PHASE II

AUGUST 2014

DARBY BOROUGH

GRADE CROSSING STUDY

DELAWARE VALLEY
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REGIONAL
PLANNING COMMISSION

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DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

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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.

CHAPTER 1

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.

Figure 1: Study Area *Source: DVRPC*

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.

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.

CHAPTER 2

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.

CHAPTER 3

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.

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

Source: DVRPC

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.

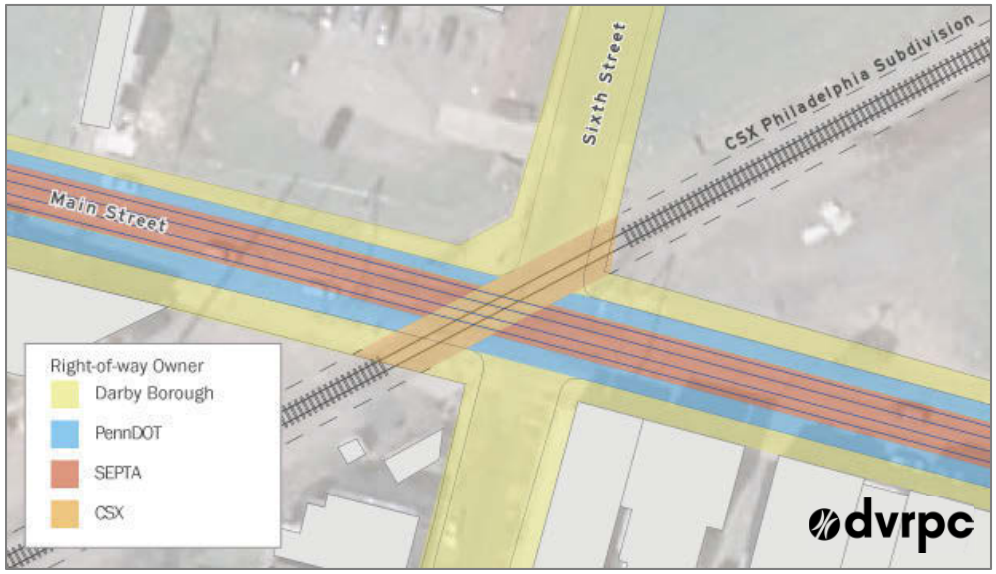

Figure 3: Stakeholder rights-of-way at Main and Sixth streets

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.

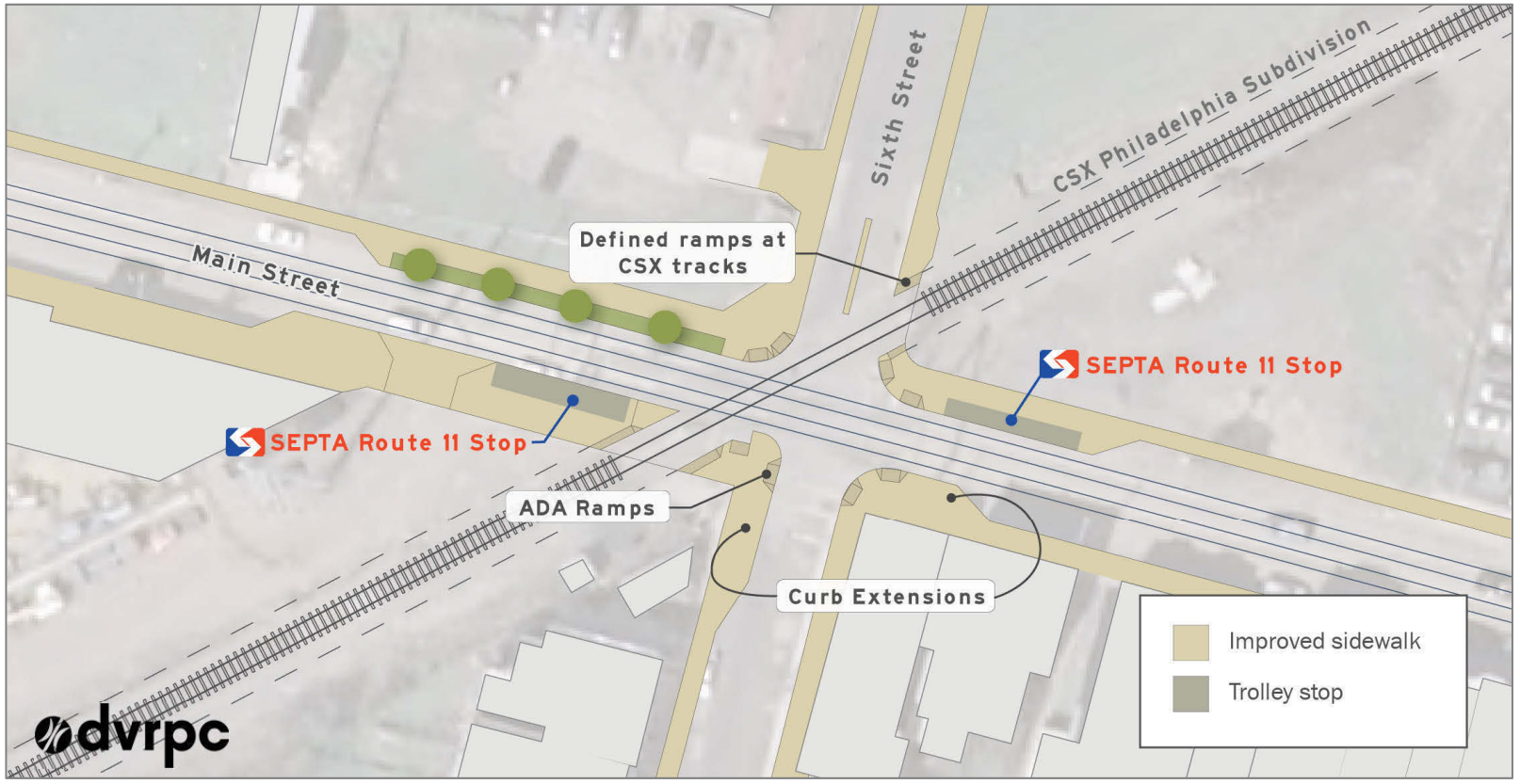

Figure 5: Sidewalk improvements at Main and Sixth streets

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.

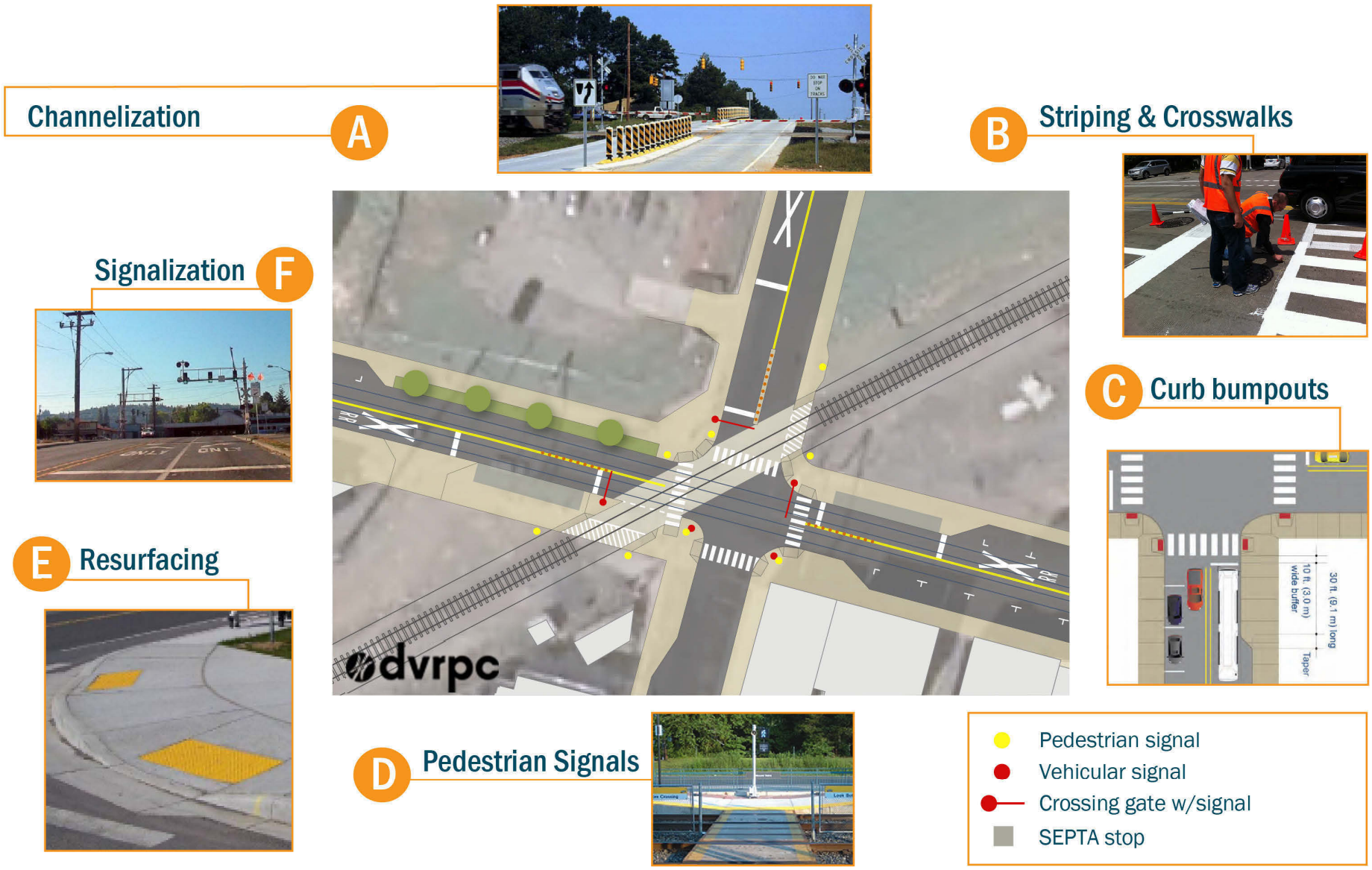

Figure 7: Recommended Improvements at Main and Sixth streets

Figure 8: Before and After Improvements

Source: DVRPC

CHAPTER 4

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 minimum[3] (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.

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[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.

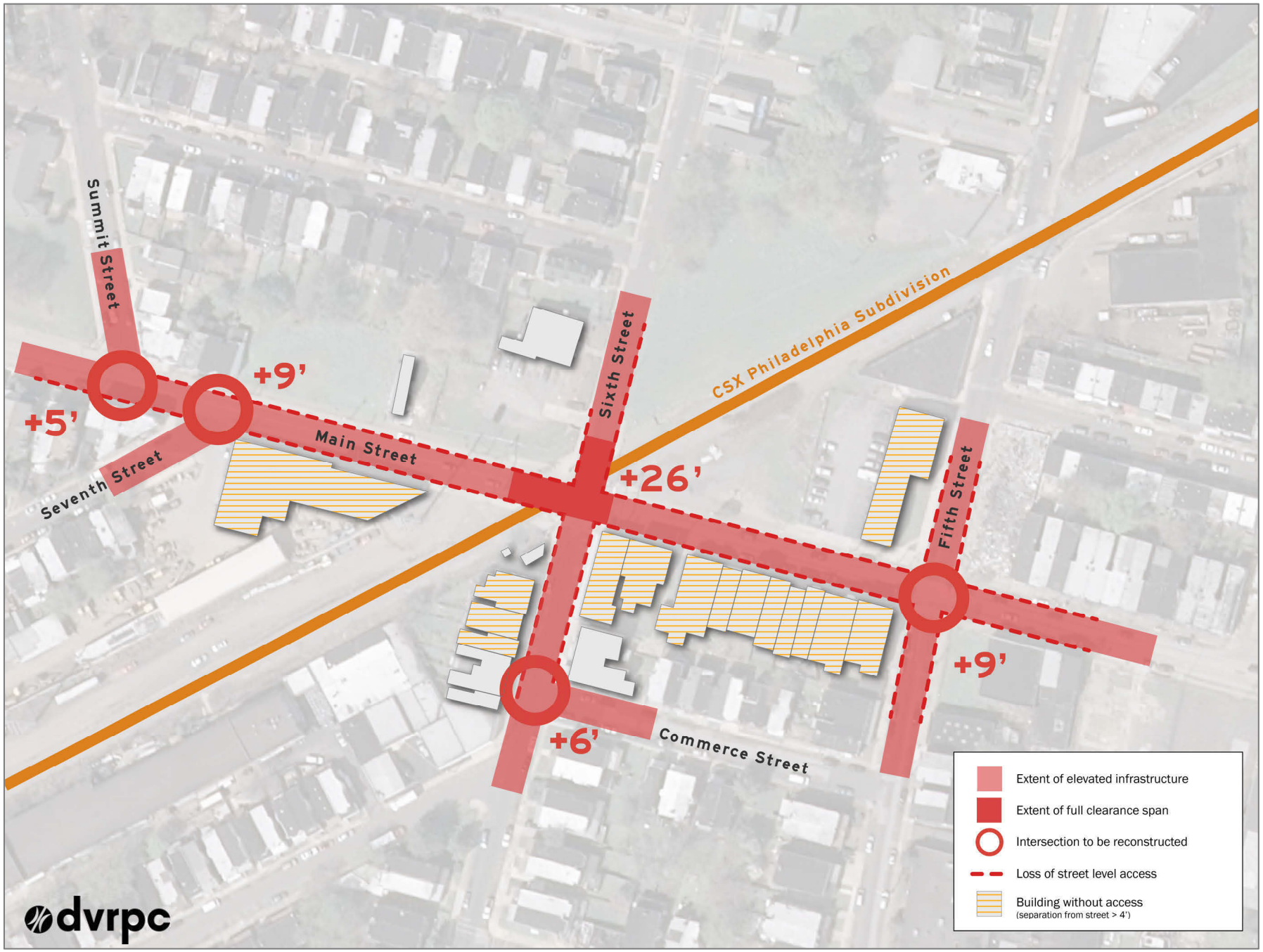


Figure 9: Alternative A plan diagram

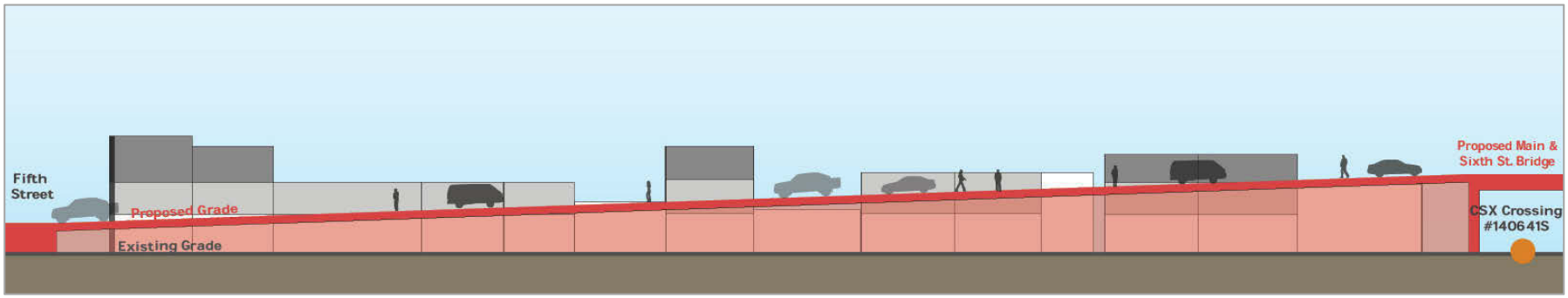


Figure 10: Alternative A Section/Elevation, south facing along 500 block of Main Street

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.

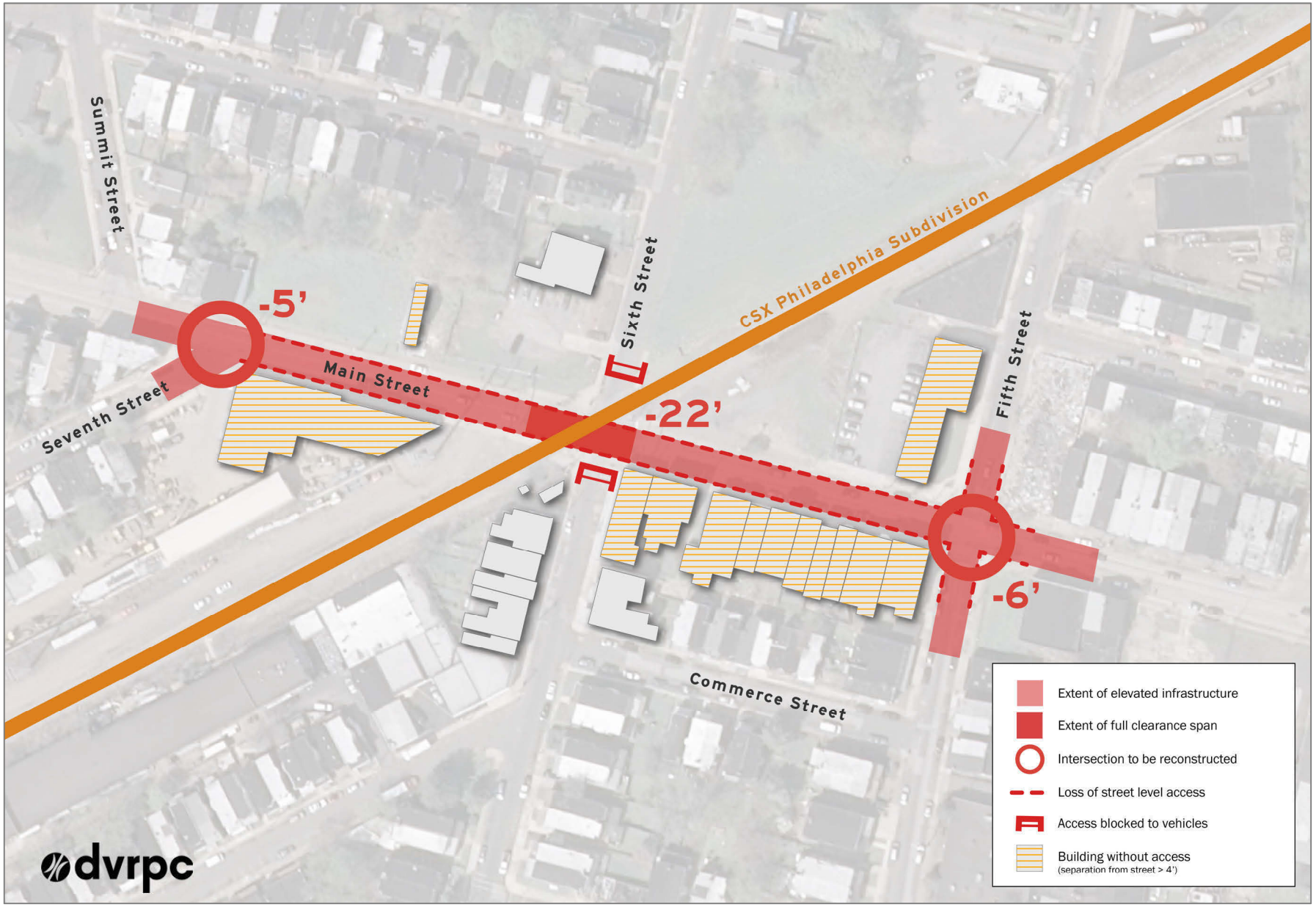


Figure 11: Alternative B plan diagram

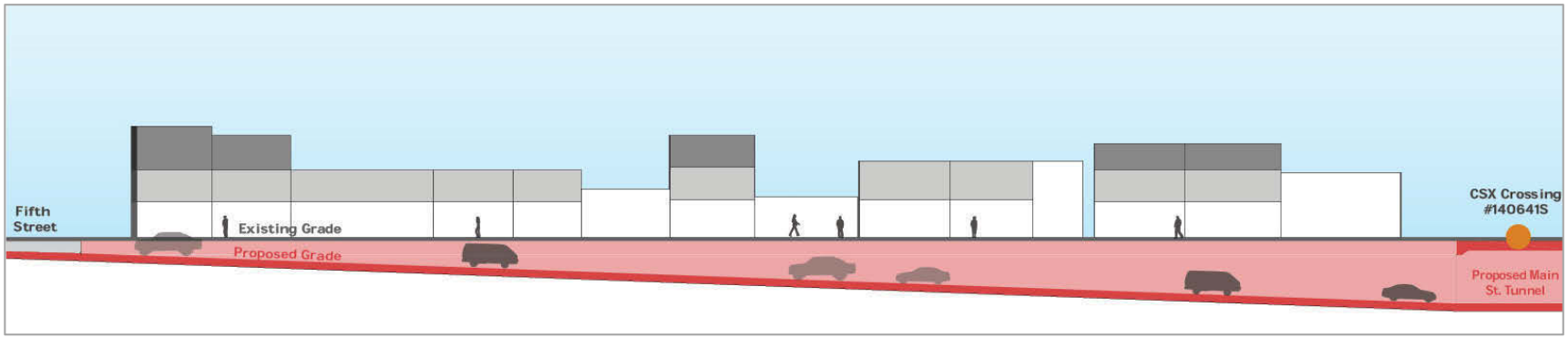


Figure 12: Alternative B Section/Elevation, south facing along 500 block Main Street *Source: DVRPC*

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.

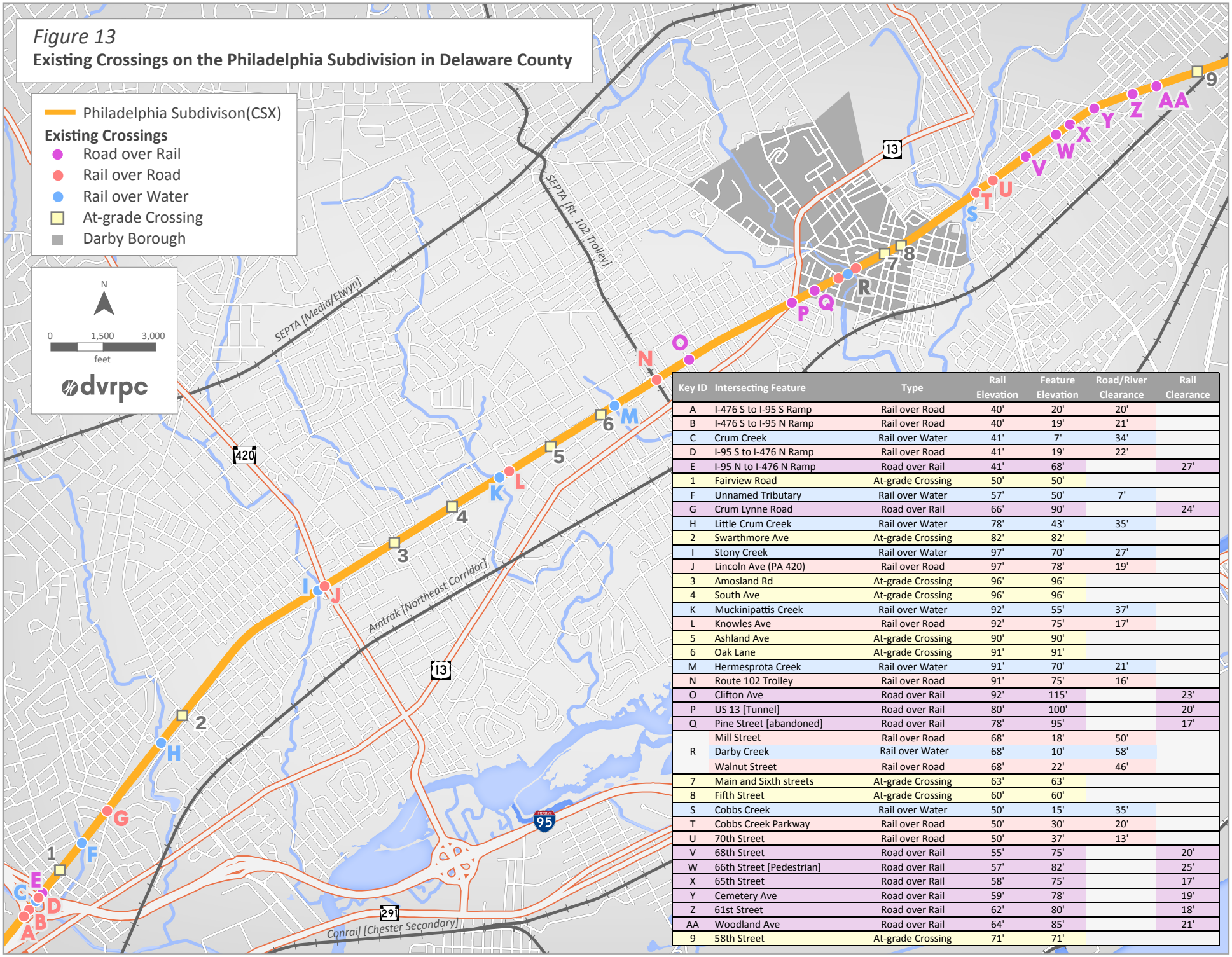
The next step to establish the feasibility for a regional improvement explored these crossings and the rail line in profile. As the elevation and maximum slopes of the rail line are fundamentally integral to deciding the feasibility of any alterations on the CSX Philadelphia Subdivision, these features were charted to scale with a vertical exaggeration. The chart shown in Figure 14 displays the approximate elevation[4] 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'
R	Mill Street	Rail over Road	68'	18'	50'	
	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'		

Using the chart shown in Figure 14, the project team identified the most feasible grade separation approaches through the study area. The goal was to provide a continuous separation through the study area to provide maximum impacts for the region. However, as shown in red in Figure 14, the variation in elevations of each crossing feature and the restrictions related to the slope of the rail line limits the project to only two separation alternatives to separate the CSX rail line from the Darby Borough crossings. Any other separation project would require excessive elevation adjustments and/or undercutting of waterways along the corridor.

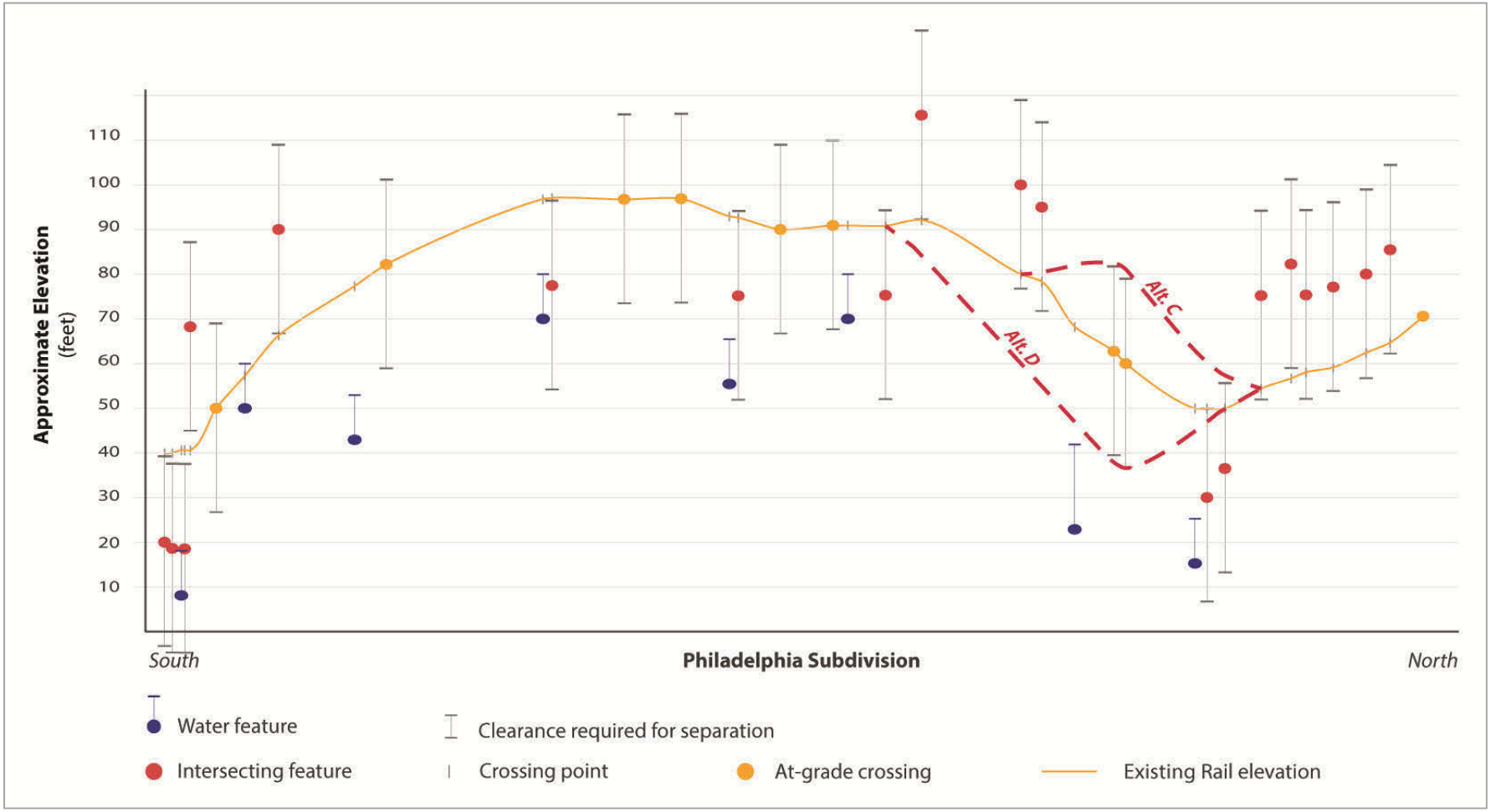


Figure 14: Separation Planning

Source: DVRPC

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.

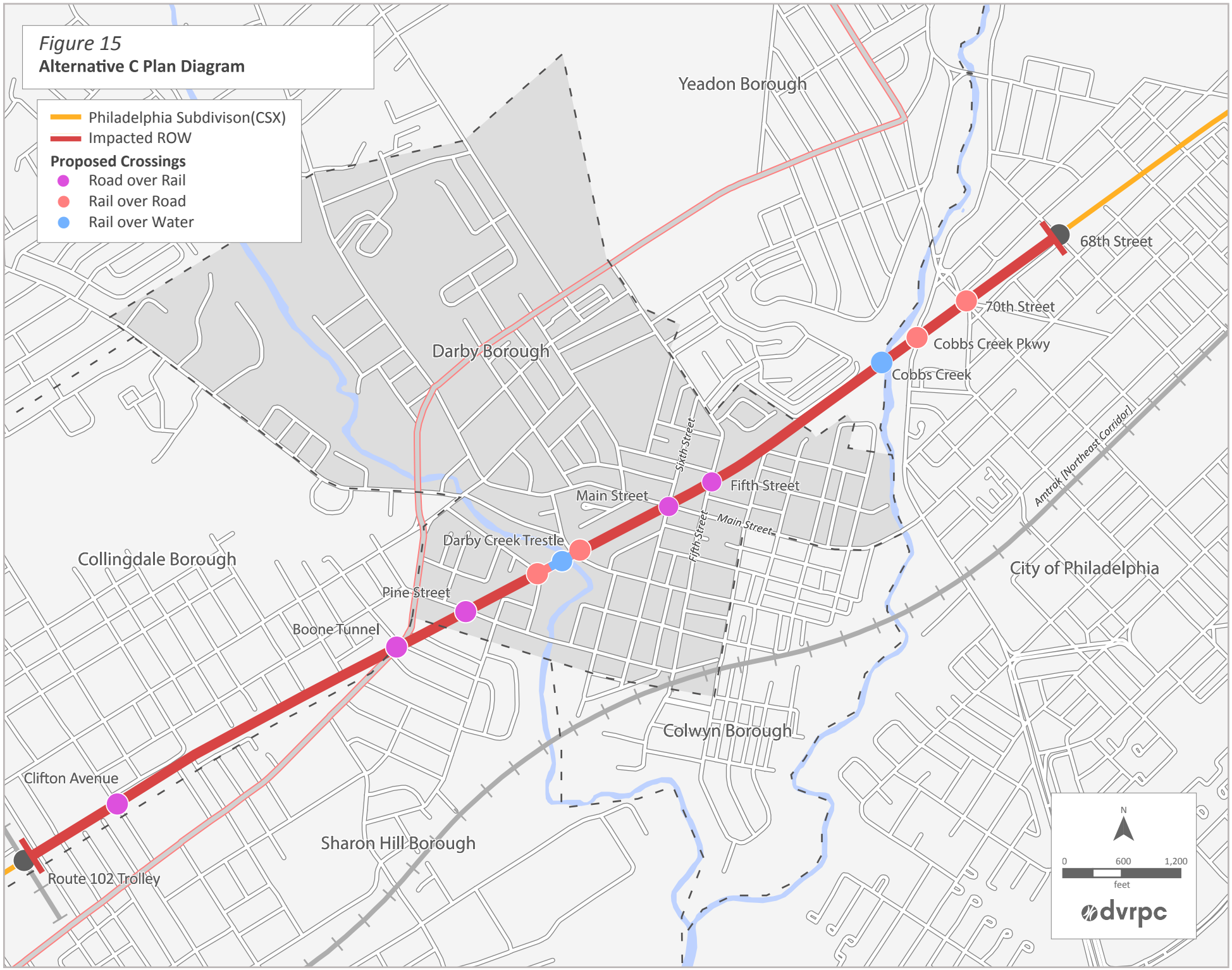


Figure 15
Alternative C Plan Diagram
Philadelphia Subdivison(CSX)
Impacted ROW
Proposed Crossings
Road over Rail
Rail over Road
Rail over Water
Yeadon Borough
Darby Borough
Collingdale Borough
Colwyn Borough
Sharon Hill Borough
City of Philadelphia
68th Street
70th Street
Cobbs Creek Pkwy
Cobbs Creek
Sixth Street
Fifth Street
Main Street
Fifth Street
Main Street
Darby Creek Trestle
Pine Street
Boone Tunnel
Clifton Avenue
Route 102 Trolley
Amtrak [Northeast Corridor]
N
0
600
1,200
feet
dvrpc

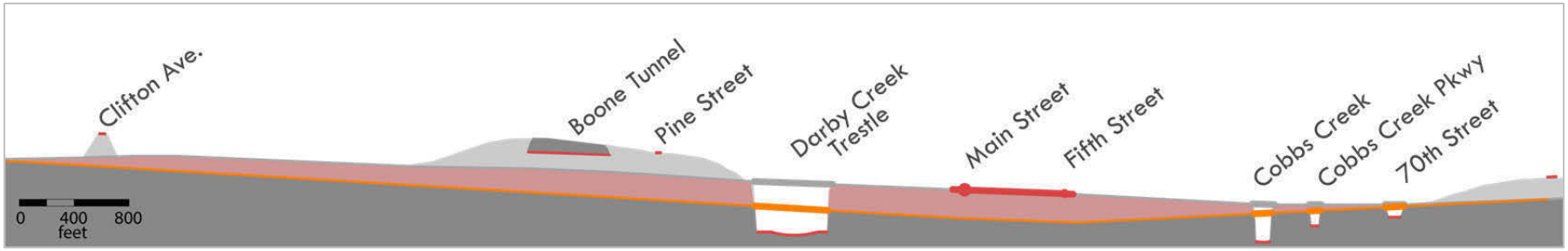


Figure 16: Alternative C Section showing impacts to existing infrastructure

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.

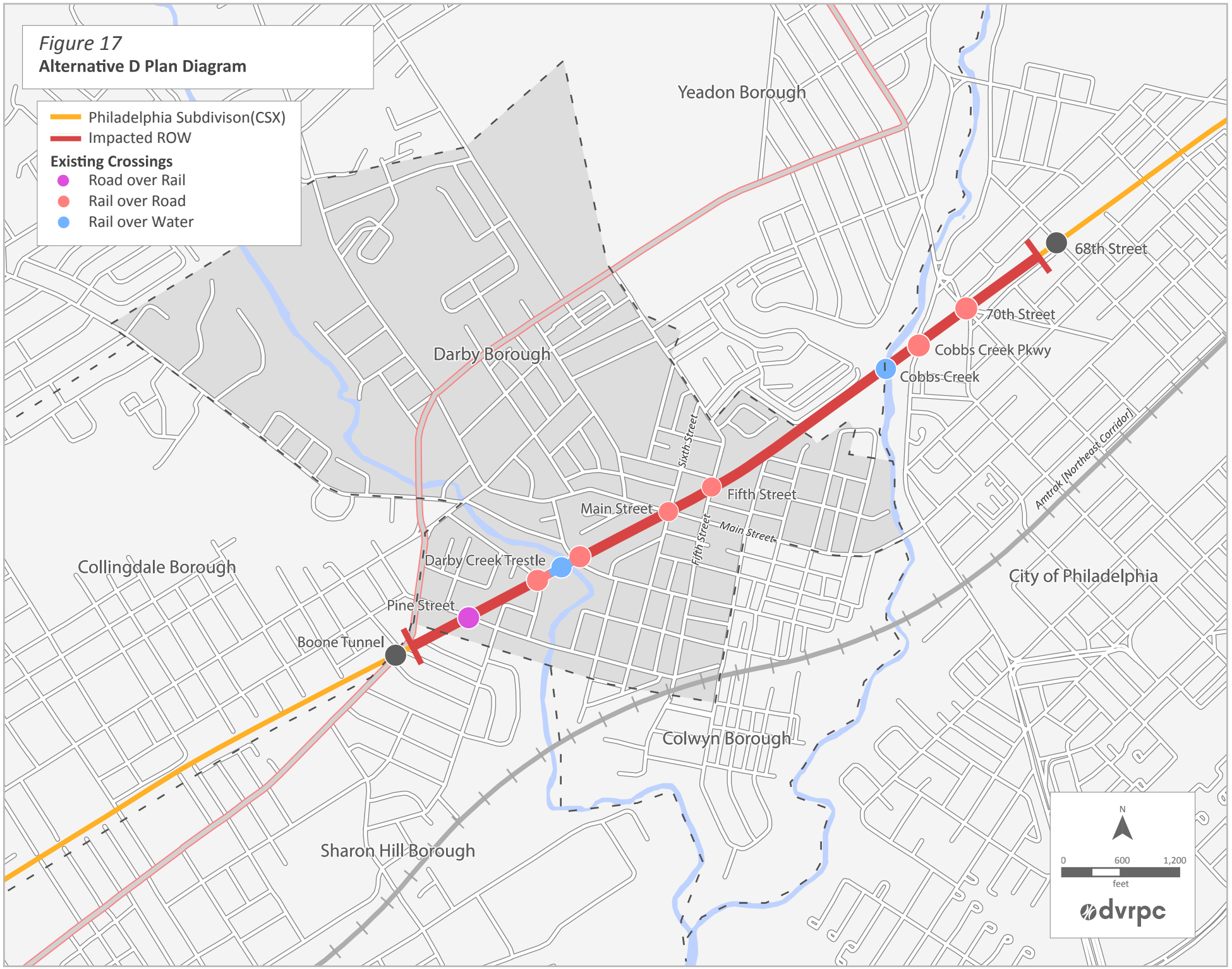


Figure 17
Alternative D Plan Diagram
Philadelphia Subdivison(CSX)
Impacted ROW
Existing Crossings
Road over Rail
Rail over Road
Rail over Water
Yeadon Borough
Darby Borough
Collingdale Borough
Colwyn Borough
Sharon Hill Borough
City of Philadelphia
68th Street
70th Street
Cobbs Creek Pkwy
Cobbs Creek
Sixth Street
Fifth Street
Main Street
Fifth Street
Main Street
Amtrak (Northeast Corridor)
Darby Creek Trestle
Pine Street
Boone Tunnel
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0
600
1,200
feet
dvrpc

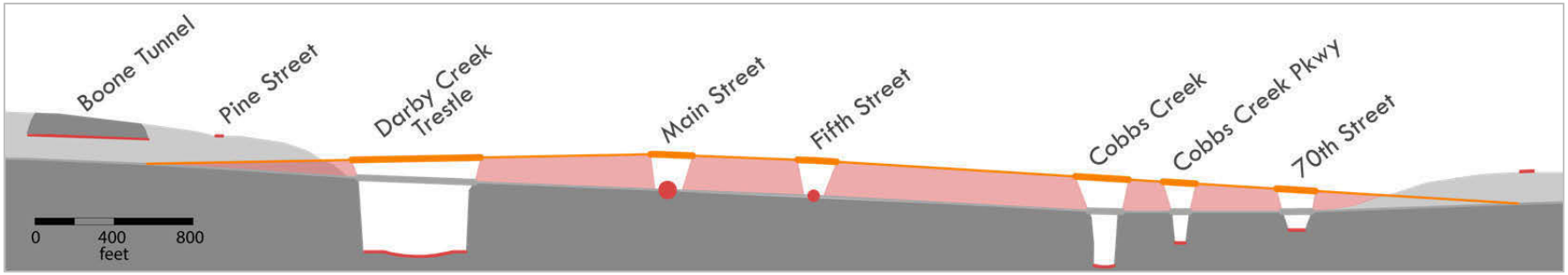


Figure 18: Alternative D Section showing impacts to existing infrastructure

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.

CHAPTER 5

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	• Solicit engineering services and seek project funding from state and regional sources.	• 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	• Provide support and assistance to Darby Borough in efforts to locate and apply for funding and acquire regional support for improvements.	• None.
CSX	• 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.	• Crossing equipment and preemptive technologies. • Pavement within the CSX right of way.
Pennsylvania Department of Transportation	• Provide funding through Section 130 program for crossing equipment upgrades. • Approve signalization request and engineering. • Potential funder for some project upgrades.	• Construction of signalized intersection and associated ADA crossings. • Main Street pavement between curb line and SEPTA right of way.
Southeastern Pennsylvania Transportation Authority (SEPTA)	• Provide input and recommendations for design of curb extensions and improved trolley stop design. • Potential funder for some project upgrades.	• Curb extension and trolley stop shelters.

Stakeholder	Role	Infrastructure Responsibility
Delaware Valley Regional Planning Commission (DVRPC)	• 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	• 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.

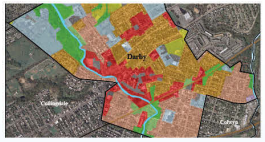
APPENDIX A

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
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

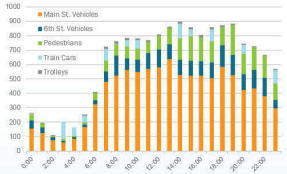
nearby **AIRPORTS** and **PORTS**:
PHL, Girard Point, Hog Island, Fort Mifflin, and Penn Terminals

Darby Borough Grade Crossing Study

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

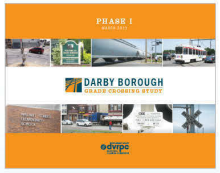
grade crossing #140641S **MAIN ST.**

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.

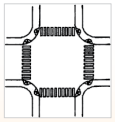
RESPONSIBLE AGENCIES:
DARBY BOROUGH / PENNDOT

CURRENT CONDITION:

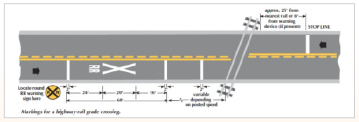
faded crosswalks

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:

OPERATION LIFESAVER
Look, Listen & Live

educate Darby Borough residents and school children on railroad safety

RAILROAD POLICE
CSX TRANSPORTATION

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.

A

Reconstruct Both Main St. and 5th St. Grade Crossings

RESPONSIBLE AGENCIES:
CSX / DVRPC / PENNDOT / SEPTA

CURRENT CONDITIONS:

Main St.
uneven pavement

5th St.
severe roadway crowning

POTENTIAL IMPROVEMENTS:

Main St. - best practice in pavement improvements

5th St. -

solutions to create more level roadway grade

reduce elevation of the rail line to create level crossing

taper roadway to soften approaches to create extended period of flat grade at the crossing

ADVANTAGES:

alleviates the frequent needed resurfacing

increases pedestrian safety by reducing tripping hazards

eliminates pooling water after rain storms

DISADVANTAGES:

does little to improve vehicular traffic delay

causes major delays to all modes during construction

B

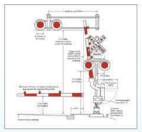
Replace All Existing Gates at Both Crossings and Add Additional Gate at Main St.

RESPONSIBLE AGENCY: CSX

CURRENT CONDITION:

gate arm falls off after striking car

POTENTIAL IMPROVEMENTS:



replace all existing gates at both Main and 5th St. grade crossings

add additional gate to stop left hand turn onto 6th St. while gates are closed

update and improve gate activation system

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

ADVANTAGES:

increases safety by making gates more visible

fixes existing gate issues

eliminates dangerous, illegal movement

DISADVANTAGES:

eliminates left hand turn onto 6th St.

C

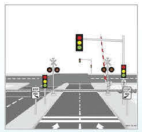
Install Traffic Signal at Main St. Crossing

RESPONSIBLE AGENCIES:
DARBY BOROUGH / PENNDOT

CURRENT CONDITION:

existing traffic lights on Main St. in Darby Borough

POTENTIAL IMPROVEMENTS:



signalized intersection is integrated into the railroad preemption program

traffic signals are used in similar situations in the region (Pottstown, PA)

ADVANTAGES:

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

DISADVANTAGES:

creates additional signal for Darby Borough to maintain

slows vehicular traffic along Main St.

does not improve the 5th St. grade crossing

D

Restrict Parking and Driveways Near Main St. and 5th St. Grade Crossings

RESPONSIBLE AGENCY:
DARBY BOROUGH

CURRENT CONDITION:

parking near the Main St. grade crossing (left), business entrance near 5th St. crossing (right)

POTENTIAL IMPROVEMENTS:

implement and enforce parking and driveway restrictions within 50 feet of crossing

apply for funding to beautify Main St. through PA Home Town Street Program

sidewalk improvements
street lighting
benches
other visual elements

ADVANTAGES:

decreases turning movements near grade crossings

increases pedestrian safety, because walkers are often focused on roadway not parked cars or driveways

DISADVANTAGES:

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

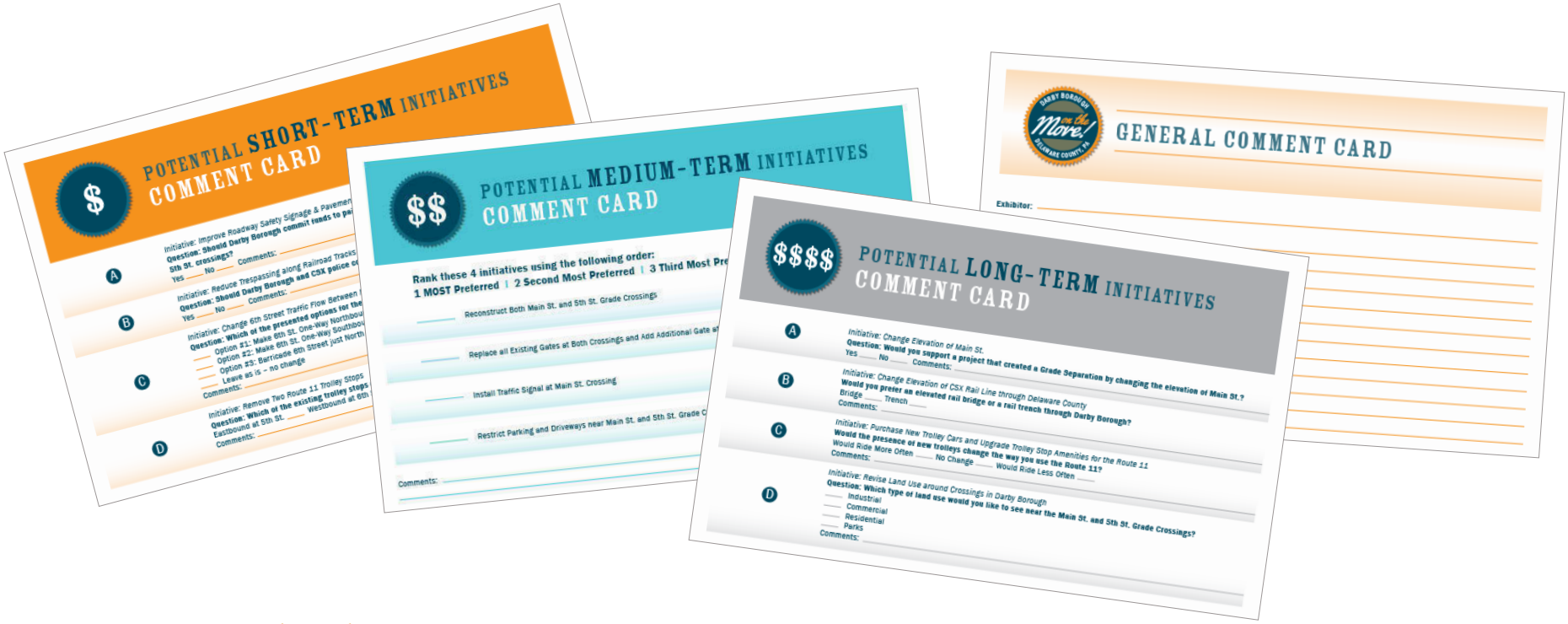
take advantage of freight rail access and create more manufacturing jobs

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

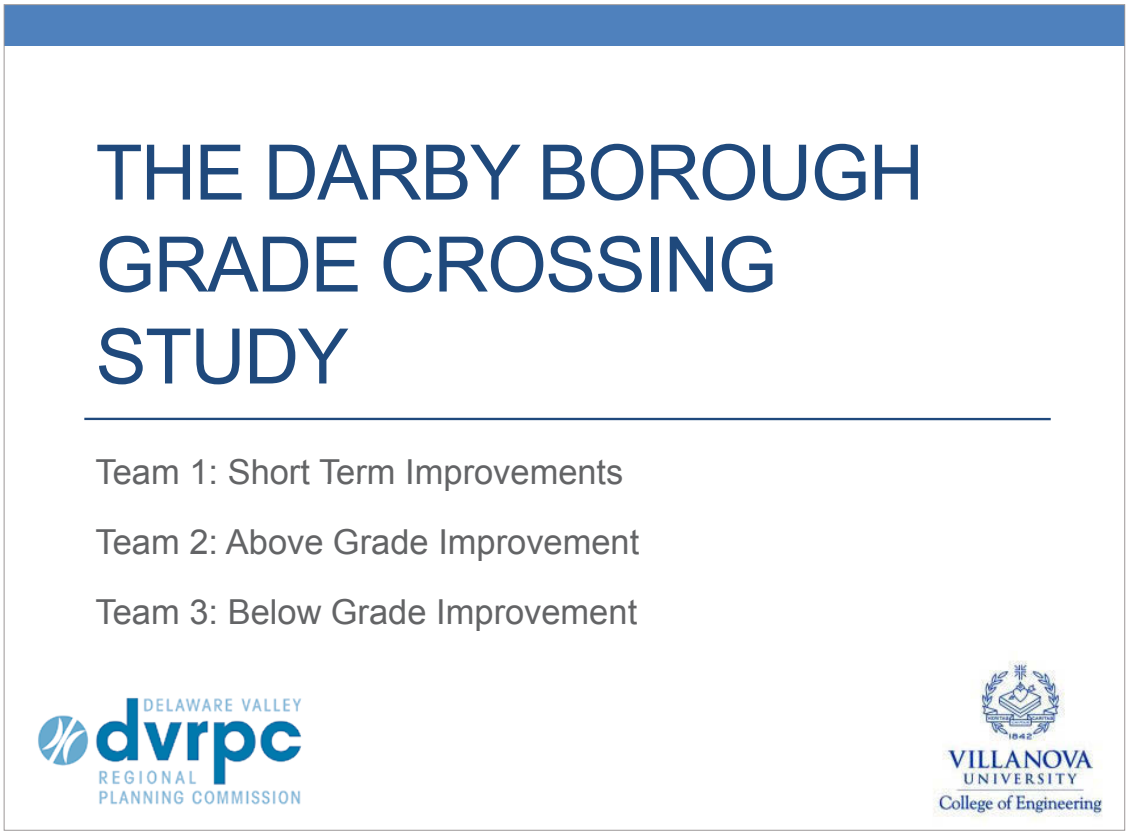
Long Term Initiatives

		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 thorugh 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

APPENDIX B

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.



Process

- Analyzed all possible improvement considerations
- Concluded which option was best able to mitigate the problem
- Designed possible improvement and determined final suggestion

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Benefit Cost Ratio

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

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

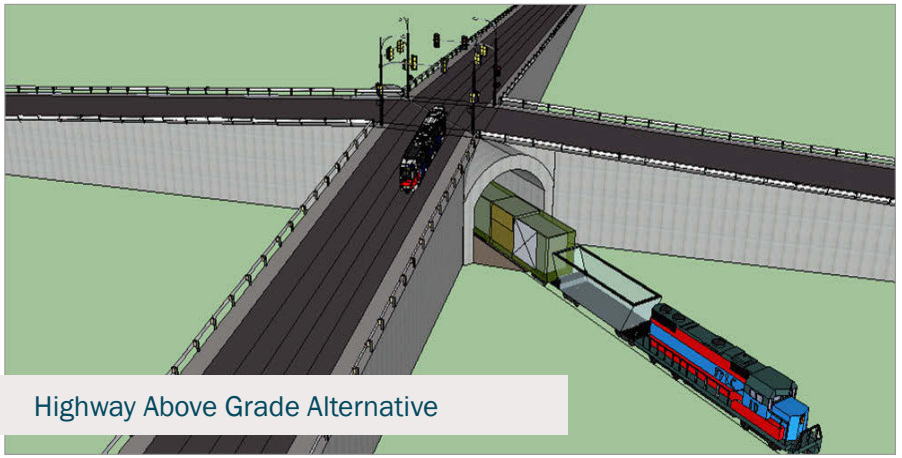
Goals of Conceptual Planning Phase

- 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

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

VILLANOVA UNIVERSITY College of Engineering

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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