Alternatives Development for
ROOSEVELT BOULEVARD
TRANSIT ENHANCEMENTS

DELAWARE VALLEY
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REGIONAL
PLANNING COMMISSION

MAY 2016

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EXECUTIVE SUMMARY

PROJECT PURPOSE

Roosevelt Boulevard is a complex corridor with many needs. The purpose of this project was to take a fresh look at transit needs specifically and develop improvement strategies that could be achieved at grade within the existing cross section of the roadway, at comparatively lower cost and in a shorter timeframe than the subway/elevated line that has historically been the focus of transit planning efforts and remains a long-term ambition.

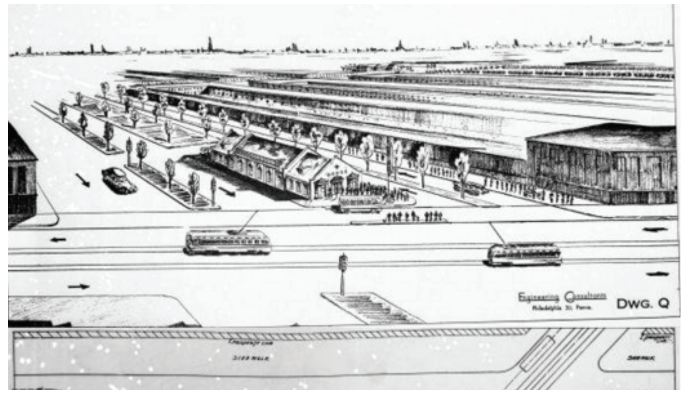
The public has expressed an ongoing interest in improved public transit service on Roosevelt Boulevard, through such feedback efforts as the Delaware Valley Regional Planning Commission's (DVRPC) Dots & Dashes exercise to develop the 2008 *Long-Range Vision for Transit,* the Philadelphia City Planning Commission's 2035 Comprehensive Plan, and DVRPC Choices & Voices feedback for the *Connections 2040* long-range plan.

This project was a response to that feedback, and to a sense that **the corridor has been long on plans but short on progress—owing to solutions that have resided in a perpetual long range for financial reasons.**

PROJECT APPROACH

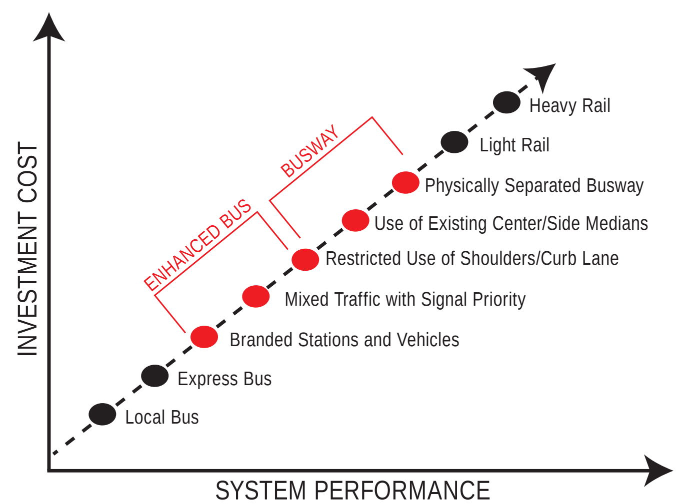
This project drew on a collaborative, stakeholder workshop-oriented approach to develop new improvement concepts that would meet the needs of two interrelated travel markets: a) inbound, longer-distance commutes to greater Center City, and b) intra-corridor and reverse commutes to employment centers in Northeast Philadelphia and Lower Bucks County.

As summarized in the chart to the right, there are a wide range of investment scales for transit improvements. While this project began in a mode-neutral way, with this project's lower-cost focus in mind, the steering committee decided fairly early to focus on Bus Rapid Transit (BRT) concepts at two scales: a short-term enhanced bus service concept (commonly referred to as BRT-lite in industry literature) and a longer-term, at-grade, separated busway.



1948 rendering of Roosevelt Boulevard median subway station
Source: Philadelphia Department of Records

Fall 2013 alternatives development workshop
Source: DVRPC, 2013



Range of Transit Investments
Sources: NBRTI, Quantifying the Importance of Image and Perception to Bus Rapid Transit, 2009; and DVRPC, 2013

Over 100 years of history in building and planning for transportation investments on Roosevelt Boulevard, and the agencies involved.

1900

1902–1962

Roosevelt Boulevard is built, and later expanded to a 12-lane parkway and its present form. This enabled residential growth into the Northeast. Various large-scale transit proposals are made, but none come to fruition.

1964–1995

Philadelphia City Planning Commission (PCPC) and SEPTA recommend long-range proposals and further study for transit along and to Roosevelt Boulevard, including heavy rail and bus preferential treatments.

Outcome: Due to funding limitations and other priorities, no project was implemented.

2003

PCPC publishes *Roosevelt Boulevard Corridor Transportation Investment Study*, which analyzed heavy rail alternatives for Roosevelt Boulevard.

Outcome: Preferred transit alternative was an extension of the Broad Street Line; this option proved to be cost prohibitive to implement.

2005 (ongoing)

Roosevelt Boulevard Safety Task Force was created and overseen by Philadelphia City Streets Department with participation from DVRPC, PCPC, Mayor's Office of Transportation and Utilities (MOTU), PennDOT, SEPTA, and the Philadelphia Police Department.

Outcome: Ongoing development of safety strategies and informational campaigns.

2007

DVRPC publishes *US1 - Roosevelt Boulevard Corridor Study.*

Outcome: PennDOT implemented recommendations at multiple intersections for pedestrian safety improvements.

2011

Michael Baker International publishes *Roosevelt Boulevard Transit Needs Study.*

Outcome: Recommendations were used by PCPC in their district planning process for *Philadelphia2035* and informed the development of the present project.

2013

PCPC outreach to Lower and Central Northeast districts using public meetings and Textizen to assess neighborhood needs.

Outcome: Development of DVRPC's *Alternatives Development for Roosevelt Boulevard Transit Enhancements Study* with participation from Philadelphia City Streets Department, PCPC, MOTU, PennDOT, SEPTA, Bucks County Planning Commission, Bucks County TMA, and Bensalem Township.

Sources: Roosevelt Boulevard Corridor Transportation Investment Study (2003), US1- Roosevelt Boulevard Corridor Study (2007).

ENHANCED BUS SERVICE (EBS) CONCEPT

The EBS concept would operate in the outer lanes of the outer drive, use existing SEPTA articulated buses (wrapped with a service brand, supplemented with distinctive interior design elements like seat inserts), and combine a limited-stop service pattern with other supportive operational and passenger enhancements, such as:

- high-capacity, well-lit shelters with digital passenger information;
- in-street transit preferential treatments to improve service effectiveness and visibility, such as Business Access and Transit (BAT) lanes or high-visibility bus zone treatments;
- Transit Signal Priority (TSP); and
- a fare collection approach that would enable multidoor boarding and alighting.

A two-phased approach (EBS-A and EBS-B) is proposed for providing service along Roosevelt Boulevard:

EBS-A:

- builds on SEPTA Route 14 bus service;
- nine stop locations: Neshaminy Mall, Neshaminy Interplex, Red Lion Road, Grant Avenue, Welsh Road, Rhawn Street, Cottman Avenue, Harbison Avenue/Bustleton Avenue, and Frankford Transportation Center (FTC);
- estimated peak bus travel time, Neshaminy Mall to FTC: 33 minutes (compares with up to 47 minutes for Route 14 local service);
- roughly 9,000 forecast daily riders (4,500, of the total are new SEPTA bus riders); and
- capital costs for stations and on-pavement elements have been estimated at less than four million dollars (including Neshaminy Mall Transit Center improvements). Additional costs would include improvements to enable TSP (estimated at four million dollars for both EBS-A and EBS-B), terminal improvements at FTC, off-board fare collection improvements, minor streetscape work to accommodate stations (e.g., tree trimming or relocating signs), design and engineering fees, and construction inspection.

EBS-B:

- builds on SEPTA Route R bus service;
- seven stop locations: FTC, Pratt Street, Tower Center Rising Sun Avenue, 5th Street, Hunting Park Avenue (Broad Street Line transfers), Wissahickon Transportation Center (WTC);
- estimated peak bus travel time, FTC to WTC: 26 minutes (compares with up to 39 minutes for Route R local service);
- roughly 8,500 forecast daily riders (1,500 new SEPTA bus riders); and
- capital costs for stations and on-pavement elements have been estimated at less than two million dollars. Additional costs would include improvements to enable TSP, terminal improvements at WTC, off-board fare collection improvements, minor streetscape work to accommodate stations (e.g., tree trimming or relocating signs), design and engineering fees, and construction inspection.

AT-GRADE BUSWAY CONCEPT

The busway concept illustrates how a physically separated, at-grade transit right-of-way could be added later to the EBS concept, building on the same station set (the same intersections) but making use of medians for bus operations and larger-footprint, more rail-like stations. The Los Angeles Metro Orange Line is an example of a similar project elsewhere in the United States.

A center median concept was preferred by this project's steering committee, but presents significant limitations and unresolved questions. For example, at-grade operations mean that traffic signals would limit busway time savings, and maintaining roadway capacity where center median space is scarce could require major changes to the existing cross section or changes to the right-of-way, at considerable expense. The median busway concept requires further evaluation, including consideration of partial or full off-grade operation.

Busway summary:

- same Roosevelt Boulevard stations as the EBS-A and EBS-B;
- exclusive busway on Roosevelt Boulevard portions only;
- travel times roughly 15 percent faster than EBS within

dedicated busway extent;

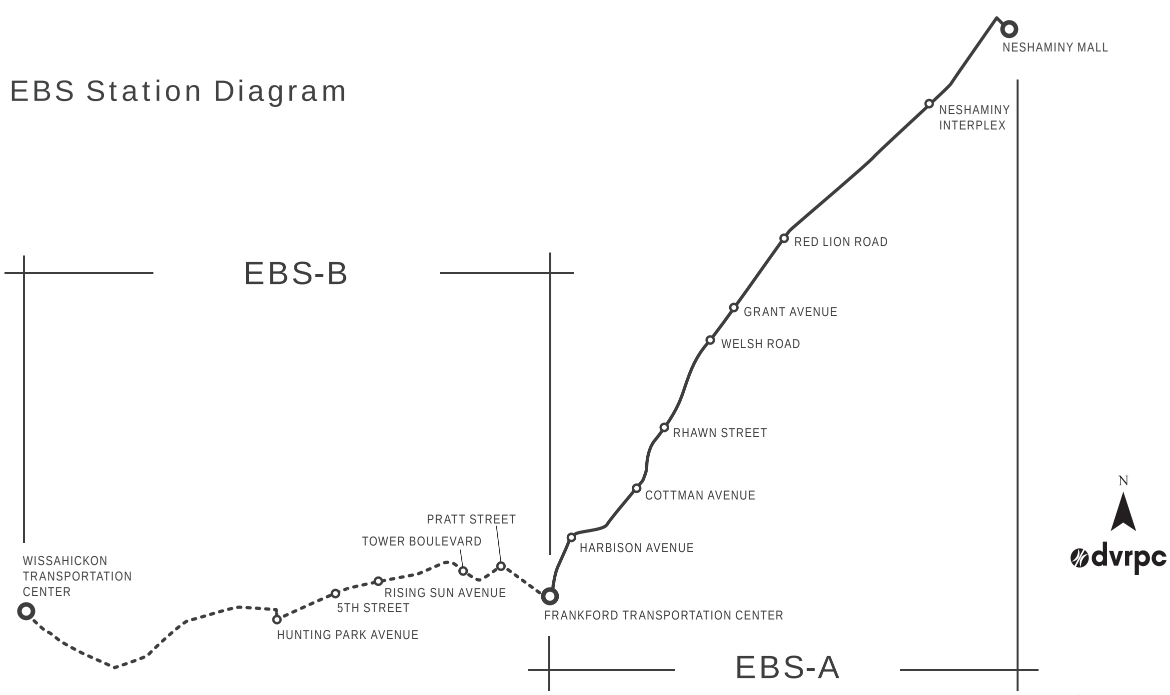
- roughly 26,000 daily riders forecast at a 2040 planning horizon (compares with roughly 17,500 daily riders forecast for EBS-A and EBS-B at a 2015 planning horizon); and
- capital costs of recent and planned peer BRT projects suggest a total order-of-magnitude cost for the busway of five hundred million dollars.

NEXT STEPS

Low investment costs and the ability to commence service quickly, together with the forecasted ridership growth, support near term project implementation of EBS-A. EBS-B implementation would follow if EBS-A succeeds, and capacity can be expanded at WTC. Due to the high project cost and physical complexity of implementing a busway, more analysis of that phase is warranted. Installation of an at-grade or grade-separated busway could meet other non-transit goals for safety, mobility, and vitality along the corridor, and should be further considered as part of the U.S. Department of Transportation (USDOT) Transportation Investment Generating Economic Recovery (TIGER)-funded *Route for Change: Transforming the Boulevard*. The graphic on the following page illustrates the relative level of investment between EBS, busway, and the recommendations that may come out of the *Route for Change: Transforming the Boulevard.* To that end, several actions have been established to advance the concepts developed in this study, as well as other improvements for the Roosevelt Boulevard corridor. These include:

- public and additional steering committee outreach to further develop near-term EBS strategies for implementation, by the City of Philadelphia–SEPTA Transit First Committee;
- the DVRPC *EBS Operations Study* (already in progress) will analyze the traffic and operational impacts of in-street EBS treatments (e.g., bus-preferential lane treatments and TSP) in more detail;
- development of a specialized brand package for EBS;
- pursuit of funding opportunities to implement EBS-A (as informed by further public and steering committee outreach), beginning with service pattern changes and curbside/station elements, while in-street treatments continue to be evaluated;
- further explore the at-grade busway alternative as a baseline project in the *Route for Change: Transforming the Boulevard*; and
- Roosevelt Boulevard is a complex corridor with often-competing multimodal needs. The strategies developed here will improve mobility and access to public transit in the near-term but would leave many other corridor needs unresolved. The *Route for Change: Transforming the Boulevard* will further develop a program of improvements for all modes in a comprehensive way.

EBS Station Diagram



Source: DVRPC, 2015

SCALED APPROACHES TO IMPROVING TRANSIT ON ROOSEVELT BOULEVARD

EBS

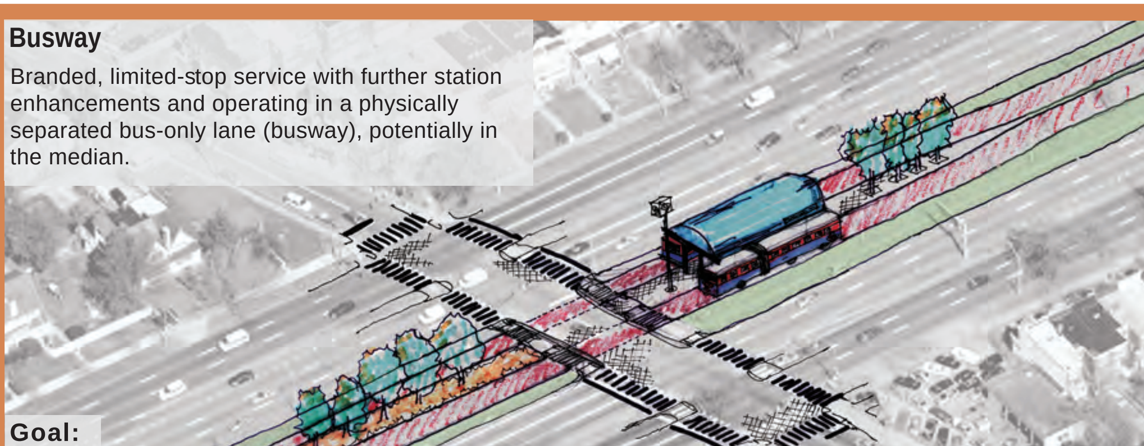
Branded, limited-stop service with enhanced station-like stops operating in the outside lane of the outer drive in a business access and transit lane.

Goal:

Develop a short-term, low-cost, enhanced bus service along Roosevelt Boulevard to better meet the mobility needs of neighborhood residents and longer-distance commuters to and from Northeast Philadelphia and Lower Bucks County.

Busway

Branded, limited-stop service with further station enhancements and operating in a physically separated bus-only lane (busway), potentially in the median.

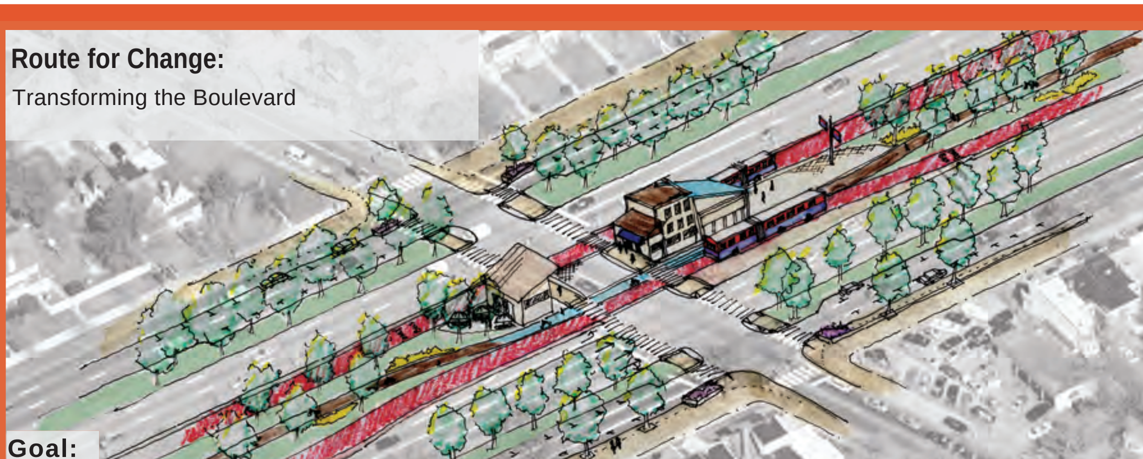


Goal:

Develop a medium-term busway that could build on the EBS concept. The service would run in an exclusive, at-grade, bus-only lane (no automobiles).

Route for Change:

Transforming the Boulevard



Goal:

Develop a vision for a reconfigured Roosevelt Boulevard that balances accessibility for automobile, public transportation, walking and bicycling modes; and better supports economic, environmental, and quality of life goals for the adjacent communities.

$ — *Approximate level of investment* — $$$

dvrpc

Chapter 1:

BACKGROUND AND EXISTING CONDITIONS

CHAPTER 1: BACKGROUND AND EXISTING CONDITIONS
Chapter 2: Transportation and Development Trends
Chapter 3: Initial Alternatives Development
Chapter 4: Station Location Selection
Chapter 5: Discussion of Common BRT Elements
Chapter 6: Shrot-term EBS Concept
Chapter 7: Long-term Busway Concept
Chapter 8: Next Steps

INTRODUCTION AND PROJECT APPROACH

The improvement of mass transit options in the Roosevelt Boulevard corridor has long been a priority of the City of Philadelphia and Philadelphia residents. Many forms of rapid transit have been previously explored. In 2011, PennDOT funded the development of a problem statement for Roosevelt Boulevard transit improvements, which reads in part:

"There is a disconnect, be it actual or perceived, between the transit services desired and the services currently offered to residents and commuters using the Roosevelt Boulevard corridor. The factors contributing to this disconnect are related to 1) transit's competitiveness in accommodating desired trips versus similar travel by private automobile and 2) the lack of transit mode choice in comparison to other busy, mixed-use corridors in Philadelphia."

That project's suggested next steps included a) survey work to better understand travel patterns and b) the development and screening of alternative transit enhancement scenarios. Starting in 2011 the PCPC began a comprehensive planning process for Philadelphia called *Philadelphia2035*. In 2011 the Citywide Vision was adopted; since that time, a detailed analysis has been ongoing to develop District Plans for each neighborhood planning district. For the Lower and Central Northeast districts (Roosevelt Boulevard bisects both), public outreach was conducted in the form of public meetings and a pilot survey using cellphones led by the firm Textizen.[1] Questions were written on posters and posted within and on buses and in bus shelters. Participants responded to a survey by texting their answer to a headline question, after which they were texted back two follow-up questions. Figure 1.1 shows an example of a survey question on a bus shelter.

Figure 1.1: Survey in Shelter

Source: PCPC, 2013

A total of 750 responses answered the question, "Would you use a rapid transit line along the Boulevard to get to Center City?" A total of 96.8 percent of responses answered "yes". This feedback from the District Plan was a key reason for the present study.

The purpose of the *Alternatives Development for Roosevelt Boulevard Transit Enhancements* project was to develop and screen a variety of alternatives for at-grade transit enhancements in the corridor. The following agencies participated in the steering committee: SEPTA, PCPC, MOTU, PennDOT District 6-0, PennDOT Central Office, City of Philadelphia Streets Department, Bucks County TMA, Bucks County Planning Commission, and Bensalem Township. Initial alternatives were developed through steering committee workshops and screened to develop a short-list of alternatives. Once the short-term alternatives were presented, the steering committee reached a general consensus on a preferred two-phase BRT approach. Steering committee agencies attended the two workshops held; however, a larger group of staff from each was represented.

[1] *Textizen. "Philadelphia Pilot Presentation." Philadelphia, 2013.*

STUDY AREA

This study focuses on the land uses and travel patterns along the 14-mile corridor of Roosevelt Boulevard (US 1) from Broad Street to Neshaminy Mall (at approximately Bristol Road), as shown in Figure 1.2. In order to assess current and potential travel patterns, demographic and land use data was analyzed for an extended study area. The Roosevelt Boulevard study area is composed of each Philadelphia Planning District and Bucks County municipality that touches or borders on the corridor. The Philadelphia districts under study are the North, Upper North, Lower Northeast, North Delaware, Central Northeast, Lower Far Northeast, and Upper Far Northeast. The Bucks County portion of the study area includes Lower Southampton, Bensalem, and Middletown townships, and the municipal enclaves contained within Middletown, including Hulmeville, Langhorne and Langhorne Manor, and Penndel. These locations are shown in Figure 1.2 as County Planning Areas (CPAs).

PREVIOUS STUDIES

Interest in improving transit on the corridor increased in the 1960s in response to the residential and employment growth in Northeast Philadelphia. PCPC proposed an extension of the Market-Frankford “El” subway line through a PECO right-of-way along Pennway Street. The project was abandoned in 1970 due to high construction costs.

Many of the rail alternatives explored to date have not proven financially feasible in the face of economic realities. This study aims to build off the previous work detailed in this section by identifying immediate and feasible transportation enhancements.

ROOSEVELT BOULEVARD CORRIDOR TRANSPORTATION INVESTMENT STUDY (2003)

PCPC

The three-year study considered a range of transit alternatives for Roosevelt Boulevard and established a Preferred Alternative. The Preferred Alternative was an elevated and underground extension of the Broad Street Subway Line in the center median of Roosevelt Boulevard with a northern terminus at Southampton Road, near the border of Philadelphia and Bucks County. Between Broad Street and Blue Grass Road, the train would operate in a cut-and-cover tunnel, and north of Blue Grass Road as an elevated line. The Preferred Alternative anticipated significant travel time savings and economic and community development from the mixed-use “town centers” at select stations. The projected costs were as great as the benefits; with a cost estimate ranging from $2.5 to $3.4 billion in year 2000 dollars, the project did not advance.

US 1 ROOSEVELT BOULEVARD CORRIDOR STUDY (2007)

DVRPC

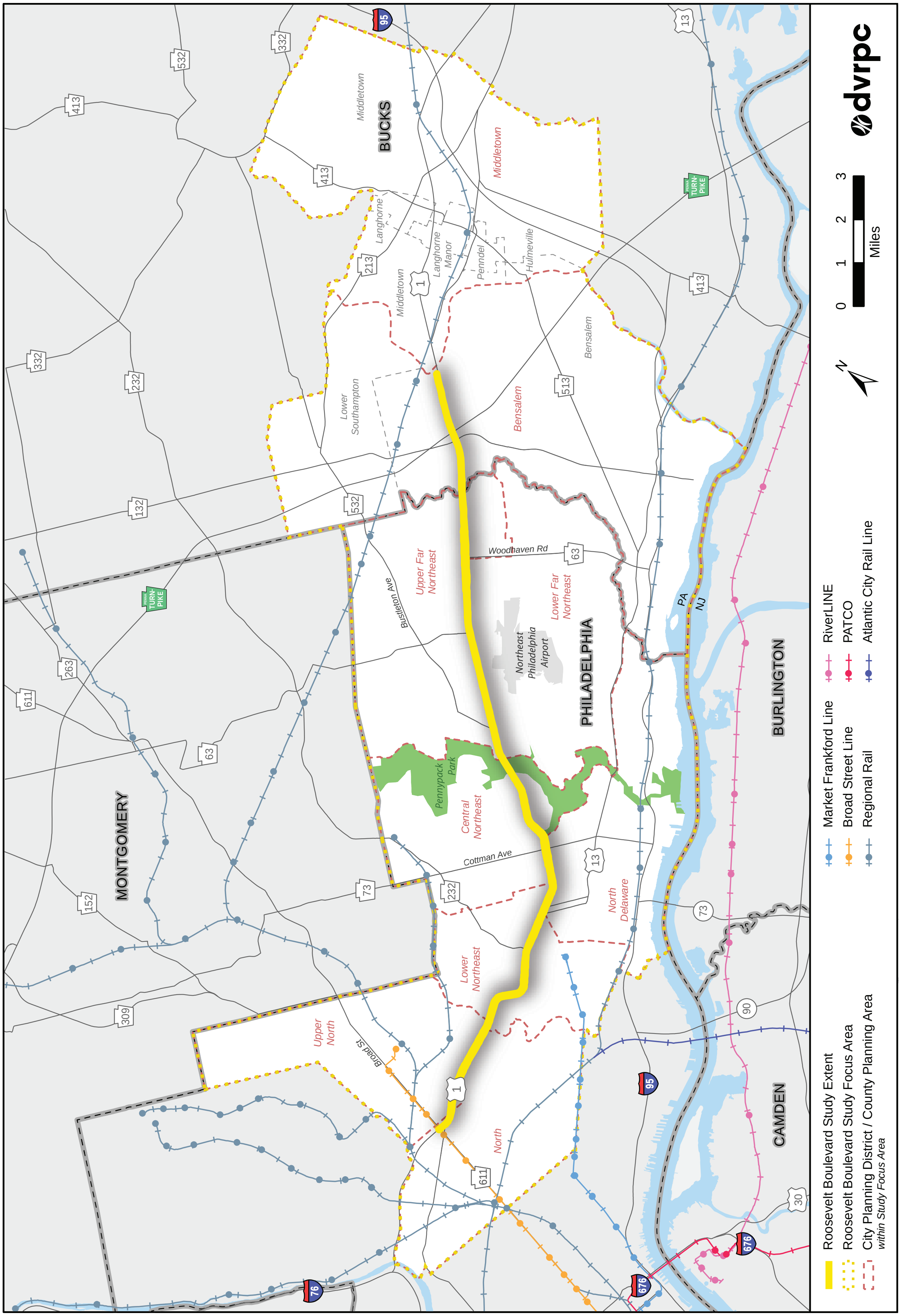
The Corridor Study examined the pedestrian and traffic safety conditions of an eight-mile stretch of Roosevelt Boulevard, from 9th Street to Grant Avenue. The study selected 14 intersections and 10 unsignalized crosswalks and examined pedestrian crossings at these sites. Pedestrian profiles indicated a large volume of bus passengers, especially around such bus hubs as C Street and Cottman Avenue. The report recommended pedestrian enhancements at crosswalks and the relocation of bus stops to account for the pedestrian context. For the unsignalized crosswalks, the study suggested upgrading five crosswalks to full crosswalks and eliminating the remainder. It also recommended eliminating 12 local-express lane crossovers and lengthening another 10. Pedestrian safety improvement recommendations were implemented at several intersections.

ROOSEVELT BOULEVARD TRANSIT NEEDS STUDY (2011)

Michael Baker Corporation

The Transit Needs Study developed a corridor profile for a 14-mile study area stretching from Neshaminy Mall to Broad Street. Assessing demographic and economic trends in the region, the study considered the ability of the existing transit network to meet current and future travel demand. The study found that while 97 percent of the population of Northeast Philadelphia was located within a quarter-mile of a transit stop, off-corridor travel was difficult, and congestion and bus stop density on Roosevelt Boulevard slowed transit speeds. Moreover, demographic trends and employment dispersal suggested a growing future demand for rapid transit service in the study area. A demographic diversification of the area (with a growing elderly and immigrant population, and an increase in people living in poverty) may indicate growth in transit-dependent households. The report recommends

Figure 1.2: Roosevelt Boulevard Study Area



low-cost enhancements, such as an increase in the distance between bus stops for certain locations along the corridor. Recommendations were used by PCPC in their district planning process for *Philadelphia2035* and informed the development of the present project.

PHILADELPHIA PEDESTRIAN AND BICYCLE PLAN (2012)

PCPC

The Pedestrian and Bicycle Plan envisioned the conversion of the sidewalk on the eastern side of Roosevelt Boulevard into a 10-foot sidepath, an enhanced path for bicycles and pedestrians that runs adjacent to the roadway. In order to integrate a shared-use sidepath into the complex roadway configuration, it requires a careful design that minimizes conflict with cyclists, pedestrians, and transit riders.

UNDERSTANDING THE ROOSEVELT BOULEVARD CONTEXT

The Roosevelt Boulevard corridor is a major north–south 12-lane-wide corridor that connects North and Northeast Philadelphia to Bucks County, Pennsylvania, and further north, to Mercer County, New Jersey—a major transportation asset for Northeast Philadelphia. For many, Roosevelt Boulevard acts as an alternative route to I-95, located to the east along the Delaware River. SEPTA bus service exists along and through the corridor, and Regional Rail service runs parallel to the north and south of the corridor, connecting the study area both to Center City Philadelphia, and Trenton and West Trenton in New Jersey. Philadelphia's Citywide Vision Plan, and several past transportation studies, emphasize the expansion of rapid transit on the corridor itself.

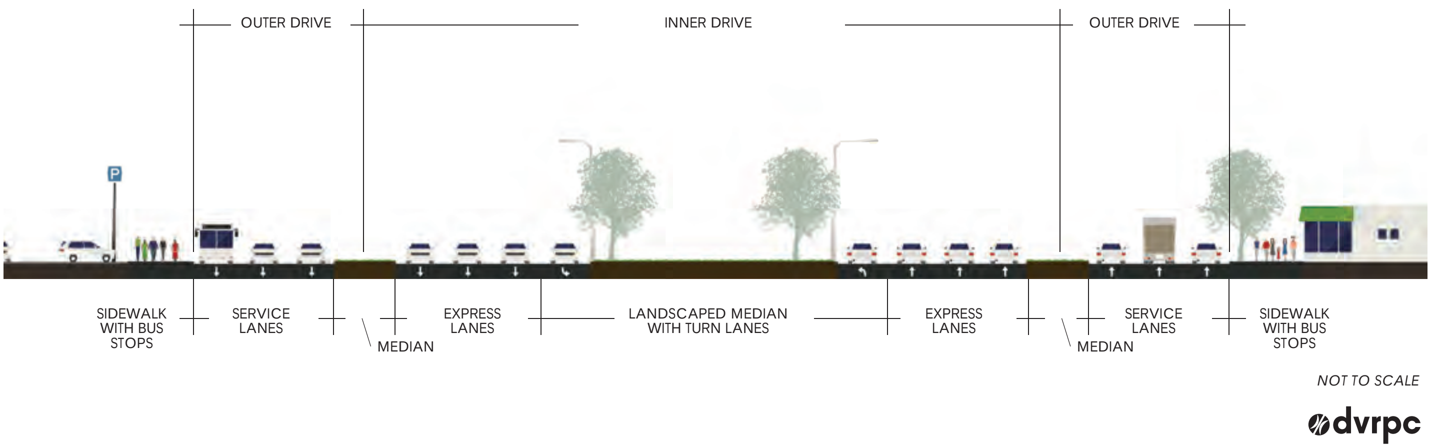
Roosevelt Boulevard alternates between an Expressway and Principal Arterial cross section, with the majority of the corridor within the study area being classified as a Principal Arterial. The typical 12-lane cross section within the study area—from approximately 9th Street to just south of Street Road and the Pennsylvania Turnpike—consists of four sets of three lanes of single-direction traffic, as shown in Figure 1.3. The middle six lanes (the "inner drive") function as "express" lanes, with each set of three single-direction lanes separated by a wide median. Medians vary in width from 12 to 82 feet and typically accommodate left-turn lanes at intersections. The outer six service lanes (the "outer drive") function as local traffic lanes with access to perpendicular streets and the land uses abutting the corridor. There are no shoulders on either the inner or outer lanes; here SEPTA buses operate using the outermost service lane for passenger boarding. Sidewalks exist along the majority of the outside edge of the service lanes and vary in width and state of repair. Each edge of pavement is curbed. The posted speed limit ranges from 40 to 45 miles per hour.

A short segment between the expressway and arterial portions of Roosevelt Boulevard acts as a physical transition between the two different cross sections. In this section near the border between the counties, beginning at Southampton Road and moving north to the north side of the interchange with the Turnpike, the inner and outer drives merge such that only the central median remains, sidewalks end, shoulders emerge, and eventually the central median ends. The number of lanes varies as through lanes "drop" and turn- and Turnpike-merging lanes appear and disappear.

North of Street Road, US 1's cross section transitions to that of an expressway with two lanes of travel in each direction with shoulders and a periodic extra turn or merge lane, as shown in Figure 1.4. Travel lanes are separated by a narrow, curbed median with two guard rails. The outside edge is curbless with a mowed grass buffer and landscape area. Land uses are set back from the corridor with their access drives oriented off the corridor on perpendicular roads. There are no sidewalks. The posted speed limit is 55 miles per hour. Both Expressway and Principle Arterial sections have "cobra head" overhead mast arm roadway lighting and underground utilities.

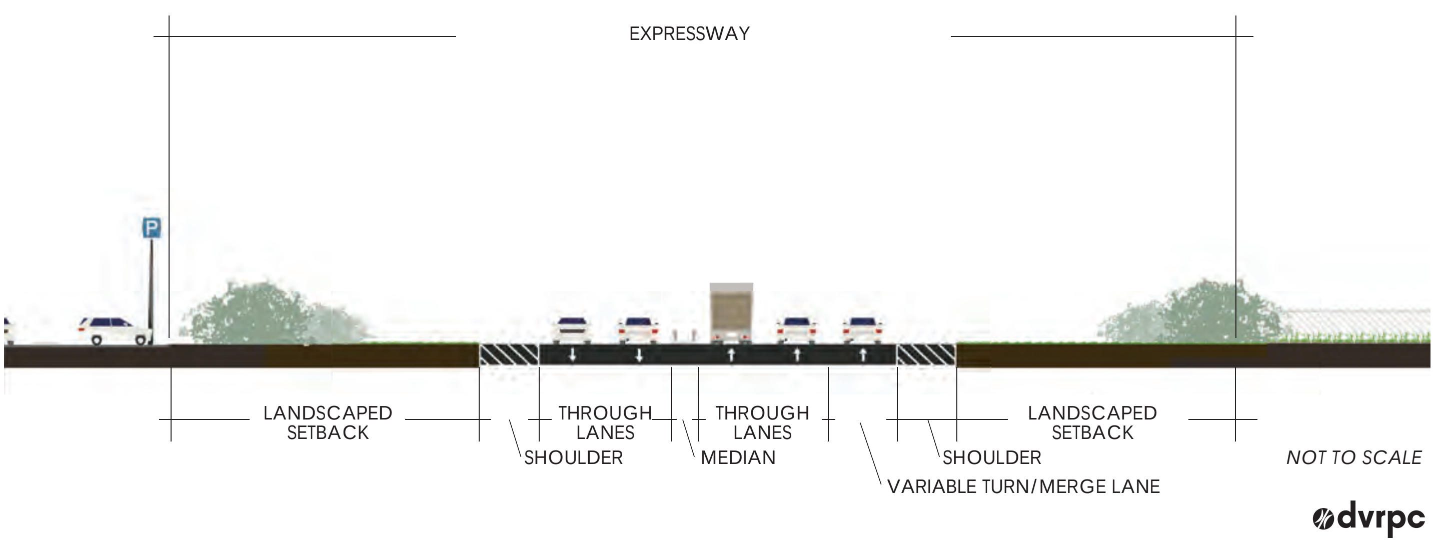
A mix of residential, community, and commercial land uses abut the corridor. Single-family attached and detached residential uses are prevalent throughout the corridor and are most dense in the southern ends of the study area. Small neighborhood commercial areas exist within the adjacent neighborhoods, while larger commercial shopping centers exist in discrete nodes, most notably at the intersections of Rockhill Drive north of the Turnpike (Neshaminy Mall), Plaza Drive, Red Lion Road, Grant Avenue, Welsh Road and Cottman Avenue (Roosevelt Mall). Areas of open space are noticeable from the corridor adjacent to Hunting Park

Figure 1.3: Arterial Cross Section



Sources: DVRPC; and www.streetmix.net, 2013

Figure 1.4: Expressway Cross Section



Sources: DVRPC; and www.streetmix.net, 2013 at the southern end of the study area and near to Friends Hospital and adjacent cemeteries between Whitaker Avenue and Summerdale Avenue. Regionally significant watershed corridors abut Roosevelt Boulevard but lack a strong visible presence along the corridor. Definitions of a "Boulevard" vary but largely relate to a strong visual sense characterized by a wide thoroughfare and abundant landscaping. As shown in Figure 1.5, the visual quality of this corridor reflects many things at once—quality housing stock, well-maintained properties, underground utilities, and an abundance of canopy trees lend themselves to a "Boulevard" aesthetic. At the same time, intense land uses, tension between pedestrian and vehicular priority, regulatory and commercial signage and street-level lighting, all experienced at fast speeds for an urban setting, compete not only with the aesthetic, but also with safety and a sense of purpose. Several unique physical conditions help to characterize the Roosevelt Boulevard setting.

Figure 1.5: Corridor Visual Character

Source: DVRPC, 2013

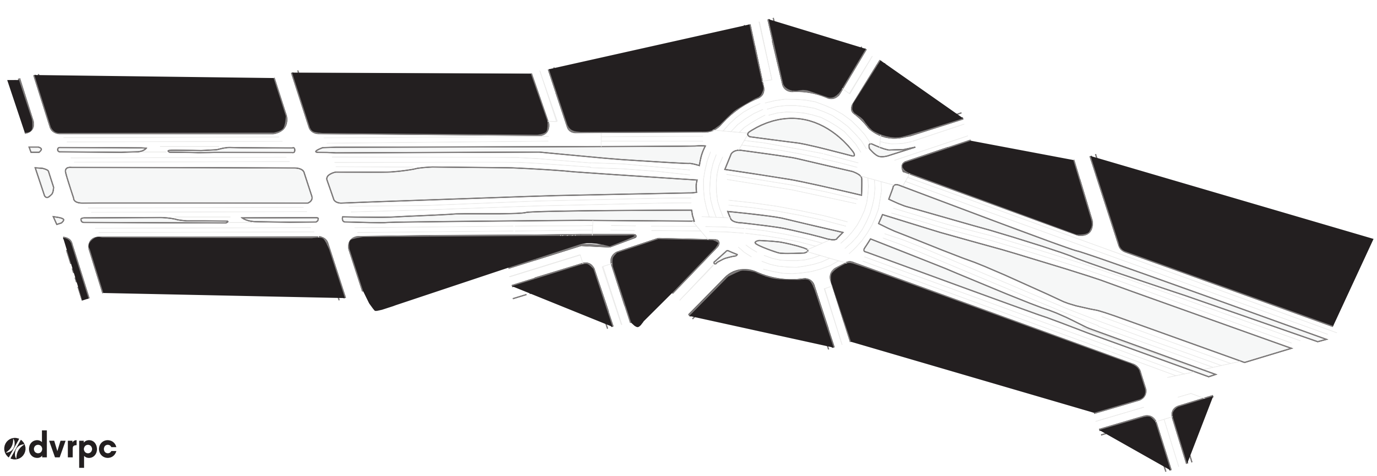
PREVALENCE OF NON-PERPENDICULAR INTERSECTIONS

Figure 1.6 illustrates Roosevelt Boulevard's diagonal orientation within a context of an orthogonal, grid type of street and block structure. Because of its skewed position, many of the corridor's intersections are not the preferred perpendicular orientation. This alignment challenges both land use and transportation patterns—making turning movements difficult for larger vehicles like trucks and buses, challenging the siting of buildings and parking in non-squared-off parcels, and taxing visibility between motorists and pedestrians.

GRADE-SEPARATION

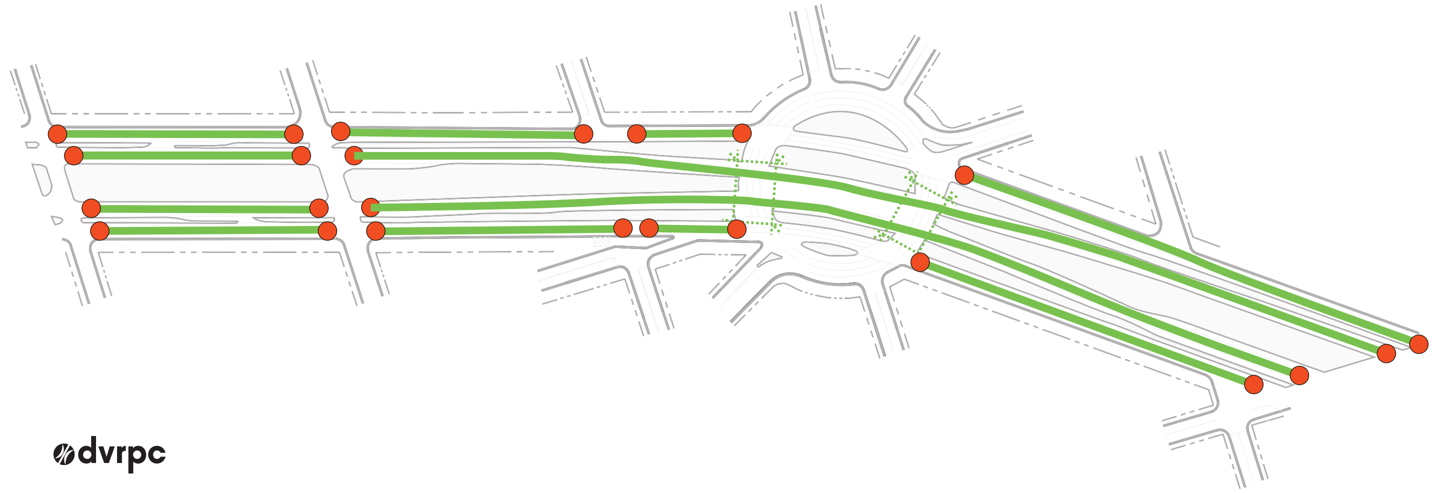
Three intersections (at Oxford Circle, Cottman Avenue and Holme Avenue) are grade separated. Figure 1.7 illustrates how, at these intersections, cross streets and service lanes are at grade and have signalized intersections while express lanes flow underneath in a "cut" condition in a non-signalized travel pattern.

Figure 1.6: Non-perpendicular Intersections



Sources: DVRPC; and PennDOT, 2013

Figure 1.7: Grade-Separation



Sources: DVRPC; and PennDOT, 2013

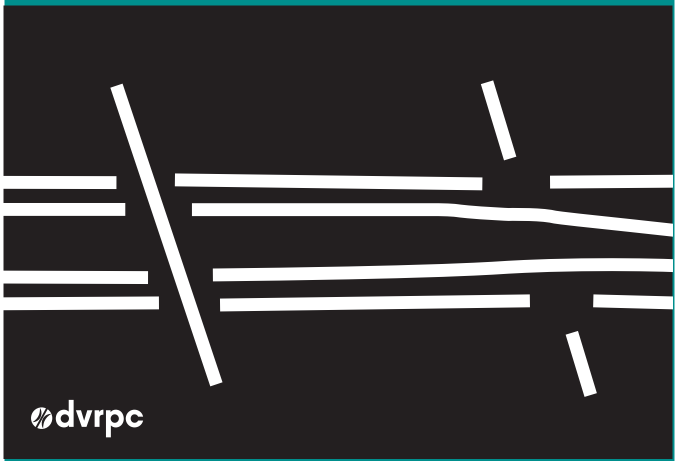
T-INTERSECTIONS

Similar to the grade-separated intersections, several T-intersections create opportunities for express lanes to bypass delays and conflicts caused by turning and merging vehicles at intersections. At these places, cross streets intersect Roosevelt Boulevard service lanes but do not cross over into the median or express lanes, as shown in Figure 1.8.

CROSS OVERS

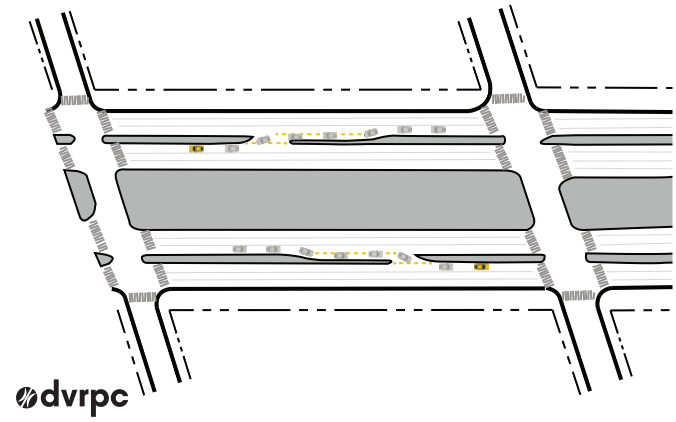
Figure 1.9 shows the access between service and express lanes via "cross over" points—typically located about 100 feet before an intersection. Lanes adjacent to cross overs have more frequent delays and conflict points while cars slow to maneuver entry into what is essentially a narrow, curbed, short slip ramp and to negotiate a merge into a new lane.

Figure 1.8: T-Intersections



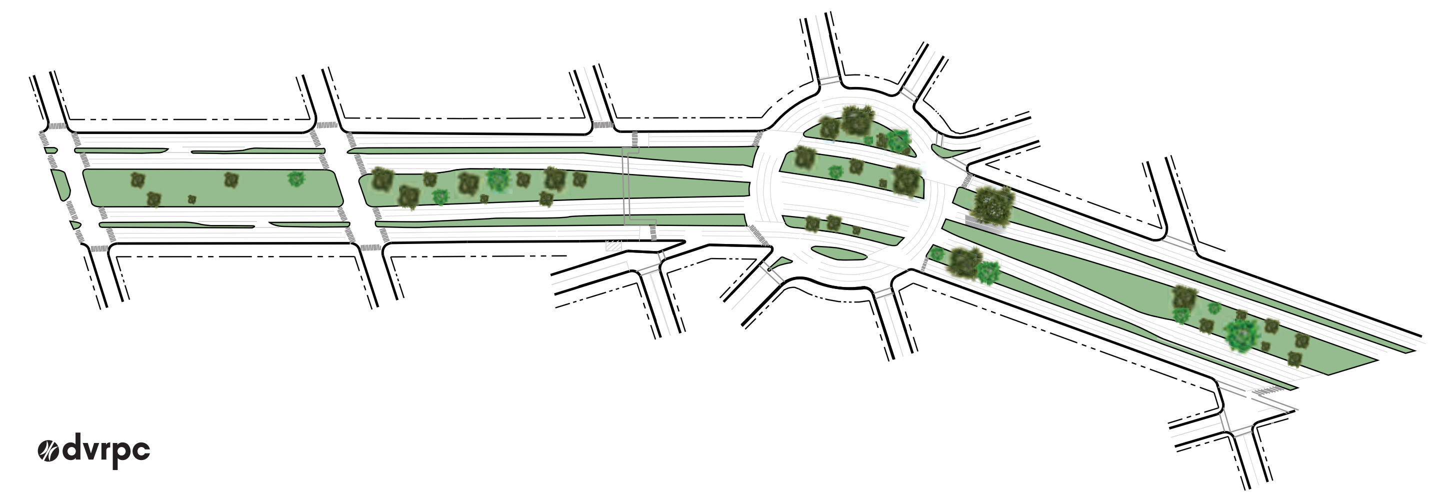
Sources: DVRPC; and PennDOT, 2013

Figure 1.9: Cross Overs



Sources: DVRPC; and PennDOT, 2013

Figure 1.10: Wide, Landscaped Medians



Sources: DVRPC; and PennDOT, 2013

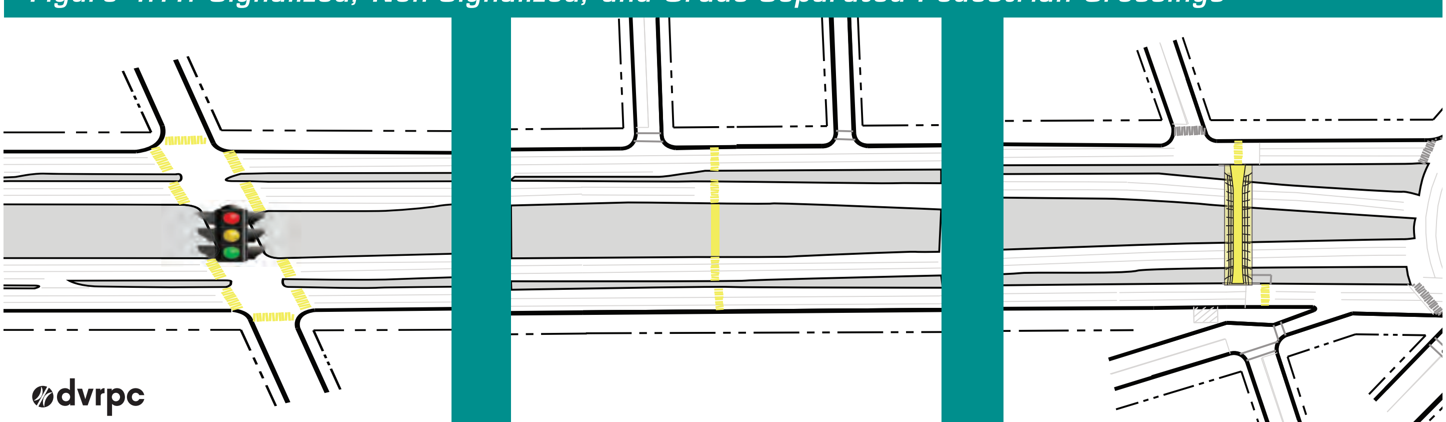
WIDE, LANDSCAPED MEDIANS

The Principal Arterial portion of the corridor is distinguished by very wide medians dividing the express lanes, as seen in Figure 1.10. This provides a distinct visual, air, and noise quality to the corridor. It also provides a safe refuge for pedestrians crossing Roosevelt Boulevard, which is important where the wide right-of-way requires several signal cycles for pedestrians to cross the cartway.

PEDESTRIAN CROSSINGS

The varying land uses adjacent to Roosevelt Boulevard (including a high percentage of residential uses) generate significant pedestrian activity. Even physically abled pedestrians require at least two traffic signal cycles at many intersections, in order to cross the corridor. To accommodate pedestrian crossings, Roosevelt Boulevard has three formalized (as opposed to jay-walking) types of crossings, shown in Figure 1.11. At *signalized crossings*, motorized vehicles stop at a red light, while pedestrians cross the corridor via painted crosswalks and pedestrian refuge areas located in typically three median areas. At *non-signalized crossings*, motorized vehicles are not stop controlled while pedestrians cross via painted crosswalks and pedestrian refuge areas. The corridor has three *grade-separated crossings* where pedestrians cross the corridor on a small bridge that spans vehicular travel lanes. The overpass at Sanger Street, just south of Oxford Circle, spans express lanes only, while the overpasses at Hoffnagle Street and Burling Avenue span both service and express lanes.

Figure 1.11: Signalized, Non-Signalized, and Grade-Separated Pedestrian Crossings



Sources: DVRPC; and PennDOT, 2013

DEMOGRAPHICS

An analysis was conducted for current and projected population and employment in study area municipalities and city districts. In addition, an assessment of environmental justice was completed to ensure that planning efforts consider the needs of disadvantaged populations.

CURRENT AND FUTURE POPULATION

Population is highest at the southern end of the study area in the North and Upper North districts, and significantly lower east of Frankford Creek in the Northeast districts of Philadelphia (Upper Far Northeast, Lower Far Northeast, Central Northeast, Lower Northeast, and North Delaware) and Bucks County. Figure 1.12 displays the current population and projected population growth from 2010 to 2040 for each of the study area districts and CPAs. CPAs share boundaries with Philadelphia neighborhood planning districts and comprise collections of municipalities in the suburban counties.

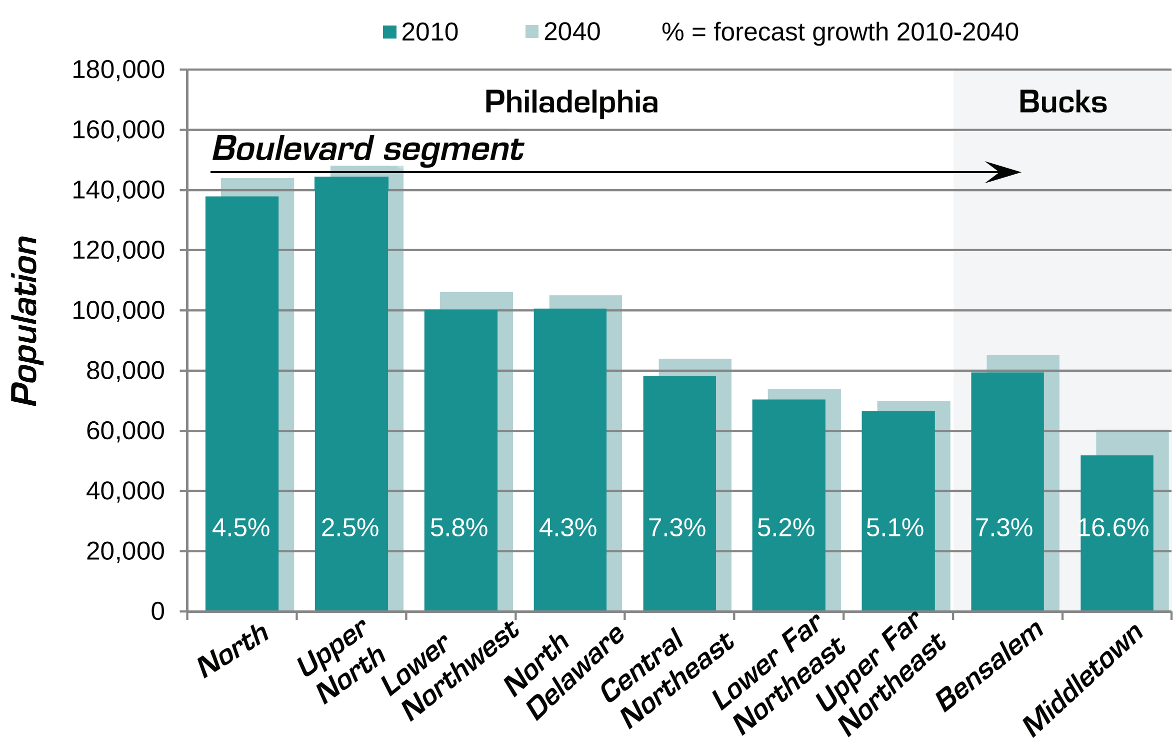
Forecast population growth is moderate throughout the study area. The Central Northeast is the fastest growing within Philadelphia, with an expected population increase of 7.3 percent from 78,266 to approximately 83,500 people. The two fastest-growing study area locations are in Bucks County, with Bensalem Township expected to grow 9.4 percent and the collective growth of Middletown Township and Hulmeville, Langhorne, and Penndel boroughs (which combine to form the Middletown CPA) projected at 16.6 percent. Enhanced transportation options along the corridor will connect this growing population to job centers in Philadelphia.

The southern section of the study area has a considerable youth population, with 0.84 K–12 students per household in comparison to 0.4 students per household in the Upper Far Northeast. In the suburban townships of Bucks County, the same student population is slowly rising to 0.61 students per household in Middletown and its encompassed boroughs.

CURRENT AND FUTURE EMPLOYMENT

The largest employment centers within the study area are located at either end of the corridor. In 2010, the study area had 264,000 jobs in total, with 39,000 in Bensalem Township and 38,000 in the North District of Philadelphia.

Figure 1.12: Population with 30-Year Growth



Sources: DVRPC; and U.S. Census, 2013

Employment growth from 2010 to 2040 in the Bucks County municipalities is projected to outstrip the growth in Philadelphia. Relative and absolute employment growth by sector is summarized in Figure 1.13. Employment in Bensalem Township is expected to increase by approximately 3,700 jobs, and employment in the Middletown CPA is expected to grow by another 3,200 jobs. Goods-producing jobs are projected to decline in nearly every district and municipality due to the loss of manufacturing jobs.

Even as jobs disperse to the townships in Bucks County, city districts such as the North, Upper North, and Lower Northeast are home to the densest employment centers along the corridor. Enhanced transit options along the corridor would come with significant gains for residents of Philadelphia and Bucks County. Bucks County residents would have easier access to these dense employment centers within the city, and Philadelphia residents will derive more benefit from the employment growth in Bucks County.

HOUSEHOLD CHARACTERISTICS

Transportation needs are especially large toward the southern end of the study area. Car ownership rates are lowest in the North and Upper North districts of Philadelphia, and rise rapidly north of Pennypack Park. Whereas the car ownership rate is approximately two vehicles per household in Middletown, the more urban North District has approximately 0.73 vehicles per household.

Traveling north along Roosevelt Boulevard, the share of low-income households declines from 72 percent to 22 percent of households. The population of employed residents climbs from 0.73 individuals per household to 1.35 per household (Figure 1.14).

ENVIRONMENTAL JUSTICE (EJ) AND INDICATORS OF POTENTIAL DISADVANTAGE (IPD)

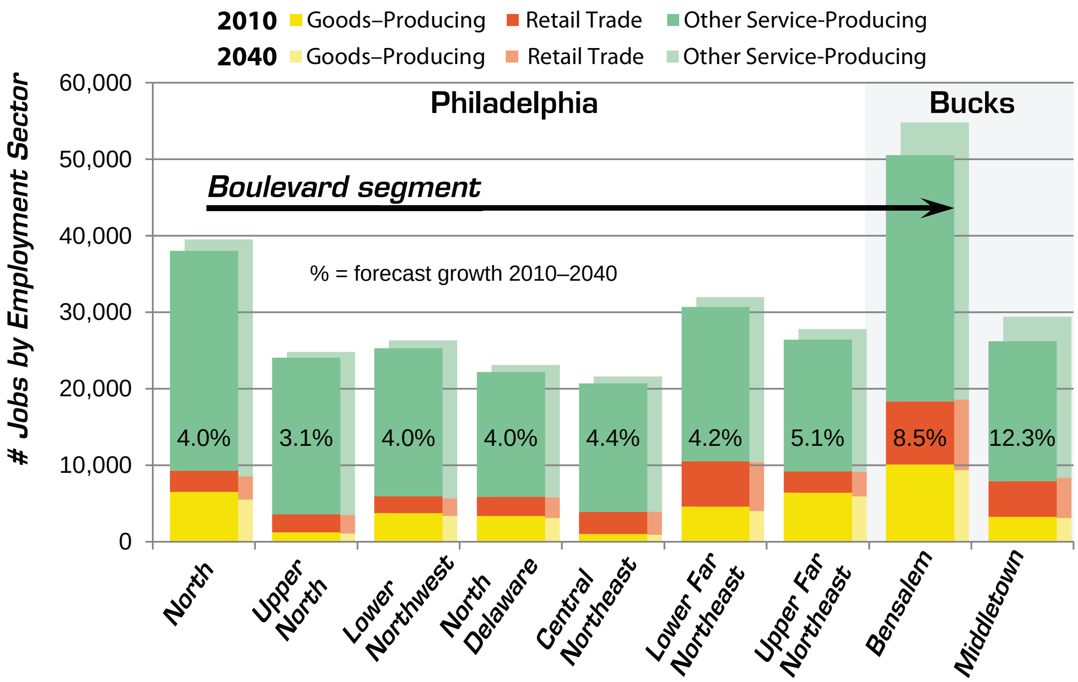
Title VI of the Civil Rights Act of 1964 and the 1994 President's Order on Environmental Justice (#12898) state that no person or group shall be excluded from participation in or denied the benefits of any program or activity using federal financial assistance. As the Metropolitan Planning Organization for the nine-county Greater Philadelphia region, DVRPC is charged with evaluating plans and programs for EJ sensitivity. In response, DVRPC has developed an EJ methodology that quantifies levels of potential disadvantage within the region for seven population groups: non-Hispanic minorities, Hispanic, limited English proficiency households, elderly over 75 years of age, carless households, female heads of household with children, and households in poverty. The assessment of EJ was conducted at the Census Tract level and aggregated to the level of city district or municipality.

The number of sensitive population groups that exceed the regional threshold in each Census Tract is referred to as the tract's IPD. Figure 1.15 illustrates the IPD for the 178 Census Tracts that are located entirely within the Roosevelt Boulevard study area.

In addition, the majority of tracts in Middletown and Lower Southampton exceed the regional threshold for population age 75 and older. As the rate of driving decreases with age, mobility for elderly residents is dramatically impacted by the quality and connectivity of the pedestrian network, frequency of transit service, and the accessibility of local services and employment.

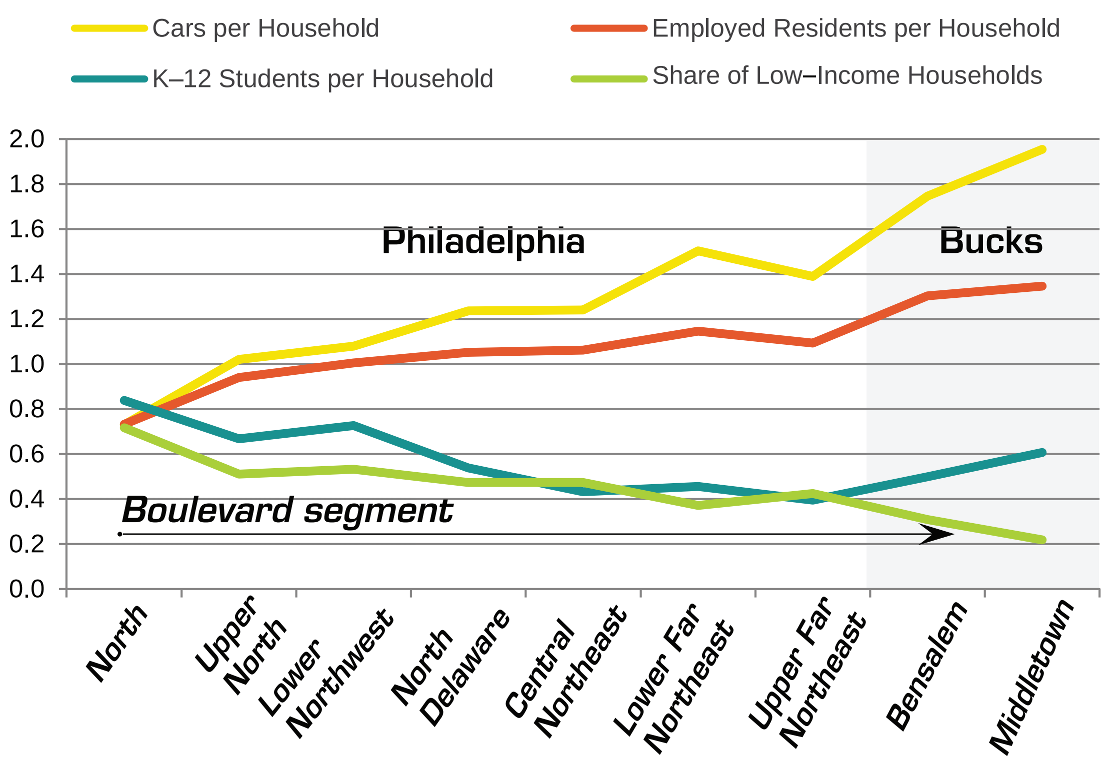
As these population groups may have specific transportation-related challenges, the study area population characteristics reinforce the need for affordable, safe, and convenient transportation options in Philadelphia and throughout the corridor. In general, the southern portion of the study area shows a significantly higher sensitivity to EJ. **Improved transit service along the corridor will better connect transit-dependent communities to the employment growth in the northern end of the study area.**

Figure 1.13: Employment Sectors with 30-Year Growth



Sources: DVRPC; and NETS, 2013

Figure 1.14: Household Characteristics



Sources: DVRPC; and U.S. Census, 2013

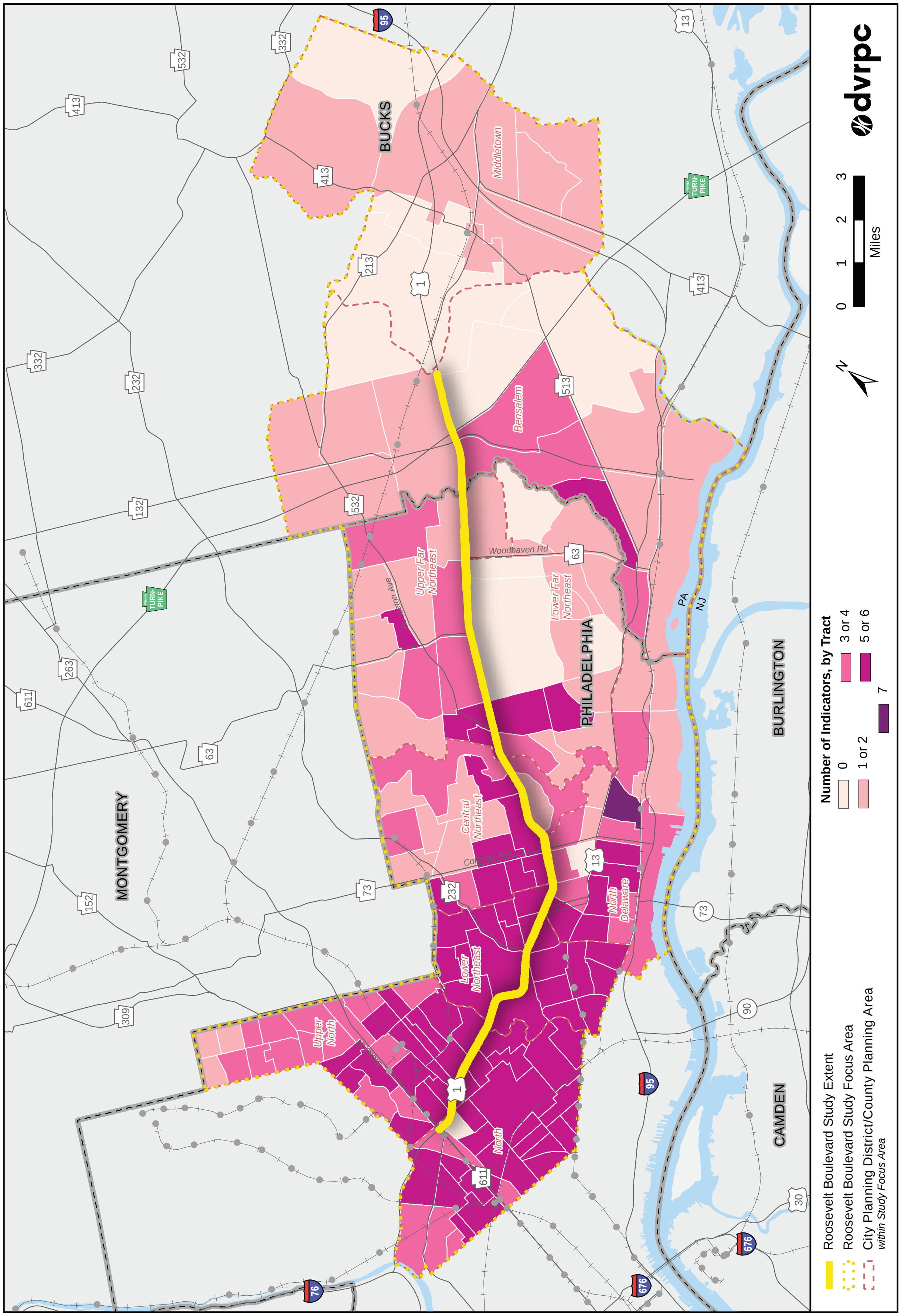


Figure 1.15: Indicators of Potential Disadvantage by Census Tract

LAND USE AND DEVELOPMENT

STUDY AREA LAND USE MIX

Every five years, DVRPC conducts a land use inventory aimed at cataloging the various types of land uses in the region. Table 1.1 and Figure 1.16 summarize the distribution of 2010 land uses throughout the Roosevelt Boulevard study area, which totals 70,728 acres. Almost half, or 46 percent, of the study area serves residential uses.

The portion of the study area south of Pennypack Park is dense and comprised mostly of multifamily and row housing intermixed with commercial corridors and light manufacturing districts. In the center of the study area, through the north end of Philadelphia, some manufacturing and industry runs along Roosevelt Boulevard. Underused industrial land parallels the Delaware River and the former industrial sites of the Upper Far Northeast.

Single-family detached housing, bordered by wooded land, is predominant in the northern portion of the study area, including Middletown Township, Bensalem Township, and Lower Southampton Township. Large strip retail centers and shopping malls constitute the majority of commercial districts throughout the study area.

LAND USES WITHIN A QUARTER-MILE OF ROOSEVELT BOULEVARD

To get a better sense of land use character in and around the corridor itself, staff also examined the land use mix for each planning district within a quarter-mile buffer of Roosevelt Boulevard—a rough approximation of the 5-minute walk shed for existing and prospective transit lines.

Figures 1.17 and 1.18 summarize the land use mix within a quarter-mile mile of Roosevelt Boulevard for each of the CPAs that it borders or passes through. Figure 1.17 summarizes uses in acreage terms, and Figure 1.18 summarizes the same uses in percentage. These figures indicate that attached and multifamily housing is the predominant use within a quarter-mile of Roosevelt Boulevard for its more southerly segments, with a higher degree of light industry, parking, and detached residential uses occurring for more northerly segments.

Table 1.1: Land Use by Acre

This table illustrates the type of land use by acre within the entire study corridor. Figure 1.16 displays the same information graphically.

Land Use	Acres	Percent of Acres
Single-Family Detached Housing	15,961.1	22.57%
Row Homes	8,649.3	12.23%
Wooded	8,447.7	11.94%
Multi-Family Housing	6,991.9	9.89%
Parking	4,467.8	6.32%
Commercial	4,282.7	6.06%
Manufacturing: Light Industrial	4,282.5	6.06%
Recreation	3,976.2	5.62%
Community Services	3,524.4	4.98%
Vacant	3,281.0	4.64%
Transportation	3,112.7	4.40%
Water	2,122.1	3.00%
Agriculture	905.6	1.28%
Utility	443.7	0.63%
Mobile Homes	161.6	0.23%
Military	75.2	0.11%
Manufacturing: Heavy Industry	23.8	0.03%
Mining	17.4	0.02%
Total	**70,726.8**	

Source: DVRPC, 2013

Figure 1.16: Study Area Land Use

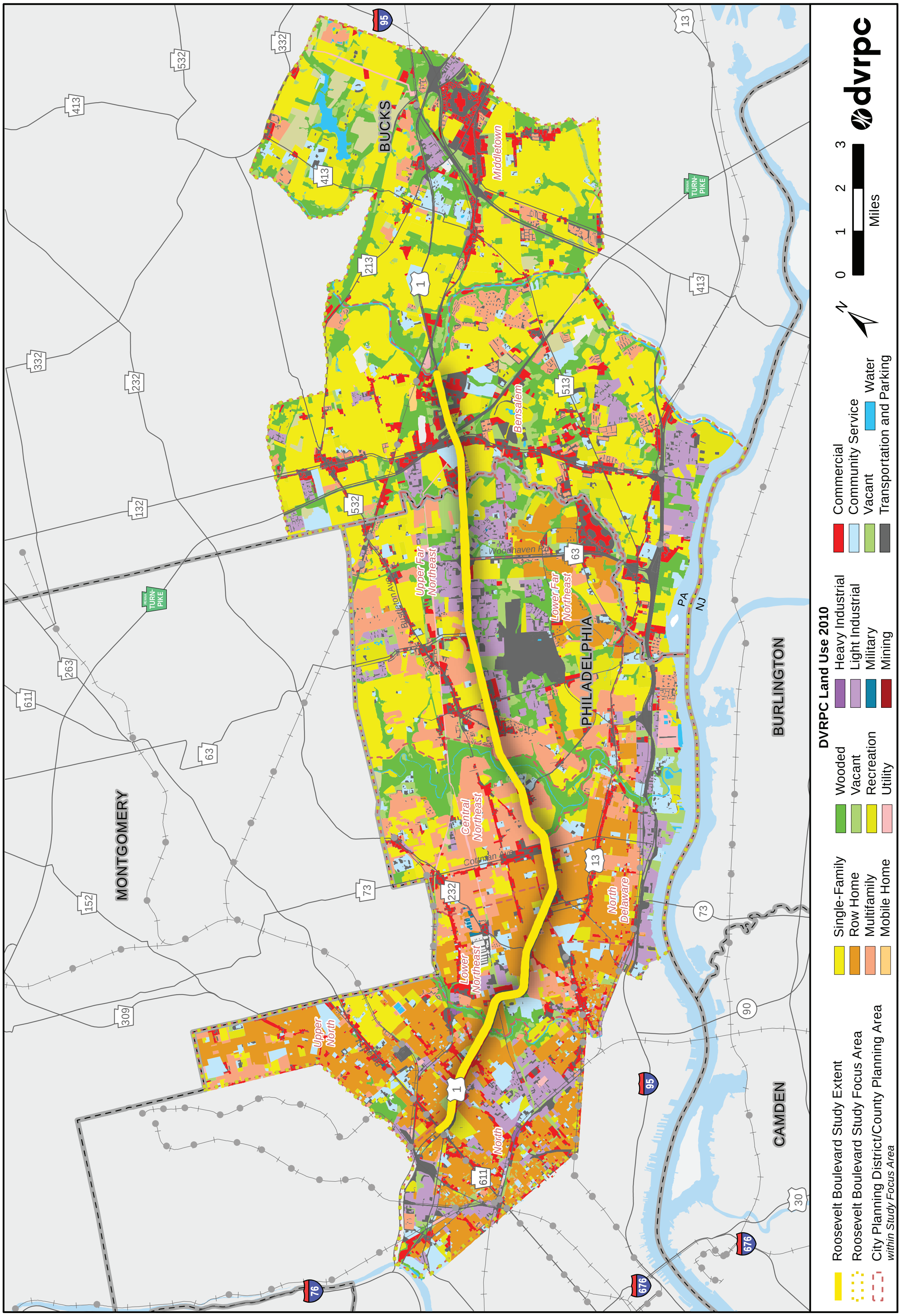
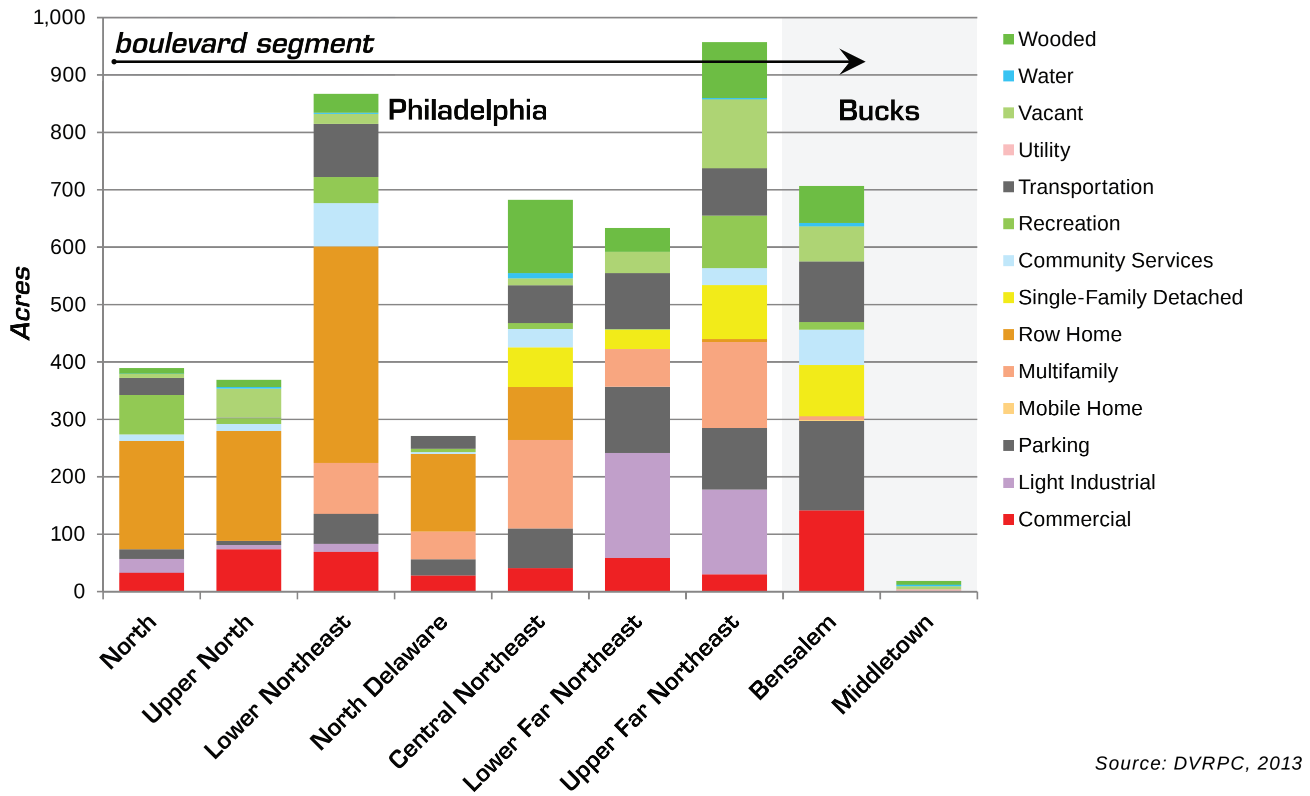
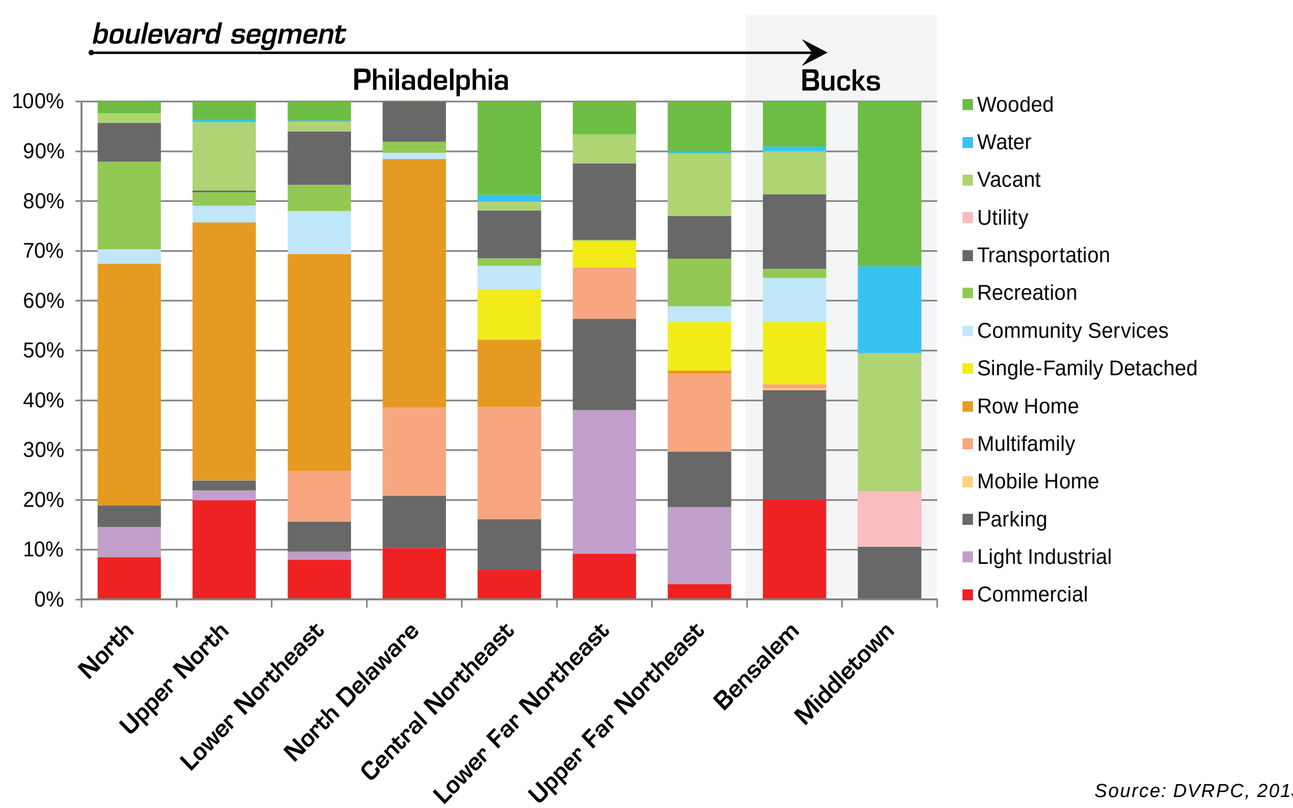


Figure 1.17: Land Use within a Quarter-Mile of Roosevelt Boulevard



Source: DVRPC, 2013

Figure 1.18: Corridor Land Use by CPA



Source: DVRPC, 2013

TRANSIT SCORE

The DVRPC Transit Score, shown in Figure 1.19, is a measure of the transit supportiveness of the land development patterns and the demographic makeup of an area, or the degree to which the development of an area permits and encourages the use of mass transit. The Transit Score Tool incorporates variables for population density, employment density, and the number of zero-car households, and then weighs each variable by its statistical impact on transit ridership. The resulting score is classified into five category ranges (from “low” to “high”), each representing an increasing level of transit supportiveness, as shown in Table 1.2. In this way, Transit Score can be used to assess the appropriateness of various modes and intensities of transit service throughout the DVRPC region. Transit Score is used as a preliminary screening tool: having a high or medium-high Transit Score does not mean that a BRT or rail investment will necessarily be effective. However, it does suggest that development patterns are transit supportive, and that an investment may be appropriate if factors like travel patterns are also favorable.

Transit Scores for the study area, analyzed at the level of the transportation analysis zone (TAZ), are displayed in Figure 1.19. The propensity of high Transit Scores at the southern end of the study area is attributable to the high density of people, jobs, and zero-car households. In general terms, the bulk of the study area’s Roosevelt Boulevard alignment bounds TAZs with medium-high or high Transit Scores, suggesting that bus rapid transit and higher levels of new rapid transit investments may be appropriate.

ENVIRONMENTAL CONTEXT

To assess potential areas of environmental concern or impact, this section details streams, floodplains, wetlands, soil types, parks and historic resources across the study area, as shown in Figures 1.20 and 1.21.

STREAMS AND FLOODPLAINS

Roosevelt Boulevard crosses multiple stream networks as it travels across Northeast Philadelphia and Bucks County, including Frankford/Tacony Creek, Pennypack Creek, Byberry Creek, Poquessing Creek, Neshaminy Creek, Mill Creek, and their tributaries. Floodplains, areas naturally subject to flooding, are located along the banks of these waterways in low-lying areas. The 100-year floodplain has a 1 percent annual chance of flooding, and the 500-year floodplain has a 0.2 percent annual chance. Floodplains are subject to the regulations of the Pennsylvania Floodplain Management Act and local ordinances, which restrict filling and developing.

WETLANDS AND HYDRIC SOILS

Wetlands are areas that are frequently inundated by water and are able to support wetland vegetation. Often called swamps, marshes, or bogs, wetlands support unique and sensitive biological communities of plants and animals. One characteristic of wetlands is the presence of hydric soils. Hydric soils are those that formed under conditions of saturation or inundation and have developed anaerobic (oxygen-free) properties in their subsurface.

Development on hydric soils may be restricted due to their relationship to wetlands. Hydric soils are located throughout the Roosevelt Boulevard study area, particularly in low-lying areas between stream corridors in more undeveloped areas (see Figure 1.20).

Table 1.2: Transit Score Categories

Transit Modal Investment	Transit Score Category				
	High	*Med-High*	*Medium*	*Marginal*	*Low*
Heavy Urban Rail	A	N	N	N	N
Light Rail Transit	A	A	C	N	N
Commuter Rail	A	A	C	C	N
Bus Rapid Transit	A	A	C	N	N
Bus Lanes	A	A	N	N	N
Bus priority treatment	A	A	C	N	N
Fixed Route/Line Haul Bus Service	A	A	A	C	N
Express Bus	A	A	C	C	C
Local Circulator Bus/Shuttle/Paratransit	A	A	A	A	A

A = Appropriate   C = Conditionally Appropriate   N = Not Appropriate

Source: DVRPC, 2013

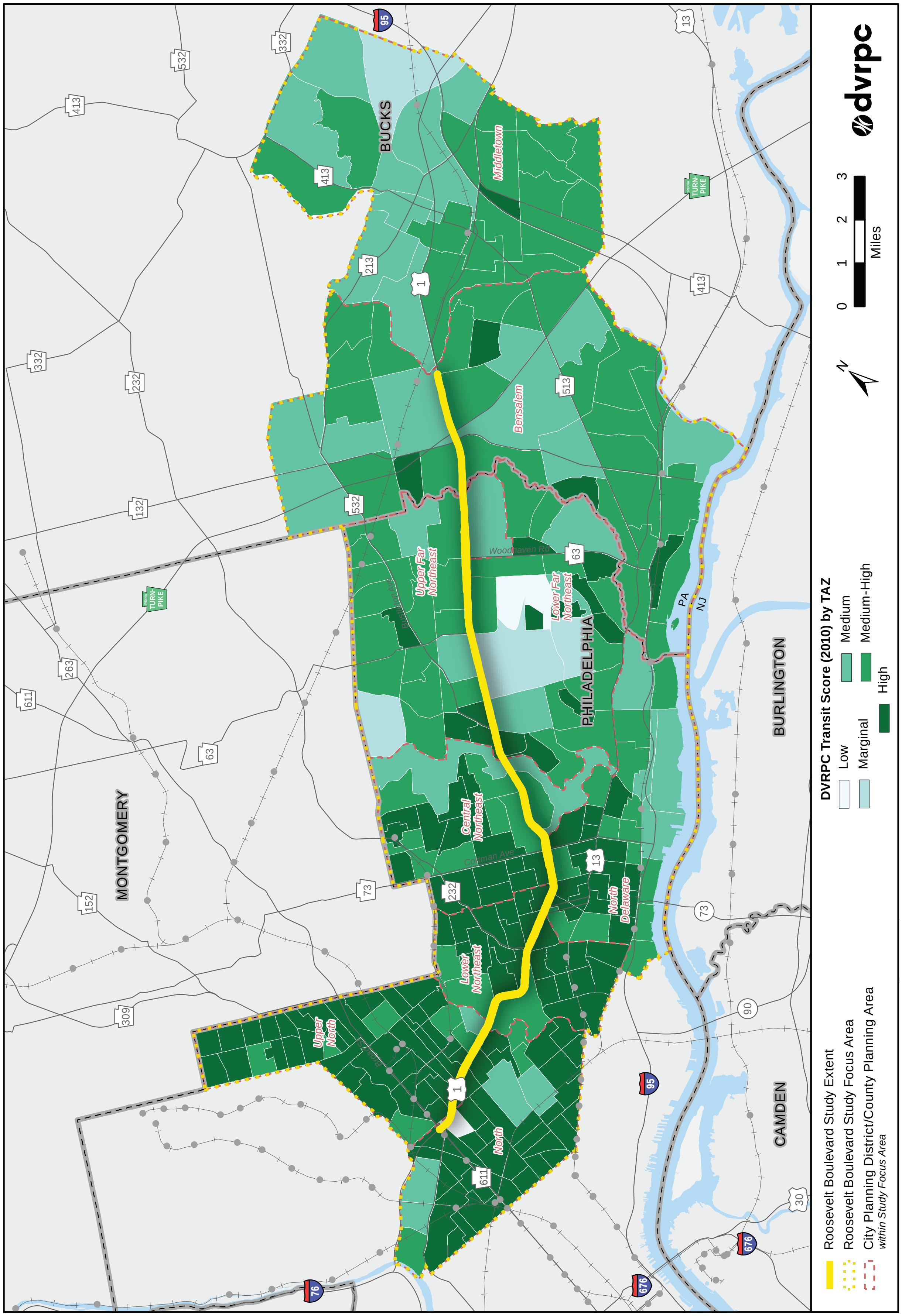
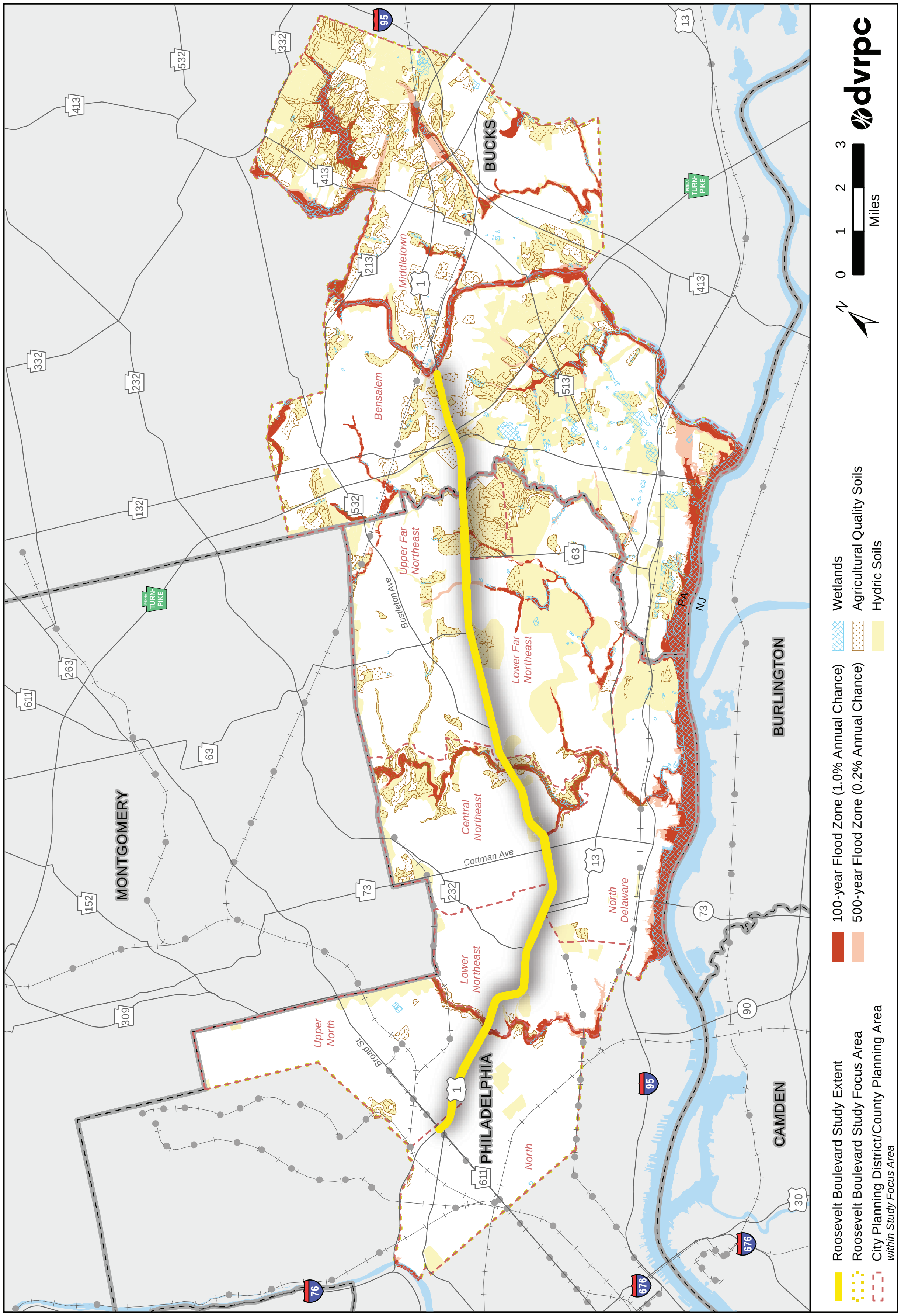


Figure 1.19: DVRPC Transit Score (2010) by TAZ

Figure 1.20: Soils and Surface Water



AGRICULTURAL QUALITY SOILS

All soils are rated by the federal Natural Resources Conservation Service for their agricultural potential. Soils are rated as Prime Farmland, Soils of Statewide Importance, Soils of Unique Importance, or are Not Rated. Prime and Statewide soils are those indicated as Agricultural Quality Soils on the map. Prime Farmlands are those that have the best combination of physical and chemical characteristics for producing high yields of crops. Soils of Statewide Importance are close in quality to Prime Farmland and can sustain high yields when managed under favorable conditions. These agricultural lands may have development restrictions under state law.

PARKS AND TRAILS

Hunting Park

Hunting Park, covering over 87 acres of parkland and recreational facilities, was originally part of the Stenton estate of James Logan (1674–1751), who served as William Penn's secretary. The property stayed in the Logan family for multiple generations until it was sold and turned into a horse racing track in 1808 called Allen's Race Track, later called Hunting Park Race Course. In 1854, the Pennsylvania Assembly outlawed horse racing in the Commonwealth, closing the facility. That same year, the notable Waln, Fisher, Lovering, and Cope families then purchased the land and turned it over to Philadelphia for a public park. The original park was 44 acres, which doubled in size with an addition made in 1903. A carousel was installed in the early 1900s, and later a kidney-shaped artificial lake, comfort stations, picnic pavilions, fireplaces, and tennis houses were constructed in the 1920s. A bath house and recreation center were constructed in 1954. A swimming pool was built in the middle of the lake to meet health department standards, although the lake was later filled in, in order to construct the current soccer field and track. The Friends of Hunting Park organization was formed in 1989. Recent improvements include a new 90-foot baseball field and football field, which were sponsored by members of the Phillies and the Eagles.

Tacony Creek Park and Trail

Tacony Creek Park was purchased by Philadelphia in 1915 and formally established as a park in 1925. The Tacony Creek Park is adjacent to the grounds of the Friends Hospital. The park occupies over 300 acres on both banks of a four-mile stretch of the Tacony Creek. South of Juniata Park, the creek combines with underground tributaries to form Frankford Creek. In Montgomery County, the stream is called the Tookany Creek. A new trail along the creek through the park is currently under construction on the south side of Roosevelt Boulevard that will connect to the existing trail to the north.

Pennypack Park and Trail

Pennypack Park was established in 1905 to ensure the protection of Pennypack Creek and the preservation of the surrounding land. The creek historically was the site of a number of mills, which closed when replaced by the technologies of the Industrial Revolution. The park covers over 1,600 acres of land along a nine-mile stretch of Pennypack Creek. The park contains the Pennypack Environmental Center off Verree Road and Fox Chase Farm off Pine Road, in addition to playgrounds and trails for hiking, biking, and horseback riding.

Benjamin Rush State Park

The Benjamin Rush State Park, developed in 1977, covers 275 acres of undeveloped natural lands and one of the world's largest community gardens. The park is bordered to the north by Poquessing Creek, which forms the border between Philadelphia and Bucks County. The park offers hiking and fishing to visitors. A major renovation project commenced in 2012 that involves a new entrance, new parking spaces, a bicycle and pedestrian trail, water service for the community garden, and other features. Named for the colonial-era physician and Founding Father, Benjamin Rush is the only state park located in Philadelphia.

HISTORIC RESOURCES

Colonial Germantown Historic District

The Colonial Germantown Historic District was designated as a National Historic Landmark District in 1965. Located in both the Germantown and Mount Airy neighborhoods, the District was expanded in size in 1987. The District contains over 500 contributing buildings from the 17th, 18th, and 19th centuries. Notable buildings include Germantown Friends School, Germantown White House, Germantown Town Hall, Cliveden, Wyck House, and Upsala.

Wayne Junction Station and Historic District

The Wayne Junction Station was an important station providing rail access from North Philadelphia to New York City, Bethlehem, Canada, and the Western United States via the historic Reading Railroad, Baltimore & Ohio Railroad, and Lehigh Valley Railroad lines. Currently, Wayne Junction is a stop on five SEPTA Regional Rail lines. The station, built in 1881 by architect Frank Furness and rebuilt in 1901 by the Wilson Brothers Company, is currently undergoing a massive renovation to upgrade and maintain the facility. The station is included as a contributing building in the Colonial Germantown Historic District.

The Wayne Junction Historic District was listed on the National Register of Historic Places in 2012. The district reflects the historic industrial district that developed around the Wayne Junction Station and contains 16 contributing buildings from the late-19th and mid-20th centuries. Historic industrial uses in the district included the manufacturing of carpets and silk, photographic and image reproduction supplies, steel foundry equipment, ball-bearings, medical instruments, pencils, and push-pins.

Olney High School

Olney High School was added to the National Register of Historic Places in 1986. The four-story school was designed by Irwin T. Catharine and built in 1929–1930 in the Late Gothic Revival architectural style. The first graduating class in 1931 had over 3,600 students. Olney High School is still part of the Philadelphia School District, although it has been managed by ASPIRA of Pennsylvania, a charter school organization, since September 2011.

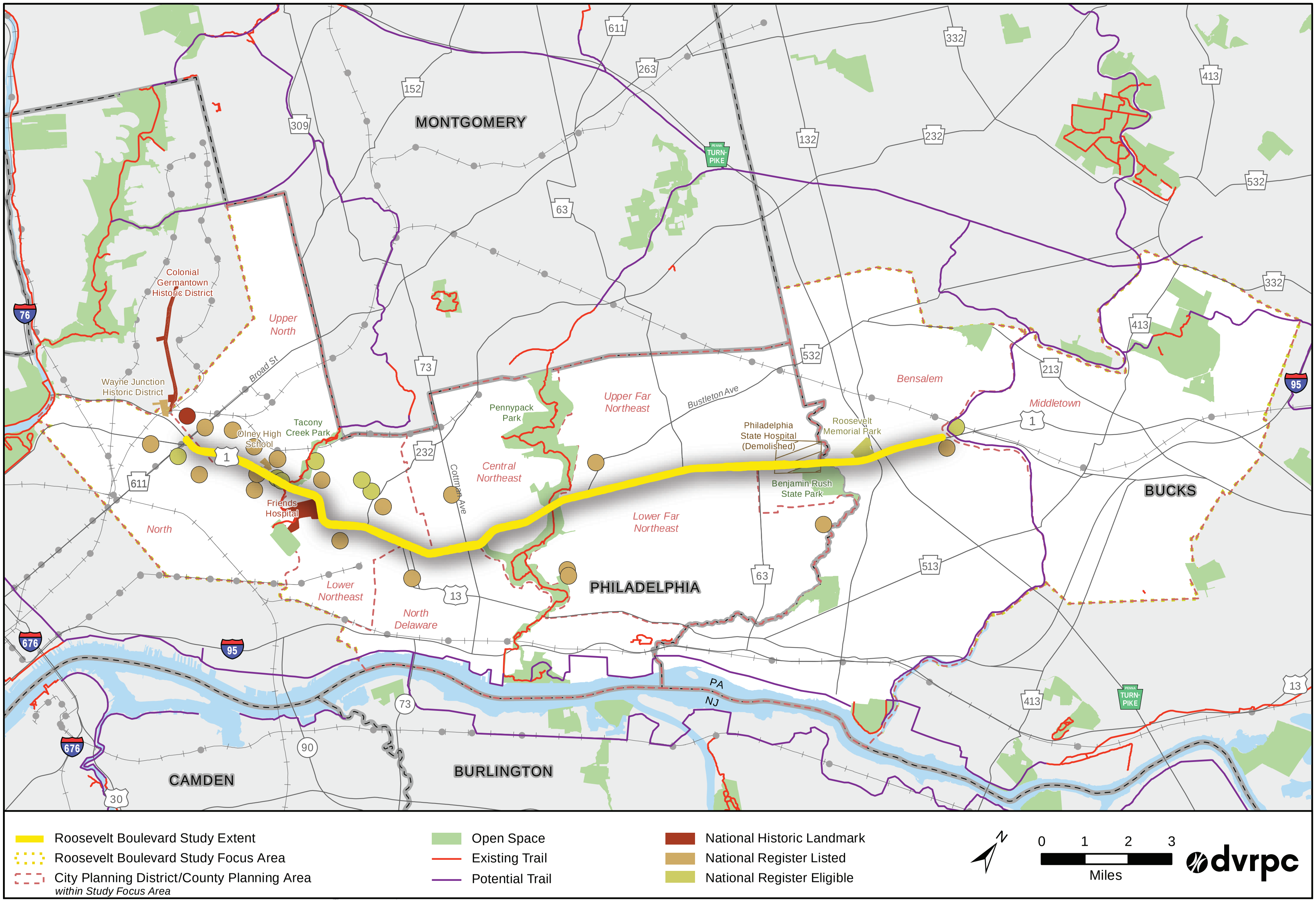
Friends Hospital

Friends Hospital was founded by the Quakers in 1813 as the nation’s first privately run psychiatric hospital. The hospital was founded on the Philadelphia Quaker Thomas Scattergood’s model of treating the mentally ill with dignity, respect, kindness, and love. The hospital originated the concepts of occupational therapy, horticultural therapy, and hydrotherapy as treatments for patients.

Roosevelt Memorial Park

Roosevelt Memorial Park is a cemetery serving the Jewish community. The structures at the cemetery were built in 1929 in the Art Deco style. The cemetery has been deemed eligible for the National Register but has not been listed yet.

Figure 1.21: Parks and Historic Resources



PUBLIC TRANSIT NETWORK

A SEPTA bus network, three Regional Rail lines, and two subway lines combine to form the present public transit network for the Roosevelt Boulevard corridor and surrounding neighborhoods.

BUS NETWORK

At various points along the corridor, Roosevelt Boulevard has anywhere from one to four individual bus routes running along it. SEPTA buses operate in the outer lanes of the outer drive. Key bus routes serving the corridor have been identified and summarized in Table 1.3.

Although travel by public transit along Roosevelt Boulevard is accommodated by existing services, the 2011 *Roosevelt Boulevard Transit Needs Study* found that bus stop density, high boarding volumes, and road congestion slow transit speeds. The most extensive service in the study area is provided by Route 14, which connects Oxford Valley and Neshaminy Malls to FTC. It runs along Roosevelt Boulevard for the greater part of its route and offers 24-hour service and headways as low as 5 minutes during the peak hour. While frequencies are high, travel from Neshaminy Mall to FTC during the peak morning commute takes approximately 50 minutes via Route 14, whereas the equivalent motor vehicle trip can be completed in about half that time.

SEPTA Route 1 operates on Roosevelt Boulevard from Parx Casino, outside the eastern boundary of the study area, to St. Joseph's University. Service is frequent in the early morning, and then continues with headways of approximately 30 to 60 minutes until 7:00 P.M. Additional bus routes running along or parallel to Roosevelt Boulevard are Routes 8, 20, 50, 58, J, K, and R. Service for these routes is summarized in Table 1.3.

Figure 1.22 summarizes both bus route ridership and segment-level bus frequencies along Roosevelt Boulevard. This figure illustrates that while reasonably high frequencies and ridership are present throughout the Philadelphia portion of the study area, the highest-volume stop locations and all-day levels of service tend to be located in the southern portion of the study area.

Bus ridership is shown in an aggregated format; each green dot includes all bus stops within 500 feet of an intersection. For example, there are five bus routes (1, 8, J, K, R) that stop at the intersection of Roosevelt Boulevard and Langdon Street northbound. The large green dot shown at this location reflects the high ridership totals across these lines. Ridership can vary by direction because of variations in service or stop locations. At the same intersection heading southbound, only three bus lines (J, K, R) stop, resulting in the comparatively smaller southbound passenger activity shown in the figure. Individual locations with the highest total levels of current passenger activity can begin to form a basis for selecting stops or stations for improved service.

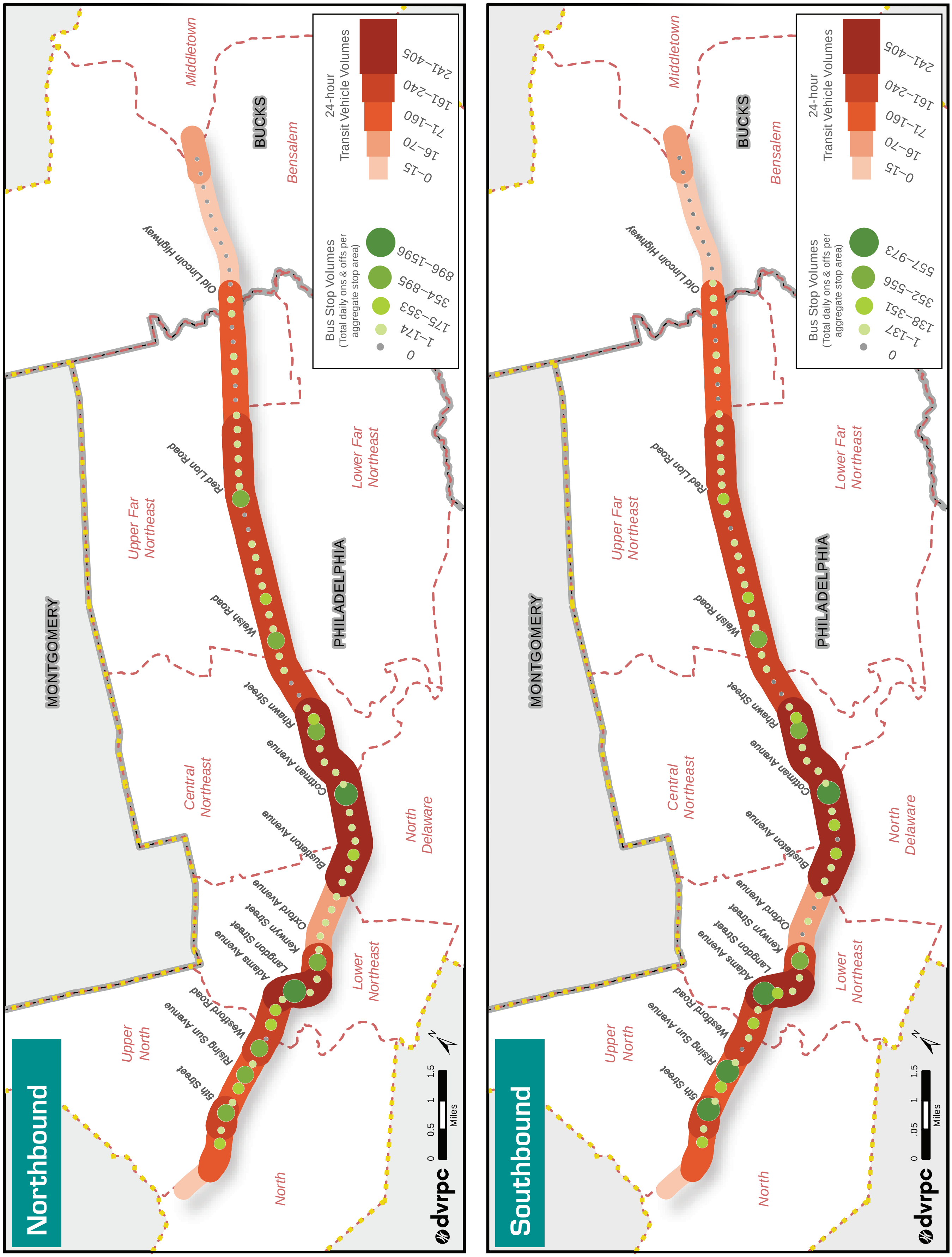
The frequency (or transit vehicle volume) data helps to highlight the locations in the corridor where multiple bus routes converge. In general, the study area segments with higher frequencies also have higher total ridership. Between Oxford and Bustleton avenues, there is a decrease in bus vehicle volumes since some major routes (including Route 14) deviate from Roosevelt Boulevard here.

Table 1.3: Primary SEPTA Bus Routes within Study Corridor

Route	Destination	Weekday Passengers Boards (Avg.)	Headways	Average One-way Trip Route Length (Miles)
1	Parx Casino to 54th Street and City Avenue	3,866	Every 11 minutes in the AM peak; every 20 minutes in the PM peak	22.0
8	Olney Transportation Center to FTC	3,080	Every 8 minutes in the AM peak; every 15 minutes in the PM peak	4.4
14	Oxford Valley and Neshaminy Mall to FTC	11,943	Every 5 minutes in the AM peak; every 5 minutes in the PM peak	19.2
20	Franklin Mills Mall to FTC	7,512	Every 12 minutes in the AM peak; every 10 minutes in the PM peak	13.7
50	Parx Casino via Franklin Mills Mall to FTC	1,989	Every 30 minutes in the AM peak; every 30 minutes in the PM peak	14.5
58	Neshaminy Mall and Somerton to FTC	9,785	Every 8 minutes in the AM peak; every 8 minutes in the PM peak	15.9
J	Chelten-Wissahickon to Richmond-Orthodox	2,865	Every 20 minutes in the AM peak; every 15 minutes in the PM peak	8.8
K	Ridge-Midvale to Arrott Transportation Center	7,387	Every 8 minutes in the AM peak; every 8 minutes in the PM peak	10.0
R	Henry-Midvale and Wissahickon Transportation Center to Frankford Transportation Center	8,112	Every 6 minutes in the AM peak; every 10 minutes in the PM peak	7.9

Sources: SEPTA Annual Service Plan, Route Operating Ratio FY, 2013

Figure 1.22: Bus Passenger and Vehicle Volumes



RAIL SERVICE SUMMARY

The rail lines and stations most relevant to Roosevelt Boulevard, in terms of providing direct service from the study area or along parallel corridors, are SEPTA's Market-Frankford Line via FTC, Broad Street Line via Fern Rock Transportation Center, Fox Chase Regional Rail Line, Trenton Regional Rail Line, and West Trenton Regional Rail Line. Limited Amtrak service is also available at Cornwells Heights station on the Trenton Line.

Ridership, Station Parking, and Station Sheds

Table 1.4 summarizes ridership, parking capacity, and parking occupancy data for 18 Regional Rail stations located in the study area, as well as the terminals of the Broad Street Line (Fern Rock Transportation Center) and the Market-Frankford Line (FTC). FTC has by far the highest rideship among individual study area stations, with Cornwells Heights and Fox Chase having the highest ridership among Regional Rail stations. Station parking capacity is generally constrained throughout the study area, with FTC and Cornwells Heights being the only stations with significant available capacity.

In partnership with SEPTA and PennDOT, DVRPC has a longstanding program to assess rail station market areas by surveying license plates of the vehicles that are parked at each station and mapping the addresses that are associated with those plates. By exploring the distribution of mapped records, we can get a sense of where a given station's highest concentrations of park-and-ride customers are located, as well as typical drive-access distances.
To help understand potential travel markets for improved transit service along Roosevelt Boulevard, this section summarizes available station shed data for study area rail stations. Figure 1.23 summarizes the locations of each station relative to the study area and maps the most recent shed data for a total of 24 SEPTA stations.

Taken as a whole, the license plate data in Figure 1.23 suggests that the West Trenton Line has the largest catchment area among these lines, extending some distance into Montgomery County and Central Bucks County. The map also illustrates relatively high concentrations of park-and-ride origins for each of these SEPTA lines within the study area, including significant drive-to-transit volumes from multiple Philadelphia neighborhoods along the corridor—suggesting that there are significant transit travel markets in the corridor that could be served by a high-quality Roosevelt Boulevard alternative.

Table 1.4: Rail Boards within the Study Area

	Station	Daily Boardings	Rail Line	Shed Year	Parking Capacity	Parking Occupancy
1.	FTC	17,416	Market-Frankford	2013	989	749
2.	Fern Rock T.C.	4,852	Broad Street	2012	713	713
3.	Cornwells Heights	1,518	Trenton	2013	1,929	1,278
4.	Fox Chase	1,390	Fox Chase	2011	325	325
5.	Torresdale	980	Trenton	2011	331	331
6.	Somerton	842	West Trenton	2011	201	201
7.	Langhorne	739	West Trenton	2011	437	392
8.	Woodbourne	612	West Trenton	2011	493	473
9.	Holmesburg Junction	547	Trenton	2011	37	37
10.	Trevose	412	West Trenton	2011	219	202
11.	Forest Hills	401	West Trenton	2011	155	155
12.	Cheltenham	368	Fox Chase	2011	74	30
13.	Ryers	328	Fox Chase	2011	59	59
14.	Neshaminy Falls	286	West Trenton	2011	187	179
15.	Lawndale	218	Fox Chase	2011	N/A	N/A
16.	Tacony	206	Trenton	2011	N/A	N/A
17.	Olney	184	Fox Chase	2011	61	61
18.	Bridesburg	172	Trenton	2011	N/A	N/A
19.	Wayne Junction	56	Fox Chase	2011	N/A	N/A
20.	Eddington	35	Trenton	2011	N/A	N/A

(N/A indicates no existing off-street parking at these stations). *Source: SEPTA, 2011-2013*

Figure 1.23: Study Area Park-and-Ride Rail Station Shed Inventory

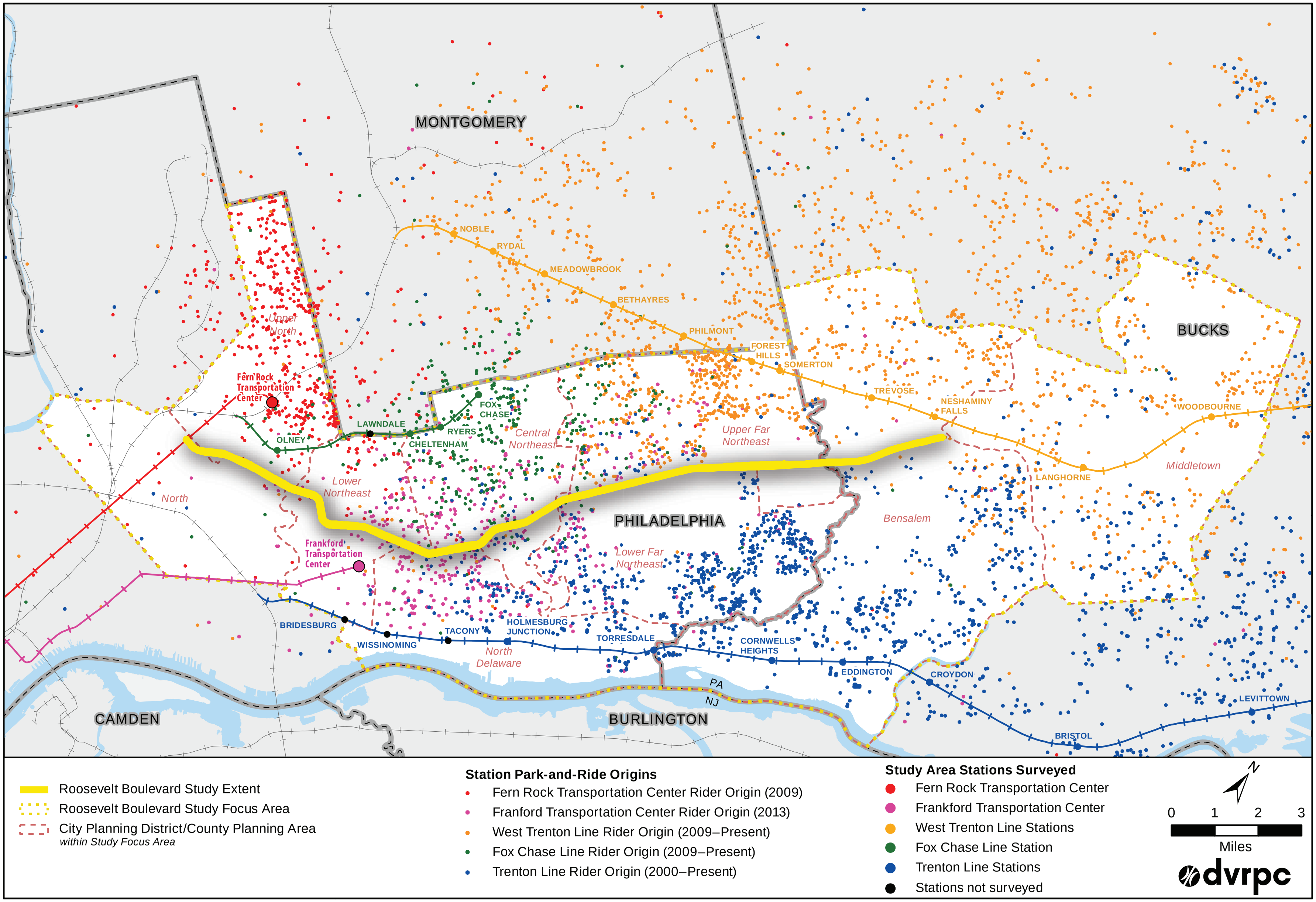
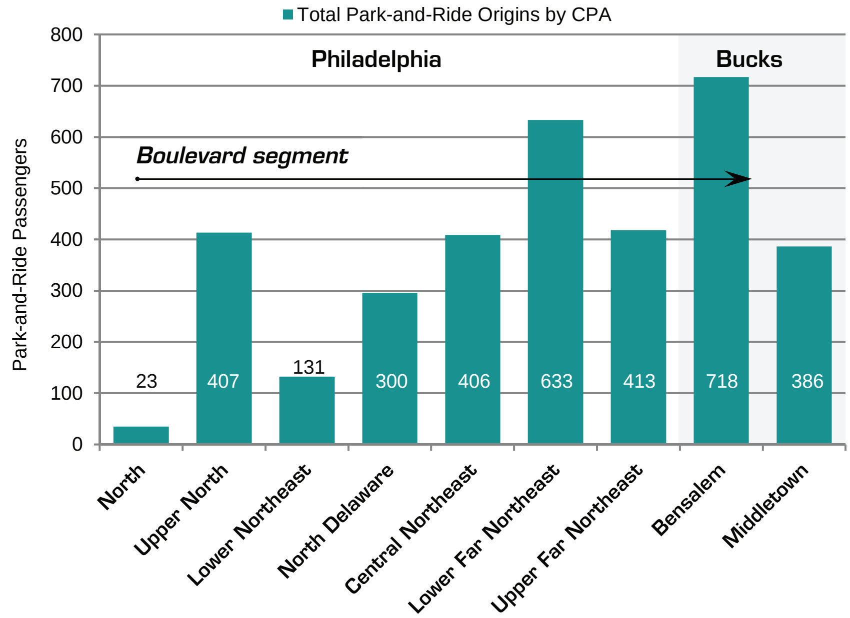


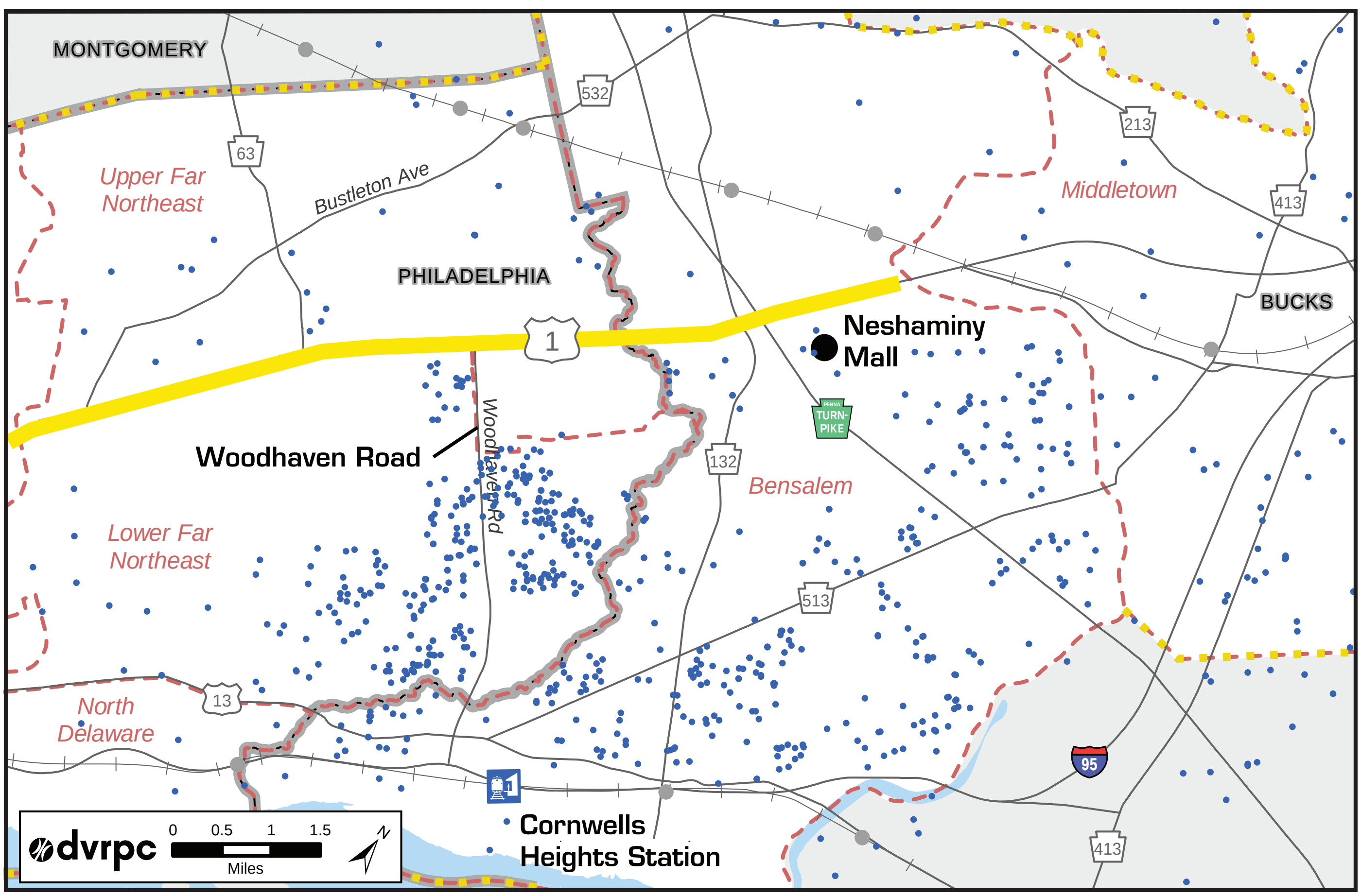
Figure 1.24 summarizes (by planning area) total study area park-and-ride origin volumes for all 24 of the station catchment areas mapped in Figure 1.23, and illustrates the high volumes of origins in both Philadelphia and Lower Bucks County. At the northern end of this project's study area, a total of 48, 347, and 667 park-and-ride origins are located within one, two, and three miles of Neshaminy Mall, respectively. Figure 1.25 highlights the highest concentrations of park-and-ride origins for Cornwells Heights Station in particular, and illustrates the significant number of passengers from the Lower Far Northeast District who drive northeast to Cornwells Heights—the vast majority of whom then board southbound trains toward Center City.

Figure 1.24: SEPTA Regional Rail Park-and-Ride Passenger Origins



Source: DVRPC, 2013

Figure 1.25: Cornwells Heights Station Shed Inventory (2013)



Source: DVRPC, 2013

AUTO CONDITIONS

Roosevelt Boulevard is a major traffic artery in Northeast Philadelphia, with an average daily traffic volume approaching 90,000 vehicles at some of the busiest points of the roadway. This section explores traffic volume, a comparison of auto and transit travel times, and roadway congestion.

TRAFFIC VOLUMES

Traffic volumes have been collected at specific sites along the corridor by DVRPC. These traffic volumes are averaged and annualized by removing seasonal biases in order to identify the annual average daily traffic (AADT). In Table 1.5 traffic volumes vary from 50,000 vehicles near Red Lion Road to 90,000 vehicles near Cottman Avenue, with volumes generally decreasing toward the northern end of Roosevelt Boulevard.

TRAVEL SPEED AND TIMES

A wealth of traffic and congestion data for Roosevelt Boulevard is available through the I-95 Corridor Coalition's Vehicle Probe Project (VPP). This initiative provides comprehensive multistate monitoring of traffic flow within the broader I-95 Corridor, including parallel or intersecting signalized arterials like Roosevelt Boulevard. Traffic flow information is collected anonymously using probe technology (GPS-equipped vehicle fleets, cellular geolocation, and a combination of the two). For the purposes of this project, staff reviewed data for the most recent full year for which data was available (2012). It bears noting that VPP data is unable to differentiate between conditions along the inner and outer drives, and consequently reflects a blend of both.

According to VPP data, free-flow traffic speed in the corridor, or the average speed of a vehicle driving in normal roadway conditions and low traffic volumes, varies from 30 to 40 miles per hour; this variation is due to changes in speed limits and to the roadway configuration for different portions of the study area. Corridor travel time, from just west of Broad Street to Rockhill Road (the closest VPP segment boundaries to this project's Broad Street to I-276/Neshaminy Mall study area boundaries), averages 29 minutes during the peak AM and PM commutes. The Planning Time Index is a measure that compares the 95th percentile worst travel time for a given trip to the free-flow travel time for the same trip, in order to account for both typical recurring congestion and unexpected delay from crashes, weather, or other events. According to VPP Planning Time Index data, the trip can take as long as 45 minutes on days when there is a specific delay-generating incident of some kind. As Figure 1.26 indicates, end-to-end average speeds along this segment of Roosevelt Boulevard do not often fall below 75 percent (30–32mph) of the free-flow speed (40–42mph). This is an overall level of congestion that is better than many other major signalized arterials in the DVRPC region.

In any case, end-to-end travel speeds by private vehicle still significantly outperform travel speeds by transit. Scheduled travel times for SEPTA Route 14 between Neshaminy Mall and FTC, operating primarily along Roosevelt Boulevard, are roughly 48 minutes, a distance covered by private car in about 23 minutes.

ROAD CONGESTION

Roadway congestion and bottleneck information is also available through the VPP, and is available at a high level of detail for specific search periods. After reviewing several "work weeks" (Monday–Friday) of data for spring 2012,

Table 1.5: AADTs along Roosevelt Boulevard

Direction	Between Tyson & Cottman Ave	Between Welsh Road & Grant Ave	Between Red Lion Road & Haldeman Ave
Local southbound lanes	26,137 [1]	10,023 [3]	9,893 [5]
Express southbound lanes	26,123 [2]	18,053 [4]	16,047 [6]
Express northbound lanes	27,087 [1]	15,120 [4]	13,976 [6]
Local northbound lanes	22,384 [2]	13,905 [3]	13,241 [5]
Total	101,731	57,101	53,157

[1] Data collected 12/2008 & 11/2009. Loop format.
[2] Data collected 5/2006 & 8/2009. Loop format.
[3] Data collected 6/2011. 15-min volume format.
[4] Data collected 5/2010. Volume format.
[5] Data collected 3/2009. Volume format.
[6] Data collected 6/2010. Volume format.

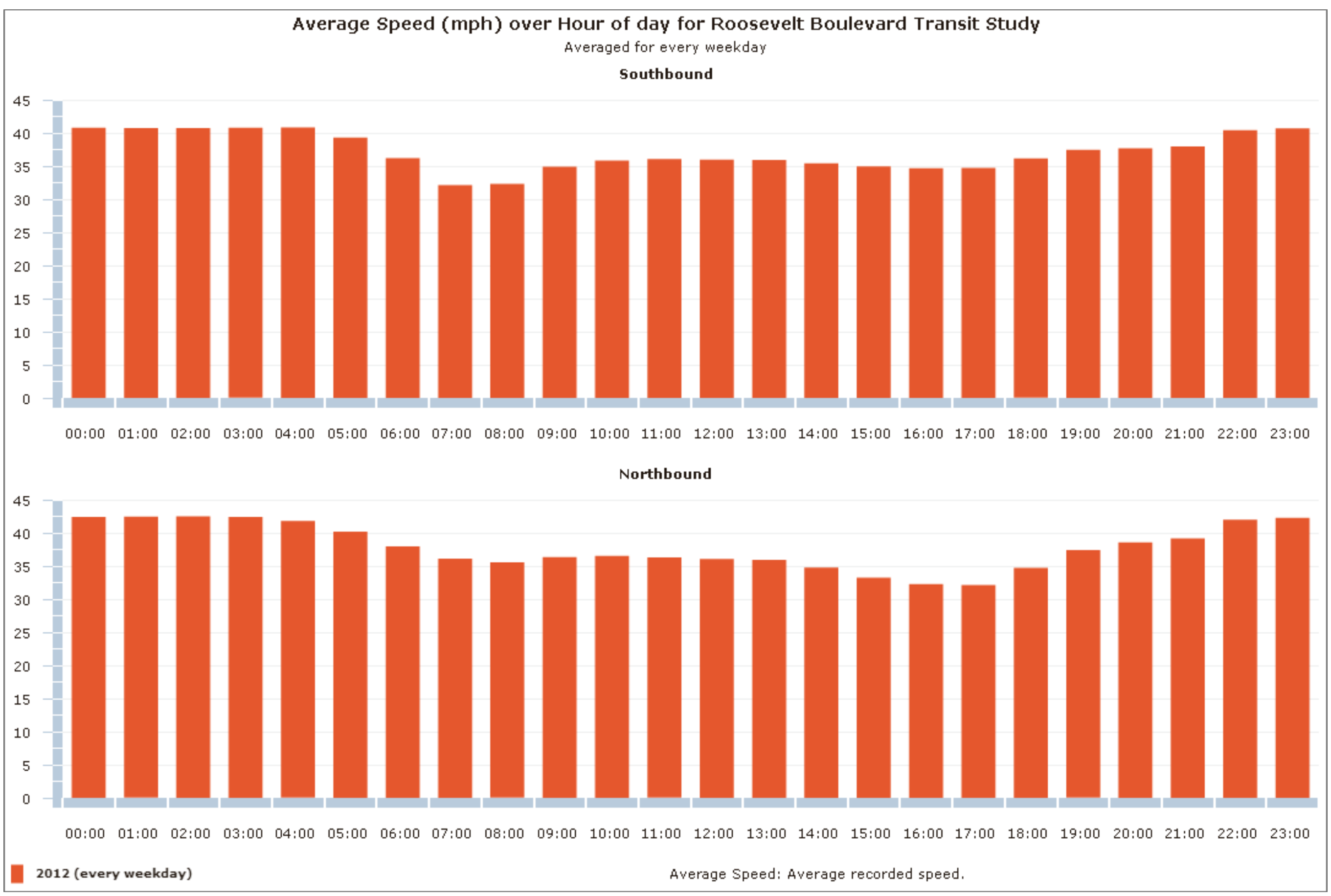
Source: DVRPC, 2013

staff selected Monday, March 5th, through Friday, March 9, for analysis. Congestion data for this typical week is summarized in Figure 1.27 and indicates that congestion patterns on Roosevelt Boulevard are generally as would be expected. Traffic builds up during the southbound commute in the morning peak—which for Roosevelt Boulevard appears to begin at 6:00 AM and end at roughly 10:00 AM, though congestion remains moderate to high, as expressed in relation to free-flow speeds, through the afternoon. Northbound congestion appears over an equivalent 4-hour window, from roughly 2:00 PM–6:00 PM in the evening. The southbound lanes near Adams Avenue experience speeds of 70–75 percent of the free-flow speed during the peak AM commute, and northbound lanes throughout Roosevelt Boulevard experience a similar reduction in average travel speeds.

Much of the congestion along Roosevelt Boulevard can apparently be attributed to specific “hotspots,” or congested intersections. The north-and southbound lanes between Red Lion Road and Grant Avenue are congested at 70–80 percent of the free-flow speed throughout the day. The northbound lanes near Rhawn Street, during the peak PM commute, experienced the only instance in which average travel speeds fell below 50 percent of the free-flow speed, but as Figure 1.28 indicates, Rhawn Street appears to be the single greatest congestion node in both directions. Rhawn Street is also a key bus transfer location.

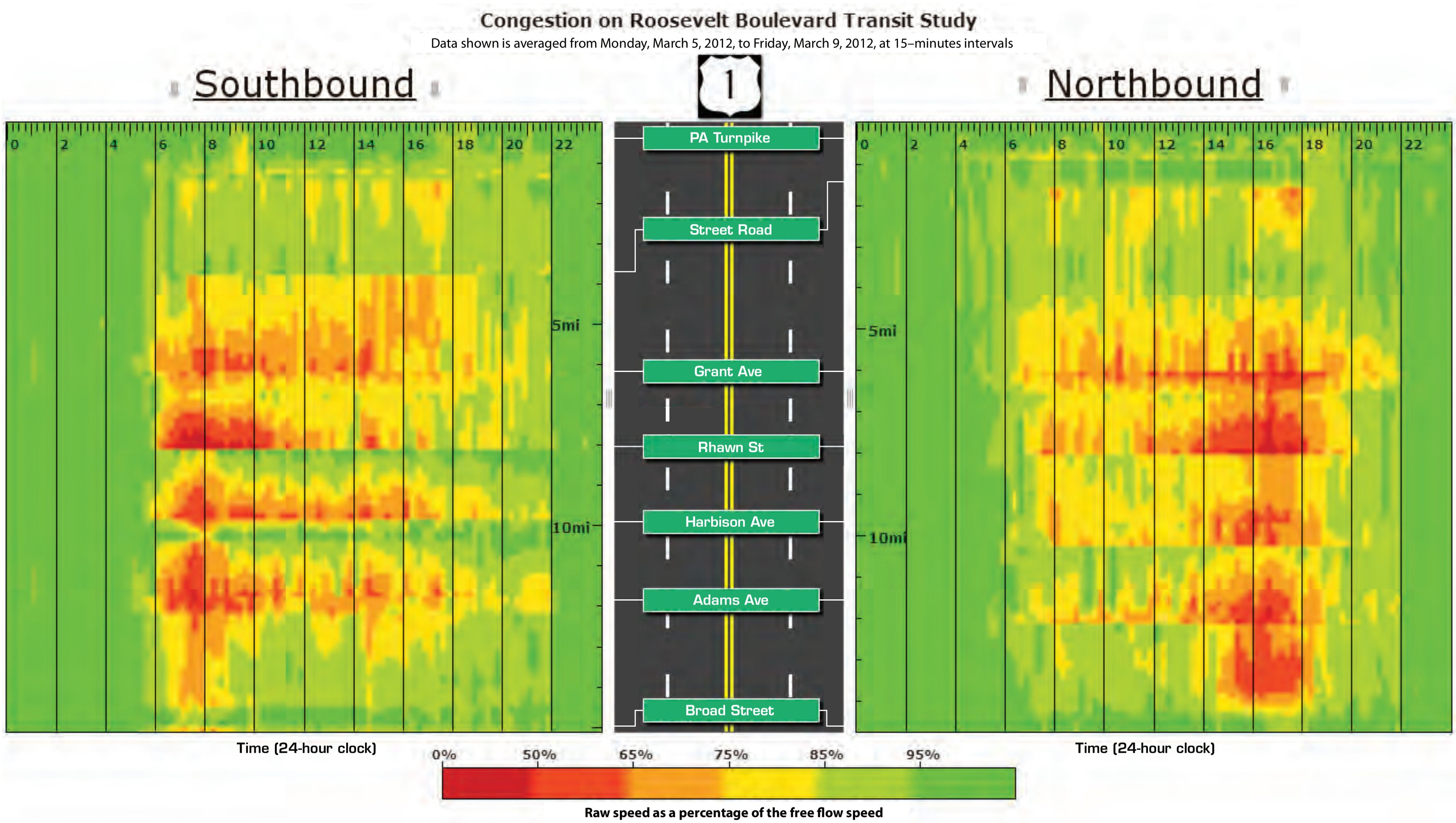
In general, the travel data suggests that traffic conditions along Roosevelt Boulevard are fairly reliable for the large volume of daily traffic between Philadelphia and the suburban districts and townships to the northeast—it is rare for travel speeds in a given segment to fall below 50 percent of free-flow speeds, and end-to-end speeds are even more consistent. However, conditions are less reliable at several bottlenecked intersections—especially Rhawn Street, but also Harbison Street and Adams Avenue—which will be important to consider when developing effective transit station locations.

Figure 1.26: Average Speed on Roosevelt Boulevard by Time



Source: DVRPC, 2013

Figure 1.27: Congestion along Roosevelt Boulevard



Source: Vehicle Probe Project, 2012-2013

ROOSEVELT BOULEVARD CRASH ANALYSIS

This analysis was conducted using reportable crashes, which in Pennsylvania are defined as crashes resulting in an injury or a fatality, or a vehicle being towed from the scene. Data for five-years inclusive (2009–2013) were used, consistent with PennDOT practices. Spatial analysis was done using ArcGIS.

Roosevelt Boulevard is a divided roadway that has both express (US 1) and local lanes (SR 6001); thus, crash data was considered by facility and by direction. Because the study corridor's US 1 express lanes cross county boundaries, summary information for the City of Philadelphia and Bucks County portions was aggregated. The Bucks County portion of the study corridor is 1.75 miles long. The SR 6001 local lanes do not cross county boundaries, lying completely within Philadelphia. The analysis is separated into three parts: US 1—Express Lanes, SR 6001—Local Lanes, and Concentrations by Roadway Segment. Figure 1.28 depicts crash totals and the number of people injured and killed per roadway segment (see Concentrations by Roadway Segment for details).

US 1—Express Lanes

There were 1,795 total crashes from 2009 to 2013 on the 14 miles of the US 1 express lanes for an average crash density of 128 crashes per mile, with the majority in Philadelphia. By direction, there were 994 crashes northbound and 801 southbound (19 percent more crashes northbound). Over the five-year period, crashes climbed slightly but steadily on the corridor. The southbound lanes averaged about 160 crashes per year for most of the analysis period. The northbound lanes showed an average of 199 crashes per year.

Severity

Fatal crashes represented approximately 1 percent of the crashes, with eight southbound and 10 northbound, killing a total of 22 people during the five-year analysis period. Crashes coded as minor severity accounted for the largest share of incidents, with 43 percent of the total southbound and 34 percent northbound. Property-damage-only (PDO) crashes had the next highest share with 23 percent southbound and 25 percent northbound. The balance of crashes was split among the following categories (southbound and northbound data combined): major injury (2 percent), moderate injury (12 percent), unknown severity (21 percent), and unknown if injured (2 percent). In total there were 2,121 people injured on Roosevelt Boulevard's express lanes from 2009 to 2013.

Collision Type

Rear-end crashes were the predominant collision type, both overall and by direction, with 38 percent of the total southbound and almost 41 percent northbound. Angle crashes were the next most common type representing 33 percent of the southbound crashes and 29 percent northbound. Angle crashes reflect the point of impact between two vehicles, often referred to as T-bone crashes. Hit-fixed-object crashes were the next most common type at 13 percent (directions combined). Mapping these crashes may identify trend locations where a physical impediment exists. There were also 69 pedestrian crashes along the combined directions of the study corridor, representing 4 percent of the collision-type distribution.

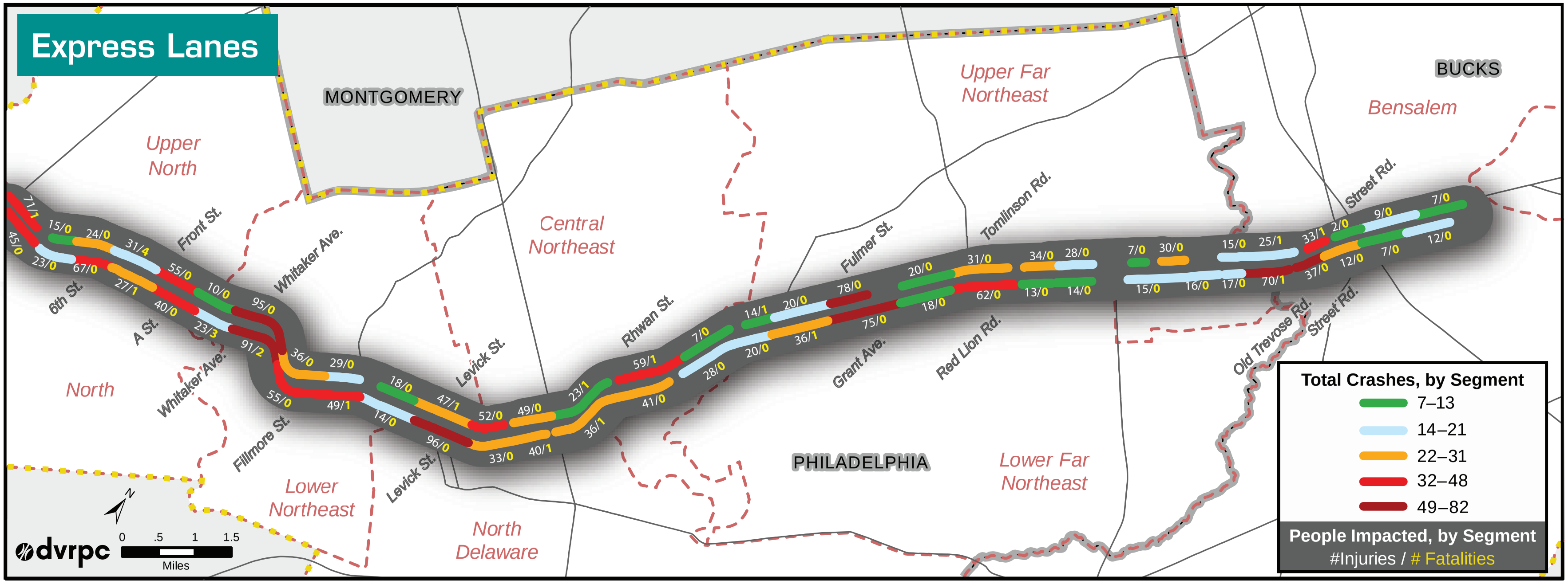
Weather, Road Surface, Illumination

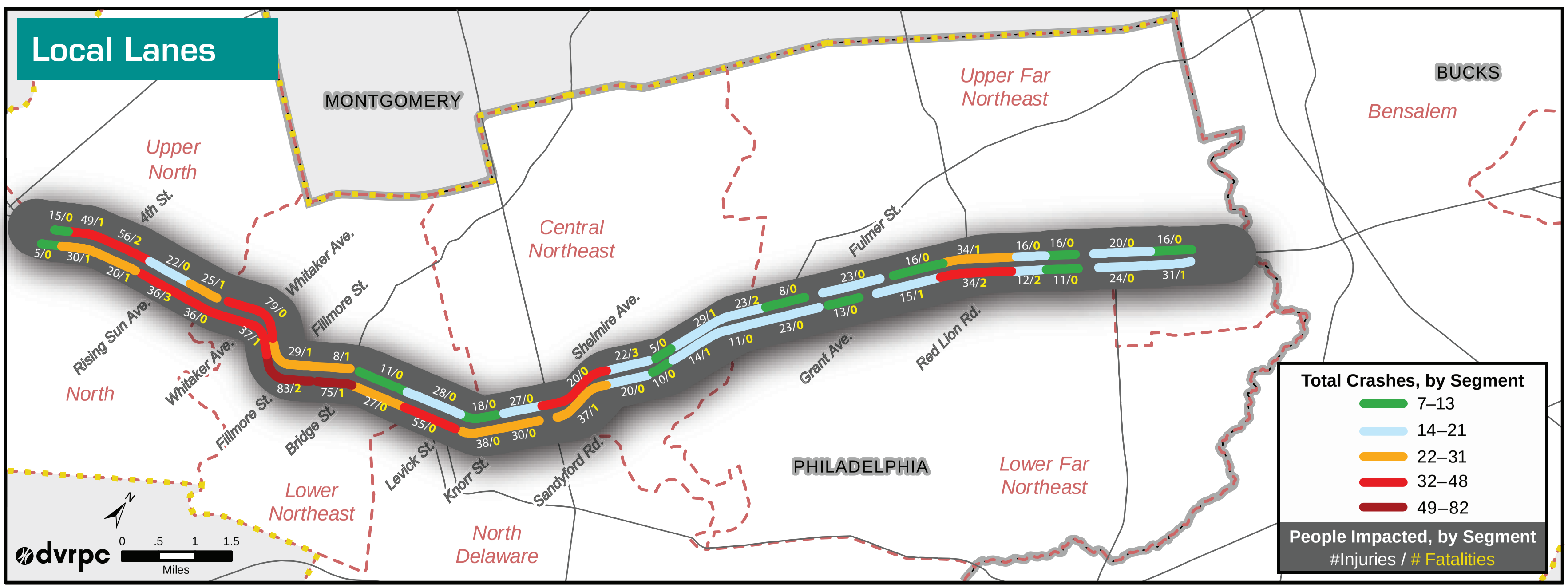
More than 80 percent of the crashes during the analysis period occurred on dry roads and under clear skies. Regarding light condition, approximately 59 percent of all crashes occurred in daylight and approximately 38 percent in darkness.

SR 6001—Local Lanes

Crash characteristics on the 12.2 miles of the SR 6001 local lanes were similar to the express lanes, except there were 37 percent fewer crashes on the local lanes. A total of 1,123 crashes were recorded (directions combined), and the crash density was an average of 92 crashes per mile. By direction, crashes northbound (635) were 30 percent higher than southbound (488). From 2009 to 2011, the number of crashes increased in both directions (18 percent increase in 2010 and 5 percent increase in 2011) but experienced slight decreases since. The northbound crash total peaked at 139 in 2011, and at 111 crashes southbound in 2010, representing 22 percent and 23 percent, respectively, of the five-year per direction totals.

Figure 1.28: Crash Concentrations by Roadway Segment





Severity

Fatal crashes represented approximately 2 percent of the of the crash total, with 12 southbound and 16 northbound, killing a total of 30 people from 2009 to 2013 (13 southbound, 17 northbound). The remaining crash severity categories had a distribution similar to the express lanes (southbound and northbound combined): minor injury (38 percent), moderate injury (13 percent), major injury (3 percent), unknown severity (19 percent), and unknown if injured (2 percent), with data by direction being nearly equal. PDO crashes, were again the second highest category at 23 percent in each direction. Comparing the two facilities, the total number and percentage of fatal crashes as well as the number of people killed, was greater on the local lanes, but the total number of people injured was higher on the express lanes.

Collision Type

Rear-end collisions were again the predominant collision type overall and per direction on the local lanes, accounting for 43 percent southbound and almost 35 percent northbound, followed by angle crashes representing 25 percent southbound and 26 percent northbound. Hit-fixed-object crashes were third most common at 16 percent southbound and 21 percent northbound. Combined, these three collision types account for 82 percent of the crashes experienced on the local lanes. There were 57 pedestrian crashes along the combined directions of the local lanes (5 percent), 1 percent more than on the express lanes.

Weather and Road Surface

Approximately 80 percent of the crashes on the local lanes occurred on dry roads and under clear skies. Regarding light condition, approximately 57 percent of all crashes occurred in daylight and about 40 percent in darkness.

CONCENTRATIONS BY ROADWAY SEGMENT

A crash total by roadway segment report was generated for each direction of each facility and is also depicted in Figure 1.28, “Crash Concentrations by Roadway Segment” (data years 2009–2013). Roadway segments are color coded by crash total, and each is labeled with the corresponding number of injuries and fatalities that occurred in that segment. This map allows for easy identification of high crash-trend segments and fatal crash locations for further investigation. (Note: segment sections that are uncolored had no crashes during the analysis period).

PennDOT’s roadway segments do not have a standard length but typically average a half-mile. The Roosevelt Boulevard study corridor’s segments are between 0.15 and 0.74 miles long. The express lanes are divided into 62 segments (31 per direction) and the local lanes are divided into 50 segments (25 per direction). Based on the map and supporting data, the following text identifies roadway segments to be considered for further study based on per segment crash volume, and number of fatalities.

US 1–Express Lanes

Along the express lanes there were seven road segments (five northbound and two southbound) colored dark red, indicating the highest category of total crashes (49 to 82). There are over three times as many road segments in this category along the express lanes as compared to the local lanes. Road segments are identified by their southern-most cross street, or nearest labeled cross street.

Northbound lanes (listed from south to north):

1) Whitaker Avenue (91 injuries, two fatalities)
2) Levick Street (96 injuries, no fatalities)
3) Grant Avenue (75 injuries, no fatalities)
4) Old Trevose Road (70 injuries, one fatality)
5) Street Road (37 injuries, no fatalities)

Southbound lanes (listed from south to north):

1) Whitaker Avenue (95 injuries, no fatalities)
2) Fulmer Street (78 injuries, no fatalities)

Regarding fatality concentrations, most deaths did not concentrate in a given segment but were spread out along the study corridor. Only three segments along the express lanes had more than one fatality (listed from south to north):

1) C Street (northbound): – blue segment, three fatalities, 23 injuries
2) Whitaker Avenue (northbound): – dark red segment, two fatalities, 91 injuries)
3) N. 5th Street (southbound): – blue segment, four fatalities, 31 injuries

SR 6001–Local Lanes

Along the local lanes, there were only two road segments (both northbound) colored dark red, indicating the highest category of total crashes (49 to 82). Road segments are identified by their southern-most cross street, or nearest labeled cross street. The following are the ***northbound lanes (listed from south to north):***

1) Whitaker Avenue (83 injuries, two fatalities)
2) Bridge Street (75 injuries, one fatality)

Although crash fatalities were found throughout the corridor, there were seven segments along the local lanes that had more than one fatality, over twice as many as in the express lanes (listed from south to north):

1) Rising Sun Avenue (northbound): red segment, three fatalities, 36 injuries
2) Fillmore Street (northbound): dark red segment, two fatalities, 83 injuries
3) Red Lion Road (northbound): red segment, two fatalities, 34 injuries
4) Plaza Drive (northbound): blue segment, two fatalities, 12 injuries
5) N. 4th Street (southbound): red segment, two fatalities, 56 injuries
6) Ryan Avenue (southbound): blue segment, three fatalities, 22 injuries
7) Winchester Avenue (southbound): blue segment, two fatalities, 23 injuries

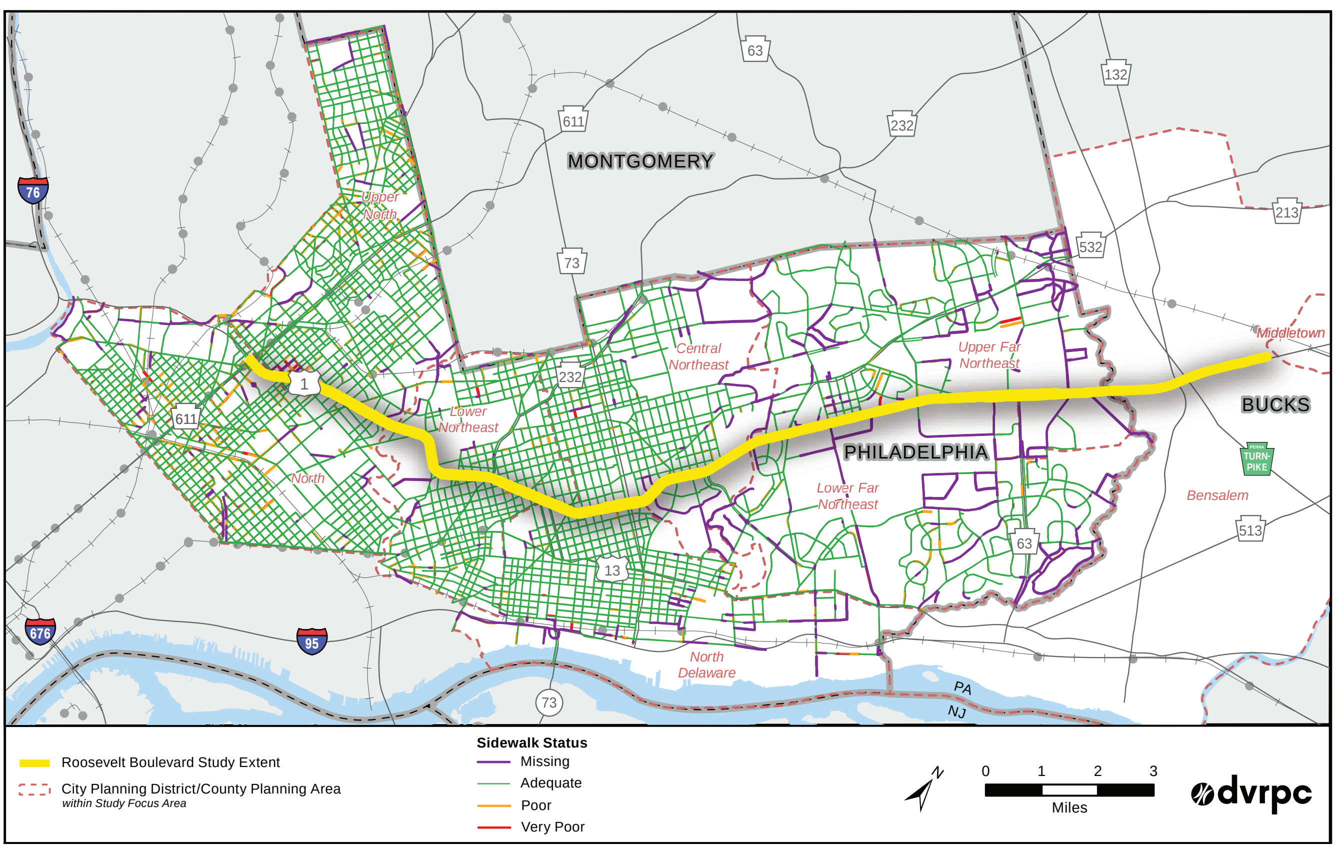
PEDESTRIAN AND BICYCLE NETWORK

PEDESTRIAN NETWORK

DVRPC conducted the *US 1—Roosevelt Boulevard Corridor Study* in 2007 in order to address transportation safety issues along an eight-mile stretch of the corridor within the City of Philadelphia. The analysis and recommendations of the Corridor Study are discussed in more detail in the Previous Studies section of this report.

The pedestrian convenience and safety of a corridor is realized by the network of sidewalks, crosswalks, and trails available for use by foot. The availability of pedestrian amenities, which define the interaction of pedestrian and vehicular traffic along Roosevelt Boulevard, is a critical factor

Figure 1.29: Sidewalk Inventory (Only Available for Philadelphia County)



in siting decisions for rapid transit stops. This section of the Roosevelt Boulevard cuts through a dense residential area that generates high pedestrian traffic. The PCPC developed a sidewalk inventory as part of the *Philadelphia Pedestrian & Bicycle Plan* (2012), shown in Figure 1.29. This inventory, last updated in 2010, shows a generally complete sidewalk network within a quarter-mile buffer of the Philadelphia section of Roosevelt Boulevard. There are several missing or poor-quality sidewalks along side streets in the North and Upper North districts. Upper Far Northeast and Lower Far Northeast, which are less urbanized and have a lower density at the northern limit of the Philadelphia, lack a complete sidewalk network.

Roosevelt Boulevard connects with several trails that are described more in the trails and parks section of this chapter.

BICYCLE NETWORK

The portion of the study area in Philadelphia has 91.4 miles of bicycle lanes and another 29.2 miles of streets characterized as "bicycle-friendly" by the Philadelphia Streets Department. A bicycle-friendly street has been designed or modified with traffic-calming treatments that discourage high-speed traffic. Several major cross streets have bicycle lanes on either side of Roosevelt Boulevard, potentially enabling safe bicycle access to proposed rapid transit stop locations. There are no accommodations for cyclists on Roosevelt Boulevard itself; however, within the study area there are 101 miles of conventional bike lanes and three miles of shared lanes (sharrows). Sharrow markings are a visual reminder to all road users that bicyclists share the road, and may offer a preferred location or line for cyclists.

TRAVEL PATTERNS

ORIGINS AND DESTINATIONS OF VEHICLES

Origin-destination data was collected using Bluetooth technology (collected in June and July 2013) to develop a better understanding of the travel patterns of autos and trucks in the study area. This technology is able to track the movement of vehicles as they travel along Roosevelt Boulevard. It was used to answer the following two questions:

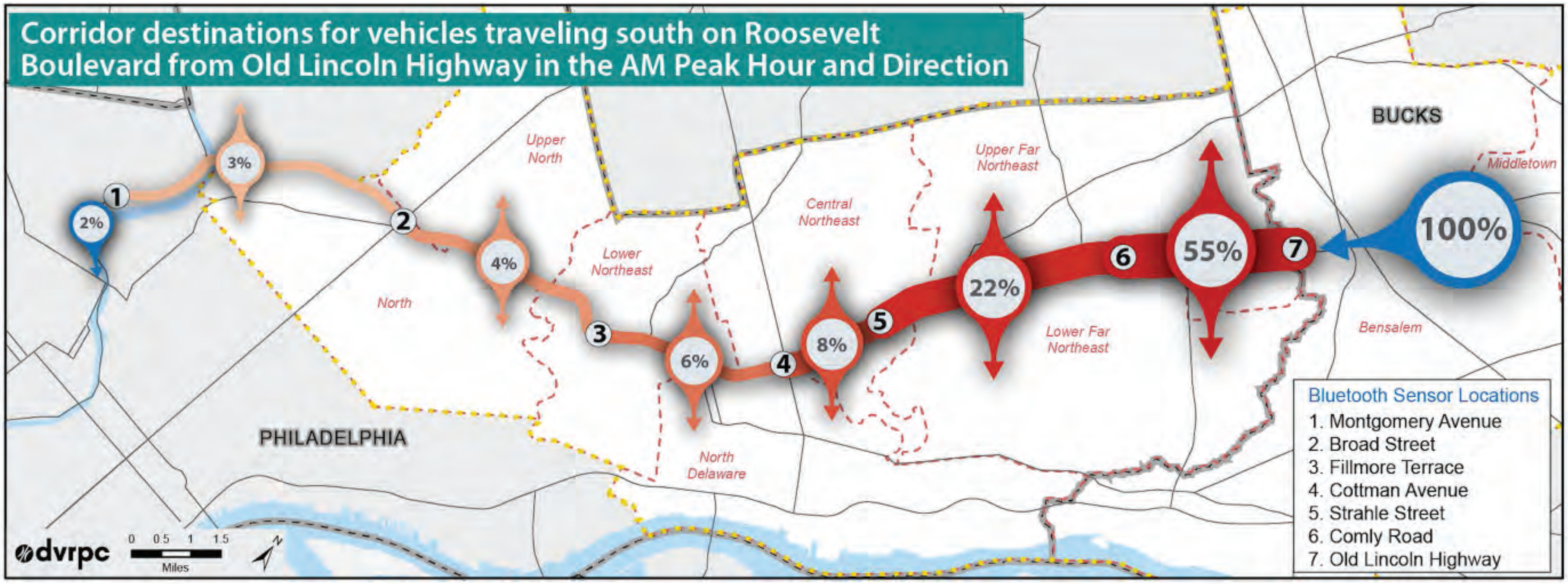
1) ***SOUTHBOUND TRAFFIC:*** For vehicles that start out at the northern end of the corridor, that pass over the Pennsylvania Turnpike (I-276) and are traveling south on Roosevelt Boulevard, where do southbound vehicles exit the Roosevelt Boulevard?

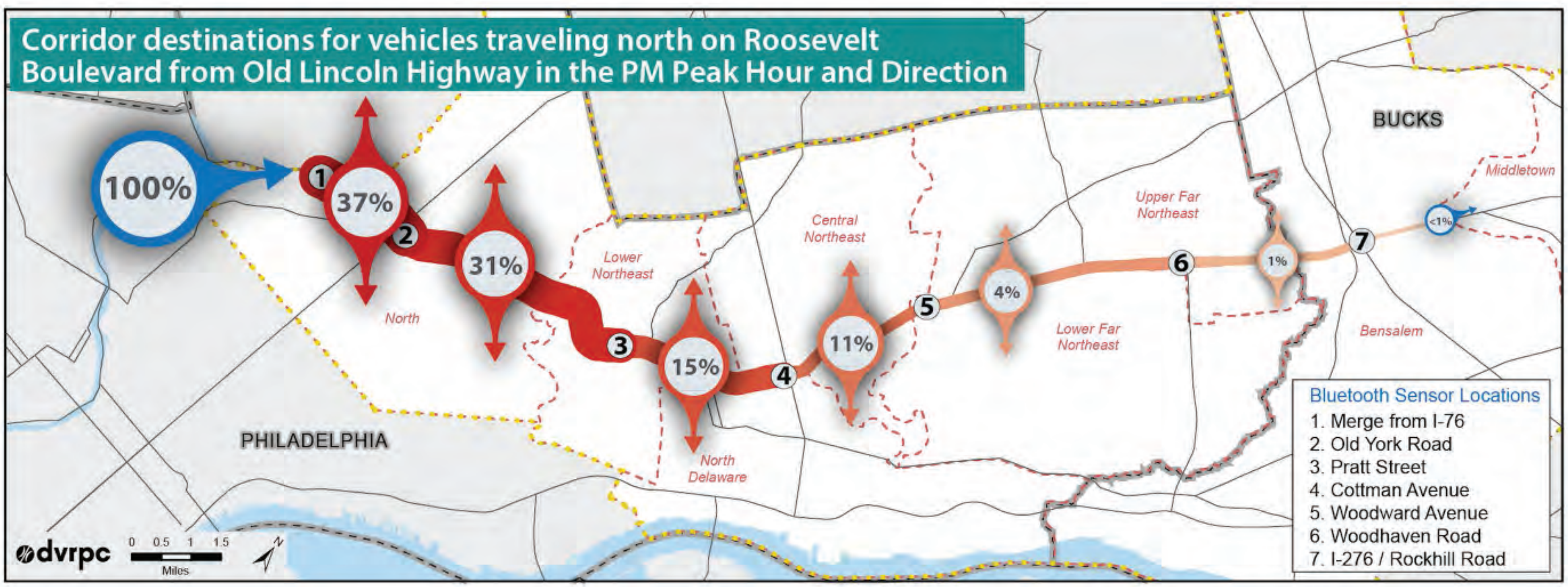
2) ***NORTHBOUND TRAFFIC:*** For vehicles that start out at the southern end of the corridor, that come off of the I-76 exit ramps and cross over the Schuylkill River and are traveling north on Roosevelt Boulevard, where do northbound vehicles exit the Roosevelt Boulevard?

As shown in Figure 1.30, most of the southbound traffic exits Roosevelt Boulevard in the northern section of the study area, between Old Lincoln Highway and Comly Road. During the AM Peak period between 6:00 and 10:00 AM, approximately 55 percent of southbound traffic exits in this section. This part of the corridor includes the ramps to Woodhaven Road, for traffic that is connecting to I-95, and downtown Philadelphia; this could be a faster way to get to work downtown than driving south on the Roosevelt Boulevard. However, if congestion on I-95 were to worsen, for example due to construction, then some portion of this traffic will likely remain on Roosevelt Boulevard. Only 5 percent of the southbound traffic in the AM Peak period travels all the way from the Pennsylvania Turnpike to Broad Street, and only 2 percent continues all the way to I-76.

Figure 1.30 also shows the flow of traffic in the reverse, northbound direction during the PM Peak period, between 3:00 and 7:00 PM. Close to 70 percent of northbound traffic originating at Roosevelt Boulevard's entry from I-76 exits prior to Pratt Street, in the first 6 miles of the 16-mile-long corridor, 37 percent exit at or before Broad Street, and another 31 percent exit between Broad and Pratt. Less than 1 percent continues north on Roosevelt Boulevard beyond the Pennsylvania Turnpike.

Figure 1.30: Bluetooth Data Summary for Trips from Corridor Ends





ORIGINS AND DESTINATIONS OF PUBLIC TRANSIT PASSENGERS

Similar to the use of Bluetooth data to better understand the movement of vehicles through the study corridor, DVRPC also used the *Philadelphia Regional On-Board Transit Survey*, a recent on-board survey of transit passengers in the Philadelphia area (DVRPC publication number 14040) to better understand transit travel patterns.

The survey was conducted during 2010 and 2011 and asked passengers for information on the trip that they were making on the day of the survey, as well as information about their household. In particular, trip information included the origin of their trip, the stop/station where they boarded transit, the purpose of their trip, their ultimate destination, if they had to transfer to another bus or train to reach their destination, and the final transit stop where they alighted the bus or train near their destination. The household information included the number of people in the passenger's household, the income range of the household, and the number of vehicles that the household owned. Three of the main transit routes that travel along Roosevelt Boulevard in the study area are SEPTA Bus Routes 1, 14, and R. **Among the survey results for the passengers of these three routes:**

- Twenty-nine percent of SEPTA Route 1 passengers, 57 percent of Route 14 passengers, and 54 percent of Route R passengers take transit because they have no other way to travel. This is compared to 40 percent for all passengers surveyed across all routes. Based on this, most Route 1 passengers probably could be driving or carpooling but take the bus because it is the best transportation alternative for them. But most passengers of Routes 14 and R have no other transportation options.
- Thirty-four percent of SEPTA Route 1 passengers, 44 percent of Route 14 passengers, and 71 percent of Route R passengers report zero vehicles in their household. This is compared to 39 percent of all passengers surveyed across all routes. Again, most Route 1 passengers have other options (a vehicle they could use). At the other extreme, very few Route R passengers have a car at home. Route 14 passengers fall somewhere in between: 32 percent report having one vehicle at home, and 21 percent report having two vehicles. But, when combined with the response to the above question, it appears as if someone else in their home may have priority access to the car.
- In terms of access mode, approximately 75 percent of SEPTA Route 1, 97 percent of Route 14, and 94 percent of Route R passengers walk to the bus, compared to 82 percent for all passengers (all modes) on all routes.
- Approximately 47 percent of Route 1 passengers, 63 percent of Route 14, and 81 percent of Route R passengers have to transfer to another bus or train to reach their final destination. This is compared to only 61 percent of all passengers.

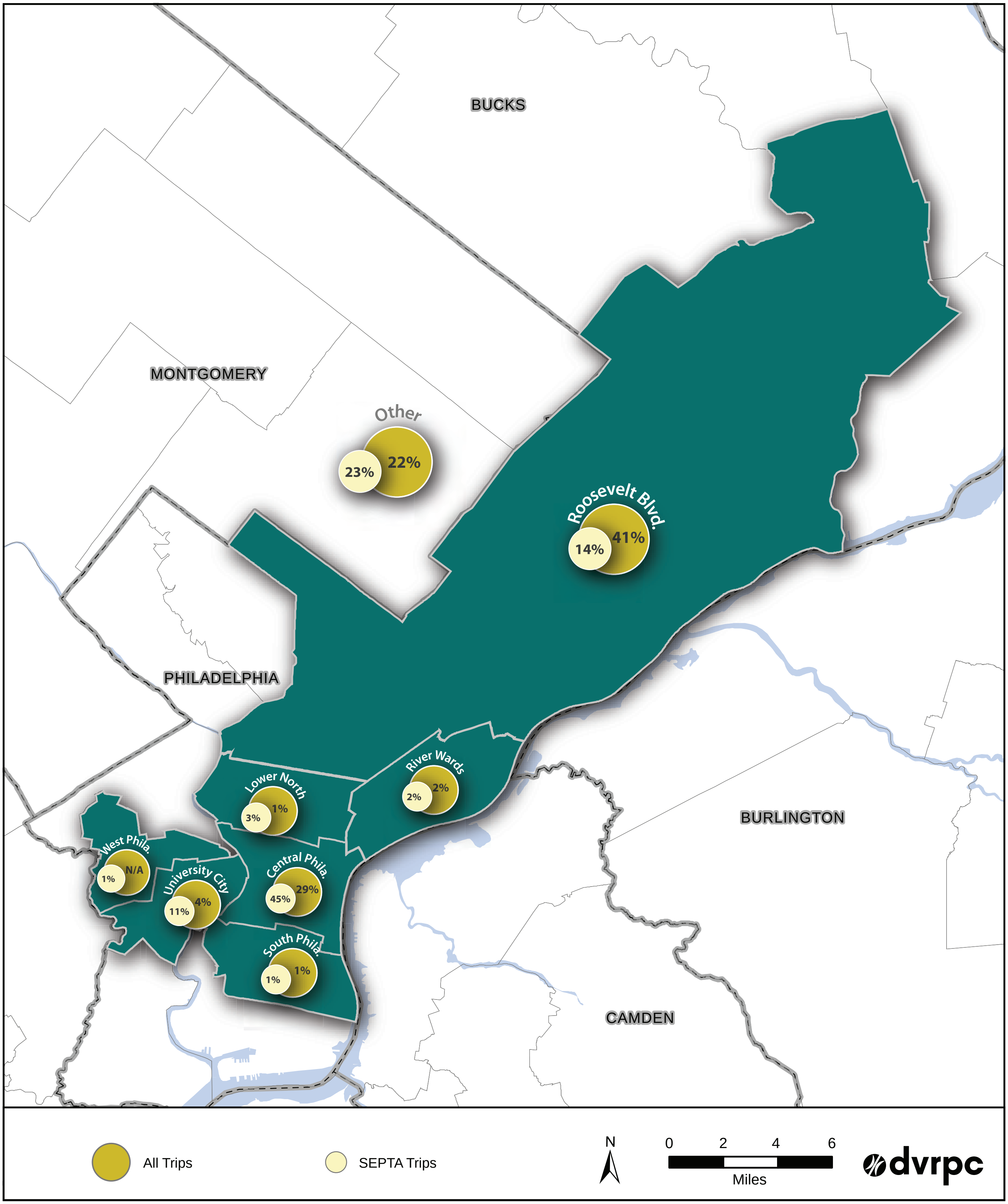
The overall picture that emerges is that Route R passengers are the least well off, have the least options, and are the most dependent on transit for transportation. Route 14 passengers are doing a little better, in terms of the number of transfers they have to make to reach their final destinations. Route 1 passengers are at the other extreme—they have other transportation options available to them, do not rely on transit as their only means to get around, and do not have to transfer as much.

JOURNEY TO WORK

DVRPC staff used U.S. Census On-the-Map data to get a better understanding of where study area residents are working. While the section above summarizes trip patterns for residents of the study area who take transit to work, the On-the-Map data presented in this section is a little bit different, in that it shows where residents go to work, irrespective of their mode of travel. All-mode trip patterns are compared with SEPTA rider trip patterns in Figures 1.31-1.33.

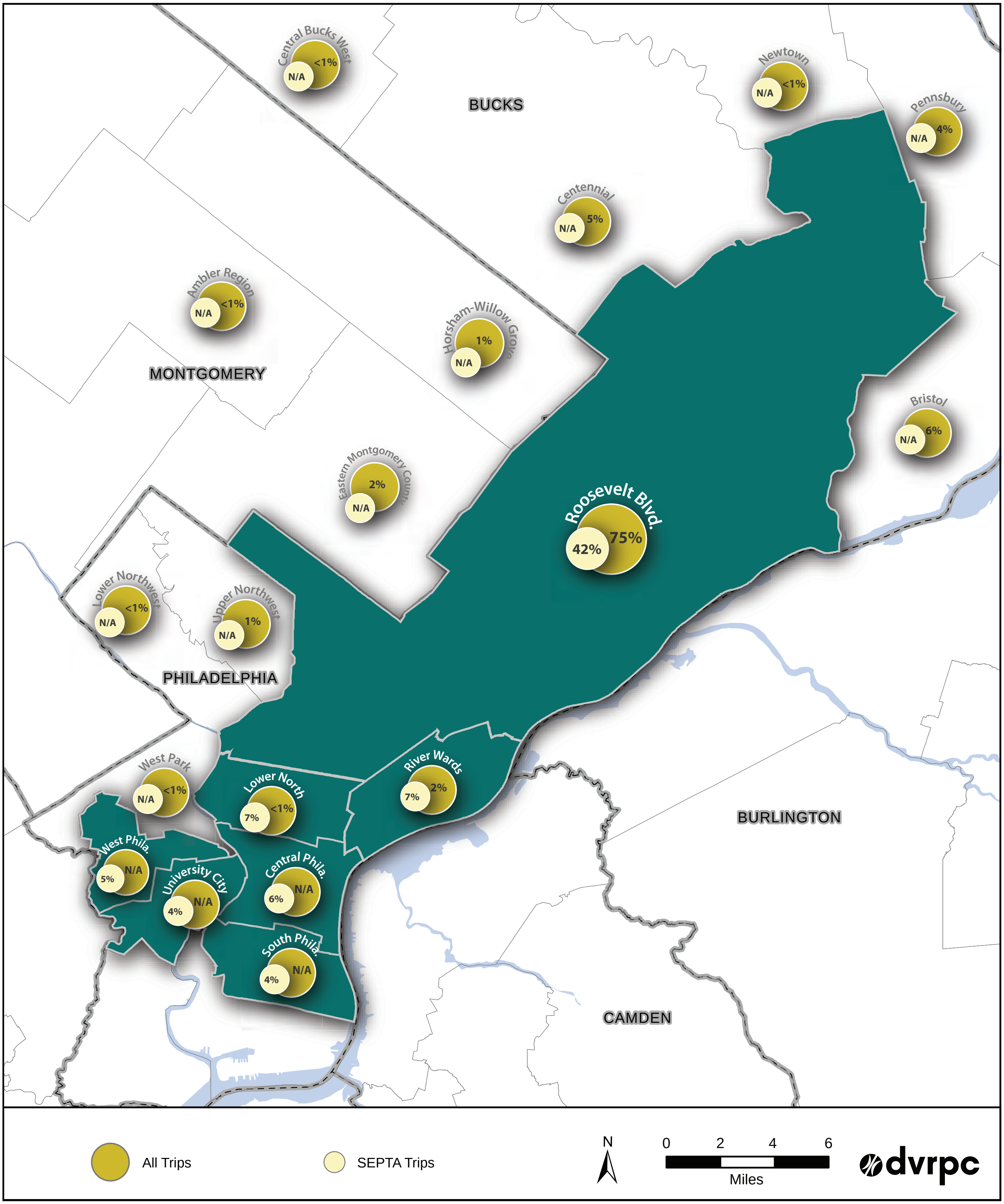
Figure 1.31 shows where respondents to the SEPTA survey, who live in the study area and take transit to work, are working. The survey shows three main work destinations. Approximately 45 percent work in Center City Philadelphia, 14 percent of respondents both live and work in the study area, and close to 11 percent work in the University City section, west of the Schuylkill River.

Figure 1.31: Where People Who Live in the Study Area Work



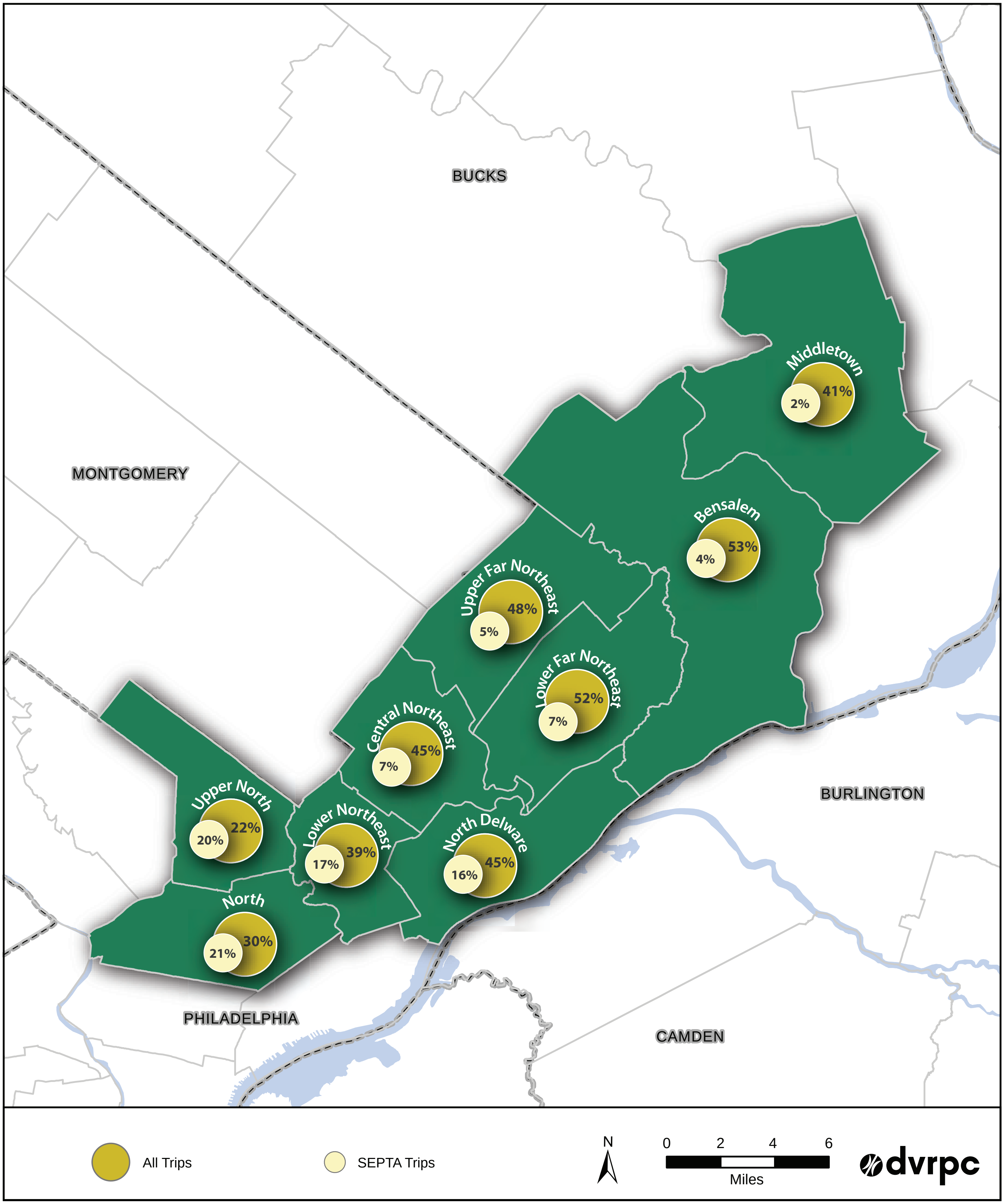
Sources: SEPTA Passenger Survey, 2010; and U.S. Cenus On-The-Map, 2013

Figure 1.32: Where People Who Work in the Study Area Come From



Sources: SEPTA Passenger Survey, 2010; and U.S. Cenus On-The-Map, 2013

Figure 1.33: Work Trip Origins for Intra-Study Area Journey-To-Work trips



Sources: SEPTA Passenger Survey, 2010; and U.S. Cenus On-The-Map, 2013

As shown in Table 1.6, for the study area as a whole, approximately 59 percent of residents work outside of the study area, and 41 percent work inside the study area (e.g., 41 percent both live and work in the study area). Of those who work outside the study area, the single largest destination is Center City Philadelphia (29 percent). However, the percentage working in downtown Philadelphia varies considerably depending on where within the study area people are coming from. Not surprisingly, those living in the southern part of the study area, in areas such as the North, Upper North, and Lower Northeast districts, are much more likely to work in downtown Philadelphia than people living farther away, at the northern end of the study area.

Table 1.7 shows where people who work in the study area live. Seventy-five percent of the jobs in the study area are held by study area residents, and 25 percent are held by people who commute from outside the area. This percentage varies quite a bit depending on the neighborhood. For example, only 5 percent of the jobs in Lower Northeast are held by people coming from outside, whereas 54 percent of the jobs in Middletown are.

Table 1.6: Work Locations for Residents of the Roosevelt Boulevard Study Area

LIVE IN	WORK IN CENTER CITY	WORK OUTSIDE STUDY AREA, BUT NOT CENTER CITY	WORK IN STUDY AREA	TOTAL (PEOPLE)
North	7,153 (37%)	6,451 (33%)	5,767 (30%)	19,371
Upper North	11,851 (41%)	10,590 (37%)	6,167 (22%)	28,608
Lower Northeast	6,726 (36%)	4,512 (24%)	7,237 (39%)	18,475
North Delaware	7,739 (36%)	4,186 (19%)	9,653 (45%)	21,578
Central Northeast	5,853 (34%)	3,695 (21%)	7,897 (45%)	17,445
Lower Far Northeast	5,633 (30%)	3,475 (18%)	9,941 (52%)	19,049
Upper Far Northeast	5,086 (30%)	3,782 (22%)	8,261 (48%)	17,129
Bensalem	1,386 (7%)	8,431 (40%)	11,207 (53%)	21,024
Middletown	595 (4%)	8,111 (55%)	6,077 (41%)	14,783
TOTAL STUDY AREA	**52,022 (29%)**	**53,233 (30%)**	**72,207 (41%)***	**177,462**

* Minor data variances result from On-The-Map tabulation inconsistencies.
Source: U.S. Census On-the-Map, 2013

Table 1.7: Home Locations of People Who Work in the Roosevelt Boulevard Study Area

WORK IN	LIVE OUTSIDE STUDY AREA	LIVE IN STUDY AREA	TOTAL (JOBS)
North	1,681 (17%)	8,082 (83%)	9,763
Upper North	1,882 (27%)	5,019 (73%)	6,901
Lower Northeast	427 (5%)	7,466 (95%)	7,893
North Delaware	857 (11%)	7,274 (89%)	8,131
Central Northeast	973 (12%)	6,926 (88%)	7,899
Lower Far Northeast	872 (8%)	10,649 (92%)	11,521
Upper Far Northeast	1,325 (15%)	7,525 (85%)	8,850
Bensalem	7,523 (37%)	13,063 (63%)	20,586
Middletown	8,193 (54%)	6,881 (46%)	15,074
TOTAL STUDY AREA	**23,733 (25%)**	**72,885 (75%)***	**96,618**

* Minor data variances result from On-The-Map tabulation inconsistencies.
Source: U.S. Census On-the-Map, 2013

Comparing the work and home locations for residents of the Roosevelt Boulevard study area points out how the study area contains only a small portion of the region's total number of jobs; hence, the difference between the 41 percent of residents who live in the study area and also work in the study area, versus the 75 percent of jobs in the study area that are also held by residents. There are many more residents living in the study area than there are jobs in the study area.

One use of this information is to evaluate the demand for a northerly park-and-ride lot at Neshaminy Mall. In terms of the percentages, only 4 and 7 percent of the people living in Middletown and Bensalem, respectively, work in downtown Philadelphia. However, in terms of actual numbers, there are almost 2,000 people making this commute every day. This number is even greater when one considers the residents who work in Lower North Philadelphia (at Temple University) or in University City (at the University of Pennsylvania or Drexel University).

I-95 CORRIDOR IMPROVEMENTS AND THEIR POTENTIAL IMPACTS ON ROOSEVELT BOULEVARD

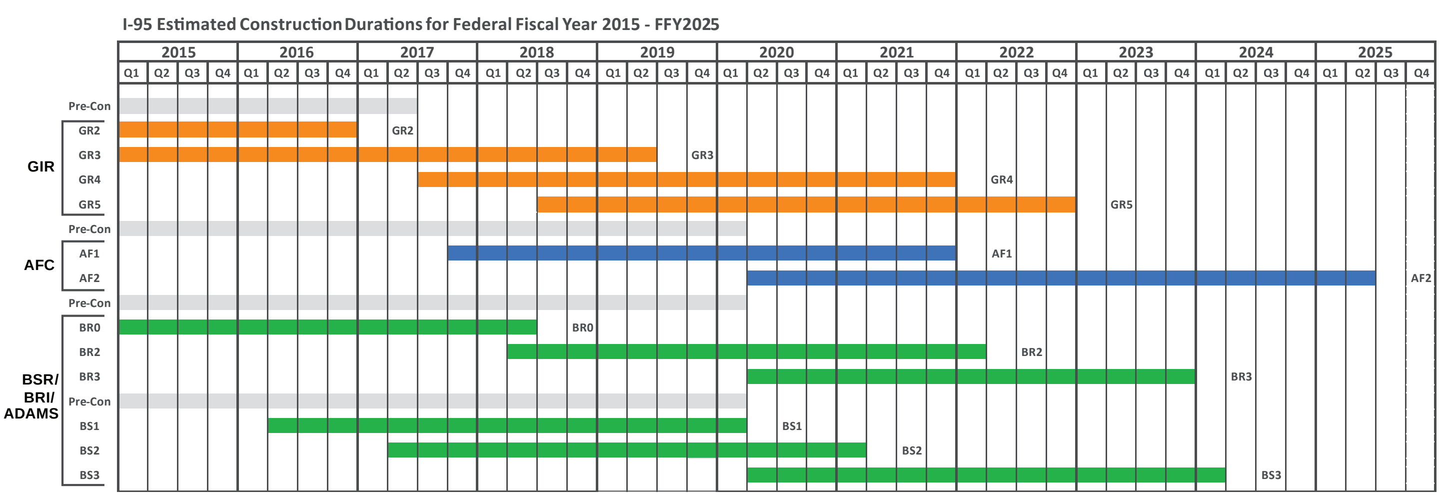
Construction on Interstate 95 (I-95) through the City of Philadelphia began in the 1960s and continued into the mid-1980s. The elevated sections between the Girard Avenue and Bridge Street interchanges were some of the first sections to be completed, opening to traffic between 1968 and 1970. These sections are nearing the end of their useful life and are in need of reconstruction.

PennDOT is currently working on a long-term, multiphase program to rebuild and improve I-95 throughout Pennsylvania (a portion is shown in Figure 1.34). In addition to rebuilding

Figure 1.34: I-95 Construction Phasing

Sources: PennDOT; and KSK, 2015

Figure 1.35: I-95 Construction Phasing Schedule



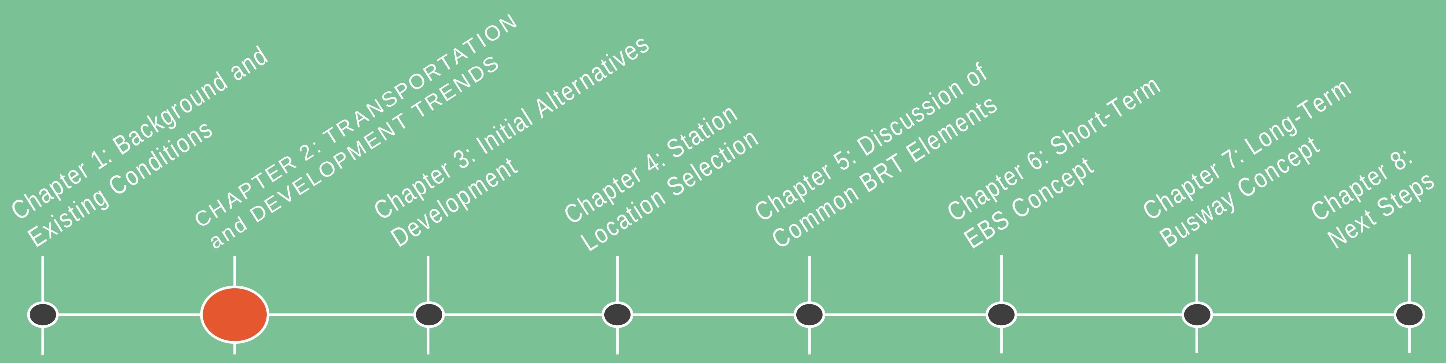
Sources: PennDOT; and KSK, 2015

the interstate and its bridges, the I-95 projects will improve the interchanges, build new ramps, and improve traffic flow. In the Philadelphia urban area, the sections of I-95 between Girard Avenue and Bridge Street (roughly segments GR2 through BS3) are critical components of PennDOT's reconstruction plan, a portion of which is also detailed in Figures 1.34 and 1.35.

Figure 1.34 summarizes project segmentation in and around this area, and illustrates the complexity of this project and its phasing. The table rows in Figure 1.35 correspond with the individual project components in the map and summarize currently anticipated project timetables. DVRPC is closely coordinating with PennDOT to provide planning assistance and help implement congestion mitigation strategies during the I-95 reconstruction projects. This includes evaluating strategies on critical parallel facilities, including Roosevelt Boulevard.

During construction on I-95 drivers may deviate to Roosevelt Boulevard, which may cause more significant delays and congestion.

Chapter 2:
TRANSPORTATION AND DEVELOPMENT TRENDS



This chapter focuses on bus routes along the corridor, locating significant concentrations of ridership, land uses which may contribute to this concentration, and pending development that might further increase ridership in the future. This further existing conditions research was completed to satisfy additional questions that were asked by the steering committee.

A few of the major takeaways from the analysis are:

- SEPTA Bus Routes 1, 14, 20, and R have the highest percentage of their route-level ridership within the study area.
- High-ridership stops are primarily located in the southwest and central sections of the study corridor.
- Hospitals, commercial strips, malls, and bus transfer locations are the key trip generators at high-ridership stop locations.
- Pending development (proposed and under construction) is concentrated in the northeast section of the study corridor.

EXISTING BUS RIDERSHIP

Multiple bus routes serve various portions of Roosevelt Boulevard along the study corridor, and Figure 2.1 illustrates the complete existing bus route network. The most concentrated areas of bus activity are between C and Langdon streets and between Bustleton Avenue and Rhawn Street, where there are four bus routes that converge. However, not all bus routes provide service to every stop. Service is lighter on Roosevelt Boulevard between Pratt Street and Bustleton Avenue because most routes are diverted to FTC.

Figure 2.1: Bus Routes in Proximity and Along Roosevelt Boulevard Study Area

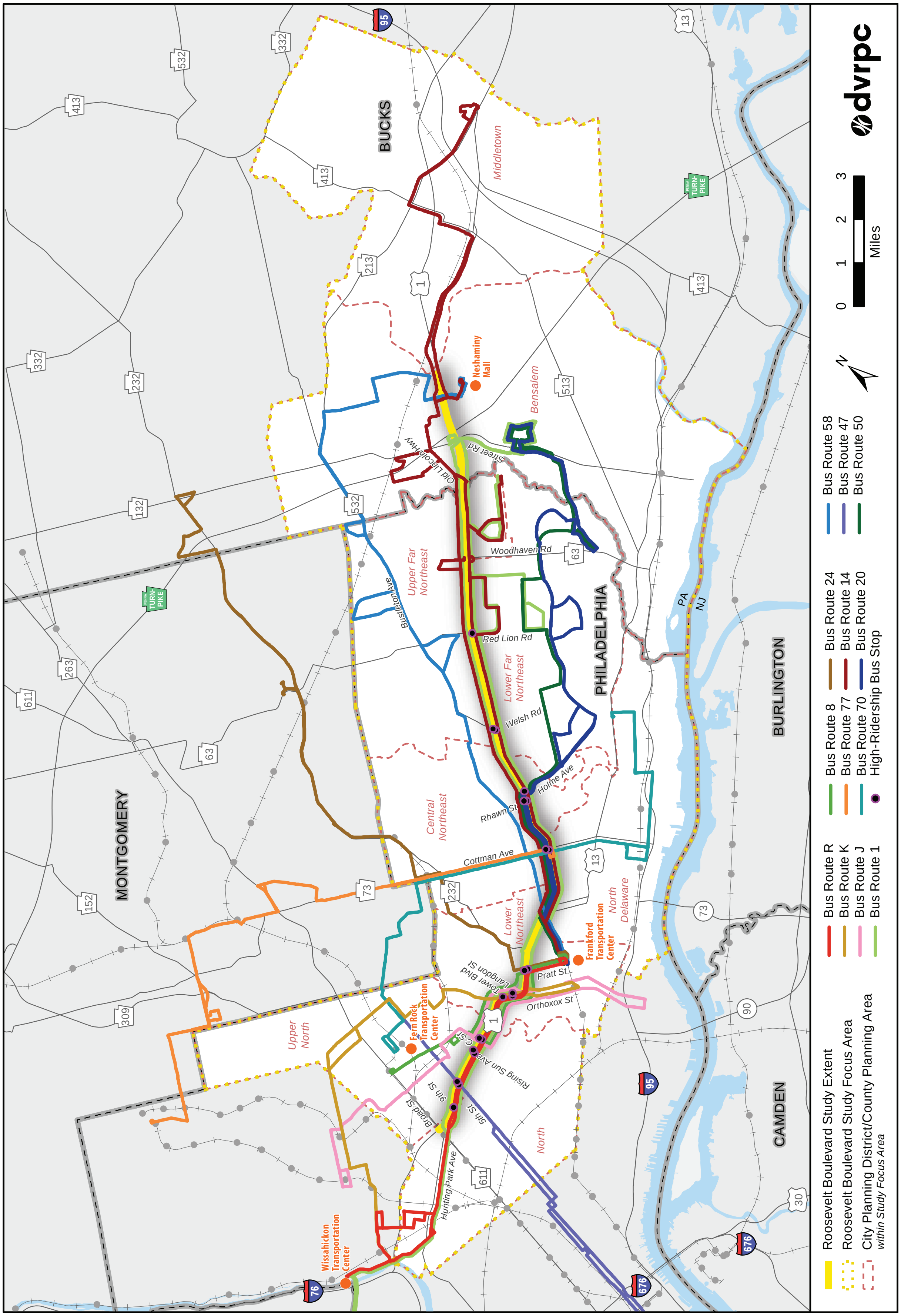
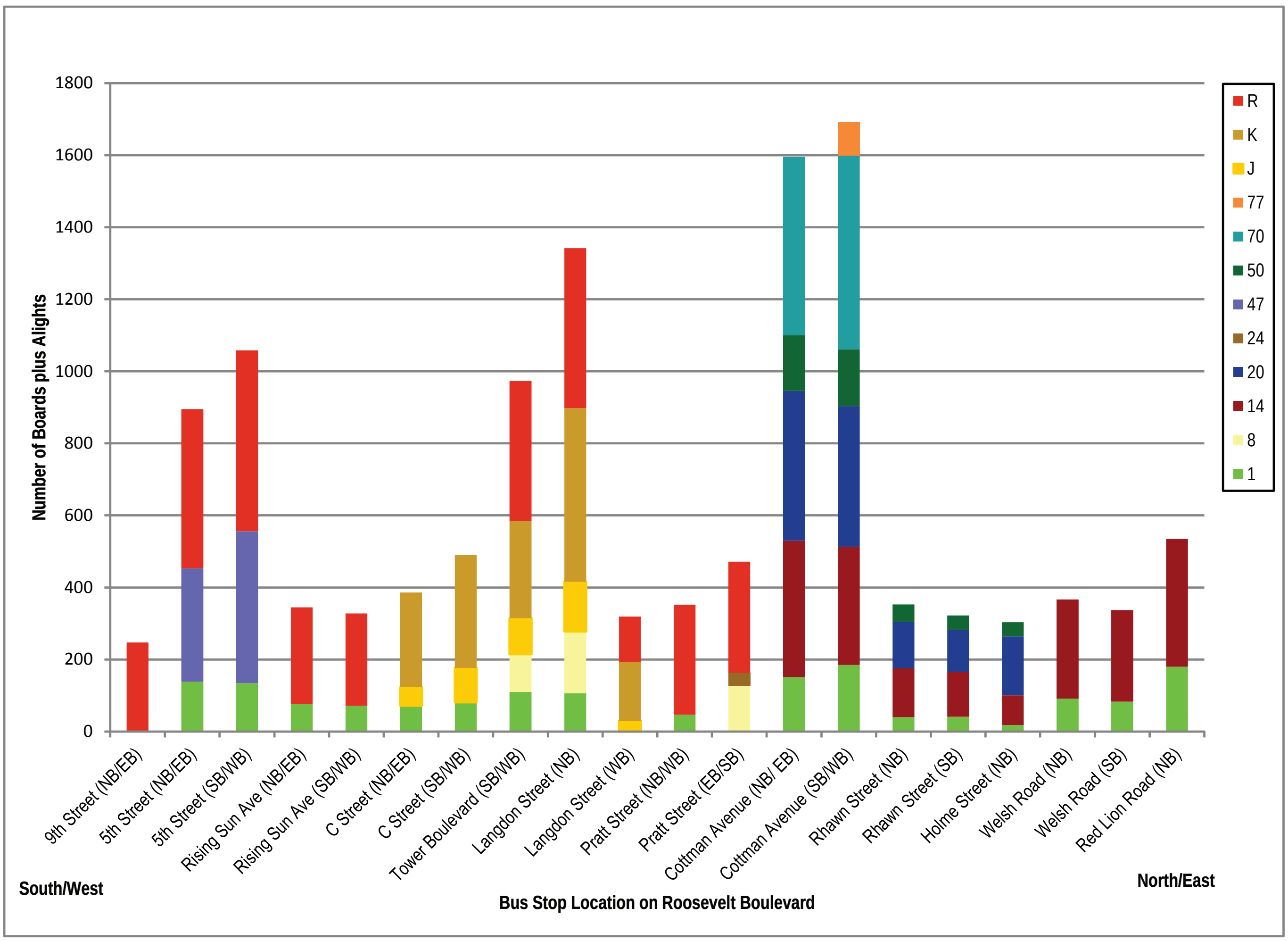


Figure 2.2 identifies the 20 bus stops with the highest ridership in the study area. These were calculated using SEPTA Spring 2012 Automated Passenger Counter and Ridecheck data. The stops are shown from southwest to northeast by location, and the number of passengers that are boarding and alighting by stop and by route. Figure 2.2 shows that SEPTA Route 1 has consistent ridership throughout the corridor, with a presence in 17 of the top 20 stops, and hovers between 100 and 200 passengers at each of these locations. In comparison, Route R has a higher number of daily passengers (between 250 and 500) at a fewer number of stops (nine), or less evenly distributed ridership throughout the corridor. The three locations with the highest passenger volumes are Cottman Avenue (both directions), Langdon Street (northbound) and Tower Boulevard (southbound/westbound), which both serve the Northeast Tower Center, and 5th Street (both directions).

Figure 2.2: Top 20 Bus Stops by Passenger Volume within Study Corridor



Source: SEPTA, 2012

Table 2.1 summarizes study area bus routes' ridership and changes in ridership over the past 10 years. SEPTA Route 1 has the most significant increase (59 percent) in weekday boards. Route 14 has the highest overall boards, and the third highest increase in weekday boards between 2003 and 2013. Both of these routes run over 12 miles along Roosevelt Boulevard, suggesting a strengthening in ridership along the Roosevelt Boulevard corridor itself.

DEVELOPMENT TRENDS

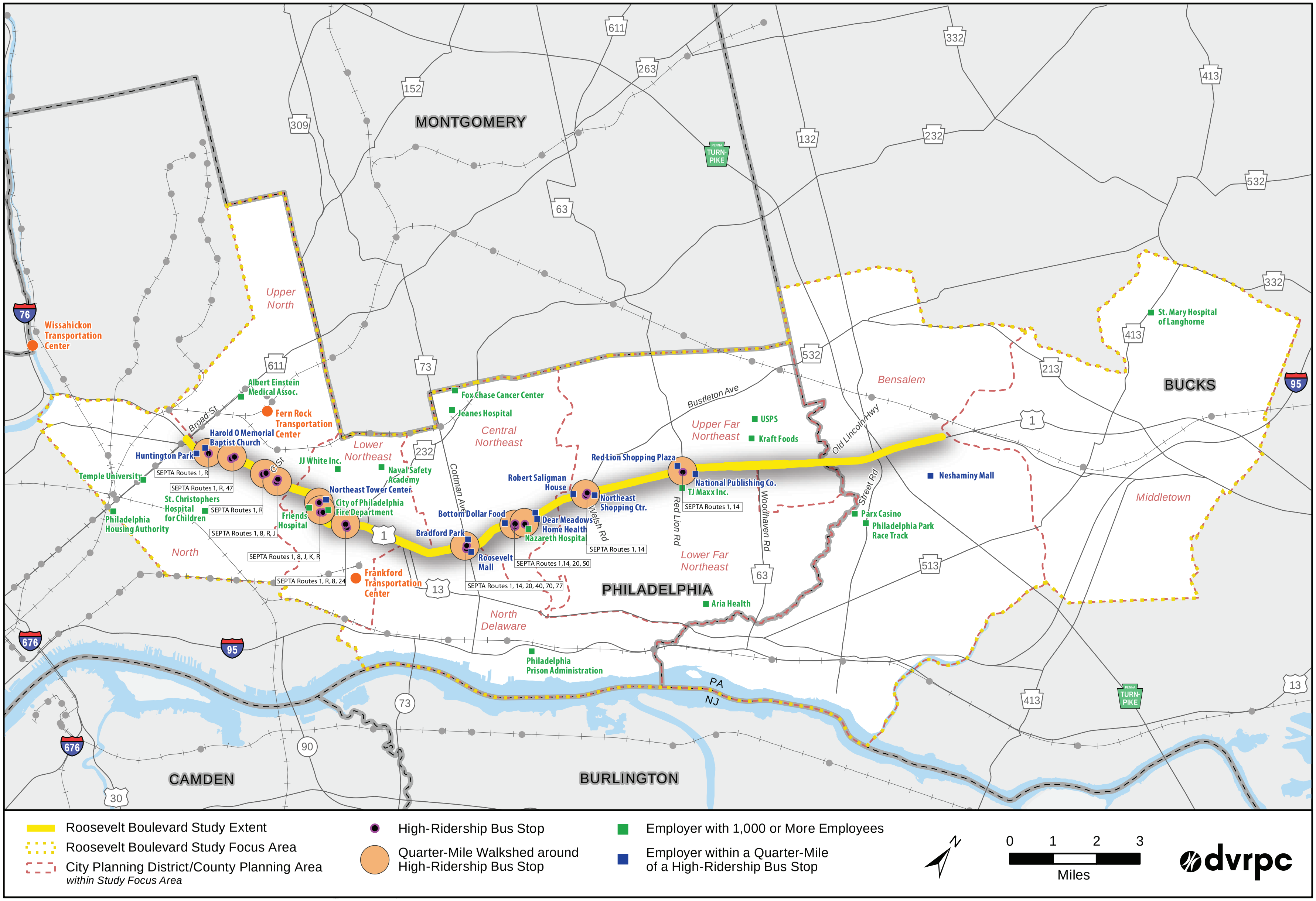
Points of interest or key destinations will generate higher passenger activity at nearby transit stops. Figure 2.3 highlights the top 20 passenger volume stops in the study area, points of interest identified by the DVRPC study team, and employers of 1,000 persons or more. The map shows that each high-ridership stop is a center of activity for a number of reasons. At Cottman Avenue, passengers can transfer between six bus routes and can get to the destinations of Roosevelt Mall and Bradford Park; while at Langdon Avenue and Tower Boulevard, there is a combination of a large employer (City of Philadelphia Fire Department), a commercial retail center (Northeast Tower Shopping Center), a large hospital (Friends Hospital), and the capability to transfer between four bus routes. Finally at 5th Street, there is the capability for passengers to transfer between Bus Routes 1, 47, and R. This is the only location where the Bus Route 47 intersects with Roosevelt Boulevard, and at these two bus stops approximately half of the passenger volumes are boarding and alighting Route 47.

Table 2.1: Percentage Change of Passenger Volume from 2003 to 2013

	2003 Ridership	2006 Ridership		2010 Ridership		2013 Ridership		Percent Change between 2003 & 2013
Route	Weekday Boards	Weekday Boards	% Change from 2003	Weekday Boards	% Change from 2006	Weekday Boards	% Change from 2010	
1	2,430	3,070	26%	3,270	7%	3,866	18%	59%
8	2,015	1,993	–1%	2,158	8%	3,080	43%	53%
14	9,800	11,553	18%	11,399	–1%	11,943	5%	22%
20	7,500	8,716	16%	6,986	–20%	7,512	8%	0%
50	N/A	N/A	N/A	2,205	N/A	1,989	–10%	N/A
58	8,690	9,066	4%	9,703	7%	9,785	1%	13%
J	2,998	3,307	10%	3,776	14%	2,865	–24%	–4%
K	9,100	9,828	8%	8,591	–13%	7,387	–14%	–19%
R	7,163	8,384	17%	8,347	–1.44%	8,112	–3%	11%

Source: SEPTA Annual Service Plan FYs 2003, 2006, 2010, and 2013

Figure 2.3: High-Ridership Bus Stops and Employment Centers



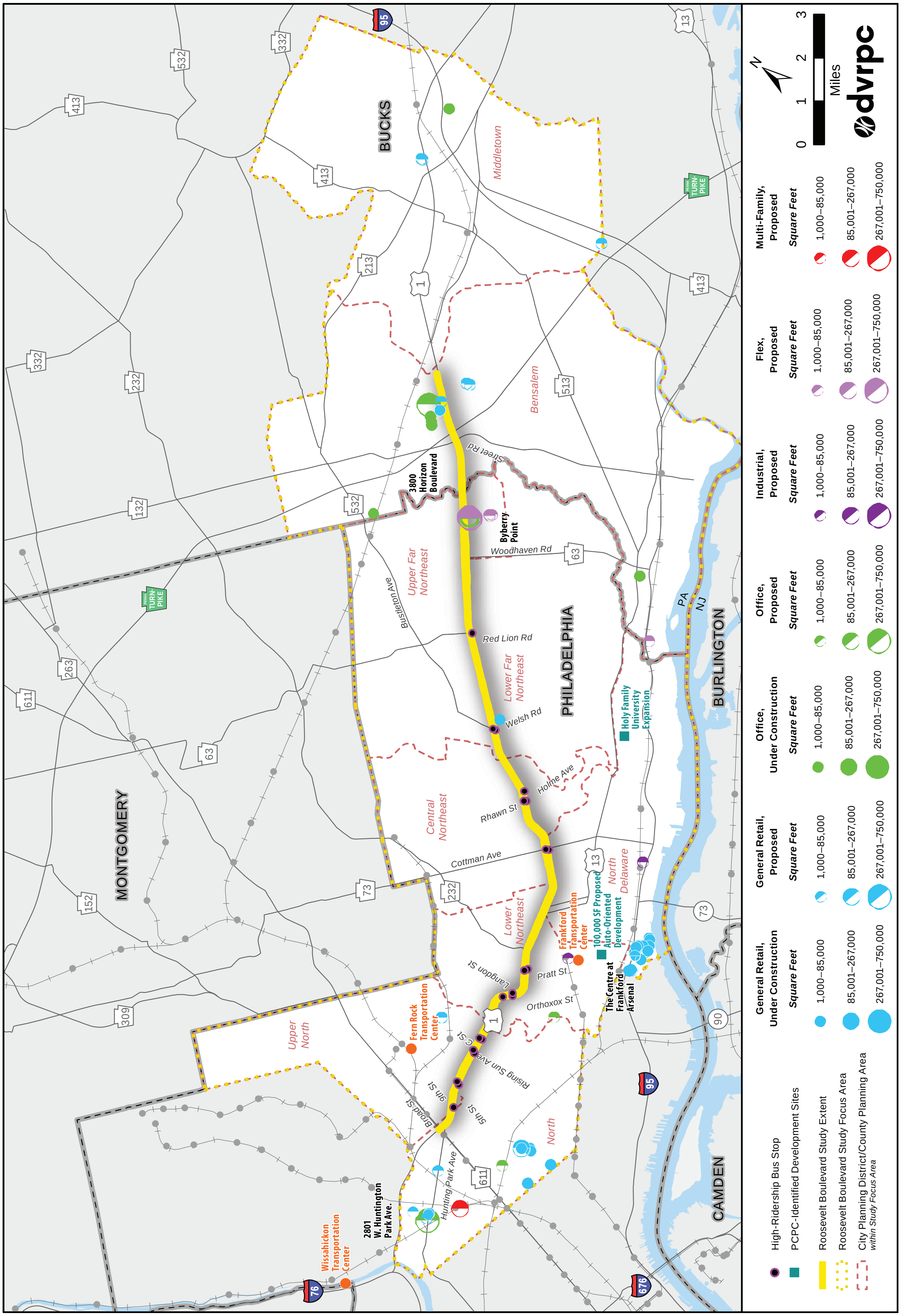


Figure 2.4: Pending and Proposed Development Projects within the Roosevelt Boulevard Study Area

Figure 2.4 shows projects within the study area that are proposed and under construction, drawn from the PCPC and CoStar database. There is considerable development happening in the northeast section of the study corridor, as well as in the southwest and southern sections. Figure 2.4 highlights specific locations with anywhere from 267,001 to 750,000 square feet of new development pending or proposed.

None of the development is located close to current high-passenger volume stops, suggesting that additional locations may become new ridership hubs in the future, particularly at Welsh Road, Byberry Point, and Horizon Boulevard, where new development is planned near current bus service.

CONCLUSION

There is significant existing bus ridership along Roosevelt Boulevard across multiple SEPTA routes but chiefly (along Roosevelt Boulevard itself) Routes R, 1, and 14. This chapter details the top 20 corridor stops by overall passenger volume and identifies the intersecting points of interest and employment centers that combine to generate this ridership.

These stops, as well as other locations where significant new development is pending or proposed adjacent to the study corridor, can begin to form the backbone of new limited stop service alternatives in the corridor.

Chapter 3:

INITIAL ALTERNATIVES DEVELOPMENT

Following the completion of the existing conditions analysis, the steering committee (**comprised of SEPTA, City of Philadelphia, Bucks County Planning Commission, PennDOT, Bucks County TMA, and Bensalem Township staff**) were invited to attend a project workshop on November 7, 2013. Workshop participants formed six groups, were given a presentation, and were asked to reach an agreement on a "big picture" vision statement for improving public transit along Roosevelt Boulevard. Groups were then asked to develop specific service proposals, including service termini and end-of-line connections, park-and-ride and kiss-and-ride opportunities, general stop spacing, levels of service, service patterns, stop locations and configuration, route alignment between stops, stop access and connectivity, and location-specific Transit First or "better bus" interventions.

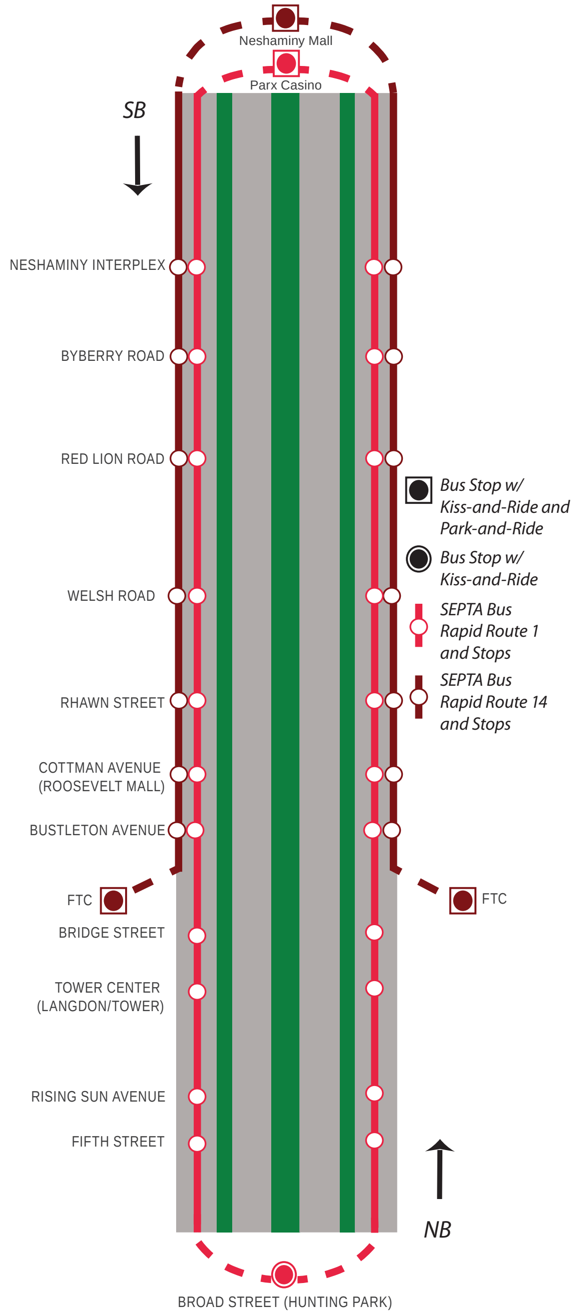
WORKSHOP RESULTS

Each group created a different plan for how the corridor could be improved for transit service. To best recognize areas of consensus, as well as unique ideas, a matrix was created, tabulating each group's (A B C D E F) proposed stops, alignment, park-and-ride locations, and "better bus" interventions. The ideas were summarized in a matrix (Appendix B) and then used to create six initial service alternatives (Figures 3.1–3.6) which are detailed in the pages that follow. Each alternative was intended to illustrate a specific service concept or package of BRT strategies, as expressed in its title. These initial illustrative alternatives provided a sounding board that was used to further develop preferred concepts for implementation, as detailed in subsequent chapters of the report.

Figure 3.1: Initial Alternative 1—On the Ground Tomorrow

CROSS SECTION FOR INITIAL ALTERNATIVE 1

Station and Service Concept for Initial Alternative 1



Source: DVRPC, 2015

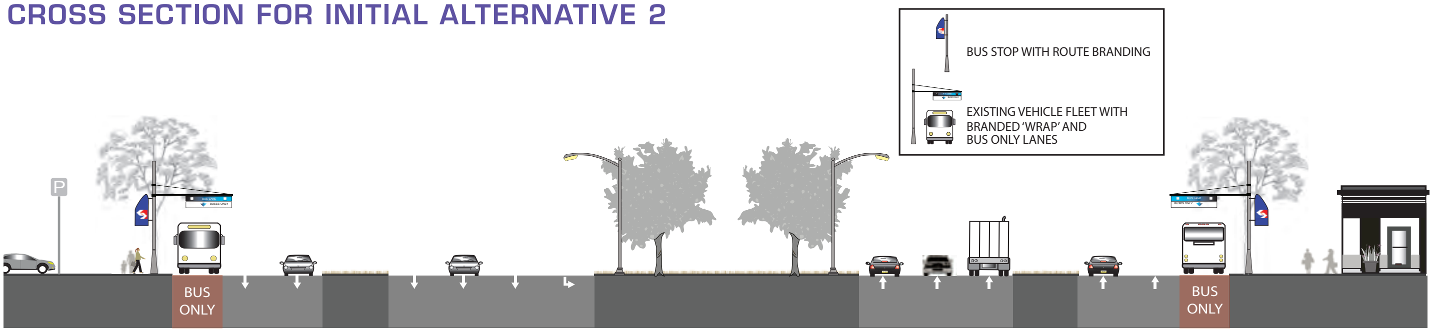
This is a Transit First bus alternative that focuses on service strategies that could be implemented most quickly and at the lowest cost, building on existing transit service in the corridor. New enhanced variations of SEPTA Routes 14 and 1 would be introduced that—in combination—would serve the corridor's two primary northern (Route 14: Neshaminy Mall and US 1: Parx Casino) and southern (Route 14: FTC and US 1: Hunting Park Station) termini. In the case of US 1, a new route variation to serve Hunting Park Station would be introduced. Between these termini, both routes would serve a shared set of express stops along the Roosevelt Boulevard (US 1) corridor, with "Rapid Route 14" serving seven stops, and "Rapid Route 1" serving 11 over a longer distance. Stops would be relocated to the far side of intersections to enhance operations.

Service would be branded using special route designations, marketed widely, and offered all day to serve a variety of trip purposes in the corridor, with combined peak headways of roughly 10 minutes and combined off-peak headways of roughly 15 minutes.

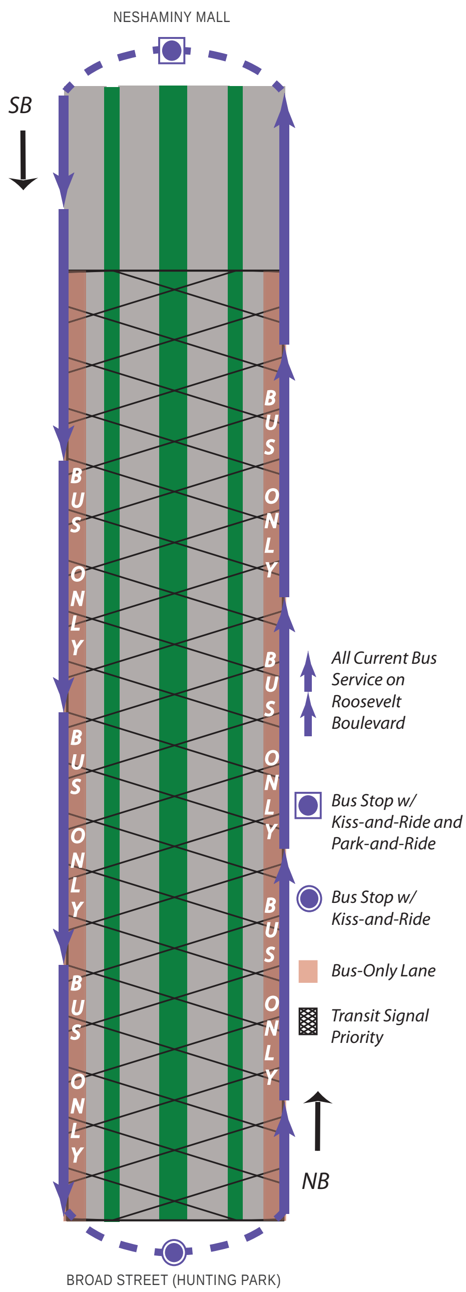
The cross section shows a typical Roosevelt Boulevard segment with a large center median and turn lanes. For this alternative, stop-area cross sections could be the same as today, but limited or "rapid" stops would be specially branded and marketed to customers, similar to the 2011 Transit First Service Enhancement Pilot for Route 47 in South Philadelphia.

Figure 3.2: Initial Alternative 2—Quick Win for Current Riders

CROSS SECTION FOR INITIAL ALTERNATIVE 2



Station and Service Concept for Initial Alternative 2



Source: DVRPC, 2015

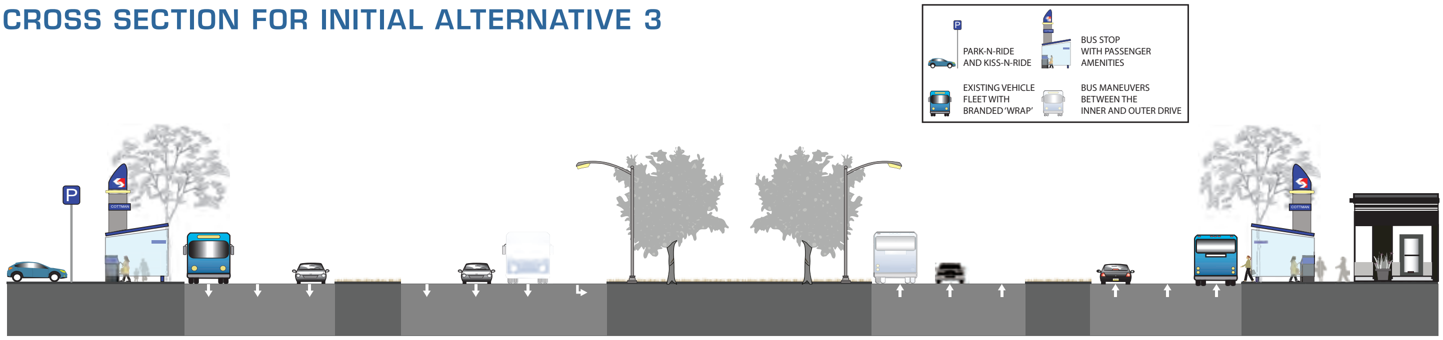
This is an alternative that enhances existing bus operations in the corridor at a low cost. No new route would be establised and all current stops would be served; all current riders would realize modest travel time savings. **TSP would be installed for the length of the corridor, and emitters may be installed on Routes 1, 14, 20, K, and R (the highest-ridership routes that operate along Roosevelt Boulevard for at least two miles).**

In addition, the outermost lanes of the outer drive would be striped and painted as a designated bus-only lane for the length of the corridor, from Broad Street to Woodhaven Road (with right turns also being permitted). This bus-only travel lane would lead to some time savings for bus riders, and also help give transit a more consistently visible presence in the corridor (a "Roosevelt Boulevard Transitway").

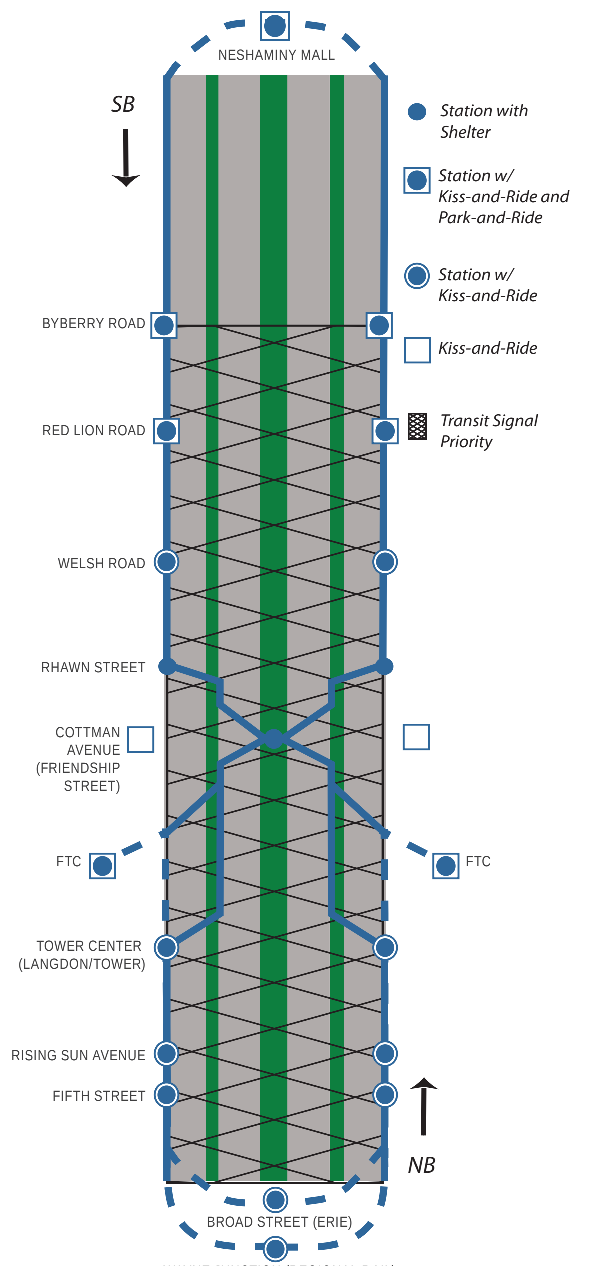
This cross section for a typical Roosevelt Boulevard segment shows the addition of a painted bus-only lane in the outer lanes of the outer drive, with supplemental overhead signage.

Figure 3.3: Initial Alternative 3—Long-Distance Commuter Focus

CROSS SECTION FOR INITIAL ALTERNATIVE 3



Station and Service Concept for Initial Alternative 3



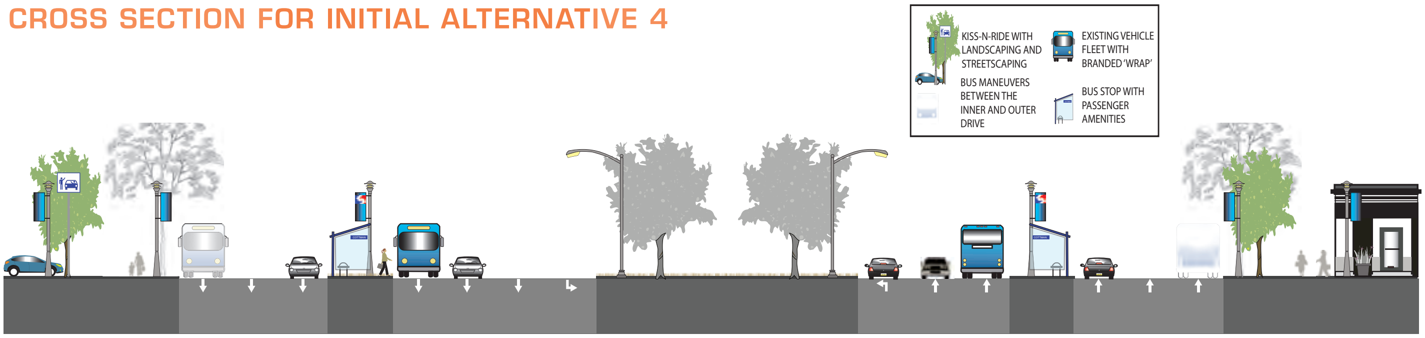
Source: DVRPC, 2015

This alternative focuses on improving service attractiveness and travel times for long-distance commuters. Multiple park-and-ride facilities would be provided to ease drive-up access for inbound commuters from Lower Bucks County and Far Northeast Philadelphia, and kiss-and-ride facilities for easy drop-off access would be provided at these and other stations. Service variations would provide direct connections from these northern park-and-rides to the Broad Street Line (Erie Station), Market-Frankford Line (FTC) and frequent Regional Rail (Wayne Junction), enabling high-quality rail connections to multiple central job hubs, and free or discounted rail transfers would make these connections more attractive. For outbound commuters from Lower North Philadelphia, stations would be located at key transfer nodes like 5th Street, as well as at important job centers further north, such as Tower Center and Red Lion Road.

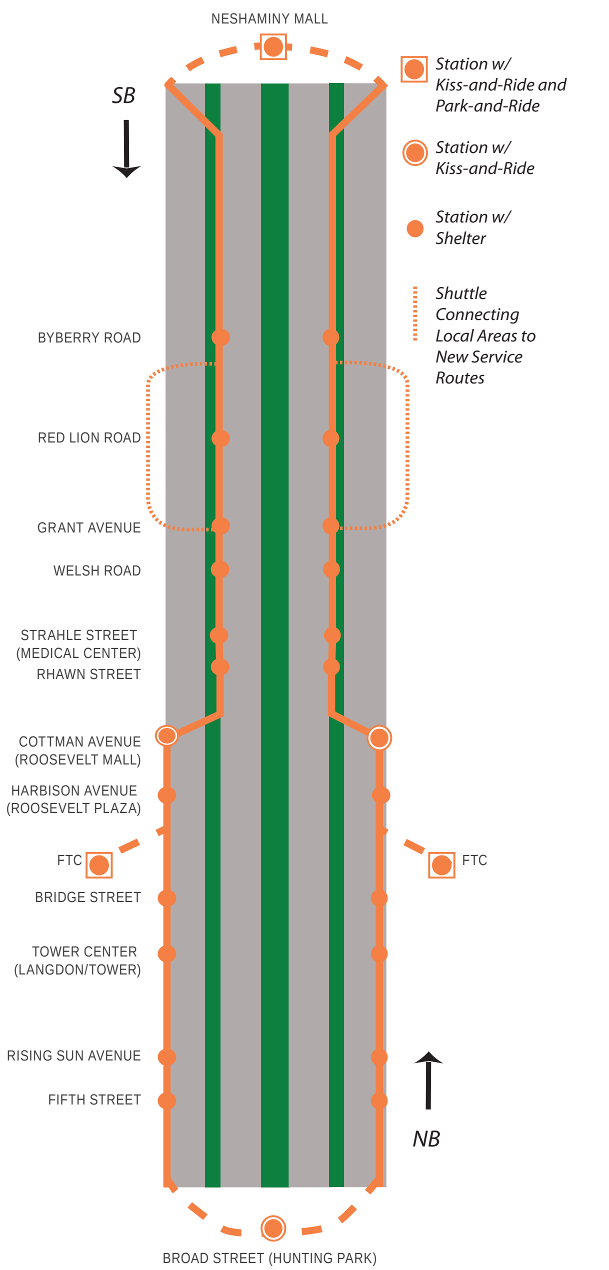
Regardless of a rider's direction of commute, wide station spacing, TSP, high-quality stations with fare prepayment, and limited inner drive operations, as well as queue-jump treatments in select locations, will help make their trip quick and convenient. Service would operate primarily in the outer lanes of the outer drive, but inner drive operations between Rhawn Street and Tower Center offer some additional travel time savings. The concept shown here reflects the inclusion of one inner median "super station" just south of Cottman Avenue. Service would be available all day but concentrated in the peak period, with each route variant (Erie Station, FTC, and Wayne Junction) having 10-minute peak headways, resulting in 3- to 4-minute shared headways at intermediate stations. This cross section shows the enhanced shelters, maneuvers buses make between the inner and outer drives, and branded signage and vehicles with wraps that are envisioned for this alternative.

Figure 3.4: Initial Alternative 4—Community and Economic Development Focus

CROSS SECTION FOR INITIAL ALTERNATIVE 4



Station and Service Concept for Initial Alternative 4



Source: DVRPC, 2015

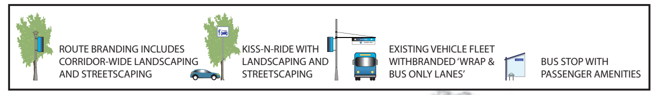
This alternative focuses on community connectivity and local mobility. Stations are more frequently spaced than Initial Alternative 3, in order to increase the number of locations where they can be leveraged for local economic development. Each station also serves as a local pedestrian node and is supported by complementary pedestrian infrastructure, such as enhanced crosswalks.

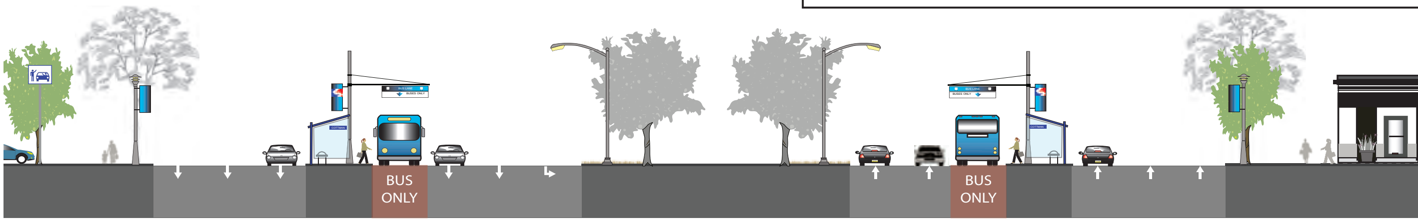
Similar to Initial Alternative 3, high-quality stations with fare prepayment, partial inner drive operations, and queue-jump treatments in select locations will help make riders' trips along the corridor quick and convenient. This alternative enhances broader corridor mobility by linking stations with off-corridor commercial centers (such as the Northeast Airport) using new circulator/shuttle options or with other local buses that serve this purpose. Service would operate in the outer lanes of the outer drive south of Cottman Avenue, and in the outer lanes of the inner drive further north. Partial inner drive operations offer the potential for some time savings, better service differentiation, and better future proofing for a future inner drive fixed guideway. Service levels would be consistently high all day, with each of the service's two southern termini (Hunting Park Station and FTC) having 10-minute all-day headways, resulting in roughly 5-minute all-day headways for shared stations.

This cross section shows the enhanced shelters, maneuvers buses make between the inner and outer drives, and branded signage and vehicles (or vehicle wraps) that are envisioned for Initial Alternative 4. Stations are shown in the outer median for this typical cross section for points north of Cottman Avenue.

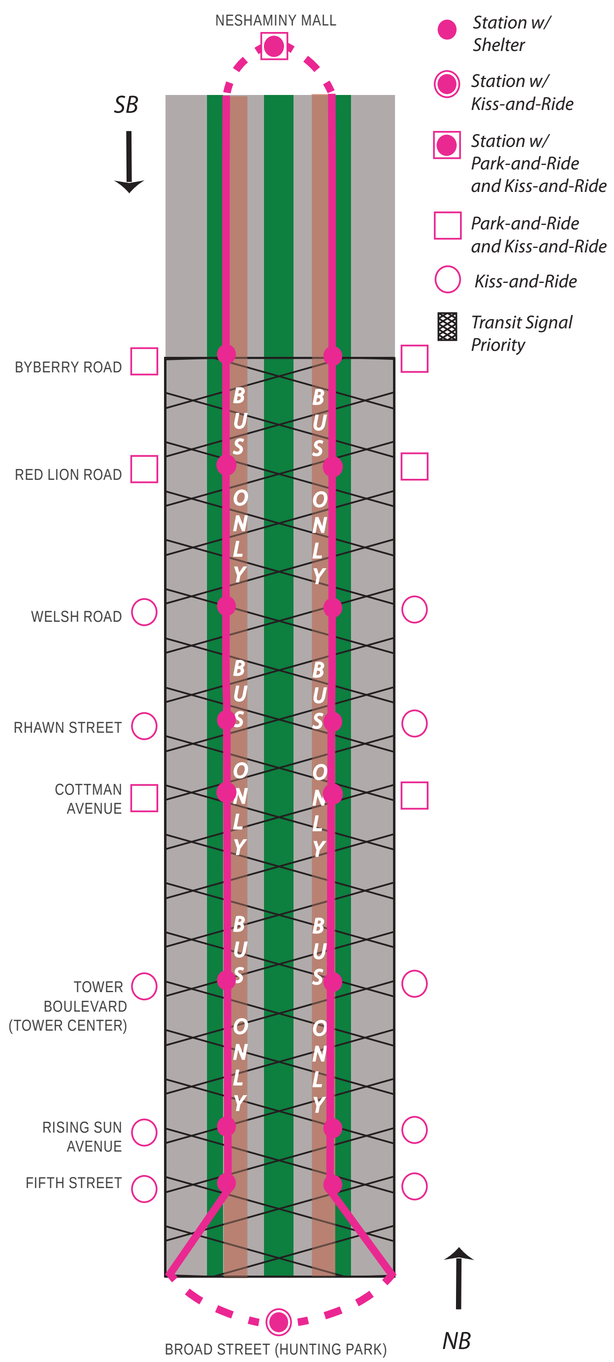
Figure 3.5: Initial Alternative 5—The Roosevelt Boulevard Line (Inner Drive, Outer Lanes)

CROSS SECTION FOR INITIAL ALTERNATIVE 5





Station and Service Concept for Initial Alternative 5



Source: DVRPC, 2015

Initial Alternatives 5 and 6 would have both the fastest travel times and the greatest sense of permanence of the alternatives proposed, but they are also the most expensive. Like Initial Alternative 3, park-and-ride and formal drop-off facilities would help make service more attractive for auto commuters, and transit travel speeds would be maximized with wide station spacing, TSP, and enhanced stations with fare prepayment. For Initial Alternative 5, stations would be bidirectional pairs in the outer medians, and would have a much more significant physical footprint than for Initial Alternatives 1–4. **Buses would operate in the outer lanes of the inner drive. Stations would be designed to be compatible with a future conversion of the inner drive's outer lanes into physically separated busway lanes.**

To permit safe pedestrian access to these median stations, pedestrian crossings at stations would be greatly enhanced with new Americans with Disabilities Act (ADA)-compliant pedestrian overpasses where crossings cannot otherwise be safely accommodated. Service levels would be consistently high all day long. The cross section illustrates high-quality station amenities and signage. Overhead signage reinforces the bus-only lane. Some portions of the bus-only lane would need to be shared with turning or merging traffic; queue-jump treatments would be used to help mitigate transit delay in these instances.

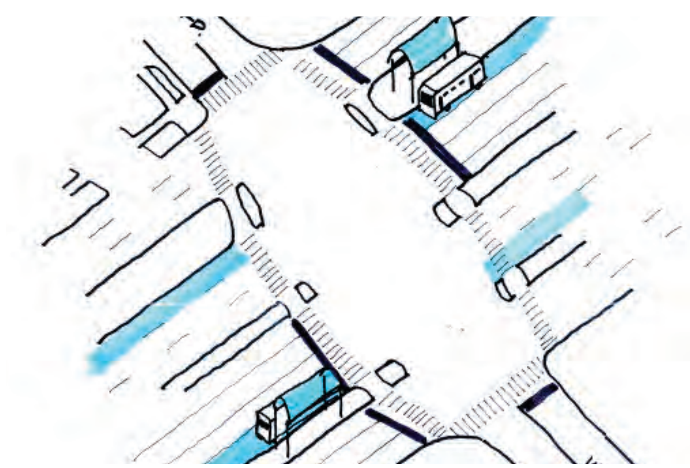
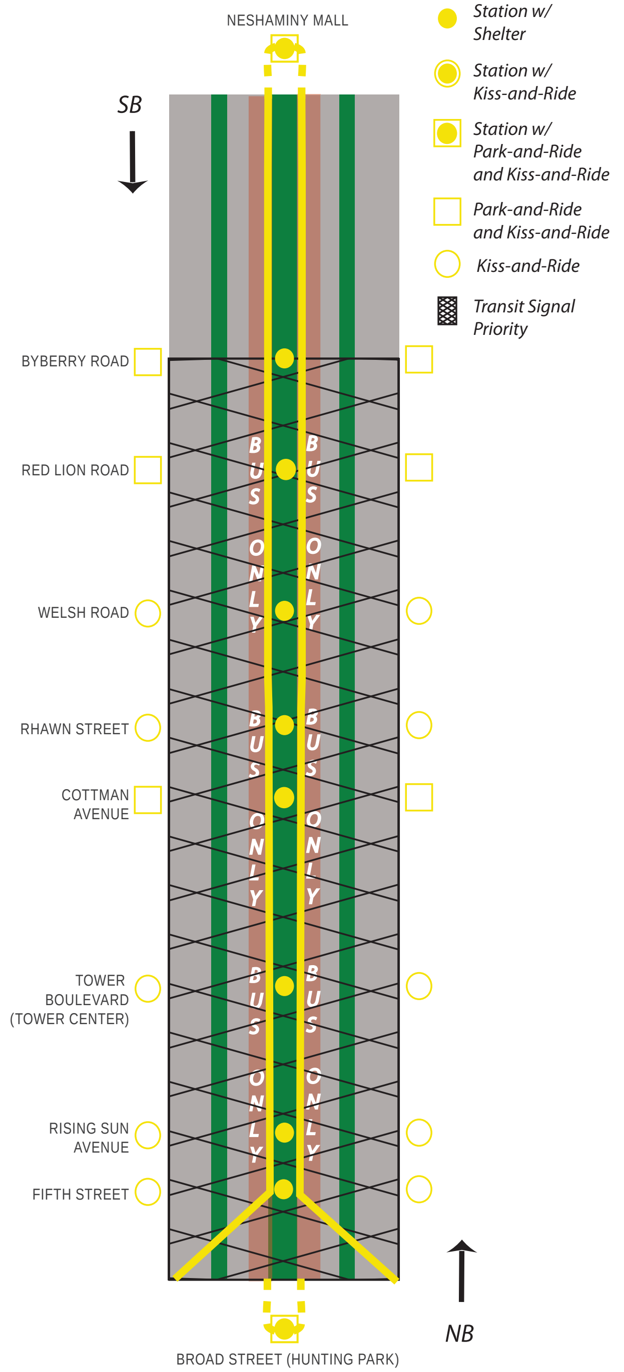


Figure 3.6: Initial Alternative 6—The Roosevelt Boulevard Line (Inner Drive, Inner Lanes)

CROSS SECTION FOR INITIAL ALTERNATIVE 6

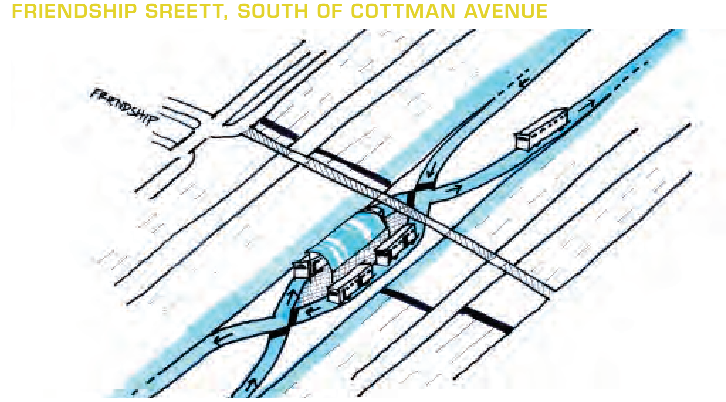
Station and Service Concept for Initial Alternative 6



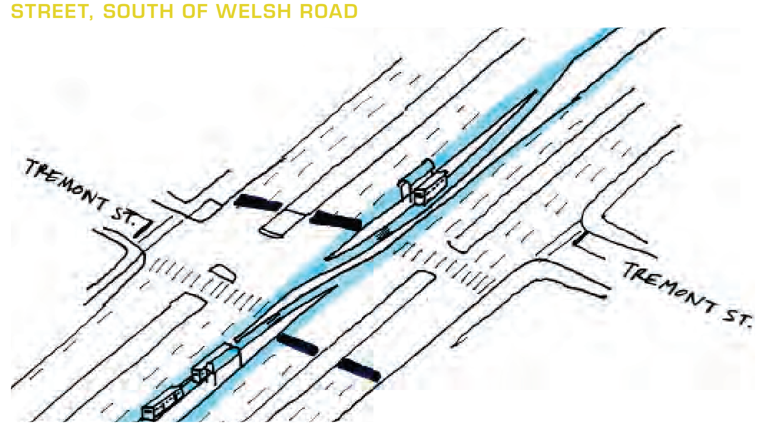
Source: DVRPC, 2015

For this alternative, **stations would be located in the center median, allowing them to be shared by service operating in both directions**, and would have a much more significant (and rail-like) physical footprint. Buses would operate in the inner lanes of the inner drive to serve these stations, and queue-jump treatments at station intersections would minimize transit signal delay. Stations would be designed to be compatible with a future conversion of the inner drive's inner lanes into physically separated busway lanes. To permit safe pedestrian access to these new median stations, pedestrian crossings at these locations would be greatly enhanced, including new ADA-compliant pedestrian overpasses where crossings cannot otherwise be safely accommodated. Service levels would be consistently high all day.

CONFIGURATION CONCEPT AT ROOSEVELT BOULEVARD AND FRIENDSHIP SREETT, SOUTH OF COTTMAN AVENUE



CONFIGURATION CONCEPT AT ROOSEVELT BOULEVARD AND TREMONT STREET, SOUTH OF WELSH ROAD



PERFORMANCE MEASURES COMPARISON

The purpose of these performance measures was to allow the initial alternatives to be compared with one another in a comprehensive way. With one exception (travel time savings), performance measure ratings are comparative, not absolute values. Alternatives are rated in comparison to one another in Table 3.1.

CAPITAL COSTS (EXCLUDING VEHICLES)

Capital cost categories were created as follows to permit a cost comparison between alternatives: $ = < $1 Million; $$ = $5–15 Million; $$$ = $15 Million+. Each alternative was assigned a rating based on prior studies and recent projects. Note that the $$$ category has no maximum.

ESTIMATED TIME SAVINGS

For each alternative, estimated running times for the AM peak (southbound) were developed between all pairs of proposed termini based on current auto travel times, transit operating characteristics, and each of the Transit First or enhanced bus strategies proposed for that alternative. Travel time savings were calculated by comparing these estimated running times with the most comparable current transit trip using SEPTA AM peak schedule data. The full travel time calculations (and all assumptions) can be found in Appendix B.

POTENTIAL TO ATTRACT NEW RIDERS (AND I-95 CONGESTION MITIGATION POTENTIAL)

This measure rates each alternative on its likely attractiveness for longer-distance commuters, particularly commuters from Far Northeast Philadelphia and Bucks County traveling toward Center City via the broader I-95/ US 1 corridor. Ratings are based on factors like limited-stop operations and convenient park-and-ride and kiss-and-ride access.

ACCESSIBILITY ALONG THE CORRIDOR

This measure explores the positive aspects of more frequent stops: namely, convenient passenger access to a greater number of corridor (versus end-of-line) destinations, which can help make the new service more useful for a greater variety of trip purposes.

POTENTIAL STATION-AREA LAND USE IMPACT

This rating measures an alternative's potential to be leveraged for development (physical and economic) based on a balance of stop/station spacing and location, as well as the level of infrastructure investment and the alternative's resulting sense of permanence.

POTENTIAL PEDESTRIAN CROSSING AND SAFETY IMPACTS

This measure also rates alternatives on their levels of investment; alternatives with higher levels of investment at stops/stations are also intended to incorporate significant pedestrian crossability enhancements, to permit safe access to and through proposed stations.

SERVICE DIFFERENTIATION AND UNIQUE IDENTITY

This measure rates each alternative on characteristics that would differentiate it from other transit options in the corridor, city, and region; especially local bus service. It reflects factors like unique branding, creative use of the right-of-way, level of station investment, and service visibility.

IMPLEMENTATION TIMEFRAME

Alternatives are rated on their ease of implementation (related to their complexity and need for engineering) and likely timetable as follows:

= <1 year; = 1–3 years; = 3 years+.

LIKELIHOOD FOR NEGATIVE TRAFFIC IMPACTS

Alternatives that include exclusive bus lanes or where stop locations would impact travel lanes have a higher likelihood to negatively impact traffic flow and motor vehicle capacity.

FUTURE PROOFING

This measure explores the degree to which each alternative forwards the development of more advanced transit services in the future, through the likelihood of shared stop locations, rights-of-way that could become physically separated fixed guideways in the future, or some combination of the two.

Table 3.1: Performance Measures for Initial Alternatives

	Capital Cost: Excluding Vehicles	Estimated Time Savings	Potential to Attract New Riders and I-95 Congestion Mitigation Potential	Accessibility Along the Corridor	Potential Station-Area Land Use Impact	Service Differentiation and Unique Identity	Implementation Timeframe	Likelihood for Negative Traffic Impacts	Future Proofing/ Phaseability
INITIAL ALTERNATIVE 1: On the Ground Tomorrow (Rapid Routes 1 and 14)	$	Neshaminy Mall-FTC: 8.1 min (17.6%) Parx Casino-Hunting Park: 11.2 min (18.7%)	Medium	Medium	Low	Low	🕒	Low	Medium
INITIAL ALTERNATIVE 2: Quick Win for Current Riders	$	7.8 min (15.9%)	Low	High	Low	Medium	🕒🕒	High	Low
INITIAL ALTERNATIVE 3: Long-Distance Commuter Focus	$$	Neshaminy Mall-FTC: 16.1 min (35%) Neshaminy Mall-Erie: 17.4 min (29%) Neshaminy Mall-Wayne Junction: 21.6 min (34.8%)	High	Low	Medium	Medium	🕒🕒	Medium	Low
INITIAL ALTERNATIVE 4: Community and Economic Development Focus	$$	Neshaminy Mall-FTC: 13.4 min (29.1%) Neshaminy Mall-Hunting Park: 16.0 min (26.7%)	Low	Medium	High	High	🕒🕒🕒	Medium	Medium
INITIAL ALTERNATIVE 5: The Roosevelt Boulevard Line (Inner Drive, Outer Lanes)	$$$	23.8 min (39.7%)	High	Low	High	High	🕒🕒🕒	High	High
INITIAL ALTERNATIVE 6: The Roosevelt Boulevard Line (Inner Drive, Inner Lanes)	$$$	23.8 min (39.7%)	High	Low	High	High	🕒🕒🕒	High	High

Source: DVRPC, 2015

SCREENING OF INITIAL ALTERNATIVES

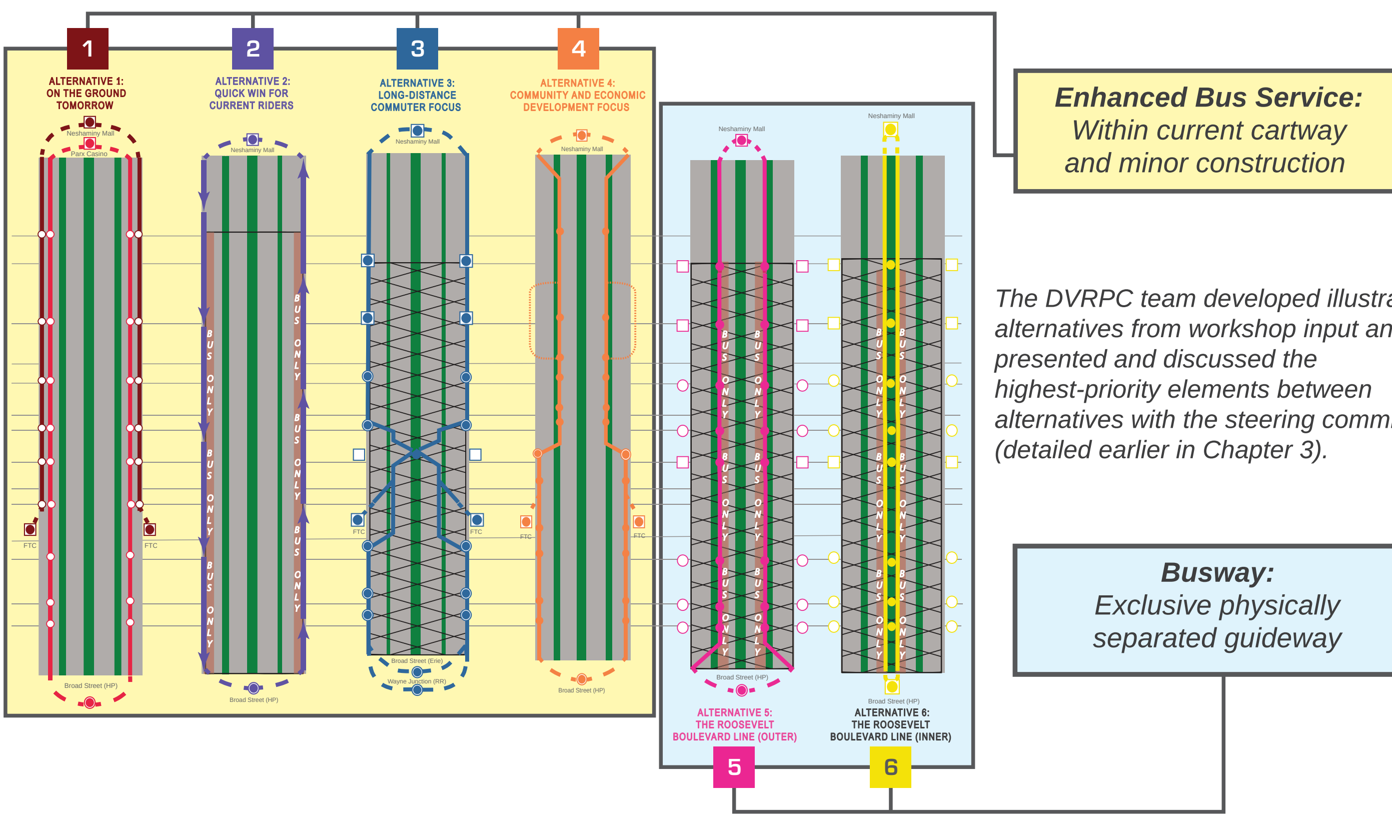
The diagram in Figure 3.7 is a photo taken during the workshop showing the interagency coordination among steering committee members. This was an iterative process that started by combining the knowledge of each agency at the workshop to develop priority stops, alignments, and BRT elements that would be attractive for a service along Roosevelt Boulevard and decrease end-to-end travel times. DVRPC used this feedback to develop the initial illustrative alternatives (shown in Figure 3.8), which in turn informed two key steering committee decisions:

- Since many of the desirable “better bus” elements could be implemented relatively quickly and at a relatively low cost, these should be further refined and developed into a comprehensive short-term improvement concept for EBS.
- Initial Alternatives 5 and 6 would be quite expensive and complex, and the incremental cost and complexity to step them up into a physically separated guideway relatively low. As a result, these alternatives should be further evaluated and developed into a long-term improvement concept: the busway.

These decisions framed much of the subsequent work undertaken for this project, as described in the chapters that follow.

Figure 3.7: Photo of Stakeholder Workshop

Figure 3.8: Initial Alternatives Related to Final Alternatives



Source: DVRPC, 2015

Chapter 4:
STATION LOCATION SELECTION

From the stakeholder workshop in November 2013, a number of suggested station locations and six possible end points (or termini) were identified. Stations and termini were identified largely because of stakeholders' familiarity with current high-ridership locations and intersections that have a concentration of destination land uses surrounding the area.

The current public transit option to travel end to end from the two priority termini, FTC to Neshaminy Mall, on SEPTA Route 14, takes approximately 47 minutes with 105 stops. During a similar peak hour, auto travel time is roughly 25 minutes. Decreasing this gap in travel time would allow more passengers greater mobility to get to their destinations faster. One way to do this would be to decrease the number of stops, as shown in several of the initial alternatives in Chapter 3. However, by decreasing the number of stops the new service serves fewer local destinations. This tradeoff between travel time and local accessibility informed further analysis for station selection.

NON-TERMINAL STATIONS

Stations that were consensus choices by stakeholders were either selected due to obvious merit (e.g., Cottman Avenue) or went on for further evaluation. Stations that were less popular among stakeholders fell out of consideration. In some instances, stakeholders identified multiple intersections that could serve a discrete area. Because BRT requires limiting stops, the study team, together with the steering committee, worked to identify the most transit-supportive intersection within a general area, rather than recommending serving both locations. Transit-supportive indicators were compared against each other at each intersection to predict which might serve the highest number of riders and thus be a priority service location.

Transit-supportive indicators included performance indicators such as existing high ridership and transfer availability. To calculate ridership the study team aggregated total passenger activity (to include transfers from cross-street transit) at all stops within 50 feet of an intersection. Most of the stop locations (with the exception of Bustleton and Harbison avenues) that were evaluated already have bus or bus and subway service. Bustleton and Harbison avenues both have bus stops anywhere from 50 to 350 feet from the intersection, and those ridership numbers were used to supplement their ridership. During the analysis process, current ridership was considered the highest-priority factor in selecting stations because the fewest number of passengers would have to change their boarding and alighting patterns.

Demographics and planning indicators like the mix and density of adjacent land uses, adjacent population density, density of employees, zero-car population, and percentage of public transit commuters were also evaluated for candidate station areas. Population and employment are both valuable indicators because they relate to the trips people take most often on transit, from home to work and back. Land use mix was also an important indicator; more mixed land use was ideal, particularly high office and retail, because of the opportunity for economic development and infill with the implementation of a BRT-like service.

The distance to the next station was also relevant in determining the best station in a candidate area. BRT service has greater stop spacing than local bus service, so stations should not be located too closely to one another. On the other hand, stop spacing should not be so great that it leaves gaps in service to the communities along the corridor. For example, the steering committee decided to keep both locations in the candidate pair of Welsh Road and Grant Avenue, since otherwise the distance between stops would be too great for many passengers to be within walking distance.

The study team also evaluated station location-based measures of congestion, including: cross-street transit vehicle volume, volume-to-capacity (V/C) ratio, traffic volume, and cross-street traffic volume. In addition to congestion levels along the corridor, it is also important to consider the congestion levels of cross streets. Philadelphia has a grid-based street network, and many roadways across the city are highly congested with both traffic and transit. These are important and noteworthy indicators that identify the benefits and disadvantages of adding transit service to the current traffic conditions. Adding an EBS stop where cross-street congestion levels are high allows a new stop to capitalize on gaining transit riders at a popular location but also has to be balanced with not exacerbating queueing and congestion.

Although the congestion indicators are helpful in the comparison, the data is only available for a one-mile segment or length along a roadway rather than a specific location, such as an intersection. For example, 5th Street and Rising Sun Avenue have the same volumes and V/C ratio because both locations share the same one-mile segment. Therefore, congestion-related indicators were not always the best point of comparison.

A pilot analytical tool from the Transit Cooperative Research Program (TCRP) called the H-46 Transit Benefit Calculator was also used as a performance indicator. The calculator estimates the impact of new transit on land use and the resulting impact on transportation-related greenhouse gas (GHG) emissions and energy use. One output is an estimated increase in area jobs and population around a new station, which the study team found to be helpful in comparing locations.

TERMINI

The six identified termini were vetted among stakeholders and the project team with the goal of finding the termini that would offer the greatest number of transfer opportunities, reduce trip length and time as much as possible, and require the least construction to accommodate a station.

At the southern end of the study area, connections to Regional Rail (Wayne Junction station), Broad Street Line (both Erie and Hunting Park stations) and to Market-Frankford Line (FTC) were identified as candidate EBS termini. While a connection to Regional Rail would provide transfer opportunities, the transfer is to a higher-cost mode with less frequent service. Also, the on-road travel time to get from the Roosevelt Boulevard corridor to Wayne Junction largely cancels out the time saving benefits of Regional Rail into Center City. To connect to the Broad Street Line, Erie Station is located at a very complicated intersection that would be difficult to support an end-of-line BRT facility without significant construction. Similar to the problem with a Wayne Junction terminus, the travel time to traverse the half-mile off of Roosevelt Boulevard to get to Erie Station largely cancels out the time saving benefits of the Broad Street Line express service provided at Erie Station. **Connections to Hunting Park and FTC provide enormous transfer opportunities to multimodal facilities located proximate to Roosevelt Boulevard and that have a high frequency of service.**

At the northern end, endpoints at Neshaminy Mall and Parx Casino were both identified during the first workshop. More stakeholder groups identified Neshaminy Mall as a terminus. Neshaminy Mall is also a current stop on the existing Route 14 service, affords transfer opportunities to other bus routes, and has the capacity to operate at both the existing, and a new, stop location; therefore, Neshaminy Mall was the preferred northern terminus.

As a result of this review, the steering committee generally determined that termini at Neshaminy Mall, FTC (connections to the Market-Frankford Line) and Hunting Park (connections to the Broad Street Line) made the most sense, particularly in the short term.

CONCLUSION

Table 4.1 shows all locations that were considered as candidate stations and that required further discussion. The group compared the performance indicators detailed in this chapter to decide which of the locations would be best as a station for enhanced service. Stations preferred during this process largely went on to become recommended EBS stations; however, during the operations and service analysis described in Chapter 6, some further changes were made. Proposed stations are indicated in Table 4.1. The entire summary table of all candidate station locations' values on each performance indicator can be found in Appendix B.

Table 4.1: Station Candidates and Recommendations

CANDIDATE STATION LOCATIONS	PROPOSED STATION LOCATIONS
Neshaminy Mall	✔
Neshaminy Interplex	✔
Byberry Road/Comly Road	
Red Lion Road	✔
Grant Avenue	✔
Welsh Road	✔
Strahle Street (Medical Center)	
Solly Avenue	
Rhawn Street	✔
Cottman Avenue (Roosevelt Mall)	✔
Harbison Avenue	✔
Bustleton Avenue	Alternate if Harbison Ave. proves operationally infeasible.
Frankford Transportation Center (Market-Frankford Line Station)	✔
Bridge Street	
Pratt Street	✔
Langdon Street	
Tower Boulevard (Tower Center)	✔
Rising Sun Avenue	✔
5th Street	✔
Hunting Park (Broad Street Line Local Station)	✔
Erie (Broad Street Line Express Station)	

Source: DVRPC, 2015

Chapter 5 :

DISCUSSION OF COMMON BRT ELEMENTS AND NORTH AMERICAN CASE STUDIES

This chapter includes a primer and evaluation of treatments commonly implemented for new BRT service in peer systems, and notes which elements are recommended for the near-term and long-term EBS and busway phases in the Roosevelt Boulevard corridor. Many BRT projects include multiple upgrades to local service at one time, making it hard to determine the effectiveness of any particular element. Therefore, throughout this section, the effectiveness of BRT elements are described by city-specific data and industry general standards as well as anecdotal reports on BRT projects.

Within this document the phrase “BRT elements” refers to strategies used across the full continuum of peer system projects that have been called “Bus Rapid Transit,” from low-cost enhancements to fixed guideway projects. For the purposes of this chapter, a BRT element is a general term; ideas that relate specifically to the Roosevelt Boulevard project’s near-term (EBS) or long-term (busway) concepts—or both—are noted accordingly. Recommendations proposed for the Roosevelt Boulevard corridor are summarized in Table 5.1 and detailed in the pages that follow.

Table 5.1: Recommended EBS and Busway BRT Elements

RECOMMENDED BRT ELEMENTS	EBS	BUSWAY
Branding shared across vehicles, stations, signage, and running way	✔	✔
Curbside far-side stations (where feasible)	✔	
Center median, far-side stations		✔
Stations with shelters and streetscape furnishings	✔	✔
Real-time passenger information	✔	✔
Multidoor boarding	✔	✔
Low-friction fare payment	✔	✔
Aesthetically modified standard articulated bus	✔	
Dedicated fleet with unique vehicles		✔
Signal optimization	✔	✔
Transit signal prioritization	✔	
New configuration and signal phasing at intersections		✔
BAT lanes or other in-street preferential treatment	✔	
Exclusive physically separated busway		✔

Source: DVRPC, 2015

IMPORTANCE OF BRANDING

Creating a unique brand for the EBS will distinguish it from current local bus service and help create a higher-quality aesthetic that will contribute to an identity of the new service for current and potential passengers. Some studies suggest that unique branding and imaging alone can contribute to a 20 percent increase in ridership.[2] The brand developed will affect the way that the public thinks and feels about the service. Therefore, it is important to consider the following aspects: identifying who the target audience will be (researching user demographics), developing what the brand will promise to potential passengers (i.e., premium benefits such as a decrease in end-to-end travel times, increase in service frequency, or passenger amenities), and how the brand should be communicated to this audience (vinyl posters, decals, public outreach meetings, media outreach, signage, a website). Since Roosevelt Boulevard is already a high-bus-ridership corridor, many of these elements could be asked of or tested with the current passengers to capture what residents in this community may appreciate for their bus ride.

Figure 5.1: Swift BRT, Washington State

Source: Swift Bus Rapid Transit Website, 2015

Initial branding steps include identifying the name of the service and line, as well as deciding on color schemes, graphics, and logos. Figure 5.1 shows the branding of a Swift station and vehicle in Washington State. Stations, vehicles, and the running way are the most visible project elements to current and potential passengers, and thus primary locations to saturate with branding, wayfinding, and promotional materials. The notion of high service quality is reinforced when all buses, routes, and stations have a shared and consistent brand for the entire system.

[2] APTA. "BRT Branding, Imaging, and Marketing", Washington, DC, 2010.

Recommendation for EBS and Busway:
Because the EBS represents a new service model for SEPTA and will help set the tone for future BRT projects, messaging will be key. Consistent branding for vehicles, stations, and signage should be developed and implemented as part of the EBS and busway phases.

STATIONS

Stop or station siting and amenities along a BRT line have the capability to reinforce branding and promote visibility of a new service, and provide a safe and comfortable environment for passengers. Station siting—which includes the platform, shelter, and vehicle stopping points—requires design and careful consideration prior to implementation. The amenities within the shelter have the potential to attract riders by providing them with a weather-protected, safe environment and passenger information; and by being accessible by all modes and people.

STATION SITING

Locating a station requires consideration of curbside (outside of the cartway) and streetside (within the cartway) issues. Dwell time savings can be achieved when there is level boarding or when there is no (or a minimal) gap between the vehicle and the platform; however, there are additional capital, maintenance (damage to the vehicle), and operational (training of operators) costs to be considered prior to implementation. For a near-term scenario such as the EBS, changing the curb height or location to achieve level boarding is an option but a challenge from a time and cost perspective. Raising the curb to make level boarding possible would be a higher priority for the busway.

The streetside station area (or bus zone) is typically longer than the curbside station area (or passenger zone). A method to calculate the standard length of the bus zone would be the length of the largest vehicle stopping at a location multiplied by the number of vehicles that would be present at any one time. In addition, there should be sufficient length provided for a vehicle to be able to merge in and out of the stop area comfortably while other buses are stopped.

Where multiple routes and services stop at one location, there may be multiple designated stop locations with clear signage for passenger and operator legibility. Roosevelt Boulevard bus stops have a varying number of shelters and station loading zones; Figure 5.2 is a photo of a stop at Welsh Road and Roosevelt Boulevard. Implementing new station designs and reconsidering locations can enhance the customer experience and safety.

Traditionally, buses operate in the curbside lane and therefore have curbside stops. Curbside stops can be located either prior to an intersection (near side) or just after an intersection (far side). The advantages to near-side stops are that the passenger has a shorter distance to get from the bus to the intersection, and the bus can readily make a right turn. There are several benefits to far-side stops, including:

- more effective TSP (if present) because it reduces instances where the vehicle stops twice, once for passengers and once for the signal, at one intersection;
- transit vehicles avoid conflicts with and delay from right-turning vehicles; and
- a safer pedestrian environment by encouraging passengers to cross behind the bus.

Figure 5.2: Roosevelt Boulevard Bus Stop

Source: DVRPC, 2014

Far-side stops are typically preferred for BRT projects due to these time savings and safety improvements. Median stops are used for BRT services that have a median (side or center median) running way or busway. The primary advantage to a center and most side-median stations is that both inbound and outbound services can share station facilities, including the cost to build and maintain the facilities. One weakness is the cost to purchase vehicles that have left-side or dual-side opening doors to serve the stations.

Figure 5.3 shows a location on Cleveland's BRT, named the Healthline, which has a far-side, side-median station. In this circumstance the buses share the station platform. Center-median stops are proposed for implementation for the busway phase of the Roosevelt Boulevard project due to their identity and visibility benefits, and possible cost savings.

Recommendation for EBS:
Curbside station siting and far-side station locations where circumstances permit.

Recommendation for Busway:
Center-median, far-side stops are recommended for the future busway.

STATION SIZE AND AMENITIES

Typical BRT projects have stations of various sizes based on forecasted ridership, transfer volume at a particular location, budget, and available right-of-way.

Figure 5.3: Healthline, Cleveland, Ohio

Source: Greater Cleveland Regional Transit Authority, 2014

The following is a list of facility sizes that can be implemented for EBS based on the chosen level of investment or available footprint.

- A typical station has some amenities such as a standard shelter, some passenger information, seating, lighting, branding, and fare collection (if applicable). This is the minimum facility level for BRT or EBS.
- An enhanced or "super" station has a large shelter with all the amenities of the typical station but with a larger and more permanent-feeling footprint. Typically there is a larger capital and maintenance investment required and potentially more right-of-way needed.
- A transit center/end-of-line station is a facility which includes all recommended amenities from the super stations (depending on available space). Also, the configuration and connections enable passengers to transfer easily and may require space for buses to layover or turn around.

Shelter designs are typically branded for BRT service and vary in cost from a simple shelter (Figure 5.4 for Seattle's RAPIDRIDE BRT) that could be associated with a basic stop to an intermodal transit center.

Figure 5.4: RAPIDRIDE, Seattle, Washington

Source: King County Metro Website, 2014

Recommendation for EBS:
Three types of EBS stations are recommended (a typical station, super station, and a transit center station) with weather-protected shelters and furnishings that are large enough to accommodate anticipated passenger demand.

Recommendation for Busway:
Center median bus stations should have the same footprint as super stations or larger, depending upon site constraints within the right-of-way.

PASSENGER REAL-TIME INFORMATION

Passenger real-time information refers to the sharing with passengers of up-to-date bus location, operational, and schedule information collected through automatic vehicle location (AVL) systems for viewing at stations or on their personal devices. The most common form of AVL is GPS based. Through customer satisfaction surveys and academic research it has been determined that the public places a dollar value on real-time information, and that this feature alone has the potential to increase ridership by 1–3 percent.[3] Passenger information provided by agencies as part of BRT projects varies, and includes both static and real-time information in the same location; the following is a list of some typically displayed data.

- estimated arrival, departure, or countdown times for the approaching vehicle;
- transit vehicle locations;
- general static information such as fares, end-to-end travel times, wayfinding information, and available transfers with travel times for common ultimate destinations;
- service disruptions and delays; and
- real-time information such as the date, time, weather, and current news, often with advertisements

Figure 5.5 shows how the Chicago Transit Authority's (CTA) Jeffery Jump BRT provides passengers with real-time information displayed on its shelters. Providing real-time passenger information at each stop location gives passengers

[3] FTA, "Real-Time Transit Information Assessment, White Paper Literature Search and Review of Current Practices in Providing Real-Time Transit Information", Washington, DC, 2002.

Figure 5.5: Jeffery Jump, Chicago

Source: Might as well Jump! The CTA debuts a stepping-stone to bus rapid transit, Grid Chicago, 2015

an opportunity make an informed choice on the time it will take them to get to their destination and may also make the wait time feel less onerous. Studies have shown that time spent traveling to and waiting at transit stops is perceived to up to three times as long as the amount of time spent on the vehicle itself, and that reducing the uncertainty of wait time substantially lowers the perceived burdens of using transit.[4] Passenger real-time information is provided in many cities in the United States with BRT service. However, there can be barriers to implementing this type of system due to cost, institutional coordination, and integrity of providing accurate information.

Currently SEPTA provides customers with various electronic passenger information. The SMS Transit Schedule Information service allows passengers to text their station ID to find out the next four scheduled trips for this location. The official SEPTA App is another way passengers can stay connected to schedule information. When downloaded, the app allows passengers to view a map that shows the current vehicle location of a particular route he or she has selected. However, the data updates through a Computer Aided Radio Dispatch, which does not have the capacity to update more than every 3 minutes, and longer at peak periods. SEPTA's anticipated fare payment system, SEPTA Key, requires that all vehicles have cellular modems on them. Engineers at SEPTA believe that (by later in 2016) the same wireless technology on these modems could improve the next arrival notification system.[5] Therefore, countdown clocks at stations are recommended for the EBS and busway.

Recommendation for EBS and Busway:
Implement real-time information with countdown timers at stations.

LOW-FRICTION FARE PAYMENT WITH MULTIDOOR BOARDING

There are three major characteristics of fare collection: fare media and payment, fare structure, and the fare collection process.[6] Although all three are important to BRT implementation, the fare collection process can significantly impact travel time. The following describes how fares can be paid, processed, and verified in a manner that reduces per passenger dwell times and improves operating efficiencies.

Off-Board Fare Payment and Proof-of-Payment

Off-board fare payment can be implemented either with a barrier system (e.g., gates) or barrier-free. In the latter case, proof-of-payment is typically required. Proof-of-payment requires passengers to have a valid pass, transfer, or ticket when boarding the transit vehicle, and to show it if requested. Tickets can be purchased from various locations: a ticket vending machine (TVM) at a stop, online, or at a retailer. Passengers' tickets are subject to inspection by agency staff or another chosen authority to ensure validity for each ride at any time they are on the vehicle, with financial penalties for riders who cannot show proof of payment.

The major benefit to off-board fare collection with proof-of-payment is the quick, convenient, all-door boarding process, which can decrease dwell times, increase reliability, and decrease overall transit travel times. Implementing off-board fare collection can decrease boarding times by up to 38 percent, and enabling multidoor boarding can decrease vehicle dwell times even further.[7] Off-board fare payment contributes to the service feeling more "rail-like" than bus and reinforces a new brand for the system. Drawbacks to this approach include the increased risk of fare evasion, the

[4] Access Magazine. Thinking Outside the Bus, California, 2012.
[5] PLANPHILLY. "Next to arrive on all SEPTA platforms: real-time ETA data", Philadelphia, 2015.
[6] FTA. "Characteristics of BUS RAPID TRANSIT for Decision-Making", Virginia, 2004.
[7] TCRP Report 100. Transit Capacity and Quality of Service Manual, 2nd Edition, Washington, DC, 2003.

Figure 5.6: SBS, New York City

Source: DVRPC, 2014

cost of purchasing, installing, and maintaining TVMs and other necessary equipment, and the cost of fare inspection staffing that would be required to mitigate fare evasion. Figure 5.6 shows the off-board fare payment machines for New York City's Select Bus Service (SBS; BRT-lite approach). A recent DVRPC sketch analysis for SEPTA trolley service estimated that dwell times could be reduced by roughly 60 percent and travel times improved by roughly 15 percent through a hypothetical switch from a single-channel, step-up, farebox boarding scenario to a two-door, level, low-friction fare payment scenario. Off-board fare collection is preferred for many BRT systems due to the significant travel time savings that can be achieved, particularly at high-volume stop locations.

Figure 5.7: SFMTA, Muni

Source: SF Streetsblog, 2014

On-Board Fare Payment

There are approaches to on-board payment that allow multidoor boarding with lower risks of fare evasion and reduced TVM installation and maintenance costs. Installing new payment methods such as readers for contactless credit cards and smart cards at multiple doors on a vehicle would still allow for time savings to be garnered relative to SEPTA's current fare payment approach. Figure 5.7 illustrates the back-door on-board fare payment device installed on Muni in San Francisco in 2012. Over a five-year period (2009–2014), these devices have decreased average boarding time per passenger by 1.5 seconds or 38 percent and dropped fare evasion from 9.5 to an estimated 7.9 percent.[8]

SEPTA's fare modernization program, SEPTA Key, has started testing. The development of this new technology could be used for low-friction payment on Roosevelt Boulevard. Riders could use branded cards with low-friction payment devices that will replace tokens, paper tickets, and magnetic stripe passes.[9]

Recommendation for EBS and Busway:
Multidoor boarding with low-friction fare payment is recommended to reduce dwell times and travel times, and to further differentiate from local service.

FLEET CHARACTERISTICS

The vehicle chosen for a BRT project has major impacts on the physical attributes, capacity, and travel time of a new service. Vehicle choice can also heavily influence perception of the service, since customers spend most of their time on the vehicle, and it is one of the most visible elements seen by potential users. There are two ways an agency can update their vehicles: through aesthetic upgrades to an existing fleet, or by procuring a new vehicle type. When adding new service to an active network, there are likely to be vehicle operations implications. For example, the bus depot that is closest to the new alignment may not be able to accommodate more vehicles or specialized vehicles and could require facility modifications or redesigns for operations and maintenance purposes. These costs and considerations need to be evaluated early in the planning process.

[8] SFMTA , "All-door Boarding Evaluation Final Report", San Francisco, CA, 2014.

[9] SEPTA website, Philadelphia, PA, 2015.

AESTHETIC ENHANCEMENTS

The vehicle serves as a primary platform for the service's brand. Enhancements such as the paint and branding scheme of the inside and outside of the vehicle can be completed at low cost via strategies like vehicle wrapping or seat inserts that reinforce the brand's stylistic elements. Modifications to an existing vehicle can also go beyond look and feel to functionally improve the passenger experience. For example, New York SBS vehicles (shown in Figure 5.8) are equipped with bright passenger notification lights on the front of the vehicle that allow a passenger to see whether the bus coming down the street is a BRT vehicle or a local bus. Relatively minor modifications like these help make the service more identifiable to local bus riders and potential passengers.

Figure 5.8: SBS Vehicle, New York City

Source: Official Website of New York City, 2015

NEW VEHICLES

Procuring entirely new vehicles for a service is a tailored and costly approach. In addition to any aesthetic enhancements, this would allow an agency to change elements such as the length, passenger capacity, body type, or floor height of a vehicle, as well as to make enhancements for circulation purposes (left-side opening or wider doors). The benefits can vary; for example, adding left-side doors allows flexibility for the stations to be located in the median of a roadway, while keeping only right-side doors ensures the stations will be on the curb side. In addition, new vehicles can be more "top of the line" and provide a more rail-like experience for passengers.

Currently, SEPTA uses articulated vehicles for Route 14. SEPTA has procured new articulated vehicles that will be in service by later in 2016. These vehicles (with low-cost aesthetic treatments) are recommended to be used for the EBS concept. A new vehicle is recommended for procurement for the busway phase since center-median stops are being suggested, and currently SEPTA vehicles only have doors on the right side.

Recommendation for EBS:
Aesthetically modified articulated bus with branded bus wraps, seat inserts, and other low-cost treatments such as passenger notification LEDs.

Recommendation for Busway:
Purchase a unique and dedicated vehicle fleet.

TRANSIT PREFERENTIAL INTELLIGENT TRANSPORTATION SYSTEMS (ITS) TREATMENTS

Various signals and communication strategies are available to give priority to transit vehicles in mixed traffic at relatively low cost.

SIGNAL OPTIMIZATION TO BENEFIT TRANSIT

Signal optimization is a change in cycle length to reduce the delay for transit vehicles at a specific signal or along a corridor, helping to improve running times. In general, it changes the cycle length to favor the progression of traffic on the higher-capacity roadway. Two major benefits to signal optimization are that it can be done by purchasing little or no additional equipment and can be adjusted as corridor conditions change. However, coordination with other signals on the same corridor is sometimes difficult.

TSP IMPLEMENTATION

The Federal Transit Administration's (FTA) Los Angeles Metro Orange Line BRT Project Evaluation notes that as much as 25 percent of all bus travel time consists of delay at intersections. TSP is one strategy that can help mitigate this delay and can save between 3 and 10 percent of travel time, depending on the operating context.

TSP is a modification of the phase split times of a traffic signal. Generally, the green phase is extended or the red phase truncated to provide more time for the transit vehicle to pass through the intersection. TSP can be implemented at a single intersection or at a number of intersections along a transit corridor. Signal times given to the transit vehicle upon TSP actuation are generally recovered by cross streets on the following signal cycle or cycles, still allowing for signal loop coordination. TSP is particularly effective when combined with complementary time savings strategies such as stop consolidation or the relocation of near-side bus stops to the far side of an intersection.

TSP is often found to work best with far-side transit stops, as this allows the transit vehicle to clear the intersection before stopping to load and unload passengers. As a result, the time that it takes the transit vehicle to clear the intersection after being detected by the controller is more predictable. Alternatively, the major benefit of TSP for near-side stops, especially under moderately congested conditions, is the ability to clear the general traffic queue between a transit vehicle and the near-side stop. This allows the transit vehicle to only stop once, if at all, instead of twice—once behind the vehicle queue to reach the stop, and a second time while waiting to load and unload passengers. One obstacle to installing TSP can be concern about delays for cross street or other through traffic due to the extended green time for transit. However, increases in cross-street traffic delay accompanying TSP have been shown to be fairly low, ranging from 0.3 to 2.5 percent.[10]

DVRPC has explored the potential of TSP as an emerging best practice in prior planning projects with SEPTA. For purposes of order-of-magnitude time savings estimates, previous studies drew on the TSP experiences of Los Angeles and Portland in referencing a rule-of-thumb reduction of 6.8 percent in running time savings following TSP implementation.[11] Specifics from the Los Angeles implementation are described in a case study on the following page. The travel time savings achievable through TSP for the EBS are conservatively estimated to be around 6 percent based on prior local projects. A citywide analysis conducted by DVRPC in developing the TSP Favorability Score found Roosevelt Boulevard to be one of the most suitable corridors in the city for TSP, considering transit and traffic conditions for the corridor, as well as crossing streets and transit lines.

Recommendation for EBS and Busway:

Transit-favorable signal optimization and TSP are recommended to support EBS operations. As one of the more technically complex project elements, implementation could be phased over time.

The busway phase would add new through movements at intersections and require new signal configurations and phasing.

[10] TCRP Report 118. BRT Practitioner's Guide, Washington, DC, 2007.

[11] Delaware Valley Regional Planning Commission. Speeding Up SEPTA: Finding Ways to Move Passengers Faster, Philadelphia, PA, 2008.

CASE STUDY: LA METRO ORANGE LINE (CONSIDERED "FULL BRT" BECAUSE IT HAS ITS OWN SEPARATED RIGHT-OF-WAY)

Location: Los Angeles, California

Service Connections: *Subway and local bus*
Potential Applicability for Roosevelt Boulevard EBS and Busway: Real-time information systems, off-board fare payment, TSP, park-and-ride at bus stops, large stations[12]

The Los Angeles Metro Orange Line opened in 2005 and since implementation has been widely viewed as a tremendous success, due to its high transit ridership and decrease in end-to-end travel times. In 2012 it was estimated that 18 percent of passengers using the Orange Line switched from a drive commute to take transit, and a total of 33 percent of all users had a car available to use for their trip. The Orange Line route runs on a physically separated busway, shown in Figure 5.9, and is part of the LA Metro Rapid system, which includes BRT elements of varying scales. Although there are many major BRT elements that were implemented for the Orange Line that have performed well, the impacts of TSP and lessons learned are particularly important to understand prior to implementing TSP on the Roosevelt Boulevard corridor.

Description of TSP on LA Metro Orange Line:
The Orange Line system has implemented unconditional TSP at every intersection in the corridor. Prior to each intersection there are predetermined locations where loop-detectors detect an approaching vehicle to either grant early or extended green time. The Orange Line signals are vehicle or pedestrian actuated and standardized for specific bus speeds and dwell times per stop; traffic managers monitor priority requests in a central system. When a vehicle approaches, it is granted an early green, green extension, or a phase hold. Although priority is granted to the first bus that approaches the intersection, both directions can benefit from an extended green light. TSP does not grant preemption at every red light because this would cause major impacts on cross-street traffic and could also exacerbate bus bunching.

A post-implementation review of the end-to-end travel times for the Orange Line found that they were longer than forecast, one reason being that the estimated time savings from TSP implementation in reality was smaller than predicted. There were two contributing reasons for this lost time. First, after several accidents that occurred shortly after the service began, the speed limit was lowered for buses traveling through intersections. Second, in early travel time projections, immediate green time was likely anticipated at every intersection; in reality buses wait at red lights at certain points along the corridor.[13]

Overall, the case of TSP along the Orange Line illustrates that even for state-of-the-art practice high-impact BRT projects, operating at grade and interacting with traffic signals introduces a complex element that can significantly impact travel times. TSP can have a significant impact, but solutions are not one size fits all.

Figure 5.9: LA Orange Line Running Way

Source: LA Metro Website, 2014

[12]Los Angeles Metro, www.metro.net, Los Angeles, CA, 2014.

[13]Federal Transit Association. "Research: Peer-to-Peer Information Exchange on Bus Rapid Transit (BRT) and Bus Priority Best Practices", Washington, DC, 2012.

RUNNING WAY DESIGN

The running way for a BRT service has a big influence on the travel time and reliability of the service. For this project's short-term concept (EBS), an in-street lane dedicated to transit, vehicles accessing businesses or adjacent properties, and right-turning vehicles—a "business access and transit," or BAT lane—has the potential to decrease travel times by up to 10 percent, assuming reasonable levels of enforcement or self-enforcement through high visibility.[14] The long-term busway concept with its separated, fully exclusive lanes could decrease travel times by an estimated additional 15.4 percent, at significantly greater cost. Enforcement to restrict forbidden vehicles is necessary to garner the most significant time savings for any partial or fully exclusive running way.

ON-STREET RUNNING WAYS AND BUS LANES

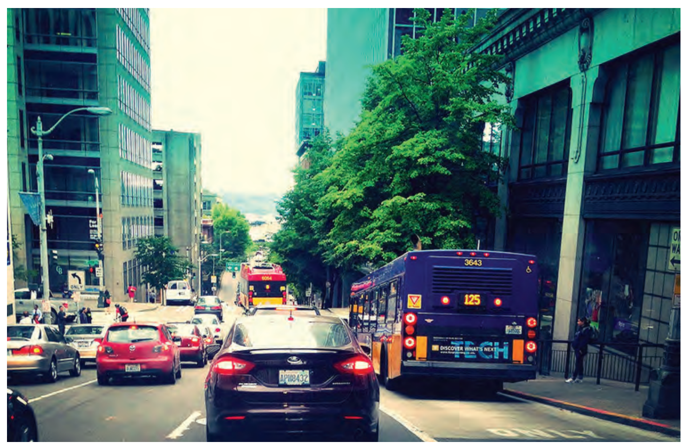
Typically a running way can be called a bus lane (as opposed to a busway) when it is distinguishable from the typical vehicle lanes on a roadway but not physically separated.

For the purposes of the Roosevelt Boulevard EBS, the most feasible short-term running way options are those that can be completed with little or no construction and within the current cartway width that will have minimal impact to vehicle capacity. The service could either run with mixed traffic or in an exclusive transit and access lane. The following are a few variations for on-street running ways implemented for peer BRT services.

- A mixed-use lane is when the transit vehicle runs in a lane open to all traffic. This is the standard operating context for local buses.
- A BAT lane is when buses share a lane with high-occupancy vehicles, vehicles accessing businesses or adjacent properties, or right-turning vehicles. Buses share space with some other road users but of a narrower mix than in a mixed-use lane, helping to save some travel time.
- A peak-hour-only bus lane is when curbside lanes or parking lanes are restricted during specific hours (peak commuting times) so the bus can run exclusively in that lane. This is another form of partial bus-exclusivity.
- A bus-only lane is when a lane that is restricted for buses only (full exclusivity) at all times but which is not curbed off or otherwise physically separated from other travel lanes.

The above bus lane types are not mutually exclusive and can be combined throughout a corridor. Implementing a vehicle-restricted on-street running way will impact other traffic and transit patterns; therefore, important details to consider or evaluate before recommending specific restrictions are: current capacity, public education of the changes being made, parking impacts, turning vehicles, and local access to adjacent properties. Figure 5.10 shows an example from the RAPIDRIDE in Seattle. In the photo, both RAPIDRIDE (the BRT) and a local bus are using the BAT lane.

Figure 5.10: Seattle RAPIDRIDE In-Street



Source: Flickr.com @SDOTphotos

Signage and pavement markings are minimum requirements to distinguish a partial or fully exclusive transit lane from general traffic lanes. Higher levels of visibility result in higher levels of compliance and, consequently, effectiveness.

> ***Recommendation for EBS:***
> A pair of partially exclusive BAT lanes in the curbside lanes of the outer drive is recommended, with specific treatments and operating strategies to be further developed through subsequent work. Other in-street options are explored in the next section.

[14] TCRP Report 165. Transit Capacity and Quality of Service Manual, 3rd Edition, Washington, DC, 2013.

BUS LANE OPTIONS FOR THE EBS CONCEPT

As developed through the design workshop and subsequent steering committee discussions, the EBS concept includes a marked BAT lane in the outer lane of the outer drive northbound and southbound, for each EBS route's Roosevelt Boulevard extent in Philadelphia. Proposed EBS route patterns are described in Chapter 6.

PROPOSED BAT LANE EXTENTS:

- EBS-A: Bustleton Avenue (south); Woodhaven Road or Southampton Road (north)
  - 6.2 miles; no on-street parking impacts (parking already prohibited)
- EBS-B: 9th Street (south); Pratt Street (north)
  - 2.9 miles; current peak-period parking restrictions would be extended for the entire day

There are two benefits to marked bus lanes (exclusive or shared). First, they offer some measure of transit travel time savings by removing a portion of the vehicle mix. Industry literature suggests that a BAT lane can offer up to 10 percent running time savings when compared with fully mixed traffic operations, although this assumes that bus lane violations are enforced, or that a combination of high-visibility bus lane treatments and frequent bus service make the lane self-enforcing. Second, they reinforce the priority and prominence of transit in a corridor. This can be especially impactful for BRT projects as a way of differentiating the service from local buses and attracting new ridership as a result.

However, as noted in the prior section, bus lanes also present several challenges and tradeoffs with respect to cost, complexity, and capacity:

- Cost: In-street treatments have both an upfront installation cost and—perhaps more importantly—an ongoing maintenance and upkeep cost. Pavement markings and painted lane treatments can wear out quickly under heavy vehicle and bus loads, and require regular upkeep to maintain their operational and visibility effectiveness.
- Complexity: There are not yet Manual on Uniform Traffic Control Devices (MUTCD)-compliant treatments for color bus lanes or bus/BAT lane markings (New York City's red bus lane treatments are a Federal Highway Administration (FWHA)-approved experimental treatment). This means that the types of high-visibility treatments that would be most effective would likely also be more complex to implement and manage, requiring additional upfront and ongoing efforts to coordinate an FHWA-approved experiment.
- Capacity: Dedicating street space and corridor capacity for EBS means reducing it for other road users. For EBS-B, this means that curbside on-street parking (in off-peak hours) would no longer be available. Converting a lane to business and transit-access-only will require timing modifications, most likely additional time for Roosevelt Boulevard and less for the minor approaches and turning movements. This could have significant impact on the locations where congestion associated with the overlapping lefts are most severe. For both EBS-A and EBS-B, the exclusion of the bus/BAT lane as a vehicle through lane diminishes overall corridor automobile capacity. A Synchro analysis conducted by Philadelphia Streets Department staff found that excluding vehicle through movements from the outer drive's curbside lanes would increase auto delay at Grant Avenue by about 30 seconds per vehicle in the PM peak, with V/C ratios worsening from 0.89 to 1.03 and 0.82 to 1.04 in the northbound and southbound directions, respectively. Another DVRPC study, *Enhancing Bus Service on Roosevelt Boulevard-Traffic Modeling Study,* is in progress to evaluate some of these capacity issues in more detail.

Figure 5.11: SBS, New York City

Source: StreetsBlog Chicago, 2015

As noted in the prior section, the range of running way and in-street operating treatments available is quite broad (as shown in New York City in Figure 5.11), from standard white text markings communicating some form of transit preference to a color bus/turn lane with tactile elements to reinforce its special status. Converting the outer lane of the outer drive on Roosevelt Boulevard to a BAT lane will require traffic control markings and/or signage, particularly in the longer mid-block sections, to minimize non-desired vehicular usage of these lanes.

Generally speaking, more intensive and high-visibility treatments will also be more impactful from a travel time standpoint, since they will be more self-enforcing. However, some more modest treatments—particularly at station areas—could help achieve visibility objectives at a lower cost, with reduced operational impact. Table 5.2 below lists available treatments with a preliminary assessment of their impacts and upfront costs (impact [+], medium impact [++], high impact [+++]). A preferred in-street strategy will be further developed by conversations with the Transit First Committee and others, with a BAT lane treatment being technically evaluated at key intersections in the ongoing DVRPC EBS operations analysis for Roosevelt Boulevard. Chapter 6 includes more details on the estimated project costs shown here.

Table 5.2: Estimated Costs for Various In-Street Treatments

TREATMENT	LIKELY TRAVEL TIME IMPACTS	VISIBILITY IMPACTS	ESTIMATED UPFRONT COST FOR EBS-A (COMBINED NORTHBOUND AND SOUTHBOUND; FULL 6.2-MILE PROJECT EXTENT)
White text (e.g., "bus lane" or "bus and right turns only") with standard white dashed lane divider	+		$105,000—$116,000
Color text with standard white dashed lane divider	+	+	$105,000—$116,000
Text with non-textured **solid** lane divider (white or colorized; single or double)	+	++	$120,000—$230,000
Color text with **textured** lane divider (reflective delineators every 80 feet; edgeline rumble strip; additional 1 inch asphalt coat for entire lane)	++	++	$120,000 (delineators or rumble strips); $885,000 (extra asphalt coat lane height, including mill/repave costs)
White markings and lane dividers over a solid **colored lane** (epoxy over or mixed into asphalt)	+++	+++	$1,350,000
Solid **colored bus zone treatment** (epoxy over or mixed into asphalt; at station locations only; 180-foot length)		++	$50,000
Color concrete pad bus zone treatment at stop locations only (180-foot length)*		++	$810,000

*Currently the City of Philadelphia prefers, but does not always have, concrete pads at bus stops to prevent pavement push; these should be provided at the new stop locations.

Source: DVRPC, 2014

PHYSICALLY SEPARATED BUSWAY

A higher-cost, higher-impact scenario for running way design is a fully exclusive, physically separated busway. This type of busway is commonly created where there is available right-of-way and finances (and operating tradeoffs) permit. When creating a new busway there are many standards to consider, such as:

- pavement structure, which is determined by the gross vehicle weight on a roadway;
- restrictions to non-transit traffic;
- pedestrian restrictions for safety purposes;
- vehicular traffic restrictions at entry and exit points to limit other vehicles accessing the busway; and
- other elements: drainage, landscaping, lighting, signage, pavement markings, and traffic control.

Figure 5.12 shows the Metropolitan Area Express (MAX) in Las Vegas. Significant travel time savings were seen through the implementation of this BRT compared to the local complementary service, with one contributing factor being the dedicated right-of-way.[15]

Figure 5.12: MAX, Las Vegas, Nevada

Source: ATKINS Engineering Group Website, 2015

Providing the BRT service with its own busway reduces traffic-related delays and thus upholds service reliability. This allows buses to travel freely without obstruction from non-transit vehicles.

There are various types of busways, including:

- bidirectional busways: dual exclusive lanes where only transit operates;
- a bidirectional lane: a single exclusive bus lane is used by transit vehicles in both directions, one at a time (similar to a single-tracked rail line); there must be restricted headways and additional signalization safeguards; bidirectional lanes can provide some reliability enhancements beyond mixed traffic lanes in congested circumstances; and
- a reversible lane: a single bus lane where the bus travels exclusively in one direction in each peak period (for example, in the morning peak period toward the Central Business District, and the reverse direction in the afternoon peak); buses not traveling in the peak direction travel in mixed traffic.

Long-term busway concepts for Roosevelt Boulevard are explored in more detail in Chapter 7.

Recommendation for Busway:
Construct a physically separated running way along the Roosevelt Boulevard portion of the project extent.

[15] Federal Transit Administration, US DOT, and Regional Transportation Comission. “Las Vegas Metropolitan Area Expres MAX Bus Rapid Transit (BRT) Demonstration Project”, Washinton, DC, 2005.

CASE STUDY: NEW YORK CITY TRANSIT SELECT BUS SERVICE (SBS)

Location: New York, New York

Service Connections: Subway and local bus
Potential Applicability for EBS: Curbside bus lanes, TSP, real-time travel information, new bus shelters, off-board fare payment

NYCT Select Bus Service Exclusive Lanes

New York City Transit developed a number of enhancements applied to their local bus fleet to create the new SBS that currently operates in six corridors throughout the boroughs of New York City. A common element that Philadelphia shares with New York is the density of commercial and residential uses compared to many other North American cities. While there are many upgrades that NYCT and New York City Department Of Transportation (NYCDOT) used in their implementation of SBS, most relevant for the EBS are the use of concurrent-flow curbside bus lanes in the majority of the corridors with service. This section will detail the process to install bus lanes as well as the lessons learned thus far.

In developing a preferred treatment, NYCDOT had specific requirements for the painted lanes that included high visibility (visual signal for drivers), durability (length the product would last), safety (skid resistance), low cost, ease of installation (realistic to install without lengthy lane closure), and ease of patching.

Red Bus Lanes

Newer SBS lanes are painted a terra cotta color using epoxy street paint and are either in the curbside lane or an offset bus lane (which is one lane from the curb, making parking and loading possible at the curb). **The following are the permissions and restrictions for the bus lanes in various locations; cameras are used as an enforcement mechanism.**

- a peak-hour-only lane, or a lane that is restricted to buses only during certain hours of the day, and is also signed with specific vehicle restrictions;
- emergency vehicles are permitted to drive in the bus lane at any time;
- vehicles may enter to make a right turn if their turn is at the next corner; and
- other vehicles may enter the bus-only lane to drop off or pick up passengers.

The major benefit to transit is the travel time savings for buses because of the decrease in congestion from other vehicles. The red paint is a visual cue to drivers to obey bus lane rules and helps self-enforce instances of vehicles using the bus lane illegally.[16]

The red painted lanes were deteriorating in many places within a few years or months in some cases; therefore, NYCDOT issued a *Request for Information Regarding Red Bus Lane Treatments in New York City* in 2010. Along with dirt pileup and utility paint infringement, **the following problems were listed as major contributing factors to the observed poor durability of the red painted lanes.**

- Red paint does not adhere well to concrete and peels rapidly or within months of implementation.
- Red paint does not adhere well to older asphalt and cracks and degrades within a year.
- In the station area, the red paint deteriorates due to heat exposure from bus engines starting and stopping.
- The water buildup in the street gutters leads to rapid peeling of the red paint close to the curb.

In 2011 and 2012, research was completed and compiled to create a *Red Bus Lane Treatment Evaluation* document. The point of the evaluation was to test nine products from seven manufacturers both in the lab and in the field to find the most resistant product. There were two screenings: one, two weeks after installation; and the second, six months later after many miles of bus traffic and a winter season. Figure 5.13 shows the painted bus lanes in New York City.

DVRPC contacted the NYCDOT to discuss their current programs for the red painted lanes. The program's current practice is to continue to use the epoxy street paint in use

[16] New York City Department Of Transportation. 'New York City Department of Transportation Request for Information Regarding Red Bus Lane Treatments in New York City", New York, 2010.

for the initial installation, but wherever possible they are painting on freshly resurfaced streets (and where they are not, they are using shot-blasting or water-blasting to clean the roadway surface first). They are also putting down white markings ("Bus Only") before applying the red, since the standard thermoplastic material was not adhering well to the epoxy paint. NYCDOT is continuing to test additional products as well; the manufacturers have been improving the product quality, both in terms of the color, and in terms of the fumes emitted, so there is more promise in the future. Additionally, there are plans to test red-tinted asphalt, which has a very high cost, but the durability should be much higher than painting.

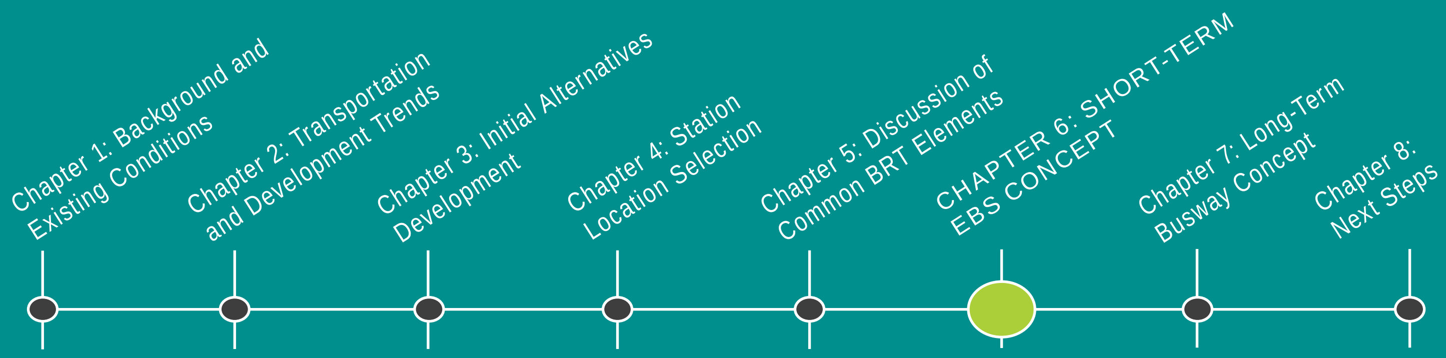
If a painted bus lane is implemented for the EBS, it should be installed as part of an official experiment approved by FHWA since it is not yet an MUTCD-compliant treatment.

Figure 5.13: SBS, New York City

Source: The Official Website of the City of New York, 2015

Chapter 6:

SHORT-TERM EBS CONCEPT



This section details the concept plan for EBS-A and EBS-B, including: bus operating patterns, bus frequency, typical station layouts with a design toolkit, and a station site design for each of the selected locations. These concepts build on the work written and reviewed in the report thus far, specifically the EBS recommendations in Chapter 5.

SERVICE ROUTES AND FREQUENCY

To determine proposed route patterns, the study team began by reviewing ridership data from three bus routes that serve Roosevelt Boulevard. The analysis included Route 14, which has the highest ridership on the northern end of the corridor, and Route R, which has the highest ridership on the southern end of the corridor. In addition, SEPTA Route 1 data was collected and reviewed because it provides service to the entire Roosevelt Boulevard study corridor, except Neshaminy Mall. There are two sets of data used throughout this section. The first is a passenger survey completed by DVRPC in 2012 for the AM and Midday periods; only the AM Peak is used in this analysis. Passengers filled out a form indicating their origin, destination, and the service or services used to get to their destination. Address information was subsequently mapped and used to verify routing information. The second dataset is SEPTA stop-level ridership from spring 2012 and fall 2012 and 2013 (APC and Ridecheck, respectively).

SEPTA Service Planning and the steering committee decided that an iterative and phased implementation of service would likely have the lowest cost, be fastest to get underway, and build the most ridership.

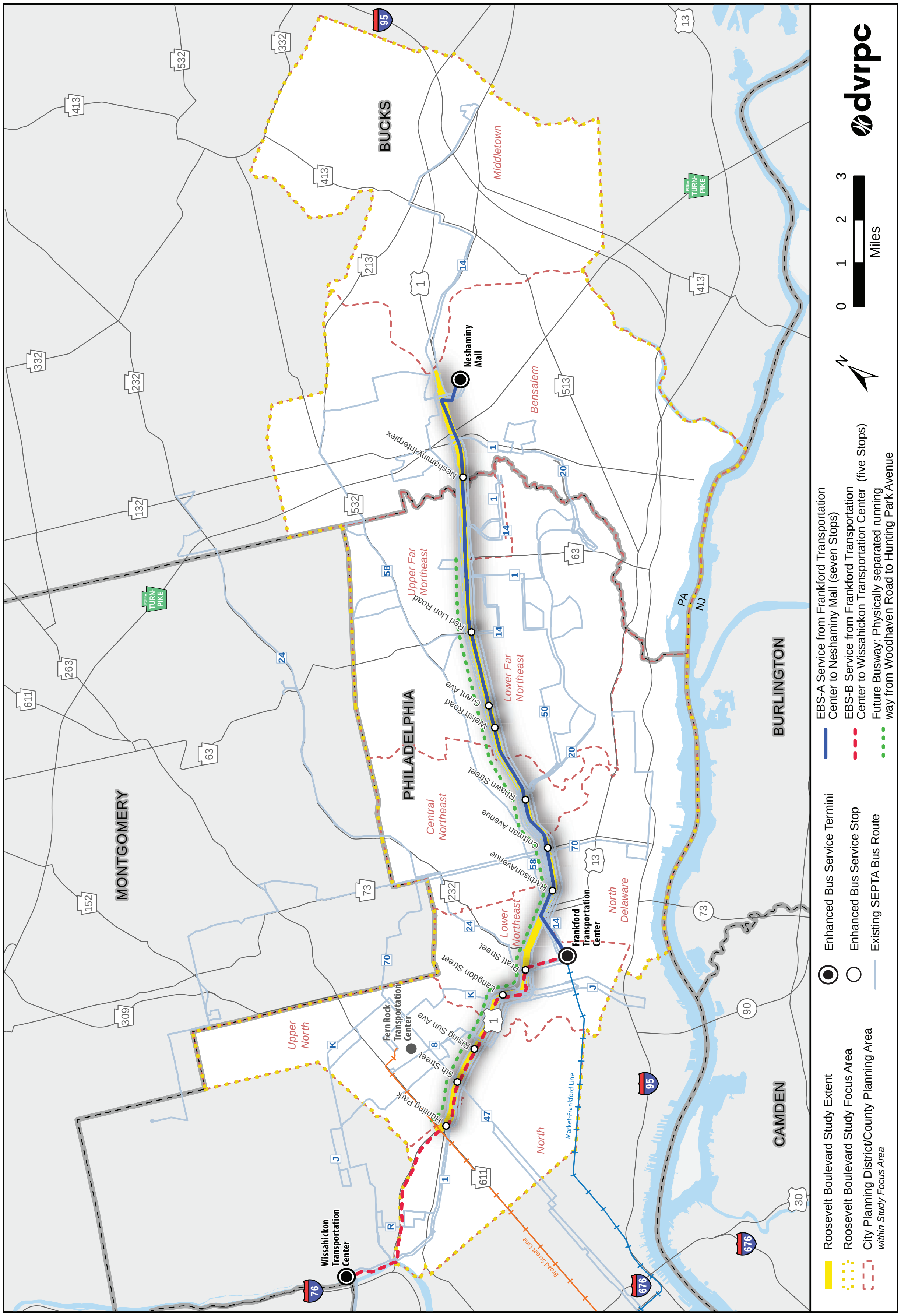
The process can be summarized as follows:

- The new EBS-A route based on the highest-priority stops will be deployed, and **layered onto existing local service (which would continue, other than the Route 14 Limited).**
- After one or more schedule cycles, EBS-A route performance will be reviewed.
- Changes and updates will be made to the EBS-A service, as well as other area transit service.
- This process would be repeated for the EBS-B (if implemented) and any other EBS routes.

Figure 6.1 illustrates a phased approach of service implementation using this type of iterative process for the Roosevelt Boulevard corridor. Phase I would implement the first proposed route, EBS-A. This route would operate between FTC and Neshaminy Mall, serving seven stations along Roosevelt Boulevard, and would have a similar route pattern to the current Route 14. Figure 6.1 shows EBS-A's alignment in blue. This was chosen as the first route to implement for the following reasons:

- Existing ridership patterns suggest that a smooth transition could be made for passengers from Route 14 to EBS-A due to the travel time savings and shared high-ridership stop locations.
- The route is mostly linear, direct, and therefore easily understood by both current and potential passengers, as well as by SEPTA staff.
- Both termini, FTC and Neshaminy Mall, are already destination points and key trip generators, which increases the chance of higher passenger loads for the service.

Figure 6.1: Phased Approach to Service Implementation

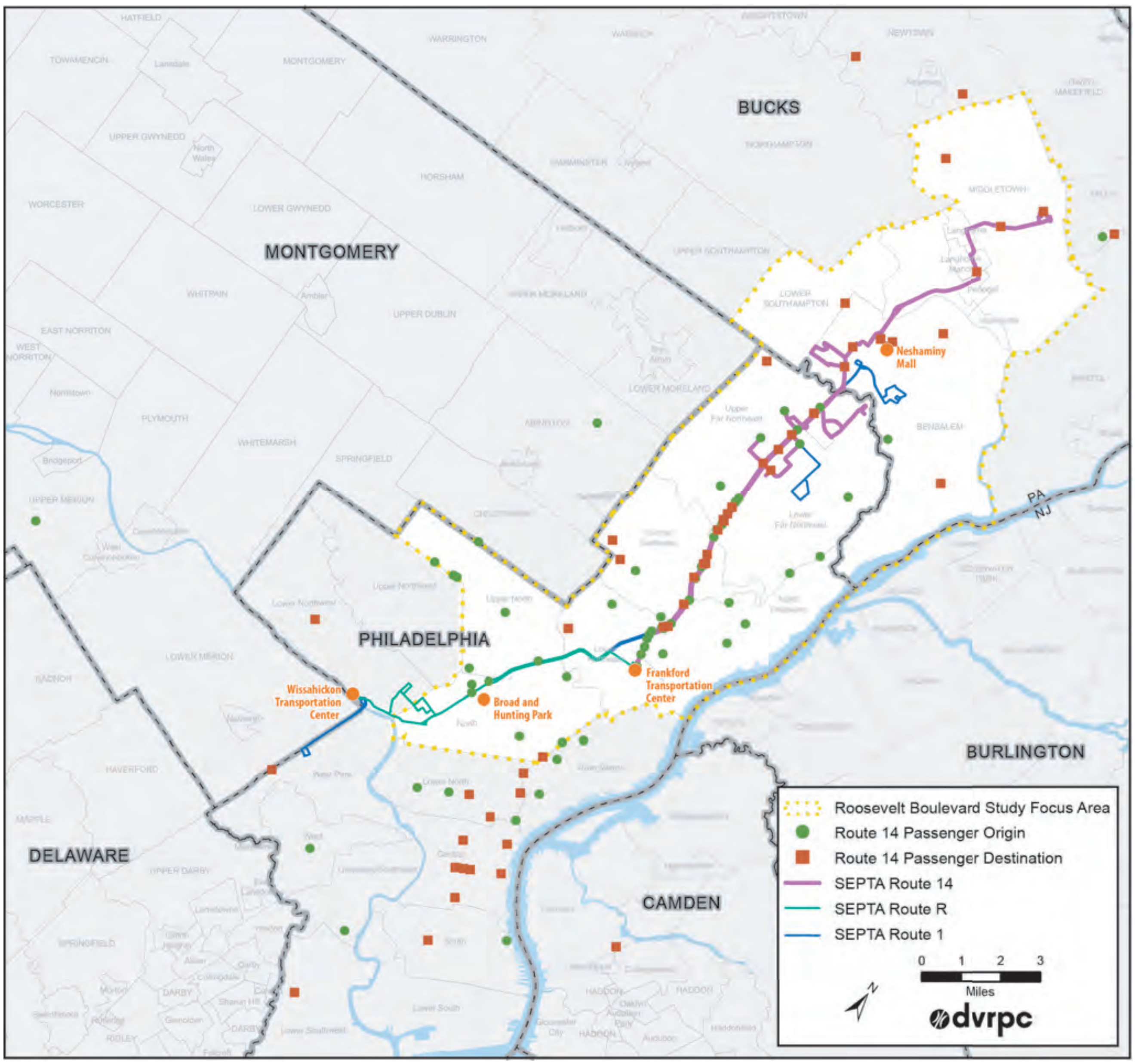


After EBS-A has been active for one or more seasonal schedule changes, route performance would be reviewed. SEPTA staff would use performance measures that are already being monitored (e.g., ridership, on-time performance, customer satisfaction, etc.) to make judgments on successes and deficiencies of the service. Following this evaluation, changes could be made to EBS-A service patterns and lessons learned can be used when promoting and implementing the second proposed route, EBS-B.

Figure 6.2 shows the origins and destinations of passengers using Route 14 in the AM peak time period and shows that many southbound commuters are transferring at FTC and traveling into Center City and other employment centers to the south. This market would be served well by the EBS-A. One downside to this implementation is that many corridor passengers who start or end their trips from points south of FTC will still rely on transfers to get to their destination if they are traveling north of FTC.

Figure 6.3 shows origins and destinations of passengers using FTC, either to transfer or as their end point of SEPTA transit service. This figure illustrates that most origins of passengers are in Northeast Philadelphia traveling inbound to

Figure 6.2: SEPTA Route 14 Origin and Destination AM Peak Analysis

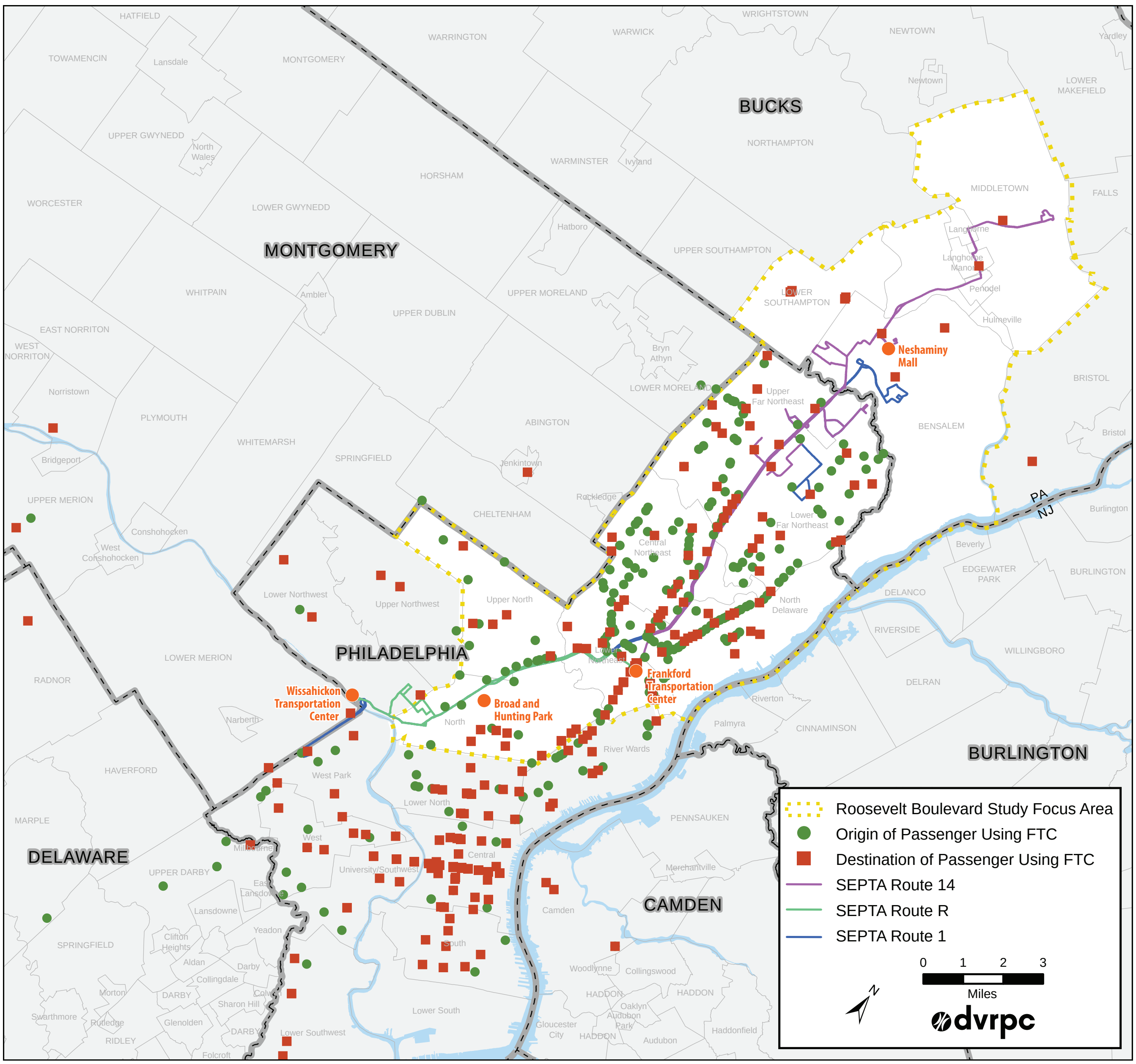


Center City, West Philadelphia, and University City, an overall travel pattern that the EBS-A would supplement well.

EBS-B is proposed to implement a second service from WTC to FTC, the same termini as the current Route R, shown in Figure 6.4. By building on another successful existing service (Route R), EBS-B will be legible for SEPTA passengers and staff because of its similar route pattern and termini. Additional transfers available at WTC will allow a larger group of passengers with many travel patterns to benefit from enhanced service. EBS enhancements (e.g., dedicated bus lanes, TSP, etc.) will still focus on Roosevelt Boulevard east of Broad Street. Currently WTC is at capacity; therefore, EBS-B would not be implemented until renovation of the transportation center occurs to accommodate additional buses, or an alternate option that creates capacity arises.

There was discussion about serving Erie Station with the EBS-B instead of Hunting Park Station. Hunting Park seems to remain the best near-term option, since it is closer to Roosevelt Boulevard and much more accessible from the EBS-B's preferred expressway alignment west of Broad.

Figure 6.3: FTC Origin and Destination AM Peak Analysis



Wyoming Station was suggested as another alternative to Hunting Park; however, this was not modeled in any of the scenarios due to its distance from Roosevelt Boulevard. Figure 6.4 shows the origins and destinations of passengers traveling on Route R in the AM Peak period. The origin and destination points are primarily along Roosevelt Boulevard, between WTC and FTC. There are fewer points north of FTC, which suggests that reinforcing this service pattern rather than providing a through service would not represent a lost opportunity for many existing riders.

Figure 6.4: SEPTA Route R Origin and Destination AM Peak Analysis

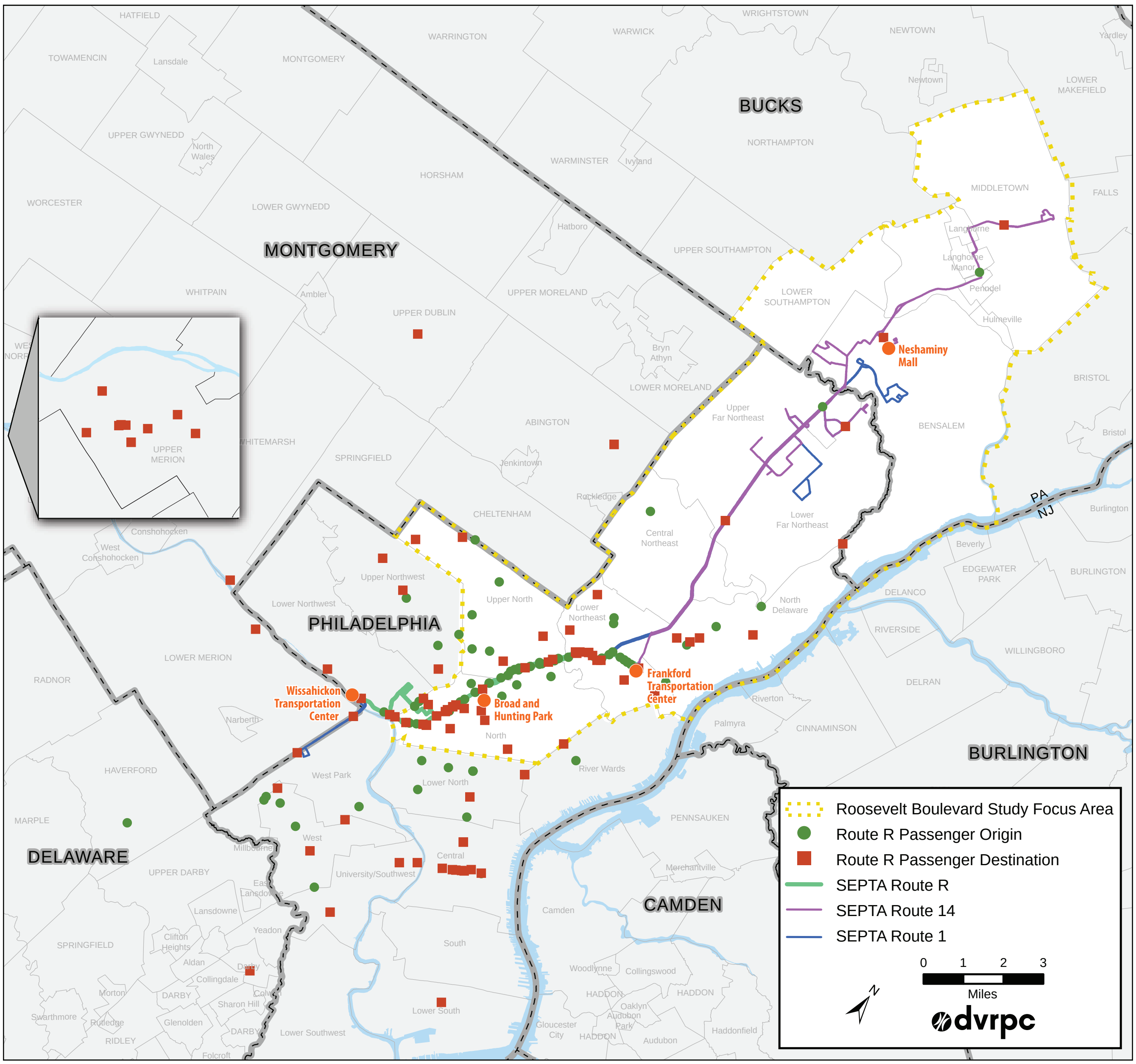


Table 6.1 illustrates potential existing passenger markets by stop for the EBS-A and B services by identifying boards by direction for Routes R, 1, and 14 (the three routes presently serving the proposed EBS travel markets). In addition, high-ridership locations south of Roosevelt Boulevard (between Hunting Park and WTC) were included as potential additional stop locations for the EBS-B service. Each table also displays the boards for the Route 14 Limited service, which has 11 total daily runs and stops at 26 of the 105 stops of the local Route 14. The percentage of passenger boards of the Limited Route 14 service is shown as a portion of total Route 14 passenger boards: despite representing less than 4 percent of weekday vehicle trips (11 of 290), Route 14 Limited captures roughly 20 percent of passengers at several stops. This illustrates the success of the Route 14 Limited, a market the EBS-A would build on. Table 6.1 makes it clear that Routes R and 14 are high-ridership routes, while SEPTA Route 1 has lower ridership.

EBS-B service was originally proposed to serve Roosevelt Boulevard from Hunting Park (Broad Street Line) to Neshaminy Mall. There are two reasons why the new more westerly oriented route pattern for EBS-B service is suggested instead.

1.) The Neshaminy Mall to Hunting Park route pattern was extremely similar to the EBS-A proposal, creating an overlapping service and possibly confusion at stop locations for passengers.

2.) Ridership numbers in the southern portion of the Roosevelt Boulevard corridor and beyond indicate a limited service could be successful for a Route R-like service pattern.

PROPOSED FREQUENCIES FOR EBS

Enhanced bus or BRT-like services are typically linear and more frequent than local service. These advantages make it easier for the occasional or everyday passenger to use the service. FTA Small Starts BRT standards of 10-minute peak period and 15-minute off-peak headways running for at least 14 hours per day were used as a reference for frequencies for the service. Figures 6.5 and 6.6 illustrate northbound and southbound boards by five time periods for Routes 1, 14, and R, aggregated by direction and time period. This data indicates fairly consistent all-day usage, suggesting that high all-day frequencies are desirable and appropriate.

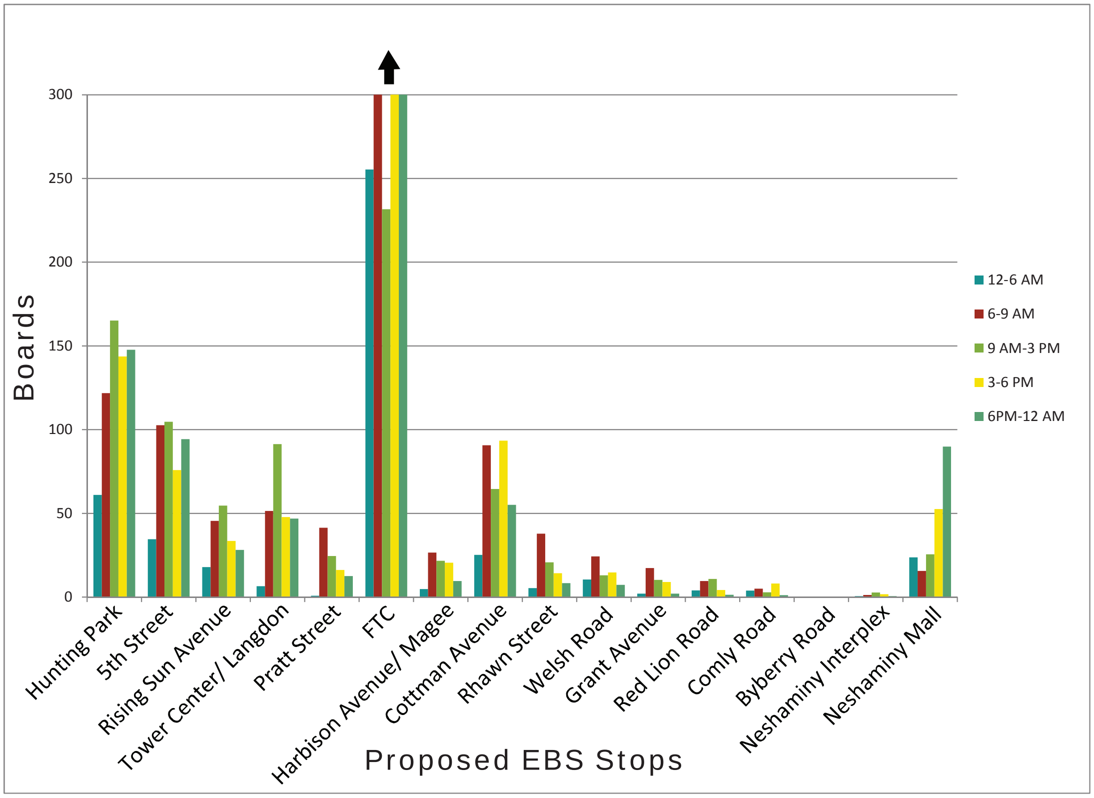
Table 6.1: Total Weekday Boards for SEPTA Routes 1, 14, and R (Select Stops)

Stop	Total NB Weekday Boards: Routes 1, 14, R				Share of Route 14 Limited Boards of Total Route 14 Boards
	Route R	Route 1	Route 14	Route 14 Limited	
Wissahickon TC	555	93			
Ridge Av. And Midvale Av.	81	21			
Hunting Park & Fox St.	56	1			
Hunting Park & Pacific Av.	440	79			
Hunting Park & Germantown Av.	275	68			
Hunting Park/ Roos. Blvd. & Broad St.**	401	82			
Broad St. & Roos. Blvd.	636	145			
5th St. & Roos. Blvd.	295	88			
Rising Sun Av. & Roos. Blvd.	174	46			
Tower Blvd./Langdon St. & Roos. Blvd.	243	53			
Pratt St. & Roos. Blvd.	97	17			
FTC	57		1820	181	10%
Harbison Av./ Magee Av. & Roos. Blvd.		11	72		
Cottman Avenue & Roos. Blvd.		69	260	60	18%
Rhawn Street & Roos. Blvd.		17	70	17	20%
Welsh Road & Roos. Blvd.		11	58	4	6%
Grant Avenue & Roos. Blvd.		7	34	6	15%
Red Lion Road & Roos. Blvd.		4	26	5	17%
Comly Road & Roos. Blvd.		1	20	1	5%
Neshaminy Interplex & Roos. Blvd.		1	6	0	0%
Neshaminy Mall			207	17	8%

Stop	Total SB Weekday Boards: Routes 1, 14, R				Share of Route 14 Limited Boards of Total Route 14 Boards
	Route R	Route 1	Route 14	Route 14 Limited	
Neshaminy Mall*			12	41	336%
Neshaminy Interplex & Roos. Blvd.		3	61	8	13%
Comly Road & Roos. Blvd.		0	27	5	19%
Red Lion Road & Roos. Blvd.		47	152	27	18%
Grant Avenue & Roos. Blvd.		29	92	18	20%
Welsh Road & Roos. Blvd.		59	208	12	6%
Rhawn Street & Roos. Blvd.		22	64	3	5%
Cottman Avenue & Roos. Blvd.		90	118	19	16%
Harbison Av. & Roos. Blvd.		10	27		
FTC	1,398		8	0	0%
Pratt St. & Roos. Blvd.	230	40			
Langdon St. & Roos. Blvd.	63	31			
Rising Sun Av. & Roos. Blvd.	133	27			
5th St. & Roos. Blvd.	258	66			
Broad St. & Roos. Blvd.**	353	82			
Hunting Park & Germantown Av.	94	20			
Hunting Park & Wissahickon Av.	221	59			
Hunting Park & Fox St.	13	1			
Ridge Av. And Midvale Av.	30	19			
Wissahickon TC	0	26			

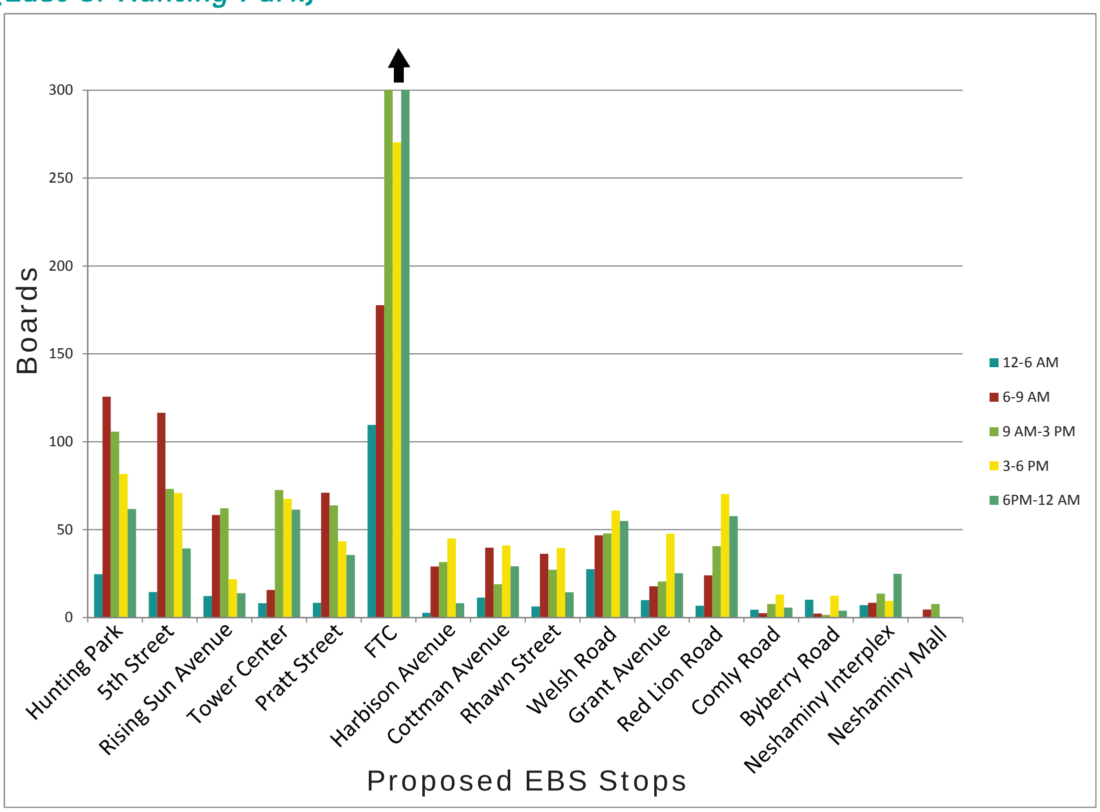
Sources: SEPTA Spring 2012 APC & Fall 2012, 2013 Ridecheck
** Neshaminy Mall numbers are distorted due to issues with the Ridecheck data.*
***Broad Street and Roosevelt Boulevard and Hunting Park and Broad Street have combined ridership here.*

Figure 6.5: Roosevelt Boulevard Northbound Boards Combined for Routes 1, 14, & R (East of Hunting Park)



Source: DVRPC, 2014

Figure 6.6: Roosevelt Boulevard Southbound Boards Combined for Routes 1, 14, & R (East of Hunting Park)



Source: DVRPC, 2014

The following are the proposed operating patterns for Roosevelt Boulevard enhanced bus service that the steering committee favored during the course of this study through a series of workshops, meetings, and interim deliverables.

- Twelve stops and three termini were prioritized along the corridor either due to their high ridership or transfer capabilities.
- Two routes are proposed in the short term. EBS-A will provide service from Neshaminy Mall to FTC, building on SEPTA Route 14 local service (replacing the current limited service), while EBS-B will provide service from WTC to FTC, building on SEPTA Route R local service. EBS-B will operate on the US 1 Expressway between Hunting Park and WTC (with no intermediate stops) because of the potential for much faster travel times.
- EBS service would decrease current end-to-end travel times and create a rapid transit passenger experience by implementing: TSP, low-friction fare payment and multidoor boarding, real-time passenger information, distinctive vehicle and station branding, and high-visibility transit-preferential running way treatments. Recommendations for these elements are discussed in Chapter 5.
- Proposed service frequencies are 10 minutes during peak weekday hours; 15 minutes early morning, midday, and early evening; and 30 minutes from 9:00 PM until 12:00 AM. Only local service is proposed from 12:00 AM to 5:00 AM (shown in Table 6.2). Weekend service not determined.

In addition, Table 6.3 provides an estimate that was provided by SEPTA of operating costs for the weekday service of EBS-A. This route would replace the current Route 14 Limited; and SEPTA estimates that would save approximately five hundred thousand dollars annually, partially offsetting the added costs for the new service.

Table 6.2: Proposed EBS-A Frequencies

PERIOD	HOURS	FREQUENCY
AM Peak	5:00-7:00 AM; 7:00-9:30 AM	15 minutes;10 minutes
Midday	9:30 AM-3:30 PM	15 minutes
PM Peak	3:30-6:00 PM	10 minutes
Evening	6:00-9:00 PM; 9:00 PM-12:00 AM	15 minutes; 30 minutes
Overnight	12:00-5:00 AM	Local Service Only

Sources: DVRPC; and SEPTA, 2014

Table 6.3: Estimated EBS-A Operating Costs (from SEPTA)

UNIT	DAILY AMT.	TOTAL ANNUAL AMOUNT (DAILY AMT. X 255 WEEKDAYS PER YEAR)	MULTIPLIER ($ PER VEHICLE)	ANNUAL COSTS
Time (hours)	130 hours, 41 minutes	33,324	$59.71	$1,947,464
Miles	1,902.91	485,242	$3.87	$1,877,887
Peak Vehicles	8	N/A	$41,400.00	$331,200
Total Costs				$4,156,551

Source: SEPTA, 2015

ESTIMATED TRAVEL TIMES FOR EBS

Once the station selection, BRT elements, route pattern, and frequencies were all established, the DVRPC study team estimated EBS-A and EBS-B travel times as shown in Table 6.4, including sources (calculated from left to right). These estimates suggest that the EBS treatments and service patterns can save roughly one-third of local bus running times, offering a transit option that is much more competitive with driving for the equivalent trip. These estimated travel times were used to inform the ridership forecasts summarized later in this chapter.

Table 6.4: Travel Time Estimates for EBS-A and EBS-B

ROUTE AND ENDPOINTS			CALCULATING ESTIMATED BUS TRAVEL TIMES			TRAVEL TIME COMPARISON		
	Northern Terminus	Southern Terminus	1. AM peak auto travel time	2. Time added for buses between endpoints	3. Time subtracted for buses between endpoints	= Estimated bus travel time	Current travel time for comparable transit trip	Transit time savings
EBS-A (Phase I) *Stops at:* Neshaminy Mall Neshaminy Interplex Red Lion Road Grant Ave Welsh Road Rhawn Street Cottman Ave Harbison Ave Frankford TC	Neshaminy Mall	FTC	29 minutes	Dwell Time*: 7 stops x 35 seconds ([17 pass/stop x 1.2s] + 15s) = 4.13 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 4.35 minutes	TSP [south of Southampton Road, inc. Bustleton]: 6% (1.7 minutes) Bus-only lane shared with business access and right turns [Southampton Road to Bustleton Ave]: 10% (2.6 minutes)	33.2 minutes	47 minutes (Route 14)	13.8 minutes (29%)
EBS-B (Phase II) *Stops at:* Frankford TC Pratt Street Tower Center Rising Sun Ave 5th Street Hunting Park (BSL) Wissahickon TC	FTC	WTC	21 minutes	Dwell Time*: 5 stops x 44 seconds ([24 pass/stop x 1.2s] +15s) = 3.65 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 3.15 minutes	TSP [Broad Street to Pratt Street]: 6% (0.8 minutes) Bus-only lane shared with business access and right turns [Broad Street to Pratt Street]: 10% (1.3 minutes)	25.7 minutes	39 minutes (Route R)	13.3 minutes (34%)

**Dwell Time: 120 boards plus alights (maximum Route 14 non-terminal passenger activity for a southbound run; a proxy for highest single-run loads) divided by number of stops (assumes same demand, differently distributed) and multiplied by 2.9 seconds per passenger (standard fare payment) or 1.2 seconds per passenger (prepaid fares/multidoor boarding and alighting). Fifteen seconds per stop is added in all cases for bus deceleration (5 seconds) and acceleration (10 seconds).*

***Auto-derived travel times between stops were adjusted to reflect slower acceleration and deceleration for buses, based on a rule of thumb that buses operate 5 mph slower than equivalent general traffic speeds. Per VPP data, end-to-end auto operating speeds in the study area are roughly 32.5 mph southbound at 8:00 AM; 5 mph is 15 percent of 32.5 mph. As a reasonable, round estimate, 15 percent was also applied as an overall bus speed penalty to transit travel time calculations for other segments.*

Sources:
Transit Capacity and Quality of Service Manual (TCQSM), 3rd Edition, TCRP Report 165, 2013
BRT Practitioner's Guide, TCRP Report 118, 2007
Current auto travel times: Google Maps, 2014; and I95 Corridor Coalition VPP, 2013 calendar year data

Travel time index: I95 Corridor Coalition VPP, 2013 calendar year data
Current equivalent transit travel times: SEPTA morning peak schedule data via Google Transit, December 2013

EBS FACILITY DESIGN

The BRT best practices highlighted in the previous chapter point to specific implementation tools that are recommended for an enhanced bus service along Roosevelt Boulevard. Applying BRT elements such as branding, wayfinding, running way characteristics, and station elements will create the overall image, or impression, of EBS along Roosevelt Boulevard. These running way and station design characteristics will be, in large part, the public's interface and introduction to the enhanced bus service.

The design elements that characterize the running way and station are summarized in the EBS Toolkit—with concept designs for both EBS Station Layouts (Figure 6.7) and EBS Station Design (Figure 6.8). Together the Station Layout and Station Design Toolkits provide a grounded concept plan for the EBS design elements that could be applied to the Roosevelt Boulevard.

EBS DESIGN GUIDANCE

EBS Station Layout Toolkit

The EBS Station Layout Toolkit provides design guidance on the bus zone, shelter, and other design elements that are recommended for stations. Two types of stations are described: a "typical" station that operates at most curbside locations along the Roosevelt Boulevard and occupies the minimum amount of space; and a "super station" that is located curbside along the Roosevelt Boulevard and has the elements of a typical stop, plus enhanced streetscape furnishings to emphasize the high ridership of the station and the proximity of land use destinations. A third type of station, "transit center" stations, are located off the corridor at major transportation hubs and are also terminal stations for the two proposed EBS services (as shown on EBS layout pages).

The Station Layout Toolkit draws on SEPTA's *Bus Stop Design Guidelines,* as well as conversations with SEPTA operations, service planning, and strategic planning staff, to design the two non-terminal station types that are proposed. In the street, each station is designed to accommodate up to three buses (one 62-foot articulated EBS vehicle and two 40-foot local buses) with appropriate buffer space. The project team proposes a "toolkit" or modular approach to EBS implementation, with standardized facilities (to the greatest practical extent) applied throughout the corridor. This approach reinforces project/brand identity and helps achieve upfront cost efficiencies. Conceptual station layouts for each proposed station are shown later in this chapter.

EBS Design Toolkit

The Station Design Toolkit illustrates how a project brand can be created and reinforced through consistent vehicle, station, and signage treatments, building a project identity. The EBS elements illustrated here supplement and reference the plans shown in the station layout toolkit.

EBS LAYOUTS

The application of recommended BRT elements to EBS service along Roosevelt Boulevard is shown in the following series of concept station location plans (typical, super station, or transit center) for each proposed station associated with the EBS-A and EBS-B routes. The station at Harbison Avenue would perpetuate an existing difficult southbound condition where buses must manuver across six lanes to turn left onto Bustleton to get to FTC. Because of this, during project implementation, a substitution to a station on Bustleton Avenue should be further considered.

Stations are presented in a sequence in the following pages: Figures 6.9 through 6.17 show EBS-A (south to north), then Figures 6.18 through 6.23 show EBS-B (south to north). Each station layout shows the proposed station's siting and approximate size along with contextual information on existing routes that serve the area and their 2012 boards and alights. Station siting is based on best practices that support the prioritization of EBS through intersections, minimize conflicts between bus operations and adjacent land uses, and streamline transfer activity between the EBS and local routes. For each proposed EBS station, the following principles based on BRT case study best practices and input from the steering committee were applied to station siting:

- Stations should be far side where possible.
- Local service will stop at EBS stations and may require relocating existing local stops to the far side and consolidating the stops into one station.
- Bus zones within the bus lane should be approximately 180 feet long (min.) to accommodate one EBS articulated

vehicle (62 feet) and two standard buses (40 feet) with buffer space between vehicles for pulling into and out of the bus zone. Bus zones should be free of access drives where possible but can be adapted to a smaller length and possibly overhang access drives or split between them, if siting options are limited.

While these design principles were favored, a far-side, 180-foot uninterrupted bus stop was not always possible or preferable. Situations that might lead to a stop being located near side or being split into a two-bus-zone stop include:

- Moving the stop to far side would change the station location from being in front of a commercial use to being in front of a residential use.
- An existing, high-destination land use is located on the near side.
- Strong transfer activity happens or could happen if the stop were near side.
- Existing driveway access(es) prevents a 180' continuous bus zone, and closure of the drive would have a negative effect on property access.
- Steep slopes, utilities, street trees, or other physical obstruction prevents a 180-foot continuous bus zone or bus stop.
- No sidewalk exists on the far side of the intersection, and implementation would require new walkways of considerable length.

Station plans that do not follow the EBS station principles include a short description of why the station is sited as shown. Since each of the transit center stations requires individual site planning during EBS project implementation, transit center station layout illustrations focus on the routing to that stop that is located off of the Roosevelt Boulevard corridor and, where possible, show a concept drawing of the most current plans being considered for the site.

Terminal or transit center stations (FTC, WTC, and Neshaminy Mall) will require an individual approach to implementation due to the number of passengers and routes that are served, and because each terminal station occupies a distinct parcel off Roosevelt Boulevard, not just a curbside location along the roadway. At all three terminal locations, EBS vehicles will need bus bays rather than curbside shelters like EBS typical station and super station layouts.

FTC

Improvements at FTC to accommodate enhanced bus service are unique among the other transit center stations because of the large scale of the site itself. Improvements at FTC may be as minor as installing signage for EBS or may be as ambitious as setting aside a separate EBS bay and waiting area. These accommodations should be scaled according to the most up-to-date project timing and service patterns through FTC, and balanced against the needs of the entire facility during project implementation.

WTC

An approach for planning and developing an expanded WTC is currently underway by SEPTA and the PCPC and is recommended to include accommodation of EBS-B service, as well as to add capacity for existing services. A portion of the *Philadelphia2035: Lower Northwest District* shows plans for a larger WTC area on the site plan later in this chapter and shows a new bus boarding area with bus bays in the rear of the site.

NESHAMINY MALL

An expanded mall transit center has previously been prepared by DVRPC on behalf of SEPTA, Bucks County, and Bensalem Township in the *Neshaminy Mall Transit Center Evaluation and Concept Plan*. The conceptual plans from this previous study are shown on the Neshaminy Mall EBS station site plan.

Figure 6.7: EBS Station Layout Toolkit

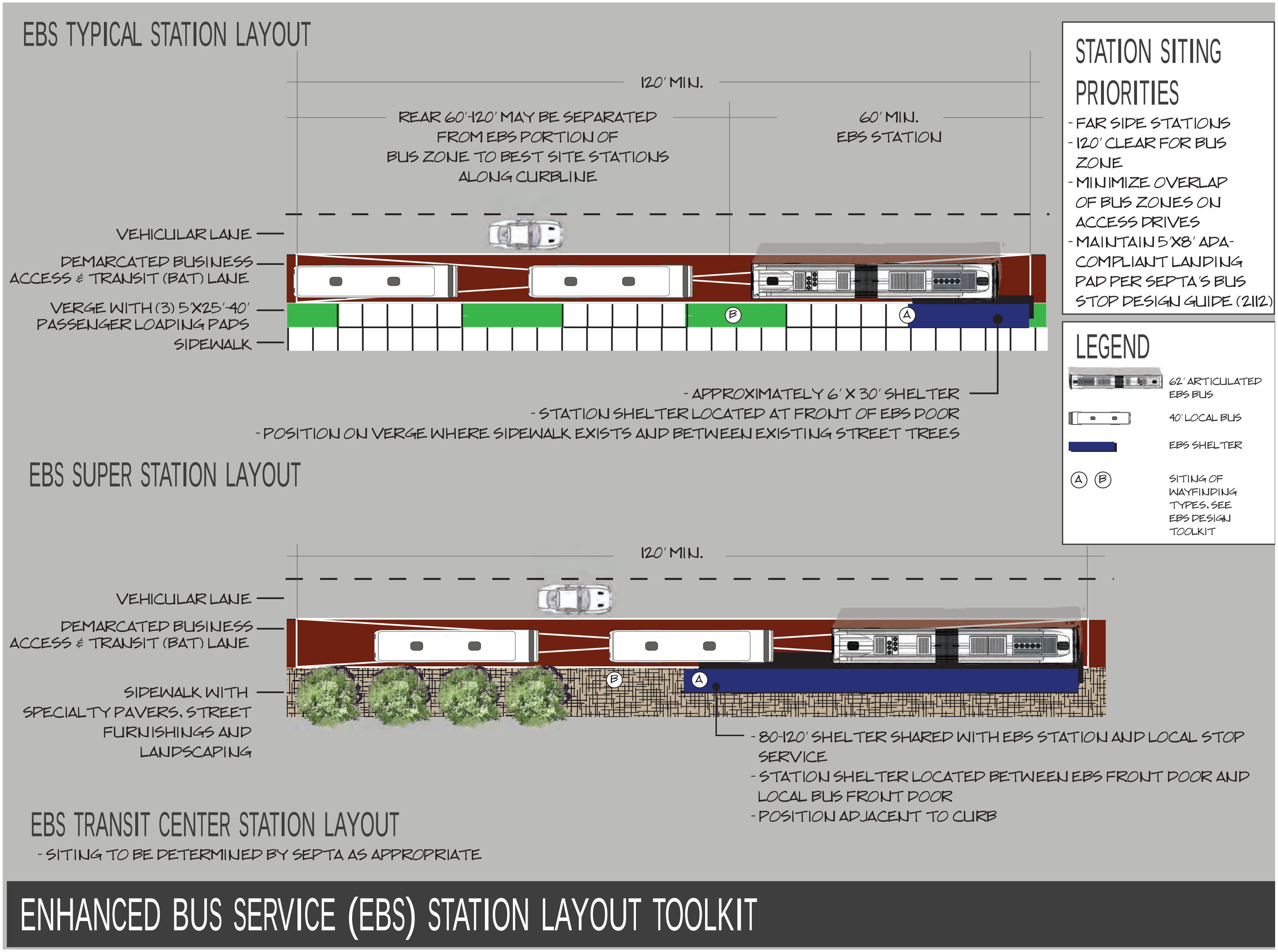


Figure 6.8: EBS Station Design Toolkit

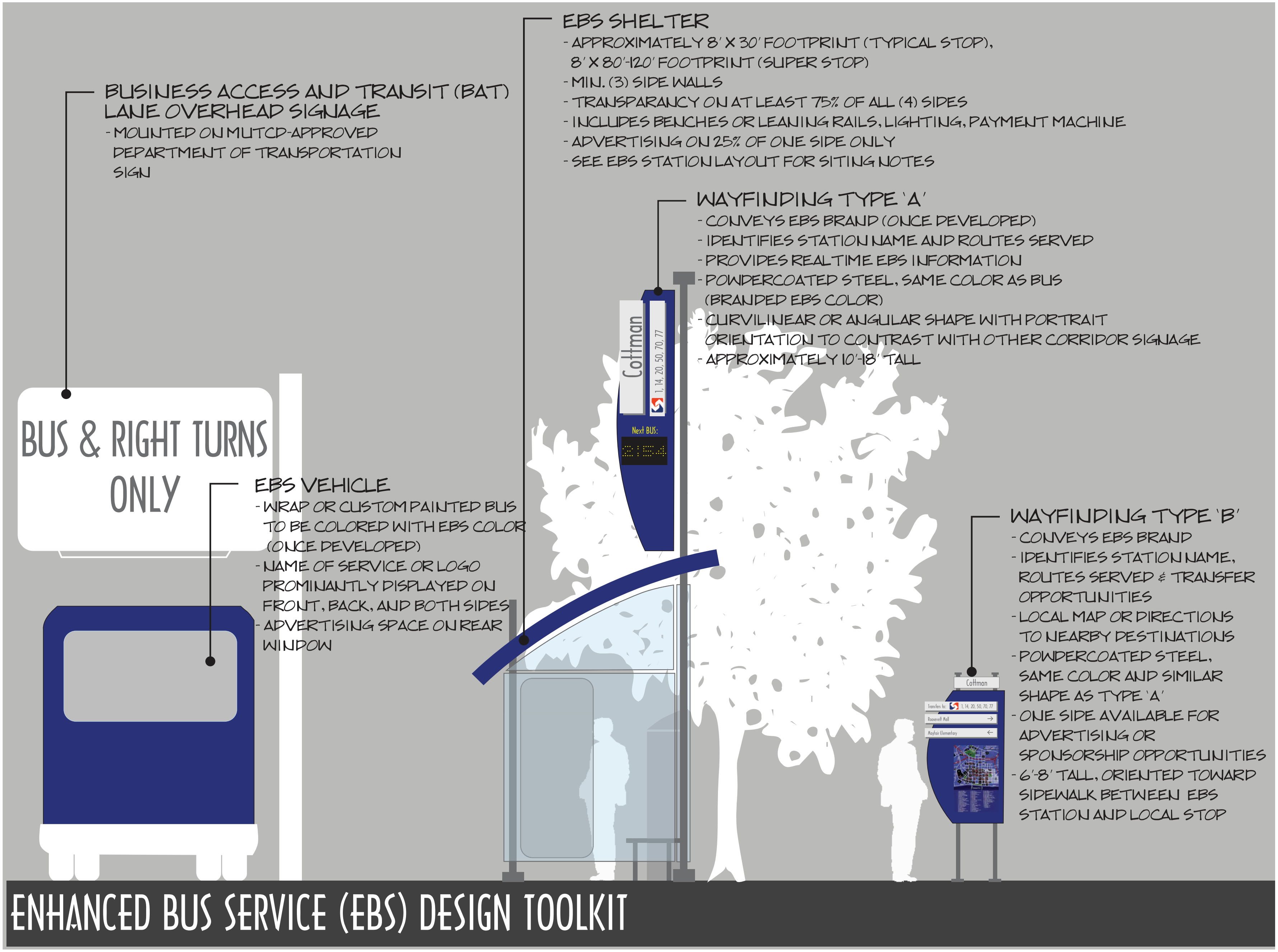


Figure 6.9: FTC Concept Plan

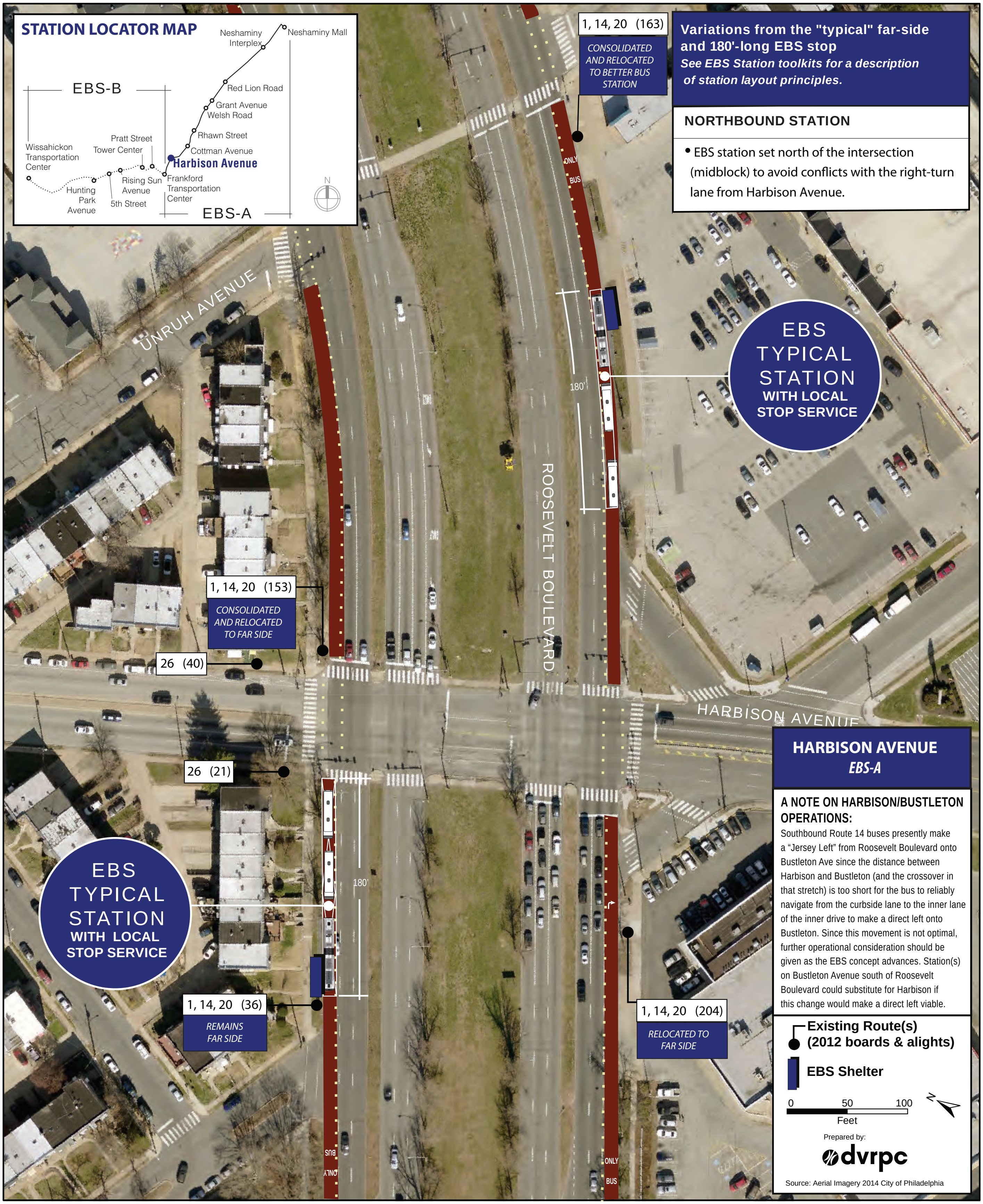
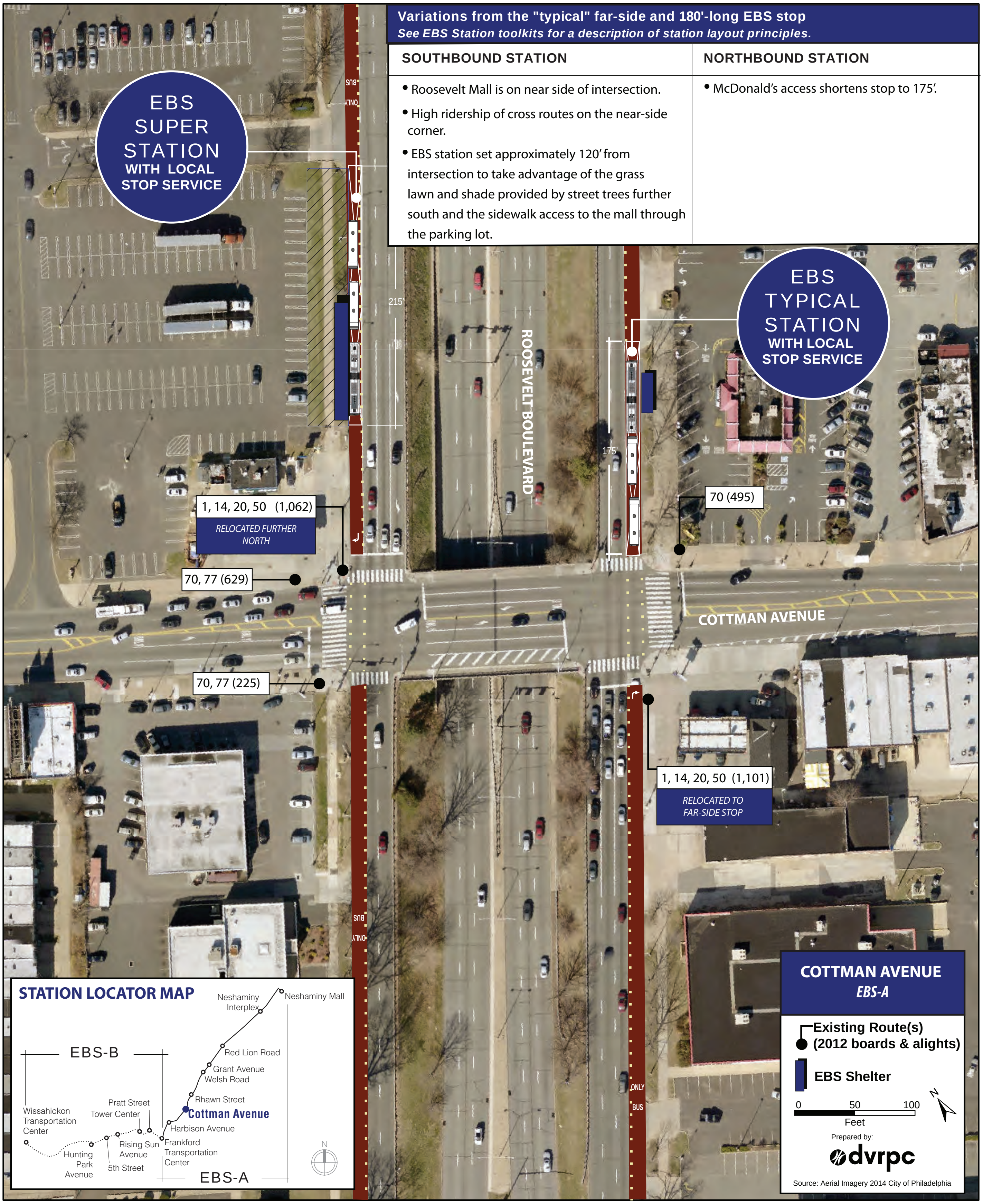


Figure 6.10: Harbison Avenue Concept Plan



SOUTHBOUND STATION	NORTHBOUND STATION
• Roosevelt Mall is on near side of intersection. • High ridership of cross routes on the near-side corner. • EBS station set approximately 120' from intersection to take advantage of the grass lawn and shade provided by street trees further south and the sidewalk access to the mall through the parking lot.	• McDonald's access shortens stop to 175'.

Figure 6.11: Cottman Avenue Concept Plan

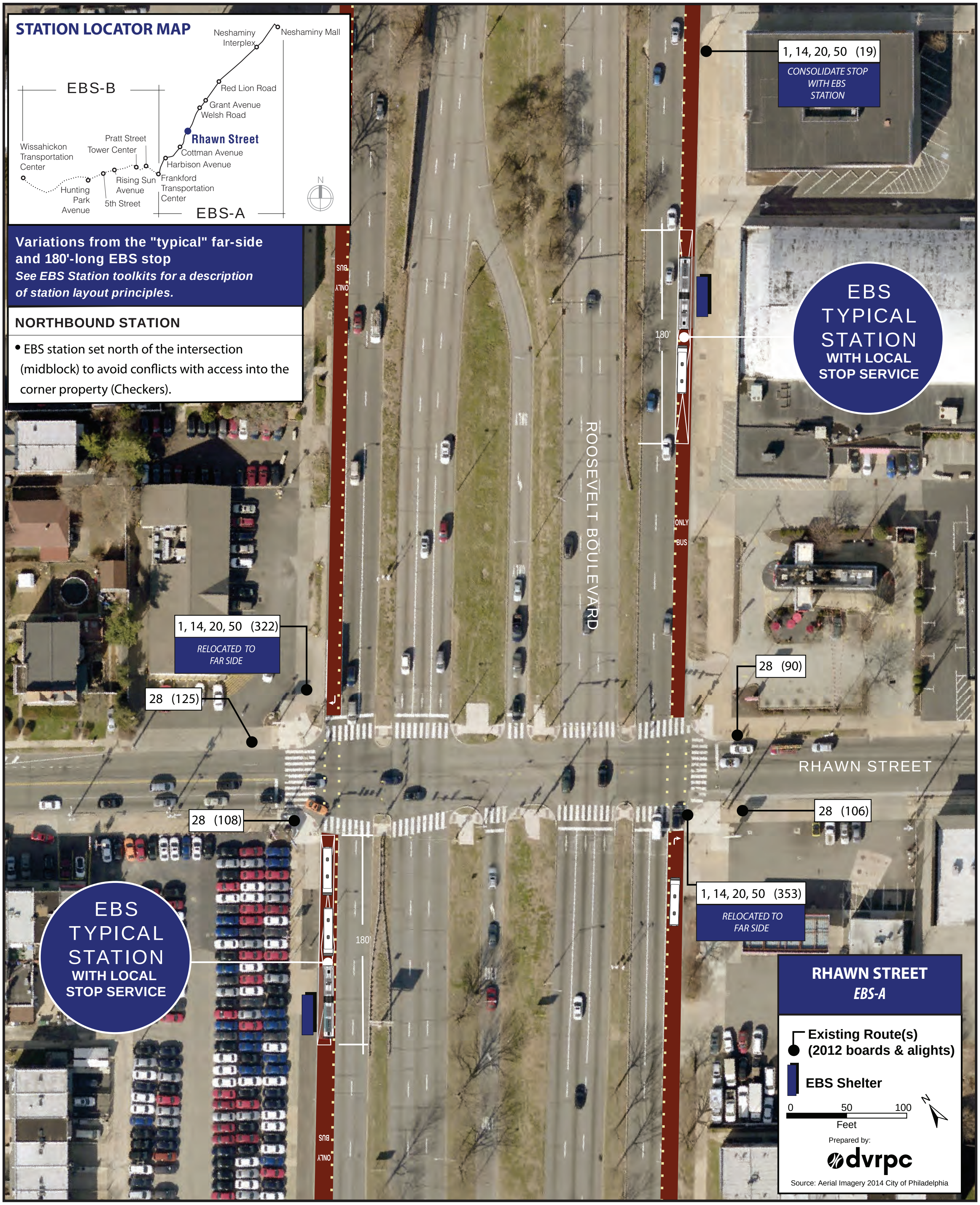


Figure 6.12: Rhawn Street Concept Plan

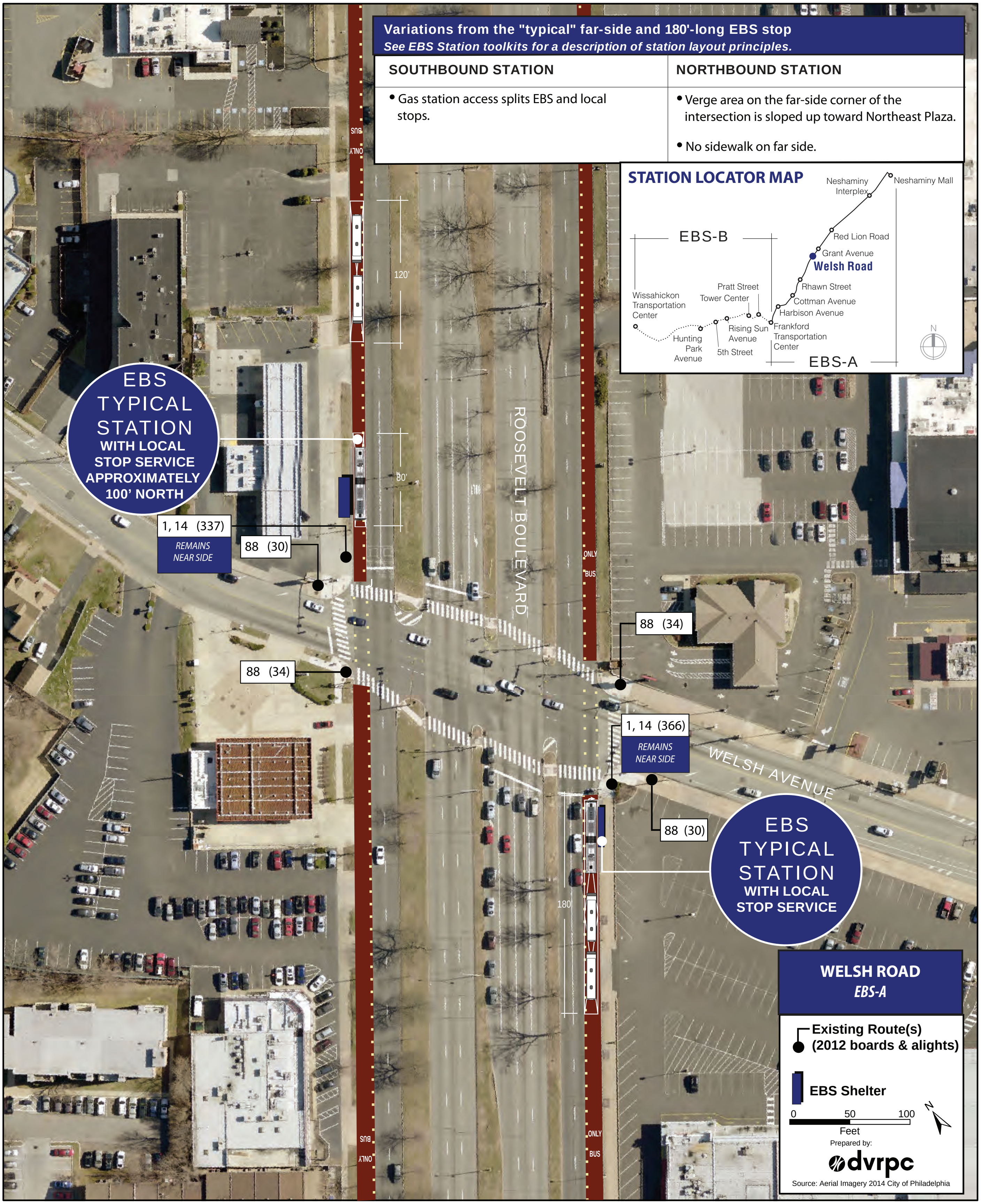


Figure 6.13: Welsh Road Concept Plan

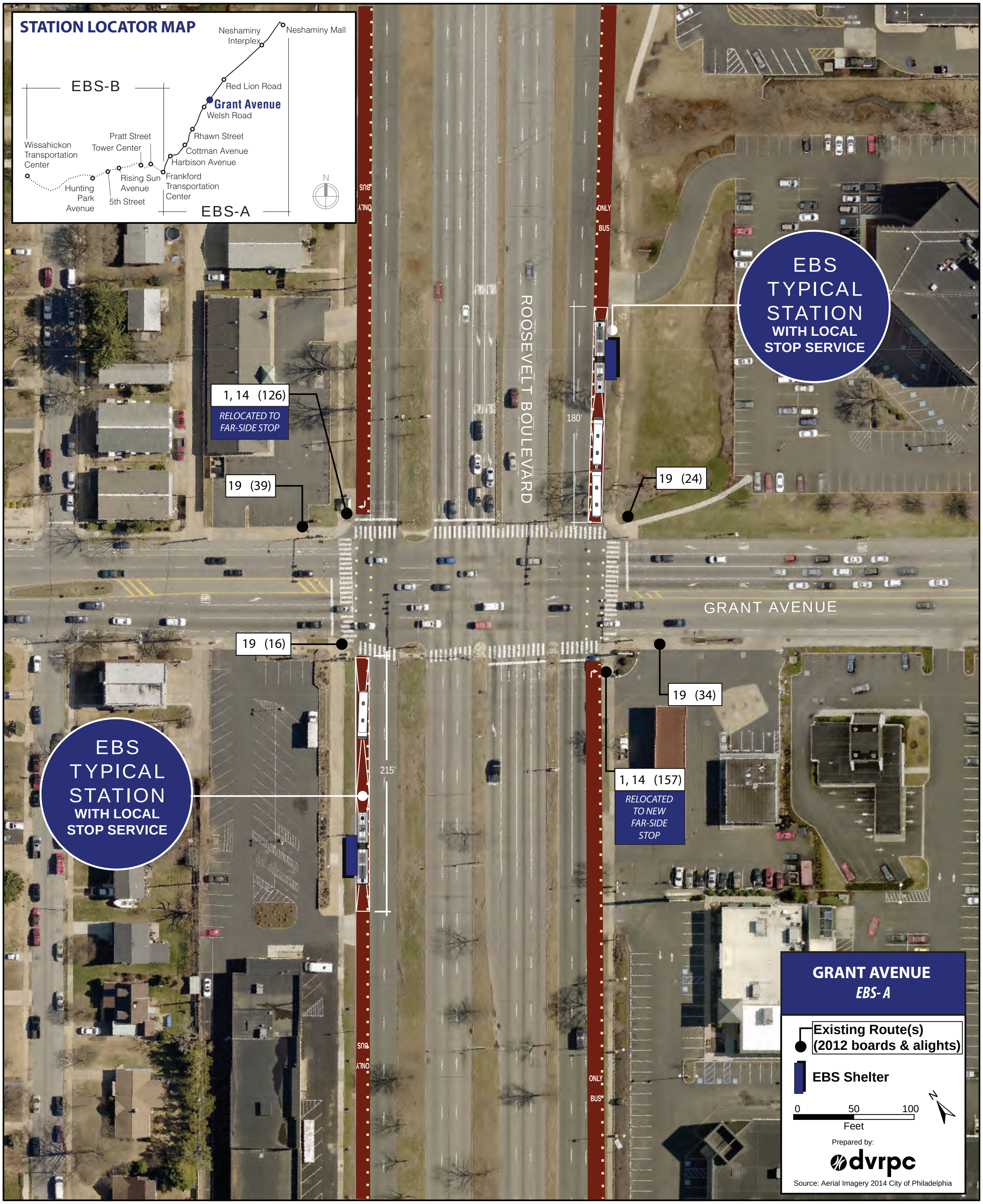


Figure 6.14: Grant Avenue Concept Plan

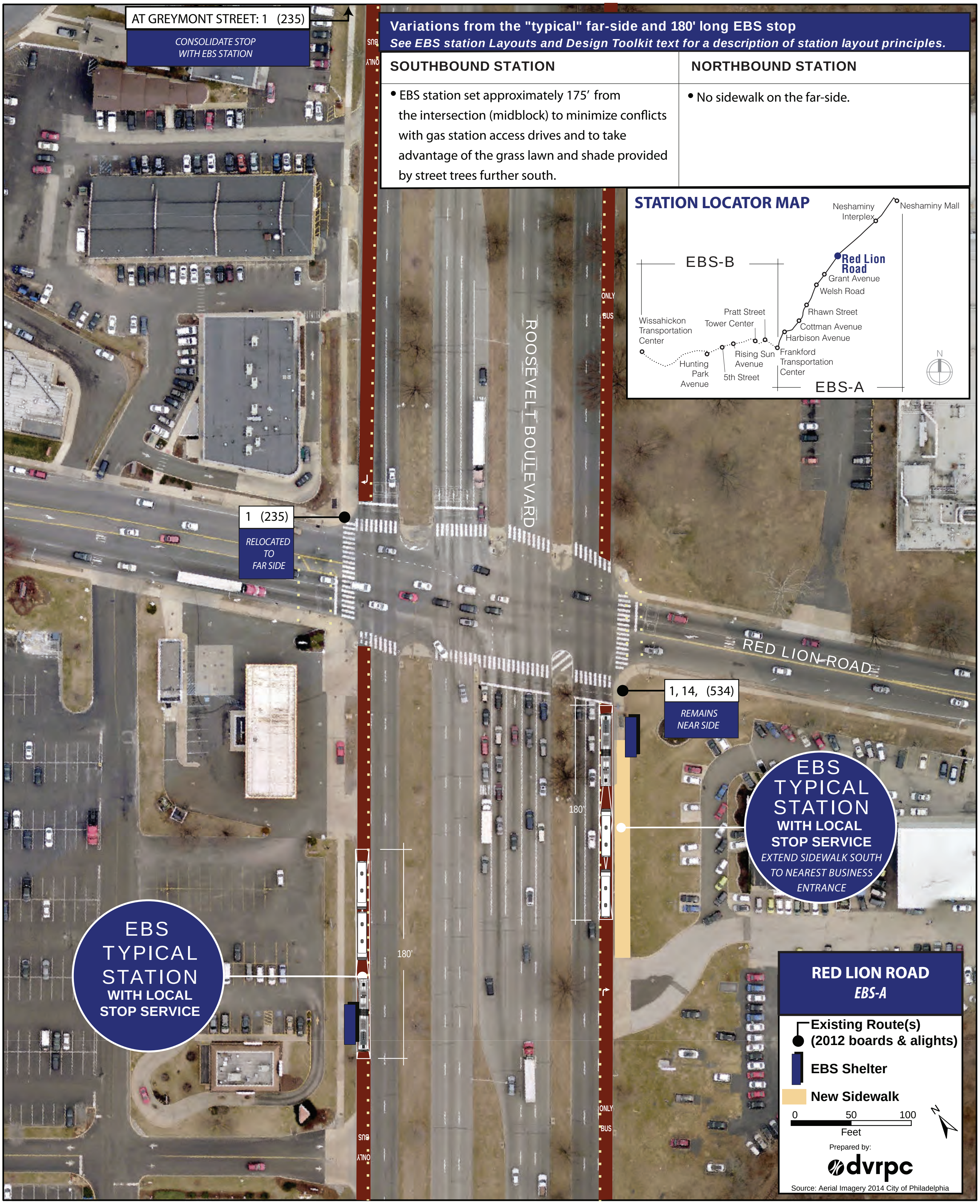


Figure 6.15: Red Lion Road Concept Plan

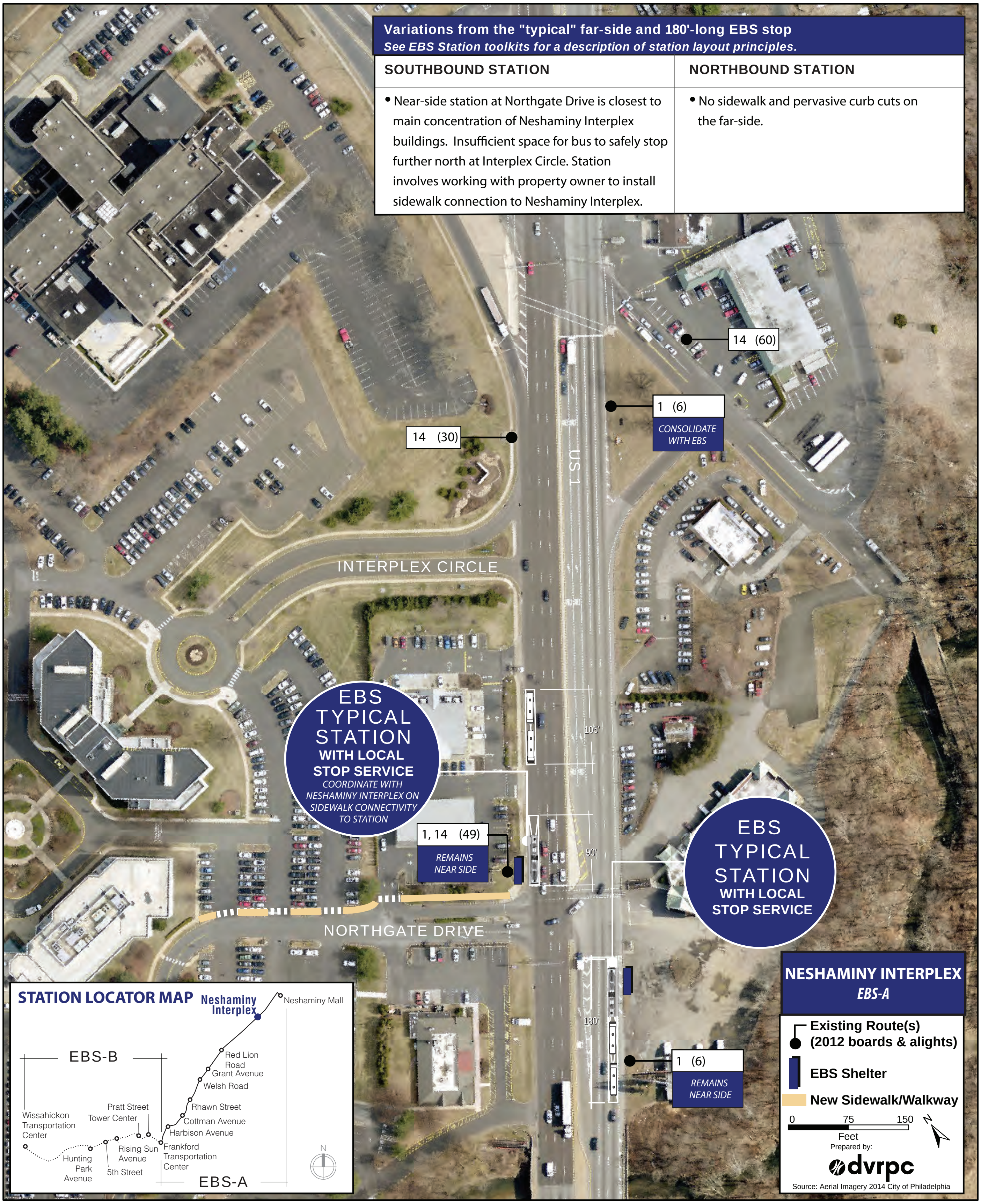


Figure 6.16: Neshaminy Interplex Concept Plan

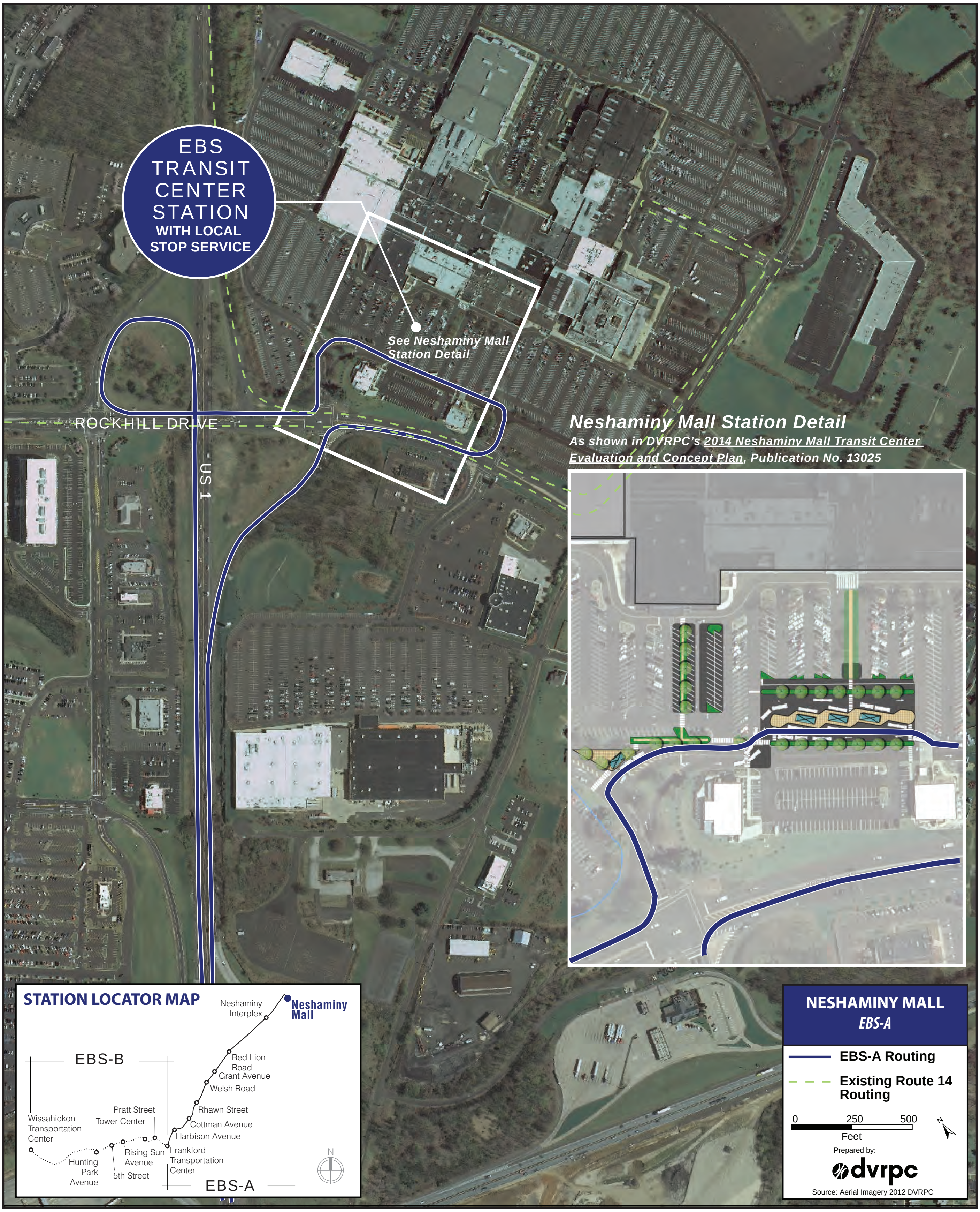


Figure 6.17: Neshaminy Mall Concept Plan

Figure 6.18: WTC Concept Plan

Figure 6.19: Hunting Park Concept Plan

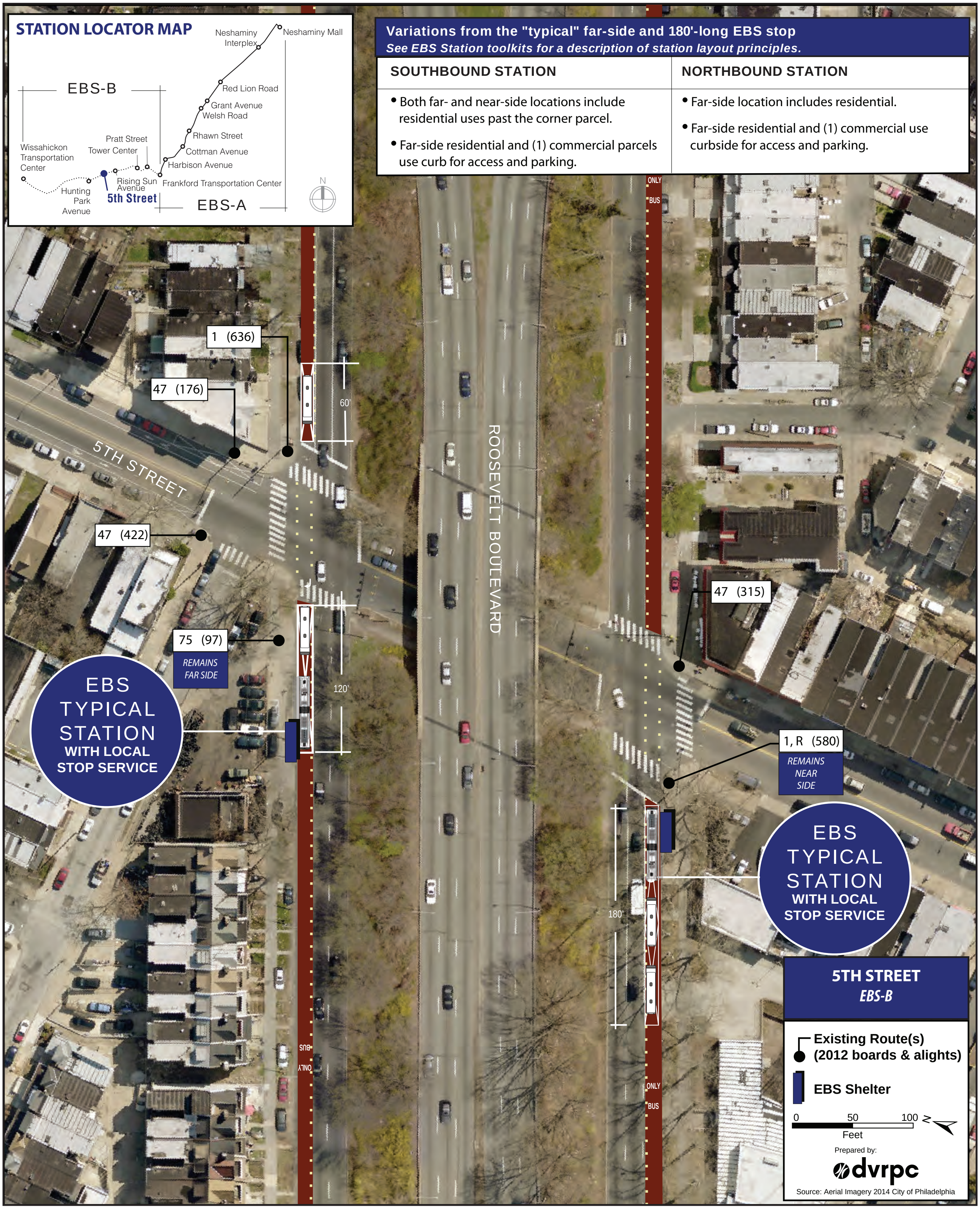


Figure 6.20: 5th Street Concept Plan

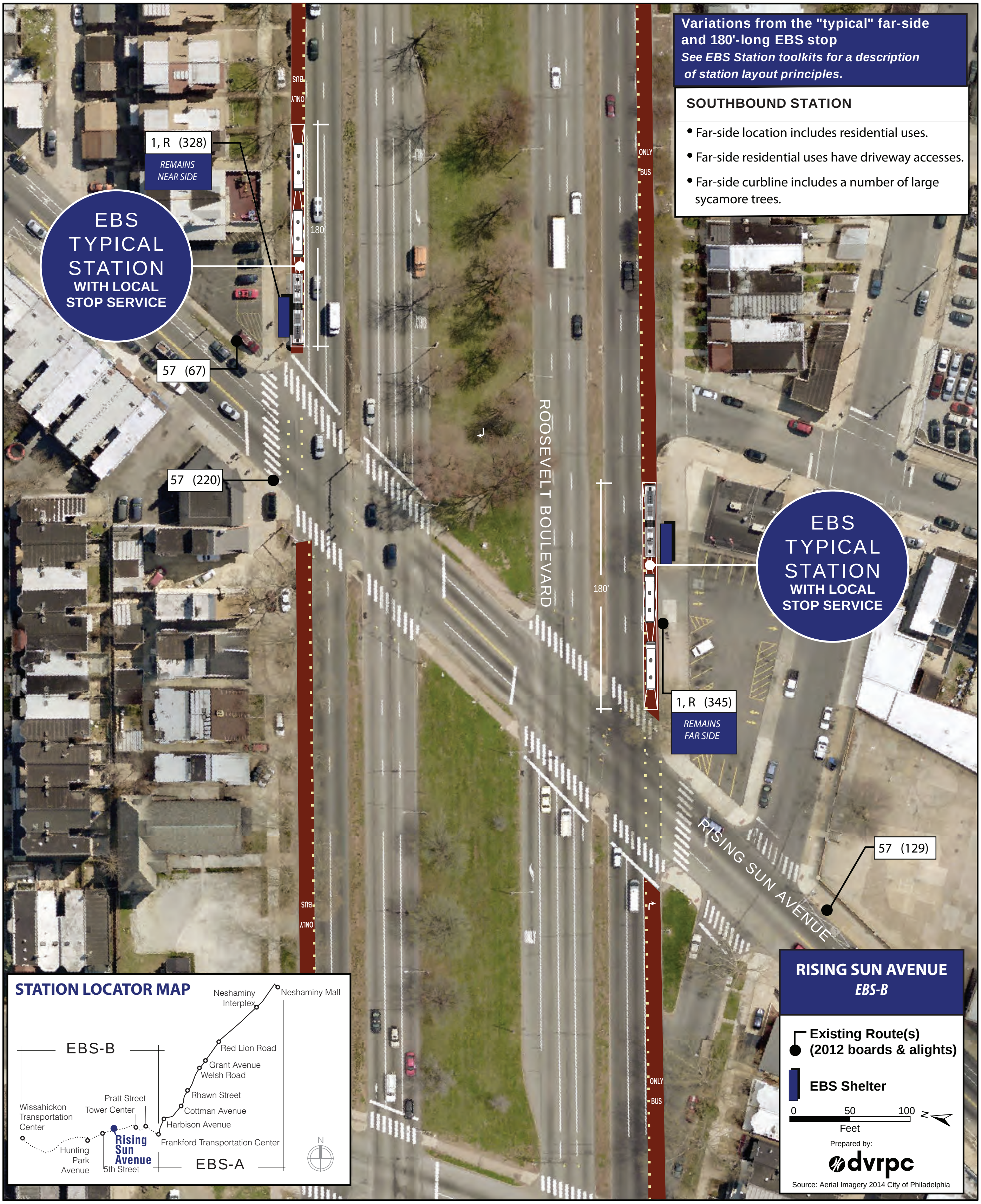


Figure 6.21: Rising Sun Avenue Concept Plan

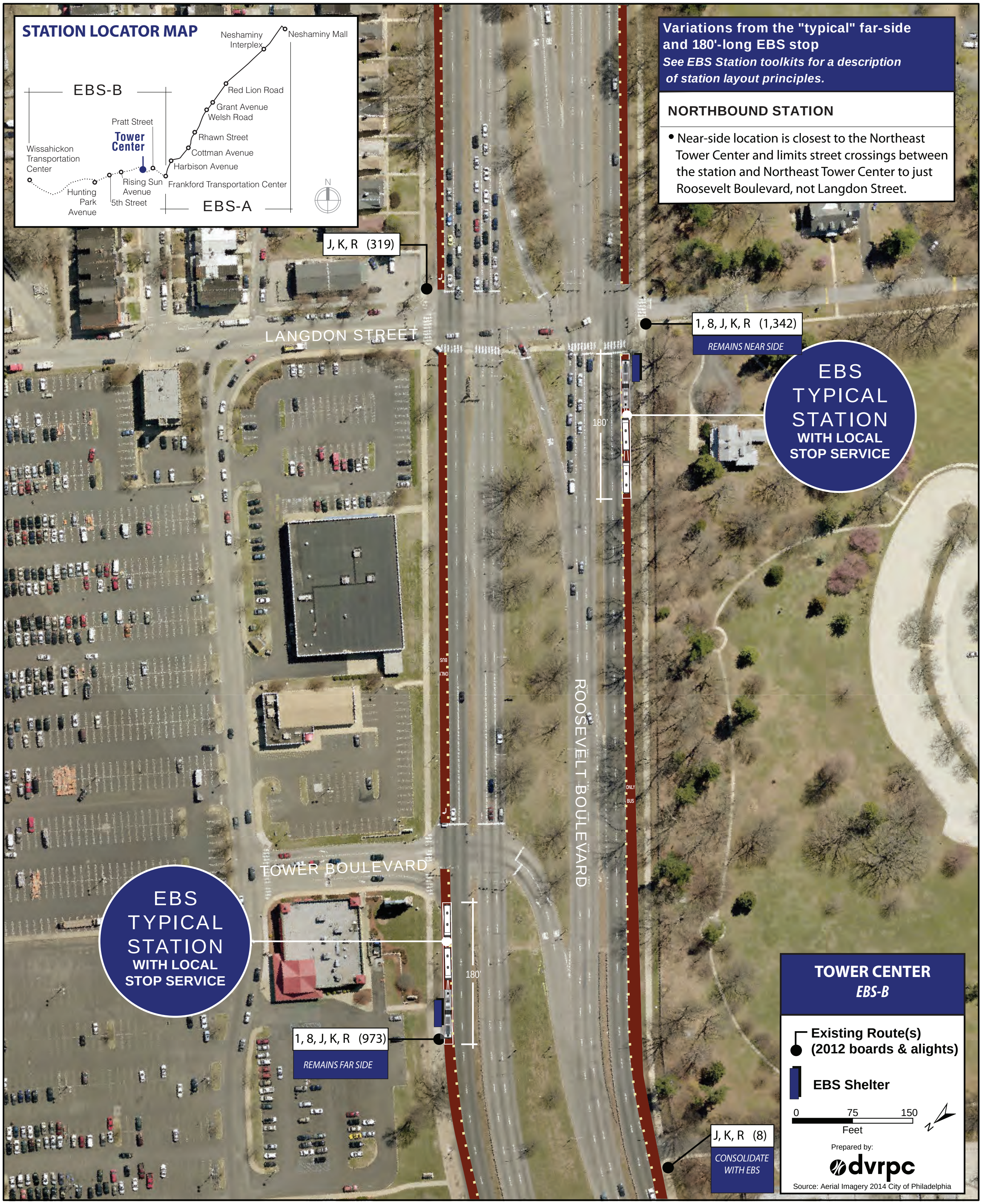


Figure 6.22: Tower Center Concept Plan

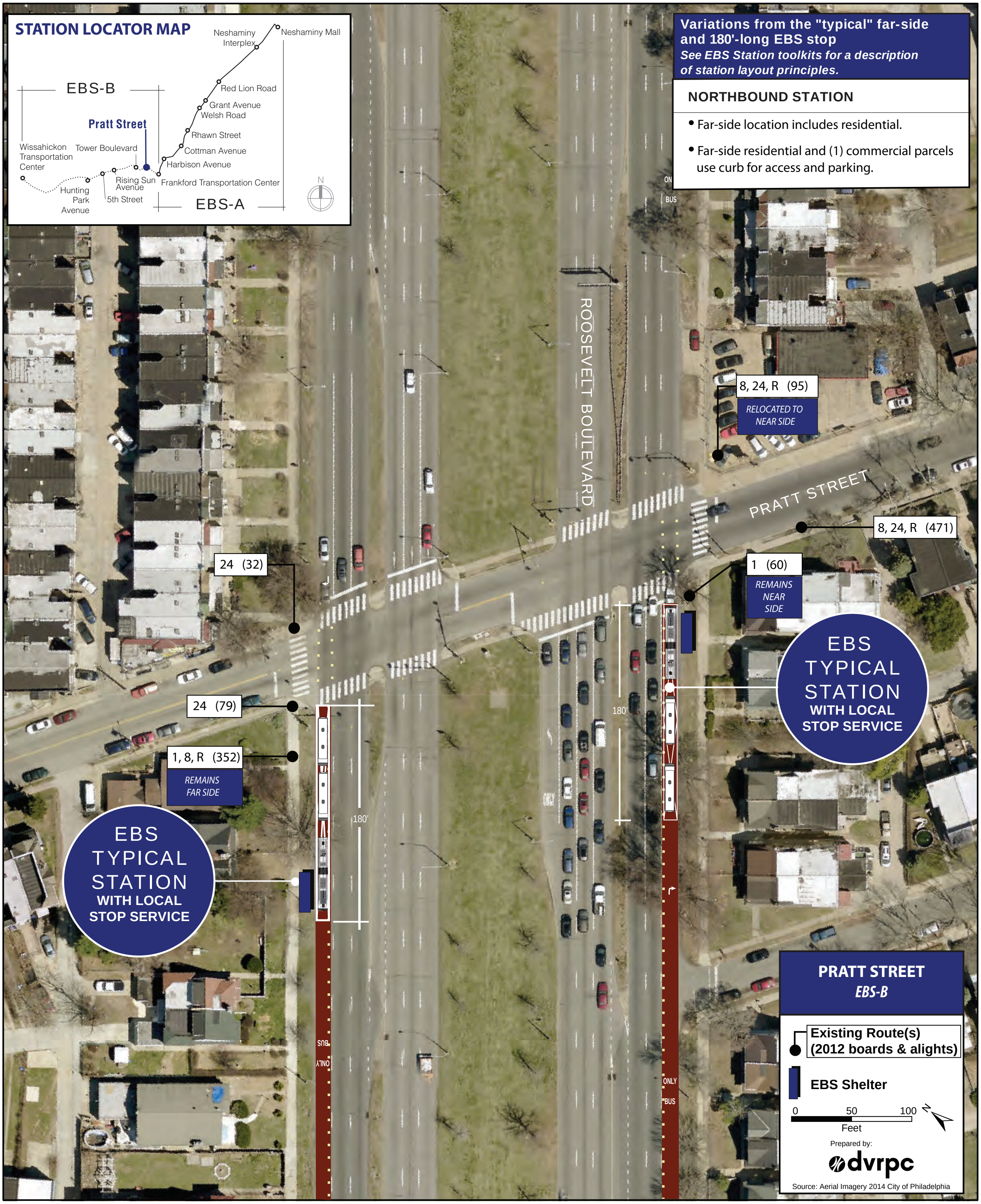


Figure 6.23: Pratt Street Concept Plan

SAFETY CONSIDERATIONS FOR TRANSIT USERS

To access a transit stop all riders travel some distance by foot, bicycle, or wheelchair. Making transit stops and their surrounding environments safe and accessible for all users means designing facilities that protect riders from traffic as best as possible. This report discusses in detail considerations for maximizing service efficiency and growing ridership through stop type, siting, and design. This section is intended to complement that discussion with pedestrian safety considerations at the bus stop level.

Because each stop location has a unique setting, safe pedestrian access to transit may take different forms throughout the system. Despite local variations, the same approach should be used to assess conditions and determine appropriate safety improvements. Naturalistic observation is an effective method for gathering first-hand knowledge about the way pedestrians access transit stops and how riders behave at stops, examining driver behavior and interactions between drivers and pedestrians, and examining the physical and operational issues unique to each stop.

Minimizing crashes between pedestrians and automobiles at and near transit stops is addressed in detail in the FHWA publication *Pedestrian Safety Guide for Transit Agencies* (2008). This guide lays out approaches to enhancing pedestrian safety that are appropriate for transit agencies, including internal actions (organizational improvements, policy changes) and external actions (develop partnerships with local authorities, land owners, and community groups). In the DVRPC companion *Roosevelt Boulevard Safety Study* (in progress), an analysis of pedestrian crashes at each of the proposed EBS station locations along Roosevelt Boulevard is underway. This work will be included in the final report for that study.

Safety considerations are an important part of the station design process. Each of the proposed EBS stations is at or near a major intersection, which means many riders will be crossing one or more roadways going to or from bus stations. Properly marked and maintained crosswalks establish a pedestrian's space within the roadway. Philadelphia exclusively uses continental-style crosswalk striping, a design that is proven by research to be the most visible to drivers.

SIDEWALKS AND CURB RAMPS

Properly designed and maintained sidewalks ensure that pedestrians and wheelchair users have access to safe, separated paths to bus stops, adequate waiting areas, and proper pads for boarding and alighting. Title II of the ADA requires state and local governments to make pedestrian crossings accessible to people with disabilities by providing curb ramps. These provisions are required on all roadway projects using federal funds. Curb ramps also provide a benefit to pedestrians pushing baby strollers or pulling grocery baskets, etc.

PEDESTRIAN-SCALE LIGHTING

According the National Highway Traffic Safety Administration, in 2012, 32 percent of pedestrian fatalities in the U.S. occurred in crashes between 8:00 PM and 11:59 PM. Of the pedestrian fatalities recorded along Roosevelt Boulevard from 2008 to 2013, 42 percent occurred during the same 4 hour evening time period. In many cases, the lighting provided at transit stops exists as part of the road system and is intended to illuminate the roadway. Pedestrian-scale lighting is specifically designed to make the pedestrian experience safer and more pleasant. Typically these fixtures are about 15 feet high and are designed to light the walkway and illuminate pedestrians, making them more visible to each other and to motorists. These fixtures work best when used in addition to overhead roadway lighting.

REDUCED TRAFFIC SPEEDS

Pedestrians have the greatest chances of surviving a conflict with an automobile when the driver's speed is less than 20 mph. When hit by a driver travelling at 30 mph, a pedestrian has only a 55 percent chance of surviving; as speed increases, survivability decreases. Transit stops are places of high pedestrian activity, and reducing average vehicle speeds in the vicinity of bus stops is a proactive approach to improving pedestrian safety. Traffic-calming techniques are effective at reducing vehicle speeds while maintaining steady traffic flow and are typically low cost.

RIDERSHIP FORECASTS FOR EBS

In order to better understand the market potential of the EBS concept proposed in this plan, DVRPC staff prepared detailed ridership forecasts using the regional travel demand model (TIM 2.1) for two EBS scenarios:

EBS-A: Service from Neshaminy Mall to FTC

- 2015 forecast horizon;
- one park-and-ride: Neshaminy Mall (500 stall capacity assumed for forecast purposes);
- assumes travel time savings from full deployment of the EBS BRT elements: TSP, shared bus and right-turn lane, and fare prepayment/multidoor boarding and alighting; and
- assumes elimination of current Route 14 Limited stop runs and continuation of all other local services at current service levels.

EBS-B: Extended service from Neshaminy Mall to WTC via FTC

- 2015 forecast horizon;
- modeled as a southward extension of EBS-A rather than a separate route, in order to test for through-trip demand;
- assumes travel time savings from full deployment of the EBS BRT elements for the Roosevelt Boulevard portion of the alignment only; and
- assumes discontinuation of SEPTA Route 1 and continuation of all other local services at current service levels.

Table 6.5 summarizes the results of these forecasts. Several key takeaways can be drawn from them:

- There is a meaningful ridership market for each of the service patterns proposed, with comparable levels of EBS passenger activity being forecast north and south of FTC.
- The forecasts suggest that there is a greater likelihood of attracting new riders in the EBS-A service area. This is sensible, as the southern portion of the corridor served by EBS-B has a higher concentration of transit-dependent riders, and therefore fewer potential new riders. While many southern riders presently have transit options, they nevertheless stand to benefit from the travel time savings and passenger amenities afforded by enhanced bus service.
- The forcasts assume that the travel time savings that have been estimated for EBS planning purposes are realistic, particularly in comparison to automobile travel times. As we know from peer projects such as the Los Angeles and New York case studies highlighted in this report, the complexities of implementing at-grade rapid transit in an environment as complex as Roosevelt Boulevard should not be underestimated. Further, any phased or partial implementation of the EBS project elements would likely reduce estimated travel time savings. As a result, it bears reinforcing here that these forecasts should be viewed as estimates only.
- Finally, the ridership forecasts presented in Table 6.5 should be viewed as estimates. Travel forecasting models are designed to provide the most likely future travel patterns, traffic volumes, and transit ridership indicative of the model inputs. Travel forecasts are highly influenced by the future transportation network and projected future land use, population, and employment. The actual ridership could differ for several reasons. When these

Table 6.5: Summary of EBS-A and EBS-B Ridership Forecasts

SCENARIO	RIDERSHIP FORECAST			
	AM PEAK RIDERS	PM PEAK RIDERS	TOTAL DAILY RIDERS	ROUGH EST. DAILY NEW SEPTA BUS RIDERS*
EBS-A	3,109	3,438	9,028	4,500
EBS-B	2,824	3,134	8,492	1,500
Full EBS forecast extent: WTC to Neshaminy Mall via FTC	5,933	6,572	17,520	6,000

Daily EBS boardings minus the net change in boardings for parallel bus routes, rounded to convey uncertainty; see Appendix A.
Source: DVRPC, 2015

projections are met, travel model outputs generally fall within 15 percent of the actual, future values. Unforeseen changes in the national and regional economies and other market forces can have a profound effect on future land use and therefore travel patterns. The TIM2.1 travel model assumes that household income, transit fares, parking charges, tolls, and other auto operating costs will all increase at approximately the same rate through 2040. Unanticipated policy changes that heavily influence one or more of these variables can cause the margin of error in the traffic forecasts to increase.

A more detailed description of the forecast scenarios and results, including station-level ridership forecasts and an exploration of transfer activity, is available in Appendix A.

CONCEPTUAL COST ESTIMATES FOR EBS IMPLEMENTATION

Many EBS project components have been developed at a concept level but have multiple available options for implementation and a variety of ways in which they could be sequenced. For example, in-street bus-preferential treatments could range from standard white pavement markings to special bus zones to painted lanes. In order to assist implementing partners (the Transit First Committee) in better understanding the tradeoffs of various options, DVRPC staff prepared a concept-level capital cost estimate of the project's in-street and curbside components, which is summarized in this section. Some BRT station elements that are still under development ("next bus" displays or fare vending equipment) are not included here and would be an additional cost.

Curbside elements are listed in Table 6.6 for EBS-A and Table 6.7 for EBS-B for both sides of Roosevelt Boulevard. Estimated costs were gathered from recent bid history in PennDOT ECMS. Specific cost notes, sources, and references can be found at the bottom of each table. Each table uses the following headings to explain total station costs:

- Concrete pads are needed where there is consistent heavy bus weight for longer periods of time (bus dwelling) so the street will not need to be paved as often.
- Specialty paving is recommended at super stops (only Cottman Avenue at this time) because of the larger footprint and landscaping that will be built versus at the typical stations.
- Wayfinding signage allows passengers to locate the EBS station from a distance, as well as figure out how to use the entire SEPTA system to make connections.
- Overhead bus lane or zone signage is the sign indicating the BAT lane at each station location.
- Conduit is to serve electricity to the station.
- Shelter is the cost of the shelter itself.

Additional considerations and work costs are any site-specific needs that may be needed prior to station implementation, with costs where known.

EXCLUSIONS

Cost estimates on the following pages exclude:

- any infrastructure or equipment required to support off-board/station fare payment;
- design and engineering fees; and
- construction inspection.

Table 6.6: Cost Estimates for EBS-A Stations

Station Location	Concrete Pads	Speciality Paving (Super Station)	Wayfinding Signage	Overhead Bus Lane/Zone Signage	Conduit	Shelter	Additional Considerations	Additional Work Costs (if known)	Total
NORTHBOUND									
Harbison Ave.	$2,000		$1,500	$600	$750	$35,000			$ 39,850
Cottman Ave.	$2,000		$1,500	$600	$450	$35,000	Trim Tree		$ 39,550
Rhawn Street	$2,000		$1,500	$600	$450	$35,000	Relocate speed limit sign		$ 39,550
Welsh Road	$2,000		$1,500	$600	$450	$35,000			$ 39,550
Grant Ave.	$2,000		$1,500	$600	$450	$35,000	Relocate signage on light pole		$ 39,550
Red Lion Road	$2,000		$1,500	$600	$450	$35,000	200 LF sidewalk (5' wide)	$11,000	$ 50,550
Neshaminy Interplex	$2,000		$1,500	$600	$450	$35,000			$ 39,550
SOUTHBOUND									
Harbison Ave.	$2,000		$1,500	$600	$450	$35,000			$ 39,550
Cottman Ave.		$12,000	$1,500	$600	$450	$45,000	Relocate sign		$ 59,550
Rhawn Street	$2,000		$1,500	$600	$1,125	$35,000	Concrete pad to replace existing asphalt		$ 40,225
Welsh Road	$2,000		$1,500	$600	$450	$35,000			$ 39,550
Grant Ave.	$2,000		$1,500	$600	$450	$35,000			$ 39,550
Red Lion Road	$2,000		$1,500	$600	$450	$35,000	Remove trees - at least two		$ 39,550
Neshaminy Interplex	$2,000		$1,500	$600	$750	$35,000	300 LF Sidewalk (5' wide), 9 ADA ramps, 8'x100' Crosswalks (4 total = 300 LF @$10 / LF)	$74,000	$ 113,850
								Subtotal	**$ 659,975**
								5% Mobilization	**$ 32,999**
								3% Traffic control	**$ 19,799**
								15% Contingency	**$ 98,996**
								Total	**$ 811,769**

Notes:
1. Estimated costs for shelters and super station shelters are taken from recent peer practice ranges (New York SBS, HART MetroRapid, TCRP Report 118, and others), and include furnishings and signage (wayfinding type 'B')
2. Any infrastructure or equipment required to support off-board/station fare payment is not reflected in these costs, and would be additional.
3. Additional considerations not included in total station costs except where noted.
4. Design/engineering costs are not included.
5. Estimated costs gathered from recent bid history in PennDOT ECMS:
   a) Concrete Pads 6'x30' = 180 SF = 20 SY @$100 / SY
   b) Specialty paving (super station) = 6'x100' = 600 SF = 70 SY @$150 / SY + $1500 for landscaping
   c) Wayfinding sign = $1,500 / per sign - Recently-bid City trail project signage of similar type and size (40"W x 35"H) used to estimate cost per wayfinding sign.
   d) Overhead Sign = 30 SF @ $20 / SF
   e) Conduit, Trench & Backfill = Min. 30 LF per station @$15 / LF
   f) Construction Inspection not included.

Source: DVRPC, 2015

Table 6.7: Cost Estimates for EBS-B Stations

Station Location	Concrete Pads	Wayfinding Signage	Overhead Bus Lane/Zone Signage	Conduit	Location	Additional considerations	Additional work costs (if known)	Total
NORTHBOUND								
Hunting Park	$2,000	$1,500	$600	$2,250		Existing sidewalk cracked; remove/trim tree		$ 41,350
5th Street	$2,000	$1,500	$600	$450	Near side	Remove 2 trees; existing sidewalk in disrepair		$ 39,550
Rising Sun Ave.	$2,000	$1,500	$600	$450	Far side	Replace signage; existing concete in fair condition, tree may be able to remain		$ 39,550
Tower Blvd./ Langdon Street	$2,000	$1,500	$600	$450	Near side	Remove tree or relocate light pole, existing shelter		$ 39,550
Pratt Street	$2,000	$1,500	$600	$450	Near side	Relocate signs on light posts		$ 39,550
SOUTHBOUND								
Hunting Park Ave.	$2,000	$1,500	$600	$450	Near side	Remove parking, remove 1-2 trees, relocate sign		$ 39,550
5th Street	$2,000	$1,500	$600	$450	Far side	Relocate light post(s); cars parked on sidewalk		$ 39,550
Rising Sun Ave.	$2,000	$1,500	$600	$450	Near side	Nearby hydrant may need relocation, along with street sign on light post		$ 39,550
Tower Blvd./ Langdon Street	$2,000	$1,500	$600	$450	Far side	Existing sidewalk		$ 39,550
Pratt Street	$2,000	$1,500	$600	$600	Far side	Remove 2 trees		$ 39,700

Subtotal	$397,450
5% Mobilization	$19,873
3% Traffic control	$11,924
15% Contingency	$59,618
Total	$488,864

Notes:
1. Estimated costs for shelters and super station shelters are taken from recent peer practice ranges (New York SBS, HART MetroRapid, TCRP Report 118, and others), and include furnishings and signage (wayfinding type 'B')
2. Any infrastructure or equipment required to support off-board/station fare payment is not reflected in these costs, and would be additional.
3. Additional considerations not included in total station costs except where noted.
4. Design/engineering costs are not included.
5. Estimated costs gathered from recent bid history in PennDOT ECMS:
   a) Concrete Pads 6'x30' = 180 SF = 20 SY @$100 / SY
   b) Specialty paving (super station) = 6'x100' = 600 SF = 70 SY @$150 / SY + $1500 for landscaping
   c) Wayfinding sign = $1,500 / per sign - Recently-bid City trail project signage of similar type and size (40"W x 35"H) used to estimate cost per wayfinding sign.
   d) Overhead Sign = 30 SF @ $20 / SF
   e) Conduit, Trench & Backfill = Min. 30 LF per station @$15 / LF
   f) Construction Inspection not included.

Source: DVRPC, 2015

TERMINAL COSTS

Some level of improvement at three terminals (FTC, WTC, and Neshaminy Mall) would be required in conjunction with full buildout of EBS-A and EBS-B. Improvements at FTC are scalable and may even be limited to new route designation signage.

Implementation of the EBS-B concept as detailed in this report is conditioned on a redesigned and expanded WTC, for which SEPTA and the PCPC have done some conceptual planning. Costs for that project are unclear but would be significant.

DVRPC prepared the *Neshaminy Mall Transit Center Evaluation and Concept Plan* on behalf of SEPTA, Bucks County, and Bensalem Township in February 2014 (DVRPC pub. no. 13025). That report included detailed cost estimates assembled by SEPTA cost engineering staff for three transit center options, which ranged from $1,148,992 to $1,678,124. The full-buildout option (Option 2A) had the highest of these costs and is the option reflected in this report's EBS-A concept.

It bears noting here that implementation of EBS-A is not dependent on the completion of a new Neshaminy Mall Transit Center. EBS-A could launch with Neshaminy Mall's present transit center as its northern terminus, with the redesigned and expanded facility being added later.

ITS/SIGNALS COSTS

A recent evaluation of signals and ITS infrastructure along Roosevelt Boulevard indicates that there is not sufficient conduit capacity for additional fiber-optic cable, which would be required to accommodate needed ITS improvements—including TSP. The cost to expand conduit capacity for the corridor has been roughly estimated at four million dollars. This is the greatest single investment that would be required to enable TSP for EBS: fiber-optic cable and the TSP equipment itself would have additional costs.

RUNNING WAY COSTS

As detailed in the "Bus Lane Options for the EBS Concept" section in Chapter 5, a BAT lane is the preferred option for the EBS service concept but has several drawbacks. Table 6.8 includes cost estimates for a variety of possible in-street treatments that have a wide range in scale and complexity. Table 6.9 summarizes cost options for an alternative approach where in-street treatments are limited to bus zones only.

Table 6.8: Estimated Costs for EBS In-Street Treatments

Component	Unit cost	Estimated Capital Cost for EBS-A (combined NB and SB; 6.2-mile extent)	Estimated Capital Cost for EBS-B (combined NB and SB; 2.9-mile extent)
Option 1: White or color text (e.g., "bus lane" or "bus and right turns only") with standard white dashed lane divider			
BUS LANE/RT ONLY painted marking set, 8'0" height (spaced every 300 feet)	$500/ea.	$100,000	$50,000
Dashed lane divider line: 4"–6" width; 10' strip; 30' gap (waterborne)	$0.33/LF	$5,400	$2,500
Dashed lane divider line: 4"–6" width; 10' strip; 30' gap (thermoplastic)	$1.00/LF	$16,400	$7,700
	TOTAL RANGE	**$105,400–$116,400**	**$52,500–$57,700**
Option 2: White or color text with white or color solid stripe lane divider			
BUS LANE/RT ONLY painted marking set, 8'0" height (spaced every 300 feet)	$500/ea.	$100,000	$50,000
Single solid lane divider line 4"–6" width (waterborne)	$0.33/LF	$21,600	$10,100
Single solid lane divider line 4"–6" width (thermoplastic)	$1.00/LF	$65,500	$30,600
Double solid lane divider line 4"–6" width (waterborne)	$0.33/LF	$43,200	$20,200
Double solid lane divider line 4"–6" width (thermoplastic)	$1.00/LF	$131,000	$61,200
	TOTAL RANGE	**$121,600–$231,000**	**$60,100–$111,200**
Option 3: White or color text with textured lane divider			
BUS LANE/RT ONLY painted marking set, 8'0" height (spaced every 300 feet)	$500/ea.	$100,000	$50,000
Reflective delineators (snow-plowable) every 80' with dashed lane divider line: 4"–6" width; 10' strip; 30' gap (waterborne)	$25 per delineator plus $0.33/LF	$25,900	$12,000
Reflective delineators (snow-plowable) every 80' with dashed lane divider line: 4"–6" width; 10' strip; 30' gap (thermoplastic)	$25 per delineator plus $1.00/LF	$36,900	$28,200
Edgeline rumble strip	$0.30/LF	$19,600	$9,200
1" asphalt overlay for entire lane (e.g., raised lane); assumes milled 0.5"–1.5" bituminous surface	Milling $8/SY; new top course $10/SY	$785,700	$367,500
	TOTAL RANGE	**$119,600–$885,700**	**$59,200–$417,500**
Option 4: White markings and solid lane dividers over a color lane			
BUS LANE/RT ONLY painted marking set, 8'0" height (spaced every 300 feet)	$500/ea.	$100,000	$50,000
Single solid lane divider line 4"–6" width (waterborne)	$0.33/LF	$21,600	$10,100
Single solid lane divider line 4"–6" width (thermoplastic)	$1.00/LF	$65,500	$30,600
Color epoxy paint over asphalt (comparable cost for mixing into asphalt; available when resurfacing)	$1.50/SF	$1,180,000	$551,000
	TOTAL RANGE	**$1,301,600–$1,346,000**	**$611,100–$631,600**

Source: DVRPC, 2015

Table 6.9: Estimated Costs for EBS Bus Zone Treatments

Component	Unit cost	Estimated Capital Cost for EBS-A (combined NB and SB; 6.2-mile extent)	Estimated Capital Cost for EBS-B (combined NB and SB; 2.9-mile extent)
Option 1: Color bus zone treatment (epoxy over asphalt; 12-foot width, 180-foot length)	$3,240 per bus zone	$45,360 (not including terminal stations)	$32,400 (not including terminal stations)
Option 2: Integral color concrete pad bus zone treatment (6" depth, 12-foot width, 180-foot length)	$240/SY; $57,600 per bus zone	$806,400 (not including terminal stations)	$576,000 (not including terminal stations)

Source: DVRPC, 2015

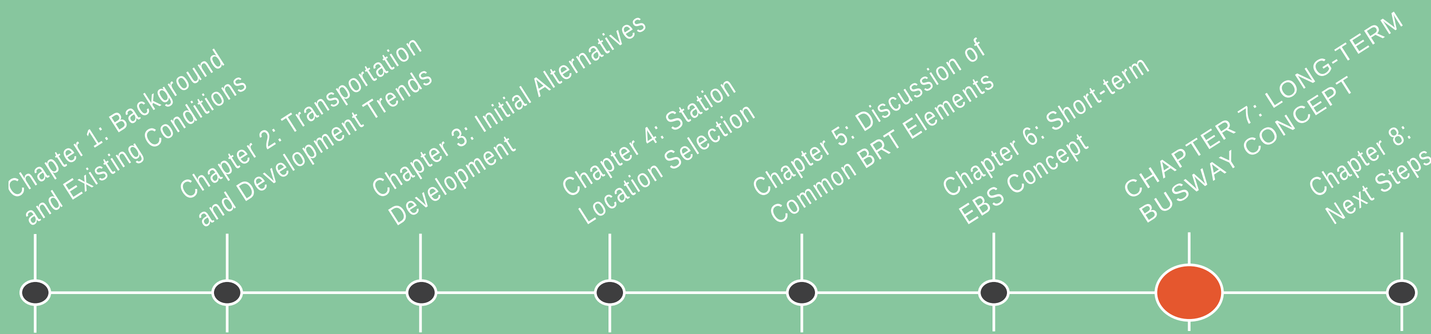
COST SUMMARIES FOR EBS-A AND EBS-B

Implementation of EBS-A stations and in-street elements would cost between $2,594,893 and $3,835,893. The same elements for EBS-B would cost between $541,364 and $1,120,464. In addition, corridor-wide upgrades to conduit capacity to enable TSP for both EBS-A and EBS-B would cost approximately four million dollars (plus fiber-optic cable and TSP equipment). Excluded from these costs are:

- terminal improvements at FTC and WTC;
- improvements that enable off-board fare collection;
- additional considerations from station cost estimate tables;
- design and engineering fees; and
- construction inspection.

Chapter 7:

LONG-TERM BUSWAY CONCEPT



The DVRPC project approach included the study of both a short-term enhanced bus concept and a long-term busway alternative. The busway alternative would build on the design characteristics of EBS but would operate in its own physically separated lane, possibly with a new, unique vehicle fleet and with further enhanced stations. To explore the busway alternative, the project steering committee attended a workshop on July 21, 2014, to discuss alignment options for a physically separated guideway along with the opportunities and possible fatal flaws for these alignments. Participants also discussed how the EBS might transition into full BRT service with the addition of a busway.

Workshop participants from SEPTA, MOTU, Bucks County Planning Commission, Philadelphia Streets Department, Bensalem Township, PCPC, and PennDOT attended and divided into six groups. DVRPC gave a presentation on BRT practices and each group was asked to complete two activities. In the first activity, participants were tasked with laying out their ideal physically separated busway either in the outer drive, inner drive, or in the center median. Groups also discussed station location, size, and amenities.

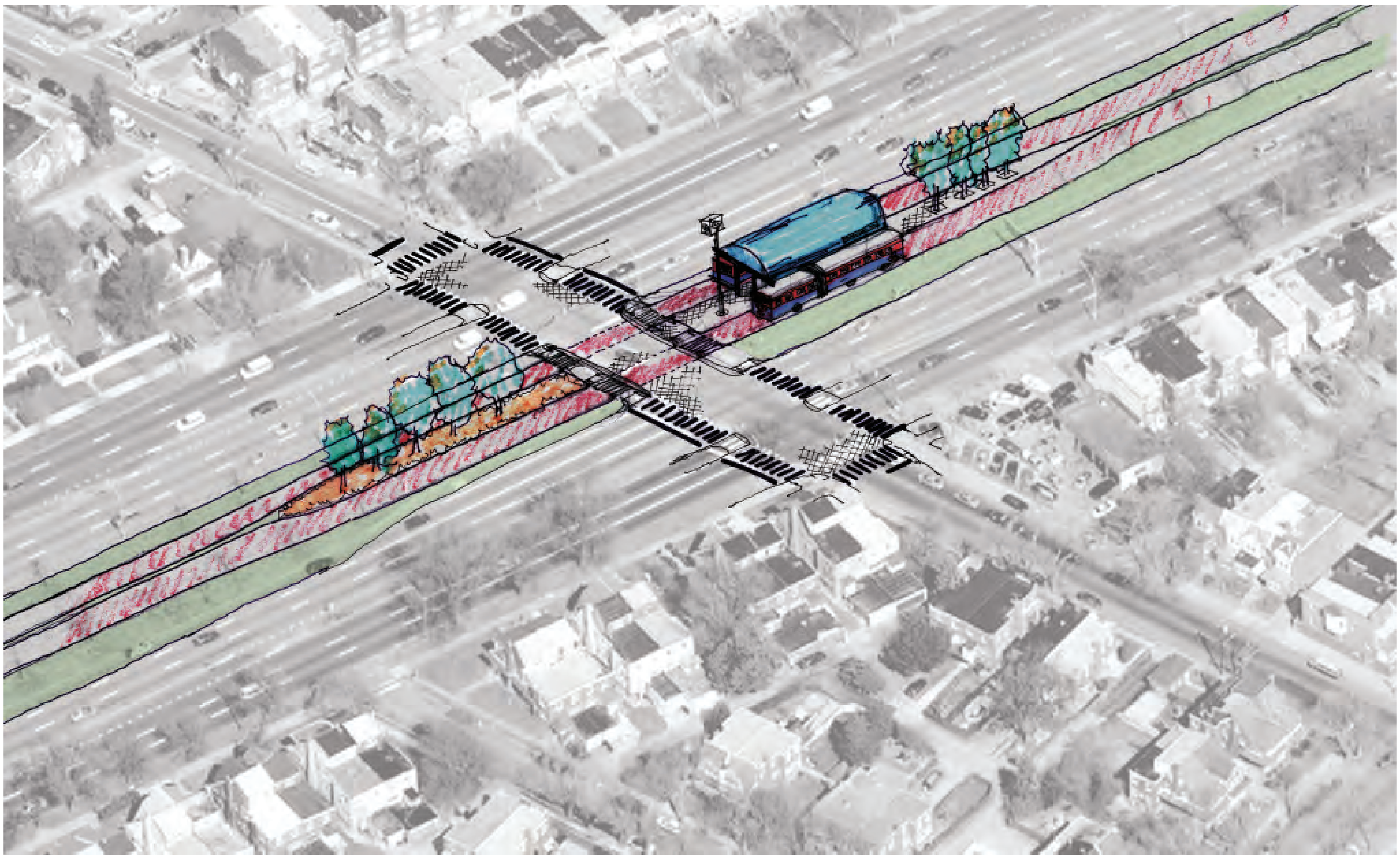
The second activity asked participants to site plan an alignment (either inner or outer drive, or a combination of both) at six representative proposed station locations. Each group located an EBS station facility and a busway station facility, as well as a busway. Groups were also asked to investigate how automobiles, local buses, and pedestrians would interact with the new service and facilities. Participants were asked to adhere to three guiding principles about the busway: occupy only one vehicular lane in each direction (max), operate within the existing right-of-way, and run service at grade.

The site planning exercises from the workshop resulted in three options: a center median busway (Figures 7.1 and 7.2), a southbound side-running median (Figures 7.3 and 7.4), and two concurrent-flow busways running adjacent to the side medians (7.5 and 7.6). These three options are outlined on the following pages along with a cursory look at some of the pros and cons associated with each.

BUSWAY OPTION 1: CENTER MEDIAN

The running way for Busway Option 1 would operate in the center median of Roosevelt Boulevard with a single bidirectional station facility for each intersection proposed to have a station. The curbed median would act as the physical separation between busway and vehicular use along the corridor, shown in Figures 7.1 and 7.2. Where a center median does not exist or is too narrow for a two-way busway, either additional right-of-way would be required, or some reportioning of the existing cartway (including service running in the inner lane of the inner drive or conversion of the outer medians to travel lanes) would be required to site the busway and station and maintain vehicle capacity.

Figure 7.1: Sketch of Busway Option 1, Center Median



Source: DVRPC, 2014

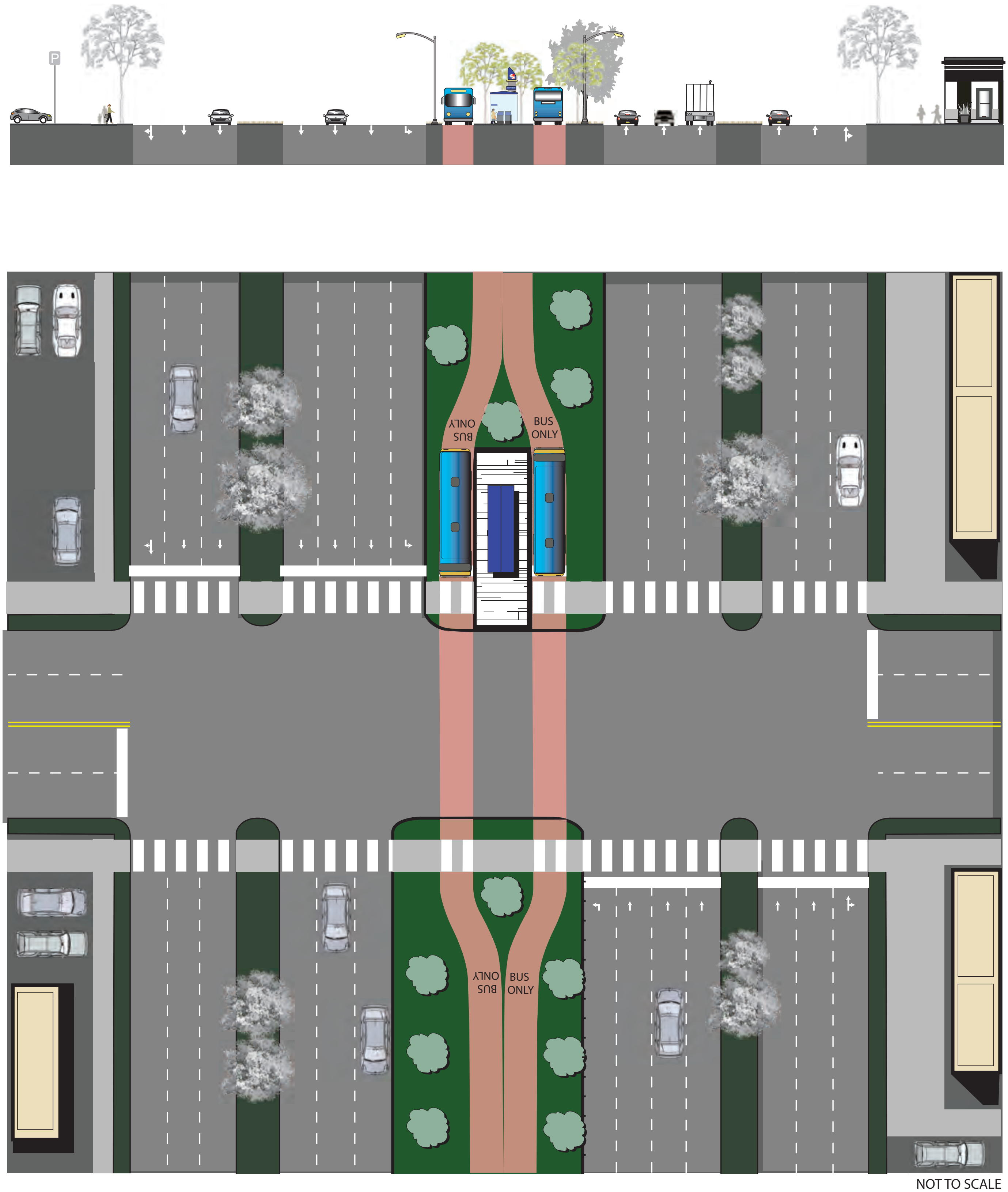
PROS:

- less impact to end-to-end vehicular capacity than other options;
- one centralized station;
- construction of new right-of-way communicates a message of permanence;
- clearly legible as rail-like service;
- access between inner and outer drive is maintained

CONS:

- reduces green space along the corridor;
- high construction costs;
- adds more impervious surface;
- bridges would need to be rehabilitated to accommodate space in the median for the busway;
- may require additional right-of-way;
- adds additional conflict points at intersections between modes;
- requires a bus fleet with doors on the left

Figure 7.2: Section and Plan Views of Busway Option 1, Center Median



Source: DVRPC, 2014

BUSWAY OPTION 2: SOUTHBOUND SIDE MEDIAN

This concept (shown at Pratt Street) creates a dual-direction, separated busway running adjacent to the southbound median, shown in Figures 7.3 and 7.4. This eliminates one southbound inner lane of the outer drive to create the southbound bus lane and one southbound outer lane of the inner drive to create the northbound bus lane. North- and southbound stops can share the station infrastructure. Where a side median does not exist, or is too narrow for a station, additional right-of-way would be required to accommodate the busway and all existing lanes.

Figure 7.3: Sketch of Busway Option 2, Southbound Side Median (Pratt Street)

Source: DVRPC, 2014

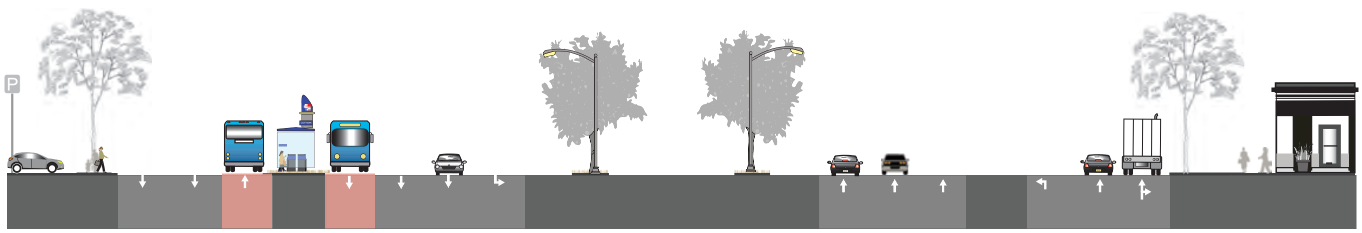
PROS:

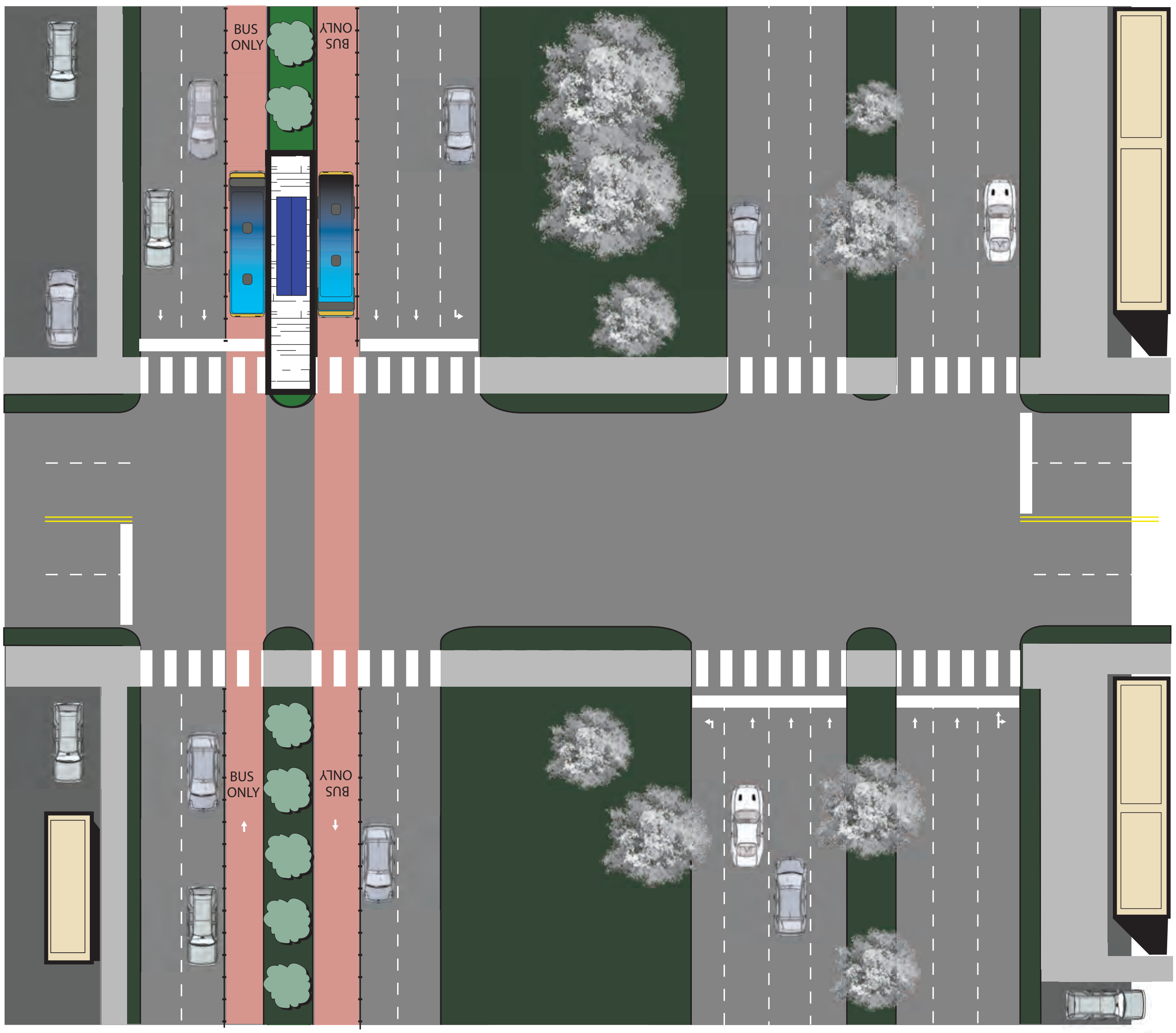
- one centralized station;
- clearly legible as rail-like service;
- makes use of the southbound side medians, which are generally wider than the northbound side medians;
- uses existing impervious pavement footprint except at stations; and
- the majority of stations could be closer to transfer stops if SEPTA relocates cross street bus stops to the west side of intersections (transfers could be easier).

CONS:

- loss of two southbound travel lanes, reducing vehicle capacity significantly;
- requires prohibiting crossovers between inner and outer drive, or auto crossovers would need to make use of the busway;
- high construction costs;
- operating on one side of the corridor may not be; considered equitable by adjacent land owners
- one lane of the busway operates contraflow to vehicular traffic, potentially creating confusion even with a curb; and
- requires a bus fleet with doors on the left.

Figure 7.4: Section and Plan Views of Busway Option 2, Southbound Side Median





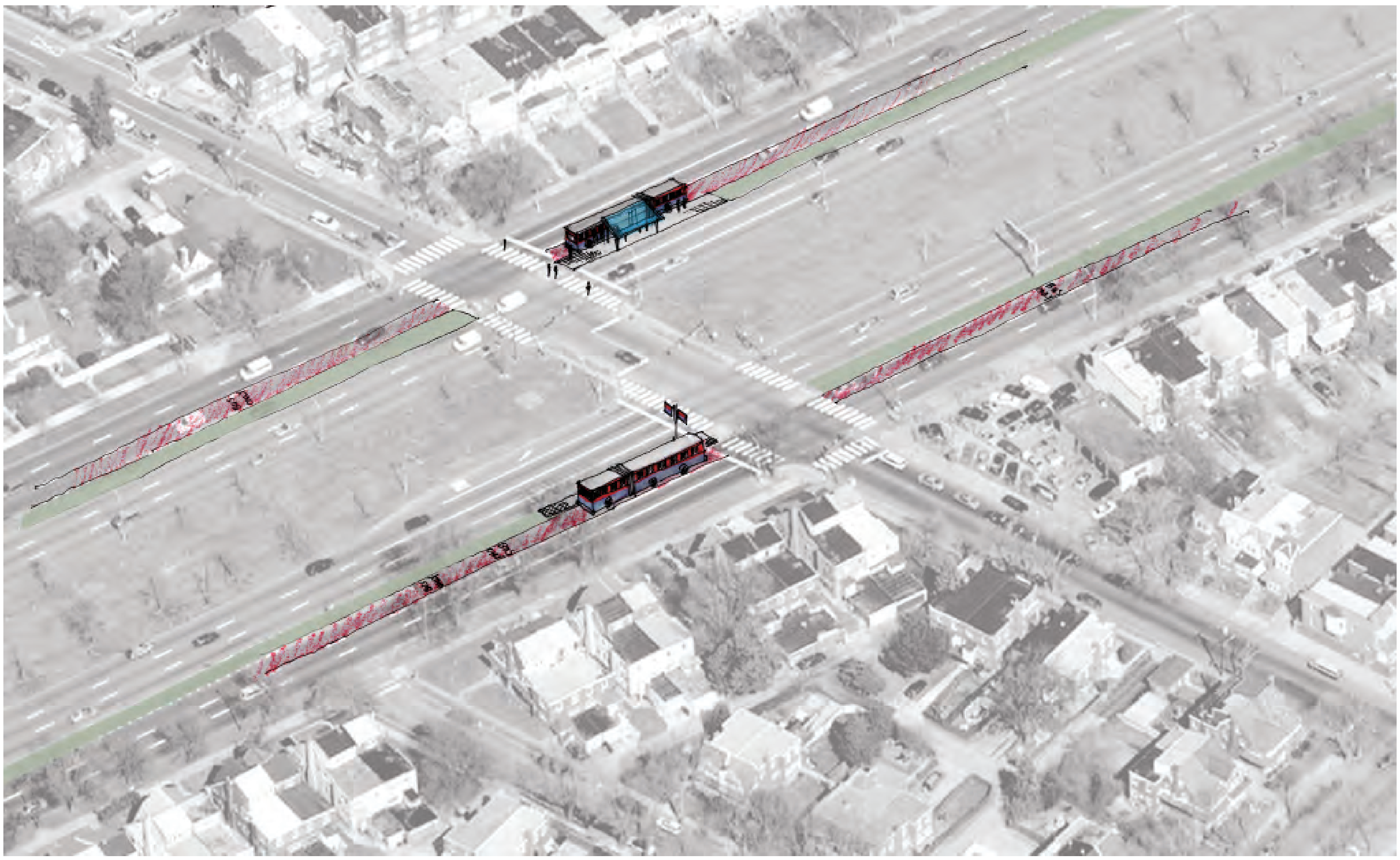
NOT TO SCALE

Source: DVRPC, 2014

BUSWAY OPTION 3: CONCURRENT-FLOW BUS LANE RUNNING ADJACENT TO OUTER MEDIANS

This concept creates a busway in the southbound and northbound directions using the outer medians for station infrastructure, shown in Figures 7.5 and 7.6. This concept eliminates the inner lane of the outer drive in each direction to create the busway; however, a variation on this option could instead operate in the outer lanes of the inner drive and similarly use the side median for station infrastructure. Where a side median does not exist, or is too narrow for a station, additional right-of-way would be required to accommodate the busway and all existing lanes.

Figure 7.5: Sketch of Busway Option 3, Side Medians



Source: DVRPC, 2014

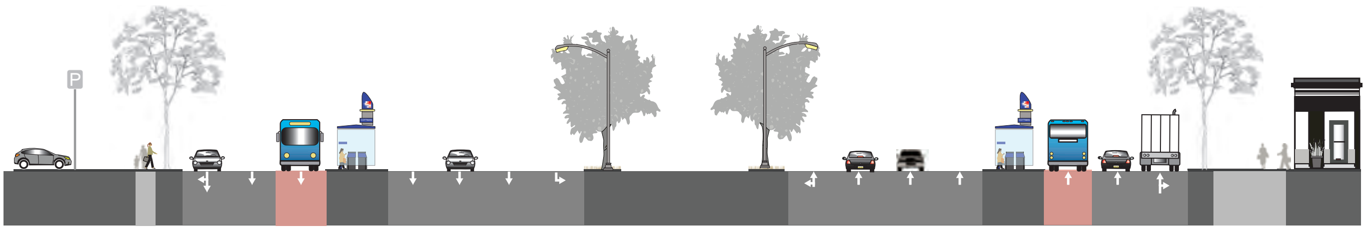
PROS:

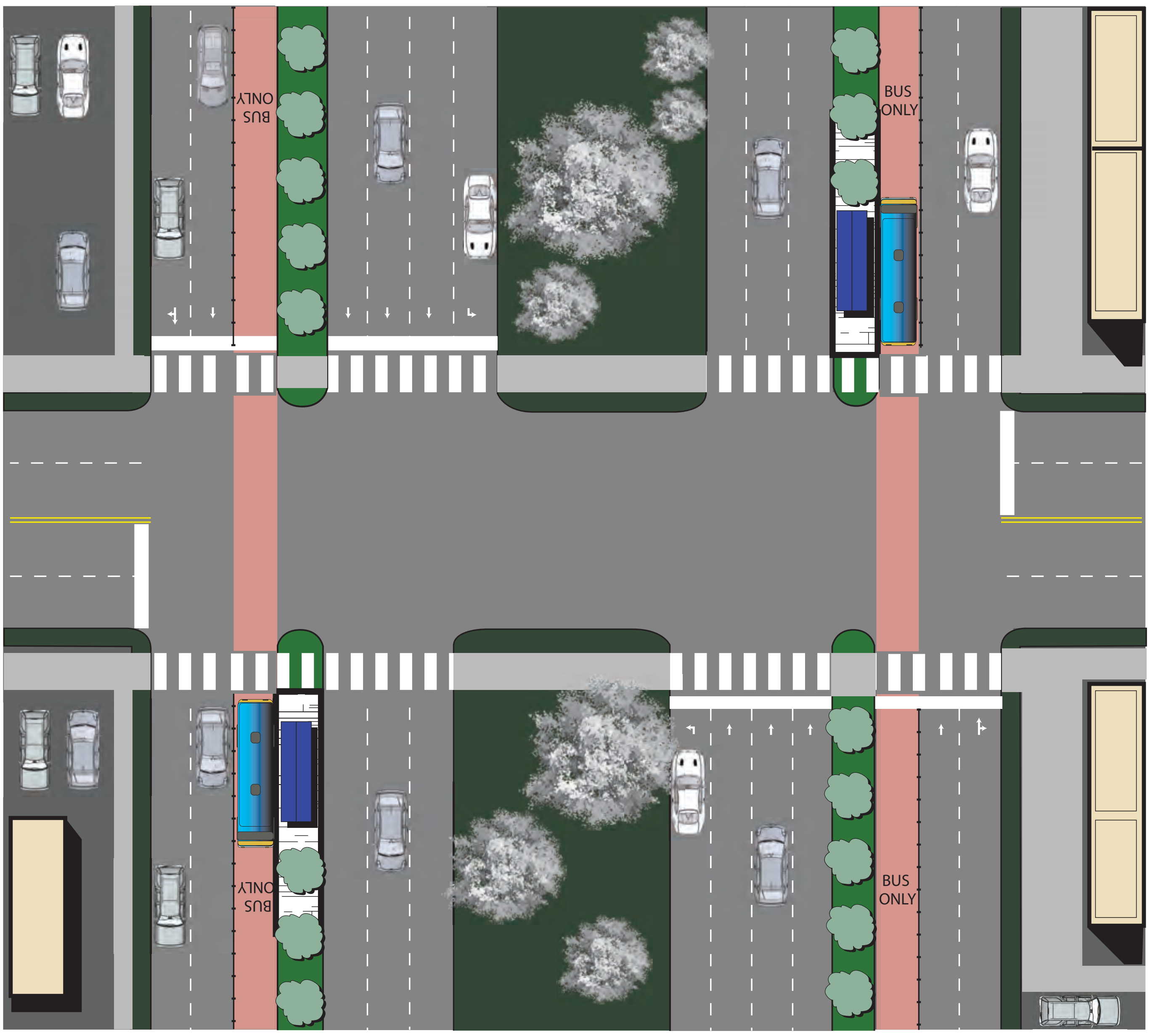
- maintains center median green space;
- uses existing impervious pavement footprint except at stations;
- physically and visually connected to adjacent land uses; and
- inner drive variation could use existing bus fleet with doors on the right.

CONS:

- requires prohibiting crossovers between inner and outer drives, or auto crossovers make use of the busway;
- may require reducing travel lane widths, or additional right-of-way to accommodate stations where there is no side median or it is too narrow for a station;
- reduces vehicular capacity by removing one travel lane in each direction; and
- a busway on the inner lane of the outer drive would require a bus fleet with doors on the left.

Figure 7.6: Section and Plan View of Busway Option 3, Concurrent-Flow Bus Lane Running Adjacent To Side Medians





NOT TO SCALE

Source: DVRPC, 2014

BUSWAY ALTERNATIVES EVALUATION

This section is a conceptual evaluation of the three primary busway alternative concepts.

A number of criteria that are influential in determining the benefits and constraints of a new busway can be sorted into four categories: cost, mobility, safety, and unique identity and legibility.

While some criteria had measurable differences between busway options, others were functionally the same for each option. Criteria were scored by assessing which alternative had the lowest number of constraints (0) versus those that had the most constraints (1); where criteria were the same among options, no score was given. Both the center-median busway and the southbound side median options had the lowest (most favorable) score for the criteria explored. **There was an overwhelming consensus preference for the center median from attendees of the busway workshop.**

Table 7.1 summarizes each alternative, category, criteria, and constraints. On the following pages is a description of each criteria and an explanation of whether each was evaluated and how it was scored.

Table 7.1: Comparative Evaluation of Busway Alternatives

	Criteria	Center Median	Southbound Side Median	Concurrent-Flow Bus Lane Running Adjacent to Side Medians (Inner Drive)	Concurrent-Flow Bus Lane Running Adjacent to Side Medians (Outer Drive)
Infrastructure Investment	Physical Restrictions at Stations	1	0	0	0
	Center Stations	0	0	1	1
	Bridge Replacements	1	1	0	0
	Fleet Vehicle or Left Side Boarding	1	1	0	1
Transit Mobility	Dificulty of Transfers	1	0	1	1
	Takes Advantage of Separated- Grade Intersections	0	1	1	1
	Impacts Capacity	0	1	1	1
Vehicular Mobility	Impedes Crossovers	0	1	1	1
	Increases Conflict Points	1	0	0	0
Safety	Pedestrian Comfort at Stations	0	0	1	1
Unique Identity/ Legibility	Recognition	0	0	1	1
	Total (lower = more favorable)	5	5	7	8

Source: DVRPC, 2014

INFRASTRUCTURE INVESTMENT

There would be significant costs incurred to construct an exclusive right-of-way for buses on Roosevelt Boulevard. The availability of right-of-way, sharing facilities, bridge replacement, and procuring a new vehicle platform are costs that can be compared at an exploratory level between alternatives for this early conceptual busway planning exercise, as shown in Table 7.2. More detailed cost comparisons can be made later when and if a busway option is to be more fully designed.

Table 7.2: All Infrastructure Investment Criteria

INFRASTRUCTURE INVESTMENT CRITERIA MATRIX		
Infrastructure Investment	**Evaluated**	**Description**
Physical Restrictions around Proposed Station Areas	Yes	The availability of the physical space for the station infrastructure (center or side median area) for each of the alternatives varies. Each of the intersections with proposed stations was assessed, and the most available space tends to be in the side medians. Therefore, the side median alternatives scored zero constraint points and were favored for this criterion.
Shared Bidirectional Stations	Yes	In two of the four alternatives, both directions would share a physical station location; if there is only one facility it is likely that both capital costs and operating costs would be lower because the facility is centralized. Therefore, the two alternatives that could not share a single facility were each assigned one constraint point.
Bridge Replacements	Yes	The inner lanes along Roosevelt Boulevard are grade separated from the outer lanes in some locations, allowing Roosevelt Boulevard's inner lanes to bypass at-grade intersections. In the two alternatives where the busway is in the inner lanes, these bridges would need to be redesigned to accommodate the additional width for the new service. Therefore, from a cost perspective the two alternatives where the busway is in the outer drive were favored and assigned zero constraint points.
Left-side Boarding Vehicles	Yes	In the two alternatives where the bus shares a bidirectional station facility, passengers would board on the left side of the vehicle. The cost of procuring a new vehicle type will be high, and therefore those alternatives that do not require a new vehicle are preferred from a cost standpoint (and were assigned zero constraint points).
Upfront Capital Costs	No	Capital costs are required for building, construction, equipment, and purchase of right-of-way for a new facility or service. DVRPC's analysis of the busway portion of the project is conceptual, and the drawings will not include engineering or detailed models. The DVRPC study team believes that all concepts will incur capital costs that are fairly similar due to the sizeable construction costs to build the stations and busway in each alternative. Therefore, a cost per mile based on comparable projects throughout the United States can be used for each option to estimate costs at an order-of-magnitude level.
Operating Costs	No	Operating costs are expenses related to operating the vehicle and facilities of a service. The corridor length, number of stations, and maintenance to operate the vehicle will be similar no matter which of the alternatives are built and therefore are not used to compare the alternatives.
Phaseability	No	The EBS concept recommends curbside stations for the service. There was no chosen busway alternative that uses curbside stations, and therefore no construction elements (stations or running way) could be phased from the EBS into the busway. Similarly, phase-ability into a grade-separated busway was not evaluated as a criterion because phasing from an at-grade busway within the existing cartway would require redesigning the entire right-of-way, no matter which at-grade busway option was pursued.

Source: DVRPC, 2014

MOBILITY

Mobility in this context refers to the movement of people and the transportation they use to get from location to location. The categories in Table 7.3 impact movements that are currently made in the Roosevelt Boulevard corridor, which would be altered when building a busway.

Table 7.3: All Mobility Criteria

MOBILITY CRITERIA MATRIX			
Mobility Topic	**Mode**	**Evaluated**	**Description**
Ease of Transfer	Transit	Yes	This indicates the convenience of a passenger transfer between a local bus or subway and the proposed new station location. Southbound side-running service was assigned a constraint point for this category because of the greater time it would take to travel to a north or east transfer stop location from the station.
Takes Advantage of Separated-Grade Intersections	Transit	Yes	At some locations along Roosevelt Boulevard the inner lanes are grade separated from the outer lanes, and inner drive vehicles can avoid signalized intersections. If the bus were to travel in the inner lanes, it can be assumed that it would avoid some traffic lights and have a shorter travel time. Therefore, those alternatives proposed for the inner lanes are favored, with outer-drive alternatives being assigned constraint points.
Busway Use for Local Bus Service	Transit	No	The local bus operates in the curbside lanes and stops frequently, and the BRT would operate elsewhere under any of the proposed alternatives. This make it infeasible for the local bus to use the busway because it would require too many lane-crossing movements, given local stop frequencies.
Impacts Vehicle Capacity	Vehicular	Yes	Three of the four alternatives propose repurposing two mixed-traffic travel lanes into a busway, where only transit would be allowed to travel. In the center median alternative, it was assumed that capacity could be retained by taking space from the outer medians where necessary; therefore other alternatives were assigned constraint points.
Impedes Crossovers	Vehicular	Yes	The inner and outer lanes on Roosevelt Boulevard are curb separated. Vehicles can change between the inner and outer lanes at designated crossovers. If a busway were built in the center median, these crossovers could remain intact, thus not affecting vehicular mobility; while in any of the other three alternatives the busway would abut at least one side of the crossovers and therefore a new way for vehicles to cross between the inner and outer drives would be required. As a result, those alternatives had constraint points assigned.
Increases Conflicts	Vehicular	Yes	Each time traffic from cross streets crosses a lane of traffic on Roosevelt Boulevard, that vehicle has a potential to have a conflict with traffic along Roosevelt Boulevard. Three of the busway options use an existing lane along the boulevard, while only the center median option adds new bus lanes. If the busway is built in the center median rather than in existing lanes, there will be two new lanes added and thus two new conflict points to the roadway. Therefore, the center median alternative was not preferred for this criterion.
Pedestrian and Bicycle Amenities and ADA Access	Ped/Bike	No	Any of the four alternatives that are built will need to have space for pedestrian and bicycle amenities (parking) as well as ADA access. Because this accommodation would be required for any of the four alternatives, none are favored here.

Source: DVRPC, 2014

SAFETY AND IDENTITY/ RECOGNITION

Safety and the identity of the service are two important elements in developing and implementing a new BRT service, shown in Table 7.4. Passengers need to feel comfortable when riding a service, and name recognition and a distinctive identity can help support service legibility.

BUSWAY RIDERSHIP FORECASTS

In order to better understand the market potential of the future busway proposed here, DVRPC staff prepared detailed ridership forecasts using the regional travel demand model (TIM 2.1) for a 2040 Busway scenario:

Busway: Full extent, Neshaminy Mall to WTC via FTC

- 2040 forecast horizon;
- same stations as the combined EBS station set;
- adds a dedicated, at-grade, median busway from Woodhaven Road to Bustleton Avenue; and from Pratt Street to 9th Street;
- park-and-ride capacity at Neshaminy Mall, Red Lion Station, and WTC; and
- assumes that a center median busway can be constructed without a loss of vehicle capacity (an assumption that permits conservative transit ridership forecasts, since constrained automobile capacity would make transit more attractive, all else being equal).

Table 7.5 summarizes the results under this forecast scenario. While the incremental time savings estimated for the busway compared with the EBS (roughly 15 percent) are smaller than those estimated for the EBS relative to the local bus baseline (30 percent), achieving those time savings is forecast to attract significant additional ridership, at least for a 2040 planning horizon.

Table 7.4: Safety and Identity Criteria

SAFETY AND IDENTITY/RECOGNITION CRITERIA MATRIX		
Topic	**Evaluated**	**Description**
Safety: Pedestrian Station Comfort	Yes	Vehicles are traveling quickly (speed limit 40–45 mph) along Roosevelt Boulevard. This poses some pedestrian safety and comfort issues if passengers have to wait adjacent to vehicular travel lanes. The two concurrent-flow bus lane alternatives were thus assigned constraint points under this criterion.
Recognition	Yes	The busway alternatives that have a shared bidirectional, rail-like station and two service lanes adjacent to each other are likely to create the most iconic and legible footprint along the corridor, representing better branding opportunities and transit customer recognition. The shared station facility alternatives are therefore preferred, and other alternatives were assigned constraint points.

Source: DVRPC, 2014

Table 7.5: Summary of Busway Ridership Forecasts

SCENARIO	RIDERSHIP FORECAST		
	AM Peak	**PM Peak**	**Daily**
2040 Busway	9,592	8,967	26,080

Source: DVRPC, 2015

A more detailed description of the forecast scenarios and results, including station-level ridership forecasts and an exploration of transfer activity, is available in Appendix A.

ROOSEVELT BOULEVARD BUSWAY: COSTS FOR PEER PROJECTS OF COMPARABLE SCALE

In order to frame an order-of-magnitude understanding for what costs to implement might be, DVRPC staff reviewed recent FTA New Starts summary documents to find recent costs for planned or implemented fixed-guideway BRT projects in the United States. Table 7.6 summarizes five examples.

The variability in the total and per mile costs for these five projects is worth noting; no two projects are alike, and costs will vary greatly based on local context and construction complexity. With that caveat noted, these peer project experiences permit some high-level preliminary inferences about cost scales for a Roosevelt Boulevard busway:

- Roosevelt Boulevard busway segment 1 (Bustleton Ave to Woodhaven Road) = 6.6 miles
  - Total cost segment 1 = $40.7M x 6.6 miles = $268.6M (2014 $)
- Roosevelt Boulevard busway segment 2 (Bustleton Ave to Broad/Hunting Park) = 4.5 miles
  - Total cost segment 2 = $40.7M x 4.5 miles = $183.1M (2014 $)
- Total order-of-magnitude busway cost, inclusive of all capital elements: running way, stations, vehicles, and supportive infrastructure: $452 million
- Considering additional terminal station costs, it is reasonable to establish an order-of-magnitude cost of five hundred million dollars for the busway, with a possible range implied by these peer projects of $300M-$700M.

Table 7.6: Cost Summaries for Recent Busway/BRT Projects in the United States

Project Name	Location	Description	Status	Total Capital Costs*	Project Extent	Capital Costs Per Mile
Van Ness Avenue BRT	San Francisco, California	Center-median separated busway (physically separated lane pair)	2015 construction	$125.6M	2.0 miles, 9 stations	$62.8M/mile
New Britain-Hartford Busway	Connecticut	Exclusive-guideway busway on former rail right-of-way, shared by multiple bus routes	Under construction	$567.1M	9.4 miles, 11 stations	$60.3M/mile
Michigan/Grand River BRT	Lansing, Michigan	Separated guideway (specifics TBD) for nearly entire length	2015 construction	$215.4M	8.5 miles, 28 stations	$25.3M/mile
East–West Connector "The Amp" BRT	Nashville, Tennessee	Center-median exclusive busway; partially physically separated	Project cancelled (2014 costs)	$174M	7.1 miles, 16 stations	$24.5M/mile
Orange Line BRT	Los Angeles, California	Center-median dedicated guideway	Opened 2005	$350M (2005 dollars); roughly $430M in 2014 dollars	14 miles, 14 stations	$30.7M/mile (2014)
Average						40.7/mile (2014)

** Costs are inclusive of all capital elements: running way, stations, vehicles, and supportive infrastructure.*
Source: FTA, 2014

BUSWAY TRAVEL TIME ESTIMATES

Table 7.7 summarizes the method used to estimate busway travel times for the two service patterns proposed; these travel times were used in preparing the build scenarios for the ridership forecasts.

Table 7.7: Busway Travel Time Estimates

ROUTE AND ENDPOINTS			CALCULATING ESTIMATED BRT TRAVEL TIMES				TRAVEL TIME COMPARISON	
	Northern Terminus	Southern Terminus	1. AM Peak auto travel time for busway extent	2. Time added to or subtracted for buses within busway extent	3. AM Peak auto travel time index index -Ratio between AM peak auto travel times and free-flow travel times: a proxy for travel times limited only by signals, not other vehicles	4. Applied to approximate EBS travel times within busway extent (excluding EBS lane time savings)***	5. Plus estimated bus travel time outside of busway extent (from EBS calculations) = Estimated BRT travel time	Incremental busway time savings
BRT ROUTE A -Same stops as EBS-A -Adds an at-grade busway for Roosevelt Boulevard segments in Philadelphia (Bustleton to vicinity of city boundary)	Neshaminy Mall	FTC	18 minutes	**Added:** Dwell Time*: 6 stops x 35 seconds ([17 pass/stop x 1.2s] + 15s) = 3.5 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 2.7 minutes **Subtracted:** Transit Signal Priority: 6% (1.5 minutes)	1.3 (Bustleton Ave to Woodhaven Road)	22.7 minutes ÷ 1.3 = **17.5 minutes**	17.5 minutes (BRT travel time in busway) + 10.5 minutes (BRT travel time outside busway) = **28.0 minutes**	5.2 minutes (15.4%)
BRT ROUTE B (US 1 expressway alignment) -Same stops as EBS-B -Adds an at-grade busway for Roosevelt Boulevard segments (Broad to Pratt)	FTC	WTC	10 minutes	**Added:** Dwell Time*: 5 stops x 44 seconds ([24 pass/stop x 1.2s] +15s) = 3.65 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 1.5 minutes **Subtracted:** Transit Signal Priority [Broad Street to Pratt Street]: 6% (0.8 minutes)	1.3 (Broad to Devereax Ave, averaged conditions by hour-8am,9am- and by direction)	14.4 minutes ÷ 1.3 = **11.1 minutes**	11.1 minutes (BRT travel time in busway) + 11.3 minutes (BRT travel time outside busway) = **22.4 minutes**	3.3 minutes (12.8%)

**Dwell Time: 120 boards plus alights (maximum Route 14 non-terminal passenger activity for a southbound run; a proxy for highest single-run loads) divided by number of stops (assumes same demand, differently distributed) and multiplied by 2.9 seconds per passenger (standard fare payment) or 1.2 seconds per passenger (prepaid fares/multidoor boarding & alighting). Fifteen seconds per stop is added in all cases for bus deceleration (5 seconds) and acceleration (10 seconds).*

***Auto-derived travel times between stops were adjusted to reflect slower acceleration and deceleration for buses, based on a rule of thumb that buses operate at 5mph slower than equivalent general traffic speeds. Per VPP data, end-to-end auto operating speeds in the study area are roughly 32.5 mph southbound at 8:00 AM; 5 mph is 15 percent of 32.5 mph. As a reasonable, round estimate, 15 percent was also applied as an overall bus speed penalty to transit travel time calculations for other segments.*

****Proxy for best case transit travel times limited only by station dwells and signals, not other vehicles (which is in turn a proxy for an exclusive at-grade busway).*

Sources:
Transit Capacity and Quality of Service Manual (TCQSM), 3rd Edition, TCRP Report 165, 2013
BRT Practitioner's Guide, TCRP Report 118, 2007
Current auto travel times: Google Maps, 2014; and I95 Corridor Coalition Vehicle Probe Project (VPP), 2013 calendar year data

Travel time index: I95 Corridor Coalition VPP, 2013 calendar year data
Current equivalent transit travel times: SEPTA morning peak schedule data via Google Transit, December, 2013

Chapter 8:
NEXT STEPS

Several actions have been established to advance the concepts developed in this study, as well as other improvements for the Roosevelt Boulevard corridor. The EBS service concept has specific next steps for further outreach, concept development, and implementation. These will be coordinated by the joint City of Philadelphia—SEPTA Transit First Committee, which provides a forum for City of Philadelphia and SEPTA staff and leadership to work collaboratively on day-to-day and long-term strategies to improve the effectiveness of public transit in the Philadelphia.

ENHANCED BUS SERVICE ACTIONS

- Conduct public and additional steering committee outreach to further develop near-term EBS strategies for implementation.
  - ***Lead actors:*** Communications Subcommittee of the Transit First Committee
- Analyze the nuances and traffic impacts of in-street EBS treatments (e.g., bus-preferential lane treatments and optimization/TSP) in more detail through the DVRPC EBS Operations Study.
  - ***Lead actors:*** DVRPC, with oversight by Transit First Committee and PennDOT
- Complete the DVRPC Roosevelt Boulevard Safety Study with findings related to pedestrian safety that may inform additional specifics for station design, such as locations to prioritize for additional lighting.
  - ***Lead actors:*** DVRPC, with oversight by City of Philadelphia and PennDOT
- Retain consultant services to prepare designs for shelters and stations
  - ***Lead actors:*** SEPTA and City of Philadelphia
- Retain consultant services to develop a specialized brand/identity package for enhanced bus services generally (as a new service type in SEPTA's portfolio), as well as for the Roosevelt Boulevard EBS-A concept specifically.
  - ***Lead actors:*** SEPTA and City of Philadelphia
- Pursue funding opportunities to implement EBS-A (as informed by further public and steering committee outreach), which could begin with service pattern changes and curbside/station elements, while in-street treatments continue to be evaluated.
  - ***Lead actors:*** SEPTA and City of Philadelphia

BUSWAY ACTION

The busway is more conceptual, and will become an input for a wider array of long-term options to be developed through the USDOT TIGER-funded *Route for Change: Transforming the Boulevard.*

CONCLUSION

Roosevelt Boulevard is a highly complex corridor with often-competing multimodal needs. The strategies developed here will improve mobility and access by public transit in the near-term but would leave many other corridor needs unresolved. The USDOT TIGER-funded *Route for Change: Transforming the Boulevard* will further develop a program of improvements for all modes in a comprehensive way.

APPENDIX A

CONCEPT-LEVEL RIDERSHIP FORECASTS FOR EBS (2015) AND BUSWAY (2040) TRANSIT ALTERNATIVES

Currently there are a total of 18 SEPTA local bus routes operating in the Roosevelt Boulevard study area. Nine routes primarily travel along the Roosevelt Boulevard. For example, US 1 runs between Neshaminy Mall and Broad Street and links residential areas along the Roosevelt Boulevard with shopping, office and industrial development. These routes also provide connections to the Market-Frankford Line (at the FTC) and the Broad Street Line, both of which serve the Philadelphia Central Business District.

There are also nine routes that cross or intersect the corridor. For example, Route 70 intersects Roosevelt Boulevard at Cottman Avenue, and Route 88 crosses at Welsh Road. Some of the cross routes travel downtown themselves (such as Route 47), or feed major rail routes serving downtown Philadelphia, such as the Trenton, West Trenton, and Fox Chase Regional Rail lines.

The 2010 daily passenger counts for the parallel and cross routes are shown in Table A.1. They range from a low of 699 passengers per day on Route 77 to a high of 18,000 passengers per day on Route 47. While the bulk of the daily ridership on the parallel routes get on and off somewhere along the corridor, the cross routes may only get a few passengers at the bus stops where they intersect with Roosevelt Boulevard.

Table A.1: Local Bus Routes Currently Operating in the Roosevelt Boulevard Corridor

	SEPTA Route	Daily Count (2010)	Model (2010)	Difference	% Difference
Parallel Routes	Route 1	3,895	6,195	2,300	59%
	Route 14	11,633	11,632	-1	0%
	Route R	8,684	8,780	96	1%
	Route 8	2,945	1,672	-1,273	-43%
	Route 20	7,130	7,500	370	5%
	Route 50	1,937	3,201	1,264	65%
	Route 67	4,497	4,416	-81	-2%
	Route J	3,361	3,796	435	13%
	Route 58	9,543	6,872	-2,671	-28%
	Total Parallel	53,625	54,064	439	1%
Cross Routes	Route 88	2,478	2,195	-283	-11%
	Route 70	9,018	5,692	-3,326	-37%
	Route 77	699	1,630	931	133%
	Route 26	11,571	9,972	-1,599	-14%
	Route 24	2,931	3,447	516	18%
	Route 28	2,030	4,329	2,299	113%
	Route 47	18,000	18,518	518	3%
	Route 75	3,287	3,158	-129	-4%
	Route K	8,132	8,331	199	2%
	Total Cross	58,146	57,272	-874	-2%
	TOTAL	111,771	111,336	-435	0%

Sources: SEPTA 2010; DVRPC, 2014

Table A.1 also shows the 2010 daily ridership as estimated by the DVRPC travel demand model. The model can be significantly off for any particular route, especially in the case of some of the lower-ridership routes such as Route 77 and Route 28. But overall, the model does a good job of estimating daily ridership on most of the major routes, such as Routes 47, 26, and 14. More importantly, the model is able to estimate the overall ridership, summing across all of the routes, to within a few percentage points of the total counts. For example, the model comes within 1 percent of the total daily passenger count for routes running along the Roosevelt Boulevard, and within 2 percent of the total count for routes running across the Roosevelt Boulevard.

EBS-A

As detailed elsewhere in this report, the EBS-A service concept would have nine stops and make the trip between Neshaminy Mall and FTC in roughly 33.5 minutes, as opposed to the existing Route 14, which can have many more stops and take up to 53 minutes (depending on route variant). The headways for EBS-A would be 10 minutes during the AM and PM peaks, and every 15 minutes during most of the off-peak. A park-and-ride lot would be formalized (or shared use) at Neshaminy Mall with 500 spaces assumed (for forecast purposes) to be available for transit customers, and no cost to park. The forecast horizon for EBS-A was 2015.

Table A.2 : Assumed Number of Parking Spaces at Park-and-Ride Lot(s) in 2015

Better Bus Station	Virtual PnR #	Stop #	Parking Spaces in 2015
Neshaminy Mall	90007	1800000	500
TOTAL			500

Source: DVRPC, 2014

Table A.3: Preliminary Service Plan - Weekdays

Service Period	Hours	Duration (hours)	Headway (minutes)	Round Trips
Early	5:00 AM to 7:00 AM	2.0	15	6
AM Peak	7:00 AM to 9:30 AM	2.5	10	10
Midday	9:30 AM to 3:30 PM	6.0	15	24
PM Peak	3:30 PM to 6:00 PM	2.5	10	12
Evening	6:00 PM to 9:00 PM	3.0	15	10
Late Night	9:00 PM to 12:00 AM	3.0	30	4

Note: These Service Periods are different than the DVRPC model's time periods

Source: DVRPC, 2014

Table A.4: Weekday EBS-A Timetable for Forecast Purposes – Northbound Direction

Station	Cumulative Run Time	Dwell Time
Frankford Transportation Center	0:00:00	
Harbison Avenue	0:04:00	0:00:35
Cottman Avenue	0:07:35	0:00:35
Rhawn Street	0:11:10	0:00:35
Welsh Road	0:15:05	0:00:35
Grant Avenue	0:18:40	0:00:35
Red Lion	0:22:15	0:00:35
Neshaminy Interplex	0:28:50	0:00:35
Neshaminy Mall	0:33:25	0:00:35

Source: DVRPC, 2014

Table A.5: Weekday EBS-A Timetable for Forecast Purposes – Southbound Direction

Station	Cumulative Run Time	Dwell Time
Neshaminy Mall	0:00:00	
Neshaminy Interplex	0:04:00	0:00:35
Red Lion	0:10:35	0:00:35
Grant Avenue	0:14:10	0:00:35
Welsh Road	0:17:45	0:00:35
Rhawn Street	0:21:40	0:00:35
Cottman Avenue	0:25:15	0:00:35
Harbison Avenue	0:28:50	0:00:35
Frankford Transportation Center	0:33:25	0:00:35

Source: DVRPC, 2014

EBS-A is forecast to carry a total of 9,028 passengers per day. The service would carry 3,109 passengers during the AM Peak period (6:00 to 10:00 AM); 1,760 passengers during the Midday period (10:00 AM to 3:00 PM); 3,438 passengers during the PM Peak period (3:00 to 7:00 PM); and 721 during the Evening (7:00 PM to 6:00 AM). Table A.6 shows the forecast boardings and alightings by stop, and mode of access for the AM Peak period, and Table A.7 shows the same data for the PM Peak period. Approximately 350 passengers are forecast to drive to the park-and-ride lot at Neshaminy Mall during the morning commute.

Table A.6 : 2015 AM Peak Period EBS-A Ridership Forecast (Person Trips)

			Boardings			Alights		
Station	Stop #	Direction	Walk	Drive	Total	Walk	Drive	Total
Neshaminy Mall	1800000	southbound	165	349	514	0		0
Neshaminy Interplex	1800001		128		128	16		16
Red Lion	1800002		128		128	30		30
Grant Avenue	1800003		57		57	37		37
Welsh Road	1800004		378		378	11		11
Rhawn Street	1800005		327		327	70		70
Cottman Avenue	1800006		147		147	87		87
Harbison Avenue	1800007		647		647	47		47
Frankford Transportation Center	1800008		0		0	2,028		2,028
SOUTHBOUND TOTAL			1,977	349	2,326	2,326	0	2,326
Frankford Transportation Center	1800008	northbound	497		497	0		0
Harbison Avenue	1800009		65		65	144		144
Cottman Avenue	1800010		80		80	57		57
Rhawn Street	1800011		71		71	131		131
Welsh Road	1800012		30		30	136		136
Grant Avenue	1800013		30		30	78		78
Red Lion	1800014		9		9	113		113
Neshaminy Interplex	1800015		1		1	26		26
Neshaminy Mall	1800000		0		0	98		98
NORTHBOUND TOTAL			783		783	783		783
TOTAL					3,109			3,109

Source: DVRPC, 2014

Table A.7 : 2015 PM Peak Period EBS-A Ridership Forecast (Person Trips)

			Boardings				Alights		
Station	Stop #	Direction	Walk	Drive	Total		Walk	Drive	Total
Neshaminy Mall	1800000	southbound	112		112		0		0
Neshaminy Interplex	1800001		103		103		6		6
Red Lion	1800002		147		147		16		16
Grant Avenue	1800003		77		77		47		47
Welsh Road	1800004		209		209		31		31
Rhawn Street	1800005		173		173		103		103
Cottman Avenue	1800006		39		39		140		140
Harbison Avenue	1800007		161		161		89		89
Frankford Transportation Center	1800008		0		0		589		589
SOUTHBOUND TOTAL			1,021		1,021		1,021		1,021
Frankford Transportation Center	1800008	northbound	2,163		2,163		0		0
Harbison Avenue	1800009		47		47		882		882
Cottman Avenue	1800010		58		58		223		223
Rhawn Street	1800011		71		71		301		301
Welsh Road	1800012		22		22		473		473
Grant Avenue	1800013		31		31		91		91
Red Lion	1800014		23		23		178		178
Neshaminy Interplex	1800015		2		2		40		40
Neshaminy Mall	1800000		0		0		129	100	229
NORTHBOUND TOTAL			2,417		2,417		2,317	100	2,417
TOTAL					3,438				3,438

Source: DVRPC, 2014

Table A.8 : 2015 Daily EBS-A Ridership Forecast (Person Trips)

			Boardings				Alights		
Station	Stop #	Direction	Walk	Drive	Total		Walk	Drive	Total
Neshaminy Mall	1800000	southbound	317	455	772		0		0
Neshaminy Interplex	1800001		310		310		32		32
Red Lion	1800002		390		390		65		65
Grant Avenue	1800003		197		197		120		120
Welsh Road	1800004		817		817		70		70
Rhawn Street	1800005		722		722		274		274
Cottman Avenue	1800006		246		246		367		367
Harbison Avenue	1800007		1,070		1,070		224		224
Frankford Transportation Center	1800008		0		0		3,372		3,372
SOUTHBOUND TOTAL			4,069	455	4,524		4,524		4,524
Frankford Transportation Center	1800008	northbound	3,628		3,628		0		0
Harbison Avenue	1800009		190		190		1,412		1,412
Cottman Avenue	1800010		231		231		402		402
Rhawn Street	1800011		237		237		627		627
Welsh Road	1800012		78		78		853		853
Grant Avenue	1800013		87		87		237		237
Red Lion	1800014		48		48		403		403
Neshaminy Interplex	1800015		5		5		86		86
Neshaminy Mall	1800000		0		0		326	158	484
NORTHBOUND TOTAL			4,504		4,504		4,346	158	4,504
TOTAL					9,028				9,028

Source: DVRPC, 2014

NOTE: There are several reasons why actual ridership may deviate from the EBS-A forecasts presented in Tables A.6, A.7, and A.8:

- The ridership forecasts are based on population and employment forecasts that may or may not come true. Unforeseen changes in the national and regional economies and other market forces can have a profound effect on future land use and therefore travel patterns.
- The details discussed in this report do not necessarily represent the “final” version of the project. Many things could (and some probably will) change. For example, the number and location of bus stops, the bus schedule, and fares. Also, the location of park ride lots, the number of spaces provided, and the cost to park there could change. Changing any of these things will impact the ridership forecast.
- Ridership is also dependent on several external factors.In particular, fluctuations in the price of gasoline could have a significant impact on future bus ridership.

Tables A.9 and A.10 compare modeled travel times between Neshaminy Mall and FTC by car and by enhanced bus service. Table A.9 shows AM Peak period travel times in the southbound direction. The travel time by car is about 5 minutes faster than by EBS. Table A.10 shows PM Peak period travel times in the northbound direction. Congestion is anticipated to be worse during the afternoon commute, resulting in increased travel time by car. However, the car is still anticipated to be the faster way to travel but only by approximately 3 minutes and 12 seconds.

EBS-B

EBS-B extends service from FTC west to WTC on Ridge Avenue. In order to evaluate potential demand for through service (from points south of FTC to points north of FTC, and the reverse), EBS-B was simulated as an extension of EBS-A, rather than as a new line. Traveling west from FTC, there would be an additional six stops, and the travel time from FTC to WTC would be roughly 26 minutes and 30 seconds. Traveling east from WTC, there would also be six new stops, and the travel time from WTC to FTC would be approximately 26 minutes. EBS-B also includes the discontinuation of SEPTA Route 1 (which becomes largely redundant in this scenario as a limited-stop through service).

As with EBS-A, EBS-B headways would be 10 minutes during the AM and PM peaks, and every 15 minutes during most of the off-peak. The forecast horizon for this phase of the project was also 2015.

WTC is located a short walk (approximately 0.2 miles, or 4 minutes) from the Wissahickon Station on the Manayunk-Norristown Regional Rail line. The Regional Rail station currently has a surface parking lot with 206 spaces. Therefore, no additional parking was added for EBS-B for forecast purposes.

Table A.9: AM Peak Period Travel Times Between Selected OD Pairs - 2015

From	To	Travel Mode	Travel Time (mins)
Neshaminy Mall	FTC	Car	28.35
		EBS-A	33.42
			Difference = 5.07

Source: DVRPC, 2014

Table A.10: PM Peak Period Travel Times Between Selected OD Pairs - 2015

From	To	Travel Mode	Travel Time (mins)
FTC	Neshaminy Mall	Car	30.22
		EBS-A	33.42
			Difference = 3.20

Source: DVRPC, 2014

Table A.11: Assumed Number of Parking Spaces at Park-and-Ride Lot(s) in 2015

Better Bus Station	Virtual PnR #	Stop #	Parking Spaces in 2015
Neshaminy Mall	90007	1800000	500
TOTAL			500

Source: DVRPC, 2014

Table A.12: Preliminary Service Plan - Weekdays

Service Period	Hours	Duration (hours)	Headway (minutes)
Early	5:00 AM to 7:00 AM	2.0	15
AM Peak	7:00 AM to 9:30 AM	2.5	10
Midday	9:30 AM to 3:30 PM	6.0	15
PM Peak	3:30 PM to 6:00 PM	2.5	10
Evening	6:00 PM to 9:00 PM	3.0	15
Late Night	9:00 PM to 12:00 AM	3.0	30

Note: These Service Periods are different than the DVRPC model's time periods

Source: DVRPC, 2014

Table A.13: Weekday EBS-B Timetable for Forecast Purposes – Northbound Direction

Station	Cumulative Run Time	Dwell Time
Wissahickon Transportation Center	0:00:00	
Hunting Park	0:10:00	0:00:35
5th Street	0:14:35	0:00:35
Rising Sun	0:17:10	0:00:35
Tower Center	0:19:45	0:00:35
Pratt Street	0:22:20	0:00:35
Frankford Transportation Center	0:25:55	0:00:35
Harbison Avenue	0:30:30	0:00:35
Cottman Avenue	0:34:05	0:00:35
Rhawn Street	0:37:40	0:00:35
Welsh Road	0:41:35	0:00:35
Grant Avenue	0:45:10	0:00:35
Red Lion	0:48:45	0:00:35
Neshaminy Interplex	0:55:20	0:00:35
Neshaminy Mall	0:59:55	0:00:35

Source: DVRPC, 2014

The combined EBS plan (or EBS-A plus EBS-B) is forecast to carry a total of 17,520 passengers per day, or roughly 8,500 riders for the EBS-B service alone. The combined service would carry 5,933 passengers during the AM Peak period (6:00 to 10:00 AM), 3,447 passengers during the Midday period (10:00 AM to 3:00 PM), 6,572 passengers during the PM Peak period (3:00 to 7:00 PM), and 1,568 during the Evening (7:00 PM to 6:00 AM).

Table A.15 shows the boardings and alightings by stop, and mode of access for the AM Peak period, and Table A.16 shows the same data for the PM Peak period.

Table A.14 : Weekday EBS-B Timetable for Forecast Purposes – Southbound Direction

Station	Cumulative Run Time	Dwell Time
Neshaminy Mall	0:00:00	
Neshaminy Interplex	0:04:00	0:00:35
Red Lion	0:10:35	0:00:35
Grant Avenue	0:14:10	0:00:35
Welsh Road	0:17:45	0:00:35
Rhawn Street	0:21:40	0:00:35
Cottman Avenue	0:25:15	0:00:35
Harbison Avenue	0:28:50	0:00:35
Frankford Transportation Center	0:33:25	0:00:35
Pratt Street South	0:37:00	0:00:35
Tower Center	0:39:35	0:00:35
Rising Sun	0:42:10	0:00:35
5th Street	0:44:45	0:00:35
Hunting Park	0:49:20	0:00:35
Wissahickon Transportation Center	0:59:55	0:00:35

Source: DVRPC, 2014

Table A.15 : 2015 AM Peak Period EBS-A plus B Ridership Forecast (Person Trips)

			Boardings				Alights		
Station	Stop #	Direction	Walk	Drive	Total		Walk	Drive	Total
Neshaminy Mall	1800000	southbound	184	352	536		0		0
Neshaminy Interplex	1800001		131		131		16		16
Red Lion	1800002		155		155		29		29
Grant Avenue	1800003		73		73		34		34
Welsh Road	1800004		451		451		13		13
Rhawn Street	1800005		437		437		71		71
Cottman Avenue	1800006		185		185		80		80
Harbison Avenue	1800007		878		878		47		47
Frankford Transportation Center	1800008		250		250		1,953		1,953
Pratt Street	1800029		128		128		113		113
Tower Center	1800030		194		194		140		140
Rising Sun	1800031		303		303		188		188
5th Street	1800032		242		242		106		106
Hunting Park	1800035		17		17		1,085		1,085
Wissahickon Transportation Center	1800034		0		0		105		105
SOUTHBOUND TOTAL			3,634	352	3,980		3,980	0	3,980
Wissahickon Transportation Center	1800034	northbound	58		58		0		0
Hunting Park	1800035		264		264		24		24
5th Street	1800036		110		110		37		37
Rising Sun	1800037		153		153		55		55
Tower Center	1800038		148		148		55		55
Pratt Street	1800039		341		341		40		40
Frankford Transportation Center	1800008		586		586		499		499
Harbison Avenue	1800009		71		71		329		329
Cottman Avenue	1800010		93		93		109		109
Rhawn Street	1800011		70		70		238		238
Welsh Road	1800012		28		28		194		194
Grant Avenue	1800013		23		23		110		110
Red Lion	1800014		8		8		146		146
Neshaminy Interplex	1800015		0		0		33		33
Neshaminy Mall	1800000		0		0		84		84
NORTHBOUND TOTAL			1,953		1,953		1,953		1,953
TOTAL			5,581	352	5,933		5,933		5,933

Source: DVRPC, 2014

Table A.16 : 2015 PM Peak Period EBS-A plus B Ridership Forecast (Person Trips)

			Boardings				Alights		
Station	Stop #	Direction	Walk	Drive	Total		Walk	Drive	Total
Neshaminy Mall	1800000	southbound	120		120		0		0
Neshaminy Interplex	1800001		107		107		6		6
Red Lion	1800002		189		189		16		16
Grant Avenue	1800003		105		105		49		49
Welsh Road	1800004		271		271		32		32
Rhawn Street	1800005		293		293		104		104
Cottman Avenue	1800006		66		66		132		132
Harbison Avenue	1800007		354		354		89		89
Frankford Transportation Center	1800008		434		434		570		570
Pratt Street	1800029		84		84		264		264
Tower Center	1800030		126		126		153		153
Rising Sun	1800031		105		105		227		227
5th Street	1800032		57		57		153		153
Hunting Park	1800035		20		20		460		460
Wissahickon Transportation Center	1800034		0		0		76		76
SOUTHBOUND TOTAL			2,331		2,331		2,331		2,331
Wissahickon Transportation Center	1800034	northbound	60		60		0		0
Hunting Park	1800035		735		735		15		15
5th Street	1800036		116		116		123		123
Rising Sun	1800037		117		117		201		201
Tower Center	1800038		126		126		123		123
Pratt Street	1800039		147		147		128		128
Frankford Transportation Center	1800008		2,658		2,658		217		217
Harbison Avenue	1800009		53		53		1,315		1,315
Cottman Avenue	1800010		66		66		361		361
Rhawn Street	1800011		96		96		465		465
Welsh Road	1800012		21		21		623		623
Grant Avenue	1800013		26		26		126		126
Red Lion	1800014		18		18		249		249
Neshaminy Interplex	1800015		2		2		50		50
Neshaminy Mall	1800000		0		0		142	103	245
NORTHBOUND TOTAL			4,241		4,241		4,138	103	4,241
TOTAL			6,572		6,572		6,469	103	6,572

Source: DVRPC, 2014

Table A.17: 2015 Daily EBS-A plus B Ridership Forecast (Person Trips)

			Boardings				Alights		
Station	Stop #	Direction	Walk	Drive	Total		Walk	Drive	Total
Neshaminy Mall	1800000	southbound			815				0
Neshaminy Interplex	1800001				321				32
Red Lion	1800002				493				62
Grant Avenue	1800003				258				120
Welsh Road	1800004				1,015				74
Rhawn Street	1800005				1,078				277
Cottman Avenue	1800006				346				351
Harbison Avenue	1800007				1,717				224
Frankford Transportation Center	1800008				968				3,231
Pratt Street	1800029				327				544
Tower Center	1800030				477				421
Rising Sun	1800031				553				664
5th Street	1800032				385				418
Hunting Park	1800035				42				1797
Wissahickon Transportation Center	1800034				12				592
SOUTHBOUND TOTAL					8,807				8,807
Wissahickon Transportation Center	1800034	northbound			133				86
Hunting Park	1800035				1,791				199
5th Street	1800036				303				583
Rising Sun	1800037				374				412
Tower Center	1800038				359				412
Pratt Street	1800039				557				410
Frankford Transportation Center	1800008				3,627				844
Harbison Avenue	1800009				157				1,986
Cottman Avenue	1800010				193				556
Rhawn Street	1800011				270				784
Welsh Road	1800012				525				949
Grant Avenue	1800013				131				337
Red Lion	1800014				114				552
Neshaminy Interplex	1800015				72				182
Neshaminy Mall	1800000				107				421
NORTHBOUND TOTAL					8,713				8,713
TOTAL					17,520				17,520

Source: DVRPC, 2014

Table A.18 compares ridership on the existing routes in the study corridor with and without the proposed EBS-B; e.g., 2015 No Build versus 2015 Build. In addition to SEPTA Route 1 (which is eliminated under the EBS-B scenario), the full-extent EBS primarily pulls ridership from Routes 14 and 58, with decreases of 2,521 and 876 passengers per day, respectively. Routes 20, R, K, J, 50, 26, 88, 75, and 8 are also forecast to decrease by more than 100 passengers per day.

Routes 47, 28, 67, and 77 show small increases that may be incidental to the introduction of EBS service. Transfers from EBS to other routes at FTC and Hunting Park in the AM Peak period are shown in Table A.19. Table A.20 shows the reverse flow, from other routes to EBS at FTC and Hunting Park in the PM Peak period.

As can be seen, the vast majority of transfers at FTC are between EBS and the Market-Frankford Line. At Hunting Park, most transfers are between EBS and the Broad Street Line.

Very few people are forecast to travel from the vicinity of WTC station to Hunting Park on EBS, and then transfer to the Broad Street subway line for a trip downtown. This appears to be mainly due to SEPTA Route 9, which provides a faster way to get to Center City from WTC (and vicinity).

Table A.18: Forecast Impact to Local Bus Routes Currently Operating in the Roosevelt Boulevard Corridor – Change in Daily Ridership

Route	Daily Count (2010)	Model (2010 Base)	Model (2015 No Build)	Model (2015 Build)	Difference 2015 No Build vs. 2015 Build	% Difference 2015 No Build vs. 2015 Build
Route 1	3,895	6,195	6,417	Route eliminated	-6,417	-100%
Route 14	11,633	11,632	12,246	9,725	-2,521	-21%
Route R	8,684	8,780	8,962	8,483	-479	-5%
Route 8	2,945	1,672	1,709	1,562	-147	-9%
Route 20	7,130	7,500	7,773	7,376	-397	-5%
Route 50	1,937	3,201	3,292	3,048	-244	-7%
Route 67	4,497	4,416	4,645	4,712	67	1%
Route J	3,361	3,796	3,813	3,449	-364	-10%
Route 58	9,543	6,872	7,025	6,149	-876	-12%
PARALLEL TOTAL	53,625	54,064	55,882	44,504	-11,378	-20%
Route 88	2,478	2,195	2,270	2,087	-183	-8%
Route 70	9,018	5,692	5,913	5,828	-85	-1%
Route 77	699	1,630	1,727	1,791	64	4%
Route 26	11,571	9,972	10,288	9,935	-353	-3%
Route 24	2,931	3,447	3,605	3,621	16	0%
Route 28	2,030	4,329	4,525	4,583	58	1%
Route 47	18,000	18,518	19,686	19,806	120	1%
Route 75	3,287	3,158	3,179	2,937	-242	-8%
Route K	8,132	8,331	8,497	8,091	-406	-5%
CROSS TOTAL	58,146	57,272	59,690	58,679	-1,011	-2%
TOTAL	111,771	111,336	115,572	103,183	-12,389	-11%

Source: DVRPC, 2014

Table A.19 : Transfers from EBS-B during the AM Peak Period

To Route	Transfers at Hunting Park		Transfers at FTC	
	Eastbound bus from WTC	Westbound bus from Neshaminy Mall via FTC	Eastbound bus from WTC	Westbound bus from Neshaminy Mall
SEPTA Route 14				
SEPTA Route 17			4	
SEPTA Route 19			1	
SEPTA Route 26			3	
SEPTA Route 50			2	
SEPTA Route 53		12		
SEPTA Route 66			17	3
SEPTA Route 67			1	2
SEPTA Route 73			2	4
SEPTA Route 8				3
SEPTA Route 84			15	2
SEPTA Route 88				
SEPTA BSL	14	952		
SEPTA MFL			418	1,893
SEPTA Route C	1	55		
SEPTA Route R				
TOTAL	15	1,019	463	1,907

Source: DVRPC, 2014

Table A.20 : Transfers from other routes to EBS-B during the PM Peak Period

From Route	Transfers at Hunting Park		Transfers at FTC	
	Westbound bus to WTC	Eastbound bus to Neshaminy Mall via FTC	Westbound bus to WTC	Eastbound bus to Neshaminy Mall
SEPTA Route 8				
SEPTA Route 14			6	
SEPTA Route 19			3	3
SEPTA Route 24				
SEPTA Route 25			6	12
SEPTA Route 26			2	1
SEPTA Route 50			3	
SEPTA Route 53		6		
SEPTA Route 58			4	
SEPTA Route 66			45	10
SEPTA Route 67			2	3
SEPTA Route 84			7	2
SEPTA Route 88			2	
SEPTA Route C		17		
SEPTA Route R		22		
SEPTA BSL	14	634		
SEPTA MFL			298	2,570
TOTAL	14	679	376	2,601

Source: DVRPC, 2014

Tables A.21 and A.22 compare travel times between WTC and FTC by car and by EBS. Table A.21 shows AM Peak period travel times in the southbound direction. The travel time by car is about 9 minutes and 24 seconds faster than by EBS.

Table A.22 shows PM Peak period travel times in the northbound direction. Congestion is anticipated to be worse during the afternoon commute, resulting in increased travel times by both car and bus. However, the car is still anticipated to be the faster way to travel, by approximately 7 minutes and 42 seconds. As noted earlier, the primary reason EBS-B was simulated as an extension of EBS-A rather than as a separate route was to assess potential through-trip demand between the northern and southern portions of the study area. Table A.23 shows the number of passengers who are forecast to board the bus at Neshaminy Mall in the morning and then travel "through" to FTC (the entire EBS-A length), along with those who are forecast to travel on to Hunting Park and to WTC. As can be seen, a significant number of passengers travel to FTC and then transfer to the Market-Frankford Line. However, only 21 passengers are forecast to travel from Neshaminy Mall to Hunting Park to transfer to the Broad Street Line, and there are virtually no through passengers traveling all the way from Neshaminy Mall to WTC in the AM. This suggests limited demand for a through service.

NOTE: There are several reasons why actual ridership may deviate from the EBS-B forecasts presented in Tables A.15, A.16, and A.17:

- First and foremost, the ridership forecasts are based on population and employment forecasts that may or may not come true. Unforeseen changes in the national and regional economies and other market forces can have a profound effect on future land use and therefore travel patterns.
- The details discussed in this report do not necessarily represent the "final" version of the project. Many things could (and some probably will) change. For example, the number and location of bus stops, the bus schedule, and fares. Also, the location of park ride lots, the number of

Table A.21 : AM Peak Period Travel Times Between Selected OD Pairs - 2015

From	To	Travel Mode	Travel Time (mins)
WTC	FTC	Car	16.68
		EBS-B	25.92
			Difference = 9.24

Source: DVRPC, 2014

Table A.22 : PM Peak Period Travel Times Between Selected OD Pairs - 2015

From	To	Travel Mode	Travel Time (mins)
FTC	WTC	Car	19.08
		EBS-B	26.50
			Difference = 7.42

Source: DVRPC, 2014

Table A.23 : AM Peak Through Trips, from Neshaminy Mall

	to FTC	to Hunting Park	to WTC
Neshaminy Mall	303	21	2

Source: DVRPC, 2014

spaces provided, and the cost to park there could change. Changing any of these things will impact the ridership forecast.

- Ridership is also dependent on several external factors. In particular, fluctuations in the price of gasoline could have a significant impact on future bus ridership.

2040 BUSWAY (ASSUMES NO TRAFFIC LANE REDUCTIONS)

The forecast horizon for the busway was 2040, 25 years after the 2015 planning horizon for EBS-B. Significant changes are anticipated to occur in the 25 years between 2015 and 2040, in terms of growth in population and employment, and land use changes. Also, other major roadway and transit projects, in addition to this project, are anticipated to be built by 2040. Some of the more relevant projects that affect traffic in the Roosevelt Boulevard study area include the following:

- widening several bottleneck segments of I-95 between Woodhaven Road and Center City Philadelphia;
- improvements to several I-95 interchanges, such as at Cottman Avenue and the interchange with the Pennsylvania Turnpike;
- improvements to Bustleton Avenue, from Frankford Avenue to the Philadelphia/Bucks County Line;
- improvements to Broad Street (PA 611);
- widening US 1 in Bucks County from Old Lincoln Highway through the Pennsylvania Turnpike interchange, and from the Pennsylvania Turnpike (I-276) to PA 413.

The 2040 version of the project under study represents a far more substantial capital investment than EBS-A and EBS-B. It involves the construction of a separated busway in the center median of Roosevelt Boulevard, physically separating the bus from car and local bus traffic traveling on Roosevelt Boulevard. There would be the same number of stations as with EBS, but these stations would now be located in the center median as well.

The busway will operate at grade at intersections. Therefore, this would also include TSP to enable the bus to travel as optimally as possible through intersections. As with EBS, headways for forecast purposes are 10 minutes during the AM and PM peaks, and every 15 minutes during most of the off-peak.

In the southbound direction, the travel time from Neshaminy Mall to FTC would be 27 minutes and 35 seconds, and the total travel time from Neshaminy Mall to WTC would be approximately 50 minutes and 35 seconds. Compared to EBS, this would be an additional time savings of approximately 5.83 minutes between Neshaminy Mall and FTC, and a savings of 9.33 minutes between Neshaminy Mall and WTC.

In the northbound direction, the travel time from WTC to FTC would be 22 minutes and 25 seconds, and the total travel time from WTC to Neshaminy Mall would be 50 minutes and 35 seconds. In this direction, busway service would be 3.33 minutes faster than EBS from WTC to FTC, and approximately 9.33 minutes faster from WTC to Neshaminy Mall.

Busway service is forecast to carry a total of 26,081 passengers per day. The service would carry 9,592 passengers during the AM Peak period (6:00 to 10:00 AM); 5,342 passengers during the Midday period (10:00 AM to 3:00 PM); 8,967 passengers during the PM Peak period (3:00 to 7:00 PM); and 2,179 during the Evening (7:00 PM to 6:00 AM).

Table A.24 shows the forecast boardings and alightings by station, and mode of access for the AM Peak period. Table A.25 shows the same data for the PM Peak period.
By 2040, shown in Table A.26, there will likely be demand for additional parking capacity at the Neshaminy Mall and Red Lion Road park and ride lots. There is a forecast demand of between 650 and 700 drive-access trips (including Kiss & Ride) to each of these lots. The 400 spaces assumed for WTC are forecast to be sufficient.

Table A.24 : 2040 AM Peak Period Busway Service Ridership Forecast (Person Trips)

			Boardings				Alights		
Station	Stop #	Direction	Walk	Drive	Total		Walk	Drive	Total
Neshaminy Mall	1800000	southbound	374	677	1,051		0		0
Neshaminy Interplex	1800001		240		240		11		11
Red Lion	1800003		150	661	811		14		14
Grant Avenue	1800004		430		430		124		124
Welsh Road	1800005		772		772		33		33
Rhawn Street	1800006		642		642		253		253
Cottman Avenue	1800007		696		696		167		167
Harbison Avenue	1800008		562		562		243		243
Frankford Transportation Center	1800009		282		282		3,487		3,487
Pratt Street	1800010		232		232		124		124
Tower Center	1800011		215		215		130		130
Rising Sun	1800012		375		375		170		170
5th Street	1800013		317		317		187		187
Hunting Park	1800014		117		117		895		895
Wissahickon Transportation Center	1800015		0		0		904		904
SOUTHBOUND TOTAL			5,404	1,338	6,742		6,742	0	6,742
Wissahickon Transportation Center	1800015	northbound	64	392	456		0		0
Hunting Park	1800014		227		227		141		141
5th Street	1800013		251		251		71		71
Rising Sun	1800012		138		138		126		126
Tower Center	1800011		83		83		188		188
Pratt Street	1800010		358		358		90		90
Frankford Transportation Center	1800009		502		502		459		459
Harbison Avenue	1800008		316		316		127		127
Cottman Avenue	1800007		205		205		281		281
Rhawn Street	1800006		205		205		320		320
Welsh Road	1800005		61		61		378		378
Grant Avenue	1800004		31		31		343		343
Red Lion	1800003		17		17		145		145
Neshaminy Interplex	1800002		0		0		54		54
Neshaminy Mall	1800000		0		0		127		127
NORTHBOUND TOTAL			2,458	392	2,850		2850	0	2850
TOTAL			7,862	1,730	9,592		9,592	0	9,592

Source: DVRPC, 2014

Table A.25 : 2040 PM Peak Period Busway Service Ridership Forecast (Person Trips)

			Boardings				Alights		
Station	Stop #	Direction	Walk	Drive	Total		Walk	Drive	Total
Neshaminy Mall	1800000	southbound	138		138		0		0
Neshaminy Interplex	1800001		173		173		9		9
Red Lion	1800003		276		276		26		26
Grant Avenue	1800004		422		422		76		76
Welsh Road	1800005		351		351		102		102
Rhawn Street	1800006		319		319		234		234
Cottman Avenue	1800007		222		222		198		198
Harbison Avenue	1800008		147		147		263		263
Frankford Transportation Center	1800009		479		479		577		577
Pratt Street	1800010		159		159		363		363
Tower Center	1800011		183		183		85		85
Rising Sun	1800012		170		170		195		195
5th Street	1800013		94		94		215		215
Hunting Park	1800014		137		137		425		425
Wissahickon Transportation Center	1800015		0		0		59	443	502
SOUTHBOUND TOTAL			3,270		3,270		2,827	443	3,270
Wissahickon Transportation Center	1800015	northbound	574		574		0		0
Hunting Park	1800014		741		741		124		124
5th Street	1800013		211		211		176		176
Rising Sun	1800012		158		158		243		243
Tower Center	1800011		156		156		205		205
Pratt Street	1800010		151		151		200		200
Frankford Transportation Center	1800009		2,854		2,854		300		300
Harbison Avenue	1800008		307		307		397		397
Cottman Avenue	1800007		170		170		692		692
Rhawn Street	1800006		231		231		731		731
Welsh Road	1800005		49		49		790		790
Grant Avenue	1800004		81		81		455		455
Red Lion	1800003		10		10		133	553	686
Neshaminy Interplex	1800002		4		4		61		61
Neshaminy Mall	1800000		0		0		222	415	637
NORTHBOUND TOTAL			5,697		5,697		4,729	968	5,697
TOTAL			8,967		8,967		7,556	1,411	8,967

Source: DVRPC, 2014

Table A.26 : Assumed Available Park-and-Ride Capacity for 2040 Busway Phase

Better Bus Station	Virtual PnR #	Stop #	Parking Spaces in 2040
Neshaminy Mall	90007	1800000	500
Red Lion	90008	1800003	400
Wissahickon TC	90009	1800015	400
TOTAL			1,300

Source: DVRPC, 2014

Table A.27 : 2040 Daily Busway Service Ridership Forecast (Person Trips)

			Boardings				Alights		
Station	Stop #	Direction	Walk	Drive	Total		Walk	Drive	Total
Neshaminy Mall	1800000	southbound			1,412				0
Neshaminy Interplex	1800001				534				26
Red Lion	1800003				1,453				62
Grant Avenue	1800004				1,196				257
Welsh Road	1800005				1,561				194
Rhawn Street	1800006				1,336				763
Cottman Avenue	1800007				1,241				627
Harbison Avenue	1800008				919				803
Frankford Transportation Center	1800009				1,087				4,838
Pratt Street	1800010				557				697
Tower Center	1800011				606				353
Rising Sun	1800012				738				563
5th Street	1800013				522				652
Hunting Park	1800014				403				1,760
Wissahickon Transportation Center	1800015				0				1,970
SOUTHBOUND TOTAL					13,565				13,565
Wissahickon Transportation Center	1800015	northbound			1,812				0
Hunting Park	1800014				1,357				495
5th Street	1800013				837				349
Rising Sun	1800012				513				542
Tower Center	1800011				353				726
Pratt Street	1800010				692				492
Frankford Transportation Center	1800009				4,290				1,158
Harbison Avenue	1800008				970				790
Cottman Avenue	1800007				618				1,394
Rhawn Street	1800006				700				1,476
Welsh Road	1800005				167				1,662
Grant Avenue	1800004				155				1,160
Red Lion	1800003				44				1,120
Neshaminy Interplex	1800002				7				161
Neshaminy Mall	1800000				0				990
NORTHBOUND TOTAL					12,515				12,515
TOTAL					26,080				26,080

Source: DVRPC, 2014

As with overall ridership, the total number of transfers is also forecast to increase from EBS-B to the busway. For example, as shown in Table A.28, the number of transfers to the Market-Frankford Line at FTC in the AM Peak increases from 1,893 to 3,408.

Table A.28 : Transfers from Busway Service during the AM Peak Period

To Route	Transfers at Hunting Park		Transfers at FTC	
	Eastbound bus from WTC	Westbound bus from Neshaminy Mall	Eastbound bus from WTC	Westbound bus from Neshaminy Mall
SEPTA Route 3				1
SEPTA Route 14				
SEPTA Route 17				
SEPTA Route 19				
SEPTA Route 24				5
SEPTA Route 25			2	4
SEPTA Route 26			2	1
SEPTA Route 50				
SEPTA Route 53	2	8		
SEPTA Route 58			25	
SEPTA Route 66			30	4
SEPTA Route 67			1	
SEPTA Route 73			15	22
SEPTA Route 8				
SEPTA Route 84			17	10
SEPTA Route 88				
SEPTA BSL	99	824		
SEPTA MFL			345	3,408
SEPTA Route C	13	13		
SEPTA Route R				
TOTAL	114	845	437	3,455

Source: DVRPC, 2014

However, the number of transfers to the Broad Street Line at Hunting Park in the AM are forecast to decrease from 952 to 824. It appears this is due to the quicker travel times to FTC via busway service in 2040. For example, for somebody traveling from Neshaminy Mall to the West Kensington area during the AM Peak in 2015 (Table A.29), the model has them taking EBS-B to Hunting Park and then transferring to the Broad Street Line.

But in 2040, it is much quicker to travel from Neshaminy Mall to FTC via busway service, take the Market-Frankford Line for a few stops, and then transfer to a local bus, as shown in Table A.30.

Table A.29 : Travel Time from Neshaminy Mall to West Kensington in 2015

activity	from	to	time
Walk to bus stop at Neshaminy Mall			2 minutes
EBS-B	Neshaminy Mall	Hunting Park	49 minutes 20 seconds
Transfer to Broad Street Line at Hunting Park			26 seconds
Broad Street Line	Hunting Park	West Kensington	7 minutes
Walk to final destination			15 minutes 39 seconds
TOTAL TRAVEL TIME			74 minutes 25 seconds

Source: DVRPC, 2014

Table A.30 : Travel Time from Neshaminy Mall to West Kensington in 2040

activity	from	to	time
Walk to bus stop at Neshaminy Mall			2 minutes
Busway service	Neshaminy Mall	FTC	27 minutes 35 seconds
Transfer to MFL at FTC			21 seconds
MFL	FTC	Huntingdon Station	9 minutes
Transfer to local bus Route 39			1 minute
SEPTA Route 39	Huntingdon Station	7th and Susquehanna	7 minutes
Walk to final destination			8 minutes and 34 seconds
TOTAL TRAVEL TIME			55 minutes 30 seconds

Source: DVRPC, 2014

Table A.31 : Transfers from other routes to Busway Service during the PM Peak Period

From Route	Transfers at Hunting Park		Transfers at FTC	
	Westbound bus to WTC	Eastbound bus to Neshaminy Mall	Westbound bus to WTC	Eastbound bus to Neshaminy Mall
SEPTA Route 5			1	2
SEPTA Route 8				
SEPTA Route 14			4	
SEPTA Route 19			9	1
SEPTA Route 24				
SEPTA Route 25			6	8
SEPTA Route 26			5	4
SEPTA Route 50			4	
SEPTA Route 53		4		
SEPTA Route 58			5	
SEPTA Route 66			55	13
SEPTA Route 67			6	4
SEPTA Route 84			9	5
SEPTA Route 88			6	
SEPTA Route C	6	5		
SEPTA Route R		10		
SEPTA BSL	106	676		
SEPTA MFL			329	2,775
TOTAL	112	695	439	2,812

Source: DVRPC, 2014

Tables A.32 and A.33 compare travel times between WTC and FTC by car and via busway service. Table A.32 shows AM Peak period travel times in the northbound direction. The travel time by car is about 5 minutes and 50 seconds faster than via busway. Table A.33 shows PM Peak period travel times in the southbound direction. In this direction, travel by car is approximately 4 minutes and 7 seconds faster. So, travel by car is still anticipated to be faster than by bus, but the differences between the bus and car are smaller.

It should also be noted that although there will be more cars on the road in 2040, travel times by car in the Roosevelt Boulevard corridor do not degrade significantly between 2015 and 2040. For example, the travel time by car between WTC and FTC in 2015 is 16.68 minutes, versus 16.58 minutes in 2040.

However, it bears noting that traffic congestion is not forecast to be significantly improved by 2040. Any observed improvements are likely due to several major roadway and transit improvements planned to be completed between 2015 and 2040 that will provide some degree of auto congestion relief.

NOTE: There are several reasons why actual ridership may deviate from the Busway forecasts presented in Tables A.24, A.25, and A.27:

- First and foremost, the ridership forecasts are based on population and employment forecasts that may or may not come true. Unforeseen changes in the national and regional economies and other market forces can have a profound effect on future land use and therefore travel patterns.
- The details discussed in this report do not necessarily represent the “final” version of the project. Many things could (and some probably will) change. For example, the number and location of bus stops, the bus schedule, and fares. Also, the location of park ride lots, the number of spaces provided, and the cost to park there could change. Changing any of these things will impact the ridership forecast.
- Ridership is also dependent on several external factors. In particular, fluctuations in the price of gasoline could have a significant impact on future bus ridership.

Table A.32 : AM Peak Period Travel Times Between Selected OD Pairs - 2040

From	To	Travel Mode	Travel Time (mins)
WTC	FTC	Car	16.58
		BRT	22.42
			Difference = 5.84

Source: DVRPC, 2014

Table A.33 : PM Peak Period Travel Times Between Selected OD Pairs - 2040

From	To	Travel Mode	Travel Time (mins)
FTC	WTC	Car	18.88
		BRT	23.00
			Difference = 4.12

Source: DVRPC, 2014

Table A.34: Summary Results – Preliminary Ridership Forecasts

Scenario	Travel Time for Forecast Scenarios				Ridership Forecast			
	South / Westbound		North / Eastbound		AM Peak	PM Peak	Daily	Est. Daily New Bus Riders for EBS*
	Neshaminy Mall to FTC	Neshaminy Mall to WTC	WTC to FTC	WTC to Neshaminy Mall				
2015 EBS-A	33.42	NA	NA	NA	3,109	3,438	9,028	4,500
2015 EBS-B (full extent; WTC to Neshaminy Mall via FTC)	33.42	59.92	25.92	59.92	5,933 (full extent) 2,824 (south of FTC)	6,572 (full extent) 3,134 (south of FTC)	17,520 (full extent) 8,492 (south of FTC)	6,000 (full extent) 1,500 (EBS-B extent, south of FTC)
2040 Busway	27.58	50.58	22.42	50.58	9,592	8,967	26,080	N/A

* Daily EBS boardings minus the net change in boardings for parallel bus routes, rounded to convey uncertainty.

Source: DVRPC, 2014

CONCLUSIONS

Table A.34 summarizes the model results of the three forecast scenarios analyzed for this project. The results for EBS-A and EBS-B seem realistic and reasonable. There is one caveat associated with the 2040 busway analysis. Several of the major intersections along the Boulevard are already experiencing congestion during the morning and afternoon peak periods. The addition of an at-grade busway in the median will only add to the delay. Therefore, we would recommend more detailed traffic operations analysis be conducted at several of the intersections with major cross-streets, such as Cottman Avenue. Just to see if an at-grade busway is truly feasible, or whether grade separation would be required

APPENDIX B

Table B.1: Tabulation of Workshop Group Results

	STOPS & ALIGNMENT					"BETTER BUS" / MISC.												
	Location	Stop	Park-and-Ride	Inner Drive	Outer Drive	Special Branding	multidoor boarding	Enhanced Stations	TSP	Bus-only lane	Far-Side Stops	Real-time info	Queue-jump lane	Enhanced lighting	Kiss-and-ride at all stations	Enhanced Ped. Access	Free rapid Transit transfers	Development opportunity
	Neshaminy Mall	ABCDEF	ABCEF			ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
	PA Turnpike Interchange	E	E			ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
	Regional Rail stations: Cornwells Heights, Eddington, Neshaminy Falls	DF	D			ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
	Parx Casino	A				ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
	Old Lincoln Hwy (Neshaminy Interplex)	E				ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
	Southampton Road	E				ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
Roosevelt Boulevard	Woodhaven Rd	ADE	ADE	AC	BDEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
Roosevelt Boulevard	Red Lion Rd (IRS/Airport)	ABCDEF	ABCEF	AC	BDEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E	A		
Roosevelt Boulevard	Conwell Ave	E	E	AC	BDEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
Roosevelt Boulevard	Grant Ave	EF	F	AC	BDEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
Roosevelt Boulevard	Welsh Rd (Northeast Shopping Center)	ABDE		AC	BDEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	BCDE	ACE	F	A	E	A		A
Roosevelt Boulevard	Huffnagle/Benson/Strahle (Medical Center)	AE		ABC	DEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E	A		
Roosevelt Boulevard	Rhawn St	CBDEF	C	BC	ADEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	BF	A	E			A
Roosevelt Boulevard	Cottman Ave	ABCDEF	ACE	C	ABCDEF	ABCDEF	ABCEF	ABCDEF	CD	CDF	BCDEF	ACE	ABF	A	E	A		A
Roosevelt Boulevard	Harbison Ave (Roosevelt Plaza)	A		BC	ADEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
Roosevelt Boulevard	Bustleton Ave / Levick St	CEF		BC	ADEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDEF	ACE	F	A	E	C		
Roosevelt Boulevard	Frankford TC	ADEF		BC	ADEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E		AE	
Roosevelt Boulevard	Oxford Circle	F		BC	ADEF	ABCDEF	ABCEF	ABCDEF	CDF	CDF	CDE	ACE	F	A	E			
Roosevelt Boulevard	Bridge/Pratt	BDE		BC	ADEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	BCDE	ACE	BF	A	E			
Roosevelt Boulevard	Tower Center (Langdon/Tower)	ABCDEF	C	C	ABDEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	BCDE	ACE	F	A	E	AC		
Roosevelt Boulevard	Whitaker Ave / Garland St	E		C	ABDEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
Roosevelt Boulevard	C Street	DE		C	ABDEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
Roosevelt Boulevard	Rising Sun Ave	ACDEF		C	ABDEF	ABCDEF	ABCEF	ABCDEF	CDF	CDF	CDEF	ACE	F	A	E	A		
Roosevelt Boulevard	5th Street	ABDEF		C	ABDEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	BCDEF	ACE	F	A	E	A		
Roosevelt Boulevard	9th Street	D		C	ABDEF	ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
	Broad Street (Wyoming)	C				ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			
	Broad Street (Hunting Park)	ABCDF				ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E		A	
	Broad Street (Erie)	BCDE				ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E		E	
	Wayne Junction	D				ABCDEF	ABCEF	ABCDE	CDF	CDF	CDE	ACE	F	A	E			

Source: DVRPC, 2014

Table B.2: Travel Time Estimates from Initial Alternatives 1–3

ALTERNATIVE & TERMINI			CALCULATING ESTIMATED BUS TRAVEL TIMES			TRAVEL TIME COMPARISON		
	N. Terminus	**S. Terminus**	**AM Peak inbound auto travel time**	**Time added for buses between termini**	**Time subtracted for buses between termini**	**Estimated bus travel time**	**Current travel time for comparable transit trip**	**Transit time savings**
Initial Alternative 1: On the Ground Tomorrow (Rapid Route 14)	Neshaminy Mall	Frankford TC	25 minutes	Dwell Time*: 6 stops x 91 seconds ([20pass/stop x 3.8s]+15s) = 9.1 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 3.75 minutes	N/A	37.9 minutes	46 minutes (Route 14)	8.1 min. (17.6%)
Initial Alternative 1: On the Ground Tomorrow (Rapid Route 1)	Parx Casino	Broad Street at Hunting Park	34 minutes	Dwell Time*: 9 stops x 64.4 seconds ([13pass/stop x 3.8s]+15s) = 9.7 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 5.1 minutes	N/A	48.8 minutes	60 minutes (Route 1)	11.2 min. (18.7%)
Initial Alternative 2: Quick Win for Current Riders	Various	Various	Various	N/A	Bus-only Lane with right turns: 10% (4.9 minutes, Southampton Rd to Broad St) Transit Signal Priority: 6% (2.9 minutes, Southampton Rd to Broad St)	41.2 minutes (Southampton Rd to Broad St)	49 minutes (Route 1 Southampton Rd to Broad St)	7.8 min. (15.9%)
Initial Alternative 3: Long-Distance Commuter Focus	Neshaminy Mall	Frankford TC	25 minutes	Dwell Time*: 5 stops x 51 seconds ([24 pass/stop x 1.5s] + 15s) = 4.25 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 3.75 minutes	Inner drive operation***: 45 seconds (45 seconds x 1 signal bypassed) Queue-jump treatments: 24 seconds (assumes treatments at 4 intersections) Transit Signal Priority: 6% (2 minutes)	29.9 minutes	46 minutes (Route 14)	16.1 min. (35%)
Initial Alternative 3: Long-Distance Commuter Focus	Neshaminy Mall	Broad Street at Erie Ave	36 minutes	Dwell Time*: 8 stops x 37.5 seconds ([15 pass/stop x 1.5s] +15s) = 5 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 5.4 minutes	Inner drive operation***: 45 seconds (45 seconds x 1 signal bypassed) Queue-jump treatments: 24 seconds (assumes treatments at 4 intersections) Transit Signal Priority: 6% (2.7 minutes)	42.6 minutes	60 minutes (Route 1 Parx terminus; Neshaminy Mall equivalent destination distance)	17.4 min (29%)
Initial Alternative 3: Long-Distance Commuter Focus	Neshaminy Mall	Wayne Junction Station	34 minutes	Dwell Time*: 8 stops x 37.5 seconds ([15 pass/stop x 1.5s] +15s) = 5 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 5.1 minutes	Inner drive operation***: 45 seconds (45 seconds x 1 signal bypassed) Queue-jump treatments: 24 seconds (assumes treatments at 4 intersections) Transit Signal Priority: 6% (2.6 minutes)	40.4 minutes	62 minutes (Route 1, Parx to Hunting Park Ave. & Clarissa St.)****	21.6 min (34.8%)

Table B.3: Travel Time Estimates from Initial Alternatives 4-6

ALTERNATIVE & TERMINI			CALCULATING ESTIMATED BUS TRAVEL TIMES			TRAVEL TIME COMPARISON		
	N. Terminus	S. Terminus	AM Peak inbound auto travel time	Time added for buses between termini	Time subtracted for buses between termini	Estimated bus travel time	Current travel time for comparable transit trip	Transit time savings
Initial Alternative 4: Community & Economic Development Focus	Neshaminy Mall	Frankford TC	25 minutes	Dwell Time*: 8 stops x 37.5 seconds ([15 pass/stop x 1.5s] +15s) = 5 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 3.75 minutes	Inner drive operation***: 45 seconds (45 seconds x 1 signal bypassed) Queue-jump treatments: 24 seconds (assumes treatments at 4 intersections)	32.6 minutes	46 minutes (Route 14)	13.4 min. (29.1%)
Initial Alternative 4: Community & Economic Development Focus	Neshaminy Mall	Broad Street at Hunting Park	34 minutes	Dwell Time*: 12 stops x 30 seconds ([10 pass/stop x 1.5s] +15s) = 6 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 5.1 minutes	Inner drive operation***: 45 seconds (45 seconds x 1 signal bypassed) Queue-jump treatments: 24 seconds (assumes treatments at 4 intersections)	44.0 minutes	60 minutes (Route 1 Parx terminus; Neshaminy Mall equivalent destination distance)	16.0 min. (26.7%)
Initial Alternatives 5 & 6: The Roosevelt Boulevard Line (Inner or Outer Median Options)	Neshaminy Mall	Broad Street at Hunting Park	34 minutes	Dwell Time*: 8 stops x 37.5 seconds ([15 pass/stop x 1.5s] +15s) = 5 minutes Travel Time**: 5mph bus/heavy vehicle speed penalty (+15%) = 5.1 minutes	Inner drive operation***: 90 seconds (45 seconds x 2 signals bypassed) Queue-jump treatments: 48 seconds (assumes treatments at 8 stations) Bus-only Lane with shared turns: 10% (4.3 minutes, Southampton Rd to Broad St) Transit Signal Priority: 6% (2.3 minutes)	36.2 minutes	60 minutes (Route 1 Parx terminus; Neshaminy Mall equivalent destination distance)	23.8 min. (39.7%)

*Dwell Time: One hundred and twenty boards plus alights (maximum Route 14 non-terminal passenger activity for a southbound run; a proxy for highest single-run loads) divided by number of stops (assumes same demand, differently distributed) and multiplied by 3.8 seconds per passenger (standard fare payment) or 1.5 seconds per passenger (prepaid fares/multidoor boarding and alighting). Fifteen seconds per stop is added in all cases for bus deceleration (5 seconds) and acceleration (10 seconds).

**Auto-derived travel times between stops were adjusted to reflect slower acceleration and deceleration for buses, based on a rule of thumb that buses operate at 5 mph slower than equivalent general traffic speeds. Per VPP data, end-to-end auto operating speeds in the study area are roughly 32.5 mph southbound at 8:00 AM; 5 mph is 15 percent of 32.5 mph.

***Inner drive operations: Assumes 45 seconds saved per signal skipped, or half of the typical 90-second signal cycle, accounting for the fact that some signals “skipped” would be skipped anyway (encountered while green).

****No closely comparable bus trip exists. The equivalent Regional Rail travel time is 34 minutes from Neshaminy Falls to Wayne Junction via the West Trenton Line.

Sources:

Transit Capacity and Quality of Service Manual (TCQSM), 2nd and 3rd Editions, TCRP Reports 100 and 165, 2003 and 2013

BRT Practitioner’s Guide, TCRP Report 118, 2007

Current morning auto travel times: I95 Corridor Coalition Vehicle Probe Project (VPP), 2012 calendar year data

Current equivalent transit travel times: SEPTA morning peak schedule data via Google Transit, December 2013

Table B.4: Performance Indicator Matrix for Station Selection

Baseline stops - 1-mile Buffer around proposed stop	Area population (Census 2010)	Number of jobs in station area	Mix of land uses (DVRPC 2010)				% Pop with No Car	% of Pop commuting using Public Transi	Proximity to Next Station		Ridership Activity at Intersection	Cross Street Transit Vehicle Volume		V/C Ratio		Traffic Volumes; outer lanes only		Cross-Street Volumes ; outer lanes only	
	Block Lvl	Average of DVRPC and NETS Job Data	Residential (%)	Office / Retail (%)	Public / Institutional (%)	Vacant Land (%)	Census 2010	Census 2010	S/W (miles)	N/E (miles)		NB	SB	NB	SB	NB	SB	NB	SB
Terminus Option: Hunting Park	61,534	16,931	48.93%	12.27%	6.66%	5.81%	14.74%	13.24%	-	1	2542	-	-	0.01-0.49	0.01-0.49	-	-	11,062-16,086	11,062-16,086
5th Street	67,026	9,732	49.12%	13.17%	10.79%	4.15%	12.26%	11.91%	1.3	0.7	1804	217-319	217-319	0.49-.7	.7-.95	9,459-14,393	14,394-18,641	11,062-16,086	0.01-11,062
Rising Sun Ave	60,005	9,208	46.14%	12.26%	7.38%	5.47%	10.11%	10.30%	0.7	1.2	960	217-319	217-319	0.49-.7	.7-.95	9,459-14,393	14,394-18,641	16,086-23,253	0.01-11,062
Tower Boulevard/ Tower Center	50,471	11,118	40.60%	9.82%	14.27%	5.55%	8.68%	9.05%	1.2	0.7	981	217-319	319-675	.7-.95	0.49-.7	18,642-24,354	14,394-18,641	16,086-23,253	11,062-16,086
Pratt Street	54,315	13,352	45.45%	9.71%	17.84%	4.14%	9.05%	9.70%	0.7	0.1	1089	319-675	319-675	.7-.95	0.49-.7	18,642-24,354	18,642-24,354	0.01-11,062	11,062-16,086
Bridge Street	56,029	11,995	47.13%	9.96%	19.67%	3.46%	9.13%	9.44%	0.1	0.9	19	319-675	319-675	.7-.95	0.49-.7	18,642-24,354	18,642-24,354	0.01-11,062	11,062-16,086
Bustleton Ave	81,807	7,909	71.03%	9.75%	9.72%	0.21%	7.37%	8.30%	0.9	0.9	351	319-675	319-675	.7-.95	.7-.95	9,459-14,393	9,459-14,393	11,062-16,086	0.01-11,062
Harbison Ave (Roosevelt Plaza)	76,707	9,318	69.70%	14.15%	7.54%	0.01%	6.27%	7.44%	1.2	0.8	633	319-675	319-675	.7-.95	.7-.95	14,394-18,641	9,459-14,393	11,062-16,086	16,086-23,253
Cottman Ave	57,410	10,251	64.68%	16.09%	5.39%	0.16%	5.27%	6.54%	0.8	1	3511	133-217	133-217	0.49-.7	.7-.95	18,642-24,354	14,394-18,641	16,086-23,253	16,086-23,253
Rhawn Street	35,329	9,496	50.91%	12.55%	5.84%	1.17%	7.03%	5.93%	1	0.5	1104	133-217	133-217	0.49-.7	.7-.95	14,394-18,641	9,459-14,393	16,086-23,253	16,086-23,253
Strahle Street (Medical Center)	38,403	9,067	60.03%	8.50%	4.36%	1.32%	8.04%	6.08%	0.5	0.9	90	0-41	0-41	0.49-.7	.7-.95	9,459-14,393	9,459-14,393	16,086-23,253	0
Welsh Road	29,270	9,033	41.11%	13.15%	2.37%	4.12%	7.85%	5.80%	0.9	0.6	832	0-41	0-41	0.49-.7	.7-.95	9,459-14,393	5,993-9,458	16,086-23,253	23,253-33,022
Grant Avenue	23,620	10,727	26.71%	13.54%	0.72%	5.83%	7.37%	5.54%	0.6	1.2	397	0-41	0-41	0.49-.7	.7-.95	9,459-14,393	9,459-14,393	23,253-33,022	23,253-33,022
Red Lion Road	13,944	12,859	45.65%	10.45%	7.22%	6.74%	6.30%	4.21%	1.2	1	770	0-41	0-41	0.01-0.49	0.01-0.49	9,459-14,393	9,459-14,393	16,086-23,253	16,086-23,253
Comly Road/ Byberry	10,805	12,562	13.53%	1.93%	3.49%	11.12%	3.63%	4.48%	1	1.7	122	41-133	41-133	0.01-0.49	0.01-0.49	9,459-14,393	14,394-18,641	11,062-16,086	11,062-16,086
Neshaminy Interplex	9,577	11,783	20.56%	13.75%	5.68%	13.09%	2.63%	2.92%	1.7	2.3	36.5	-	-	-	-	24,355-32,042	9,459-14,393	-	-
Terminus Option: FTC	67,253	9,514	60.60%	11.28%	11.08%	2.82%	9.48%	9.72%	0.9	1.2	16734	-	-		-	-	-	-	-
Terminus Option: Neshaminy Mall	9,021	5,941	26.87%	22.79%	8.91%	7.10%	2.14%	2.17%	2.3	-	462	-	-	-	-	32,043-46,161	32,043-46,161	-	-

Source: DVRPC, (2014)

ALTERNATIVES DEVELOPMENT FOR ROOSEVELT BOULEVARD TRANSIT ENHANCEMENTS

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ABSTRACT:
DVRPC conducted this project to take a fresh look at transit needs for the Roosevelt Boulevard corridor in response to public requests for improved transit. This project's focus was on developing improvement strategies that could be achieved at grade within the existing cross section, at comparatively lower cost and in a shorter timeframe than the subway/elevated line that has historically been the focus of transit planning efforts for the corridor—and which remains a long-term ambition. This project drew on a collaborative, workshop-oriented approach to develop two Bus Rapid Transit service concepts that could be implemented in a phased way: a short-term enhanced bus service concept and a future exclusive busway that requires further concept development.

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