of a person past the machine, so the numbers above do not represent total pedestrians, but rather total movements. For example, it is possible that some people were counted twice if they went to and returned from a destination using the same route. For both Main Street and Fifth Street, pedestrian activity peaked in the evening between roughly 7:00 and 9:00 PM. There were also slight peaks in the morning and afternoon rush hours, which are likely the result of student activity before and after school.

During field views, DVRPC staff observed that Sixth Street carried a high amount of pedestrian traffic, specifically students walking to the local elementary and middle schools. Because of the placement of the automated pedestrian counters, this activity was not documented on April 27, 2011; therefore, on May 11, 2011, manual pedestrian counts were performed from 7:00 to 9:00 AM.



An automated pedestrian counter on the north side of Main Street.
(Source: DVRPC)

Figure 4: Total Number of Pedestrians during the Morning Peak Hours (7:00-9:00 AM)

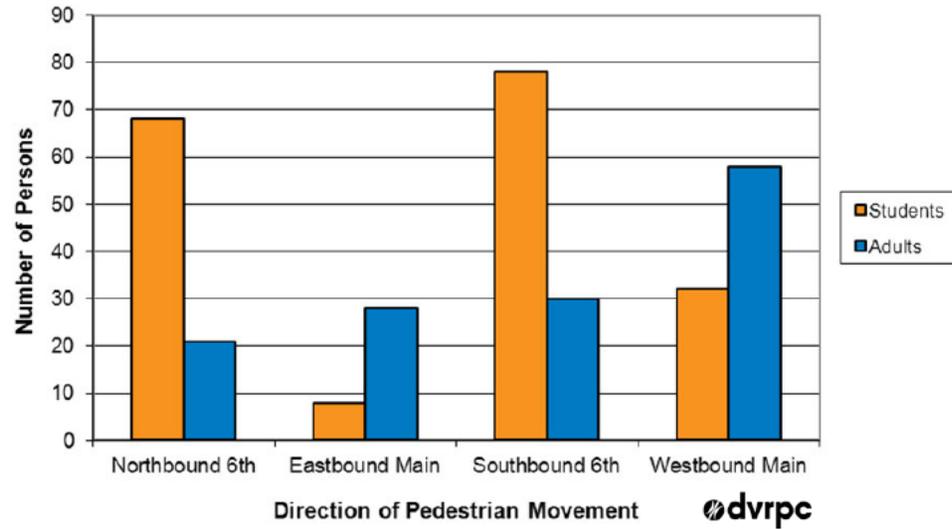


Figure 4 displays the number of pedestrians by their direction of movement away from the Main Street grade crossing. This illustrates which students are going toward the Penn Wood Middle School and which are going toward the Walnut Street Elementary School. Students (shown in orange) exiting the grade crossing going southbound on Sixth Street are almost exclusively elementary school students, while students exiting the intersection traveling northbound on Sixth Street are almost exclusively middle school students. While middle school students may take a bus to get to school, many choose to walk instead. There is a grade-crossing guard positioned at the corner of Sixth and Main Street during both the morning and afternoon to guide children safely across the intersection, and thus the grade crossing as well. A significant portion of persons going westbound on Main Street use the Route 11 trolley stop for eastbound trolleys to Philadelphia.

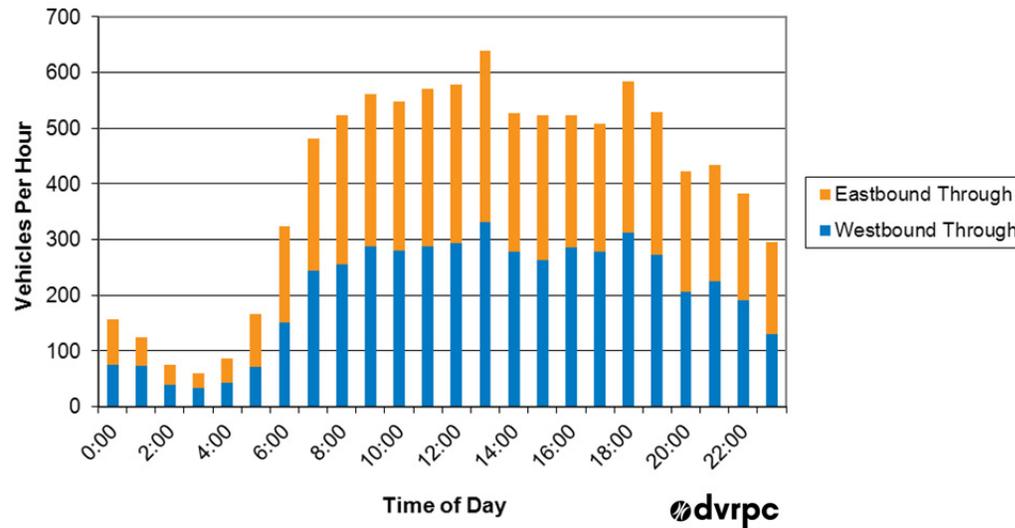


DVRPC staff conducts manual traffic counts at the Main Street crossing. (Source: DVRPC)

Vehicular Counts

DVRPC collects and manages traffic volume counts at over 5,000 locations each year. The majority of the counts are collected by laying pneumatic tubes across the road, with manual counts being completed to supplement the data where necessary (primarily turning movement counts). Because of the presence of trolley tracks on Main Street, it is not possible to conduct a pneumatic tube traffic volume count for the stretch of Main Street near the grade crossing. For the purposes of this study, a manual traffic volume count was conducted at the intersection of Main and Sixth streets. On April 27, 2011, DVRPC staff spent 24 hours at the grade crossing (in four six-hour shifts) conducting a manual count of vehicular traffic. Staff counted through movements along both Main and Sixth streets, as well as all turns between the two roadways. These counts provided a total intersection volume of 11,649 vehicles in the 24-hour period (note: DVRPC also conducted a series of counts using pneumatic tubes at other locations in Darby Borough to validate the manual counts).

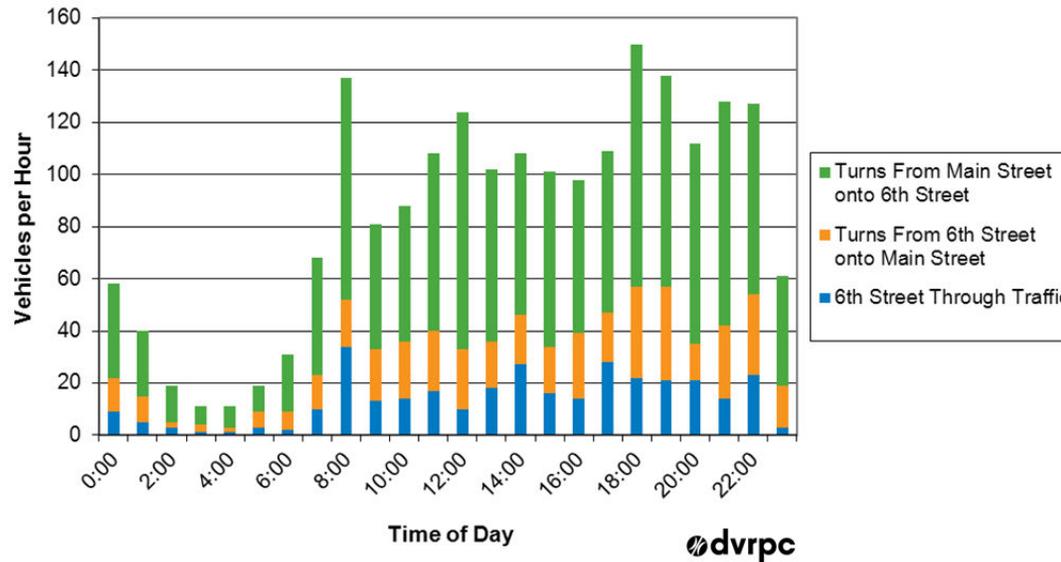
Figure 5: 24-hour Profile of Vehicular Traffic on Main Street by Direction



A total of 9,620 through movements were counted on Main Street at the grade crossing. While westbound and eastbound distribution was close to equal, there were slightly more westbound movements than eastbound movements. The total peak for through movements occurred between 1:00 and 2:00 PM. The observed through movements do not display the type of peak activity during the morning and afternoon rush hours that one may expect; however, there are slight upticks in the distribution during the 9:00 to 10:00 AM period and the 6:00 to 7:00 PM period.

Figure 6 represents the other three types of vehicle movements that were collected using the manual counts: turns from Main Street onto Sixth Street, turns from Sixth Street onto Main Street, and through traffic on Sixth Street. These movements produced a volume of 2,029 vehicles during the 24-hour period. The largest concentration of any of these move types are vehicles turning off of Main Street and onto Sixth Street. While a lot of the traffic distribution in Figure 5 is through traffic in nature, almost all the traffic in Figure 6 likely represents a local movement, with either its origin or destination in Darby Borough. There are distinct peaks in Sixth Street related traffic in the 8:00 AM and 6:00 PM hours, which are likely commuting-related trips. There is also an elevated traffic level from 7:00 to 11:00 PM. This is the time of day when most people are home from work and available for vehicular trips that are more local in nature.

Figure 6: 24-hour profile of Vehicular Traffic on Sixth Street by Turn Type



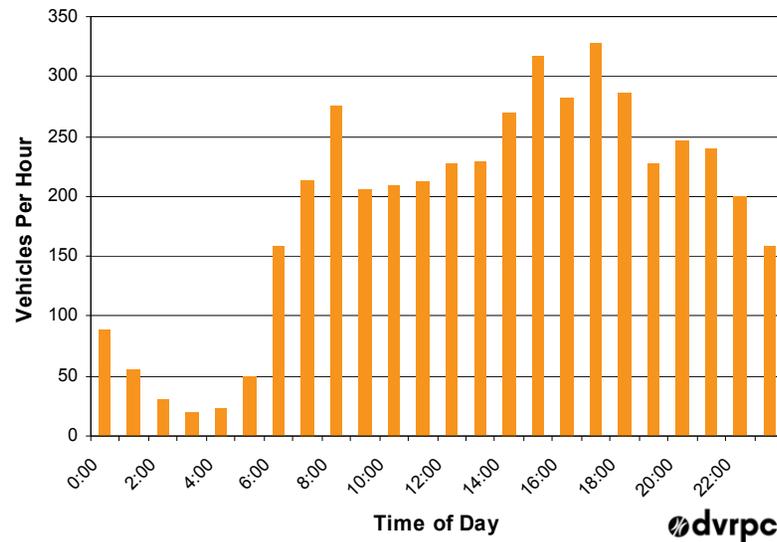
DVRPC also performed informal counts of school buses at both Darby Borough crossings, (note: data collection was focused on vehicle turning movements; school bus totals provide a good estimate. Also, the William Penn School District is moving the school bus depot, which will cause more school buses to traverse the crossings). On April 27, 2011, DVRPC staff noted 51 school buses traveling across the Darby Borough grade crossings during the AM peak period. Additionally, DVRPC staff counted trucks in 15-minute intervals to determine the percentage of truck traffic along Main Street. For the purposes of these counts, trucks were defined as any commercial vehicle that has greater than or equal to six tires. It was determined that the average

truck percentage for Main Street is roughly three percent. The only major trucking operation that regularly uses Main Street was observed to be the United State Postal Service (USPS).

Given the high amount of traffic on Main Street compared to Sixth Street, and given the employment attraction of Philadelphia International Airport (PHL) and airport-related businesses that can be accessed via Main Street, it is clear that Main Street is used as a through route. The USPS truck traffic that was documented is likely due to this trend, as the major Philadelphia area distribution center for USPS is located on Island Avenue near the PHL. Furthermore, DVRPC staff witnessed a high concentration of car drivers wearing safety vests, which would seem to suggest drivers use Main Street to access work sites.

DVRPC also conducted pneumatic tube counts on Sixth Street on either side of the grade crossing, and on Main Street west of the end of the Route 11 trolley tracks, over a 72-hour period from midday on Monday, April 25, to midday on Thursday, April 28. This allowed for a validation of the manual counts, which took place over a 24-hour period. During the manual counts along Sixth Street north of the grade crossing, a total of 1,159 cars were counted by DVRPC staff. Meanwhile, the pneumatic tube counts determined the annual average daily traffic (AADT) for this portion of roadway to be 1,275. This helps DVRPC to verify that there were no major gaps in the manual counts, and to verify that the 24-hour manual counts were accurate.

Figure 7: 24-hour profile of Vehicular Traffic on Fifth Street (both directions)



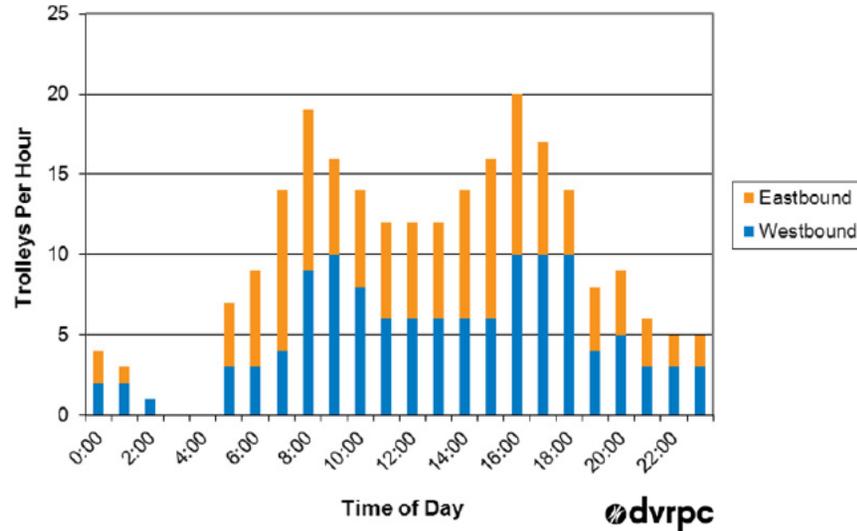
The traffic on Fifth Street carries a similar distribution to Sixth Street, with a morning peak between 8:00 and 9:00 AM, and generally more evening traffic than morning traffic. As with Sixth Street, Fifth Street serves a higher proportion of local traffic

than Main Street does. Traffic is less dictated by travel to work and more by local trips. Using the traffic volumes collected for a 72-hour period from Monday, April 25, 2011, to Thursday, April 28, 2011, and adjusted for seasonality, it was determined that the AADT for Fifth Street is 4,146.

Trolley Counts

Figure 8 shows the distribution of scheduled trolley traffic at the crossing throughout a weekday. There are clearly two peaks of scheduled trolley traffic during the morning and afternoon rush hours. Trolleys tend to run in equal amounts in each direction during the day and night, but during the two peak periods, directional distribution is varied. The standard schedule for midday trolley traffic is one trolley every 10 minutes in each direction. In the morning peak hours from 6:00 to 9:00 AM, 26 trolleys travel eastbound (to Center City) over the crossing, while 16 travel westbound (to Darby Transportation Center). This trend is reversed in the afternoon from 4:00 to 7:00 PM. Thirty trolleys travel westbound and 21 travel eastbound (note: the time interval directly after the morning peak has more westbound trolley traffic because the additional trolleys from the peak period need to be redistributed at Darby Transportation Center. This also occurs before the afternoon peak, but in reverse fashion).

Figure 8: Number of Scheduled Route 11 Trolleys at the Main Street Grade Crossing (Weekdays)



A Route 11 Trolley drives over the crossing at Main Street. (Source: DVRPC)

On the weekends, the trolleys have significantly abbreviated schedules. On Saturdays, 65 Route 11 trolleys travel eastbound across the Main Street grade crossing to Center City, and 66 run westbound to the Darby Transportation Center. Both directions peak at roughly one trolley every 15 minutes, but that peak activity schedule is from 9:30 AM to 6:00 PM traveling to Center City, and 11:00 AM to 7:00 PM traveling to the Darby Transportation Center. On Sundays, there are 54 trolleys to Center City, peaking at one every 20 minutes between 10:00 AM and 10:00 PM, and 54 trolleys to the Darby Transportation Center, peaking at one every 20 minutes from 11:00 AM to 11:00 PM.

In addition to the scheduled trolleys, there are both Route 11 and Route 13 trolleys that cross the intersection deadheading to the trolley depot and service station at the corner of Island and Elmwood avenues. These deadheading trolleys create additional wear and tear on the grade crossing surface and increase maintenance costs, but, since they do not stop to serve passengers, they do not affect the efficiency of vehicular traffic through the grade crossing in the same way that the scheduled Route 11 trolleys do.

Train Counts and Gate Closures

The freight rail line through Darby Borough is owned by CSX, which is the only carrier that operates along the line. DVRPC staff used manual traffic counts to count the number of cars on each train, and noted a number of other pieces of information (note: while all data in this section was collected at the Main Street grade crossing, because of their close proximity, it is logical to deduce that much of the data would have been virtually the same if collected at the Fifth Street grade crossing). The following is a list of all the data that was collected for each train observed during the field views:

- ▶ Direction of the train;
- ▶ Train speed (in MPH, captured using DVRPC radar gun); and
- ▶ Number of carloads for each train.

In addition to this train-specific information, DVRPC also collected data that documented gate closure information. This data included:

- ▶ Time the gate goes down (to the second);
- ▶ Number of auto violations (i.e., cars that circumvent the gates when down);



A CSX tank car travels over the grade crossing at Main Street. (Source: DVRPC)

- ▶ Number of pedestrian violations (i.e., persons that cross the rail line when gates are down);
- ▶ Time the gate goes up (to the second); and
- ▶ Estimated number of queued cars traveling in each direction on Main Street created by gate closure.

Table 1 summarizes the observed train and gate closure information over five time periods.

Table 1: Train Activity along the CSX Philadelphia Subdivision in Darby Borough on April 27, 2011

Time Period	Number of Freight Trains	Number of Switch Trains and Other Gate Closures	Average Number of Cars per Freight Train	Average Time Gates are Closed per Closure	Average Estimated Stacked Vehicles on Main Street WB	Average Estimated Stacked Vehicles on Main Street EB
12midnight-6AM	3	2	72	2:23	1	1
6AM-9AM	1	1	82	1:51	11	7
9AM-3PM	4	1	50	1:59	10	12
3PM-6PM	2	0	63	2:23	17	11
6PM-12midnight	3	2	51	2:00*	10	7

* One train stopped prior to the grade crossing for testing due to an earlier incident; this gate closure information was not consistent and was not included in the average for this time period. (Source: DVRPC)

Train traffic through the Darby Borough grade crossings is spread out relatively evenly throughout the day. The average time of closure in the chart represents the time the gates closed during DVRPC's field work, be it a long freight train, a short switching train, or just for testing. In terms of longer freight trains, the average time that the gates were closed was approximately two minutes and 30 seconds. The longest the gates were closed was roughly five minutes, but this was between 3:00 A.M. and 4:00 A.M. and resulted in only one stacked car in each direction. Stacked cars along Main Street were the greatest during the afternoon peak period between 3:00 and 6:00 P.M. In general, the gate closures did not seem to cause any major traffic delays, as the entire queue was able to clear out and return to free-flow conditions within approximately one minute after each closure ended.

On one occasion it was noted by DVRPC staff that a southbound train came through Darby Borough within five minutes of the passing of a northbound train. This is due to the fact that the Philadelphia Subdivision has two tracks approximately 1,000 feet north of the Fifth Street grade crossing. Southbound trains wait at this location until northbound trains pass through Darby Borough, and then proceed. DVRPC also witnessed that during these occurrences, the gates might malfunction and open and close when no train was present.

Accidents/Incidents

Accidents Reported to the Federal Railroad Administration

The Federal Railroad Administration maintains a database containing reported cases of impacts between on-track equipment and any user of a public or private highway-railroad intersection dating back to 1975. The database contains seven accident reports for the Main Street crossing, which are summarized below, starting with the most recent:

- ▶ September 11, 2012, at 12:52 PM, a train that was 101 cars long struck a truck stopped on the crossing. The driver was not in the vehicle and was not injured. The estimated damage to the truck was \$2,000.
- ▶ November 30, 2011, at 8:10 AM, a train that was 23 cars long struck a vehicle that had stopped on the tracks after the gates had come down. The driver had exited the vehicle before impact and was not injured. The estimated damage to the car was \$2,000.
- ▶ December 29, 2010, at 6:00 PM, a train that was 37 cars long struck a pedestrian who was trying to beat the train through the crossing. The teenage pedestrian was injured, but not killed.
- ▶ January 24, 2006, at 7:28 AM, a train that was 81 cars long struck a pedestrian who was trying to beat the train through the crossing. The pedestrian was injured, but not killed.
- ▶ December 14, 1987, at 9:51 PM, a train that was 52 cars long struck an automobile that was moving over the crossing. The driver of the automobile was injured, but not killed, and the estimated damage to the car was \$4,000.
- ▶ June 9, 1986, at 1:50 PM, a train that was 14 cars long struck a pedestrian who was stopped on the crossing. The pedestrian was injured, but not killed.
- ▶ June, 23, 1982, at 12:05 AM, a train that was 34 cars long struck an automobile that was moving over the crossing. The driver was not injured and the accident only caused an estimated \$400 in damage.

While none of these accidents were major, the Main Street crossing had more accident reports than any other individual crossing in the region (although more serious accidents have occurred at other crossings). The Fifth Street grade crossing had no reported accidents in the FRA database.

Community Incidents

As detailed in this section, the Main Street crossing has significant activity in the form of pedestrians, automobiles, trolleys, and trains. Compounding the problem, and possibly because of the high activity levels, there is a high concentration of undesirable activity near the crossing as well. According to the Darby Borough Police Department, there have been 131 documented reports at the intersection of Sixth and Main streets between January 1, 2007, and April 15, 2011. The crimes include, but are not limited to, public drunkenness, fighting, drug sales, theft, disorderly conduct, curfew violations, and motor vehicle accidents.

Field Observations

While not expressly part of the more comprehensive data collection efforts, notable observations about the operations and goings-on in the vicinity of the subject grade crossings were made in conjunction with the scheduled field work. The most significant and prevalent of these, which have direct tie-ins to transportation and safety considerations, are described below.

- ▶ **Citizen/pedestrian trespassing on and along railroad right-of-way**
At various times, individuals were observed walking along the railroad tracks (sometimes, “inside the tracks”) in either direction for significant distances, presumably as a type of short cut to reach their final destination.
- ▶ **Dislodging of grade crossing gates by vehicles in transit on the intersecting streets**
This occurred when vehicles temporarily stopped “on top of” the grade crossing, backed up into a descended gate due to the approach of a train, or when the gate came down on top of a vehicle as the train approached the grade crossing. In two observed cases, the railroad gates were rendered inoperable and railroad personnel had to be summoned to the scene to repair the gates.
- ▶ **“False alarm” episodes created by the descent of grade crossing gates and the activation of grade crossing lights and bells, but without the appearance of an actual train passing through the grade crossings**
These observed grade crossing closures and train warnings each lasted a relatively short period of time.

Activity Overview

The Darby Borough grade crossings are a series of complicated moving parts. Below is a summary of some of the numbers that were collected in DVRPC’s data collection effort. These numbers represent observed totals from one 24-hour period, and are believed to be in the range of what an average day at the grade crossing would yield.

- ▶ **11,649** total vehicles were counted on both Main and Sixth streets at the grade crossing
- ▶ **4,146** was determined to be the AADT of Fifth Street at the grade crossing
- ▶ **13** freight trains moved through Darby Borough
- ▶ **763** carloads worth of goods moved through Darby Borough
- ▶ **323** total pedestrians traversed the grade crossing at Main and Sixth streets between 7:00 and 9:00 A.M
- ▶ **237** SEPTA Route 11 trolleys are scheduled to cross the Main Street on a weekday

Figure 9: All Modes of Transportation at the Main Street Grade Crossing

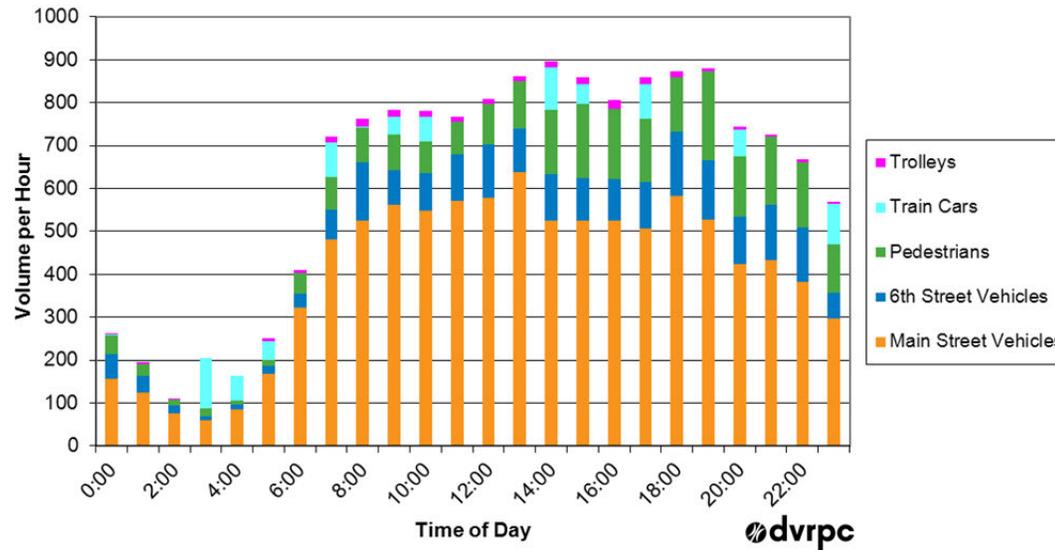


Figure 9 shows all modes of traffic at the Main Street grade crossing in one summary chart. It shows that from 7:00 A.M. to 10:00 P.M., the total traffic, when considering all these different modes, maintains a comparable level from hour to hour. Sixth Street traffic is defined as all turning movements at the intersection of Main and Sixth streets, as well as all through movements on Sixth Street. Pedestrian traffic does not show the impact of students traveling to and from school using Sixth Street. Train traffic is represented in terms of total train cars per hour.

Summary of Issues

The majority of the key issues that exist are at the Main Street grade crossing, but given the proximity of the Fifth Street grade crossing, it remains important to view the two crossings as closely related. Below is a summary of the major issues at the Main Street grade crossing.

The safety issue is of primary importance to pedestrians and motorists. The Main Street grade crossing creates a possible dangerous situation for both motorists and pedestrians. Over the past 30 years, there have been seven incidents reported to the Federal Railroad Administration (FRA); three involving pedestrians, and four involving vehicles. However, upon conducting the field views and talking with the Delaware County Planning Department and Darby Borough officials, safety concerns may be greater than the reported incidents suggest. For example, traffic at the intersection of Main and Sixth streets occasionally queues within the grade crossing due to the traffic light at 5th and Main Street and/or the trolley stop. This creates a potentially dangerous situation if a train is coming and a driver may be put in a precarious situation.

An operations issue is caused when trains block vehicular traffic, which creates delays for motorists, obstacles for emergency vehicles, and emissions concerns due to the idling cars. On April 27, 2011, 13 freight trains traversed the Main Street grade crossing, leading to a total gate closure time of approximately 32 minutes and 30 seconds. This blockage led to roughly 219 total cars queued along Main Street at the gate, for various lengths of time, throughout the course of the day. The operations issue also exists for Fifth Street, although in a lesser sense, purely due to the fact that the Fifth Street grade crossing has less vehicular activity.

Lastly, there is a maintenance issue because the Main Street grade crossing does not hold up well over time and needs regular, ongoing reconstruction. Highway-railroad grade crossings can be constructed of many different materials. In the DVRPC region, Class I grade crossings utilize various construction materials including timber, asphalt, rubber, and concrete to solidify the roadway around the railroad. The Main Street grade crossing in Darby Borough represents a unique grade crossing surface because of the presence of the trolley line. For many years, the grade crossing had to be regularly replaced because the pounding exerted by the trolleys and trains would wear down the pavement quickly, creating potholes and generally unsafe pavement conditions.

Recently, double-frogged flange, was installed at the Main Street grade crossing. The trolley tracks are situated at a slightly higher elevation than the railroad tracks. This allows the trolley to virtually pass over the rail line without making as much contact and without creating as much wear and tear on the surrounding pavement. While the double-frogged flange has



*A close-up of the grade crossing surface on Main Street in Darby Borough.
(Source: DVRPC)*

provided some improvements, the surrounding pavement is still deteriorating and will still need regular maintenance in the future. This regular maintenance is expensive, and any major project at the crossing should seek to continue to improve the surface conditions.

Additionally, the grade crossing has a history of drainage issues. Main Street is slightly sloped, so that running water in each direction moves toward the grade crossing. When there is a surge in the water system, like with a heavy rain storm, a large puddle can be found on the east side of the rail line all along the land between the Main Street and Fifth Street grade crossings. It is not totally clear how much this lack of drainage is contributing to the need for maintenance, but if resolved, it is possible that it could create an improved situation. Additionally, the excess water is unattractive and detracts from economic activity along Main Street.

The maintenance of grade crossings is the responsibility of the railroad that owns that particular rail line, in this case, CSX. Meanwhile, the roadway leading up to the grade crossing is the responsibility of the roadway owner, in this case, the Pennsylvania Department of Transportation. This creates a complex situation in Darby Borough along Main Street because it is not totally clear who is responsible for issues of drainage around the Main Street grade crossing.

Possible Improvements

This chapter details a list of possible improvements that could be made to improve safety and traffic conditions at grade crossings. This chapter is designed to put forward a range of different options for improving grade crossings, but does not make any recommendation as to which would best fit for either the Main Street or Fifth Street grade crossings. This range of improvement options provides a sound basis for identifying appropriate “next steps” for the study.

Improvements at the Grade Crossings

The grade crossings at Main Street and Fifth Street in Darby Borough are furnished with standard safety features: bells, lights, gates, and signage. When looking to improve a grade crossing that already has this equipment, possible improvements fall into three categories:

- ▶ Upgrades to existing equipment;
- ▶ Supplementary Safety Measures (SSMs); and
- ▶ Grade separation.

Each of these possible improvements is presented in three parts:

- ▶ Overview: what is the improvement and how it is typically applied
- ▶ Possible Application: what this improvement would achieve at the Darby Borough grade crossings
- ▶ Considerations: what needs to be considered and overcome before this improvement can be advanced

In addition, this chapter will discuss other possible improvements (e.g., modified traffic patterns) and community-based improvements (e.g., a public education campaign).

Upgrades to Existing Equipment

A first step in identifying potential improvements is to explore opportunities to improve existing passive devices, active control systems, and roadway and grade crossing surfaces. Upgrades to existing equipment can be made to a single piece of equipment or to all aspects of the existing equipment.

Passive Devices

Overview

Passive Devices refer to the signage and striping at a grade crossing and the advanced signage and striping leading up to a grade crossing. In many rural areas or on seldom-used rail lines, passive devices are the only safety measure present at a grade crossing. Advanced passive devices play an important role in warning vehicular traffic, which is especially important for drivers unfamiliar with the area. Passive devices at a crossing usually consist of a cross buck railroad sign and striping to let motorists know exactly where the train crosses.

Figure 10: Examples of Popular Passive Warning Devices



Left: An Advanced grade crossing warning sign.
Center: Advanced grade crossing warning striping in pavement.
Right: Grade crossing cross bucks.
(Source: Operation Lifesaver)

Possible Application

All signage at the Main Street grade crossing and advanced signage leading up to the Main Street crossing could be replaced with new passive devices. When placing the signs, it is important to have sufficient sight distance and visibility so that the signs can be easily seen. Striping could be improved at the crossing by providing advanced warning signs. Stop bars should be



Above: A cross buck sign is obscured by a “Trolley Stop” sign and “Do Not Block Intersection” sign on the eastbound approach to the grade crossing on Main Street. (Source DVRPC)

refreshed well before the crossing gate on Main Street. Currently, the stop bars on eastbound Main Street bisect the train tracks. At Fifth Street, the posted cross bucks are clearly visible, but there are no advanced warning signs or striping in the pavement to warn drivers.

Considerations

Given the location of the crossings in a mature community, the placement of signage should be well coordinated to ensure the prominence of signs, the coordination of information and messages, and the minimization of visual clutter.

Active Control Systems

Overview

Active Control Systems alert drivers and pedestrians of the presence of a train by using flashing lights, bells, crossing gates, or any combination of the three.

Possible Application

In Darby Borough, both the Main Street and Fifth Street crossings have the three major active control systems. Complete reinstallation of these systems with new equipment would allow for a reassessment of the best placement for both lights and gates. Additionally, newer LED lights are brighter and more energy efficient than the lights currently in use. Also, some grade crossings now use LED lights on the gate arms to act as an extra deterrent for pedestrians and motorists circumventing the gates.

Considerations

Installing new gates is expensive, costing anywhere from \$100,000 to \$300,000 depending on the crossing. Adding LED lights and making other small, less expensive upgrades to the existing gate infrastructure would require much less funding.

Roadway and Grade Crossing Surfaces

Overview

All grade crossing surfaces are periodically reinstalled to keep the rail line and roadway smooth and “bump-free.” Accelerating that process and possibly using a different material (be it established or new) to strengthen the grade crossing will hopefully reduce the need for future maintenance.

Possible Application

At Main Street, frequent resurfacing of the crossing has been necessary due to the additional wear and tear caused by trolley traffic. While the new double-frogged flange has been a major upgrade over the previous crossing mechanism, new technologies may be discovered that provide an even better solution. Additionally, a new water drainage system for the crossing and the surrounding roadway and railroad bed has the possibility of lessening future maintenance needs and making the area around the crossing more visually appealing. At Fifth Street, the resurfacing could focus on the roadway leading up to and proceeding away from the crossing to create a smoother change of grade instead of the severe ramp that currently exists on either side.

The primary purposes of a paved surface are to protect the subgrade by limiting vertical compressive stresses at the surface of the native soil (known as the subgrade layer) and to keep water and debris out in order to ensure the structural integrity and safety of the system. Within the pavement structure, the subbase layer functions primarily as a structural support for the system. This layer evenly distributes the loads onto the subgrade layer.

The subbase and subgrade layers can be improved by a few methods. First, if the native soil is poor, it may be excavated out. Higher-quality fill may then be placed and compacted to remedy the poor subgrade conditions. Second, an adequate drainage system can be provided. This will aid in directing water away from the pavement system. Third, the subgrade may be treated with certain materials, such as asphalt binder, cement lime, and fly ash. These materials will help to stabilize the subgrade by increasing its stiffness. They primarily fill in any air voids that may trap water, which will weaken the system. Fourth, the thickness of the base and subbase layers may be increased. Finally, additional base layers may be included in the system in order to protect the integrity of the subgrade layer.

Considerations

As mentioned earlier, the ownership of the area at and around crossings is varied, and it would require extensive coordination to fund a new water drainage system. The recent double-frogged flange mechanism at the Main Street crossing has provided great benefit.

Supplementary Safety Measures (SSMs)

Supplementary Safety Measures (SSMs) are defined as traffic-control measures that help prevent unsafe movements over a crossing. According to US Code Title 49: Transportation Appendix A to Part 222, there are many types of approved SSMs, but this report will focus on the two that have the most potential for Darby Borough:

- ▶ Four-Quadrant Gate System; and
- ▶ Highway Medians or Channelization Devices.

These SSMS were originally developed to be used for “Exception to the Use of the Locomotive Horn” code, otherwise referred to as quiet zones. Quiet zones are grade crossings where the local municipalities have opted to finance SSMS and the railroad in turn agrees to not blow the locomotive horn at the crossing. The quiet zone classification can only be achieved through close coordination with the FRA and other stakeholders. While SSMS are typically used to support quiet zones, there is no reason that their effectiveness would not also pertain to improving safety, and in some cases efficiencies, at grade crossings where the train still blows the horn.

In addition to these SSMS, there are a series of technological improvements, referred to as intelligent transportation systems (ITS), or an intelligent grade crossing, that may also be grouped under the SSMS category.

Four-Quadrant Gate System

Overview

Traditional grade crossing gates, like those at both Fifth and Main streets, use a two-gate system, where an arm blocks only the traffic lane on which vehicles approach the grade crossing. Four-quadrant gates provide one gate for each direction of traffic at a grade crossing, both entering and exiting. When a train is approaching, all gates close and prevent a vehicle from circumventing the gates to proceed through the grade crossing. Because of the lack of exit lanes, four-quadrant gate systems must have a built-in delay between when the entrance lanes are closed and when the exit lanes are closed. This allows any queued traffic to exit the grade crossing before all the gates come down. The timing of the four-quadrant gate system should be established by a qualified traffic engineer to determine the specific timing. Additionally, the engineer may determine that it is necessary to have a vehicle presence detector that would keep the exit gates open until all cars are clear of the grade crossing.

Possible Application

Both the Main Street and Fifth Street grade crossings are candidates for four-quadrant gates. At Main Street seven gates would be required due to the two additional approaches created by Sixth Street.

Considerations

Typical grade crossings involve just a single intersecting highway. If installing a four-quadrant gate system at the Main Street crossing, at least seven gates would be needed to reach the desired effect. In general, four-quadrant gates have a price range of \$150,000 to \$500,000, but this is likely a low cost estimate considering the amount of gates needed for Main Street.

Figure 11: Example of Four-Quadrant Gate System



Left: A four-quadrant gate in North Carolina (note: the gates to the entrances are already closed, but the gates for the exits are in the process of closing). (Source: North Carolina Department of Transportation)

Additionally, gates are mechanical devices that are exposed to weather and tampering and thus, are subject to a small degree of malfunction. With additional gates, there is an additional risk of malfunction. Generally speaking, gate systems are designed to close if any gate is malfunctioning. Closed gates at all approaches on Main Street due to a nonworking gate would create a substantial traffic flow problem in Darby Borough.

Medians or Channelization Devices

Overview

Medians or channelization devices are designed to deny vehicles the possibility of circumventing closed gates. It is advised that these devices extend 100 feet from the gates on each highway approach to the crossing. There are three potential types that could serve the function of a channelization device:

- ▶ **Barrier wall systems** are full concrete medians that create a barrier. These are the most successful form of preventing traffic from circumventing the gates, but they take up a wide section of the roadway between the lanes. Also, barrier wall systems leave little wiggle room in the event of an emergency and can increase the risk of a car accident, as well as the severity of car accidents.

- ▶ **Nonmountable curb islands** are usually about six inches high and about two feet in width. Nonmountable curb islands can be very appealing for a community because they can be filled with landscaping to enhance the streetscape of the road. Like barrier wall systems, curb islands require a wide section of the roadway and pose the same risks in terms of increased traffic accidents and severity.
- ▶ **Mountable raised curbs** are short curbs that have raised vertical panels on top of them. They are designed to create a visual deterrent to circumventing a lowered gate. They have the benefit of allowing cars to drive over them, albeit by knocking over the panels, in case of emergency. The raised vertical panels need to be frequently monitored to replace broken elements.

Possible Application

Both Main Street and Fifth Street could be viable candidates for medians or channelization devices. Typically, these improvements cost a total of \$10,000 to \$15,000 per crossing. While this SSM does not provide any direct pedestrian safety benefit, the raised vertical panels bring additional visible attention to the crossing, which may improve driver awareness of pedestrians at the crossing.

Figure 12: Example of Mountable Raised Curb Channelization Device



Left: A mountable raised curb with vertical panels in North Carolina. (Source: North Carolina Department of Transportation)

Considerations

As mentioned above, there is an increased potential for vehicular accidents around channelization devices. This is especially true with nonmountable devices. Also, these devices require a variable amount of the roadway space depending on which alternative is chosen. Space may also be an issue in configuring a system that allows the SEPTA trolleys to pass without obstruction. It is possible that the trolley lines would need to be moved to accommodate a channelization system.

With any of the channelization alternatives, it is possible that parking would no longer be possible along Main Street near the crossing, and with some of the alternatives, Main Street may need to be widened. Due to the commercial aspect of the land use along Main Street, these alternatives may not be favorable to local businesses.

Intelligent Grade Crossings

Overview

Intelligent Transportation Systems (ITS) represent an array of new technologies that monitor travel conditions and convey information to travelers. For grade crossings, ITS-type projects are referred to by many names, but for the purposes of this report, they will be referred to as Intelligent Grade Crossings. They include a host of different improvements, with the common theme being a use of technology to improve both safety at the crossing and the flow of traffic. Traditional railroad systems sense a train, which triggers a gate, whereas an Intelligent Grade Crossing provides continuous information of train location and speed. Below is a list of sample Intelligent Grade Crossing projects.

▶ **Preemption of Traffic Signals near Railroad Crossings**

The U.S. DOT's guidelines state, "where a signalized highway intersection exists in close proximity to a railroad crossing, the railroad and traffic signal control equipment should be interconnected, and normal operation of the traffic signals controlling the intersection should be preempted to operate in a special control mode when trains are approaching." (*Railroad-Highway Grade Crossing Handbook, U.S. Department of Transportation, Revised Second Edition, August 2007*). A traffic engineer would be needed to design the preemption system in consultation with CSX in order to optimize the safe flow of traffic along Main Street in Darby. Any system that is designed would also include the Fifth Street grade crossing.

▶ **Automated Enforcement of Lowered Crossing Gates**

These systems use photo technology to capture the license plate number of motorists who circumvent closed railroad gates.

▶ **Advanced Warning for Railroad Delays**

These systems provide real-time information about upcoming delays to variable message signs and emergency personnel. Variable message signs can be placed along the roadway to let drivers know about upcoming delays, approximate time of delays, and possible alternative routes. Likewise, these systems can be tied into emergency personnel switchboards so that ambulance, fire, and police activity can anticipate an upcoming crossing closure.

▶ **Second Train Coming Warning Systems**

If a second train is going to pass through the crossing shortly after the first one has (e.g., in the opposite direction where the train line has two sets of tracks), this system will light up signs letting drivers know to anticipate the second train. This prevents anyone from assuming that the gates are not functional.

▶ **In-Vehicle Alert System**

This system can broadcast over the radio and let drivers know whether to expect a closure and how long it will be.

▶ **Stalled Automobile Detection**

This system can sense if a vehicle is stalled on the railroad tracks and transmit a signal to the train operator. This system can be tied in with four-quadrant gates, and if the rail line has Positive Train Control (PTC), the system can override the railroad engineer so the train stops before the crossing (if possible given the train's speed and distance from the crossing).

Possible Application

Given the proximity of the traffic signal at Fifth and Main streets, a traffic signal that is interconnected with the grade crossing should be designed and installed in accordance to the federal guidelines. Other Intelligent Grade Crossing improvements presented here are applications that could be also used to improve efficiency and reduce queuing.

Considerations

Currently, the State of Pennsylvania does not allow for photo enforcement beyond Automated Red Light Enforcement, which has limited deployment in Pennsylvania. If this law changes, then Intelligent Grade Crossing systems could be installed to photograph vehicles that attempt to circumvent the gates.

The cost of implementing any sort of Intelligent Grade Crossing can vary a great deal. It is also possible that some of the queuing problems along Main Street could be lessened by the installation of a traffic signal at Sixth and Main streets at far less cost.

Grade Separation

One way to completely remove any conflict between vehicles and railroads at grade crossings is to grade separate the crossing. This section will lay out the different possible grade separation configurations in general and how they may or may not be applied in Darby Borough. Because of traffic volumes, the focus will be on separating vehicle and train traffic on Main Street.

Benefits of a Grade Separation

One of the most successful freight corridor programs in the country is located in the Everett-Seattle-Tacoma area in the State of Washington. Organized as the Freight Action Strategy (FAST) Corridor, this partnership between local cities, counties, ports, federal, state, and regional transportation agencies, railroads, and trucking interests has worked collaboratively to fund regionally significant freight projects. Of the 24 projects they have identified, half of them are grade separations.

As an example of how impactful a grade separation can be, below are the identified benefits of completing a grade separation on M Street in Auburn, Washington, as part of the FAST Corridor program:

- ▶ Removing the conflict of rail and vehicle traffic (currently this grade crossing has about 16 to 24 trains per day, with roughly five minutes of closure per train);
- ▶ Improving freight mobility for trains and trucks;
- ▶ Improving emergency vehicle access;
- ▶ Increasing the capacity to accommodate 2030 traffic volumes;
- ▶ Improving air quality through emissions reduction from waiting vehicles;
- ▶ Reducing neighborhood cut-through traffic on residential streets; and
- ▶ Improving safety (project will ensure the safety of the 53 daily school bus grade crossings).

Alignment Types

Grade separations modify the elevation of either the road or the rail line. This prevents major disruptions to both modes during construction and normally lessens the cost of the overall project. This section will discuss the considerations for changing the grade of the road versus changing the grade of the rail line and provides examples of each.

Change Elevation of the Roadway

Overview

There are two basic ways to change the elevation of the road; either build a highway bridge over the rail line, or tunnel the road under the rail line. Changing the elevation of the road is often chosen as the means to create a grade separation because cars can climb and descend at a much steeper grade than a train can.

Possible Application

Since the issues at Main Street overshadow the issues at Fifth Street, this alignment scenario assumes that the Main Street grade crossing would be separated but that the Fifth Street grade crossing would not. Generally, when confronted with a scenario of two grade crossings in close proximity to each other, where one is being grade separated, the other will be closed and traffic rerouted over the now separated grade crossing. Due to some of the considerations noted below, this may be

difficult in Darby Borough, but closure or upgrade of the Fifth Street grade crossing should be strongly considered if this scenario is ultimately advanced.

Considerations

There are a number of factors to consider when analyzing a scenario where the elevation of Main Street would change in order to create a separated grade crossing. They include, but are not limited to:

- ▶ Building a bridge on Main Street may require an extended right-of-way along the road which does not currently exist. It is possible that eminent domain powers would have to be exercised to remove some buildings on either side of Main Street. Even if the buildings are able to remain, the road will no longer be at grade, and may not be flush with sidewalks and parking locations. The potential loss of parking could be detrimental to Darby Borough businesses.
- ▶ Sixth Street would have to be shut down to both vehicular and pedestrian traffic at Main Street, which would cause extra traffic to flow over the Fifth Street grade crossing. It would also remove Sixth Street as a pedestrian throughway, so pedestrian traffic would need to be rerouted as well. There is a concern that trespassing along the rail line would increase because it would be a more direct route than rerouting pedestrian traffic over another street.
- ▶ The presence of the Route 11 trolley would mean that the trolley tracks and overhead electrical lines would need to be either diverted to a different road or be rebuilt as part of the new Main Street Alignment, or the trolley would have to have a terminal east of the Main Street crossing and then use shuttle buses to access the Darby Transportation Center.
- ▶ In addition to the trolley adding to the cost of the project, any roadway elevation change would likely result in the removal of the Sixth Street trolley stop, and possibly the Fifth Street trolley stop as well. Accommodations would need to be made to create new trolley stops in Darby Borough to facilitate the grade separation.
- ▶ A grade separation creates an underpass that has the possibility to serve as a breeding ground for crime and other unwanted activity.
- ▶ With either a highway bridge or tunnel, any vehicular accident at or near the crossing would likely be more difficult to clear in a timely fashion, and it would create more of a backup on Main Street than the current configuration. Additionally, accidents may affect the integrity of the grade separation (i.e., a truck that is too tall striking the rail bridge over the road), which forces additional funds to be spent to repair the grade separation infrastructure.
- ▶ In the case of a highway bridge over the railroad, there is a concern that the bridge would create a darker, less attractive corridor along Main Street. In a disadvantaged community such as Darby Borough, steps should be taken to make roadways brighter and more attractive, not the opposite.

Road over Rail Example

Creating a grade separation by bridging the highway over the rail line is the most common grade separation approach. One example is on Iowa Avenue in Riverside, California. Iowa Avenue has an AADT of 16,000 cars, and the Burlington Northern Santa Fe currently operates about 90 freight trains and 10 passenger trains per day on the rail line. The project will construct a four-lane highway bridge along Iowa Avenue and change local circulation patterns. The total cost will be \$31.64 million for construction and is expected to start in August 2012 and take 16 months to complete. The project will cost the local government about \$1.58 million, and the remainder will come from a combination of county, state, federal, and railroad dollars.

Figure 13: Example of Road over Rail Grade Separation Project



Left: Present conditions at Iowa Avenue in Riverside, CA. Right: A rendering of a planned roadway bridge over the railroad tracks. (Source: Riverside California, Public Works Department)

Road under Rail Example

The FAST Corridor project on M Street in Auburn, Washington, is designed to be grade separated by tunneling the road under the existing rail line. The project is in close proximity to the local high school. The Burlington Northern Santa Fe Railroad operates 16 to 24 trains per day through the crossing, each of which stops traffic for roughly five minutes. The project is expected to cost \$22,250,000, and will also widen the roadway from two to four lanes and build new pedestrian walkways and bike lanes.

Figure 14: Example of Road under Rail Grade Separation Project



Left: Present at-grade conditions at M Street in Auburn, WA. Right: A rendering of a planned roadway tunnel under the rail line in Auburn, WA. (Source: Puget Sound Regional Council)

Change Elevation of the Rail Line

Overview

There are two basic scenarios for changing the elevation of the rail line: dropping the rail line under the highway, or building a rail bridge over the road. The ascent or descent for the train must be gradual, so either of these scenarios would require changes to the rail lines well beyond the actual crossing.

Possible Application

In Darby Borough, creating a grade separated crossing at Main Street by changing the elevation of the rail line would undoubtedly lead to a grade separated crossing at Fifth Street given the proximity of the grade crossings. When dealing with a long rail corridor with multiple grade crossings, such as the Philadelphia Subdivision in Delaware County, changing the elevation of the rail line is often chosen. By changing the elevation of the rail throughout the entire corridor, the grade crossings can be separated through a single project, instead of tackling each grade crossing individually.

Changing the elevation of the rail would likely be much less disruptive to the Darby Borough community than changing the elevation of the roadway. It would not greatly affect the Main Street businesses and it is possible that the trolley tracks could be more easily accommodated given this alternative.

Considerations

While modifying the elevation of the railway would be less disruptive to local traffic patterns, there are still considerations that would need to be worked out in order for this alternative to be advanced.

The largest consideration is the surrounding railroad infrastructure. Any change in elevation of the rail line would have to start a substantial distance from the grade crossing and extend a long way after the grade crossing. Existing rail bridges and tunnels would likely have to be modified as part of the project. Below is a list, from north to south, of notable railroad infrastructure within a mile from the Darby Borough grade crossings (note: the project may require going beyond a mile, in which case additional infrastructure would have to be dealt with):

- ▶ 68th Street, Philadelphia: rail line goes under the roadway;
- ▶ 70th Street, Philadelphia: rail line goes over the roadway;
- ▶ Cobbs Creek Parkway, Philadelphia: rail line goes over the roadway;
- ▶ Cobbs Creek, Yeadon Borough and Philadelphia: rail line goes over the water;
- ▶ Darby Creek, Darby Borough: rail line goes over the water and Walnut Street;
- ▶ Pine Street, Darby Borough: rail line goes under the road; and
- ▶ Chester Pike, Sharon Hill and Collingdale boroughs: rail line goes under the road.

A project to change the elevation of the rail line, either for the entire corridor, or for just Darby Borough, will have a major impact on rail traffic during construction. Normally, when major rail construction is undertaken along a main line, the rail line keeps at least one track open for segments of the day to allow for train operations to occur. It is difficult to imagine how trains could remain operative during this type of construction.

Lastly, given documented criminal activity and the trespassing witnessed during field views, these aspects of the Darby Borough grade crossings are a concern under this improvement scenario. A rail bridge through Darby Borough would create significant additional poorly lit spaces that may lead to increases in crime underneath the superstructure that holds the rail. Additionally, trespassing has already been witnessed on the rail bridge over Darby Creek, so it is logical to assume that trespassing would occur on any new bridge or tunnel. This trespassing would be especially dangerous given the few options trespassers would have when trains traveled through Darby Borough.

Rail over Road Example

In City of Industry, California, a 1.6 mile concrete-walled flyover structure with steel railroad bridges spanning Sunset and Orange avenues was recently completed. The flyover structure is 45 feet wide and reaches a height of 32 feet. The bridge over Sunset Avenue is 132 feet long and the Orange Avenue Bridge is 66 feet long. The project cost \$95,200,000 and took four years to complete.

Figure 15: Example of a Rail over Road Grade Separation Project

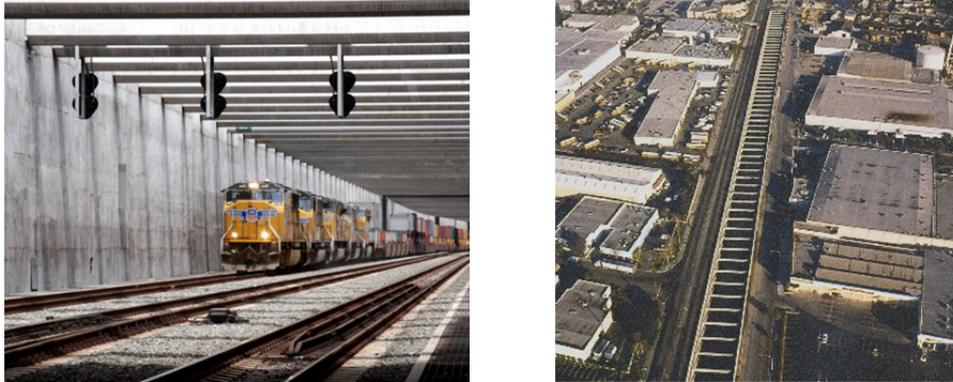


*A railroad bridge over Sunset Avenue
in the City of Industry, CA.
(Source: Alameda Corridor-East
Construction Authority)*

Rail under Road Example

One of the most famous grade separation projects took place in Los Angeles, California, along what is called the Alameda Corridor. The project's centerpiece is the Mid-Corridor Trench, which carries freight trains in an open trench that is 10 miles long, 33 feet deep, and 50 feet wide between State Route 91 in Carson and 25th Street in Los Angeles. The total cost of the 20-mile project was \$2,400,000,000. Construction began in April 1997 and operations began in April 2002. The need for the corridor was driven by the container cargoes moving through the ports of Long Beach and Los Angeles. It was paid for by a mixture of public and private funds and the railroads pay a user fee to retire debts. In March 2011, the corridor averaged 38.4 trains per day, 10,245 TEUs (i.e., twenty-foot equivalent units) per day, and generated \$7,000,000 in revenue.

Figure 16: Example of Rail under Road Grade Separation Project



*Left: A train passes through the Alameda Corridor's Mid-Corridor Trench.
Right: An overhead view of the Alameda Corridor's Mid-Corridor Trench.
(Source: Alameda Corridor Transportation Authority)*

Other Possible Improvements

There are additional ways to improve operations at grade crossings that do not require physical changes to the grade crossings. This section will explore some of those possibilities. Everything presented in this section could be done as a stand-alone improvement, or as part of a package of improvements.

Traffic Patterns

Changing the traffic patterns of vehicles, trains, and/or trolleys represents a possible strategy at the Darby Borough grade crossings. The initiatives identified in this section are all relatively low cost, but have many considerations due to potential disturbances in traditional traffic patterns. These disturbances can cause a backlash from the local community and other unforeseen traffic issues, which may require further study.

Temporary Closure of a Public Highway

Overview

A temporary closure entails closing the crossing to highway traffic during specific periods of time, often at night and during other off-peak highway hours. The closure system (which can take multiple forms from hand-laid cones to automated gates) must

completely block highway traffic on all approach lanes to the grade crossing. Daily activation and deactivation of the system is the responsibility of the public authority, which is responsible for maintenance of the street crossing the rail line. A successful system would seek to have as many trains as possible operate during this time frame and as few as possible during the time when the grade crossing is open.

Possible Application

Temporary closure of a public highway is generally more common in a rural area than in an urbanized area such as Darby Borough. Main Street has far too much through traffic to recommend any temporary closure; however, it would be a possibility for Fifth Street. A temporary closure is often deemed a good solution because it requires very little in the way of capital costs.

Considerations

The rail line through Darby Borough does not operate in a condensed window, and it is doubtful that a temporary closure would result in a significant difference for Darby Borough in general. Additionally, any temporary closure of the Fifth Street grade crossing would likely funnel more traffic to the Main Street grade crossing.

One-way Street(s) with Gates

Overview

This initiative consists of taking a two-way street and changing the traffic to exclusively one-way. Once the one-way street is created, a new gate is installed that completely blocks both lanes. This can be done by installing one extra-long gate, or two gates on either side of the roadway.

Possible Application

Traffic volumes on Main Street are far too high to contemplate changing traffic patterns to create a one-way road. However, this is a viable possibility for both Fifth and Sixth streets. South of Main Street, both Fifth and Sixth streets are one way, with Fifth Street running northbound and Sixth Street running southbound. Below are three options for consideration:

- ▶ Option 1: Change Sixth Street between Main and Greenway to one-way northbound. This would make all vehicle movements involving Sixth Street proceed away from the crossing at Sixth and Main streets, which is anticipated to improve safety. This option does not affect Fifth Street at all and will not eliminate turns from eastbound Main Street onto northbound Sixth Street. Individuals making these turns often stop on the CSX tracks until there is a break in westbound Main Street traffic.
- ▶ Option 2: Change Sixth Street between Main Street and Greenway to one-way southbound and change Fifth Street between Main Street and Greenway to one-way northbound. This would extend the existing one-way zones on Fifth and Sixth streets

to Greenway instead of stopping them on Main. This allows for one-way traffic on Sixth and Fifth streets at both grade crossings and eliminates cars making left turns from eastbound Main Street onto northbound Sixth Street. By eliminating southbound Fifth Street traffic, there is likely to be a major increase in southbound Sixth Street traffic, the consequences of which would need to be analyzed.

- ▶ Option 3: Change Sixth Street between Main Street and Greenway Avenue to one-way southbound and leave Fifth Street unchanged. This would eliminate cars making the turn from eastbound Main Street onto northbound Sixth Street, but would not make any safety improvement to the Fifth Street crossing. By leaving Fifth Street unchanged, there should be very little change to the total Sixth Street traffic volumes.

Considerations

A full traffic plan would need to be conducted by a traffic engineer in order to decide the best reconfiguration for traffic movement and safety. Additionally, any change along Fifth Street would require modifications to the signal placements and timing at the corner of Fifth and Main streets.

Vehicular Traffic Patterns

Overview

Diverting vehicular traffic so that fewer vehicles travel over the Darby Borough grade crossings each day would lessen safety concerns at the grade crossing and improve operations. The route used to divert vehicles would need to be improved to be made more appealing and well-signed to encourage use.

Possible Application

There are two possible applications to divert vehicular traffic in Darby Borough. The first possibility is a local diversion, where nonlocal Main Street traffic would be directed to take a different route through Darby Borough that did not involve traveling over either the Fifth or Main street grade crossings. For example, this route could travel via either Walnut Street or Pine Street.

The other possibility is a more regional diversion. For some of the surrounding communities, such as Lansdowne and Clifton Heights, the most direct route to the Philadelphia Airport and I-95 is to travel through Main Street in Darby Borough to access Island Avenue. There are multiple alternative routes that are similar in length, so with signage and improvements to those routes, diverting some of the through traffic off of Main Street is a possibility.

Considerations

Diverting vehicular traffic may create some negative side effects to the community of Darby Borough. The first is that Main Street in Darby Borough is a commercial corridor with multiple businesses. Taking vehicular traffic off of Main Street has the possibility of negatively affecting those businesses.

Besides this concern, there are logistical obstacles that would have to be overcome in order for this solution to be put into effect. Even after the other roads are improved and signs erected, it may be difficult to modify people's driving habits, so the desired results are not guaranteed. Also, there is likely to be strong opposition to the traffic diversion from any neighborhood through which the new traffic flows. Any diversion project would need extensive public outreach to ensure the support of the local communities.

Train Traffic Patterns

Overview

Diverting train traffic is a regular practice for railroads because of construction projects, and in some instances can provide a solution to a grade crossing issue.

Possible Application

In Darby Borough, there are three general ways that through train traffic could be diverted (note: local trains serving facilities and customers along the line would still be needed). The Philadelphia Subdivision, which runs through Darby Borough, is a vital segment of the CSX main rail line connecting Florida to North Jersey. Any successful diversion project would not significantly affect CSX from a business point of view.

The first option would be to construct a freight-only track within the right-of-way of the AMTRAK Northeast Corridor, which CSX would use to divert through trains off of the Philadelphia Subdivision, thus, out of Darby Borough. This project was first proposed in the Mid Atlantic Rail Operations Study as a way of reducing conflicts between Norfolk Southern and Amtrak. The cost of the project could approach \$1,000,000,000.

A second option would be to build a rail bypass around Darby Borough. Given the dense urban nature of the communities surrounding Darby Borough, there is no clear, viable bypass alternative. Further research could be done to look into this possibility, but given the potential cost and lack of a clear route, it probably is not feasible.

Considerations

There is a significant concern that any diversion of train traffic could negatively impact train traffic, which could be detrimental to the DVRPC region. Furthermore, given the high costs of the two diversion scenarios, it is likely that all 12 grade crossings

along the Philadelphia Subdivision in the DVRPC region could be grade separated (or closed) for the same cost, and with less impact than any of the proposed train diversion scenarios.

Trolley Traffic Patterns

Overview

Diverting trolley traffic out of the Main Street grade crossing would alleviate some of the maintenance concerns and costs that surrounded the grade crossing. Any change to a trolley route or elimination of a trolley stop must be closely coordinated with both SEPTA and the local neighborhoods being affected.

Possible Application

In order to remove the trolley tracks from the Main Street grade crossing, the Route 11 could be terminated east of the grade crossing; and shuttle buses would then be used to connect the termination point with the Darby Transportation Center. One possible termination point is the trolley yard on Island Avenue, where trolleys would be able to conveniently turn around. This is already done whenever track work is performed between Island Avenue and the Darby Transportation Center.

The trolley stops at Sixth Street do not have any major effects on traffic operations, but they do increase the amount of pedestrian traffic around the Main Street grade crossing. Trolleys stopped at Fifth Street occasionally back up eastbound Main Street vehicular traffic to the point where cars are queued into the Main Street grade crossing. If removing trolley stops is considered, the most logical solution would be to remove the Sixth Street stop traveling westbound, and the Fifth Street stop going eastbound.

Considerations

Moving the termination point of the Route 11 trolley would necessitate major capital costs, including building a new turnaround for the Route 11 and removing the existing trolley tracks along Main Street in Darby Borough. Additionally, the shuttle bus to trolley connection may disincentivize some Darby Borough residents from using public transportation. The Route 13 trolley could still terminate at the Darby Transportation Center, but would need a new route for deadheading to and from the trolley yard on Island Avenue.

Relocating the trolley stops would be a small capital cost, but would require extensive community participation to ensure that the new locations served the community to the same extent, while improving traffic operations and safety.

Community-Based Improvements

As mentioned in chapter 2, there is a high level of activity; vehicular, pedestrian, and criminal, around the crossing. This activity can lead to increased safety risks at the crossing. This section will detail some community-based actions that could counteract these forces and create safer grade crossings in Darby Borough.

- ▶ **Create Continuing Public Education Campaign.** Operation Lifesaver is a nationwide, non-profit public awareness program that is designed to draw attention to grade crossing safety. Through Operation Lifesaver, certified presenters meet with school children and other groups to outline safe practices at grade crossings. The Federal Highway Administration estimates that safety awareness initiatives through Operation Lifesaver have saved 10,000 lives in 30 years. This emphasis on safety is critical, particularly given the fact that both train and highway volumes are on the rise.
- ▶ **Pedestrian Improvements.** The two grade crossings in question are largely traversed by pedestrians who are travelling to or from the elementary and middle schools in the nearby area. Therefore, a primary goal is to improve the safety within the area for these pedestrians. As part of the Phase II Report, the initiative Safe Routes to School (SRTS) will be covered in detail. This program focuses on improving children's safety while walking and bicycling to and from school. It looks to actively engage the children, as well as the community, in discovering potential hazards surrounding the schools and neighborhoods.

SRTS incorporates education, encouragement, enforcement, and engineering into its goal of increasing the number of children walking to and from school. Educational activities instruct students, parents, and the community about pedestrian safety. SRTS encourages schools and communities to generate excitement about walking and biking to and from school. Enforcement activities can help to improve driver behavior, as well as bicyclist and pedestrian behavior. Finally, the engineering aspect of SRTS aids in transforming the community, through maintenance, operation, and construction projects, into a safe and pedestrian-friendly environment.

One suggestion to encourage students and their families to walk to school is to begin a walking school bus. A walking school bus is an organized group of children walking to and from school with one or more adults. This allows children to walk to school even if their parents are unable to walk with them. It enables parents to feel that their children are safe when walking to school.

Next Steps

The contents of this report provide a summary of the work conducted as Phase I of the Darby Borough Grade Crossing Study. As a follow-up, a number of tasks will be undertaken in Phase II of the study. Phase II will focus on public outreach in Darby Borough, an identification of the most applicable short-, medium-, and long-term grade crossing improvements, and a fleshing out of the most preferred improvements.

Walkability Audits

Walkability audits are an exercise that provides technical assistance to assess walking conditions for school children and to create a plan for improving them. The walkability audit process is led by an engineer, with the help of a team of local school officials, municipal staff, law enforcement officials, and other community members. After a two-day assessment, the school is presented with a final report that includes recommendations for improving safety and increasing student participation along the walking routes.

Walkability audits are conducted as part of the Safe Routes to School (SRTS) program. SRTS programs are efforts by parents, schools, and governments to improve the health and safety of children by enabling and encouraging them to walk and bicycle to school. SRTS programs examine conditions around schools and seek to improve safety and accessibility in the vicinity of schools. The goal of these programs is to help make bicycling and walking to school safer and more appealing.

In coordination with the William Penn School District, DVRPC hosted walkability audits for both the Penn Wood Middle School and the Walnut Street Elementary School as part of Phase II activities. Both audits covered the grade crossing at Sixth and Main streets, and the Penn Wood Middle School Audit additionally covered the grade crossing at Fifth and Main streets. The audits provide additional information and insight to help identify potential improvements for the grade crossings.

Open House and Transportation Expo

DVRPC also conducted a public outreach event in the Darby Borough Recreation Center as part of Phase II activities. The event featured a number of stations for various transportation agencies, such as SEPTA, CSX, and Operation Lifesaver. The focal point of the Open House was four poster boards, which displayed background information and possible improvements for the two

grade crossings. Possible improvements were organized into three categories: short-term initiatives, medium-term initiatives, and long-term initiatives.

Short-term initiatives are projects that take six months to two years to implement and cost less than \$250,000. Medium-term initiatives are projects that are likely to take two to 10 years to implement and cost between \$1,000,000 and \$6,000,000. Long-term initiatives are projects that take over 10 years to implement or cost over \$50,000,000.

At the Open House, Darby Borough residents were given a chance to provide comments on a variety of potential recommendations, which will be included in the Phase II report. The public comments will be summarized and used as an additional guide to select future improvements.

Possible Initiative Follow-Up

Following the Open House, DVRPC will follow up on the short-, medium-, and long-term options for the Darby Borough grade crossings. One example of this work may be to perform a traffic signal warrant analysis for the intersection of Sixth and Main if that is a preferred alternative identified by Darby Borough and the steering committee. DVRPC will continue to hold meetings of the steering committee as needed to follow-up on commitments made by all stakeholders.

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Abstract: This study examines two highway-railroad grade crossings in Darby Borough, Delaware County, Pennsylvania. The purpose is to document existing conditions at the grade crossings and provide background to possible grade crossing improvement or separation scenarios, which will be explored in greater depth in the Phase II report.

This report is divided into six chapters: an introduction and study purpose; general background information about Darby Borough, the two grade crossings, and Class I grade crossings in general; a summary of data collected for this study; an examination of possible improvements based on the Federal Railroad Administration guidelines and example projects from around the country; and some of the key next steps that will be undertaken in Phase II.

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PHASE II

AUGUST 2014



DARBY BOROUGH

GRADE CROSSING STUDY





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



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

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

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Executive Summary

The Delaware Valley Regional Planning Commission (DVRPC) is the officially designated Metropolitan Planning Organization (MPO) for the nine-county Philadelphia-Camden-Trenton region. The Delaware County Planning Department requested that DVRPC study two highway-railroad grade crossings in Darby Borough. Phase I of that effort, completed in 2013, provided background and analysis of the existing conditions at the crossings. This report represents the summation of Phase II of that effort.

The two grade crossings that are the focus of this study are located in Darby Borough in close proximity to one another, at Main Street (US DOT Crossing # 140641S) and Fifth Street (US DOT Crossing # 140640K), respectively. The two grade crossings are created by the Philadelphia Subdivision, which is owned and operated by CSX, a Class I railroad. The Philadelphia Subdivision runs between Baltimore and Philadelphia, and is a subsection of a main line in the CSX system that runs from Florida to New York. The grade crossing at Main Street has a highly unusual added dimension: the SEPTA Route 11 trolley, which operates in the Main Street right-of-way from 5:00 AM to 2:00 AM daily, also bisects the freight rail line. Additionally, the meeting of the freight line and SEPTA trolley takes place within the intersection of Main Street and Sixth Street.

The focus of the Phase II work was to identify and explore implementation strategies to improve the safety and efficiency of all modes at the crossings. This report lays out the options for short-term improvements, recommends a short-term improvement package, and explores the feasibility of grade separation alternatives that may be explored long term.

This report provides guidance to the project sponsors on potential sources of funding, key considerations for each of the improvements, and outlines responsibilities for various components of the infrastructure at this very complicated intersection. This Phase II report is concluded by discussing Next Steps, which should be pursued by the Delaware County Planning Department and Darby Borough to follow through with implementation of recommendations. Included is a basic implementation matrix demonstrating roles and responsibilities as they relate to each stakeholder moving forward.

Introduction

The highway-railroad grade crossing at the intersection of Main and Sixth streets in Darby Borough, Pennsylvania, is the only known location in the country in which an active freight rail line intersects an active trolley line within a state-owned roadway. The unique conditions at this grade crossing pose three major challenges: maintenance, traffic flow, and safety. The pounding of the surface and rail where the roads, trolley tracks, and train tracks meet has caused substantial continuous pavement degradation, which has forced the grade crossing to be resurfaced many times. Main Street is an active commercial district and a main through road, with over 10,000 vehicles daily. Each train that passes creates a queue of cars and trolleys trying to proceed along Main Street. A high volume of pedestrians, many of whom are students attending one of the two nearby schools, also pass through the grade crossing daily.

Previous Technical Work

In 2006, DVRPC published a report, the Delaware County Highway-Railroad Grade Crossing Study, which examined 11 highway-railroad grade crossings along the CSX Philadelphia Subdivision in Delaware County. The study contained an inventory of each grade crossing in the corridor, highlighting the existing conditions, such as DOT Identification Number, location, road owner, annual average daily traffic, number of daily trains, warning devices, adjacent land use, and crash data.

The purpose of the study was to identify improvements that might better integrate the rail freight traffic with the goals of the host communities, particularly taking into account the grade crossings. To this end, the report spelled out improvement options for the entire rail corridor and for individual grade crossings, such as supplemental safety measures, grade crossing consolidation, and grade separation.



Figure 1: Study Area

Source: DVRPC

In 2013, DVRPC published a report, *Darby Borough Grade Crossing Study: Phase I* (Publication #11012), which explored in greater detail the operations and issues at the Main and Sixth streets and Fifth Street crossings in Darby Borough. This study provided a complete inventory of activity levels by mode at the crossings and identified a full range of improvements that might be considered for the crossings. This study provided the guidance for the current Phase II study which began to provide feasibility assessments of the improvements that held the most merit and were supported by the project steering committee.

Project Steering Committee

Integral to the completion of this report was the steering committee, which met to discuss the report's progress and review completed materials. Members of the steering committee also assisted by sharing data and lessons learned. The following is a list of organizations that were invited to participate in the steering committee and made invaluable contributions to the contents of this report:

- ▶ CSX;
- ▶ Darby Borough;
- ▶ Delaware County Planning Department;
- ▶ Delaware County Transportation Management Association;
- ▶ Federal Railroad Administration (FRA);
- ▶ Pennsylvania Department of Transportation (PennDOT);
- ▶ Pennsylvania Public Utility Commission – Rail Safety Section (PA PUC);
- ▶ Southeastern Pennsylvania Transportation Authority (SEPTA); and
- ▶ William Penn School District.

Report Organization

The Darby Borough Grade Crossing Study: Phase II is organized as follows:

- ▶ Community Outreach

- ◆ This section provides an overview of the outreach conducted in Darby Borough with community members. This outreach was influential in guiding the Phase II product pursued by the steering committee.
- ▶ Short-term Improvements
 - ◆ This section explores in detail, short-term improvements that can be pursued at the Main and Sixth streets crossing. The section identifies specific recommendations and possible funding sources for each of the individual improvements and documents what the intersection could look like under an ideal improvement scenario.
- ▶ Feasibility of Grade Separation Alternatives
 - ◆ This section explores four options for grade separation at the Darby Borough crossings. The section provides key considerations for grade separation and provides an analysis of the benefits and constraints of each of four alternatives as they relate to existing infrastructure, adjacent properties and traffic patterns in the area.
- ▶ Moving Forward
 - ◆ This section explains what steps the members of the steering committee can pursue to continue the process of implementing improvements at the Darby Borough grade crossings.

Community Outreach

Meaningful engagement of the Darby Borough community was seen as an important aspect of the *Darby Borough Grade Crossing Study*. Since Darby Borough has served as the long-time host community for the grade crossings at Main Street and Fifth Street, local citizens are certain to have valuable insights, first-hand accounts and concerns, and informed opinions about the grade crossings and potential improvements.

Open House and Transportation Expo

In the interest of full public involvement regarding the study, an Open House and Transportation Expo was organized (see Appendix A for related open house materials). The event was held in the Darby Borough Recreation Center from 5:00 PM to 7:30 PM on Wednesday, June 6, 2012. The purpose of the event was to celebrate Darby Borough's rich transportation assets and history, and also to garner citizen input into various potential grade crossing improvements. Darby Borough officials were fully involved with the planning of the event and provided full cooperation and support. Participants at the Transportation Expo included the following:

- ▶ Delaware County Planning Department;
- ▶ SEPTA;
- ▶ PennDOT;
- ▶ CSX;
- ▶ UPS;
- ▶ AAA Mid-Atlantic;
- ▶ Community Transit;
- ▶ Amtrak;
- ▶ Bicycle Coalition of Greater Philadelphia;
- ▶ Safe Routes to School;
- ▶ Operation Lifesaver (FRA);
- ▶ Darby Borough Historic Commission; and
- ▶ Philadelphia Regional Port Authority.

Grade Crossing Study and Survey Station

A Grade Crossing Study and Survey Station was a focal point for the open house. The station was seen as a key element of the open house, one that would engage (and inform) the public about the *Darby Borough Grade Crossing Study* and also produce public comment and reaction to varied, specific improvement scenarios.

The station was organized into four substations, and participants were guided through the substations in a logical, sequential order as follows:

Introduction (background information about the *Darby Borough Grade Crossing Study* and grade crossing issues);

Potential Short-Term Initiatives (implementation within six months to two years, with a cost of \$250,000 or less per initiative);

Potential Medium-Term Initiatives (implementation within two to 10 years, with a cost of \$1 million to \$6 million per initiative);

Potential Long-Term Initiatives (implementation within 10 or more years, with a cost of more than \$50 million).

Each of the sub-stations was equipped with a summary poster board and was manned by a DVRPC staff representative. The participants were led through each of the candidate improvements by DVRPC staff and, following that, were presented with a comment card that asked them to vote on preferred options and set priorities.

Survey Results

For Potential Short-Term Initiatives, strong and clear support was expressed for painting new crosswalks and stop bars at the two crossings, increasing anti-trespassing enforcement, and keeping all existing trolley stops. At the same time, there was no prevailing sentiment about modifying traffic patterns on local roads.

In terms of ranking the Potential Medium-Term Initiatives, the option that received the highest number of votes was to install a traffic signal at the Main Street crossing. The least preferred options were replacing all existing gates and restricting parking and driveways near the crossings.

Finally, for the category Potential Long-Term Initiatives, no discernible preferences emerged, as there were just about as many voting participants in favor of a proposed large-scale improvement as there were opposed to that same improvement. For the question about preferred future land uses, the top two votegetters were industrial and park.

In addition to the survey results, one effective outcome of the open house was the gathering of all the key stakeholders and many affected community residents. The resultant dialogue was highly productive, and the demonstrated interest in the community by all of the exhibitors made a highly favorable and lasting impression on the community.

Short-term Improvements

Phase I of the Darby Borough Grade Crossing Study identified a variety of improvements that could help alleviate some of the safety and congestion issues in Darby Borough. Possible improvements were organized into three categories: short-term initiatives, medium-term initiatives, and long-term initiatives.

Short-term initiatives are categorized as projects that take six months to two years to implement and cost less than \$250,000. Medium-term initiatives are projects that are likely to take two to 10 years to implement and cost between \$1,000,000 and \$6,000,000. Long-term initiatives are projects that take over 10 years to implement or cost over \$50,000,000.

Given the current state of transportation funding and the long periods of time necessary to complete medium- and long-term initiatives, short-term initiatives should be considered above other solutions. These solutions can be more easily addressed by the local community and state agencies. Through these initiatives, many of the issues created by the existing conditions can be remedied or improved to help create safer, more efficient conditions at the Main and Sixth streets (US DOT Crossing #140641S) and Fifth Street (US DOT Crossing #140640K) crossing.

The Phase I report outlined a series of initiatives that were presented to Darby Borough residents during the Open house and Transportation Expo. Of these initiatives, several were selected for further exploration during this phase. These initiatives include upgrades to the existing equipment and surfaces, as well as Supplementary Safety Measures (SSM).

This chapter outlines recommended improvements to address the existing issues observed at the Main and Sixth streets crossing. It is recommended that these improvements be considered as a single project to provide for a more effective impact on the safety and efficiency of all modes at the crossing.

Surface Improvements

The existing state of the Main and Sixth streets grade crossing presents several opportunities for upgrades to improve safety and movement through the crossing. Phase I highlighted the need for improved delineation of travel lanes, pedestrian zones, and crossing hazard areas. In addition, degradation of the driving surface creates a rideability issue, with implications on safety. These issues can be addressed through a collaborative effort to repave, repaint, and better delineate space in and around the intersection.

Pavement

The current pavement conditions create a hazard for both vehicles and pedestrians at the crossing. The degradation of the road surface at the crossing, as shown in Figure 2, is causing poor rideability for vehicles. The rideability of a street is very important to the performance and safety of drivers. A rough surface, like that which currently exists at Main and Sixth streets, can distract drivers. Attempts to navigate around especially rough sections can cause vehicles to leave the travel lane or fail to notice crossing warnings that have been activated. In addition, these changes in road surface can cause unexpected changes in speed, which increase the risk of rear-end accidents.

The rough pavement that exists at the grade crossing also presents a hazard for pedestrian users. While grade crossings will always have some issues of accessibility, the large gaps in paving that currently exist create an unsafe walking environment. This uneven pavement creates a tripping hazard and is an obstacle for those who are disabled or travelling with strollers.

Recommendations

- Reconstruct and pave the SEPTA trolley right-of-way along Main Street.
- Repave the CSX right-of-way where it intersects with Main Street and the SEPTA right-of-way.
- Include the use of flangeway fillers to improve ADA accessibility of SEPTA and CSX tracks.
- Explore improvements to the sub-base structure and/or return to the use of reinforced panels for the crossing to improve longevity of the surface materials.



Figure 2: Pavement degradation at the Main and Sixth street crossing, concentrated around rail flanges

Source: DVRPC



Figure 3: Stakeholder rights-of-way at Main and Sixth streets

Source: DVRPC

Responsibilities

The maintenance of pavement at the intersection of Main and Sixth streets and the rail line is the responsibility of the owners of the various rights-of-way that exist, as shown in Figure 3. The area within and immediately adjacent to the CSX track is the responsibility of CSX. SEPTA is responsible for the concrete paving along Main Street within the trolley right-of-way. In addition, Darby Borough holds responsibility for Sixth Street asphalt surfaces and the Pennsylvania Department of Transportation maintains responsibility for Main Street surfaces outside of the CSX and SEPTA rights-of-way. In order to maximize the benefit of any pavement improvements, these agencies should coordinate upgrades to ensure a consistent quality of pavement through and adjacent to the crossing.

Road Striping

Existing conditions at the Main and Sixth streets and Fifth Street crossings have resulted in limited delineation of space in the street and sidewalks. While gates provide maximum approach limits during the time of approach by a train, there is no clear definition on the pavement surface, as would normally be defined by a stop bar. On southbound Sixth Street, at the stop sign, a lack of striping contributes to an issue with vehicles pulling well into the crossing while waiting to make a turn. In addition, while the current conditions do not provide a protected pedestrian crossing, a designated crosswalk would be appropriate given the volume of pedestrian activity along Sixth Street, which crosses Main Street. Combined with curb extensions and signalization, these crosswalks could greatly improve the pedestrian safety issues at the crossing from both a vehicle-pedestrian and train-pedestrian safety perspective. At Fifth Street, striping to delineate travel lanes and stop bars can serve to reduce potential conflicts between vehicles and pedestrians.

Recommendations

- Provide appropriate stop bars at all crossing approaches to define the proper stopping distance from crossing gates and/or red traffic signals.

- Provide high visibility crosswalk striping to identify to both drivers and pedestrians appropriate crossing locations.
- Provide hazard area striping where sidewalks intersect with CSX right-of-way to define clear zones for pedestrians during an active crossing.

Responsibilities

The responsibility for striping the roads and providing appropriate markings is shared by the Pennsylvania Department of Transportation and Darby Borough at the Main and Sixth streets crossing. At the Fifth Street crossing, Darby Borough is responsible for all striping improvements as this is a local road. Striping improvements should be combined with pavement improvements and/or with a full signalization of the Main and Sixth streets crossing, presented at the end of this chapter, in order to have a greater impact on the safety of pedestrians and vehicles at the crossings.

Curbs and Sidewalks

A clear delineation of pedestrian versus vehicular space is necessary to improve the safety of both drivers and pedestrians. Given the presence of two types of rail transportation at the intersection, this delineation of space becomes even more important. The current conditions of the sidewalks and crosswalks at the Main and Sixth streets crossing provide little to no identification of pedestrian-safe zones. In addition, the degradation of sidewalks and curbs has resulted in a crumbling infrastructure that is not only hard to distinguish from the travel lanes, but dangerous to traverse, as seen in Figure 4. The need for improved pedestrian facilities is amplified by the fact that this intersection falls on a primary route for children walking to and from multiple schools in the Darby Borough community. In order to facilitate a safer passage along and across Main Street, there are several recommended improvements that could be implemented.



Figure 4: Existing sidewalk conditions at Main and Sixth streets crossing

Source: DVRPC

Recommendations

- Rebuild sidewalks and curbs on Sixth Street from Greenway Avenue to Commerce Street.
- Improve the condition of sidewalks on all approaches to ensure a safe, consistent surface.
- Provide proper curbing and ramps at all intersection points of sidewalks with highway and rail lines to better define locations safe for pedestrian refuge and provide necessary ADA accessibility.
- Provide curb extensions along Main Street to accommodate SEPTA trolley access and decrease pedestrian crossing distance.
- Provide a curb extension on Sixth Street south of Main Street to provide additional pedestrian refuge between the CSX rail line and Sixth Street traffic.

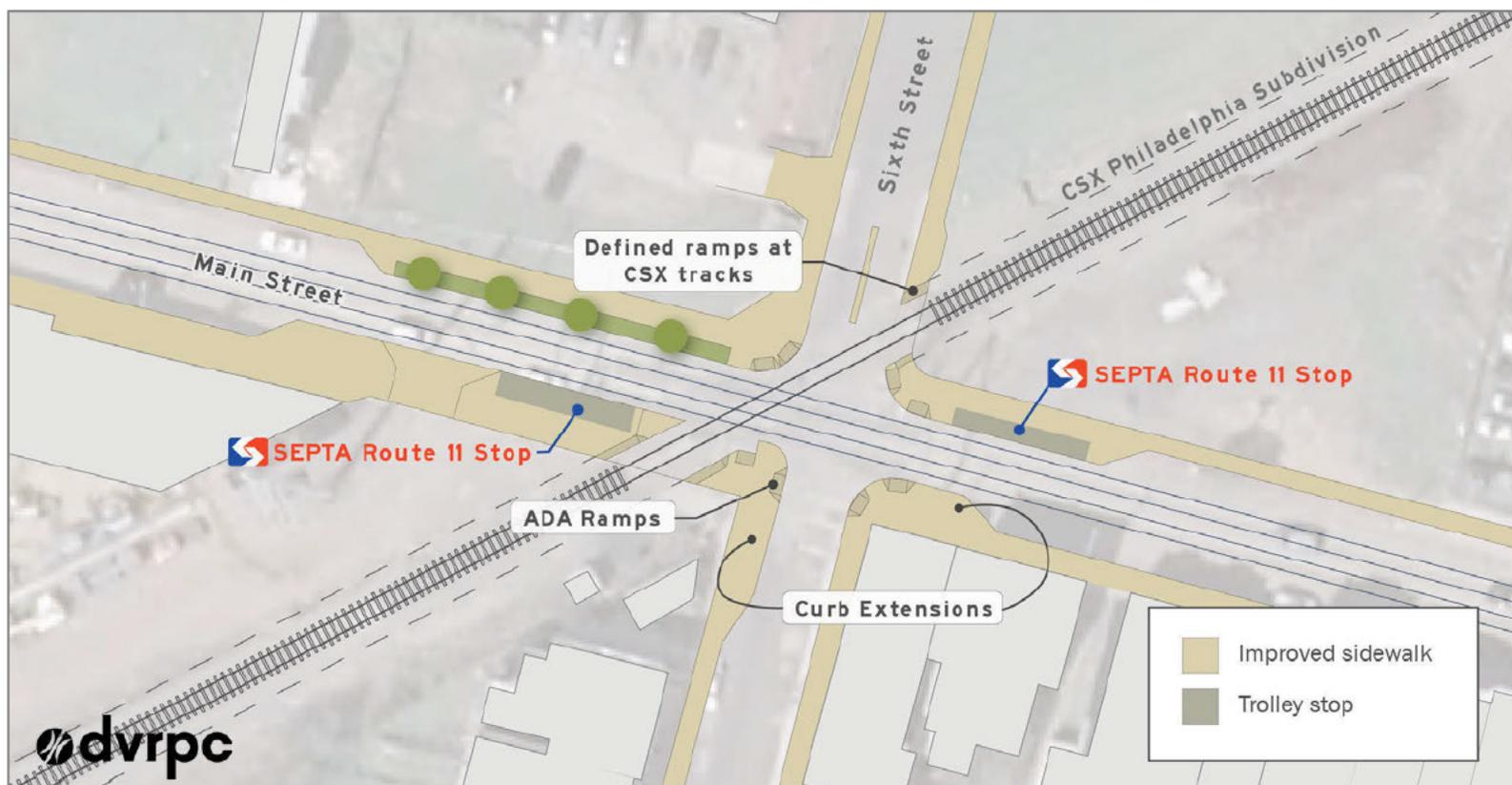


Figure 5: Sidewalk improvements at Main and Sixth streets

Responsibilities

The responsibility for the improvement of the curbs and sidewalks is divided between Darby Borough, the Pennsylvania Department of Transportation, and SEPTA. The sidewalks and curbs approaching the intersection are the responsibility of the local community. At the intersection, if a traffic signal is installed, the Pennsylvania Department of Transportation, as a part of the signal design and installation, will also be required to address the appropriate ADA accessibility, curbing, and ramps. In addition, SEPTA, which serves trolley stops adjacent to the intersection, has a vested interest in the appropriate infrastructure for bumpouts, in order to properly serve current and future streetcars. Together, these agencies can seek grants through various transportation funding sources. For example, Safe Routes to School funding, now under the Transportation Alternatives Program, can be pursued to help pay for the sidewalk improvements and bumpouts, as it is an integral part of the improvements necessary to increase the safety of school children crossing at Main and Sixth streets.

Equipment and Signal Improvements

Beyond the elements that define the ground plane at the Main and Sixth streets intersection, crossing gates, signage, and signals play a vital role in the safety and efficiency of the crossing. The existing equipment at the Main and Sixth streets crossing includes preemptive warning lights, localized warning bells, and gates on three approaches. The equipment is maintained by CSX as is typical of warning devices at highway-railroad grade crossings. While the existing equipment, represents a high level of warning and awareness at the crossing, several concerns arise from both maintenance and physical issues.

Issues with existing equipment

The existing warning equipment located at the crossing has several issues related to both maintenance and physical restrictions that degrade the effectiveness of the devices. Documented over the course of this study have been several problems with gate “misfires.” Though the exact causes of these gate malfunctions have not been documented, the issue raises concerns about the maintenance of equipment used to activate these preemptive warning devices. While occasional misfires can often be overlooked, the mistrust created by a downed gate without an approaching train is likely to contribute to higher instances of gate violations.

Contributing to the issues of visibility and warning system effectiveness are the geometrical realities of the intersection and crossing. The physical infrastructure at Main and Sixth streets creates several issues around visibility. Due to the context of the crossing, there is a very limited vertical presence created by the warning devices along Main Street. This is to say that a vehicle traveling on Main Street has very little warning that a grade crossing exists, as the usual cues (cross buck signage, cantilevers, side markers and lights, etc.) are not clearly visible from the active travel lanes. The primary reason for the lack of visibility is the

profile of Main Street. The road has two primary travel lanes, with parking lanes on either side. This extra parking lane causes the curb, and thus the roadside warning systems, to be located outside of the optimum view shed of drivers. A high concentration of signage and utility poles causes a high level of clutter that further deemphasizes the important warnings related to the crossing.

At an optimal crossing, the warning systems would be supplemented by a cantilever with warning lights and cross bucks, as well as painted cross bucks in the travel lane. The presence of the SEPTA trolley operations limits the effectiveness of these devices and prompts. The overhead wires reduce the cantilever to a stub that extends no further than the center of the parking lane. In the lane, painted cross bucks can be provided, but will be divided in multiple places by the in-pavement trolley tracks. These physical constraints can be addressed through a combination of equipment upgrades and curb extensions (as described above). In addition, there are several upgrades that can be made at Main and Sixth streets to enhance the level of safety for vehicles and pedestrians.

Pedestrian Warning Devices

The volume of pedestrians that utilize the Main and Sixth streets crossing makes it especially important to target pedestrian needs with specialized warning devices. There are several surface improvements that could help to address issues with pedestrian movements at the intersection. However, additional attention could be given to pedestrians through warning devices. The existing crossing is limited to two pedestrian gates that are fairly ineffective at blocking the paths of users due to the fluidity of their movements at the crossing. The use of audible warning devices, which on approach provide a message such as “Do not cross, a train is approaching,” would be appropriate at the crossing. These could be deployed with signal heads (see Figure 6) similar to man/hand signs used at traffic signals to provide visual cues for pedestrians.



Figure 6: Example of a pedestrian signal at a grade crossing, Delaware Valley College, New Britain, PA *Source: DVRPC*

Recommendations

- Make suggested physical improvements (see “Surface Improvements”) to better control pedestrian movement.
- Provide electronic warning signs at all pedestrian crossing points.
- Provide localized audible warnings to pedestrians when a train is approaching.

Responsibilities

The recommended improvements for pedestrian warning devices can be completed as a component of other crossing signal improvements. These improvements could be funded utilizing Section 130 funding as a part of the safety upgrades at the crossing. In addition, SEPTA, CSX, PennDOT, Darby Borough, and Delaware County can coordinate to explore additional funding that may be provided through the Safe Routes to School program.

Existing Equipment Enhancements

As the Phase I study suggested, there are several Supplementary Safety Measures that deal with the control of vehicular traffic. Specifically the use of quad-gates or channelization at Main and Sixth streets could prove to be an effective improvement over current conditions. The existing issues related to vehicles bypassing the gates to either make an illegal turn or run the crossing altogether can be effectively controlled by either of these measures. While the primary cause of these violations may be related to distrust of the gates, the lack of enforcement also contributes. As a result, physical restrictions remain the most viable improvement.

Recommendations

- Provide median channelization at all three approaches to the crossing.
- Update warning lights and gates to provide maximum visibility.
- Provide localized audible warning bells and horns, which are mounted at the crossing providing audible warnings in addition to train horns.
- Update and improve the location of existing passive devices (signs, etc.).
- Ensure proper functionality and continued maintenance of warning devices and gates.

Responsibilities

These improvements could be funded utilizing Section 130 funding as a part of the safety upgrades at the crossing. This would require coordination between Delaware County, PA PUC, and the Pennsylvania Department of Transportation to collectively support these improvements as a priority over other crossings in the state.

Combined Improvement Package

The short-term improvements that were identified and explored in this study provide a menu of items that could individually serve to improve the current conditions at the Main and Sixth streets crossing in Darby Borough. However, based on the complex interaction of activities and modes at the crossing, it is recommended that these improvements be considered as a singular effort that seeks to advance them as one improvement project. By integrating the various improvements into a singular project and leveraging various sources of funding, the project partners have a greater chance of improving the safety and efficiency of the grade crossing and intersection. The recommended improvement strategy would include full signalization of the intersection, as well as supplemental upgrades to the adjacent facilities, as identified in the improvements above and shown in Figure 7.

Full Signalization

Beyond improving the existing warning devices and providing new supplementary safety measures at Main and Sixth streets, there is a strong case to be made for signalization of the intersection. Signalization of a railroad crossing is presented by the United States Department of Transportation for use when highway intersections occur in close proximity to a grade crossing. Additionally, Section 130, which is the federal program for funding safety improvements at highway-railroad grade crossings, identifies traffic signals as an “approach improvement” that can be funded under the program.

The implementation of a traffic signal could provide a reduction in the rate of violations at the crossing. The improvements related to the traffic signal extend beyond the active crossing. The signalization of Main and Sixth streets would reduce the conflict during normal operations outside of rail freight activity. The volume of pedestrian activity at the intersection, especially school children, qualifies the intersection for signalization under Warrant 5 of a signal

Signal Warrant Analysis

A signal warrant analysis is a metric system used to determine the appropriateness of signalization of an intersection. Under the Manual for Uniform Traffic Control Devices (MUTCD), there are nine individual warrants that can be used to justify a traffic signal. These factors look at various vehicular volumes, pedestrian activity, network, and crash context as well as proximity to highway grade crossings. A signal warrant analysis at Main and Sixth street would show that the signalization is justified under the following warrants:

Warrant 5: School Crossing

Warrant 9: Intersection near Grade Crossing

warrant assessment. This signalization would also serve to reduce unsafe approaches to the intersection from Sixth Street, as the site distance issues would no longer be a factor for vehicles trying to access Main Street.

Recommendations

- Darby Borough, Delaware County, Pennsylvania Department of Transportation, and CSX should work toward the approval of a traffic signal at Main and Sixth streets.
- Signalization can only be considered along with appropriate physical improvements, including curb extensions, crosswalks, pedestrian signals, and ADA ramp improvements.
- Upgrade the advanced warning preemption system and linking to the Main and Fifth street traffic signal.

Responsibilities

Traffic signalization at Main and Sixth streets is estimated to cost approximately \$350,000 to \$500,000 including all necessary upgrades to the current infrastructure to meet ADA standards, improving pre-emptive technology, and linking of Main and Fifth streets to the new signal's phasing. The cost of these improvements would encompass many of the recommended surface improvements as a part of the project, bringing the intersection up to appropriate standards. In order to fund some of these improvements, the project sponsors could seek the funding sources mentioned previously. For the primary components of the traffic signal, Section 130 funding should be pursued for the cost of the project. The new Multimodal Transportation Funds available through the Pennsylvania Department of Transportation and Pennsylvania Department of Community and Economic Development could also serve as a funding option. Additional funding through the Pennsylvania Department of Transportation ARLE Grant Program could help to fund the signalization improvements. These, along with matching funds from CSX and Transportation Alternatives Program funding, could provide an effective public-private funding solution at Main and Sixth streets. However, it is important to note that the cost of maintenance will be the responsibility of Darby Borough and will need to be further explored by the project sponsors.

Channelization

A



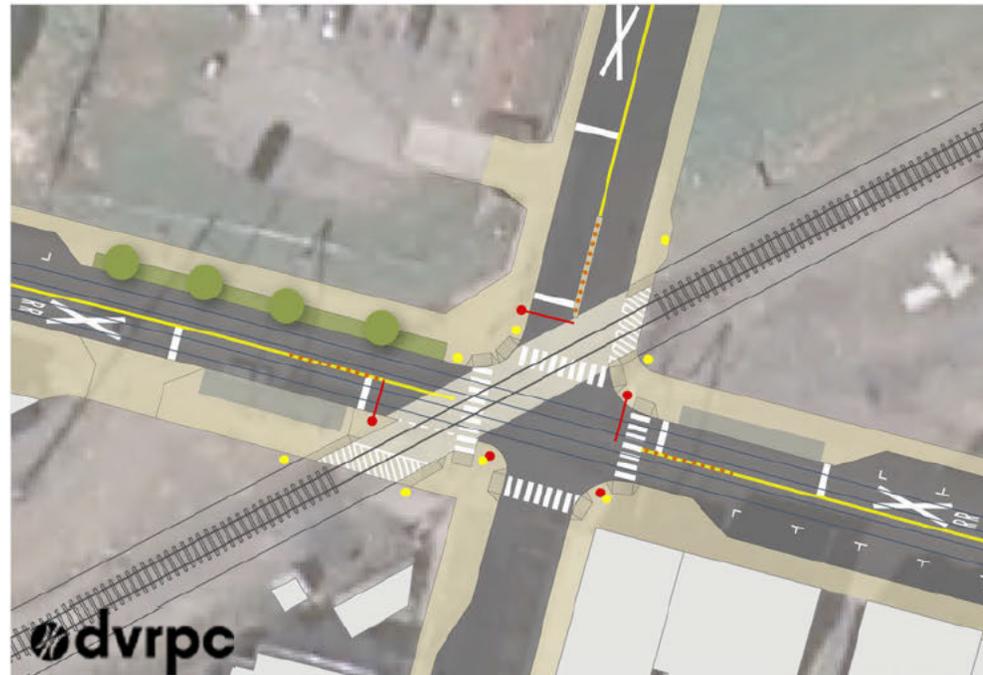
B

Striping & Crosswalks



Signalization

F



C

Curb bumpouts



E

Resurfacing



D

Pedestrian Signals



- Pedestrian signal
- Vehicular signal
- Crossing gate w/signal
- SEPTA stop

Figure 7: Recommended Improvements at Main and Sixth streets



Figure 8: Before and After Improvements

Source: DVRPC

Feasibility of Grade Separation Alternatives

Overview of Grade Separations

Short-term improvements, as presented in Chapter 3, can go a long way to solving many of the safety issues at the Darby Borough grade crossings. However, these actions would not provide a separation of the multiple circulation patterns through the intersection, and therefore would not wholly eliminate congestion or exposure to conflict. Phase I of this study identified the potential to grade separate one or both of the crossings in order to reduce the conflict between different modes. This chapter looks closely at the opportunities for grade separation in order to understand the impacts and challenges to determine the feasibility of grade separation.

The options for grade separation between the four modes of transportation are many, however, this study focused on four alternatives that fit a defined set of assumptions and limitations. In order for any alternative to move forward, there were several considerations that limited the impacts that could occur in order for consideration of an alternative. The following are the key elements that were essential considerations in each of the alternatives:

- ▶ Maintain SEPTA Trolley service on Main Street;
- ▶ Provide separation of Main Street vehicular and CSX freight train traffic;
- ▶ Maintain pedestrian access along Sixth Street;
- ▶ Minimize impacts to adjacent businesses through the use of maximum allowable approach slopes; and
- ▶ Modify only one feature (road or CSX rail) through elevation or depression (as per Phase I analysis).

In addition to these preliminary goals for the alternatives, there were also a series of technical constraints applied. Since the alternatives are focused around changes in elevation, these core technical constraints are related to the maximum slopes and minimum clearances that would need to be provided in order for the various modes to continue to operate unimpeded through the future intersection. The following technical constraints were universal across the alternatives.

- ▶ Maximum slope for SEPTA trolley rail: 4.5 percent;¹

¹ Provided by SEPTA

- ▶ Maximum slope for CSX Philadelphia Subdivision: 0.8 percent;²
- ▶ Maximum slope for vehicular traffic on approach: 10 percent;
- ▶ Maximum slope for vehicular traffic at intersection: 4 percent; and
- ▶ Vertical clearance:
 - ◆ Rail bed to bottom of overhead structure: 22 feet minimum³ (including SEPTA trolley); and
 - ◆ Road surface to bottom of overhead structure: 18 feet minimum.

This set of goals and technical requirements were used as a baseline for establishing the final set of alternatives to evaluate. Each of these individual alternatives also provides a series of impacts and benefits that help to differentiate the feasibility of the project. The remainder of this chapter will review a set of four alternatives that are as follows:

- ▶ Reconstruction of Highway:
 - ◆ Alternative A: Road over Rail Line at Darby Borough Crossings; and
 - ◆ Alternative B: Road under Rail Line at Darby Borough Crossings.
- ▶ Reconstruction of Rail Line:
 - ◆ Alternative C: Rail Line under Road at Darby Borough Crossings; and
 - ◆ Alternative D: Rail Line over Road at Darby Borough Crossings.

Reconstruction of Highway

The first pair of alternatives explores opportunities to reconstruct the highway components of the grade crossings as elevated or depressed to provide for separation from the CSX Philadelphia Subdivision. Due to the potential cost and return on investment for a project that would tunnel under or bridge over the rail line, it was determined that Fifth Street would not be a feasible crossing for grade separation. As such, the highway separated alternatives focus on bridging over and tunneling under the Main and Sixth streets crossing, USDOT Crossing #140641S. These alternatives explore the general impacts and considerations that would need to occur for a successful grade separation. Beyond these considerations, substantial cost and engineering would be necessary for a complete feasibility assessment.

² Maximum slope for CSX was based on the maximum slope currently present in Delaware County.

³ Defined by Pennsylvania Public Utilities Commission in 52 PA Code § 33.121.(a).

Alternative A: Road over Rail Line at Darby Borough Crossings

Alternative A explores the opportunity to create a bridge that would carry Main and Sixth street traffic over the CSX Philadelphia Subdivision. This alternative would create an intersection on the bridge where Main and Sixth streets meet. In order to achieve the proper infrastructure to ensure the continued operation of both the SEPTA Trolley and CSX freight service, the following assumptions were applied.

- ▶ Maximum slope on Main Street approaches: 4.5 percent;
- ▶ Maximum slope on Sixth Street approaches: 10 percent; and
- ▶ Clearance from CSX Philadelphia Subdivision to bottom of bridge: 22 feet.

Based on these assumptions, the proposed structure would require the current intersection surface to be elevated by 26 feet, allowing for the proper 22-foot clearance below the structure. Figure 9 illustrates the impacts of this proposed structure. Visible in red is the component of the bridge structure that would be elevated to the height of 26 feet (on the upper surface).

Existing Infrastructure and Adjacent Grade Crossings

The red portions of this plan, shown in Figure 9, represent the areas that would be constructed to slope up to the final elevation of the bridge. The extent of these impacts is shown utilizing the maximum slopes allowed for the given approaches. Based on these requirements, the bridge at Main and Sixth streets would require the reconstruction of four intersections adjacent to the project. Three non-signalized intersections including Main and Seventh streets, Main and Summit streets, and Sixth and Commerce streets would need to be altered to change elevation by nine feet, five feet, and six feet, respectively. For these intersections, the reconstruction would require new sidewalks, retaining walls, railings, and right-of-way acquisition in order to maintain access to adjacent properties and preserve the pedestrian and vehicular patterns that currently exist. In addition, the signalized intersection of Main and Fifth streets would require reconstruction to increase the current elevation by nine feet. The costs associated with this would be far greater than a typical intersection reconstruction, as this intersection is signalized and all associated components would need to be redesigned and reinstalled.

Beyond the intersections that would require reconstruction, most sidewalks within the impact area would need to be rebuilt. These sidewalks could be maintained along the elevated roadway and/or at the level of shop entrances. The ground level pedestrian system would require access via ramps and steps in order to connect to the newly elevated street system. This ground level system would also create an unwelcoming environment that is both hidden from view and in some instances very enclosed. This type of environment would have negative impacts on the performance of businesses and the community environment.



Figure 9: Alternative A plan diagram

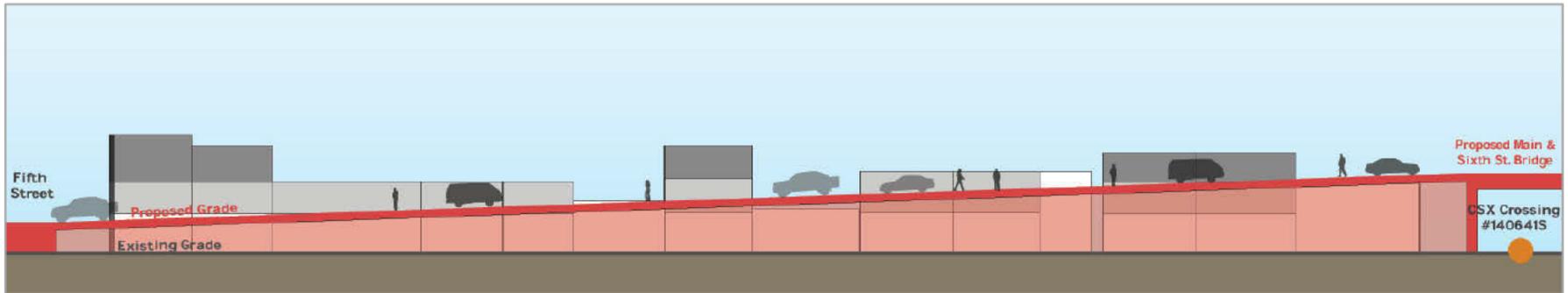


Figure 10: Alternative A Section/Elevation, south facing along 500 block of Main Street

Source: DVRPC

Adjacent Properties and Economic Development

The proposed infrastructure in Alternative A would have significant impacts on the adjacent residential and commercial properties. The level of impact would vary based on final engineering, but in general the impacts that follow would be unavoidable without the redevelopment of adjacent properties.

The elevation of the new road surface creates several dilemmas to adjacent parcels. First, direct access is restricted by the new infrastructure. Figure 10 shows the 500 block of Main Street in section/elevation view. This diagram shows the height of the proposed infrastructure relative to the existing commercial properties on the south side of Main Street. This proposed infrastructure would remove any direct access to the first floor from the street level for the entire length of the 500 block. In addition, the equipment rental property on the 600 block of Main Street would lose both driveway and pedestrian access due to this elevation change. This loss of direct access and visibility from the street level would create an unwelcoming and unproductive commercial environment for businesses.

Furthermore, the elevation change creates additional impacts to the upper levels of these buildings. In many cases, the upper floors are dedicated to residential or office uses in these types of buildings. With the proposed infrastructure, these floors would now be level with or below the street elevation. As a result, these floors would face a decline in value and vacancy rates would be likely to increase for these properties.

The final major impact to be felt by these adjacent properties is the loss of street-side parking. With the construction of a new structure, and in order to maintain pedestrian access along the road, street parking would need to be removed along all areas identified in Figure 9 by the dashed red line. This parking is essential for community access to commercial businesses. Without it, many businesses would lose valuable patronage and the commercial core's viability would be reduced.

While these negative impacts would be unavoidable given the current development along the corridor, there exists the option to redevelop these parcels. This study did not explore the economic feasibility for such a redevelopment, but based on existing

property values in Darby Borough and the current climate for development, redevelopment of these adjacent properties would be very challenging.

Traffic Patterns

Alternative A will provide significant improvements to the current condition at the Sixth and Main streets crossing. Pedestrians and vehicles will be completely separated from freight rail operations, allowing for a more fluid movement along both Main and Sixth streets. This separation allows for safer passage by school students and buses traveling along Sixth Street. In addition, the separation reduces the level of congestion along Main Street and provides a safer environment for the adjacent SEPTA trolley stops. This alternative would not improve the condition of the Fifth Street crossing. It would also have the potential to create new issues with respect to handicap pedestrian access for businesses along the 500 and 600 blocks of Main Street.

During construction of this alternative, careful phasing would need to be implemented in order to maintain north-south access across Main Street. Due to the need to reconstruct both the Fifth and Sixth streets intersections with Main Street, the phasing would need to allow for one to be completed before the closing of the other, as they are vital for north-south travel in Darby Borough. In addition, for the duration of the project, Main Street traffic would need to be detoured, including the rerouting of SEPTA trolley service.

Feasibility Summary

Benefits of Alternative

- ▶ Separation of all Main and Sixth street traffic (pedestrian, vehicle, and SEPTA) from freight rail crossing.
- ▶ Safer pedestrian access across tracks, especially for school children.
- ▶ Reduction of congestion along Main Street caused by crossing gates.

Constraints of Alternative

- ▶ Reconstruction of four adjacent intersections, including signalized intersection at Main and Fifth streets.
- ▶ Loss of street parking on 500 and 600 blocks of Main Street.
- ▶ Loss of street-level pedestrian access to residences and businesses on 3,135 feet of frontage.
- ▶ Degradation of property values on 500 and 600 blocks of Main Street.
- ▶ Does not improve the condition of adjacent highway-railroad crossings on the CSX rail corridor in Delaware County.

Alternative B: Road under Rail Line at Darby Borough Crossings

Alternative B explores the opportunity to create a trench below the CSX Philadelphia Subdivision over Main Street. This alternative would depress Main Street under the crossing, while eliminating through traffic along Sixth Street. The resulting structure would allow for only pedestrian access at-grade. In order to achieve the proper infrastructure to ensure the continued operation of both SEPTA Trolley and CSX freight service, the following assumptions were applied:

- ▶ Maximum slope on Main Street approaches: 4.5 percent; and
- ▶ Clearance from Main Street to bottom of overhead rail bridge: 22 feet.

Based on these assumptions, the proposed structure would require the current Main Street surface to be depressed by 22 feet, allowing for the proper 18-foot clearance below the structure. Figure 11 illustrates the impacts of this proposed structure. Visible in red is the extent of the bridge that would have a 22-foot clearance from current surface elevation to Main Street.

Existing Infrastructure and Adjacent Grade Crossings

The red portions of this plan, shown in Figure 11, represent the areas that would be constructed to slope down to a trench that would provide necessary clearance below a new bridge carrying the CSX rail line. The extent of these impacts is shown utilizing the maximum slopes allowed for the given approaches. Based on these requirements, the grade separation at Main and Sixth streets would require the reconstruction of two intersections adjacent to the project. One intersection at Main and Seventh streets would need to be altered to change elevation by five feet. The reconstruction would require new sidewalks, retaining walls, railings, and right-of-way acquisition in order to maintain access to adjacent properties and preserve the pedestrian and vehicular patterns that currently exist. In addition, the intersection of Main and Fifth streets would require reconstruction to depress the current elevation by six feet. The costs associated with this would be far greater, as this intersection is signalized and all associated components would need to be redesigned and reinstalled.

Beyond the intersections that would require reconstruction, most sidewalks within the impact area would need to be rebuilt. These sidewalks could be maintained at grade. The at grade sidewalks would allow for continuous pedestrian movements along Main, Sixth and Fifth streets. Improved pedestrian gates at the crossing could be implemented to allow for a safer, more controlled crossing experience.



Figure 11: Alternative B plan diagram

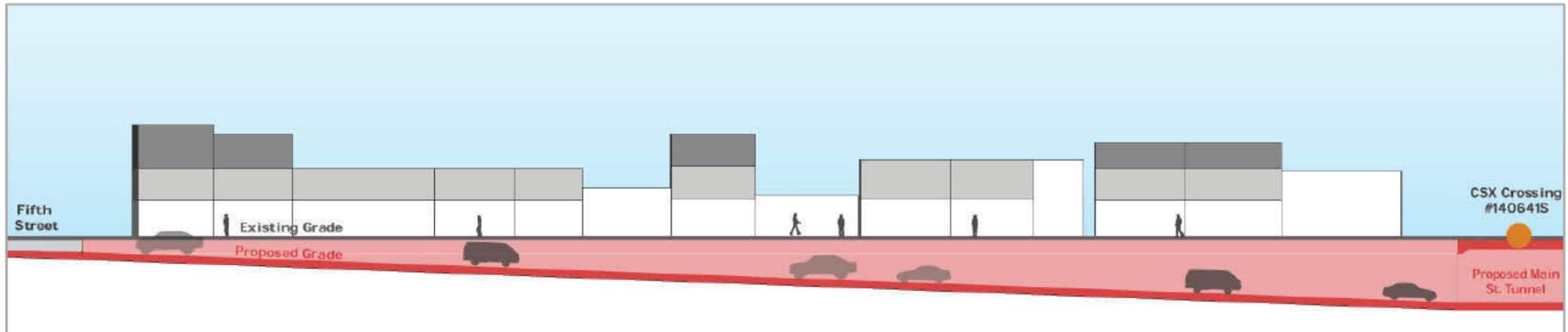


Figure 12: Alternative B Section/Elevation, south facing along 500 block Main Street

Source: DVRPC

Adjacent Properties and Economic Development

The proposed infrastructure in Alternative B would have some impacts on the adjacent residential and commercial properties. The level of impact varies along the length of the depressed roadway and would vary based on final engineering. A section/elevation of the proposed infrastructure is shown in Figure 12.

The depression of the new roadway (Main Street) would cause the loss of street-side parking for businesses and residential properties along the 500 and 600 blocks of Main Street. These areas are identified in Figure 11 by a red dashed line. The total displacement of street-side parking is 2,000 linear feet. This parking is essential for community access to commercial businesses. Without it, many businesses would lose valuable patronage and the commercial core's viability is further reduced.

In comparison to Alternative A, this alternative does retain much of the street-level experience that currently exists along the corridor. With the road depressed, access across Main Street is limited to the Main and Fifth streets intersection. While driveway access would be eliminated in these areas, pedestrian access would be maintained and businesses, while separated from the street level, would not be crowded by the presence of an overhead structure.

Traffic Patterns

Alternative B will provide significant improvements to the current condition at the Sixth and Main streets crossing. However, this alternative does not maintain all existing traffic patterns. Alternative B would allow for the separation of Main Street traffic from the at-grade crossing with the CSX Philadelphia Subdivision. This would eliminate the vehicle and trolley conflict at the grade crossing. The creation of the depressed roadway would not be possible for Sixth Street due to constraints on safe slopes for the approaches. As a result, this alternative would eliminate the through traffic on Sixth Street. The redistribution of this traffic, approximately 1,159 AADT, would be expected to create additional activity on Summit and Fifth streets to accommodate the existing movements. Fifth Street could serve as an alternate north-south route in place of Sixth Street if it were reconfigured from one-way to two-way, south of Main Street. Fifth Street as of the most recent count in 2011 has an AADT of 4,146. As a

result of the volume of activity on these streets, the redistribution of the Sixth Street movements is not expected to significantly degrade the level of service at Main and Fifth streets.

Alternative B does not separate pedestrian traffic from the at-grade crossing; however, safety can be greatly improved without the presence of the roads at the crossing. Through maintaining pedestrian access, the community is better served by the improvements at the crossing. With the implementation of a specialized fence and gate system, the crossing can be made much safer through a more controlled crossing environment. This will allow the current pedestrian activity, especially that of school students, to continue unimpeded.

During construction of this alternative, several traffic impacts will be experienced. With the reconstruction of Main Street, alternative routes will need to be established for SEPTA trolley service and east-west vehicle traffic. This alternative would also require temporary service disruption along the CSX Philadelphia subdivision, unless a second track and accompanying bridge were to be installed parallel to the mainline before the removal of the original alignment.

Feasibility Summary

Benefits of Alternative

- ▶ Separation of Main Street traffic (vehicle and SEPTA only) from freight rail crossing.
- ▶ Improved pedestrian crossing safety through gate and fence installation.
- ▶ Reduction of congestion along Main Street caused by crossing gates.
- ▶ Maintains safe, comfortable pedestrian access to Main Street businesses.

Constraints of Alternative

- ▶ Reconstruction of two intersections including a signalized intersection at Main and Fifth streets.
- ▶ Loss of street parking and driveway access on 500 and 600 blocks of Main Street, totaling 2,000 linear feet.
- ▶ Loss of north-south connection along Sixth Street, requiring new traffic patterns on Fifth Street.
- ▶ Potential degradation of property values on 500 and 600 blocks of Main Street.
- ▶ Does not improve the condition of the Fifth Street crossing.
- ▶ Does not eliminate the potential pedestrian conflicts at the crossing.

Reconstruction of Rail Line

The second pair of alternatives reverses the approach to grade separation of the crossing by exploring opportunities to elevate or depress the CSX Philadelphia Subdivision. Through an elevation change of the rail line there is a far greater impact to other bridges and crossings. While this reality can add to the cost of a project, it opens opportunities to grade separate multiple crossings along the CSX Philadelphia Subdivision where it passes through Delaware County and Philadelphia. In order to establish a broad feasibility of grade separating multiple crossings through one project, a full inventory of crossings was done for the CSX Philadelphia Subdivision to the north and south of the Darby Borough study area in Delaware County.

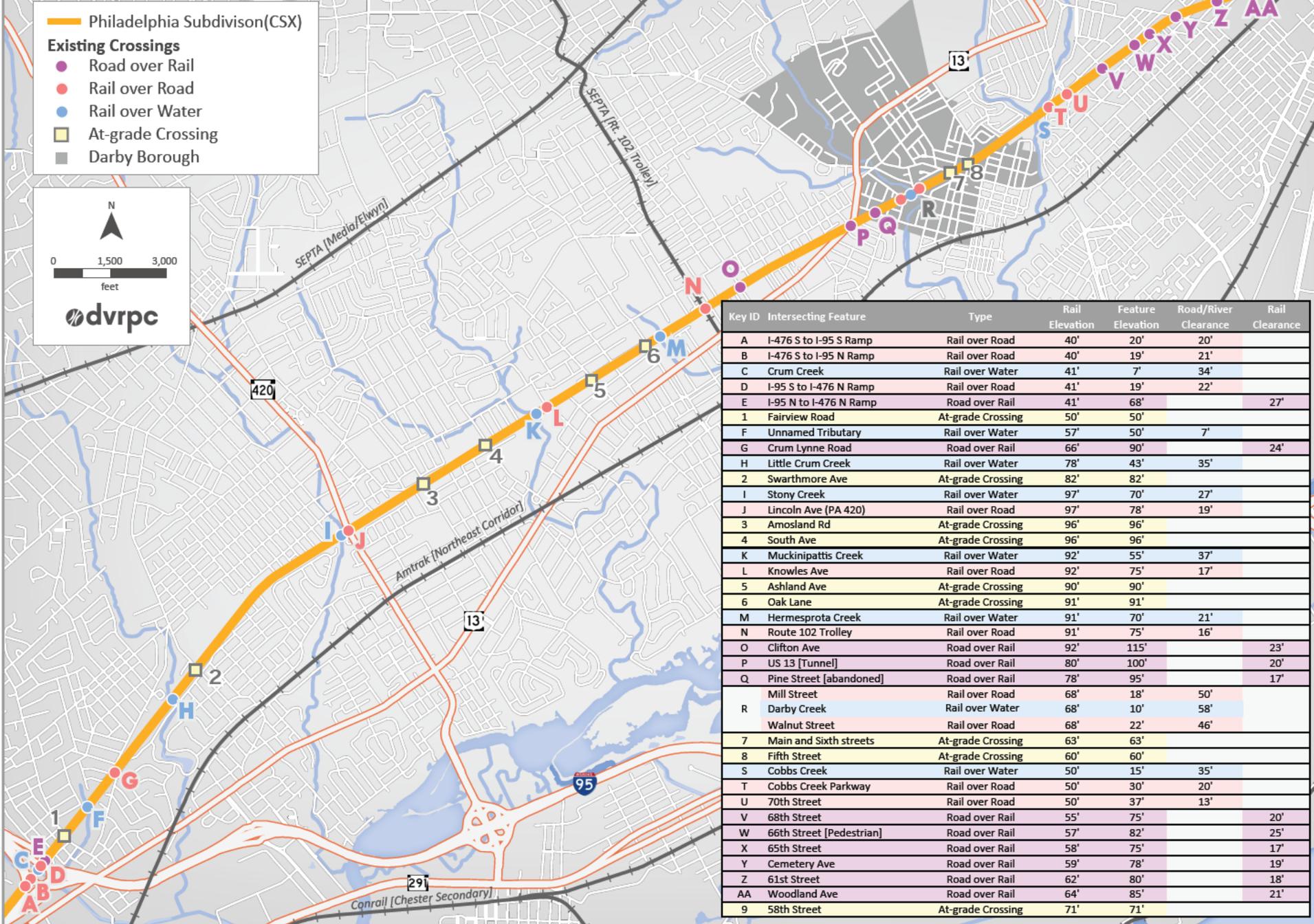
The inventory of rail crossings includes all points of intersection along the CSX Philadelphia Subdivision from the I-476 interchange in the south to the 58th Street crossing in Philadelphia to the north. These crossings included any points where the rail line intersected with a road, rail line, and/or body of water or natural feature that require a bridge, culvert, or at-grade crossing to traverse. Each of these crossings was identified and mapped. For each, the elevation of the rail line and feature were identified. These elevations provided a rough estimate of the current separation at each feature crossing. The results of this inventory are shown in Figure 13.

The next step to establish the feasibility for a regional improvement explored these crossings and the rail line in profile. As the elevation and maximum slopes of the rail line are fundamentally integral to deciding the feasibility of any alterations on the CSX Philadelphia Subdivision, these features were charted to scale with a vertical exaggeration. The chart shown in Figure 14 displays the approximate elevation⁴ and slope of the rail line, shown in purple. Each feature is also shown at their respective elevations in relation to the rail line as dots or dashes based on feature type. This provides a basic understanding of the topographical layout of the CSX Philadelphia Subdivision from the I-476 interchange to 58th Street in Philadelphia. While the vertical elevation is exaggerated, it shows the level of variation not only in the slope and elevation of the rail line, but the elevation of intersecting features. The variation in elevation of features becomes an issue for realigning the rail corridor, as it would need to weave through each of these features, while maintaining the necessary clearances.

Using the chart of the existing features and their respective elevations, the project team then overlaid the approximate minimum clearances required for each feature type. As shown in Figure 14, the existing clearances are mapped as the minimum necessary distance above or below a feature. For all features, the clearance required to allow the rail line to pass below would be at least 26 feet, 22 feet of clearance as established by the Pennsylvania Public Utilities Commission (PA PUC), plus additional height for structure. For water features, no clearance is provided below, as it would not be feasible to tunnel below water features throughout the study area. The distance required for clearance above a feature was determined by feature type and class. Water features required minimal clearance of no less than 10 feet, arterial routes and highway ramps required 21 feet, and local serving roads were provided a clearance of 18 feet. These clearances included an allowance for the structure.

⁴ Elevations for infrastructure elements are approximate based on aerial topographic survey data.

Figure 13
Existing Crossings on the Philadelphia Subdivision in Delaware County



Key ID	Intersecting Feature	Type	Rail Elevation	Feature Elevation	Road/River Clearance	Rail Clearance
A	I-476 S to I-95 S Ramp	Rail over Road	40'	20'	20'	
B	I-476 S to I-95 N Ramp	Rail over Road	40'	19'	21'	
C	Crum Creek	Rail over Water	41'	7'	34'	
D	I-95 S to I-476 N Ramp	Rail over Road	41'	19'	22'	
E	I-95 N to I-476 N Ramp	Road over Rail	41'	68'		27'
1	Fairview Road	At-grade Crossing	50'	50'		
F	Unnamed Tributary	Rail over Water	57'	50'	7'	
G	Crum Lynne Road	Road over Rail	66'	90'		24'
H	Little Crum Creek	Rail over Water	78'	43'	35'	
2	Swarthmore Ave	At-grade Crossing	82'	82'		
I	Stony Creek	Rail over Water	97'	70'	27'	
J	Lincoln Ave (PA 420)	Rail over Road	97'	78'	19'	
3	Amosland Rd	At-grade Crossing	96'	96'		
4	South Ave	At-grade Crossing	96'	96'		
K	Muckinipattis Creek	Rail over Water	92'	55'	37'	
L	Knowles Ave	Rail over Road	92'	75'	17'	
5	Ashland Ave	At-grade Crossing	90'	90'		
6	Oak Lane	At-grade Crossing	91'	91'		
M	Hermesprota Creek	Rail over Water	91'	70'	21'	
N	Route 102 Trolley	Rail over Road	91'	75'	16'	
O	Clifton Ave	Road over Rail	92'	115'		23'
P	US 13 [Tunnel]	Road over Rail	80'	100'		20'
Q	Pine Street [abandoned]	Road over Rail	78'	95'		17'
	Mill Street	Rail over Road	68'	18'	50'	
R	Darby Creek	Rail over Water	68'	10'	58'	
	Walnut Street	Rail over Road	68'	22'	46'	
7	Main and Sixth streets	At-grade Crossing	63'	63'		
8	Fifth Street	At-grade Crossing	60'	60'		
S	Cobbs Creek	Rail over Water	50'	15'	35'	
T	Cobbs Creek Parkway	Rail over Road	50'	30'	20'	
U	70th Street	Rail over Road	50'	37'	13'	
V	68th Street	Road over Rail	55'	75'		20'
W	66th Street [Pedestrian]	Road over Rail	57'	82'		25'
X	65th Street	Road over Rail	58'	75'		17'
Y	Cemetery Ave	Road over Rail	59'	78'		19'
Z	61st Street	Road over Rail	62'	80'		18'
AA	Woodland Ave	Road over Rail	64'	85'		21'
9	58th Street	At-grade Crossing	71'	71'		

Alternative C: Rail Line under Road at Darby Borough Crossings

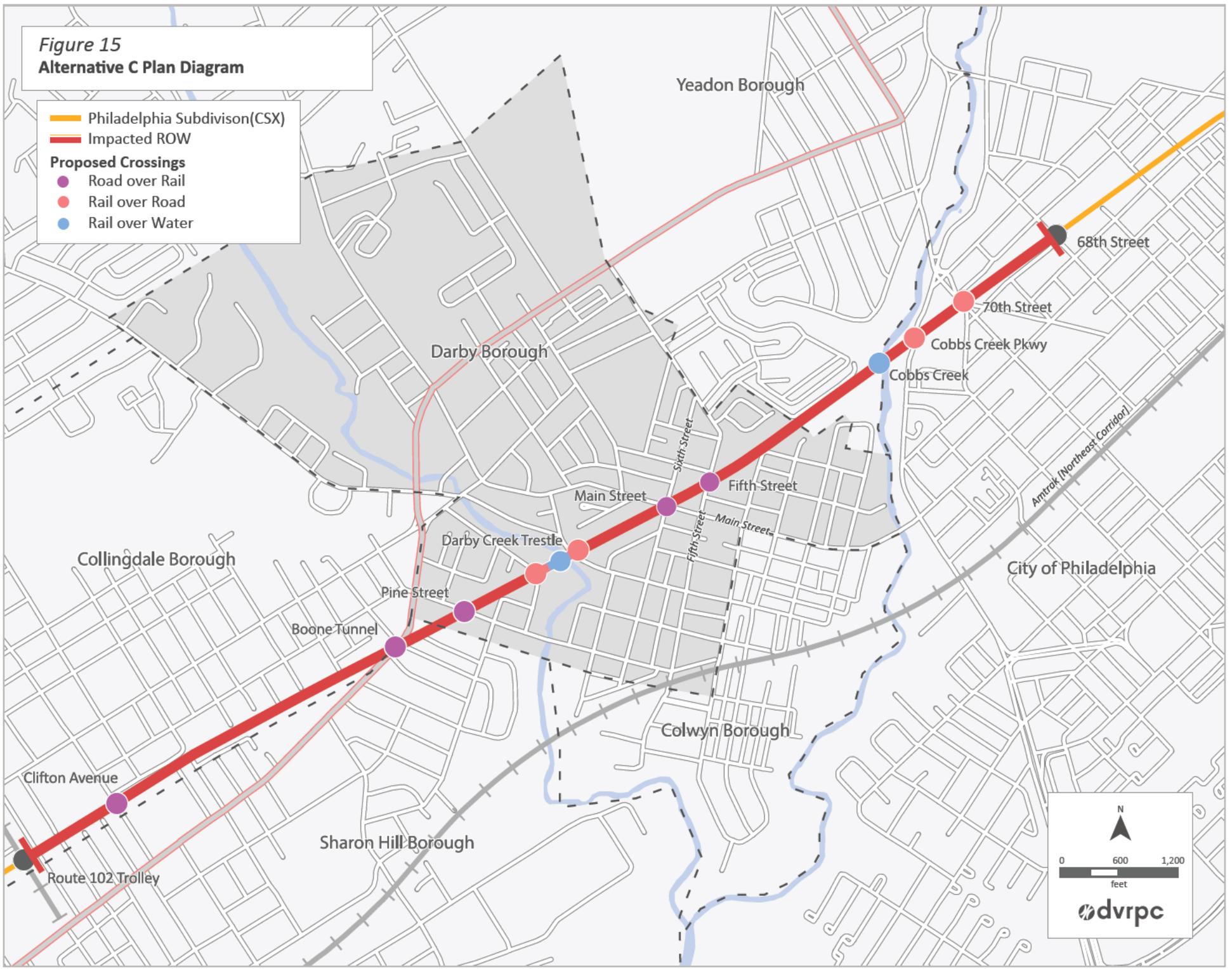
Alternative C explores the opportunity to depress the elevation of the CSX Philadelphia Subdivision below the Darby Borough crossings and adjacent crossings. Utilizing the elevation and clearance chart, it was determined that the only feasible rail under road improvement approach would require new infrastructure extending from immediately south of the 68th Street bridge to the north end of the SEPTA Route 102 trolley bridge. Through this alternative, the only at-grade highway crossings that would become grade separated would be the Main and Sixth streets and Fifth Street crossings.

Existing Infrastructure and Adjacent Grade Crossings

The proposed infrastructure in Alternative C would require the trenching of 10,750 linear feet, or 2.03 miles, of the rail right-of-way. The project would grade separate two crossings and reconstruct six existing grade-separated crossings. These feature crossings and their corresponding infrastructure modifications are as follows:

- ▶ **70th Street:** This crossing would require reconstruction of the existing rail bridge, decreasing clearance by approximately two feet from the existing conditions.
- ▶ **Cobbs Creek Parkway:** This crossing would require reconstruction of the existing rail bridge, decreasing clearance by approximately three feet from the existing conditions.
- ▶ **Cobbs Creek:** This crossing would require reconstruction of the existing rail bridge, decreasing clearance by approximately six feet from the existing conditions.
- ▶ **Fifth Street (USDOT #140640K):** This crossing would require a new road bridge to carry Fifth Street at its present elevation over the new depressed CSX alignment.
- ▶ **Main and Sixth streets (USDOT #140641S):** This crossing would require a new road bridge to carry Main and Sixth streets at their present elevation over the new depressed CSX alignment.
- ▶ **Darby Creek Trestle:** This crossing would require reconstruction of the existing rail trestle that extends approximately 200 feet across road and water features, decreasing clearance by approximately 22 feet from the existing conditions.
- ▶ **Pine Street:** This crossing would require the removal of the currently closed road bridge.
- ▶ **Boone Tunnel (Chester Pike):** This crossing would require the replacement of the existing tunnel with one built below the crossing, 20 feet lower than the current rail line. It is unclear if this would be possible due to engineering constraints.
- ▶ **Clifton Avenue:** This crossing would require lowering the existing track below the Clifton Avenue road bridge by eight feet. The modification will likely require some improvements to reinforce the existing bridge.

Figure 15
Alternative C Plan Diagram



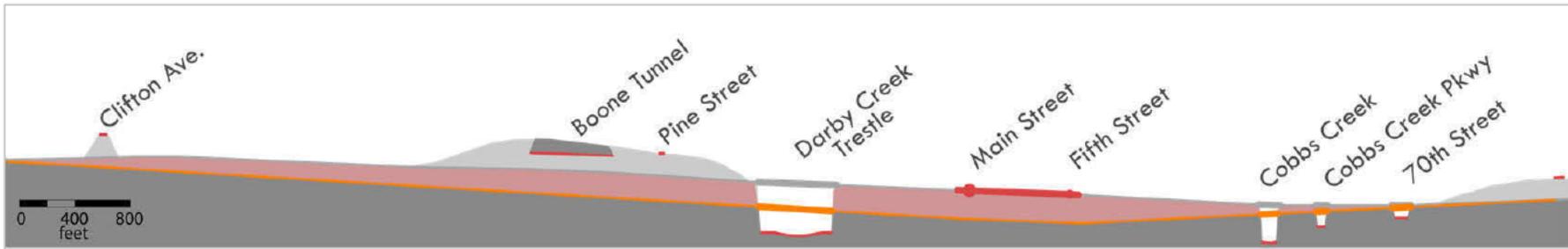


Figure 16: Alternative C Section showing impacts to existing infrastructure

Source: DVRPC

These eight modified and new pieces of infrastructure represent only a portion of the improvements necessary to achieve this grade separated alternative. The full length of the proposed alternative would necessitate a trench to be constructed to carry the new CSX rail alignment. This trench would be as deep as 45 feet, relative to the parcels that border the right-of-way. The proposed trench would require proper fencing and walls to sustain the depth and to prevent pedestrian access.

Adjacent Properties and Economic Development

The improvements proposed in Alternative C would have significant impacts on the properties and communities through which this new trench would run. Along the portion of rail that is proposed to be depressed, approximately 21 acres of industrial and vacant parcels would no longer have rail access. While there are no rail-served businesses in the study area, the potential for sidings and rail service exists as long as the rail line is at grade. The depression of the rail line would ensure that rail service for future industrial development would not be feasible. The loss of this access could mean fewer development opportunities in the community and the loss of the potential for future manufacturing jobs.

In addition to industrial access, this alternative has detrimental impacts for CSX. The areas adjacent to the Darby Borough crossings currently serve as access points for CSX work crews. With the depression of the rail line, access is diminished or relinquished completely due to the necessary space that would be required to descend to the new rail elevation.

While industrial development opportunities would be greatly reduced in Alternative C, residential and open-space land uses could benefit. The depression of the freight rail line has the potential to reduce the negative impacts on property values that proximity to freight rail has been shown to have. With the rail line depressed, the impacts of proximity would be less severe and adjacent property owners could potentially see values increase. In addition, the areas where the trench is deepest have the potential to be decked over. This is especially promising for the north side of the 500 block of Main Street. This block, if decked over the rail trench, could provide a new public space for the community.

Feasibility Summary

Benefits of Alternative

- ▶ Separation of Main and Sixth streets and Fifth Street traffic from freight rail crossings.
- ▶ Improved pedestrian crossing safety.
- ▶ Potential for community improvements on decking above tracks.
- ▶ Reduction of congestion along Main Street caused by crossing gates.
- ▶ Reduction of issues related to stopping trains.
- ▶ Reduction of noise created by the train line in the borough.

Constraints of Alternative

- ▶ Modification of five bridges, one tunnel, and new construction of two road bridges.
- ▶ Construction of a 2.03-mile trench through the borough and adjacent municipalities.
- ▶ Impacts on CSX movement along the line during construction.
- ▶ Boone Tunnel would require specialized engineering to allow for deepening.
- ▶ Extremely expensive construction costs for improvements at only two crossings.

Alternative D: Rail Line over Road at Darby Borough Crossings

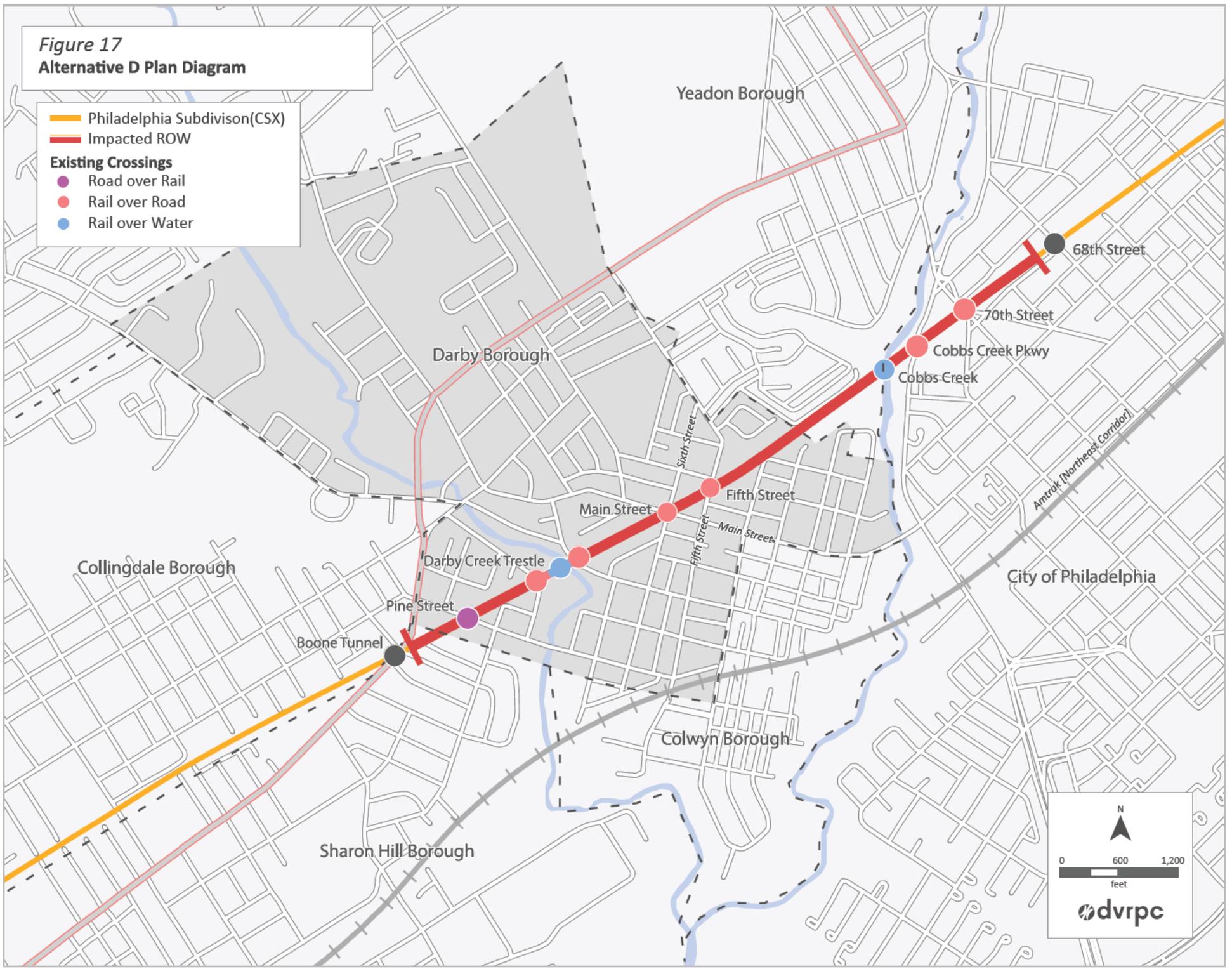
Alternative D explores the opportunity to elevate a portion of the CSX Philadelphia Subdivision above the Darby Borough crossings and adjacent crossings. Utilizing the elevation and clearance chart, it was determined that the only feasible elevated option would require new infrastructure extending from immediately south of the 68th Street bridge to the northern entrance of Boone Tunnel. The only at-grade crossings that would be made grade separated under this option would be the Main and Sixth streets and Fifth Street crossings.

Existing Infrastructure and Adjacent Grade Crossings

The proposed infrastructure in Alternative D would require the construction of an elevated structure to carry 7,500 linear feet, or 1.42 miles, of the rail right of way. The separation project would grade separate two crossings and reconstruct five existing separated crossings. These crossings and their corresponding infrastructure modifications are as follows:

- ▶ **70th Street:** This crossing would require reconstruction of the existing rail bridge, increasing clearance by approximately 15 feet from the existing conditions.
- ▶ **Cobbs Creek Parkway:** This crossing would require reconstruction of the existing rail bridge, increasing clearance by approximately 20 feet from the existing conditions.
- ▶ **Cobbs Creek:** This crossing would require reconstruction of the existing rail bridge, increasing clearance by approximately 22 feet from the existing conditions.
- ▶ **Fifth Street (USDOT #140640K):** This crossing would require a new rail bridge to carry the CSX tracks over Fifth Street at its present elevation.
- ▶ **Main and Sixth streets (USDOT #140641S):** This crossing would require a new rail bridge to carry the CSX tracks over Main and Sixth streets at their present elevation.
- ▶ **Darby Creek Trestle:** This crossing would require reconstruction of the existing rail trestle that extends approximately 200 feet across road and water features, increasing clearance by approximately 15 feet from the existing conditions.
- ▶ **Pine Street:** This crossing would require the removal of the currently closed road bridge.

Figure 17
Alternative D Plan Diagram



N
0 600 1,200
feet
odvrpc

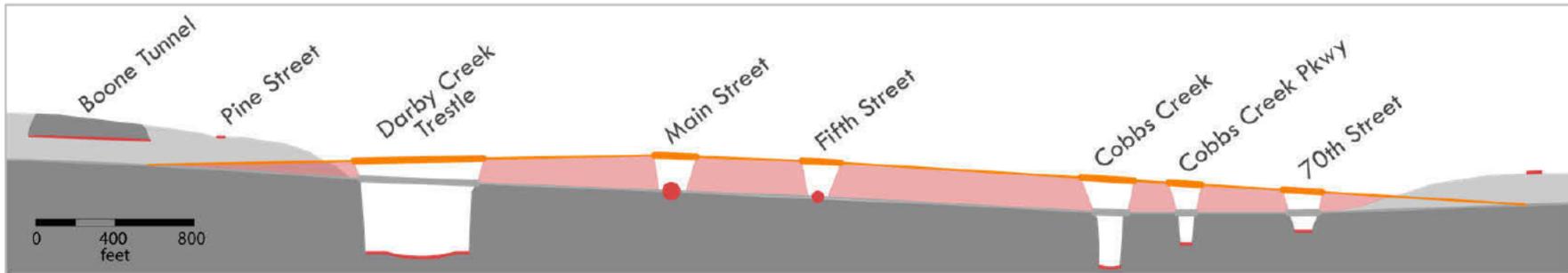


Figure 18: Alternative D Section showing impacts to existing infrastructure

Source: DVRPC

These seven modified and new pieces of infrastructure represent only a portion of the improvements necessary to achieve this grade separated alternative. The full length of the proposed alternative would necessitate an open-air structure or earthen berm to be constructed to carry the new CSX rail alignment. This infrastructure, as it passes through Darby Borough, would be as high as 26 feet, relative to the parcels that border the right of way. In addition, the Darby Creek Trestle would stand at over 70 feet above the creek and roads below.

Adjacent Properties and Economic Development

The improvements proposed in Alternative D would have significant impacts on the properties and communities through which this elevated structure would run. Along the portion of rail that is proposed to be elevated, approximately 19 acres of industrial and vacant parcels would no longer have rail access. While there are currently no rail-served businesses in the study area, the potential for sidings and rail service exists, as long as the rail line is at grade. The elevation of the rail line would ensure that rail service for future industrial development would not be feasible. The loss of this access could mean fewer development opportunities in the community and the loss of the potential for future manufacturing jobs.

In addition to industrial access, this alternative has detrimental impacts for CSX Transportation. The areas adjacent to the Darby Borough crossings currently serve as access points for CSX work crews. Similar to Alternative C, the ability to access the rail line for service would be diminished.

In addition to impacts to industrial development opportunities, existing residential and commercial properties could be adversely affected. The presence of the proposed elevated structure would increase noise pollution and create a feature that cuts the borough in two, both physically and visually. These types of structures have the potential to depress property values and over time discourage investment in adjacent properties.

Feasibility Summary

Benefits of Alternative

- ▶ Separation of Main and Sixth streets and Fifth Street traffic from freight rail crossings.
- ▶ Improved pedestrian crossing safety under the tracks.
- ▶ Reduction of congestion along Main Street caused by crossing gates.
- ▶ Reduction of issues related to stopping trains.

Constraints of Alternative

- ▶ Reconstruction of five bridges and new construction of two bridges.
- ▶ Construction of a 1.42-mile elevated structure through Darby Borough and adjacent municipalities.
- ▶ Negative pressure on adjacent property values.
- ▶ Impacts on CSX movement along the line during construction.
- ▶ Extremely expensive construction costs for improvements at only two crossings.

Moving Forward

The contents of this report provide a summary of the work conducted as Phase II of the Darby Borough Grade Crossing Study. The short-term improvements presented in the report provide an overview of possible implementation strategies that hold the potential, individually, to improve certain conditions at the crossing. Taken together as presented in the final section of Chapter 3, these improvements represent a comprehensive strategy to address on the ground concerns at the Main and Sixth streets grade crossing in Darby Borough.

In addition, the report explored several alternatives for grade separation. Based on preliminary findings, stakeholder concerns, and current transportation funding environments, these long-term strategies would be difficult to achieve, and in general, lack the return on investment for any single stakeholder individually or all stakeholders collectively to warrant implementation.

Stakeholder Implementation

DVRPC staff recommends that the stakeholders involved in the Darby Borough Grade Crossing Study pursue actions to implement the recommended short-term improvements provided at the end of Chapter 3. As the primary sponsor and concerned party of the project, Darby Borough should work closely with the Delaware County Planning Department to pursue these improvements as a single project. Together, these partners can work with the Pennsylvania Department of Transportation, CSX, SEPTA, and the Delaware Valley Regional Planning Commission to identify and secure funding. The following table represents some of the potential roles and responsibilities by stakeholder.

Table 1: Implementation Matrix

Stakeholder	Role	Infrastructure Responsibility
Darby Borough	<ul style="list-style-type: none"> Solicit engineering services and seek project funding from state and regional sources. 	<ul style="list-style-type: none"> Main and Sixth streets sidewalks. Maintenance of signalization equipment. Striping and pavement on Sixth Street and at Fifth Street crossing.

Stakeholder	Role	Infrastructure Responsibility
Delaware County Planning Department	<ul style="list-style-type: none"> • Provide support and assistance to Darby Borough in efforts to locate and apply for funding and acquire regional support for improvements. 	<ul style="list-style-type: none"> • None.
CSX	<ul style="list-style-type: none"> • Provide support on technology and equipment upgrades at the crossing. • Provide recommendations and input on engineering design to ensure compatibility with operations and practices. • Potential funder for some project upgrades. 	<ul style="list-style-type: none"> • Crossing equipment and preemptive technologies. • Pavement within the CSX right of way.
Pennsylvania Department of Transportation	<ul style="list-style-type: none"> • Provide funding through Section 130 program for crossing equipment upgrades. • Approve signalization request and engineering. • Potential funder for some project upgrades. 	<ul style="list-style-type: none"> • Construction of signalized intersection and associated ADA crossings. • Main Street pavement between curb line and SEPTA right of way.
Southeastern Pennsylvania Transportation Authority (SEPTA)	<ul style="list-style-type: none"> • Provide input and recommendations for design of curb extensions and improved trolley stop design. • Potential funder for some project upgrades. 	<ul style="list-style-type: none"> • Curb extension and trolley stop shelters.

Stakeholder	Role	Infrastructure Responsibility
Delaware Valley Regional Planning Commission (DVRPC)	<ul style="list-style-type: none"> • Provide input on design of improvements. • Alert project stakeholders about potential funding for some project costs through TCDI, Transportation Alternatives Program, ARLE Grant Program or Pennsylvania Multi-modal Transportation Fund 	<ul style="list-style-type: none"> • None

*These potential roles have been identified by the DVRPC project staff and do not represent commitments for the advancement of the recommended improvements at the Main and Sixth streets crossing in Darby Borough.

Open House and Transportation Expo Materials

In the interest of full public involvement regarding the study, an Open House and Transportation Expo was held in the Darby Borough Recreation Center from 5:00 PM to 7:30 PM on Wednesday, June 6, 2012. The purpose of the event was to celebrate Darby Borough's rich transportation assets and history and also to garner citizen input into various potential grade crossing improvements. The items in this Appendix represent the materials used in this effort to engage the local community.

DARBY BOROUGH
OPEN HOUSE and TRANSPORTATION EXPO

Join Us!

DARBY BOROUGH
on the Move!
DELAWARE COUNTY, PA

WEDNESDAY, JUNE 6, 2012 5PM-7:30PM
DARBY BOROUGH RECREATION CENTER (1020 RIDGE AVENUE, DARBY, PA)

Provide your input on improving safety at the Main Street and 5th Street highway-railroad grade crossings. Meet passenger and freight transportation experts. Help keep Darby Borough moving in the right direction!

Free REFRESHMENTS & Free GIVEAWAYS!

Exhibitors: SEPTA, PennDOT, CSX, UPS, AAA-Mid-Atlantic, Community Transit, Delaware County TMA, Amtrak, Bicycle Coalition of Greater Philadelphia, Philadelphia Regional Port Authority, Safe Routes to School, Operation Lifesaver
 For More Information: Text Darbyburg 215.236.2844 or tdshburg@dvrpc.org

BILL GOETZ
 CSX

TOM SHAFFER
 Delaware County
 Planning
 Department

COUNCIL PRESIDENT JANICE DAVIS
 Darby Borough



DARBY BOROUGH

OPEN HOUSE *and* TRANSPORTATION EXPO

an INTRODUCTION

Darby Borough: A Community on the Move



varied land uses:
RESIDENTIAL uses most prevalent



ever present **PEDESTRIANS**:
students, seniors, transit riders,
shoppers



HIGHWAY connectivity to the
region and beyond: Lansdowne
Ave., MacDade Blvd., Main St.,
Springfield Rd., Chester Pike

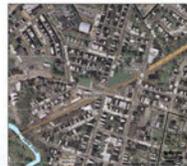


multiple forms of passenger and
freight **RAIL**: Amtrak, SEPTA,
and CSX



nearby **AIRPORTS** and **PORTS**:
PHL, Girard Point, Hog Island,
Fort Mifflin, and Penn Terminals

Darby Borough Grade Crossing Study



the primary **FOCUS** is two
highway—railroad grade
crossings



grade crossing
#140641S **MAIN ST.**



grade crossing
#140640K **5TH ST.**



DATA OVERVIEW: An intense
convergence of transportation activity

SHARED CONCERNS:
transportation
growth across all
modes, safety,
operations and
emergencies,
and land use



PHASE I REPORT will display data
collected and possible improvements

Public Input: Vital to the Transportation Planning Process



your **COMMENTS** are key to helping
envision a new safer Darby Borough



POSSIBLE SHORT-TERM INITIATIVES
time frame: 6 months—2 years
cost: less than \$250,000



POSSIBLE MEDIUM-TERM INITIATIVES
time frame: 2-10 years
cost: \$1,000,000—\$6,000,000



POSSIBLE LONG-TERM INITIATIVES
time frame: 10+ years
cost: \$50,000,000+

PHASE II REPORT WILL:
summarize methodology and results
of the Darby Borough Open House and
Transportation Expo
discuss follow-up in response
to Open House
research potential initiatives
in greater depth



POTENTIAL SHORT-TERM INITIATIVES

Time Frame: 6 Months – 2 Years

Price Range Per Initiative: \$250,000 or Less

Disclaimer: These possible improvements are for discussion purposes only. Your input will help planners, engineers, and other seek to implement improvements that promote safety and are preferred by the Darby Borough Community.

A

Improve Roadway Safety Signage & Pavement Markings at Main St. & 5th St.

RESPONSIBLE AGENCIES:
DARBY BOROUGH / PENNDOT

CURRENT CONDITION:

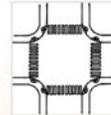


faded crosswalks

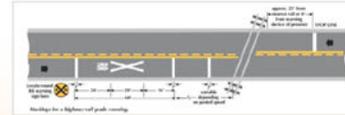
POTENTIAL IMPROVEMENTS:



more direct messages



highly visible crosswalks



railroad crossing ahead icons and stop bars

+ ADVANTAGES:

provides distinct visual clarity for pedestrians and vehicles
does not cause major construction delays
meets federal and state regulations for signage around grade crossings

- DISADVANTAGES:

does not remove the vehicle and railroad conflict
does not fix continuous deteriorating pavement conditions

B

Reduce Trespassing Along Railroad Tracks

RESPONSIBLE AGENCIES:
CSX / DARBY BOROUGH / FRA

CURRENT CONDITION:



walking along the railroad tracks is trespassing

POTENTIAL IMPROVEMENTS:



educate Darby Borough residents and school children on railroad safety



conduct enforcement blitzes and issue warnings and levy fines



place more visible signage along rail lines

encourage safe walking habits by designating walking routes and upgrading sidewalks: see Safe Routes to School table for more information

+ ADVANTAGES:

reduces possible injuries or deaths due to trespassing
reduces train noise
improved sidewalks will lead to safety benefits and make Darby more visually attractive

- DISADVANTAGES:

requires Darby Borough police resources
requires coordination across police agencies

C

Change 6th St. Traffic Flow Between Main St. and Greenway Ave.

RESPONSIBLE AGENCIES:
DARBY BOROUGH / PENNDOT

CURRENT CONDITION:



6th St. two-way North of Main St.

OPTIONS:

1



make 6th St. one-way Northbound

2



make 6th St. one-way Southbound

3



barricade 6th St. just North of Main St.

+ ADVANTAGES:

improves vehicular and pedestrian safety by eliminating some turns between Main St. and 6th St.
stops vehicles from sitting on train tracks
is relatively low cost

- DISADVANTAGES:

may be difficult for community to adjust to
would create more traffic over 5th St. crossing
would require traffic design study by a qualified engineer

D

Remove Two Route 11 Trolley Stops

RESPONSIBLE AGENCIES:
DARBY BOROUGH / SEPTA / PENNDOT

CURRENT CONDITION:



trolley stops every block on Main St.

POTENTIAL IMPROVEMENTS:



stop riders waiting for Westbound trolley, at 6th St. and Main St.



reduce traffic queues behind Eastbound trolleys



possible trolley stops to remove

+ ADVANTAGES:

eliminates undesirable pedestrian movements across Main St.
eliminates vehicle backup into Main St. crossing

- DISADVANTAGES:

creates less community access to trolley
causes more trolley boardings and departures at 6th St. & Main St. Eastbound

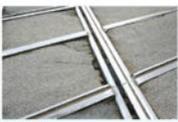
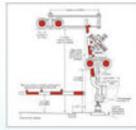


POTENTIAL MEDIUM-TERM INITIATIVES

Time Frame: 2-10 Years

Price Range Per Initiative: \$1,000,000 - \$6,000,000

Disclaimer: These possible improvements are for discussion purposes only. Your input will help planners, engineers, and other seek to implement improvements that promote safety and are preferred by the Darby Borough Community.

<p>A</p> <p>Reconstruct Both Main St. and 5th St. Grade Crossings</p> <p>RESPONSIBLE AGENCIES: CSX / DVRPC / PENNDOT / SEPTA</p>	<p>CURRENT CONDITIONS:</p>  <p>Main St. uneven pavement</p>  <p>5th St. severe roadway crowning</p>	<p>POTENTIAL IMPROVEMENTS:</p>  <p>Main St. - best practice in pavement improvements</p> <p>5th St. - solutions to create more level roadway grade</p> <p>reduce elevation of the rail line to create level crossing</p> <p>taper roadway to soften approaches to create extended period of flat grade at the crossing</p>	<p>+ ADVANTAGES:</p> <ul style="list-style-type: none"> alleviates the frequent needed resurfacing increases pedestrian safety by reducing tripping hazards eliminates pooling water after rain storms <p>- DISADVANTAGES:</p> <ul style="list-style-type: none"> does little to improve vehicular traffic delay causes major delays to all modes during construction
<p>B</p> <p>Replace All Existing Gates at Both Crossings and Add Additional Gate at Main St.</p> <p>RESPONSIBLE AGENCY: CSX</p>	<p>CURRENT CONDITION:</p>  <p>gate arm falls off after striking car</p>	<p>POTENTIAL IMPROVEMENTS:</p>  <p>replace all existing gates at both Main and 5th St. grade crossings</p>  <p>add additional gate to stop left hand turn onto 6th St. while gates are closed</p> <p>update and improve gate activation system</p> <ul style="list-style-type: none"> eliminate gate closures when no train is approaching use detection devices, so gates cannot come down on vehicles increase time between warning lights activation and train arrivals 	<p>+ ADVANTAGES:</p> <ul style="list-style-type: none"> increases safety by making gates more visible fixes existing gate issues eliminates dangerous, illegal movement <p>- DISADVANTAGES:</p> <ul style="list-style-type: none"> eliminates left hand turn onto 6th St.
<p>C</p> <p>Install Traffic Signal at Main St. Crossing</p> <p>RESPONSIBLE AGENCIES: DARBY BOROUGH / PENNDOT</p>	<p>CURRENT CONDITION:</p>  <p>existing traffic lights on Main St. in Darby Borough</p>	<p>POTENTIAL IMPROVEMENTS:</p>  <p>signalized intersection is integrated into the railroad preemption program</p>  <p>traffic signals are used in similar situations in the region (Pottstown, PA)</p>	<p>+ ADVANTAGES:</p> <ul style="list-style-type: none"> employs highly effective traffic control devices modifies behavior because drivers stop even when a train is not approaching provides a consistent stopping location which decreases confusion <p>- DISADVANTAGES:</p> <ul style="list-style-type: none"> creates additional signal for Darby Borough to maintain slows vehicular traffic along Main St. does not improve the 5th St. grade crossing
<p>D</p> <p>Restrict Parking and Driveways Near Main St. and 5th St. Grade Crossings</p> <p>RESPONSIBLE AGENCY: DARBY BOROUGH</p>	<p>CURRENT CONDITION:</p>  <p>parking near the Main St. grade crossing (left), business entrance near 5th St. crossing (right)</p>	<p>POTENTIAL IMPROVEMENTS:</p>  <p>implement and enforce parking and driveway restrictions within 50 feet of crossing</p> <p>apply for funding to beautify Main St. through PA Home Town Street Program</p> <ul style="list-style-type: none"> sidewalk improvements street lighting benches other visual elements 	<p>+ ADVANTAGES:</p> <ul style="list-style-type: none"> decreases turning movements near grade crossings increases pedestrian safety, because walkers are often focused on roadway not parked cars or driveways <p>- DISADVANTAGES:</p> <ul style="list-style-type: none"> restricts parking and access for local businesses requires Darby Borough resources



POTENTIAL LONG-TERM INITIATIVES

Time Frame: 10+ Years

Price Range Per Initiative: \$50,000,000+

Disclaimer: These possible improvements are for discussion purposes only. Your input will help planners, engineers, and other seek to implement improvements that promote safety and are preferred by the Darby Borough Community.

A

Change Elevation of Main St.

RESPONSIBLE AGENCIES:
CSX / DELAWARE COUNTY / DVRPC / PENNDOT / SEPTA

POTENTIAL IMPROVEMENTS:



road rebuilt OVER rail example

where: Riverside, California
what: construction of an overpass structure as well as modifications to adjacent intersections
cost: \$32,000,000
note: the crossing had 16,000 cars, 90 freight trains, and 10 passenger trains per day



road rebuilt UNDER rail example

where: Auburn, Washington
what: Lowered and widened roadway, also bike and pedestrian improvements
cost: \$22,250,000
note: the railroad runs 16-24 freight trains per day



ADVANTAGES:

eliminates current maintenance issues
train and vehicular traffic will be able to move freely



DISADVANTAGES:

eliminates 6th St. for pedestrian and vehicular traffic
may increase trespassing along the train tracks
involves the removal of buildings and businesses along Main St.

B

Change Elevation of CSX Rail Line Through Delaware County

RESPONSIBLE AGENCIES:
CSX / DELAWARE COUNTY / DVRPC / PENNDOT

CURRENT CONDITION:



Delaware County grade crossings

POTENTIAL IMPROVEMENTS:



railroad trench example

where: Los Angeles, California
what: An 10 miles long open trench that is 33 feet deep and 50 feet wide
cost: \$2,400,000,000 paid for by a mixture of public and private funds
note: today 40 freight trains pass through on an average day



railroad bridge example

where: City of Industry, California
what: steel railroad bridge - 1.6 mile structure, 45 feet wide x 32 feet high
cost: \$95,200,000
note: project took 4 years to build



ADVANTAGES:

train and vehicular traffic will be able to move freely
not limited to Darby Borough, removes all class 1 freight rail grade crossings in Delaware County
6th St. could still serve pedestrian and vehicular traffic



DISADVANTAGES:

requires the reconstruction of the rail bridge over Darby Creek
poorly lit spaces may attract crime to the railroad structure

C

Purchase New Trolley Cars and Upgrade Trolley Stop Amenities for Route 11

RESPONSIBLE AGENCIES:
DVRPC / SEPTA

CURRENT CONDITION:



Kawasaki K-Car LRV delivered 1981 to 1982



6th St. trolley stop Westbound

POTENTIAL IMPROVEMENTS:



purchase new low floor, articulated trolleys



upgrade transit stops using lighting, shelters, and benches



ADVANTAGES:

improves the on-time performance
reduces overcrowding and accommodates some ridership growth
vehicles are quicker and easier to board



DISADVANTAGES:

does not remove the vehicle / trolley and railroad conflict
does not fix continuous deteriorating pavement conditions on public roads where trolleys operate

D

Revise Land Use Around Crossings in Darby Borough

RESPONSIBLE AGENCIES:
CSX / DARBY BOROUGH / DVRPC

CURRENT CONDITION:



zoning near grade crossings

POTENTIAL IMPROVEMENTS:



restrict incompatible zoning within 250 feet of each grade crossing



redevelop areas near grade crossings and direct traffic away from grade crossings

Enhance Industrial Zone

take advantage of freight rail access and create more manufacturing jobs



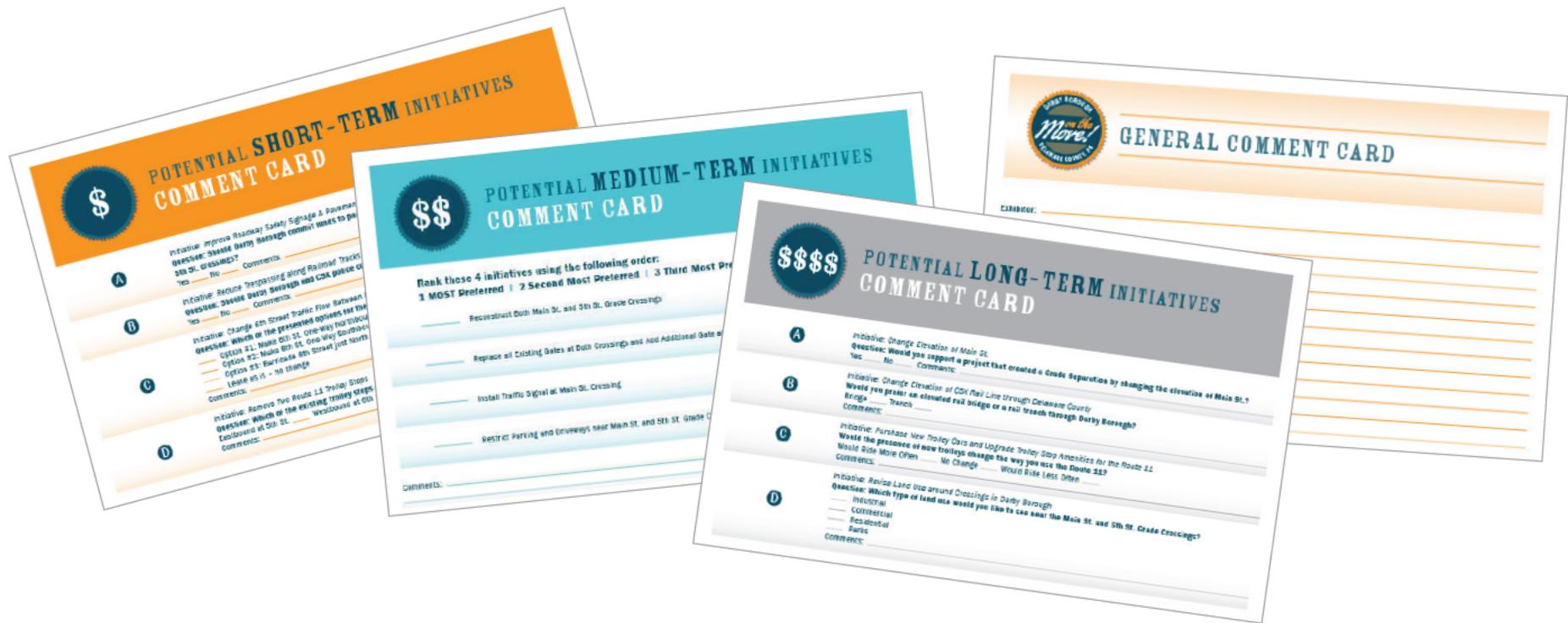
ADVANTAGES:

increased safety through improved sight distance
Improved traffic flow due to removal of driveways
provides local family-sustaining jobs



DISADVANTAGES:

does not remove the vehicle / trolley and railroad conflict
does not fix continuous deteriorating pavement conditions



Comment Card Results Short-term Initiatives

		YES	NO		
A	Should Darby Borough commit funds to paint new crosswalks and stop bars at the Main St. and 5th St. crossings?	20	1		
B	Should Darby Borough and CSX Police conduct safety blitzes and issue fines to trespassers?	15	3		
	Option #	1	2	3	4
C	Which of the presented options for the traffic flow of 6th St. do you prefer?	5	4	3	8
	EB@5th	WB@6th	Both	Neither	
D	Which of the existing trolley stops do you support removing?	1	2	3	11

Medium Term Initiatives

		Rank 4	Rank 3	Rank 2	Rank 1	Score
A	Reconstruct Both Main St. and 5th St. Grade Crossings	4	3	3	4	2.5
B	Replace all Existing Grade Crossings and Add Additional Grade Cross	2	6	5	1	2.6
C	Install Traffic Signal at Main St. Crossing	3	1	4	6	2.1
D	Restrict Parking and Driveways near Main St. and 5th St. Grade Crossings	5	4	2	3	2.8

Long Term Initiatives

			YES	NO	
A	Would you support a project that created a Grade Separation by changing the elevation of Main St?		8	5	
			Bridge	Trench	
B	Would you prefer an elevated rail bridge or a rail trench through Darby Borough?		6	4	
			Ride more	No change	Ride less
C	Would the presence of new trolleys change the way you use the Route 11?		6	7	0
		Industrial	Commercial	Residential	Park
D	Which type of land use would you like to see near the Main St. and 5th St. Grade Crossings?	4	3	2	4

Villanova University Study

During the Fall semester of 2013, a group of students from Villanova University's College of Engineering undertook a parallel study that was supported by the DVRPC staff and representatives from several project stakeholders, including CSX and SEPTA. The class of senior engineering students explored several alternatives for improvements at the Main and Sixth streets crossing, attempting to add more depth to the work that had already been completed. This appendix includes highlights of the students' work that was completed during the semester.

THE DARBY BOROUGH GRADE CROSSING STUDY

Team 1: Short Improvements

Team 2: Above Grade Improvement

Team 3: Below Grade Improvement



Process

Analyzed all possible improvement considerations



Concluded which option was best able to mitigate the problem



Designed possible improvement and determined final suggestion



Benefit Cost Ratio

- BCR was calculated as 0.56
- BCR < 1 = Some Concern

Total Benefit	
Total Cost	\$16,300,000
Benefit Cost Ratio	\$29,200,000
	0.56

Goals of Conceptual Planning Phase

- Identify, clarify and quantify the issue
- Preliminary brainstorming of design
 - Create multiple solutions to the problem
- Explore feasibility of each option
 - Benefit/Cost
- Develop a general course or proposed action
- Document the preliminary design





Short Term Improvements



Highway Above Grade Alternative

The students conceptual design work outlined a variety of recommendations and process driven products. Through the work that they conducted estimates were created for benefit cost ratios of the various alternatives and the work was compiled into presentations.

Class Participants
Professors: Frank Falcone & Dr. Leslie McCarthy



Rail Below Grade Alternative

Publication Title: Darby Borough Grade Crossing Study Phase II

Publication Number: 12014

Date Published: August 2014

Geographic Area Covered: Darby Borough, Delaware County

Key Words: Freight, Freight Rail, Safety, Grade Crossing, Darby Borough, Operation Lifesaver, existing equipment, supplemental safety measures, grade separation, grade crossing improvement, Delaware County, Environmental Justice, pedestrians, trolley, signalization, rail traffic signal implementation, implementation

Abstract: This study examines two highway-railroad grade crossings in Darby Borough, Delaware County, Pennsylvania. This report serves as the second phase of the Darby Borough Grade Crossing Study. The study explores implementation strategies that can serve to improve safety and efficiency at the grade crossings and provides preliminary analysis and recommendations.

This report is divided into five chapters: an introduction; a review of outreach initiatives; an identification of short-term improvements; a preliminary feasibility analysis of grade separation alternatives; and an identification of next steps for implementation.

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