I-95 Interchange Enhancement and Reconstruction

I-95 EXPRESSWAY INTERCHANGES SECTIONS GIR/VINE AND AFC TRAFFIC STUDY - SUPPLEMENT NUMBER 2

FEBRUARY 2010

Prepared for Pennsylvania Department of Transportation by

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

PENNDOT

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February 2010

Prepared for
Pennsylvania Department of Transportation
By
Delaware Valley Regional Planning Commission
190 North Independence Mall West, 8th Floor
Philadelphia, PA 19106-1520

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

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

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EXECUTIVE SUMMARY

This supplemental technical report presents I-95 Expressway Enhancement and Reconstruction Alternative 10 and the accompanying Year 2030 traffic forecasts for Section GIR (Girard Avenue) and Section AFC (Ann Street to Frankford Creek). It also presents Year 2030 pedestrian forecasts for proposed facilities around Section GIR intended to improve walk access to the Delaware River waterfront.

This document supplements the 2025 traffic forecasts in the initial traffic study reports for Section GIR, entitled "I-95 Girard Avenue and I-676 Vine Expressway Interchanges, Section GIR Traffic Study" published in June 2005; and Section AFC, entitled "I-95 Section AFC (Ann Street to Frankford Creek) Interchange Traffic Study" published in May 2006. It also supplements, "I-95 Expressway Interchanges Sections GIR/Vine and AFC Traffic Study - Supplement Number 1" published in November 2008.

I-95 Expressway Interchange Enhancement and Reconstruction Alternative 10 replaces the Widened Diamond (studied in November 2008 Supplement Number 1 of this report series) as the preferred alternative for Section AFC. It addresses the unacceptable Level of Service conditions projected for the Widened Diamond - Alternative 5 and avoids land acquisition problems associated with the northbound Allegheny Avenue ramps.

Alternative 10 replaces the Widened Diamond - Alternative 5 in Section AFC with the following changes:

- The I-95 northbound off and on-ramps are moved from Allegheny Avenue north to Castor Avenue.
- Access to the Betsy Ross Bridge is redirected by a slip ramp from the Castor Avenue northbound on-ramp to the bridge approach viaduct.
- The Delaware Avenue Extension across Conrail property (also called the "Temporary Relief Road") is removed in favor of a temporary construction relief road immediately adjacent to the I-95 embankment.

Alternative 10 is identical to Build Option 7 in Section GIR with the following changes:

- The Delaware Avenue Extension across Conrail property is removed as above.

Removing the proposed Delaware Avenue Extension diverts about 3,900 daily vehicles onto I-95 northbound. In Section GIR, these diverted vehicles use the I-95 northbound on-ramp from Delaware Avenue/Richmond Street and the opposite I-95 southbound off-ramp to Girard Avenue. Also, about 2,800 daily vehicles are diverted from the Delaware Avenue Extension to Aramingo Avenue.

Relocating the I-95 northbound ramp causes an increase of 5,400 daily vehicles on the adjacent section of I-95. Traffic volumes on Richmond Street between Ann and Clearfield streets are also increased by 3,300 daily vehicles due to the elimination of the Delaware Avenue Extension. This also reduces volumes on Delaware Avenue north of Allegheny Avenue by 3,200 vehicles per day.

All forecasts in this document assume construction of the slots casino, condominium, and commercial developments on Delaware Avenue and Columbus Boulevard.

Proposed pedestrian facilities forecasts are prepared to support community initiatives that improve walk access to Penn Treaty Park and the rest of North Delaware Avenue from the areas of Aramingo and Girard avenues west of the I-95 interchange complex as detailed in the May 2008 Penn Praxis Study "An Action Plan for the Central Delaware: 2008-2018."

The sidewalk connection between the Girard Avenue Extension at Richmond Street is projected to carry about 426 daily pedestrian trips. The sidewalk along the Aramingo Avenue on-ramp from Delaware Avenue is projected to serve about 140 daily pedestrians, of which 114 continue on to Port Richmond Village at York Street. This results in 438 daily pedestrian crossings at the Aramingo Avenue ramp. Pedestrian turning movements within this sidewalk intersection are small.

The intersections of Columbia Avenue and Beach Street with North Delaware Avenue have significant forecast pedestrian crossings, especially across the northeast side of these intersections – 138 and 179 daily person trips, respectively. Most of these pedestrians are assumed to be accessing Penn Treaty Park, although the adjacent Penn Treaty Park Plaza building also generates significant volume at this intersection. Forecast daily pedestrian flows along Delaware Avenue between Palmer and Berks streets tend to be light - 32 or fewer daily crossings. Aramingo Avenue has higher pedestrian volume due to the sidewalk connection to Port Richmond Village. The proposed Girard Avenue Extension sidewalk generates 348 daily person trips crossing Richmond Street to access the adjacent commercial/industrial land uses, many more than current.

The most critical peak period movement is across the Aramingo Avenue northbound on-ramp from Delaware Avenue. At this crosswalk, 44 persons use the crosswalk during the AM peak period and 175 persons during the PM peak period. Movements with negligible volume should still be accommodated in the final design of Section GIR.

It is important to recognize that special events occur in Penn Treaty Park and other locations along North Delaware Avenue and Columbus Boulevard that can increase pedestrian flows dramatically. These events often occur on weekends. The pedestrian accommodations in Section GIR designs and elsewhere should also adequately serve these special events. There may be a need for special event pedestrian forecasts to insure that the pedestrian sidewalks and crossings designs are adequate.

I.   INTRODUCTION

This supplemental technical report presents I-95 Expressway Enhancement and Reconstruction Alternative 10 (Alternative 10) and accompanying Year 2030 traffic forecasts for Section GIR (Girard Avenue) and Section AFC (Ann Street to Frankford Creek). Additionally, pedestrian forecasts are presented herein for sidewalk and crosswalk facilities proposed for Section GIR along with the calibration data and model development procedures. This model is prepared in support of the design and evaluation of Section GIR interchange improvements as detailed in the May 2008 Penn Praxis Study "An Action Plan for the Central Delaware: 2008-2018."

All forecasts in this document assume construction of the slots casino, condominium, and commercial developments along Delaware Avenue and Columbus Boulevard.

Alternative 10 is prepared to mitigate projected Level of Service problems associated with the I-95 northbound Allegheny ramps in Section AFC, under the Widened Diamond Alternative studied in Supplement Number 1 of this report series dated November 2008. It also avoids land acquisition problems associated with the I-95 northbound off-ramp at Allegheny Avenue. In response to the land acquisition problems and projected congestion levels under the Widened Diamond Alternative, the proposed I-95 northbound off and on-ramps are relocated from Allegheny Avenue northwards to Castor Avenue. Access to the Betsy Ross Bridge will be provided by a slip ramp from the Castor Avenue on-ramp to the bridge approach viaduct. The proposed Delaware Avenue Extension across Conrail property (also called the "temporary relief road") is removed from Alternative 10 in favor of a temporary construction relief road immediately adjacent to the I-95 embankment.

This document supplements the 2025 traffic forecasts in the initial traffic study reports for I-95 Section GIR, entitled "I-95 Girard Avenue and I-676 Vine Expressway Interchanges, Section GIR Traffic Study" published in June 2005; and Section AFC, entitled "I-95 Section AFC (Ann Street to Frankford Creek) Interchange Traffic Study" published in May 2006. It also supplements, "I-95 Expressway Interchanges Sections GIR/Vine and AFC Traffic Study - Supplement Number 1", published in November 2008.

As documented in the initial and Supplement Number 1 report, DVRPC conducts a focused simulation, where the travel zones in the study area are subdivided into smaller zones to better reflect the highway network and land use characteristics of the study area. The model's highway network within the study area is reviewed and modified as needed. These Section GIR and AFC forecasts assume the opening of SugarHouse and Foxwoods casinos along with the proposed condominium and commercial developments along the Delaware River waterfront. The forecasts also assume the preferred I-95 Interchange designs for sections Vine, BSR/BRI, and CPR.

Seven Section GIR alternatives are described in the June 2005 report along with the 2025 traffic forecasts and basic modeling assumptions as well. The May 2006 report also presents the modeling methodology and forecasts for nine Section AFC construction alternatives.

The November 2008 Supplement Number 1 describes the slots casino, condominium, and commercial development assumptions and the 2030 DVRPC Board Adopted socioeconomic forecasts. It also presents 2030 traffic forecasts for Build Option 7 with Delaware Avenue Extension for Section GIR and Alternative 5 - Widened Diamond for Section AFC.

The travel simulations presented in this document are conducted using the TRANPLAN travel computer package.

Chapter II of this report presents the facility design assumptions for Sections GIR and AFC under Alternative 10. The 2030 average annual daily traffic (AADT) and AM and PM peak-hour turning movement traffic forecasts are presented in Chapter III. An overview of the pedestrian forecasting model, together with schematics showing the current daily and peak period pedestrian counts, as well as corresponding Section GIR Year 2030 pedestrian forecasts are presented in Chapter IV. Appendix A presents the current pedestrian counts for each intersection in the GIR study area. Appendix B presents a detailed description of the pedestrian model components, calibration methodology, parameters, and forecasting methodology. Supplemental 2030 Alternative 10 traffic forecast for Section VINE are included in Appendix C.

DVRPC uses state of the practice methods to determine the effect of various improvements on traveler behavior and system function. These include highway volumes, travel times, and modal splits of various alternatives. Alternative selection is a complex task including these and many other factors. This report does not endorse or recommend any specific alternative or project. Only projects that are included in DVRPC's Transportation Improvement Program (TIP) or Long Range Plan are officially endorsed by DVRPC.

II.   I-95 SECTION GIR/AFC ALTERNATIVE 10

The project objectives that guide the design of Section GIR and AFC alternatives include: improving access to and from I-95; improving traffic flows on I-95 by eliminating merge and weave disturbances, reducing adverse neighborhood impacts due to traffic including heavy commercial vehicles on residential streets; and improving intersection performance on the local street network. Congestion, noise, and air pollution impacts on the surrounding neighborhoods are mitigated as much as possible. Also included are improvements to the signage and incident management technology intended to improve way-finding and reduce delays due to traffic accidents.

Section GIR Alternative 10 is identical to Build Option 7, the preferred alternative in Supplement Number 1, except that the temporary detour road (Delaware Avenue Extension) from Richmond Street to Allegheny Avenue via Conrail property is eliminated. Section AFC Alternative 10 replaces the Widened Diamond - Alternative 5 and relocates I-95 northbound ramps to Castor Avenue.

The final Alternative 10 improvements include the following:

A.   Section GIR

Relocate I-95 northbound off-ramp to Delaware Avenue to tie in at Richmond Street. At this location, a signalized intersection is created providing a new entrance for the I-95 northbound on-ramp. Delaware Avenue is reconstructed in the vicinity of the former off-ramp base. The current base of the northbound on-ramp at Delaware Avenue and Richmond Street is also removed. This facilitates the realignment to a T-intersection changing the through movement from Delaware Avenue to Aramingo Avenue to Delaware Avenue to Richmond Street. This scenario also includes splitting Aramingo Avenue by direction. The new alignment of Aramingo Avenue northbound intersects the current cart-path of the Girard to Aramingo Avenue movement. A connection is installed further north on this new northbound alignment to Aramingo Avenue southbound. The I-95 northbound on-ramp from Girard Avenue is removed.

Relocating the I-95 northbound off-ramp provides a greater distance for weaving movements between this exit and the I-676 Vine Expressway interchange while also giving exiting traffic the new option of proceeding south on Delaware Avenue.

Splitting Aramingo Avenue by direction removes a conflict between northbound Aramingo Avenue and the new I-95 southbound ramp to Aramingo Avenue southbound. Girard Avenue access to northbound I-95 is maintained by the removal of the northbound Girard Avenue on-ramp; however, it becomes more circuitous, using Girard Avenue to Richmond Street to the base of the new ramp. Providing a connection between the new northbound Aramingo Avenue and southbound Aramingo Avenue allows access to the I-95 southbound on-ramp from the Delaware River waterfront without a reverse movement at Aramingo Plaza. A graphic of this alternative is shown in Supplement Number 1 (Map 7).

B.   Section AFC

I-95 is rehabilitated with full width shoulders. The northbound Betsy Ross viaduct is relocated and I-95 northbound receives an auxiliary lane from Section GIR which will exit at the Betsy Ross Bridge ramp.

 The southbound Half-Diamond interchange at Allegheny Avenue remains as is while a northbound Partial Clover interchange will be constructed at Castor Avenue. The I-95 northbound off-ramp at Westmoreland Street is eliminated, the I-95 northbound on-ramp at Castor Avenue is split to provide access to Betsy Ross Bridge.

Allegheny Avenue will be widened only between Bath Street and Richmond Street. Delaware Avenue is extended by a new bridge over Frankford Creek between Lewis Street and Hedley Street. As noted for Section GIR above, the temporary detour road (Delaware Avenue Extension) from Frankford to Allegheny Avenues (via Conrail Property) is removed.

III. 2030 PROJECTED TRAFFIC VOLUMES UNDER ALTERNATIVE 10

Projected 2030 daily traffic volume for selected highway links within the Sections GIR and AFC study areas are presented and analyzed in this chapter of the supplemental report. In *Figure 1*, current AADT is compared with forecast traffic volume for Alternative 10. The counted volume is posted under the line representing the roadway and the forecast volume is posted over the line*.* *Table 1* compares the 2030 Alternative 10 Section GIR AADT forecasts with the current traffic counts and the Build Option 7 forecasts presented in Supplement Number 1 of this report series. *Figure 2* presents the associated AM and PM peak-hour turning movements for selected intersections for Section GIR. In *Figure 2*, the number posted before the slash adjacent to the arrow representing the turning movement is the AM peak-hour turn volume and the number posted after the slash is the PM peak-hour turn volume.

Similarly, *figures 3 and 4* present the current and Alternative 10 projected 2030 AADT and AM/PM peak-hour turning movements for Section AFC. *Table 2* compares the 2030 Alternative 10 Section AFC AADT forecasts with the current traffic counts and the Widened Diamond with Delaware Avenue Extension forecasts presented in Supplement Number 1 of this report series.

Table 1 shows that removing the proposed Delaware Avenue Extension diverts about 3,900 additional daily vehicles (vpd) onto I-95 northbound. In Section GIR, these diverted vehicles use the I-95 northbound on-ramp from Delaware Avenue/Richmond Street and the opposite I-95 southbound off-ramp to Girard Avenue (1,300 vpd). Also, significant traffic (about 2,800 vpd) is diverted from the Delaware Avenue Extension to Aramingo Avenue.

Alternative 10 forecasts for Section AFC, given in *Table 2*, show a significant reduction in traffic volumes on Allegheny Avenue, especially between Richmond Street and the I-95 ramps because of the relocation of the northbound on-ramp to Castor Avenue. This ramp relocation causes a significant traffic increase on the adjacent section of I-95 (5,400 vpd). Traffic volumes on Richmond Street between Ann and Clearfield streets increase significantly (3,300 vpd) because of the elimination of the Delaware Avenue Extension. Eliminating the extension also reduces volume on Delaware Avenue north of Allegheny Avenue by 3,200 vpd.

Figure 1. Section GIR Current and 2030 Forecast Alternative 10 – Daily Traffic Volume

SCHEMATIC NOT TO SCALE

Without Proposed Delaware Avenue Extension and with Casino/Condominium Developments

Table 1. Section GIR Build Option 7 versus Alternative 10 Current and Forecast Traffic Volume

Location	Current Traffic Count AADT	2030 with Casino/Condo Developments					
		Build Option 7 with Proposed Delaware Ave Ext.			Alternative 10 without Proposed Delaware Ave Ext.		
		2030 AADT	Change from Traffic Count		2030 AADT	Change from Bld Option 7	
			Diff.	% Diff.		Diff.	% Diff.
I-95 NB Girard Ave to Allegheny Ave	90.7	111.3	20.6	23%	115.2	3.9	4%
I-95 SB Girard Ave to Allegheny Ave	90.7	112.0	21.3	23%	112.8	0.8	1%
I-95 NB Girard Ave to Vine Street	84.8	108.3	23.5	28%	109.4	1.1	1%
I-95 SB Girard Ave to Vine Street	88.2	110.8	22.6	26%	110.4	-0.4	0%
I-95 NB off-ramp to Delaware Ave	9.3	19.0	9.7	103%	18.5	-0.5	-3%
I-95 NB on-ramp from Delaware Ave/Richmond St	10.1	22.0	11.9	118%	24.3	2.3	10%
I-95 SB off-ramp to Girard/Aramingo Aves	8.9	18.0	9.1	102%	19.3	1.3	7%
I-95 SB off-ramp to Girard Ave	n/a	12.1	n/a	n/a	13.2	1.1	9%
I-95 SB off-ramp to Aramingo/Delaware Aves	n/a	5.9	n/a	n/a	6.1	0.2	3%
I-95 SB on-ramp from Aramingo Ave	10.2	16.8	6.6	64%	16.9	0.1	1%
Delaware Ave - NB North of existing NB I-95 off-ramp	21.2	21.7	0.5	2%	20.7	-1.0	-5%
Delaware Ave - SB North of existing NB I-95 off-ramp	7.4	22.0	14.6	198%	21.5	-0.5	-2%
Girard Ave - South of interchange	24.8	35.5	10.7	43%	35.7	0.2	1%
Girard Ave - NB Connection to Aramingo Ave	2.7	4.1	1.4	49%	4.2	0.1	2%
Girard Ave - Connection to Richmond St	2.1	12.5	10.4	494%	12.5	0.0	0%
Aramingo Ave - NB over Girard Ave	10.7	17.2	6.5	60%	18.1	0.9	5%
Aramingo Ave - SB over Girard Ave	13.0	14.0	1.0	7%	15.5	1.5	11%
Aramingo Ave.- South of York St	30.1	39.7	9.6	32%	42.5	2.8	7%
Aramingo Ave.- SB connection to Girard Ave	3.6	5.8	2.2	61%	5.9	0.1	2%
Richmond St - North of Aramingo Ave	10.3	30.2	19.9	194%	31.3	1.1	4%
Richmond St - South of Girard Ave	10.3	28.3	18.0	176%	26.9	-1.4	-5%
Richmond St - North of Girard Ave	11.1	24.0	12.9	116%	22.5	-1.5	-6%
Total	**540.4**	**791.2**	**232.8**	**43%**	**803.4**	**12.2**	**2%**

AADT in thousands

Source: DVRPC October 2009

Figure 2. Section GIR 2030 Forecast Alternative 10 – AM/PM Peak-Hour Traffic Volume
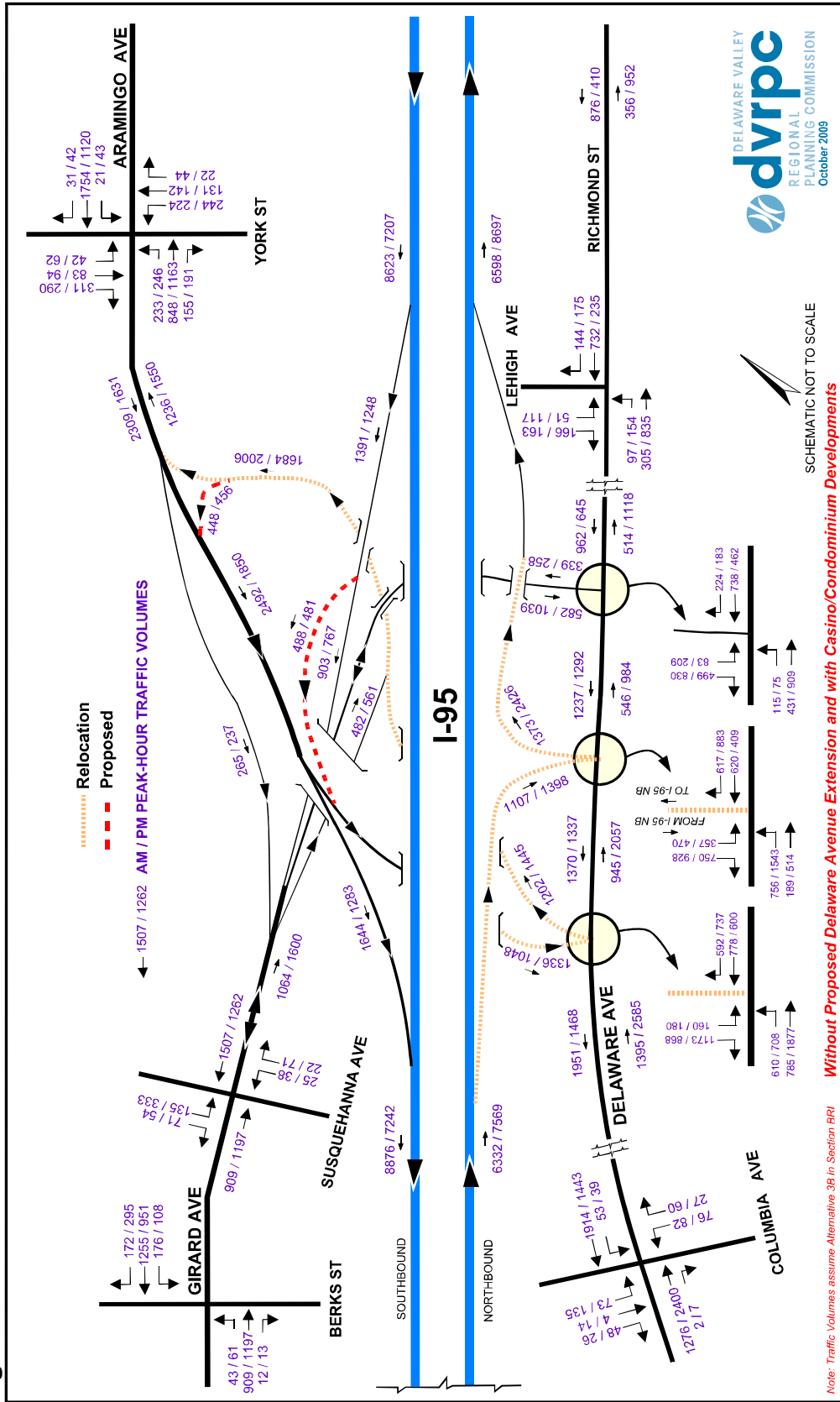
Figure 3. Section AFC Current and 2030 Forecast Alternative 10 – Daily Traffic Volume
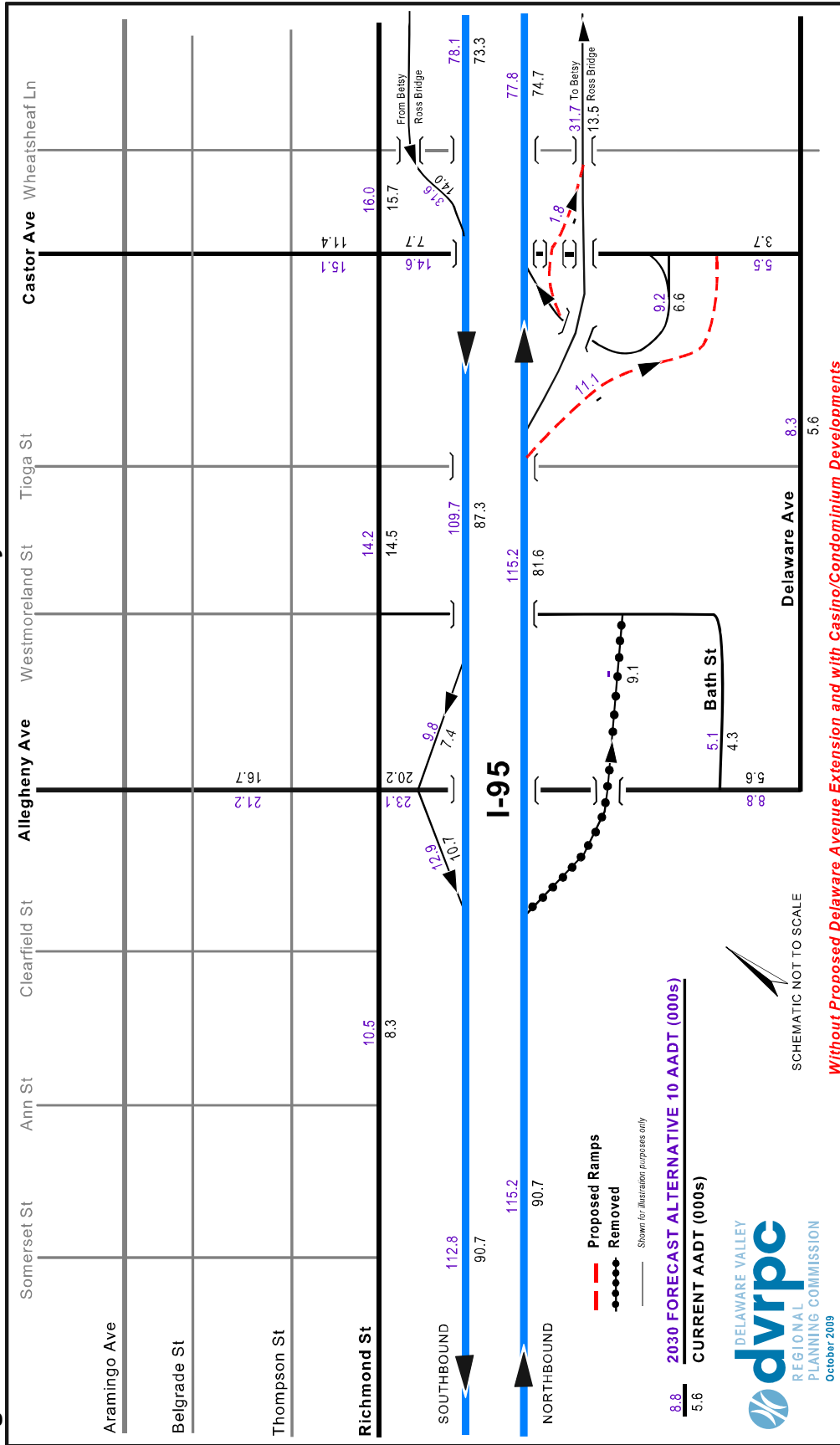
Figure 4. Section AFC 2030 Forecast Alternative 10 – AM/PM Peak-Hour Traffic Volume

Aramingo Ave

Belgrade St

Thompson St

Edgemont St

Richmond St

Cambria St · Ann St · Indiana Ave · Clearfield St · **Allegheny Ave** · Westmoreland St · Ontario St · Tioga St · Venango St · Castor Ave · Butler St · Wheatsheaf Ln

From Betsy Ross Bridge

To Betsy Ross Bridge

2703 / 2419

5518 / 4611

4542 / 6535

2009 / 2678

140 / 110
373 / 271
46 / 35
182 / 103
402 / 141
126 / 107

124 / 162

710 / 351
202 / 266
124 / 73

634 / 832

431 / 566
554 / 325
251 / 153
155 / 80
220 / 146

70 / 140
80 / 109
288 / 152
100 / 80

786 / 479

147 / 105
370 / 402
133 / 244
44 / 56
105 / 245
139 / 202

62 / 62
188 / 97
211 / 132
50 / 72
439 / 534
133 / 116

70 / 44
626 / 788
140 / 178

15 / 26
140 / 370
40 / 83

435 / 627
729 / 93
187 / 95
138 / 109

784 / 747
99 / 76

922 / 656

564 / 720

8221 / 7030

6598 / 8697

132 / 99
142 / 144

Bath St

388 / 232
301 / 242
388 / 232

31 / 40
111 / 104
94 / 68
294 / 169
38 / 31

228 / 169

301 / 242
190 / 138

I-95

Delaware Ave

SCHEMATIC NOT TO SCALE

SOUTHBOUND   8623 / 7207

NORTHBOUND   6598 / 8697

– – – **Proposed Ramps**

●●● **Removed**

Shown for illustration purposes only

→ 228 / 169   **AM / PM PEAK-HOUR TRAFFIC VOLUMES**

SCHEMATIC NOT TO SCALE

Without Proposed Delaware Avenue Extension and with Casino/Condominium Developments

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PLANNING COMMISSION
October 2009

Table 2. Section AFC Widened Diamond versus Alternative 10 Current and Forecast Traffic Volume

Location	Current Traffic AADT	2030 with Casino/Condo Developments					
		Widened Diamond with Proposed Delaware Ave Ext.			Alternative 10 w/o Proposed Delaware Ave Ext.		
		2030 AADT	Change From Traffic Count		2030 AADT	Change From Widened Diamond	
			Diff.	% Diff.		Diff.	% Diff.
I-95 SB Aramingo Ave to Allegheny Ave	90.7	111.3	20.6	23%	112.8	1.5	1%
I-95 NB Aramingo Ave to Allegheny Ave	90.7	112.0	21.3	23%	115.2	3.2	3%
I-95 SB Allegheny Ave to Castor Ave	81.6	110.9	29.3	36%	109.7	-1.2	-1%
I-95 NB Allegheny Ave to Castor Ave	87.3	109.8	22.5	26%	115.2	5.4	5%
I-95 NB Betsy Ross Bridge to Castor Ave	74.7	79.0	4.3	6%	77.8	-1.2	-2%
I-95 SB Betsy Ross Bridge to Castor Ave	73.3	78.3	5.0	7%	78.1	-0.2	0%
I-95 NB off-ramp to Westmoreland St or Allegheny Ave	9.1	10.6	1.5	17%	n/a	n/a	n/a
I-95 SB on-ramp from Allegheny Ave	10.7	12.3	1.6	14%	12.9	0.6	5%
I-95 SB off-ramp to Allegheny Ave	7.4	10.1	2.7	37%	9.8	-0.3	-3%
I-95 NB on-ramp from Castor Ave or Allegheny Ave	6.6	10.2	3.6	55%	9.2	-1.0	-10%
I-95 NB off-ramp to Aramingo Conn & Betsy Ross Bridge	13.5	31.9	18.4	136%	31.7	-0.2	-1%
I-95 NB off-ramp to Castor Avenue	n/a	n/a	n/a	n/a	11.1	n/a	n/a
I-95 SB on-ramp from Aramingo Conn & Betsy Ross Brdg	14.0	31.5	17.5	125%	31.6	0.1	0%
Allegheny Ave - Belgrade St to Thompson St	16.7	23.7	7.0	42%	21.2	-2.5	-11%
Allegheny Ave - Richmond St to I-95 SB ramps	20.2	31.9	11.7	58%	23.1	-8.8	-28%
Allegheny Ave - Bath St. to Delaware Ave	5.6	7.1	1.5	26%	8.8	1.7	24%
Westmoreland St - I-95 to Bath St	4.3	5.4	1.1	26%	5.4	0.0	0%
Richmond St - Ann to Clearfield Sts	8.3	7.2	-1.1	-13%	10.5	3.3	46%
Richmond St - Westmoreland to Tioga Sts	14.5	12.9	-1.6	-11%	14.2	1.3	10%
Richmond St - Castor Ave to Wheatsheaf Ln	15.7	16.8	1.1	7%	16.0	-0.8	-5%
Delaware Ave - Allegheny Ave to Venango St	5.6	11.5	5.9	105%	8.3	-3.2	-28%
Delaware Ave - Allegheny Ave to Richmond St	n/a	11.1	n/a	n/a	n/a	n/a	n/a
Total	**650.5**	**835.5**	**173.9**	**27%**	**822.6**	**-2.3**	**0%**

AADT in thousands

Source: DVRPC October 2009

IV. SECTION GIR PEDESTRIAN SIDEWALK AND CROSSWALK VOLUMES

The pedestrian volume forecasts that are required to complete the Section GIR design work for Alternative 10 are given below. These pedestrian requirements are oriented towards providing access to the Delaware River waterfront and insuring safe pedestrian crossings at selected intersections. They are identified as part of coordination efforts with the Penn Praxis Study and other citizen outreach efforts. See: "An Action Plan for the Central Delaware: 2008-2018" May 2008.

The pedestrian access network proposed for the Section GIR interchange redesign is shown in ***Figure 5***. The sidewalks are depicted as long dashed green lines and the crosswalks outlined by short dashed lines. These sidewalks generally follow existing streets and proposed ramps within the interchange complex.

A. Pedestrian Volume Forecast Requirements

1. *Waterfront:*

a. Both sides of Delaware Avenue from Columbia Avenue to the Aramingo Avenue.

b. Along the east side of Richmond Street from the Aramingo Avenue Extension to Girard Avenue.

2. *River Access:*

a. Sidewalks under the I-95 structure along Palmer Street, Montgomery Avenue, Berks Street, Girard Avenue Extension, York, and Cumberland streets.

b. Pedestrian walkways through the interchange with an intersection near the Aramingo Avenue northbound and Girard Avenue/Spur A.

- Along the eastside of the Aramingo Avenue northbound.
- Along the eastside of the Girard Avenue to Richmond Street ramp.

3. *Provision of traffic light controlled pedestrian phases at:*

- Columbia and Delaware avenues
- Berks Street and Delaware Avenue
- Schirra Drive and Richmond Street
- Richmond Street and Girard Avenue Extension
- Aramingo Avenue and York Street
- Delaware Avenue/Richmond Street and Aramingo Avenue
- Girard Avenue/Spur A and Aramingo Avenue northbound

4. *Proposed unsignalized crosswalks at:*

- Palmer Street and Delaware Avenue
- Beach Street and Columbia Avenue
- Montgomery Avenue and Delaware Avenue
- York Street and Richmond Street
- Cumberland Street and Richmond Street

B.   Pedestrian Count Data Collection

DVRPC staff collected pedestrian count data for existing sidewalks and crosswalks in the study area to calibrate the pedestrian model. These counts are taken primarily during the AM and PM peak time periods. Daily pedestrian counts are collected at two locations to better understand the relationship between daily and peak-hour counts at North Delaware Avenue and Columbia Street and Girard Avenue and Berks Street. DVRPC staff also utilized walk trip data from the 2000 Home Interview Survey to estimate the pedestrian trip generation and trip length distribution characteristics and to quantify the relationship between trip purposes (home-based work, home-based non-work, non-home based). ***Figures 6A and 6B*** display the current daily pedestrian counts for the selected intersections identified in ***Figure 5***. ***Table 3*** summarizes the results.

Table 3. Section GIR - Pedestrian Count Expansion Factors

Time Period	Girard_Berks	Columbia_Delaware	Average	Suggested Factor
AM Peak	13.49%	3.69%	8.59%	10%
PM Peak	37.47%	54.77%	46.12%	40%
Peak Total*	50.96%	58.46%	54.71%	50%
Midday	25.06%	36.31%	30.68%	30%
Evening	23.98%	17.85%	20.91%	20%

Note Calculated Peak factor for each fully counted intersection, averaged the two factors*

Source: DVRPC October 2009

Time period factors from daily counts are used to expand the AM and PM peak period counts at other intersections to daily estimates depicted in ***Figures 6A and 6B***. Appendix A presents the count sheets summarizing the pedestrian movement data collected as part of this study.

Figure 5. Section GIR Proposed Pedestrian Facilities

PROPOSED PEDESTRIAN ACCESS
PROPOSED CROSSWALKS

FISHTOWN HISTORIC DISTRICT

SCALE IN FEET
0   100   200
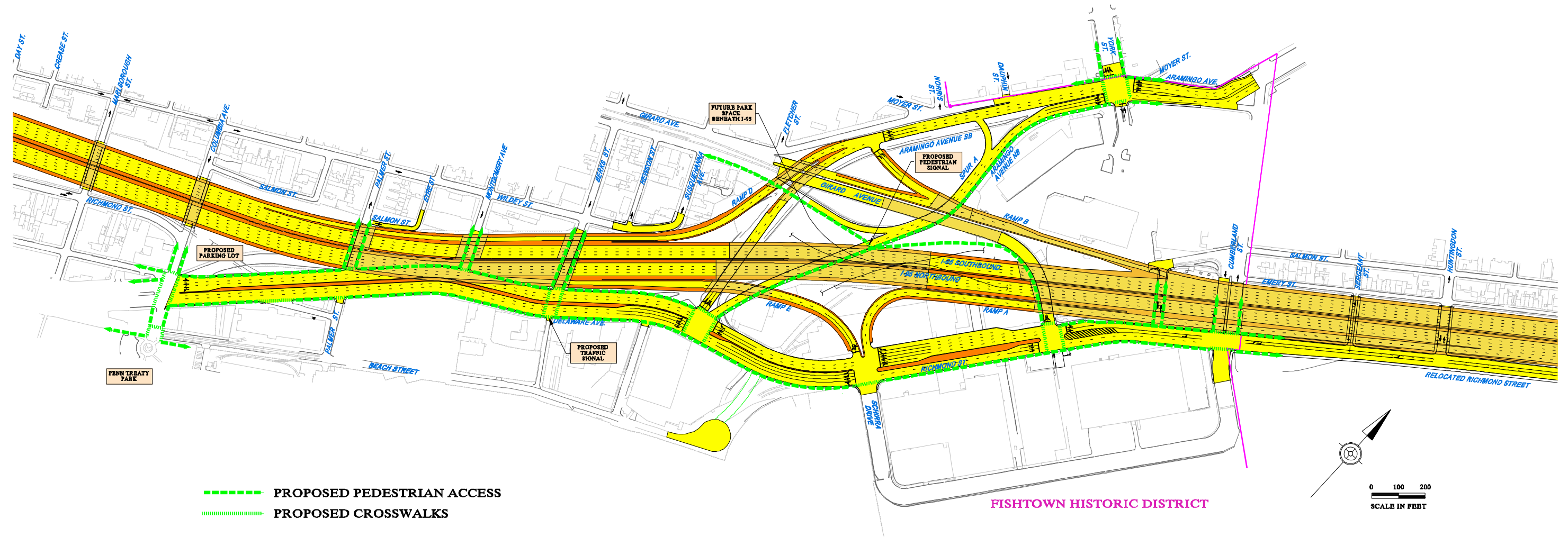
Source: URS Corporation
February 2009

Figure 6A. Section GIR Pedestrian Movements – Current Daytime

Columbia Ave

restaurant | commercial service

50 ← 334 → 18

Girard Ave

176 | 222 | Girard Ave

24 ← 236 → 52

commercial retail | commercial service

Columbia Ave

Berks St

vacant lot | commercial retail

50 ← 249 → 70

Girard Ave | Girard Ave

59 | 95

25 ← 268 → 33

commercial service | restaurant

Berks St

Wildey St

I-95 Elevated Highway

Columbia Ave | Palmer St | Montgomery St | Berks St

residential | grass lot | residential | residential | commercial | commercial | parking lot | grass lot

6 ← 24 → 7 | 6 ← 26 → 10 | 16 ← 32 → 12 | 8 ← 29 → 0

Delaware Ave

94 | 115 | Delaware Ave | 12 | 12 | Delaware Ave

Delaware Ave | Delaware Ave

9 | 40 | 58 ← 36 → 50 | Industrial manufacturing warehouse | abandoned lot 4 ← 14 → 10

grass lot | Columbia Ave | manufacturing | residential | utility station | manufacturing

Palmer St | Berks St

Beach St

30 | Beach St | Beach St | Beach St

103 | 155

Penn Treaty Park | industrial building

Match line

←— 36 —→ Current Daytime Pedestrian Count (7:00 AM – 8:00 PM)

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Figure 6B. Section GIR Pedestrian Movements – Current Daytime

York St

gas station | empty lot | commercial retail

22 | ← 204 → | 34

Aramingo St

300 | 240

Aramingo Ave

76 | ← 170 → | 26

commercial retail | commercial retail

Entance to Port Richmond Village

Cumberland St

I-95 Elevated Highway

Match line

Girard Ave ext | Cumberland St

manufacturing industrial warehouse | gas station | grass lot | grass Lot | residential

Richmond St

| ← 56 → | 0 | 32 | ← 62 → | 8

4 | 0 | 2 | 0 | 24 | 6

Richmond St | Richmond St | Richmond St | Richmond St | Richmond St | Richmond St

4 | ← 44 → | 10 | 28 | ← 32 → | 0

grass lot | industrial manufacturing warehouse | Industrial manufacturing warehouse | industrial manufacturing warehouse | grass lot

Schirra Dr | Cumberland St

← 56 → | Current Daytime Pedestrian Count (7:00 AM – 8:00 PM)

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C. Pedestrian Volume Forecasting Model

A number of approaches are possible to estimate pedestrian volumes; among them:

Option A. Using cross-classification pedestrian sidewalk and crosswalk trip generation rates per person and/or employee. These rates would be based on current counts using ITE Trip Generation Manual methods, perhaps stratified by highway functional class and predominant adjacent land use.

Option B. Detailed pedestrian trip generation and distribution at the physical block level; followed by assignment to a physical block-face sidewalk network taken from NAVTEQ or similar highway data bases.

Option C. Traffic Analysis Zone (TAZ) level pedestrian trip estimation with new pedestrian trip generation and distribution models, followed by assignment to a sidewalk network adapted from the focused assignment model.

DVRPC staff prepared a model based on Option C because a highway-style assignment is needed to satisfy the pedestrian planning requirements included in highway interchange design. Option B would also produce the required pedestrian forecasts, but with a greatly expanded level of effort that is beyond the scope of this project. The link and intersection pedestrian forecasting requirements shown previously in *Figure 5* are similar in scale to the underlying focused highway network being used for the highway link and turning movement forecasts.

This involves developing new trip generation and gravity models based on pedestrian trip generation and trip length frequency distributions taken from the DVRPC 2000 Home Interview Survey. Section GIR is served by an extensive transit network including the SEPTA Market-Frankford Subway Elevated Line, the Girard Avenue trolley, and numerous bus lines. For this reason, walk to transit pedestrian trips are a significant percentage of sidewalk and crosswalk pedestrian volumes. Walk to transit trips are extracted from the approach links of the DVRPC transit assignment model for Section GIR and added to the pedestrian only trips prepared by the new trip generation and distribution (gravity) models. The resulting total pedestrian trip matrix is assigned to minimum distance paths through a special sidewalk variant of the focused highway network to estimate sidewalk and crosswalk volumes. This network is altered to remove freeway/ramp facilities and other roadway links that do not allow pedestrians. Additional links are added as needed for proposed pedestrian walkways not adjacent to an existing or proposed street. A detailed description of the pedestrian trip generation, distribution, and assignment models and the calibration/validation statistics is given in Appendix B.

D. 2030 Forecasts for Proposed Pedestrian Facilities

Figures 7, 8, and 9 present the 2030 proposed pedestrian facilities forecasts for daytime (*figures 7A, 7B*), AM peak (*figures 8A, 8B*), and PM peak (*figures 9A, 9B*) time periods under Alternative 10. A new pedestrian flow model was adapted from the DVRPC Travel Simulation Model to

prepare these forecasts. For this reason, the pedestrian counts and the 2030 forecasts follow the peak time periods used in the DVRPC model 7:00 AM to 9:00 AM for the morning peak and 3:00 PM to 6:00 PM for the evening peak. For analysis of traffic operations, AM peak period pedestrian counts and forecasts should be divided by two to estimate a single hour while the PM counts and forecasts should be divided by three to estimate a single hour.

The sidewalk connection as shown in *Figure 5* between Girard Avenue extension at Richmond Street is projected to carry about 426 daily pedestrian trips. The sidewalk along the Aramingo Avenue on-ramp from Delaware Avenue is projected to serve about 140 pedestrians of which 114 continue on to Richmond Village at York Street. This results in 438 daily pedestrian crossings at the Aramingo Avenue ramp. Pedestrian turning movements within this sidewalk intersection are small.

The intersections of Columbia Avenue and Beach Street with North Delaware Avenue have significant forecast pedestrian crossings, especially across the northeast side of these intersections – 138 and 179 daily person trips, respectively. Most of these persons are accessing Penn Treaty Park, although the adjacent Penn Treaty Park Plaza building also generates significant pedestrian movements at this intersection. Forecast daily pedestrian flows along Delaware Avenue between Palmer and Berks streets tend to be very light - 32 or less average weekday daily crossings. Aramingo Avenue has more pedestrian crossings (100 persons crossing North Delaware Avenue) because of the proposed sidewalk connection to Richmond Village. The Girard Avenue Extension sidewalk generates 348 daily person trips crossing Richmond Street to access the adjacent commercial/industrial land uses, much more than current crossings (none were observed in the 2009 pedestrian counts).

AM and PM peak period pedestrian movement forecasts are derived from the daily counts using the percentages given in *Table 3*. This results in negligible (but non-zero) crossing movements at several locations. The most critical pedestrian crossing is at the Aramingo Avenue northbound on-ramp from Delaware Avenue. At this crosswalk, 44 persons use the crosswalk during the AM peak period and 175 persons during the PM peak period. These negligible movements should still be accommodated in the final design of Section GIR.

It is important to recognize that these current and forecasted pedestrian flows represent average weekday conditions. Special events occur in Penn Treaty Park and other locations along North Delaware Avenue and Columbus Boulevard that can increase pedestrian flows dramatically. These events often occur on weekends. The pedestrian accommodations in Section GIR designs and elsewhere should also adequately serve these special events. There may be a need for special event pedestrian forecasts to insure that the pedestrian sidewalks and crossings designs are adequate.
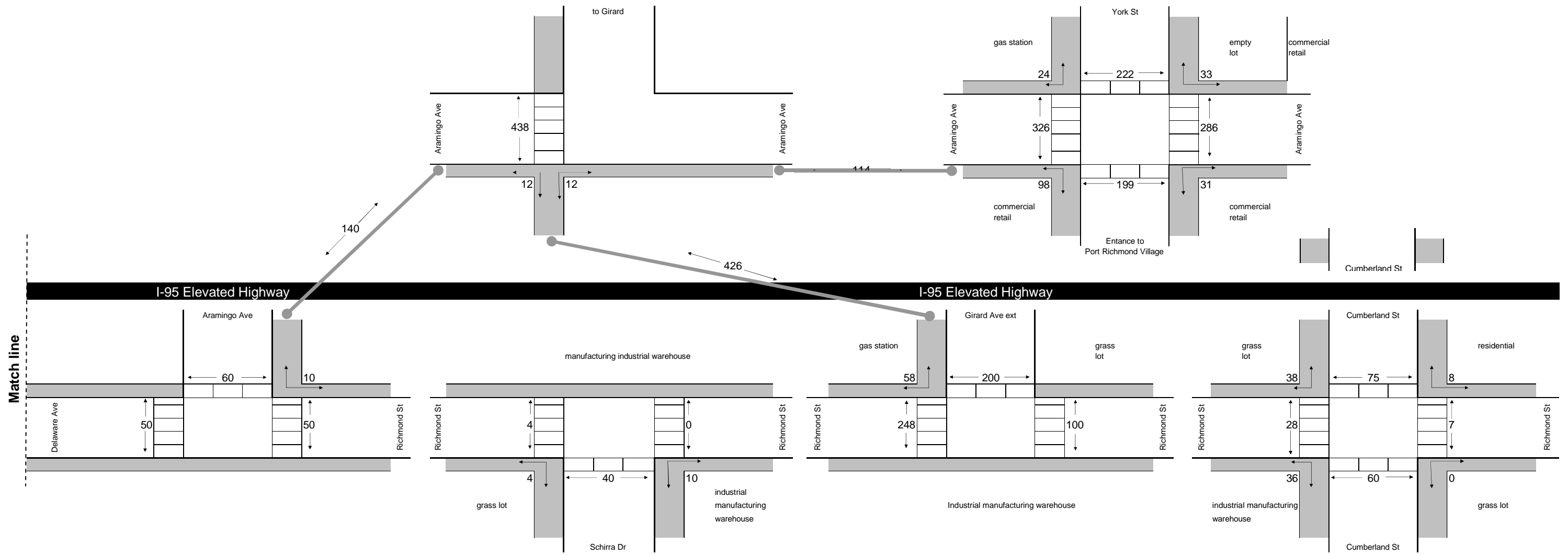
Figure 7A. Section GIR Pedestrian Movements – Forecast Daytime
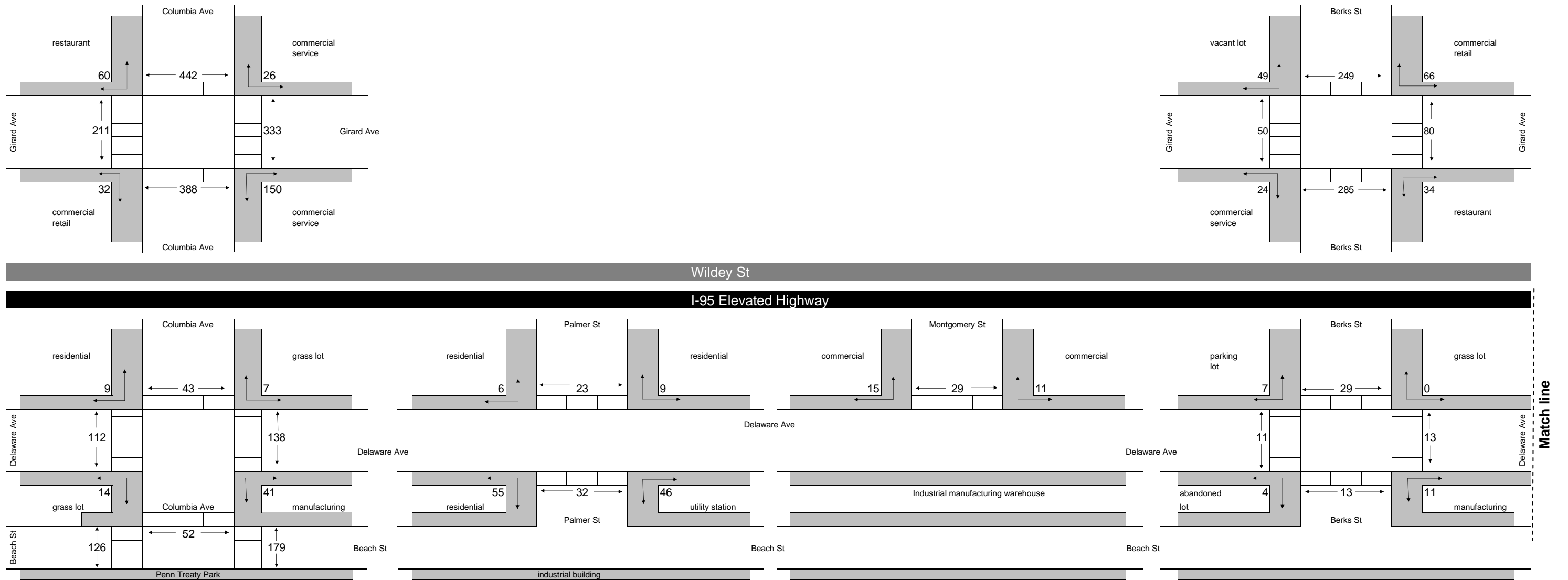
← 32 → 2030 Forecast Pedestrian Count - Daytime (7:00 AM – 8:00 PM)

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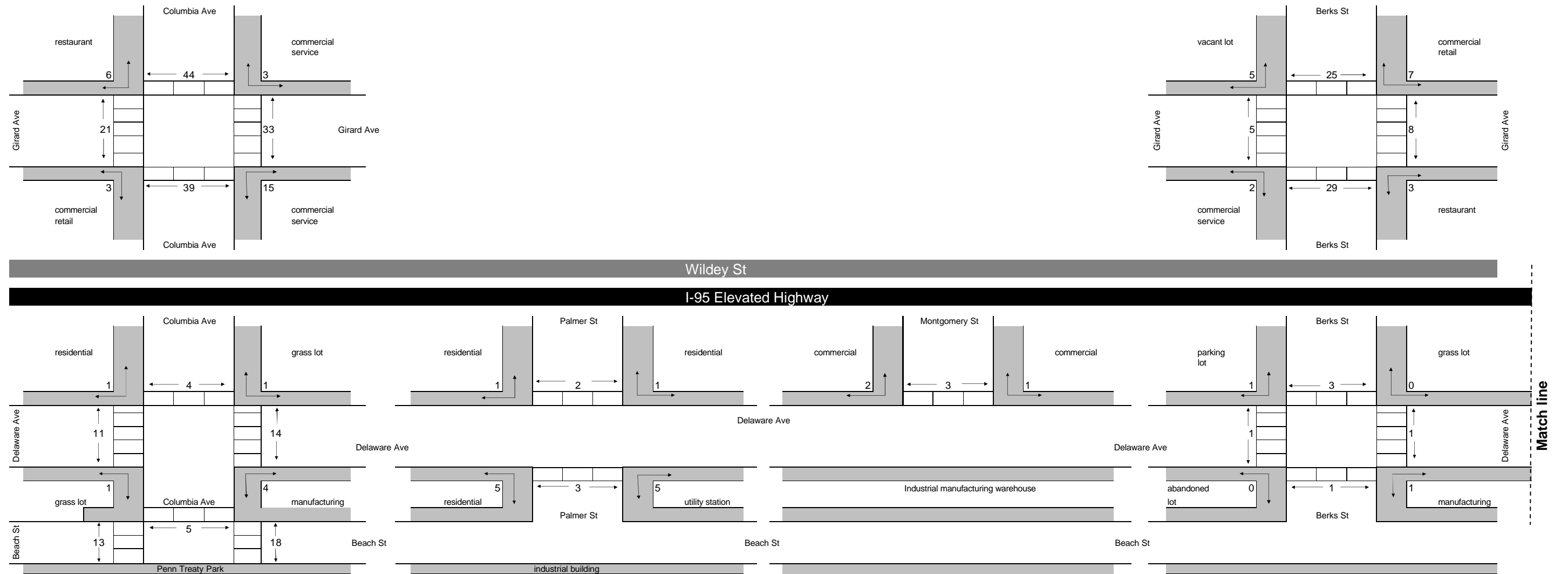**Figure 7B. Section GIR Pedestrian Movements – Forecast Daytime**

2030 Forecast Pedestrian Count - Daytime (7:00 AM – 8:00 PM)

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Figure 8A. Section GIR Pedestrian Movements – Forecast AM Peak

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3 → 2030 Forecast Pedestrian Count - AM Peak (7:00 AM – 9:00 AM)

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Figure 8B. Section GIR Pedestrian Movements – Forecast AM Peak
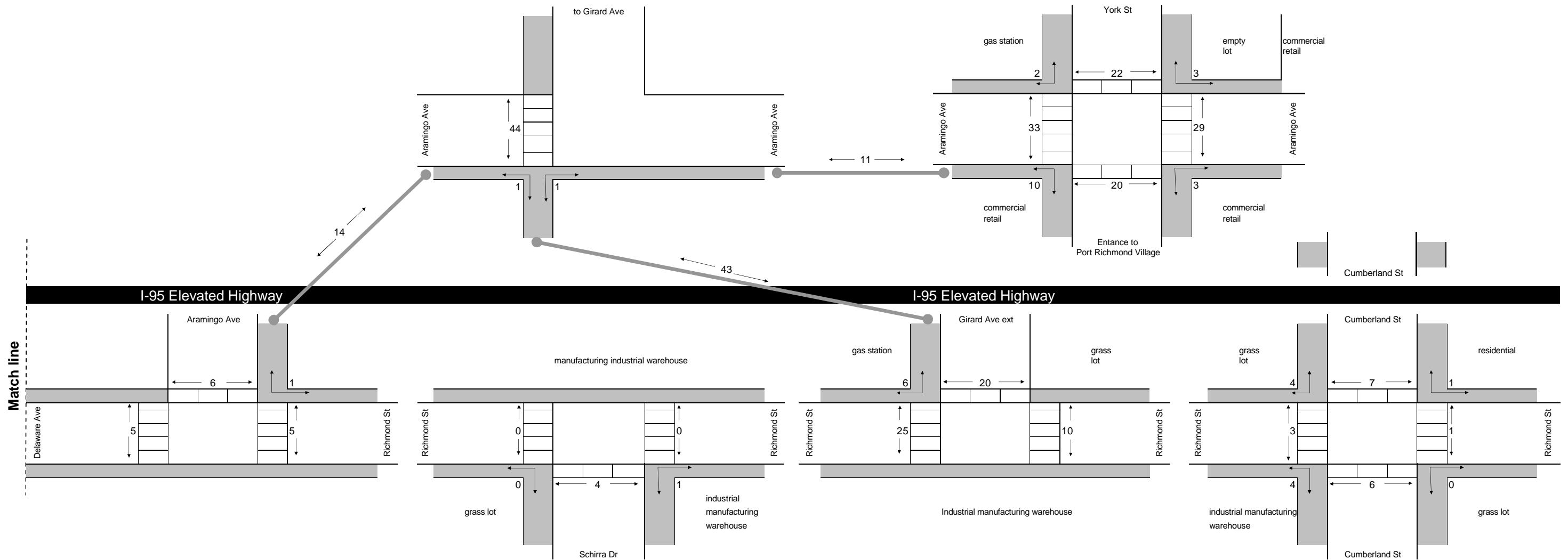
SCHEMATIC NOT TO SCALE

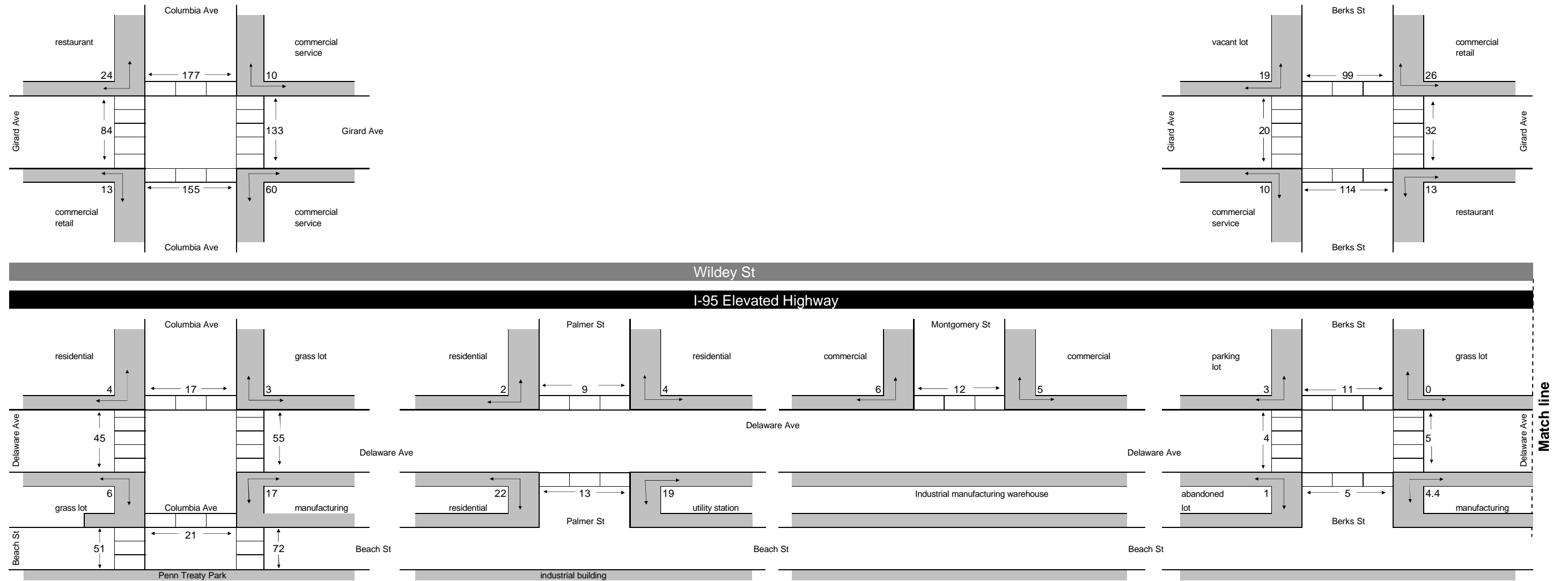←—— 11 ——→   2030 Forecast Pedestrian Count - AM Peak (7:00 AM – 9:00 AM)

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Figure 9A. Section GIR Pedestrian Movements – Forecast PM Peak

Columbia Ave

restaurant | commercial service
24 ← 177 → 10
84 | 133 | Girard Ave
Girard Ave
13 ← 155 → 60
commercial retail | commercial service

Columbia Ave

Berks St

vacant lot | commercial retail
19 ← 99 → 26
20 | 32
Girard Ave | Girard Ave
10 ← 114 → 13
commercial service | restaurant

Berks St

Wildey St

I-95 Elevated Highway

Columbia Ave | Palmer St | Montgomery St | Berks St

residential | grass lot | residential | residential | commercial | commercial | parking lot | grass lot
4 ← 17 → 3 | 2 ← 9 → 4 | 6 ← 12 → 5 | 3 ← 11 → 0
45 | 55 | 4 | 5
Delaware Ave | Delaware Ave | Delaware Ave | Delaware Ave
Delaware Ave
6 | 17 | 22 ← 13 → 19 | 1 ← 5 → 4.4
grass lot | manufacturing | residential | utility station | Industrial manufacturing warehouse | abandoned lot | manufacturing
Columbia Ave | Palmer St | Berks St
Beach St | 51 | 72 | Beach St | Beach St | Beach St
← 21 →

Penn Treaty Park | industrial building

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← 13 → 2030 Forecast Pedestrian Count - PM Peak (3:00 Pm – 6:00 PM)

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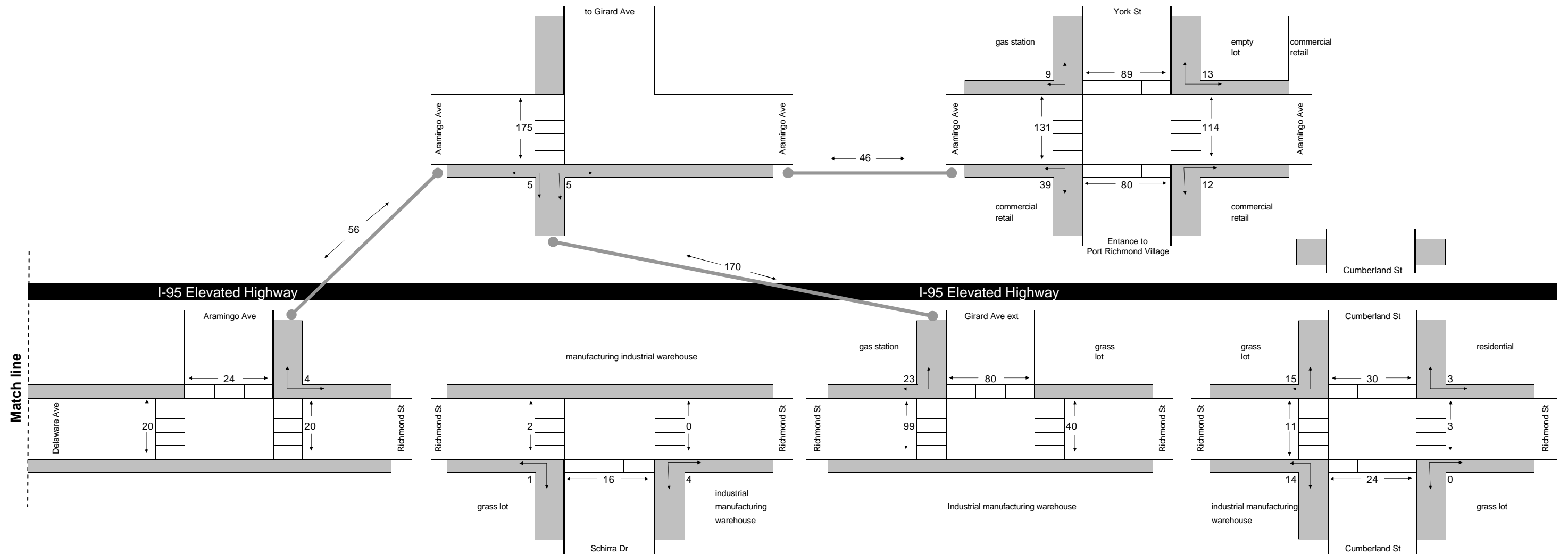PLANNING COMMISSION
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Figure 9B. Section GIR Pedestrian Movements – Forecast PM Peak

2030 Forecast Pedestrian Count - PM Peak (3:00 PM – 6:00 PM)
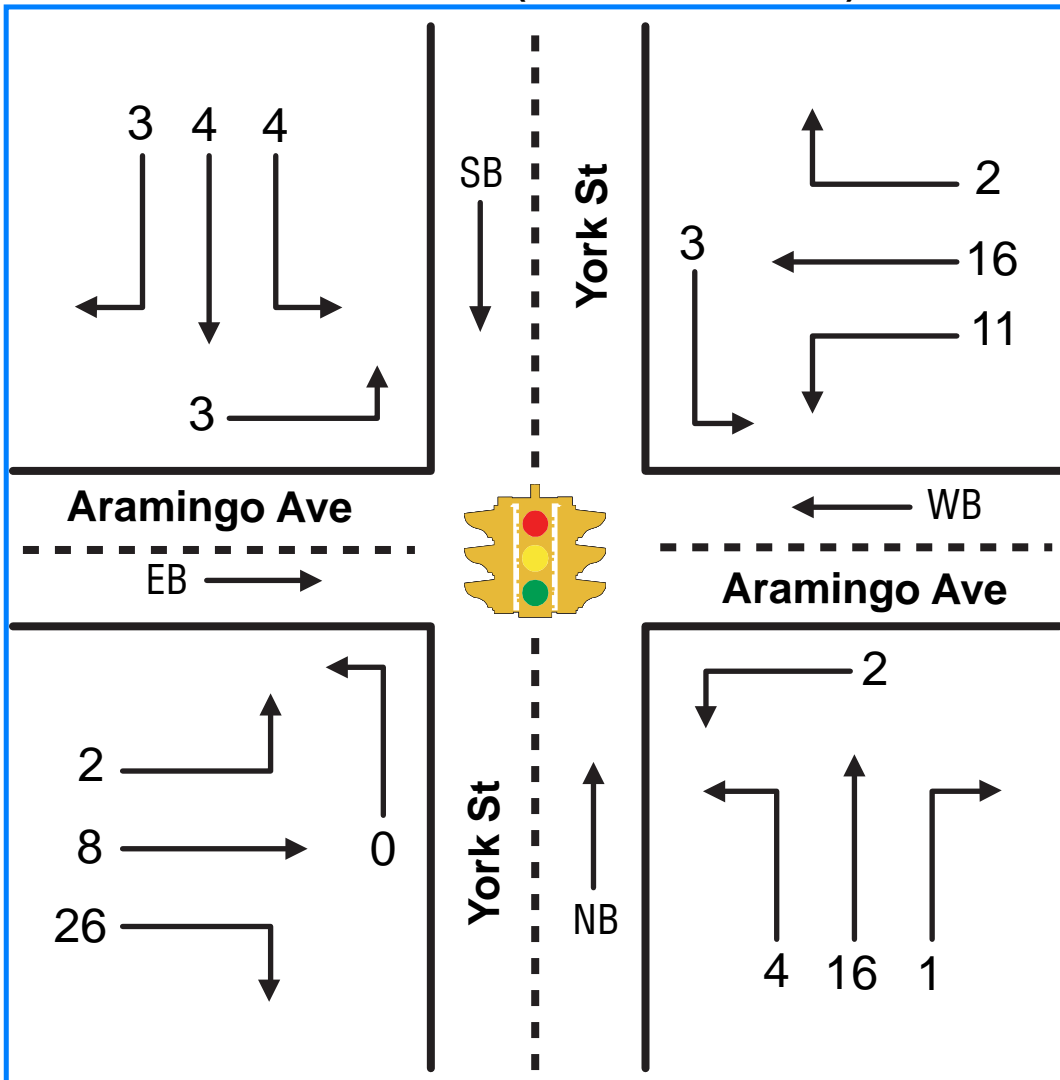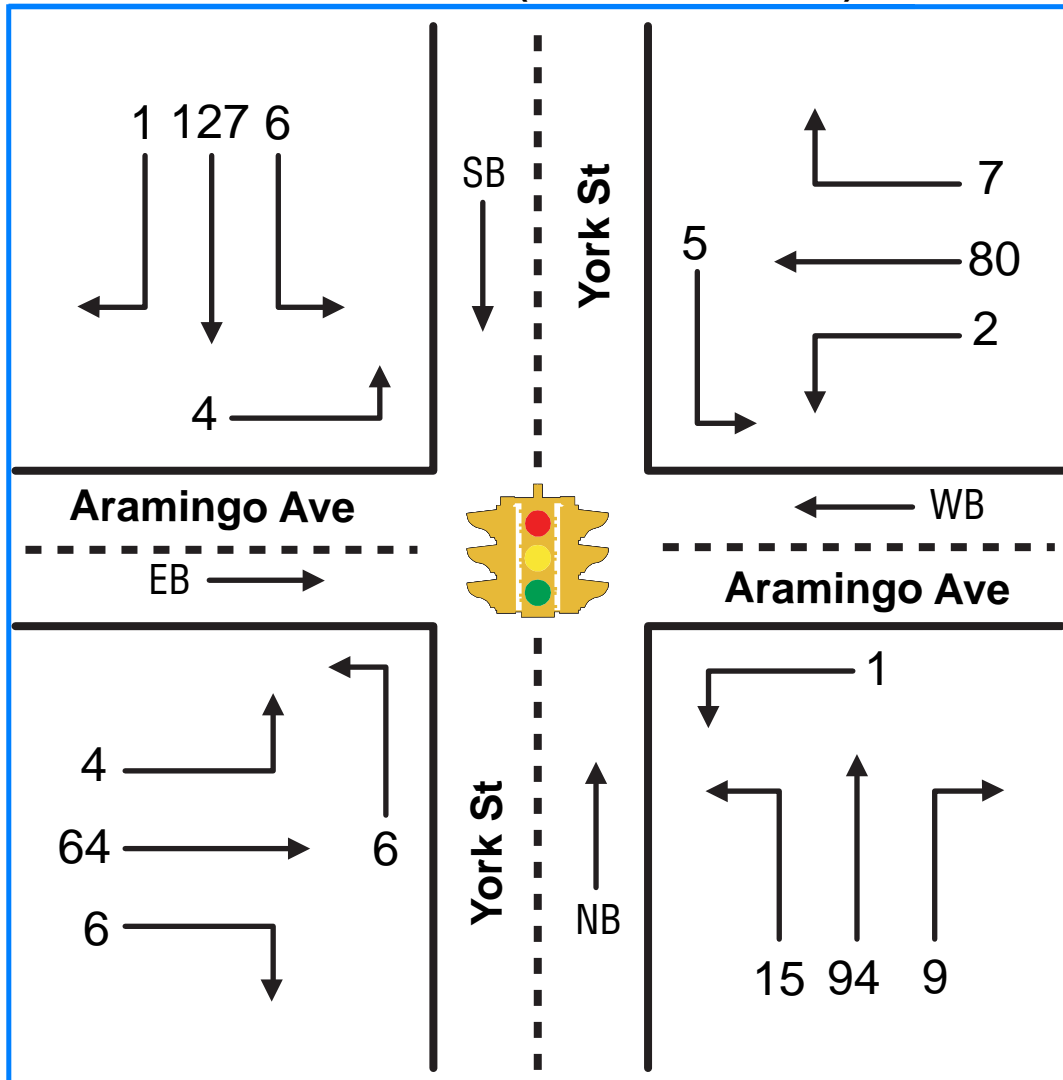
←— 16 —→

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APPENDIX A PEDESTRIAN COUNT DATA

Figure A-1. Aramingo Avenue at York Street
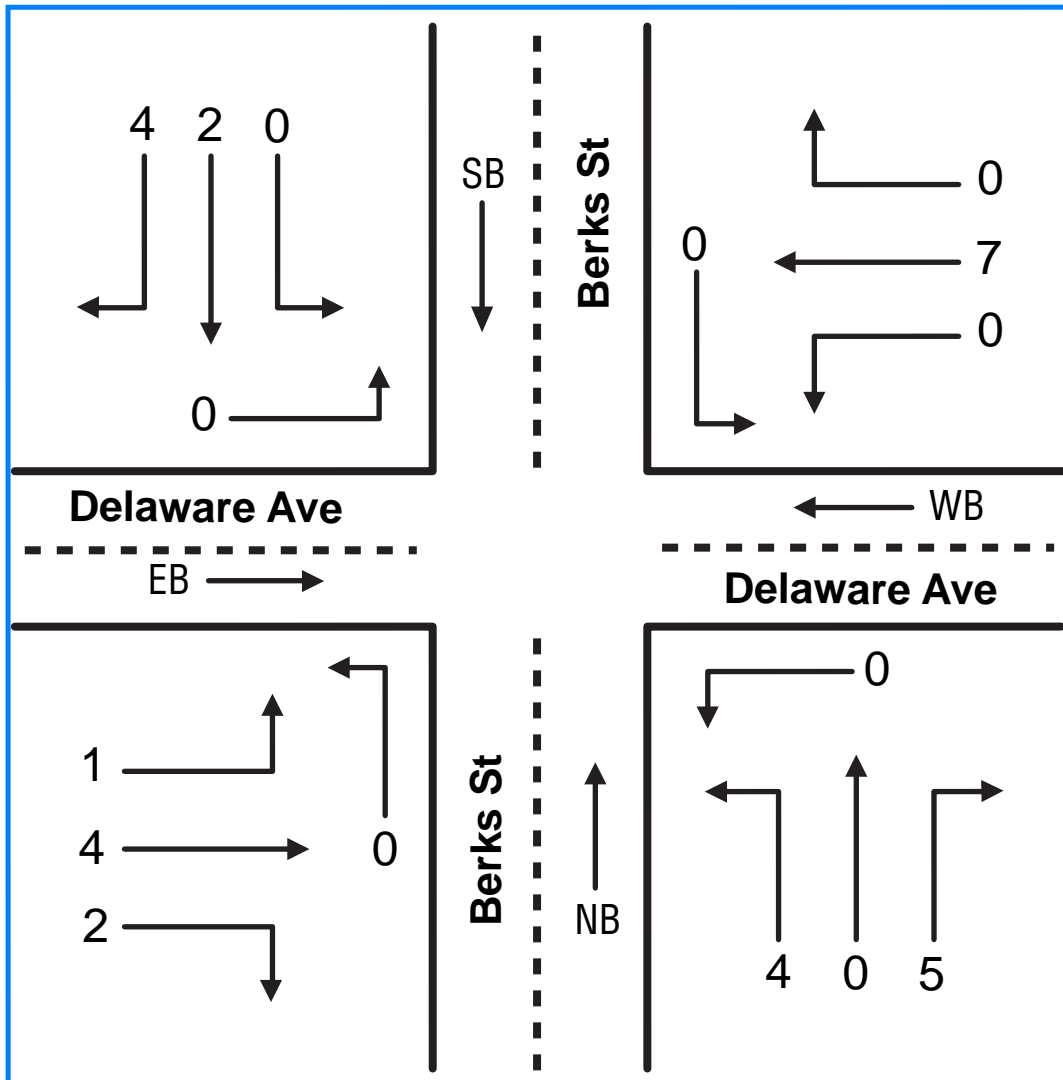**Pedestrian Count - AM Peak (7:00 AM - 9:00 AM)**

Source: DVRPC May 2009

Figure A-2. Aramingo Avenue at York Street
Pedestrian Count - PM Peak (3:00 PM - 6:00 PM)
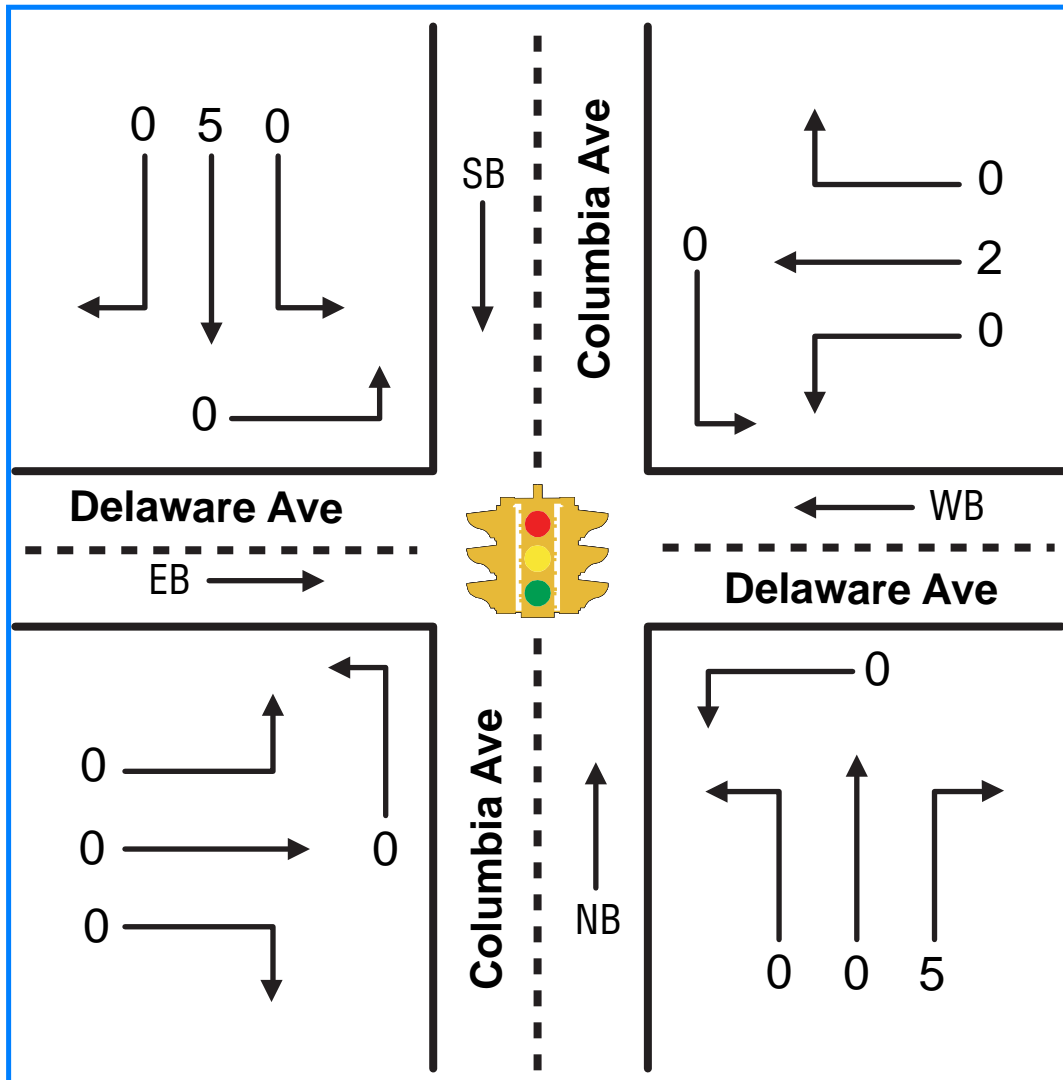

Source: DVRPC May 2009

Figure A-3. Berks Street at Delaware Avenue
Pedestrian Count - AM Peak (7:00 AM - 9:00 AM)

Source: DVRPC May 2009

**Figure A-4. Columbia Avenue at Delaware Avenue
Pedestrian Count - AM Peak (7:00 AM - 9:00 AM)**

**Figure A-5. Columbia Avenue at Delaware Avenue
Pedestrian Count - PM Peak (3:00 PM - 6:00 PM)**

Source: DVRPC May 2009

**Figure A-6. Columbia Avenue at Delaware Avenue
Pedestrian Count - Midday (9:00 AM - 3:00 PM)**

Source: DVRPC May 2009

Figure A-7. Columbia Avenue at Delaware Avenue Pedestrian Count - Evening (6:00 PM - 8:00 PM)
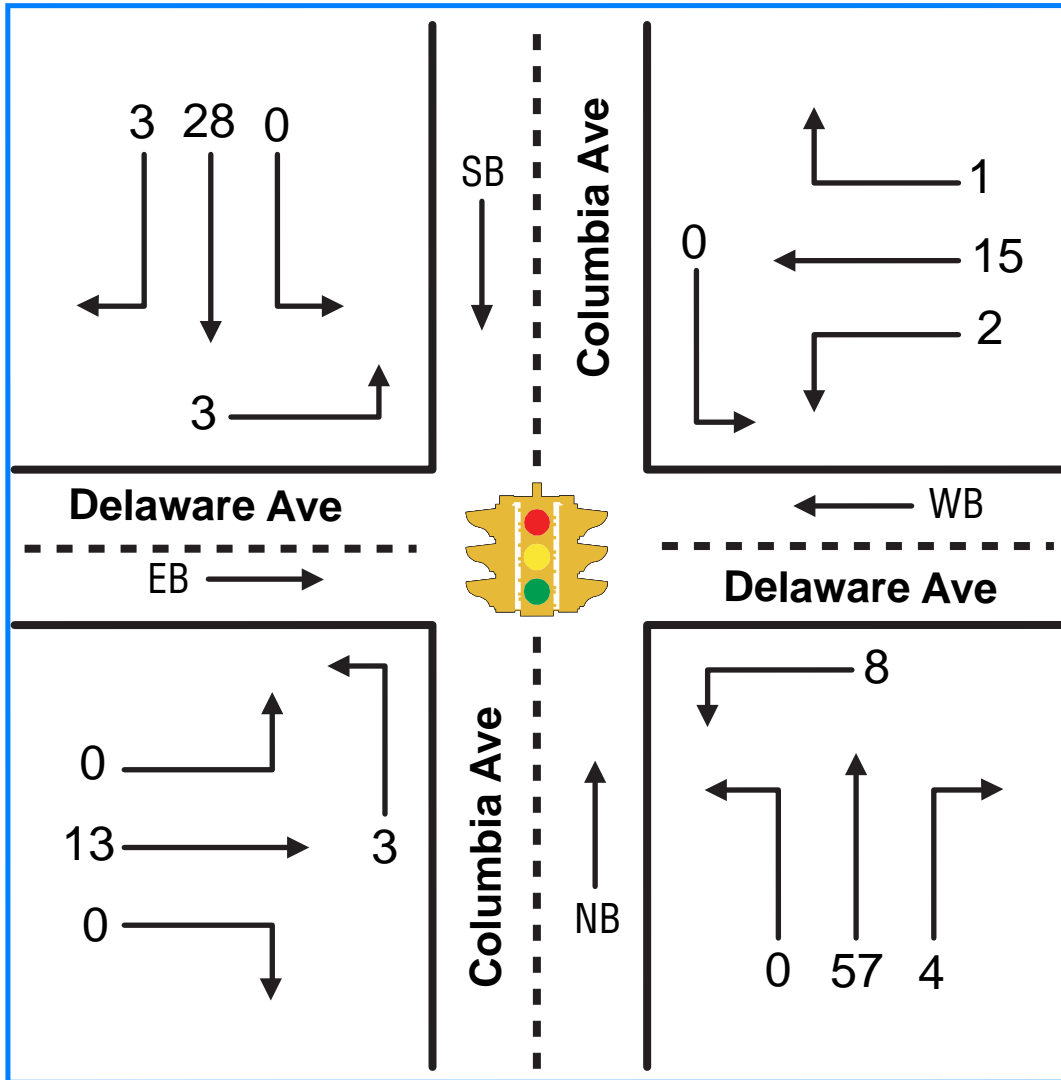

Source: DVRPC May 2009

**Figure A-8. Girard Avenue at Berks Street
Pedestrian Count - AM Peak (7:00 AM - 9:00 AM)**

Source: DVRPC May 2009

**Figure A-9. Girard Avenue at Berks Street
Pedestrian Count - PM Peak (3:00 PM - 6:00 PM)**

Source: DVRPC May 2009

**Figure A-10. Girard Avenue at Berks Street
Pedestrian Count - Midday (9:00 AM - 3:00 PM)**

Figure A-11. Girard Avenue at Berks Street Pedestrian Count - Evening (6:00 PM - 8:00 PM)

Figure A-12. Girard Avenue at Columbia Avenue Pedestrian Count - AM Peak (7:00 AM - 9:00 AM)

Source: DVRPC May 2009

**Figure A-13. Girard Avenue at Columbia Avenue
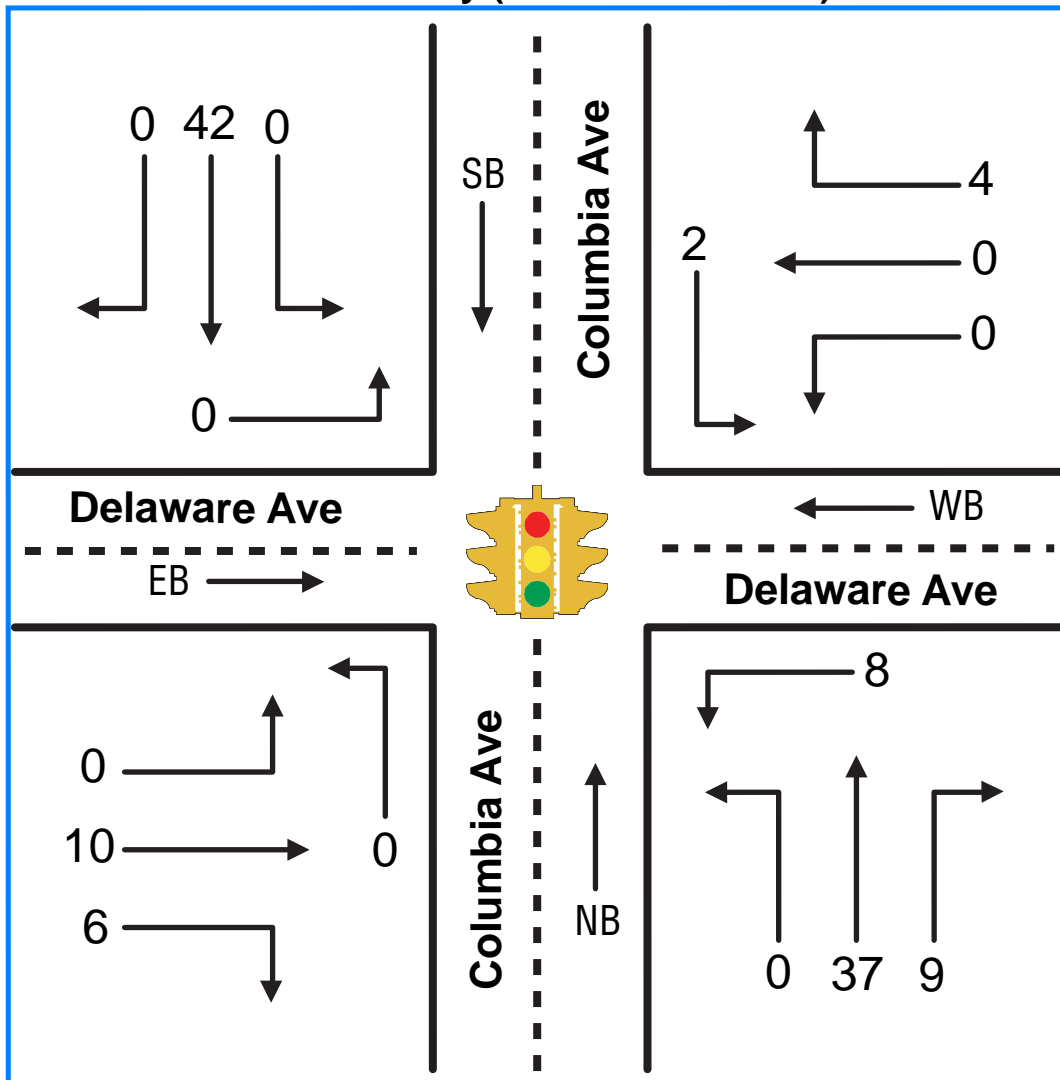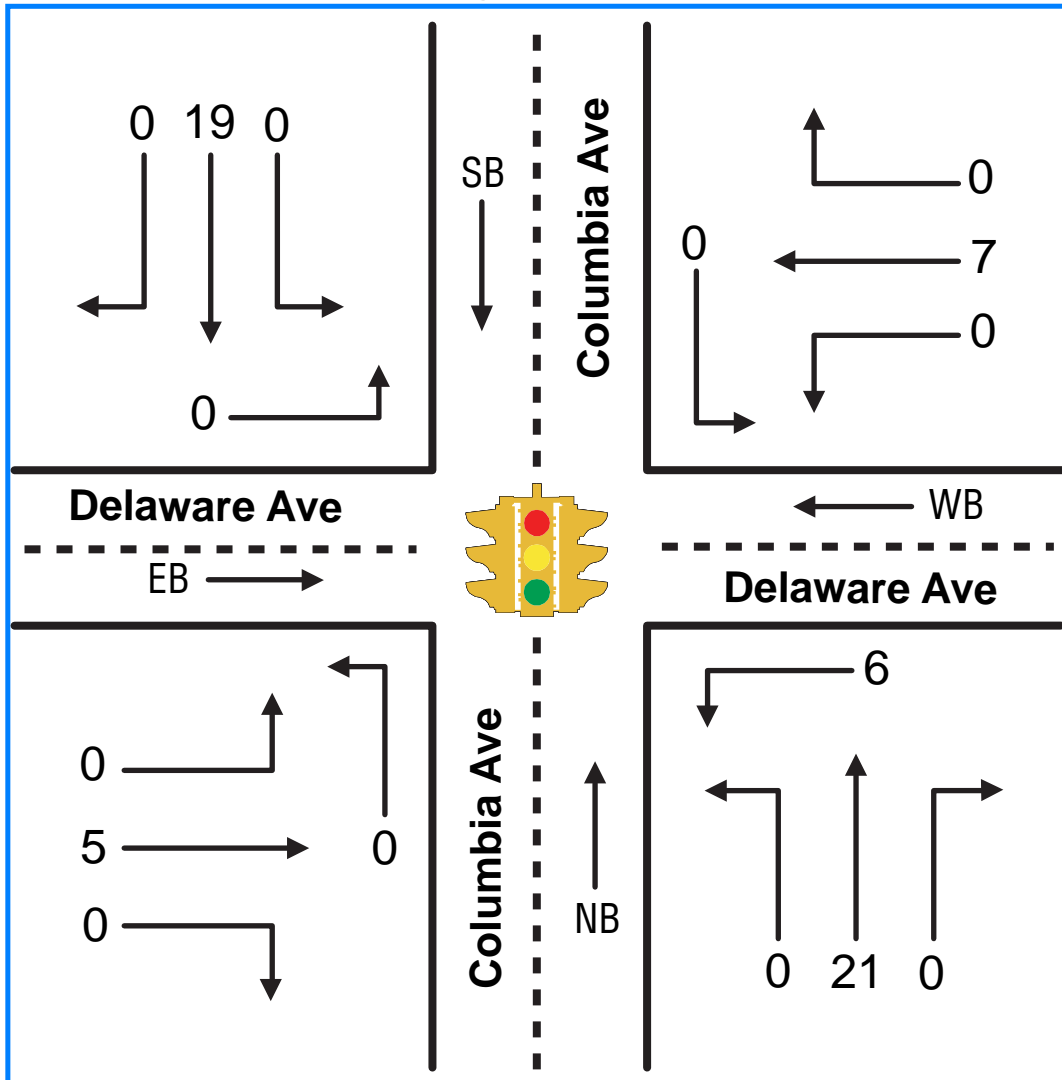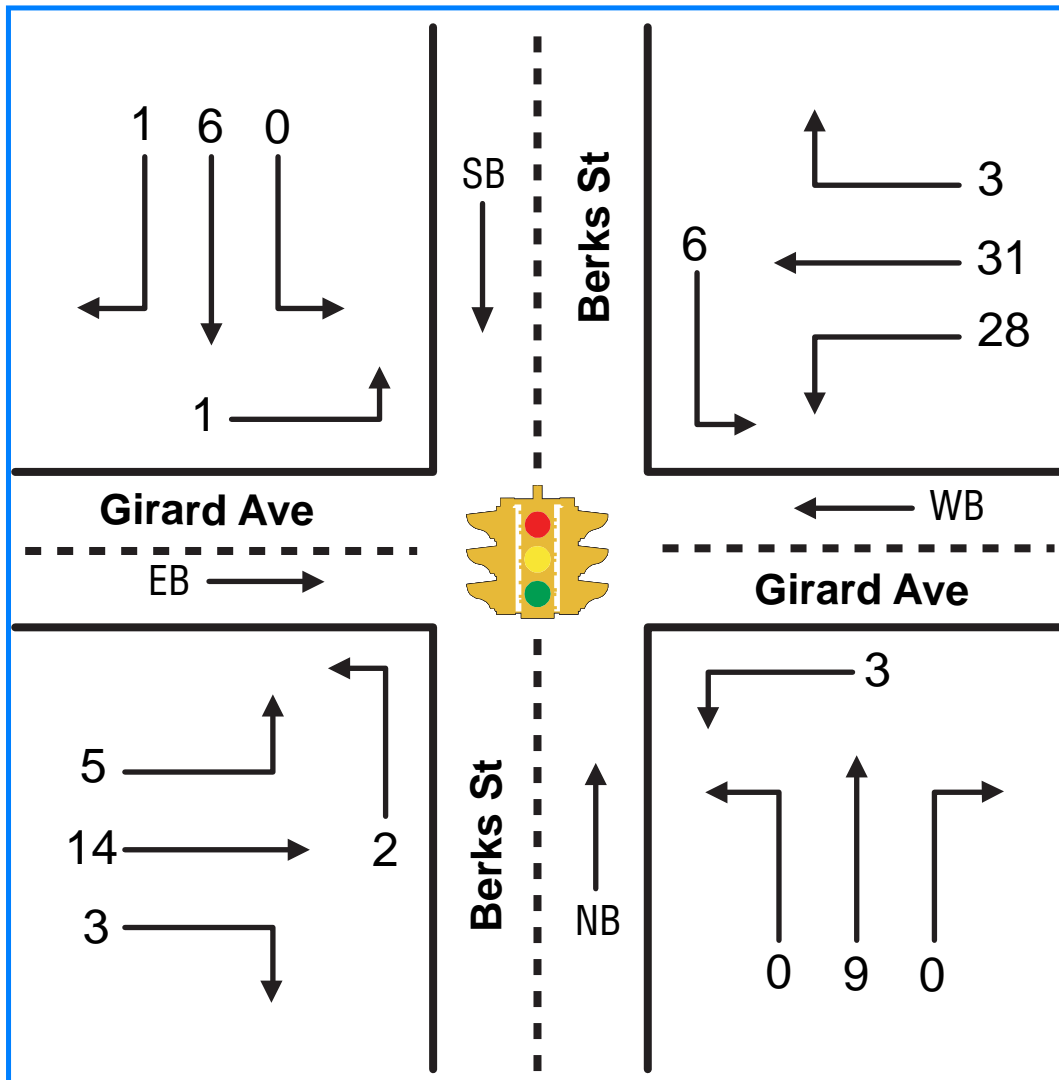Pedestrian Count - PM Peak (3:00 PM - 6:00 PM)**
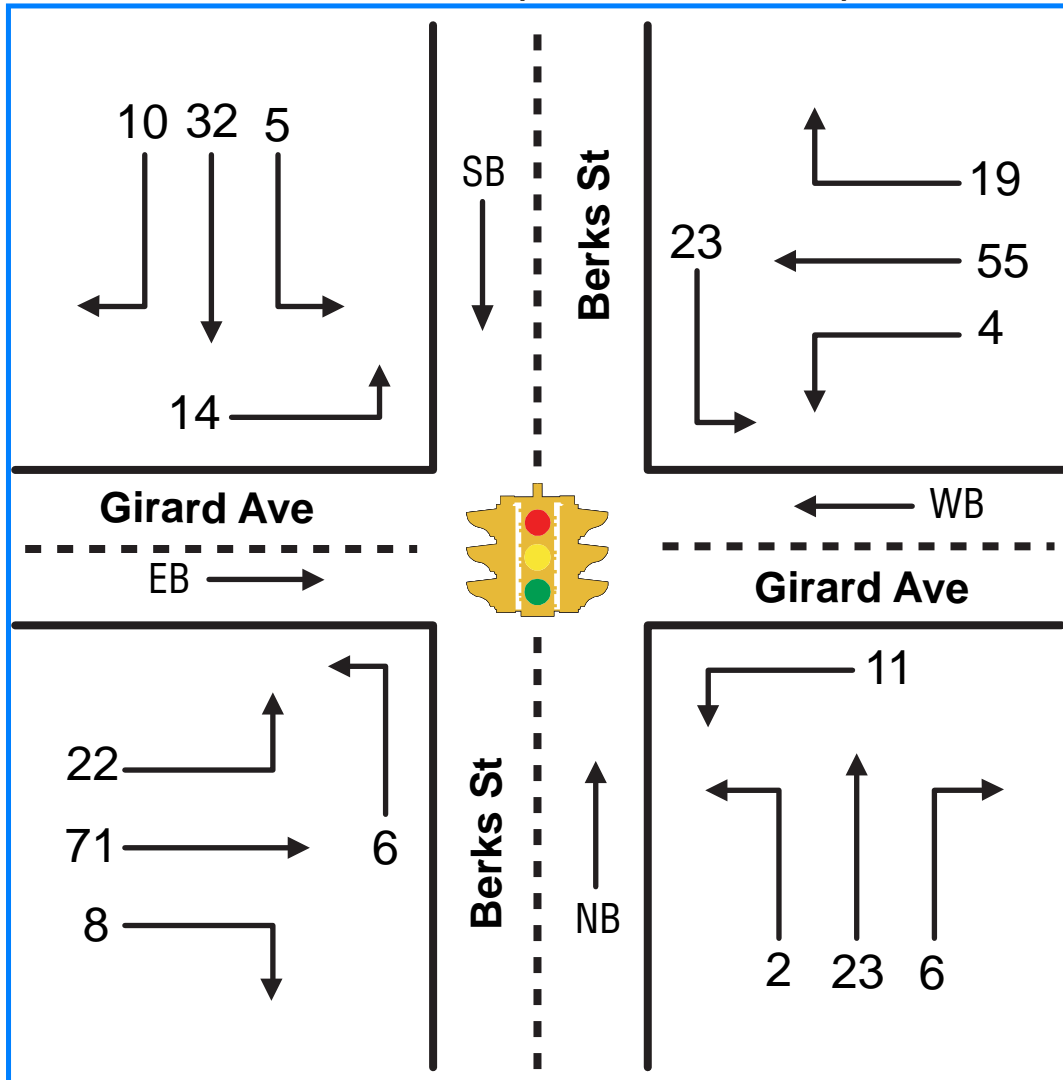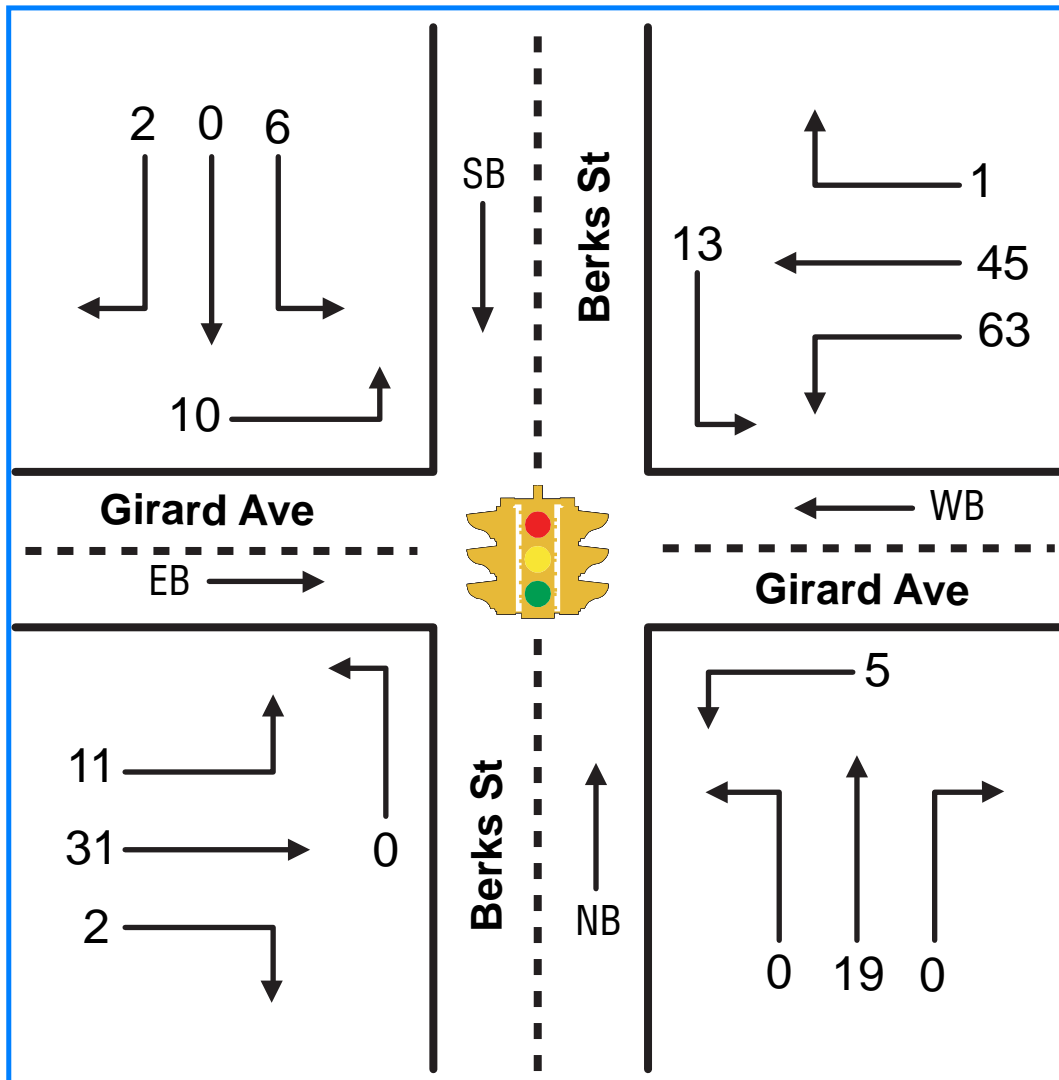

Source: DVRPC May 2009

**Figure A-14. Girard Avenue at Richmond Street
Pedestrian Count - AM Peak (7:00 AM - 9:00 AM)**

Source: DVRPC May 2009

Figure A-15. Girard Avenue at Richmond Street
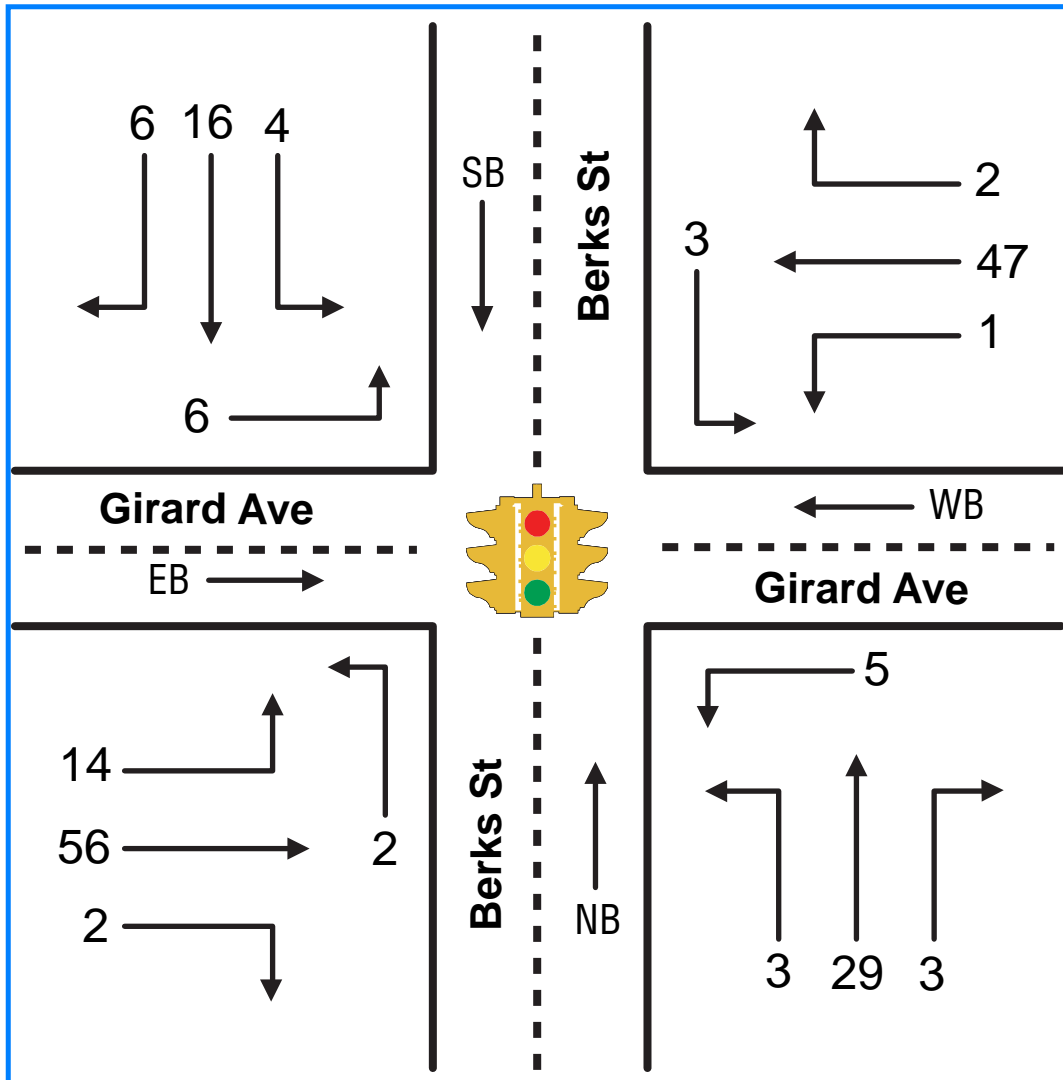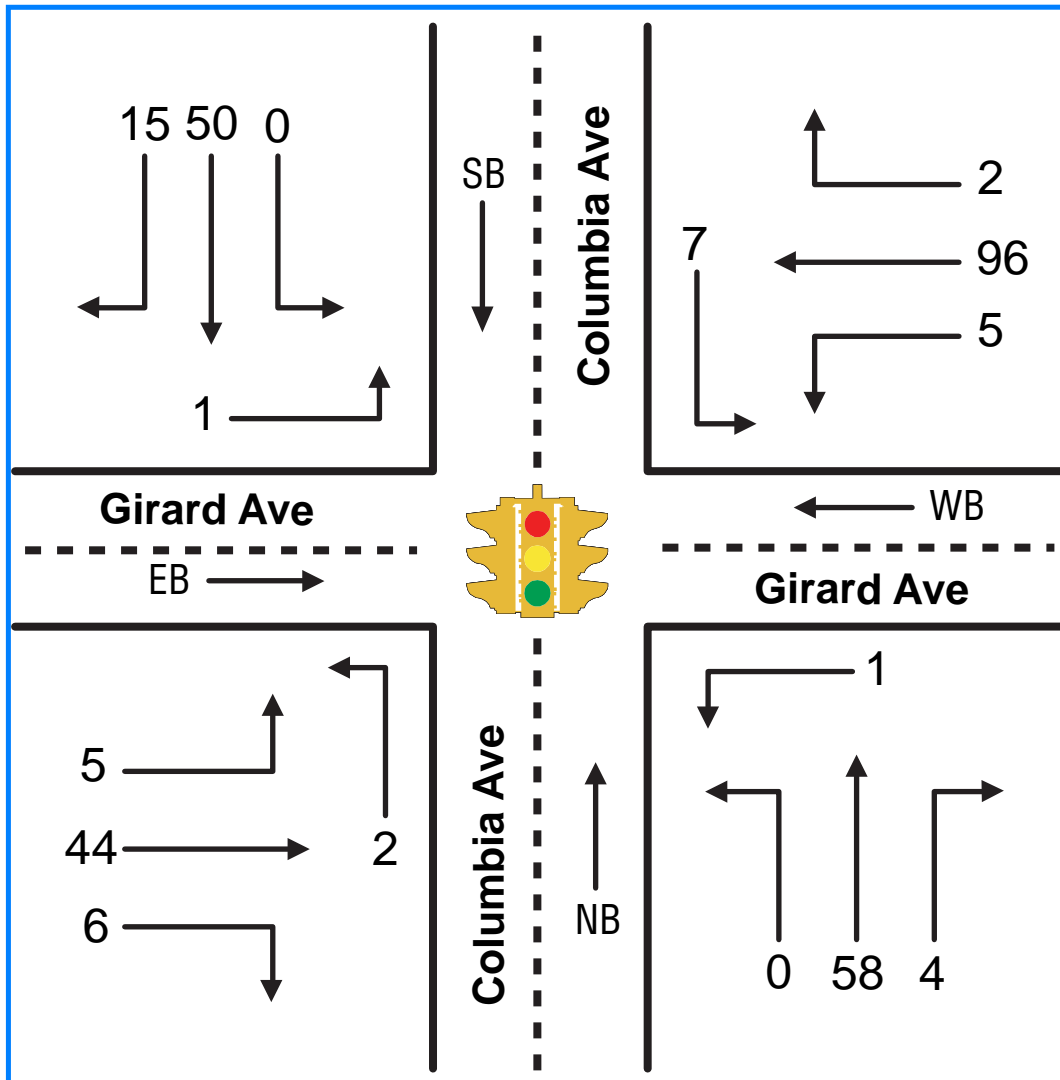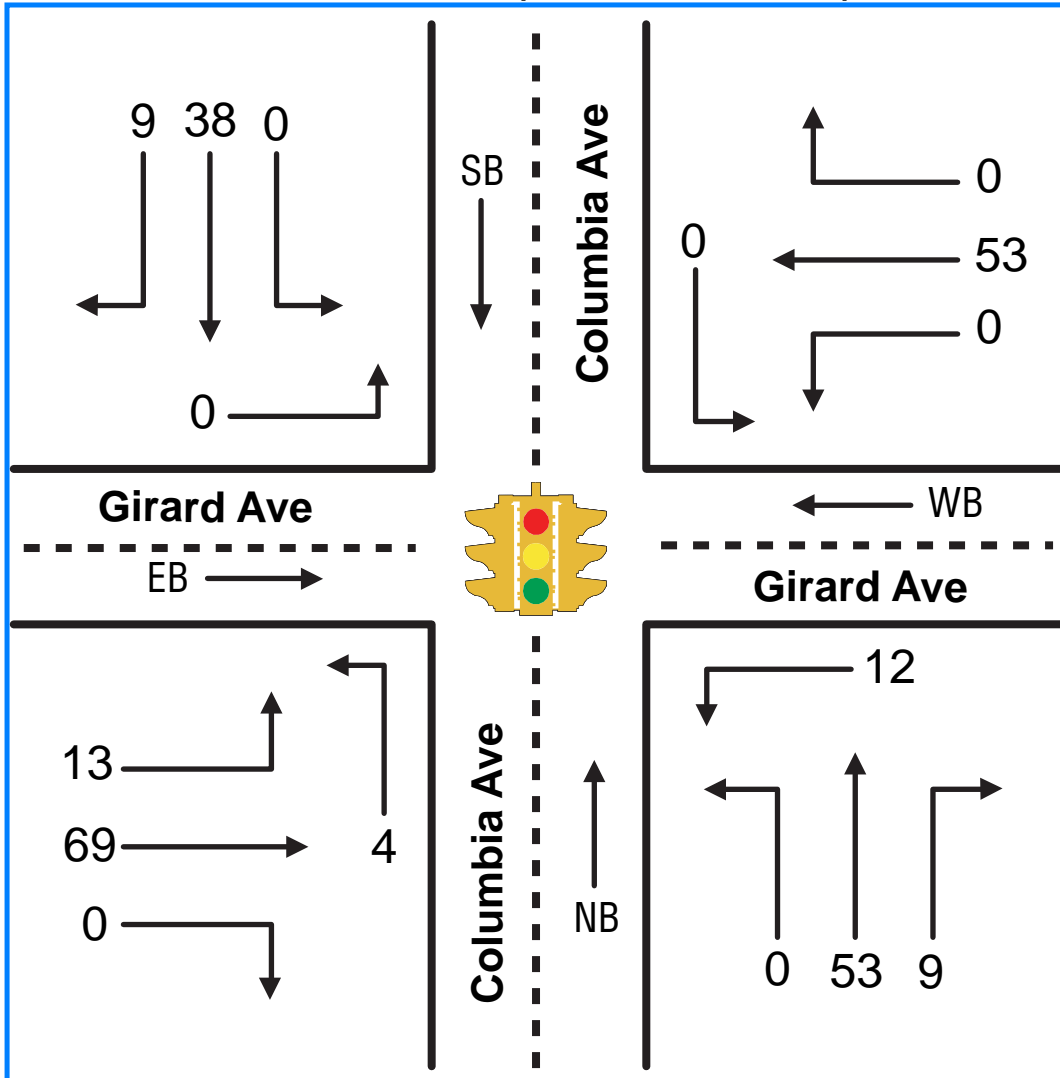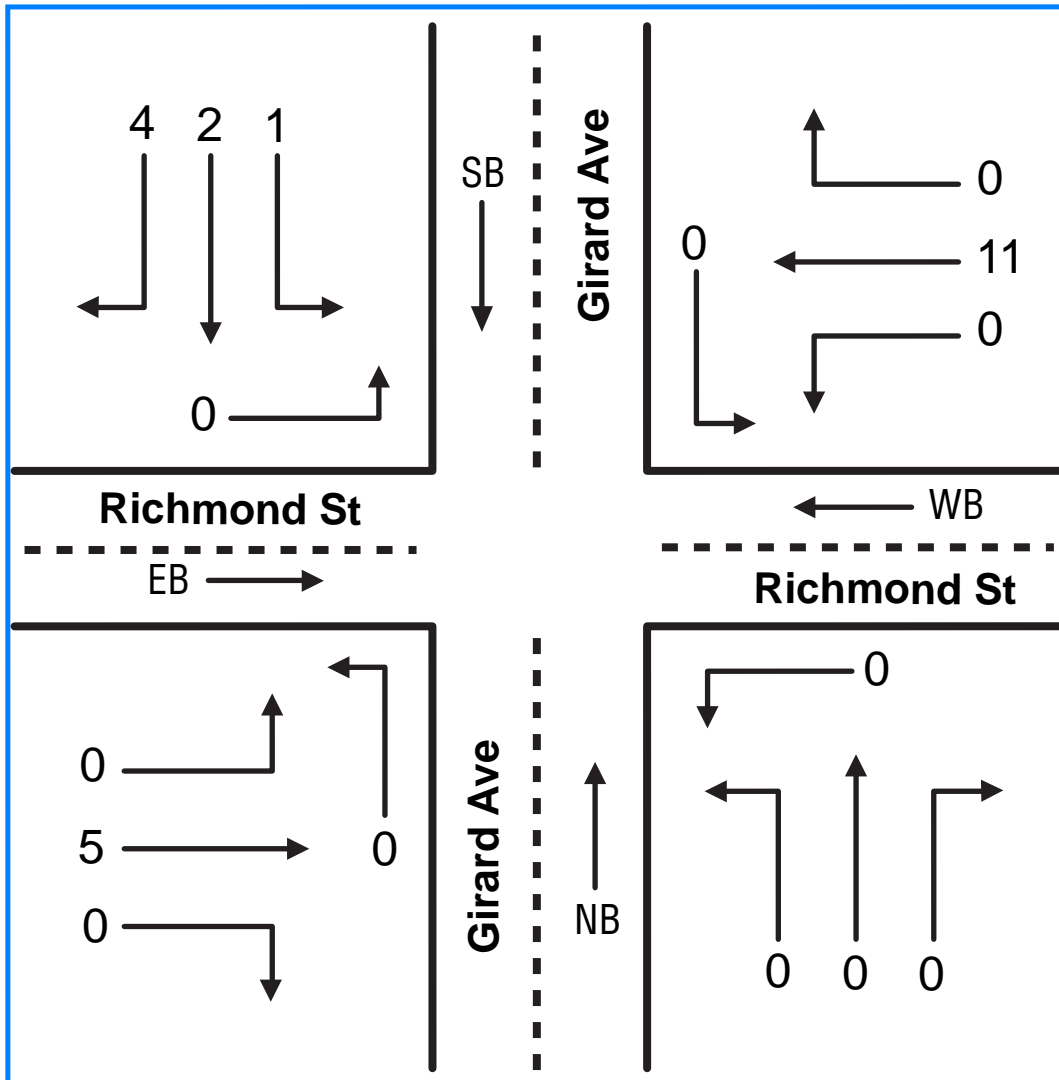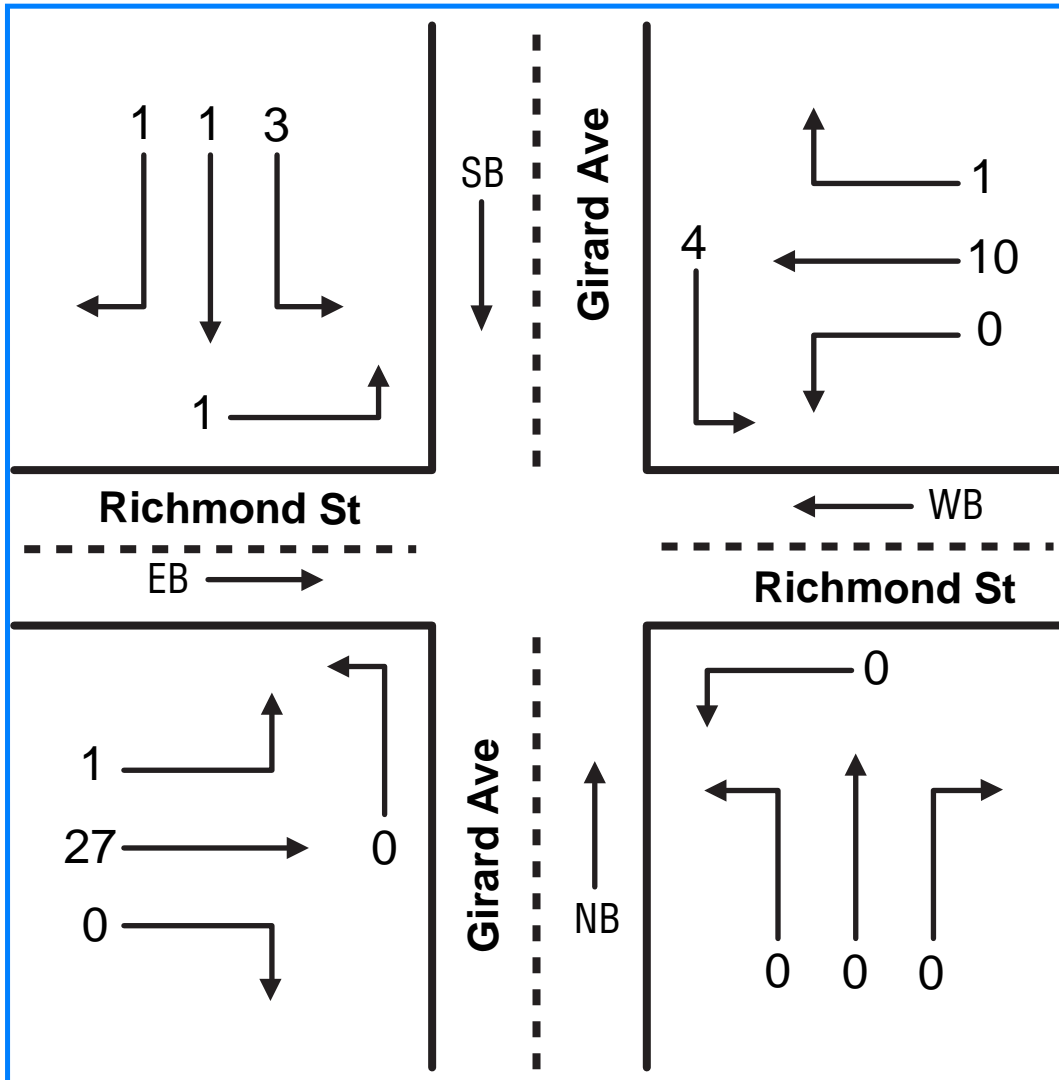**Pedestrian Count - PM Peak (3:00 PM - 6:00 PM)**

APPENDIX B PEDESTRIAN SIDEWALK AND CROSSWALK TRIP FORECASTING MODEL

As noted in Chapter IV, a new pedestrian forecasting model is developed for this study. This process includes the basic steps of trip generation, trip distribution, and travel assignment found in most urban travel forecasting models (see *Figure B-1*). There is no formal pedestrian modal split model in this process. There is some overlap between motorized and non-motorized travel. Walk to transit trips (for vehicle boarding and egress) are extracted from the transit assignment model and added to walk trips output from the pedestrian distribution model prior to loading onto the pedestrian network. This assignment produces sidewalk (link) and crosswalk (turning movement) forecasts for use in design and evaluation of proposed pedestrian facilities.

The following sections document the model specification, calibration, and parameter estimates of the various model components shown in *Figure B-1*. The section on sidewalk/crosswalk assignment model also includes model validation statistics based on recent pedestrian count data.

A. Zonal Demographic and Employment Data

The 2030 zonal socioeconomic forecasts used for pedestrian trip generation is identical to that used to prepare the highway link and turning movement forecasts for Alternative 10 presented above. These forecasts include two sources of growth: (1) the DVRPC Board Adopted forecasts and (2) the slots casino, condominium, and commercial development surcharges taken from current development plans for the Delaware River waterfront. These forecasts and development assumptions are documented in Chapter IV, Section A of Supplement Number 1 published in November 2008.

B. Pedestrian Trip Generation Model

DVRPC staff prepared a cross-classification pedestrian trip generation model based on pedestrian trip patterns taken from the DVRPC 2000 Home Interview Survey.

As in the motorized trip generation model, pedestrian trip rates are stratified by trip purpose and various combinations of household auto availability, dwelling type (residential unit versus group quarters), area type, employed residents, and employment category by Standard Industrial Code.

The pedestrian trip rates used for this model are given in *Table B-1*.

C. Pedestrian Trip Distribution Model

DVRPC staff prepared a new pedestrian trip distribution model for this study. It is configured as a standard TRANPLAN gravity model, similar in form to that utilized for the motorized trip distribution models. Pedestrian trip data taken from the 2000 Home Interview Survey is used to calibrate the model using standard gravity model calibration techniques. However, rather than travel impedance, the pedestrian trip distribution model is based on skims of minimum distance paths.

Figure B-1. Pedestrian Sidewalk and Crosswalk Trip Forecasting Model

```
                    ┌─────────────────────────┐
                    │  ZONAL DEMOGRAPHIC AND  │
                    │     EMPLOYMENT DATA      │
                    └─────────────────────────┘
                                 │
                                 ▼
                    ┌─────────────────────────┐
                    │    PEDESTRIAN TRIP       │
                    │   GENERATION MODEL       │
                    └─────────────────────────┘
                                 │
                                 ▼
┌─────────────────────────┐     ┌─────────────────────────┐
│  MODIFIED FOCUSED        │     │    PEDESTRIAN TRIP       │
│  HIGHWAY NETWORK         │────▶│   DISTRIBUTION MODEL     │
│ (LINKS WITH SIDEWALKS)   │     └─────────────────────────┘
└─────────────────────────┘
                                                ┌─────────────────────────┐
                                                │    PUBLIC TRANSIT        │
                                                │   ASSIGNMENT MODEL       │
                                                └─────────────────────────┘
                                 │                        │
                                 ▼                        ▼
                    ┌─────────────────────────┐
                    │   SIDEWALK / CROSSWALK   │
                    │   ASSIGNMENT MODEL       │
                    └─────────────────────────┘
                                 │
                                 ▼
                    ┌─────────────────────────┐
                    │  SIDEWALK AND CROSSWALK  │
                    │        VOLUMES           │
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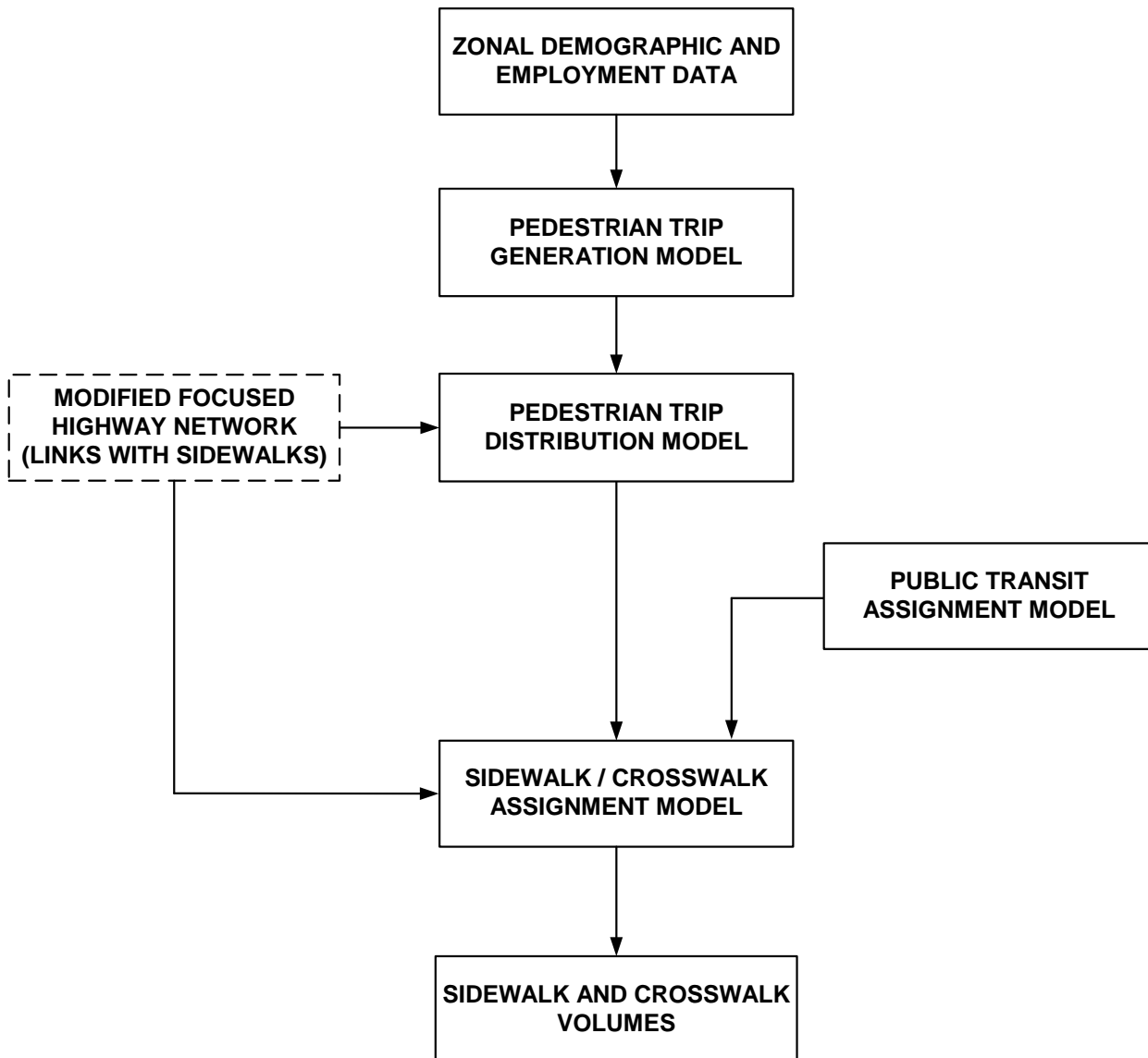
Table B-1. Pedestrian Trip Rates by Area Type

Pedestrian Trip Rates per Day						
	CBD	CBD Fringe	Urban	Suburban	Rural	Open Rural
Home Based Work Trips By Area Type (Productions)						
Per Employed Resident	0.41	0.41	0.08	0.03	0.01	0.01
Home Based Work Trips By Area Type (Attractions)						
Per Employee (Jobs)	0.10	0.11	0.04	0.03	0.01	0.01
Home Based Non-Work Trips (Productions)						
0-Vehicle Households	1.95	1.61	0.85	0.57	0.55	0.21
1-Vehicle Households	2.23	1.59	0.53	0.25	0.11	0.09
2-Vehicle Households	2.31	2.03	0.57	0.31	0.18	0.11
3+Vehicle Households	2.47	2.73	0.48	0.23	0.12	0.03
Home Based Non-Work Trips (Attractions)						
Per Household	0.89	0.86	0.31	0.14	0.06	0.03
Per Basic Employment Job	0.05	0.11	0.09	0.05	0.02	0.03
Per Retail Employment Job	0.50	0.77	0.73	0.30	0.14	0.07
Per Other Employment Job	0.27	0.21	0.21	0.06	0.05	0.02
Non-Home Based Trips						
Per Household	0.43	0.10	0.10	0.06	0.05	0.04
Per Basic Employment Job	0.45	0.47	0.06	0.03	0.01	0.01
Per Retail Employment Job	0.73	0.76	0.23	0.07	0.03	0.01
Per Other Employment Job	0.10	0.08	0.07	0.03	0.01	0.01

Source: DVRPC October 2009

Highway Network

The network used in calibration is taken from the 2000 Simulation Highway Network used for vehicular assignment. The highway network is modified as follows:

- Links representing roadways that exclude pedestrian travel (mostly freeways and ramps) are removed from the network.
- Travel distances on approach links are set to the smallest allowable value -- 0.01 mile.
- The TRANPLAN highway network skim control cards are modified to produce minimum distance matrices. Distance is the only component of impedance used, not congested travel times as in the highway assignment.
- DVRPC staff developed special software to update the minimum distance skims with terminal and intra-zonal distance values.

Given these network modifications, calibrating the gravity model consists of estimating friction factors, terminal and intra-zonal distances that reproduced the average trip lengths, trip length frequencies, and percentage of intra-zonal travel calculated from the 2000 Home Interview Survey data.

Walk Trip Friction Factors

The resulting walk trip model friction factors are listed in **Table B-2**. Friction factor curves are estimated separately for the three individual trip purposes (home-based work, home-based non-work, non-home based) and for total travel. The results of this analysis indicated that a single friction factor curve shown in **Table B-2** produces acceptable calibration results for all three purposes and for total pedestrian travel. This similarity of curves results from the short distances associated with most walk travel. Overall, almost 95 percent of walk trips are 1 mile or less. The distribution of walk trip attractions within this doubly constrained gravity model are adequate to reproduce the trip lengths for each purpose from a single friction factor curve. For this reason, the gravity model is run only for total trips, rather than for each trip purpose separately.

Predicted average walk trip distances from the model are compared with the survey results in **Table B-3**. All three trip purposes are well calibrated for this survey data. The largest error in average trip length is 0.04 miles for the non-home based purpose, or about 6.30 percent underestimated. For all purposes, the error is -0.02 miles or -3.11 percent. The predicted versus observed trip length frequency diagram for total travel is presented in **Figure B-2**. There is almost perfect agreement between the predicted and surveyed trip length frequencies.

Table B-2. Pedestrian Gravity Model Friction Factors

| Distance Miles	Friction Factor	Distance Miles	Friction Factor
0.1	2405911	3.4	39
0.2	3757389	3.5	39
0.3	4063685	3.6	30
0.4	4712276	3.7	30
0.5	3044150	3.8	21
0.6	1949320	3.9	21
0.7	1265786	4.0	14
0.8	729251	4.1	14
0.9	317518	4.2	14
1.0	157567	4.3	14
1.1	74534	4.4	8
1.2	41328	4.5	8
1.3	23391	4.6	8
1.4	13943	4.7	8
1.5	8275	4.8	8
1.6	5238	4.9	8
1.7	3413	5.0	4
1.8	2337	5.1	1
1.9	1585	5.2	1
2.0	1130	5.3	1
2.1	794	5.4	1
2.2	590	5.5	1
2.3	449	5.6	1
2.4	327	5.7	1
2.5	248	5.8	1
2.6	201	5.9	1
2.7	159	6.0	1
2.8	122	6.1	1
2.9	105	6.2	1
3.0	75	6.3	1
3.1	62	6.4	1
3.2	50	6.5	1
3.3	50	6.6	1
3.4	39	6.7	1
3.5	39	6.8	0

Source: DVRPC October 2009

Table B-3. Simulated versus Surveyed Average Trip Length

Trip Purpose	Surveyed Trip Length (mile)	Simulated Trip Length (mile)	Error	Percent Error
HBW	0.79	0.77	-0.02	-2.34%
HBNW	0.60	0.60	0.00	0.77%
NHB	0.59	0.55	-0.04	-6.30%
Total	**0.60**	**0.58**	**-0.02**	**-3.11%**

Source: DVRPC October 2009

Figure B-2. Predicted versus Observed Total Walk Trip Length Frequency Distribution
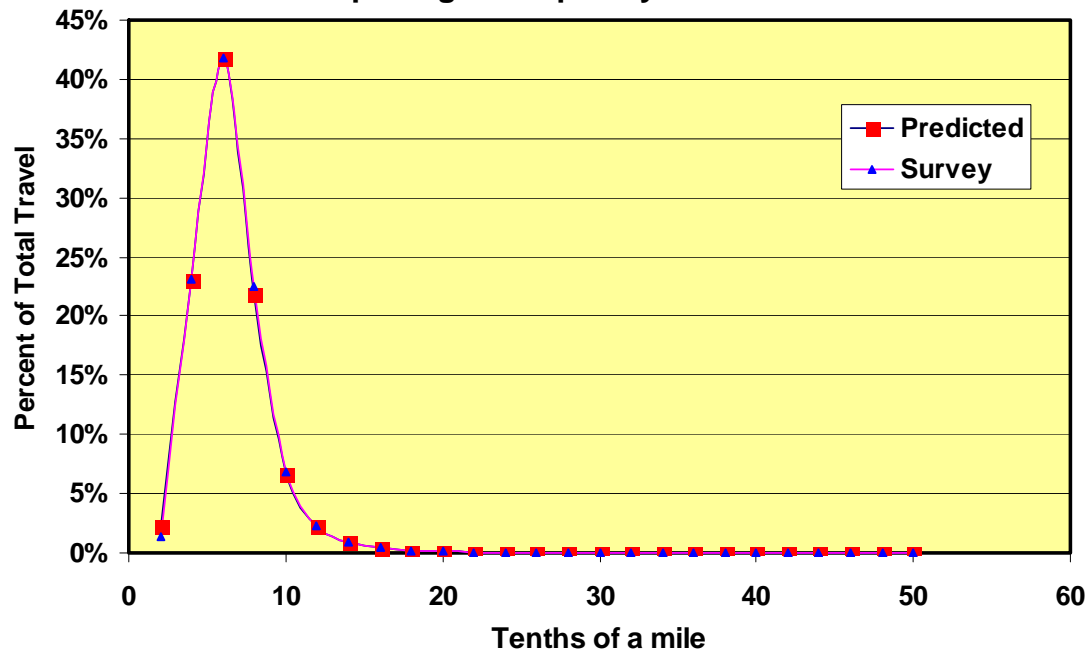
Source: DVRPC October 2009

Intra-zonal Travel

Because of short trips lengths, the pedestrian model requires very small traffic zones (on the order of 5 to 10 physical blocks) to operate and associate pedestrian trips with specific sidewalks and crosswalks. Even with these small traffic zones, about 50 percent of pedestrian walk trips taken from the home interview survey are intra-zonal; both the origin and destination of the trip are in the same traffic zone.

The pedestrian network grain should be about the same as the traffic zones. The ideal case is that included sidewalk facilities form the boundaries of traffic zones. Intra-zonal trips are unassignable to the sidewalk network. During calibration, eliminating intra-zonal trips compensates for missing sidewalks/streets in the network (low volume alleys and side streets) and the assigned pedestrian volumes are interpreted as valid sidewalk flows.

While calibrating the gravity model, terminal and inter-zonal distance factors are inserted into the network minimum distance skims along the diagonal to reproduce the surveyed percentage of intra-zonal trips. The final terminal and intra zonal distance factors, disaggregated by area type, are given in *Table B-4*.

The surveyed percent of intra-zonal walk trips is much higher than typical values for motorized travel. For this reason the diagonal of the distance matrix is updated with the terminal distance plus intra-zonal distance, rather than the more usual practice of terminal distance two times intra zonal distance. These terminal and intra-zonal factors produced an overall 49.1 percent of intra-zonal trips which compares very well with the surveyed 45.7 percent (*see Table B-5*).

Walk to Transit Travel

In urban areas like Section GIR, walk to transit constitutes a significant proportion of pedestrian sidewalk and crosswalk traffic. This includes walk to and from the Girard Avenue Station of the SEPTA Market-Frankford Subway Elevated Line, the Girard Avenue trolley, and numerous bus lines that serve the study area. The pedestrian trip generation rates given in *Table B-1* do not include walk to transit trips and this walk travel must be added before assignment to the sidewalk/crosswalk network.

Table B-4. Terminal and Intra-zonal Distance Factors

Area type	Terminal Distance (mi)	Intra-zonal Distance (mi)
CBD	0.10	0.10
Fringe	0.20	0.20
Urban	0.20	0.30
Suburban	0.20	0.50
Rural	0.20	0.70
Open Rural	0.20	0.70

Source: DVRPC October 2009

Table B-5. Surveyed versus Simulated Intra-zonal Trips

	Total Walk Trips Productions	Intra-zonal Walk Trip Productions	Percent Intra-zonal
Surveyed	2,295	1,048	45.7%
Simulated	2,721,592	1,336,607	49.1%

Source: DVRPC October 2009

The DVRPC motorized simulation model used to study the Section GIR alternatives also includes modal split and transit assignment models. The facility approach link volumes from the transit assignment provide an estimate of the number of persons walking to study area transit facilities by traffic zone. These walk approaches can easily be extracted from the transit assignment summaries. The traffic zone of residence is not directly provided by the transit approach link (the A-node), because, the other end of the link (B-node) is on a specific transit line. Assignment to the sidewalk network requires that this B-node be a traffic zone centroid.

In this pedestrian model, the transit B-node was triangulated to determine the nearest centroid and this nearest centroid was used in the assignment process. For very short approaches, the B-node is often the same as the A-node, making many walk to transit trips also an intra-zonal trip.

Table B-6 presents a comparison of the total number of simulated walk only versus walk to transit trips for the entire DVRPC region. Overall, walk to transit constitutes about 25 percent of pedestrian travel. This percentage may vary based on the level of transit service, provided to a specific location, but walk to transit is significant and must be included in the sidewalk/crosswalk assignment.

Table B-6. DVRPC Region Walk versus Walk to Transit Trips

DVRPC Region	Walk Trips	Percent of Travel
Walk to Transit Trips	937,381	25.6%
Walk Only	2,721,592	74.4%
Region Total	**3658973**	**100%**

Source: DVRPC October 2009

D. Pedestrian Sidewalk/Crosswalk Assignment Model

The final model step shown in *Figure B-1* is the assignment of simulated pedestrian trips to the sidewalk/crosswalk network. The methodology involves assigning pedestrian trips to the minimum distance paths through the focused sidewalk/crosswalk network. This network is prepared by removing freeway, ramp, and other links inaccessible to pedestrian travel for calibration and forecasting purposes as described in Section C. The calibration network is modified for the 2030 forecasts, to include the proposed new pedestrian facilities included in Alternative 10.

E. Multi-path Pedestrian Assignment

There is a problem with using simple minimum distance path assignment for pedestrian assignment. The assignment algorithm will only utilize a single minimum distance path link of egress from the origin zone to the zone of access. There are a large number of equidistant paths in a rectangular grid network, from the zone of origin to the zone of destination. Failure to consider these alternate paths results in very "lumpy" pedestrian sidewalk volumes with the initial path assigned a relatively large volume and other links not included in the initial shortest approach link of egress/access assigned zero volume.

This is a classic problem in traditional highway assignment that is solved by the capacity restraint procedure. However, typically pedestrian volumes in the study area are small and well below sidewalk/crosswalk capacity. Further, capacity restraint adjusts link travel times, not distances which remain constant. A pseudo capacity constraint was developed for pedestrian assignment to force the assignment program to build and assign alternate minimum distance paths. All sidewalks are utilized and this produces a much smoother and more reasonable pedestrian assignment. This restraint is accomplished with the traditional iterative highway assignment procedure (15 iterations), using distance instead of travel time. For purposes of this restraint, sidewalk capacity is set at a small value by setting the UROAD capacity factor in the assignment model parameters to 0.01 see *Figure B-3*. This small UROAD value reorders the links in the sequencing table in each iteration prior to building paths, producing an alternate minimum distance path from the zone of origin to the zone of destination, which are weighted together with constant weights.

F. Validation of the Pedestrian Assignment Model

Daily pedestrian counts for model validation purposes are not plentiful. This is because individual counts are labor intensive; a person or persons must be present at the intersection for 12 to 14 hours. Within Section GIR, daily counts are collected at the intersections of Girard Avenue and Berks Street and at Columbia and Delaware avenues. Additionally, daily pedestrian intersection counts were collected as part of another project at three nearby Center City Philadelphia intersections – 10th and Market streets, 15th and Locust streets, and at 20th Street and John F. Kennedy Boulevard.

Figure B-3. Pedestrian Assignment Model Parameter Setup

```
$EQUILIBRIUM HIGHWAY LOAD
$FILES
INPUT FILE = HWYNET, USER ID = $10bldwlk.dat$
INPUT FILE = HWYTRIP, USER ID = $walkt30.vol$
OUTPUT FILE = LODHIST, USER ID = $walk30d2.d15$
OUTPUT FILE = FULLSAV, USER ID = 'RESTART0.D15'
$HEADERS
$INCLUDE TITLE
Run of 2030 walk trip assignment with walk to/from transit trips
on Build Option 10 Sidewalk/Crosswalk Network
$options
$PARAMETERS
UROAD FACTOR = 0.01
IMPEDANCE = distance
selected purposes = 1
delete links link group 1 = 1,11,21, 8,18,28
EQUILIBRIUM ITERATIONS = 15
$END TP FUNCTION
```

Source: DVRPC October 2009

Total counted intersection pedestrian movements for all four legs are compared with the model calibration results in ***Table B-7***. The simulated and counted intersection pedestrian volumes are reasonably close for both study area intersections (1 percent error) and the nearby Philadelphia Central Business District (CBD) intersections (-5 percent error). The model output is more accurate for some intersections than others, but this volume check demonstrates that reasonable numbers of pedestrian trips are being produced by the model. Calibration errors were greater for individual intersection crosswalk and sidewalk movements. For this reason, the model was used to estimate growth factors for each intersection leg which factored the counted pedestrian volumes in ***figures 6A and 6B*** shown in Chapter IV to represent the 2030 Alternative 10 pedestrian forecasted daytime period volumes presented in ***figures 7A and 7B*** Chapter IV. Projected pedestrian volumes for the new sidewalks within the Girard Avenue Interchange are taken directly from the model.

Table B-7. Total Intersection Daily Counted versus Simulated Pedestrian Volumes

Street Intersection	Total Counted	Total Simulated	Error	Percent Error
Girard Ave and Berks St	1,636	1,463	173	-11%
Columbia Ave and Delaware Ave	560	714	-154	28%
Study Area subtotal	*2,196*	*2,177*	*19*	*-1%*
10th St and Market St (CBD)	14,274	11,064	3,210	-22%
15th St and Locust St (CBD)	6,356	8,288	-1,932	30%
20th St and JFK Blvd (CBD)	5,055	4,980	75	-1%
CBD subtotal	*25,685*	*24,332*	*1,353*	*-5%*
Grand Total	**27,881**	**26,509**	**1,372**	**-5%**

Source: DVRPC October 2009

APPENDIX C SECTION VINE 2030 FORECAST ALTERNATIVE 10 TRAFFIC VOLUMES

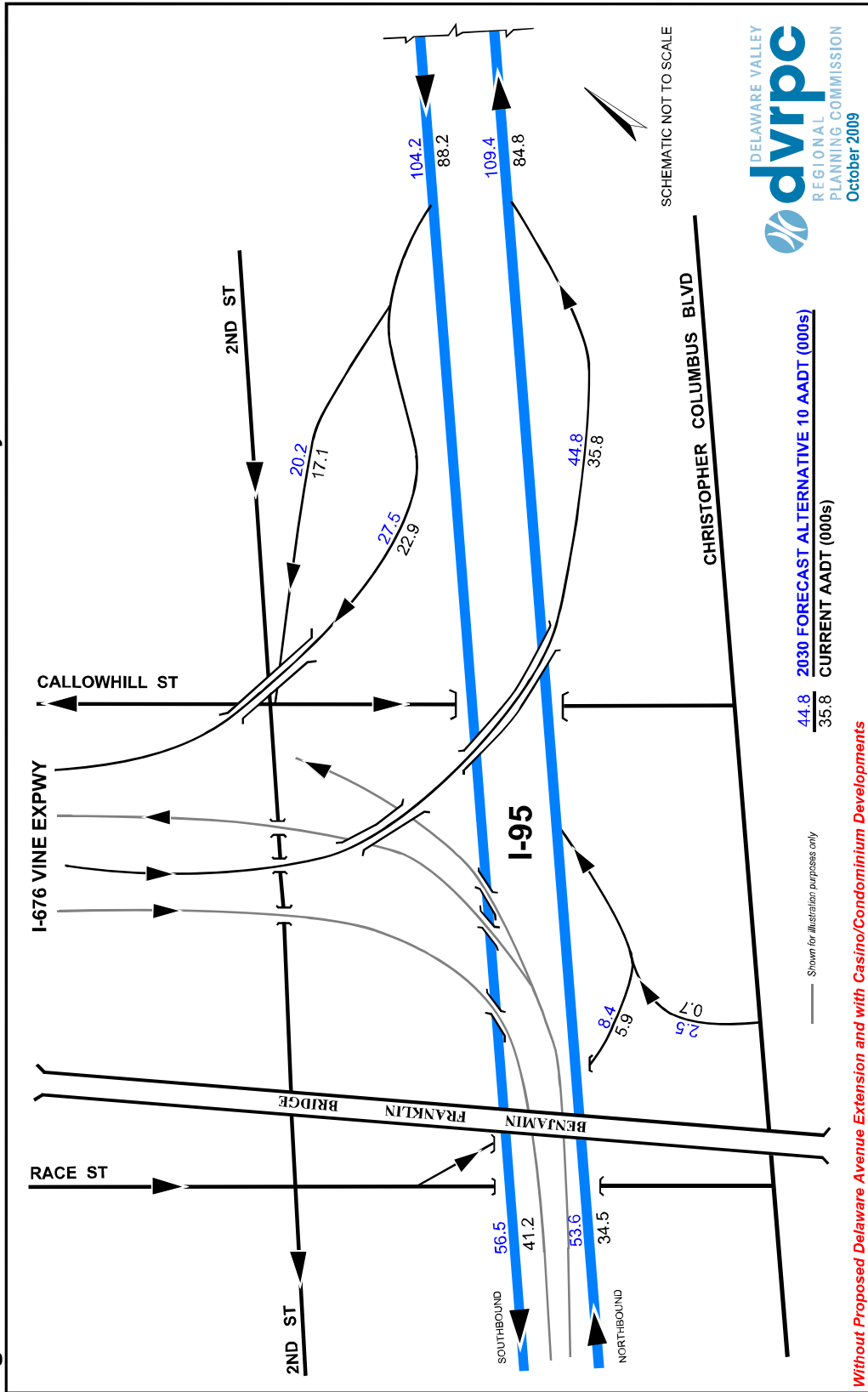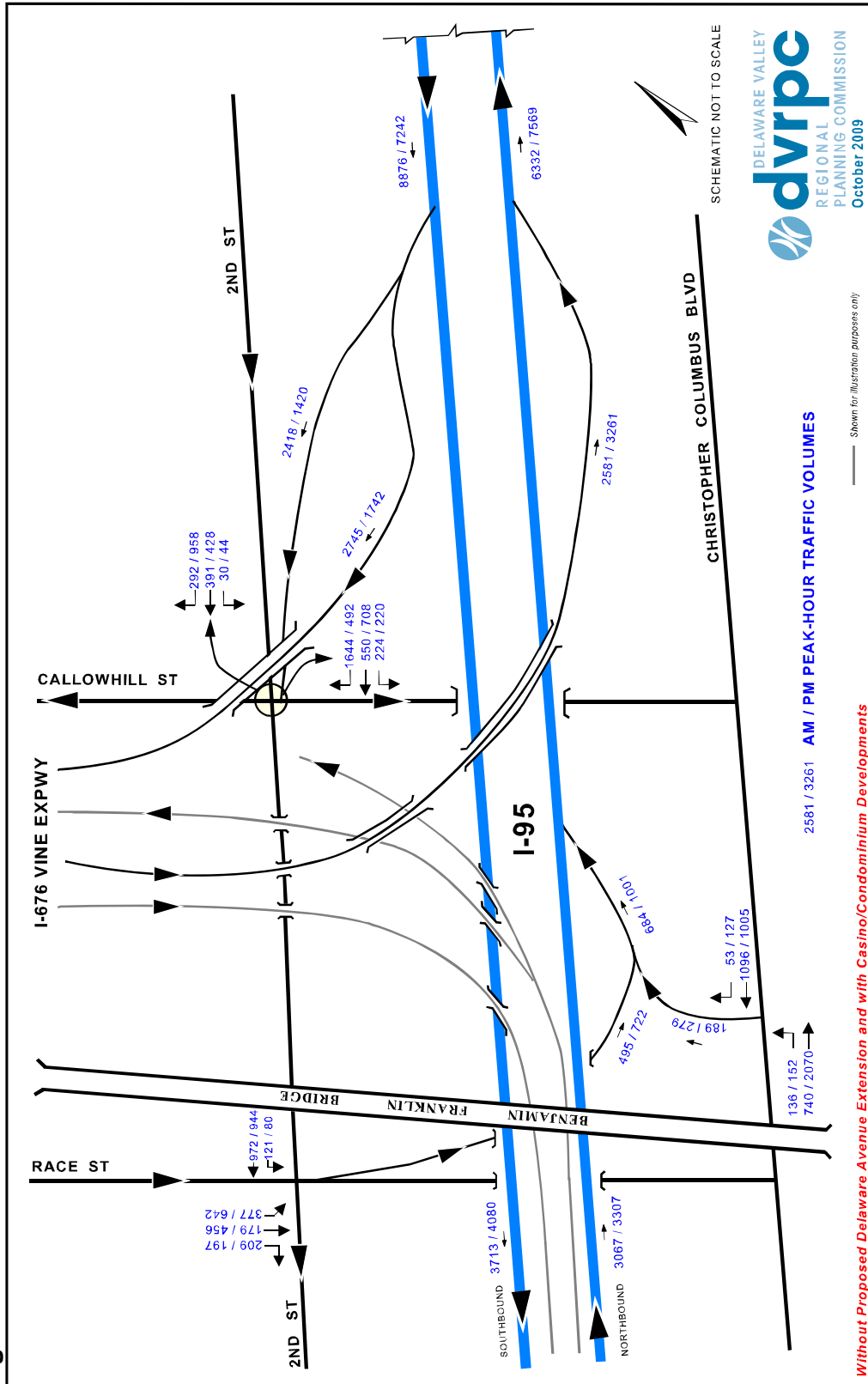**Figure C-1. Section VINE Current and 2030 Forecast Alternative 10 – Daily Traffic Volume**

Figure C-2. Section VINE 2030 Forecast Alternative 10 – AM/PM Peak-Hour Traffic Volume

Abstract

Report Title:	I-95 Interchange Enhancement and Reconstruction I-95 Expressway Interchanges, Sections GIR/VINE and AFC Traffic Study - Supplement Number 2
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Date Published:	February 2010
Geographic Area Covered:	Delaware Expressway (I-95), Allegheny Avenue, Delaware Avenue, Girard Avenue, Aramingo Avenue/Richmond Street I-676 Vine Expressway, and Lower Northeast Philadelphia which included neighborhoods of Fishtown, Kensington, and Port Richmond, and additional neighborhoods of Northern Liberties and Old City in Philadelphia
Key Words:	Traffic Volumes, Pedestrian Model, Pedestrians, Sidewalks, Crosswalk Volumes, Peak-Hour Traffic, Casino/Condominium Development, Travel Forecast, I-95 Delaware Expressway, Allegheny Avenue, Proposed Delaware Avenue Extension, Girard Avenue, Aramingo Avenue, Richmond Street, Betsy Ross Bridge, I-676 Vine Expressway, SugarHouse Casino, and Delaware Waterfront, Philadelphia

Abstract: This supplemental report documents DVRPC's traffic study and forecasts for the I-95 mainline and the Girard Avenue, and Allegheny Avenue interchanges under Alternative 10, which relocates the Allegheny Avenue NB off and on-ramps to Castor Avenue. These forecasts assume construction of the proposed slots casino(s) and condominium and apartments development along Delaware Avenue Waterfront and Christopher Columbus Boulevard. This study updates the 2030 forecasts prepared by DVRPC and presented in "I-95 Expressway Interchanges Sections GIR/Vine and AFC Traffic Study - Supplement Number 1", dated November 2008. Also, the pedestrian sidewalk and crosswalk counts, model, and 2030 forecasts prepared in support of the design and evaluation of Section GIR Interchange are documented and presented herein.

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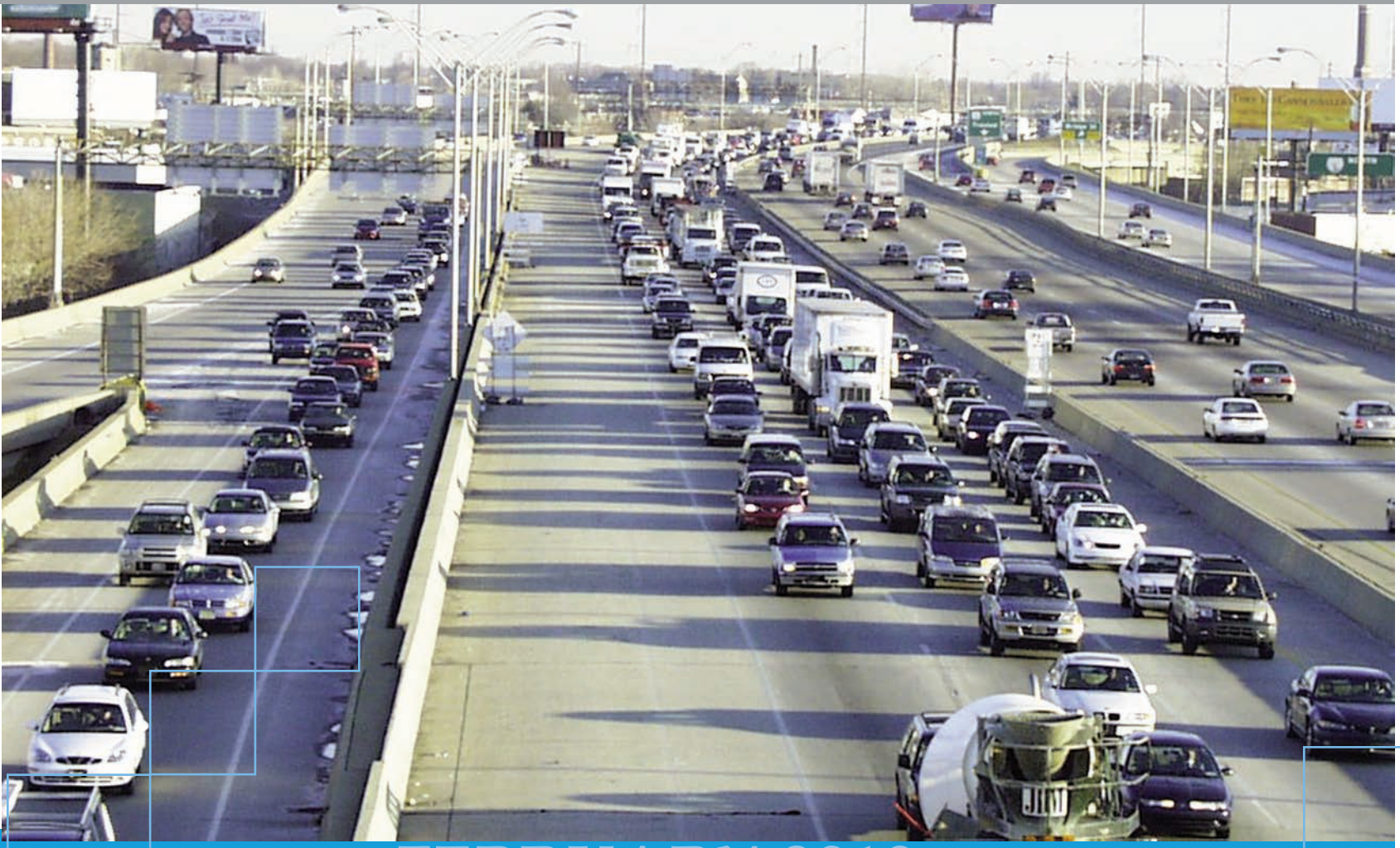
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I-95 Interchange Enhancement and Reconstruction

I-95 EXPRESSWAY INTERCHANGES SECTIONS GIR/VINE AND AFC TRAFFIC STUDY - SUPPLEMENT NUMBER 2

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