

Date: July 18, 2013

WYNN PHILADELPHIA TRAFFIC IMPACT ASSESSMENT REPORT

located in

CITY OF PHILADELPHIA,
PENNSYLVANIA

Prepared for:

*Keating Consulting, LLC
Terrence J. McKenna
1600 Arch Street, Suite 201
Philadelphia, PA 19103*



Prepared by:

*Urban Engineers, Inc
530 Walnut Street,
Philadelphia, PA 19106*



A handwritten signature in cursive script that reads "Orla H. Pease".

TABLE OF CONTENTS

I. Executive Summary 1

II. Project Background 2

III. Study Area..... 3

IV. Infrastructure Projects 19

V. Data Collection 22

VI. Existing Conditions 23

VII. Crash Analysis 24

 A. Overall Crash Analysis 24

 B. Intersection Crashes 24

 C. Homogenous Report 26

 D. Cluster List 27

VIII. Trip Generation and Distribution Projections 28

 A. Trip Generation 28

 1. Casino..... 28

 2. Hotel 31

 B. Modal Distribution 31

 C. Trip Distribution 33

IX. Turning-Lane Warrant Analysis 37

X. Signal Warrant Analysis 38

XI. Sight Distance Analysis 39

XII. Capacity Analysis 41

 A. 2016 No-Build 42

 B. 2016 Build – No mitigation 43

 C. 2016 Build – With mitigation 46

 D. 2021 No-Build 47

 E. 2021 Build 49

XIII. Queue Analysis 50

XIV. Multi-Modal Facilities 57

 A. Existing Conditions..... 57

 B. Proposed Facilities..... 60

XV. Summary and Conclusions..... 64

LIST OF TABLES

Table 1: Fatal Crash Details 24

Table 2: Crash Rates and Intensities for Richmond St and Aramingo Ave 27

Table 3: Trip Generation Based on Available Positions 28

Table 4: Excerpt of Table 5 from Gaming Casino Traffic article 29

Table 5: Trip Generation Adjusted for Seasonal Peak 30

Table 6: Vehicular Trip Generation for Friday 4-6pm and Saturday 7-10 pm 30

Table 7: Vehicular Trips Generated Based on Number of Gaming Positions 31

Table 8: Trip Generation Based on Number of Hotel Rooms 31

Table 9: Total Trip Generation Due to Site Development..... 31

Table 10: Casino Visitors Mode of Arrival 32

Table 11: Trip Distribution 33

Table 12: Richmond St & Cumberland St Turn Lane Warrant Summary 37

Table 13: Richmond St & Girard Ave Turn Lane Warrant Summary 37

Table 14: Richmond St & I-95 NB Ramps Turn Lane Warrant Summary 37

Table 15: Signal Warrant Analysis Results 38

Table 16: HCM Level of Service Criteria 41

Table 17: LOS and Delay Summary – 2016 No-Build and Build Conditions 45

Table 18: LOS and Delay Summary – 2021 No-Build and Build Conditions 48

Table 19: LOS and Delay Summary – Richmond St and Cumberland St..... 49

Table 20: Queue Results Summary – Delaware Ave and Frankford Ave 50

Table 21: Queue Results Summary – Delaware Ave and Columbia Ave 51

Table 22: Queue Results Summary – Delaware Ave and Montgomery Ave 51

Table 23: Queue Results Summary – Delaware Ave and Aramingo Ave 52

Table 24: Queue Results Summary – Richmond St and I-95 NB Ramps..... 52

Table 25: Queue Results Summary – Richmond St and Girard Ave 53

Table 26: Queue Results Summary – Richmond St and Cumberland St 53

Table 27: Queue Results Summary – Richmond St and Lehigh Ave 54

Table 28: Queue Results Summary – Richmond St and Somerset St 54

Table 29: Queue Results Summary – Richmond St and Allegheny Ave 55

Table 30: Queue Results Summary – Aramingo Ave and I-95 SB Off-Ramp..... 55

Table 31: Queue Results Summary – Aramingo Ave and York St 56

Table 32: Queue Results Summary – Aramingo Ave and Cumberland St 56

Table 33: Pedestrian Activity at Study Area Intersections 57

Table 34: 2010 HCM Pedestrian Capacity Analysis 63

Table 35: Recommendations 64

LIST OF FIGURES

Figure 1. Study Area 4

Figure 2. Intersection of Delaware Avenue and Frankford Avenue 5

Figure 3. Intersection of Delaware Avenue and Columbia Avenue 6

Figure 4. Intersection of Delaware Avenue and Montgomery Avenue 7

Figure 5. Intersection of Delaware Avenue and Richmond Street/Aramingo Avenue 8

Figure 6. Intersection of Richmond Street and Dyott Street 9

Figure 7. Intersection of Richmond Street and Schirra Drive 10

Figure 8. Intersection of Richmond Street and Girard Avenue 11

Figure 9. Intersection of Richmond Street and Cumberland Street 12

Figure 10. Intersection of Richmond Street and Lehigh Avenue 13

Figure 11. Intersection of Richmond St and Somerset St..... 14

Figure 12. Intersection of Richmond Street and Allegheny Avenue 15

Figure 13. Intersection of Aramingo Avenue and Cumberland Street 16

Figure 14. Intersection of Aramingo Avenue and York Street 17

Figure 15. Intersection of Aramingo Avenue and the I-95 SB Off-Ramps 18

Figure 16. Proposed I-95 Construction..... 21

Figure 17. Arrival Distribution and Assignment, Friday and Saturday PM Peak..... 34

Figure 18. Departure Distribution and Assignment, Friday and Saturday PM Peak 35

Figure 19. Internal Site Layout 36

Figure 20. Proposed Richmond St Configurations 40

Figure 21. 2016 Proposed Aramingo Ave and Richmond St Configuration..... 47

Figure 22. Bicycle and Pedestrian Circulation 58

Figure 23. SEPTA Transit Routes 59

Figure 24. Multi-Modal Facilities at Main Entrance..... 60

Figure 25. Multi-Modal Facilities at Employee Entrance..... 61

Figure 26. Multi-Modal Facilities at Garage Entrance..... 61

APPENDICES

- APPENDIX A: Turning Movement Counts
- APPENDIX B: Synchro Reports
- Existing
 - 2016 No-Build
 - 2016 Build
 - 2021 Build
 - 2021 Cumberland Signal analysis
 - Pedestrian Level of Service Analysis
- APPENDIX C: Signal Plans and Timings
- APPENDIX D: Crash Information
- Crash Diagrams
 - Crash Resumes
 - Homogenous Report
 - Cluster List
- APPENDIX E: Trip Generation Resources
- Sugarhouse Casino Turning Movement Counts
 - St. Charles ITE Journal Article
 - Parx Casino Turning Movement Counts
- APPENDIX F: Pennsylvania Gaming Control Board *Executive Summary of The Interim Report of Findings*
- APPENDIX G: Turning Lane Warrant Analysis
- APPENDIX H: Signal Warrant Analysis
- APPENDIX I: Sight Distance Analysis
- APPENDIX J: Volume Diagrams
- APPENDIX K: I-95 GIR DVRPC Reports
- I-95 Girard Avenue and I-676 Vine Expressway Interchanges, Section GIR Traffic Study*
 - I-95 Expressway Interchanges Sections GIR/Vine and AFC Traffic Study – Supplement Number 1*
 - I-95 Expressway Interchanges Sections GIR/Vine and AFC Traffic Study – Supplement Number 2*

I. Executive Summary

The purpose of this report was to examine the potential impact of construction of a casino resort along the Delaware River waterfront and the I-95 Corridor, directly adjacent to the I-95/Girard Avenue Interchange, which is currently under construction. The proposed project includes:

- 2,500 slot machines
- 100 table games
- 3 dining venues (~750 seats)
- 3 lounges
- 1 performance lounge
- an 11,000 square foot night club
- 1 multi-purpose entertainment facility
- 307 suite hotel
- +/- 2,400 structured parking spaces
- +/- 400 surface parking spaces

This report identifies the anticipated impacts that traffic generated by the casino resort will have on the surrounding area. The location of this site, close to the existing and reconfigured I-95 Girard Avenue Interchange, provides excellent access to and from the I-95 corridor, which will drastically minimize traffic impacts on the local neighborhood road network. In addition, it is ideally located adjacent to multiple public transit facilities, including SEPTA bus stops, as well as the Girard Avenue Trolley. It is anticipated that major infrastructure changes would not be needed to accommodate the casino resort. Mitigation measures would likely be minimal and include new signal equipment, signal timing modifications, intersection modifications, and changes to lane usage.

III. Study Area

The proposed casino site is located between Richmond Street and the Delaware River from the intersection of Richmond Street with Dyott Street to the intersection of Richmond Street with Cumberland Street, as shown in *Figure 1*.

The majority of the casino traffic will utilize I-95 to access the site, and impacts to local roads and intersections will be minimal. Visitor access to the site will be obtained by two driveways. One driveway will be located at the intersection of Richmond Street and the relocated I-95 while the other driveway will be located at the intersection of Richmond Street and Girard Avenue. A third driveway will be located at the intersection of Richmond Street and Cumberland Street, but will be reserved for employees and deliveries. The Girard Avenue Interchange with I-95 will be utilized significantly to access these intersections. Generally the casino resort is optimally located for visibility from this major highway and upon completion of the proposed highway construction, the casino will be optimally located for accessibility for those exiting I-95 northbound and just north one intersection from those exiting I-95 southbound. The following summarizes existing conditions at each intersection analyzed as a part of this report.



Delaware Waterfront Development
Traffic Study
Project Area
Figure 1

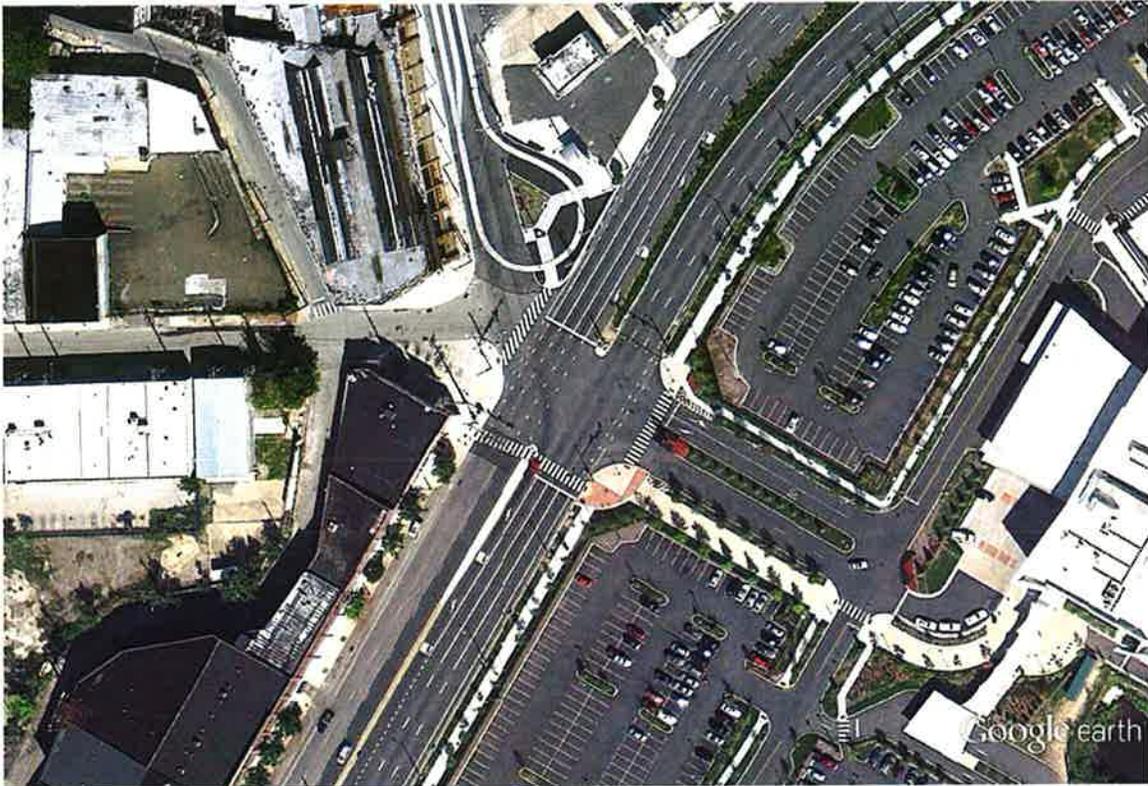
Study Area - Delaware Avenue and Frankford Avenue

Figure 2. Intersection of Delaware Avenue and Frankford Avenue

The intersection of Delaware Avenue and Frankford Avenue is a five-leg signalized intersection. The signal has a 120 second cycle length, an actuated-coordinated operation, and a three-phase timing plan. The northbound and southbound left turns are protected. The eastbound and westbound left turns are permitted. **Figure 2** shows an aerial view of the intersection.

Both the northbound and southbound Delaware Avenue approaches consist of an exclusive left turn lane, two through lanes, and one shared through-right lane. In both directions of Delaware Avenue there is an adjacent bicycle lane. The westbound approach to the intersection consists of an exclusive left turn lane and a shared through-right lane. The eastbound Frankford Avenue approach consists of an exclusive right-turn lane and a shared through-left lane. Recent construction changes have made the fifth leg of the intersection, Laurel Street, a one-way street away from the intersection. Recent changes have also included the addition of a crosswalk along the southbound approach of Delaware Avenue such that now all legs of the intersection have a crosswalk. Sidewalks exist along every approach to the intersection.

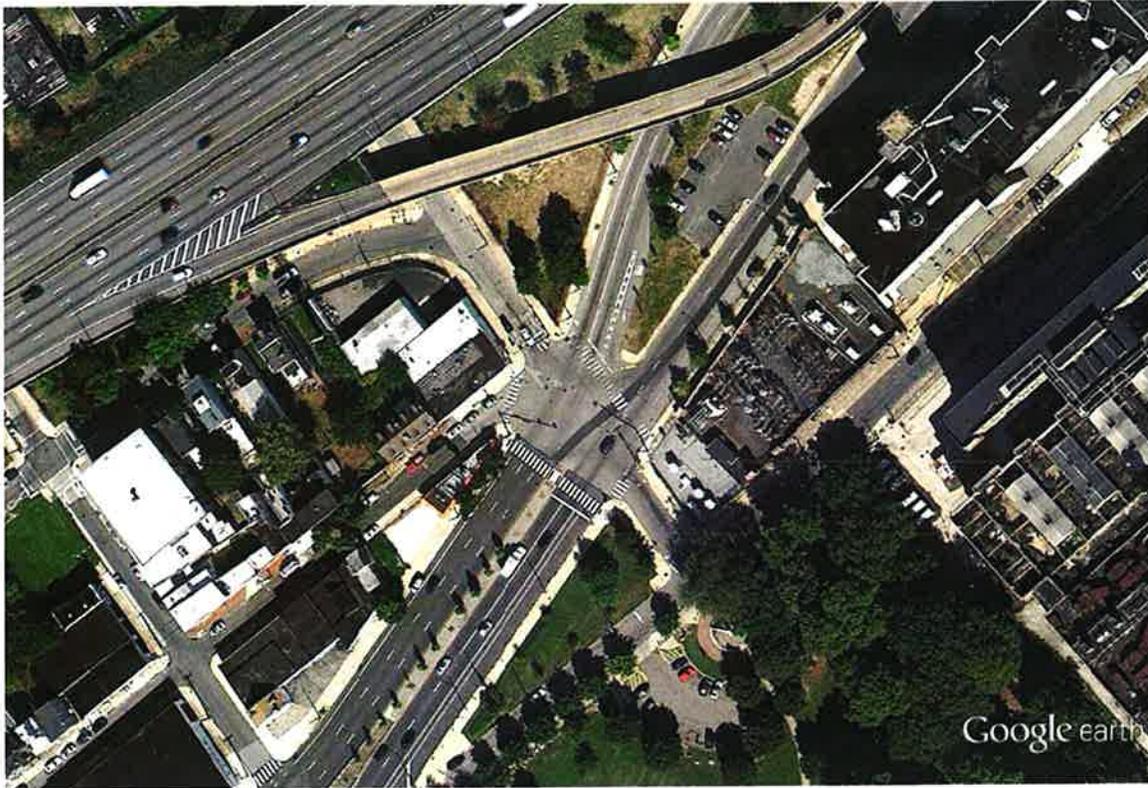
Study Area - Delaware Avenue and Columbia Avenue

Figure 3. Intersection of Delaware Avenue and Columbia Avenue

The intersection of Delaware Avenue and Columbia Avenue is a four-leg signalized intersection. The signal has a 120 second cycle length, an actuated-coordinated operation, and a two-phase timing plan. All of the left turns are permitted during the through movement phases. **Figure 3** shows an aerial view of the intersection.

The southbound Delaware Avenue approach consists of two through-lanes and an exclusive left-turn lane. The northbound Delaware Avenue approach has a through-lane and a shared through-right lane. Both approaches of Delaware Avenue have an adjacent bicycle lane. The eastbound one-way Columbia Avenue approach is essentially a one-lane road with on-street parking. The westbound approach is a continuation of Columbia Avenue, but for this short section is a two-way road. An added leg to the intersection is E Allen Street, which is one-way southbound. Essentially it is another potential movement for vehicles leaving the intersection. Crosswalks are available on every approach to the intersection, with a pedestrian "refuge area" provided on the northbound approach for those pedestrians crossing Delaware Avenue. Sidewalks are also present along all approaches to the intersection.

Study Area - Delaware Avenue and Montgomery Avenue

Figure 4. Intersection of Delaware Avenue and Montgomery Avenue

The intersection of Delaware Avenue and Montgomery Avenue is an unsignalized T-intersection. **Figure 4** shows an aerial view of the intersection.

The eastbound Montgomery Avenue approach is a one-way street with adjacent parking on both sides of the street. Vehicles coming from Montgomery Avenue can only turn right onto southbound Delaware Avenue. The southbound Delaware Avenue approach consists of two through lanes with an adjacent bicycle lane. Northbound Delaware Avenue at this intersection consists of three through lanes with an adjacent bicycle lane. A concrete median prevents left turns onto or off of Montgomery Avenue. Just south of the intersection of Delaware Avenue and Montgomery Avenue is where the I-95 northbound Girard Avenue exit currently exits onto Delaware Avenue. All approaches at this intersection have sidewalks, but there are no crosswalks across any approach to the intersection.

Study Area - Delaware Avenue and Richmond Street/Aramingo Avenue

Figure 5. Intersection of Delaware Avenue and Richmond Street/Aramingo Avenue

The intersection of Delaware Avenue and Richmond Street/Aramingo Avenue is a signalized T-intersection. The signal has a 90 second cycle length, an actuated-coordinated operation, and a two-phase timing plan. The only left turns allowed at the intersection are from Richmond Street onto Delaware Avenue southbound. **Figure 5** shows an aerial view of the intersection.

Richmond Street continues north-south as Delaware Avenue turns and becomes east-west oriented. The northbound Delaware Avenue approach consists of two through lanes. There are no turns permitted from this approach as one lane breaks from Delaware Avenue to head onto Richmond Street approximately 300 feet south of this intersection. The southbound Richmond Street approach has an exclusive left-turn lane and a shared left-right turn lane. Less than 150 feet north of this intersection, there is a channelized right-turn allowing motorists to enter onto the on-ramp for I-95 northbound. The eastbound Aramingo Avenue approach consists of two through-lanes. No turns are allowed from this approach. The bicycle lane that exists along much of Delaware Avenue continues northbound along Richmond Street. There are no sidewalks or crosswalks along any approach to this intersection.

Study Area - Richmond Street and Dyott Street

Figure 6. Intersection of Richmond Street and Dyott Street

The intersection of Richmond Street and Dyott Street is a one-way, stop-controlled T-intersection. **Figure 6** shows an aerial view of the intersection before the Girard Avenue Interchange construction began.

The northbound Richmond Street approach consists of a through-right lane with an adjacent bicycle lane. The southbound Richmond Street approach consists of an exclusive left-turn lane and a through-right lane with adjacent bicycle lane. The westbound Dyott Street approach is stop-controlled and consists of one large lane, with room for right-turning motorists to proceed without waiting for left-turning motorists. There are no existing crosswalks at this intersection. A sidewalk exists along the eastern side of Richmond Street, south of its intersection with Dyott Street.

Study Area - Richmond Street and Schirra Drive

Figure 7. Intersection of Richmond Street and Schirra Drive

The intersection of Richmond Street and Schirra Drive is a one-way, stop-controlled T-intersection. **Figure 7** shows an aerial view of the intersection before the Girard Avenue Interchange construction began.

Due to existing construction occurring along Richmond Street, the northbound and southbound Richmond Street approaches consist of one lane each. The westbound Schirra Drive approach is stop-controlled and consists of one lane with adjacent parking. The only crosswalk at this intersection is across the Schirra Drive approach.

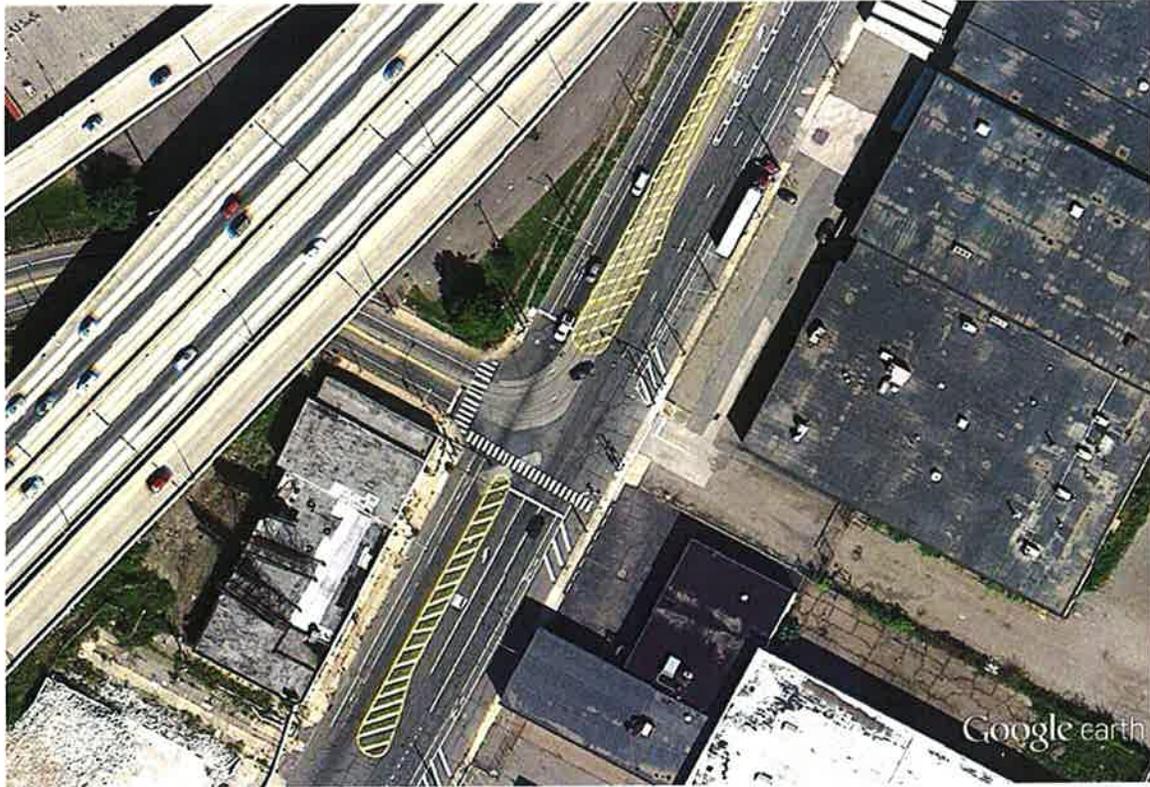
Study Area - Richmond Street and Girard Avenue

Figure 8. Intersection of Richmond Street and Girard Avenue

For the duration of this study the signalized T-intersection was under construction and Girard Avenue was closed. **Figure 8** shows an aerial view of the intersection before the Girard Avenue Interchange construction began. The signals were covered. Both the northbound and southbound approaches consisted of one through lane.

Study Area - Richmond Street and Cumberland Street

Figure 9. Intersection of Richmond Street and Cumberland Street

Figure 9 shows a street view of the intersection of Richmond Street and Cumberland Street from the northbound Richmond Street approach. Due to construction at the intersection, the westbound Cumberland Street approach was closed and made the intersection of Richmond Street and Cumberland Street a one-way, stop-controlled T-intersection.

Both the northbound and southbound Richmond Street approaches consisted of one through lane. The eastbound Cumberland Street approach consists of an exclusive right-turn lane and an exclusive left-turn lane. Due to the overpass supports, Cumberland Street at the intersection is split with the supports as the median, which proved difficult to navigate for some motorists who would enter Cumberland Avenue incorrectly, despite the “Do Not Enter” signs. Sidewalks exist along Cumberland Avenue and along the western side of Richmond Street. The only crosswalk at the intersection was across the eastbound Cumberland Street approach.

Study Area - Richmond Street and Lehigh Avenue

Figure 10. Intersection of Richmond Street and Lehigh Avenue

The intersection of Richmond Street and Lehigh Avenue is a signalized T-intersection. The signal has a 60 second cycle length, a pre-timed operation, and a two-phase timing plan. The northbound and eastbound left turns are permitted during the through movement phasing. The eastbound and westbound left turns are permitted. **Figure 10** shows a street view of the intersection from the northbound Richmond Street approach.

The northbound and southbound Richmond Street approaches consist of one shared through and turn lane. The eastbound Lehigh Avenue approach consists of an exclusive left turn lane and exclusive right turn lane. There are sidewalks and crosswalks along every approach to the intersection.

Study Area - Richmond Street and Somerset Street

Figure 11. Intersection of Richmond St and Somerset St

The intersection of Richmond Street and Somerset Street is an unsignalized T-intersection. **Figure 11** shows a street view of the intersection from the northbound Richmond Street approach.

The northbound and southbound Richmond Street approaches consist of one shared through and turn lane. The eastbound Somerset Street approach has a single shared lane. There are sidewalks along every approach to the intersection. Crosswalks do not exist across any approach to the intersection, though some depressed curbs intended for pedestrians do exist for those crossing northbound Richmond Street.

Study Area - Richmond Street and Allegheny Avenue

Figure 12. Intersection of Richmond Street and Allegheny Avenue

The intersection of Richmond Street and Allegheny Avenue is a signalized four-leg intersection. The signal has a 90 second cycle, a pre-timed operation, and a three-phase timing plan. All of the left turns are permitted during the through movement phases. **Figure 12** shows an aerial view of the intersection.

The northbound and southbound approaches consist of one shared left-through-right lane. Both approaches of Richmond Street have an adjacent parking lane. The eastbound and westbound Allegheny Avenue approaches consist of an exclusive left turn lane and a shared through-right lane. Both approaches have an adjacent bicycle lane and adjacent parking lanes. Sidewalks and crosswalks exist along all approaches to the intersection.

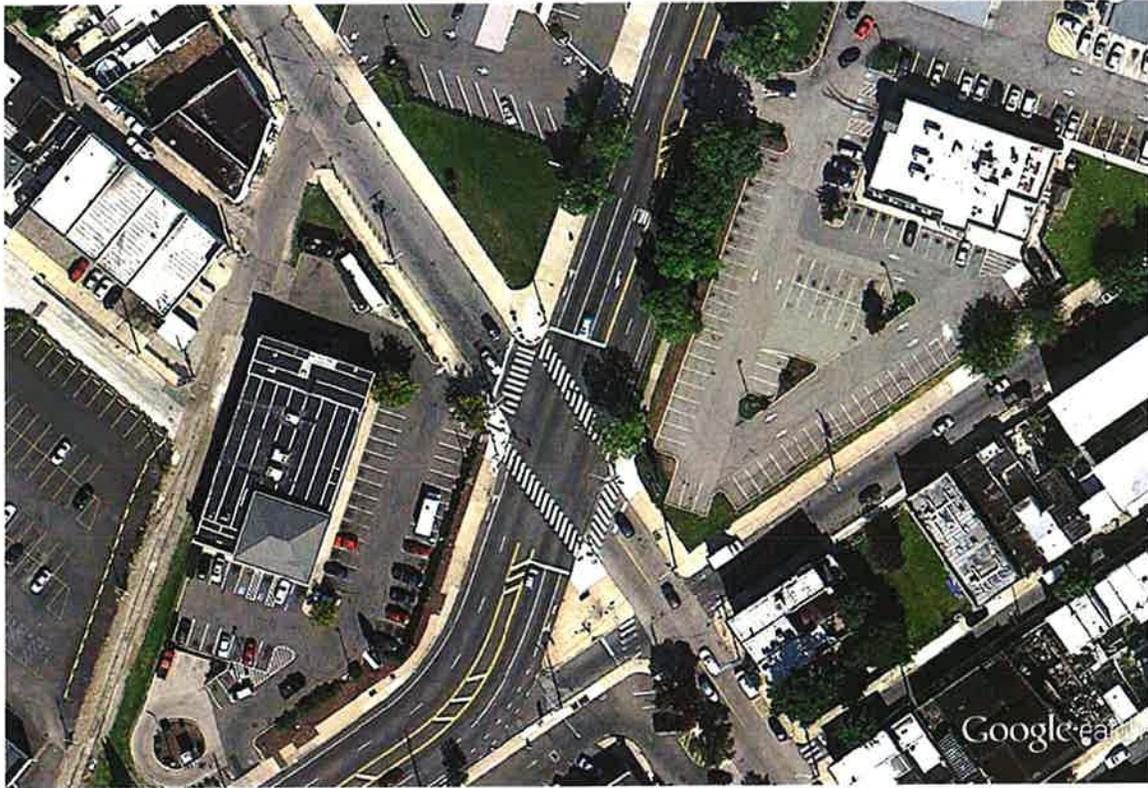
Study Area - Aramingo Avenue and Cumberland Street

Figure 13. Intersection of Aramingo Avenue and Cumberland Street

The intersection of Cumberland Street and Aramingo Avenue is a four-leg signalized intersection. The signal has three different cycle lengths, dependent on the day and time of day. The cycle length varies from 80 seconds to 120 seconds. The signal has a pre-timed operation and a two-phase timing plan. The southbound, eastbound, and westbound approaches have left turns permitted during the through movement phases. **Figure 13** shows an aerial view of the intersection.

The westbound Cumberland Street approach consists of a shared lane. The eastbound Cumberland Street approach is shared one-way, though at times motorists can be seen using the approach as a two-lane approach. The northbound Aramingo Avenue approach consists of a through lane and a shared through-right lane, with an adjacent bicycle lane. The southbound Aramingo Avenue approach consists of an exclusive left-turn lane and two through-lanes with an adjacent bicycle lane. Crosswalks exist along all legs of the intersection and pedestrian countdown timers operate coincident with the signals.

Study Area - Aramingo Avenue and York Street

Figure 14. Intersection of Aramingo Avenue and York Street

The intersection of Aramingo Avenue and York Street is a four-leg signalized intersection. The signal has a 90 second cycle, a pre-timed operation, and a four-phase timing plan. The westbound and northbound left turns are protected. The eastbound and southbound left turns are permitted during the through movement phases. **Figure 14** shows an aerial view of the intersection.

The northbound Aramingo Avenue approach consists of an exclusive left-turn lane, a through lane, and a shared through-right lane with an adjacent bicycle lane. The southbound Aramingo Avenue approach consists of an exclusive left-turn lane, through lane, and shared through-right lane with adjacent bicycle lane. The eastbound York Street approach consists of exclusive left-turn, through and right-turn lanes. The westbound shopping center driveway approach consists of an exclusive left-turn lane and through-right lane. All of the approaches to the intersection have crosswalks. When a pushbutton is activated, pedestrians are given an exclusive phase.

Study Area - Aramingo Avenue and I-95 SB Off-Ramp

Figure 15. Intersection of Aramingo Avenue and the I-95 SB Off-Ramps

The intersection of Aramingo Avenue and the I-95 southbound off-ramp near this project area is a signalized T-intersection. The signal has a 90 second cycle, an actuated-coordinated operation, and a two-phase timing plan. Each approach only has one allowed movement. **Figure 15** shows an aerial view of the intersection. The southbound Aramingo Avenue approach consists of two through lanes. The westbound off-ramp approach consists of two left-turn lanes. There are no sidewalks or crosswalks at this intersection.

IV. Infrastructure Projects

Infrastructure projects in the area will have a major impact on the site's accessibility and visibility, resulting in the minimization of impacts on the local neighborhoods. The project that will have the most significant impact is the on-going I-95 Girard Avenue Interchange construction project. **Figure 16** contains an image depicting a portion of the complete project, as well as its construction sections, in the area of the proposed casino site. The project has finished Section GR0 and is currently under construction for Sections GR1 and GR2. The upcoming Sections GR3 and GR4 will have the greatest impact on the proposed casino's accessibility from I-95. Section GR3 will essentially provide direct access to one of the site driveways for northbound traffic. Section GR4 will provide southbound traffic with easy access as well. The anticipated casino construction completion date is 2016, which is a year after the completion of Section GR3 and beginning of construction on Section GR4. Therefore, access to and from northbound I-95 will be greatly facilitated, with some construction left to complete easy access to southbound I-95. Upon completion of the Girard Avenue Interchange Project, traffic to and from I-95 will necessitate a minimal use of local roadways to access the proposed casino site. The following summarizes intersections at which major changes as a result of the construction will take place for the casino resort's opening year of 2016.

Delaware Avenue and Richmond Street

The intersection of Delaware Avenue and Richmond Street will remain as a signalized T-intersection, but will be realigned and relocated such that Delaware Avenue continues onto Richmond Street and entering onto Aramingo Avenue is the turning movement. The northbound Delaware Avenue approach will consist of two exclusive left-turn lanes and two through lanes. The southbound Richmond Street approach will consist of two through lanes and an exclusive right-turn lane. The eastbound Aramingo Avenue approach will be in interim construction, consisting of two exclusive right-turn lanes. The draft interim Signal Plan, as currently designed, is provided in **APPENDIX C**.

Richmond Street and Dyott Street

The intersection of Richmond Street and Dyott Street will remain an unsignalized T-intersection, but no left-turns will be possible from Dyott Street.

Richmond Street and Schirra Drive

Construction changes at this intersection will have the greatest impact on ease of access for the proposed casino. The Richmond Street and Schirra Drive intersection will become a signalized four-leg intersection. The major leg that is being added to the intersection includes on- and off- ramps for I-95 northbound. This eastbound ramp

approach will consist of one through-right lane and one through-left lane. The northbound Richmond Street approach will consist of two exclusive left-turn lanes, a through lane, and a through-right lane. The southbound Richmond Street approach will consist of an exclusive left-turn lane, three through lanes, and two exclusive right-turn lanes. The Schirra Drive approach will be signal controlled. The draft Signal Plan, as currently designed, is provided in **APPENDIX C**.

Richmond Street and Girard Avenue

The intersection of Richmond Street and Girard Avenue will remain as a signalized T-intersection, but widening of the roadway will allow for more lanes and different lane assignments. The northbound Richmond Street approach will remain the same. The southbound Richmond Street approach will consist of one through lane and one shared through-right lane. The eastbound Girard Avenue approach will consist of one exclusive left-turn lane and one exclusive right-turn lane. The trolley tracks and stops are being relocated to the outside lanes, and riders will now embark from the sidewalk instead of the median. This intersection is currently under construction and is anticipated to reopen in Fall 2013. The draft Signal Plan, as currently designed, is provided in **APPENDIX C**.

Aramingo Avenue and York Street

The intersection of Aramingo Avenue and York Street will remain as a four-leg signalized intersection. The main change is in the southbound Aramingo Avenue approach, where widening will allow for an exclusive left-turn lane, two through lanes, and one shared through-right lane.

Aramingo Avenue and I-95 SB Off-Ramp

The intersection of Delaware Avenue and the I-95 southbound off-ramp will remain as a signalized T-intersection. The southbound Aramingo Avenue approach will be widened to accommodate three lanes. One lane will exclusively proceed to the intersection of Aramingo Ave and Delaware Ave, one lane will exclusively proceed to I-95 southbound, and one lane will be shared to proceed to either destination.

V. Data Collection

A combination of manual turning movement counts (TMCs) and Miovision traffic collection cameras were employed to collect volume data at the following intersections:

- Delaware Avenue & Spring Garden Street
- Delaware Avenue & Frankford Avenue
- Delaware Avenue & Columbia Avenue
- Delaware Avenue & Montgomery Avenue
- Delaware Avenue & Richmond Street/Aramingo Avenue
- Richmond Street & Cumberland Street (unsignalized)
- Richmond Street & Lehigh Avenue
- Richmond Street & Somerset Avenue (unsignalized)
- Richmond Street & Allegheny Avenue
- Aramingo Avenue & Cumberland Street
- Aramingo Avenue & York Street
- Aramingo Avenue & I-95 SB Off-Ramp

One set of counts was performed at the intersections from 4:00 P.M. to 6:00 P.M. and 7:00 P.M. to 10:00 P.M. on Friday, April 26, 2013. Another set of counts was performed at the intersections from 7:00 P.M. to 10:00 P.M. on Saturday, April 27, 2013.

Turning movement counts were performed to develop baseline peak hour volume figures and determine traffic pattern characteristics. In addition to traffic count information, general observations of traffic operations during the counts were recorded along with field timings for the traffic signals. Turning movement counts can be found in **APPENDIX A** and field signal timings can be found in **APPENDIX C**.

VI. Existing Conditions

Due to the changing geometry in the study area, some of the key intersections where volumes will change due to the casino will not be completed until the casino has finished construction. Therefore, in order to be able to perform a direct comparison of with and without the Casino, the base existing traffic count data was redistributed using the geometry of the completed GR3 network.

Synchro reports listing the existing levels of service and delays, as well as queues are included in **APPENDIX B**. Existing signal timings and signal plans are included in **APPENDIX C**.

VII. Crash Analysis

Crash resumes for the period from January 2010 to December 2013 were obtained from the Pennsylvania Department of Transportation's CDART system and the City of Philadelphia for Delaware Avenue/Richmond Street (S.R. 2001), Aramingo Avenue (S.R. 2009), and Girard Avenue (S.R. 2008). Crash analysis was performed for the following intersections:

- Delaware Avenue/Richmond Street and Aramingo Avenue
- Richmond Street and Beach Street
- Richmond Street and Girard Avenue
- Richmond Street and Cumberland Street
- Cumberland Street and Aramingo Avenue
- Aramingo Avenue and York Street
- Aramingo Avenue and I-95 SB Off-Ramp

These intersections will likely have changed in traffic volumes, and/or patterns due to the proposed construction of the casino resort. The PennDOT and City of Philadelphia Crash Resumes and Homogenous Report are included in **APPENDIX D**.

A. Overall Crash Analysis

During this period, there were a total of 232 crash reports at these seven intersections. Of these crashes, 63 were reportable, involving property damage, an injury, or a fatality. There were a total of two fatalities at all of the intersections during this period, and both of them occurred in one accident at the intersection of Richmond Street and Cumberland Street. Details for this crash are summarized in **Table 1**.

Table 1: Fatal Crash Details

Date	Location	Type of Collision
4/10/2011	Richmond St and Cumberland St	Pedestrian

The crash description can be found in the crash resumes and reports that are included in **APPENDIX D**.

B. Intersection Crashes

The 63 reportable crashes that occurred in this time period were used for analysis in this report. The crashes are summarized in tables and shown in the

collision diagrams that are included in **APPENDIX D**. The collision diagrams show the approximate location of each of the crashes and provide a detailed chart of their characteristics. The diagram is not meant to suggest collisions were in the exact location shown, rather that similar collisions occurred in that area. Detailed analysis of the accident statistics is included in the table and charts included in this study. These included 21 crashes in 2010, 24 crashes in 2011, and 18 crashes in 2012. There were 58 total injuries and two fatalities reported as a result of the accidents. These included nine moderate, 21 minor, and 28 unknown severity injuries. There were seven pedestrian-related crashes and one crash that involved a bicyclist.

Delaware Avenue/Richmond Street and Aramingo Avenue

A total of 12 crashes occurred at this intersection during the three-year study period. There were eight injuries and no fatalities reported as a result of the crashes. There were 10 angle collisions, one same-direction sideswipe, and one opposite-direction sideswipe. Of the 11 crashes, six occurred during daylight hours and six occurred under street lighting. Out of the 11 crashes, 10 occurred on a dry roadway with clear weather conditions, one occurred on a wet roadway with clear weather conditions, and one occurred on a wet roadway while it was raining. The major contributing factor at this intersection is running the red light.

Richmond Street and N Beach Street

A total of one crash occurred at this intersection during the three-year study period. There were no injuries or fatalities reported as a result of the crash. The crash was an angle collision that occurred during daylight hours on a dry roadway with clear weather conditions. The major contributing factor at this intersection is unknown causes.

Richmond Street and Girard Avenue

A total of five crashes occurred at this intersection during the three-year study period. There were two injuries and no fatalities reported as a result of the accidents. There were two rear-end collisions, one angle collision, one collision involving a fixed object, and one collision involving a pedestrian. Of the five crashes, four occurred during daylight hours and one occurred under street lighting. Out of the five crashes, four occurred on a dry roadway with clear weather conditions and one occurred on a wet roadway while it was raining. The major contributing factor at this intersection is unknown causes.

Richmond Street and Cumberland Street

A total of three crashes occurred at this intersection during the three-year study period. There were two injuries and two fatalities reported as a result of the

crashes. There was one rear-end collision, one opposite-direction sideswipe collision and one collision involving pedestrians. Of the three accidents, two occurred under street lighting and one occurred during daylight hours. Out of the three crashes, two occurred on a wet roadway surface while it was raining and one occurred on a dry roadway with clear weather conditions. The major contributing factor at this intersection is unknown causes.

Aramingo Avenue and Cumberland Street

A total of 20 crashes occurred at this intersection during the three-year study period. There were 23 injuries and no fatalities reported as a result of the crashes. There were six angle collisions, five rear-end collisions, two same-direction sideswipe collisions, two head-on collisions, two collisions involving a pedestrian, two of unknown type, and one opposite direction sideswipe collision. The major contributing factor at this intersection is unknown causes.

Aramingo Avenue and York Street

A total of 20 crashes occurred at this intersection during the three-year study period. There were 20 injuries and no fatalities reported as a result of the crashes. There were seven rear-end collisions, seven angle collisions, three collisions involving a pedestrian, two head-on collisions, and one same-direction sideswipe collision. Of the 20 crashes, 14 occurred during daylight hours, three occurred under street lighting, two occurred during dawn/dusk lighting conditions, and one occurred while it was dark. Out of the 15 crashes, 14 occurred on a dry roadway with clear weather conditions, three occurred on a wet roadway while it was raining, two occurred on a wet roadway with clear weather conditions, and one occurred on unknown road conditions with clear weather conditions. The major contributing factor at this intersection is unknown causes.

Aramingo Avenue and I-95 SB Off-Ramps

A total of two crashes occurred at this intersection during the three-year study period. There was one injury and no fatalities reported as a result of the crashes. There was one rear-end collision and one same-direction sideswipe collision. Both crashes occurred during daylight hours. Both crashes occurred on a dry roadway with clear weather conditions. The major contributing factors at this intersection are unknown causes and running a stop signal.

C. Homogenous Report

From the homogenous report, included in **APPENDIX D**, for urban undivided roads with a total width between 41 and 99 feet and an ADT between 10,000 and 99,999, the state average crash rate is 2.25 accidents per million vehicle miles

with an intensity of 59.49. Delaware Avenue/Richmond Street and Aramingo Avenue were evaluated separately such that the crashes considered for Richmond Street were those at its intersection with Beach Street, Girard Avenue, and Cumberland Avenue. The remainder of the intersections were evaluated as Aramingo Avenue. **Table 2** summarizes the results.

Table 2: Crash Rates and Intensities for Richmond St and Aramingo Ave

Roadway	Accident Rate	Intensity
Richmond St	2.44	21.50
Aramingo Ave	1.79	46.27

The state average rate of fatalities per 100 million vehicle miles was calculated to be approximately 0.02. The Richmond Street section had one fatality over the three years of crash data collected, which yielded a rate of 8.78 fatalities per 100 million vehicle miles. While the crash rate and intensity for Aramingo Avenue are below the state average, the crash rate and fatality rate for the section of Richmond Street adjacent to the proposed casino resort construction is above the state average for urban undivided roads.

D. Cluster List

The PennDOT cluster list, included in **APPENDIX D**, identified a crash cluster along Richmond Street. The cluster is indicated to exist from Seg/Off 0140/0000 to Seg/Off 0170/0809. This section includes the intersections of Richmond Street with Beach Street, Girard Avenue, and Cumberland Street. The cluster list indicates that a significant number of crashes occur on wet roadways. This could indicate a need for drainage and roadway surface improvements. With the proposed I-95 Girard Avenue Interchange construction, both drainage and roadway surface improvements will be made.

VIII. Trip Generation and Distribution Projections

A. Trip Generation

Generally the Institute of Transportation Engineers (ITE) *Trip Generation* Informational Report is used to determine trip generation. However, there is a lack of available information related to trip generation of casinos in the report. To supplement this information, data from three existing casinos was used to develop a trip generation rate. Generally the casinos were in similar locations with similar amenities. The trip generation rate is based on the number of positions available in the casino, including an estimated six seats per gaming table. Restaurants and lounges were treated as casino patron services that wouldn't operate as their own entity, and therefore would not generate additional traffic. The night club in the casino is assumed to operate during off-peak hours of the adjacent streets and casino peak, with trips generated significantly lower than the peak casino trips, and therefore will not be accounted for in this analysis. The multi-purpose entertainment facility was considered to be similar to a conference center and would only affect the analysis during conferences, which are accounted for as meeting rooms in the hotel land use. The ITE *Trip Generation* report provides information on estimating the expected trip generation for hotels on weekdays based on number of rooms available.

1. Casino

The proposed casino was compared to three similar casinos in order to develop a rate for the number of vehicle trips that occur per position available at the casino. The number of positions was based on the number of slots and table games, with six seats per table game. It is anticipated that there will be 2,500 slot positions and 100 table games, with a total of 3,100 positions. **Table 3** summarizes the trip generation rates for three similar casinos for the Friday adjacent street peak (4 - 6 pm) and Saturday facility peak (7 - 10 pm).

Table 3. Trip Generation Based on Available Positions

	Friday Peak		Saturday Peak	
	In	Out	In	Out
Sugarhouse Casino, Philadelphia	0.22	0.21	0.25	0.30
Casino St. Charles, St. Louis	0.19	0.24	0.34	0.30
Parx Casino, Bensalem, PA	0.16	0.15	0.19	0.23
AVG	0.19	0.20	0.26	0.28

Turning movement count data was collected for Sugarhouse Casino in June 2012 and April 2013 from 4 - 6 pm on a Friday and April 2013 and May 2013 from 7 - 10 pm on a Saturday. Vehicular flow rates for Casino St. Charles were reported in the article *Gaming Casino Traffic* by Paul C. Box and William Bunte as published in the March 1998 ITE Journal. Turning movement count data was collected for Parx Casino in March 2013 from 4 - 9 pm on a Friday and 7 - 10 pm on a Saturday. The turning movement counts and ITE Journal report for developing the trip generation rates are provided in **APPENDIX E**.

Also included in the *Gaming Casino Traffic* report is a Monthly Variation table that shows the multipliers to expand a month's data to the seasonal peak data. **Table 4** is an excerpt from this table.

Table 4. Excerpt of Table 5 from Gaming Casino Traffic article

Month of Count	Percent of Average Month	Multiplier to Expand to Seasonal Peak
January.....	111%.....	1.1
February.....	90%.....	1.3
March.....	111%.....	1.1
April.....	108%.....	1.1
May.....	116%.....	1.0
June.....	108%.....	1.1
July.....	121%.....	1.0

As noted in the article, the trip generation rates given for St. Charles Casino had already been expanded to the summer peak months. The monthly multipliers were applied to the trip generation rates for Sugarhouse Casino and Parx Casino. Due to the Saturday data for Sugarhouse Casino being collected in the months of April and May, with multipliers of 1.1 and 1.0, respectively, an average multiplier of 1.05 was applied to the Saturday trip generation rates. **Table 5** summarizes the trip generation rates after the seasonal peak multiplier was applied.

Table 5. Trip Generation Adjusted for Seasonal Peak

	Friday Peak		Saturday Peak	
	In	Out	In	Out
Sugarhouse Casino, Philadelphia	0.24	0.23	0.26	0.32
Casino St. Charles, St. Louis	0.19	0.24	0.34	0.30
Parx Casino, Bensalem, PA	0.18	0.17	0.21	0.25
AVG	0.20	0.21	0.27	0.29

Utilizing the appropriate trip generation rate and the proposed 3,100 positions at the casino, the anticipated number of trips generated by the casino positions was calculated. **Table 6** shows the proposed vehicular trips generated for a Friday night peak between 4 and 6 pm and Saturday night between 7 and 10 pm.

Table 6: Vehicular Trip Generation for Friday 4-6pm and Saturday 7-10 pm

	Friday Peak 4-6 pm		Saturday Peak 7-10 pm	
	In	Out	In	Out
Wynn Resort				
Vehicular Trips	628	657	839	897

Analysis was also performed for the Friday PM facility peak hour from 7 - 10 pm. To determine trip generation rates for the Friday facility peak, automatic traffic recorder (ATR) data from Sugarhouse Casino was used to develop a percentage of the total daily traffic that occurred in the peak hour. It was calculated that 7.6% of the daily casino traffic was seen in the Friday PM facility peak hour. To determine a percentage of daily trips that occurred in the Friday adjacent street peak hour, Tables 4 and 5 in the *Executive Summary of the Interim Report of Findings* released by the Philadelphia Gaming Advisory Task Force were used to determine that about 5.4% of the daily casino trips were seen during the Friday PM adjacent street peak. The report is included in **APPENDIX F**. The total daily trips for the proposed casino was determined using the percentage of trips in the Friday PM adjacent street peak, and then 7.6% of the daily trips were allocated as trips occurring during the Friday PM facility peak hour. **Table 7** summarizes the total trips generated by the proposed casino construction.

Table 7. Vehicular Trips Generated Based on Number of Gaming Positions

	Friday Peak 4-6 pm		Friday Peak 7-10 pm		Saturday Peak 7-10 pm	
	In	Out	In	Out	In	Out
Wynn Resort						
Vehicular Trips	628	657	1078	882	839	897

2. Hotel

To determine the anticipated number of trips generated by the proposed hotel, the ITE *Trip Generation* Information Report was used. The hotel was designated as land use 310 (Hotel). **Table 8** summarizes the total trips generated by the hotel utilizing the respective rates given in the report.

Table 8. Trip Generation Based on Number of Hotel Rooms

	Friday PM Peak	Saturday PM Peak
TOTAL IN	108	124
TOTAL OUT	79	97

An additional consideration for trip generation for the proposed site is internal trip capture. For the purposes of this report it is assumed that 70% of hotel trips will be staying for the sole purpose of utilizing on-site facilities, such as the casino and restaurants, which are already accounted for in the casino trip generation calculation. The remaining 30% of the guests will utilize other hotel amenities or visit off-site attractions. It is likely that the percentage of Casino-related stays would be higher, but 70% was considered a conservative estimate. **Table 9** summarizes the total trips generated by the site, accounting for 70% of the hotel trips only staying for facility amenities.

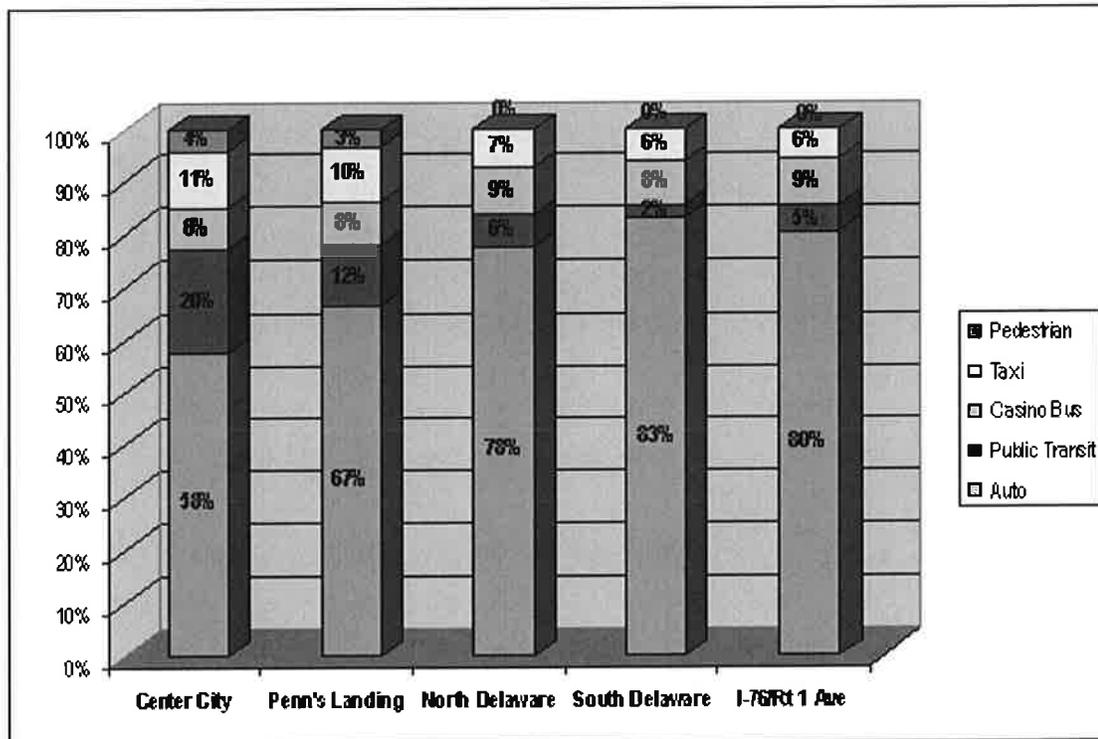
Table 9. Total Trip Generation Due to Site Development

	Friday Peak 4-6 pm		Friday Peak 7-10 pm		Saturday Peak 7-10 pm	
	In	Out	In	Out	In	Out
Wynn Resort						
Vehicular Trips	661	681	1111	906	876	926

B. Modal Distribution

The Philadelphia Gaming Advisory Task Force evaluated arrival modes for casino visitors based upon the casino's location within Philadelphia. **Table 10** is Graph 2 from the report, showing mode of arrival split variations between casino locations.

Table 10. Casino Visitors Mode of Arrival



While pedestrians were not expected to arrive on foot to a casino in North Delaware, the proposed construction of I-95 and the Girard Avenue Interchange will increase pedestrian attendance with a pedestrian trail and ample sidewalks with pedestrian crosswalk considerations. Using the Pennsylvania Department of Transportation's *Policies and Procedures for Transportation Impact Studies*, it is estimated that with pedestrian facilities on 91% to 95% of the roadways within 0.5 miles of the casino, 3% of casino visitors will come on foot. With two bus routes and one trolley route accessible at the intersection of Richmond Street and Cumberland Avenue for a minimum of 18 hours each, and an additional bus route within 0.20 miles of the casino site, the 6% of visitors using public transit was utilized for determining the total number of anticipated pedestrian trips.

Note that the trip generation rates were determined for vehicular trips, and due to the nature of hotels being locations at which visitors spend the night, the 2% pedestrian trips and 6% public transit trips will not impact the volume of vehicular trips. The number of trips determined by applying the trip generation rates was not reduced for pedestrian or transit users. Accommodations for pedestrians and public transit users is included in **Section XV**.

C. Trip Distribution

Typically, a gravity type model could be used for trip distribution. However, the Pennsylvania Gaming Control Board previously provided information and guidance on the percentage of anticipated trips to Sugarhouse Casino using I-95. Due to the proximity of Sugarhouse Casino to the proposed Wynn Casino, the dictated 85% of visitors using I-95 was accepted for this report. **Table 11** summarizes the arrival and departure trip distributions used for this analysis.

Table 11. Trip Distribution

From:	FRI 4 - 6 PM	All Other Times
I-95 SB	33%	38%
I-95 NB	37%	47%
Spring Garden St.	20%	10%
Girard Ave.	5%	3%
Richmond/Cumberland	5%	2%
	100%	100%

To:	FRI 4 - 6 PM	All Other Times
I-95 NB	38%	38%
I-95 SB	47%	47%
Spring Garden St.	10%	10%
Girard Ave.	3%	3%
Richmond/Cumberland	2%	2%
-	100%	100%

As shown in **Table 11**, there are slight differences in the arrival percentages for the Friday peak hour between 4 and 6 pm and the other two peaks. The increase in arrivals from the local city streets and decrease in those from I-95 is due to anticipated after-work trips. **Figure 17** shows the trip distribution for arriving traffic after the Girard Avenue Interchange is reconstructed. **Figure 18** shows the trip distribution for departing traffic after the Girard Avenue Interchange is reconstructed. **Figure 19** shows the internal site layout and the anticipated flow of traffic within the site.

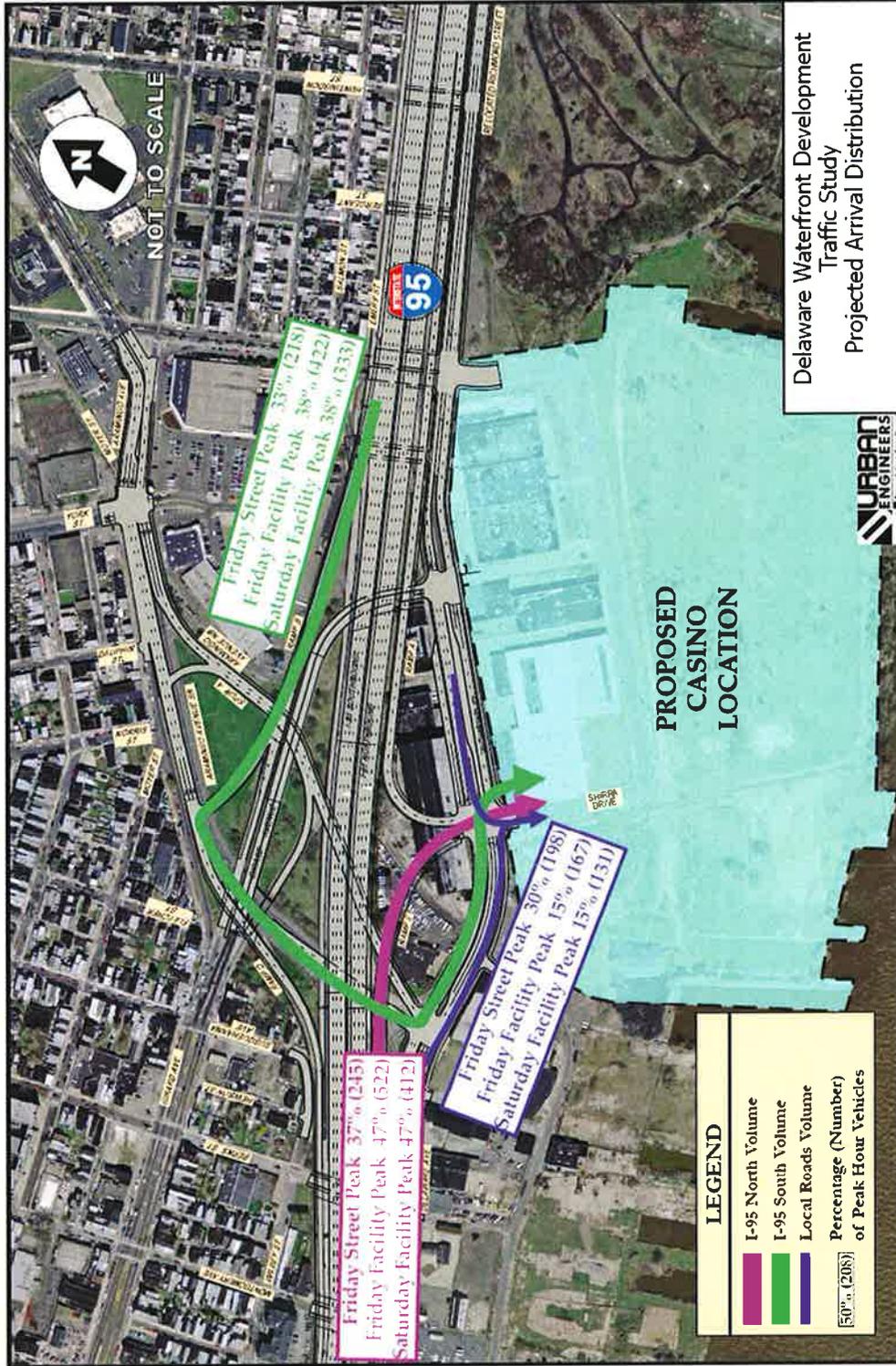


Figure 17. Arrival Distribution and Assignment, Friday and Saturday PM Peak

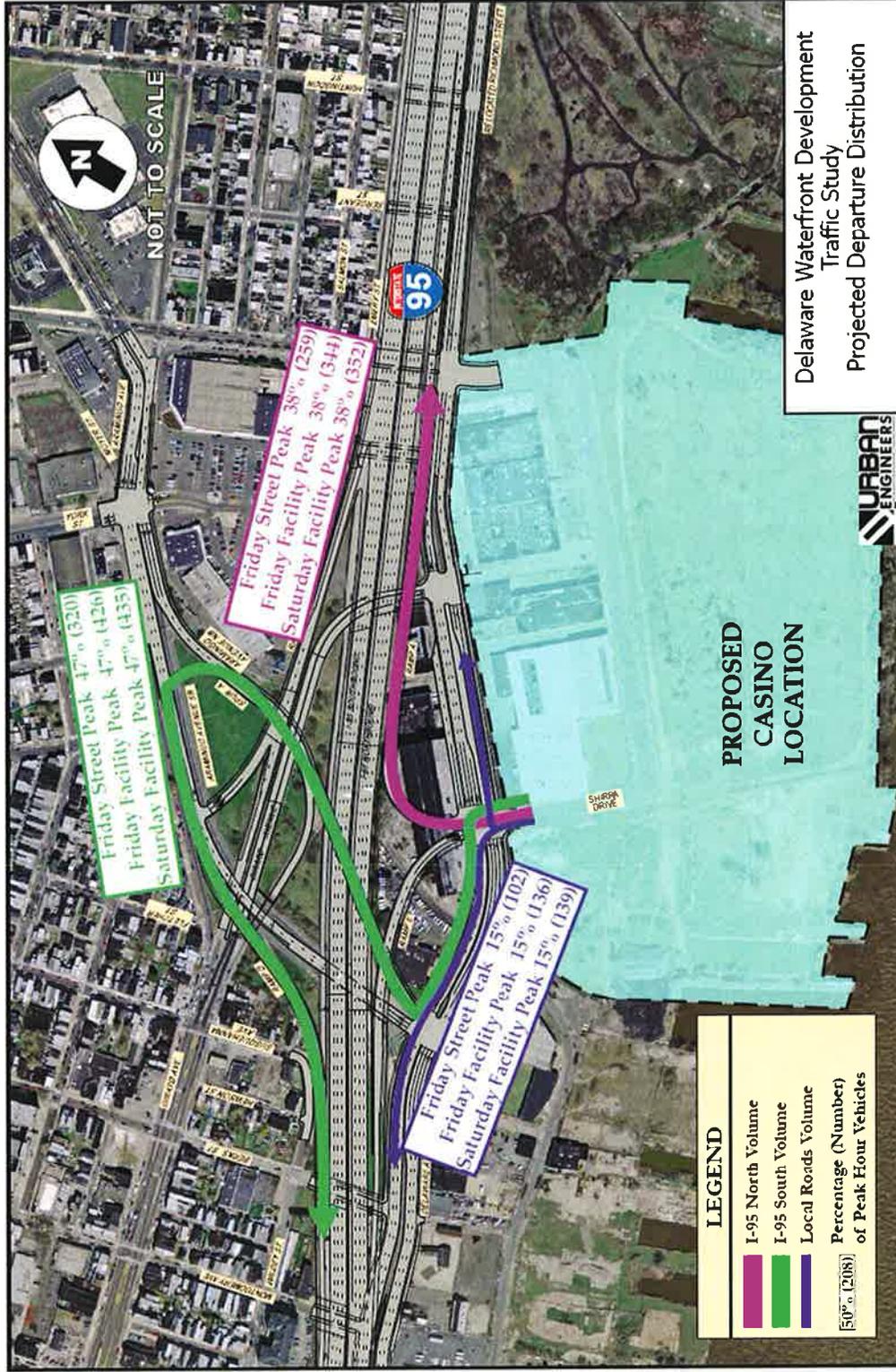


Figure 18. Departure Distribution and Assignment, Friday and Saturday PM Peak



Figure 19. Internal Site Layout

IX. Turning-Lane Warrant Analysis

A turn lane warrant analysis was carried out at the following study intersections for approaches that do not already have an existing or planned turn lane:

1. Richmond Street & Cumberland Street
2. Richmond Street & Girard Avenue
3. Richmond Street & I-95 NB Ramps

The turn lane warrant analysis includes a left-turn lane warrant and a right-turn lane warrant at the study intersections according to the procedure provided in the *PennDOT Traffic Engineering Manual (Pub. 46, Pg. 11-60 to Pg. 11-71)*. The graphs used to determine whether a turn lane is warranted are included in **APPENDIX G, Table 12, Table 13, and Table 14** summarize the turn lane warrant analysis results for the intersections of Richmond St and Cumberland St, Richmond St and Girard Ave, and Richmond St and the I-95 NB ramps, respectively.

Table 12. Richmond St & Cumberland St Turn Lane Warrant Summary

Scenario	Turn Lane Warranted?							
	NBL	NBR	SBL	SBR	EBL	EBR	WBL	WBR
Build 2016 Friday Street Peak	-	Yes	No	Yes	-	No	No	No
Build 2016 Friday Facility Peak Hour	-	No	No	No	-	No	No	No
Build 2016 Saturday Facility Peak Hour	-	No	No	No	-	No	No	No

Table 13. Richmond St & Girard Ave Turn Lane Warrant Summary

Scenario	Turn Lane Warranted?							
	NBL	NBR	SBL	SBR	EBL	EBR	WBL	WBR
Build 2016 Friday Street Peak	-	Yes	Yes	Yes	-	-	Yes	No
Build 2016 Friday Facility Peak Hour	-	Yes	No	No	-	-	Yes	No
Build 2016 Saturday Facility Peak Hour	-	Yes	No	No	-	-	Yes	No

Table 14. Richmond St & I-95 NB Ramps Turn Lane Warrant Summary

Scenario	Turn Lane Warranted?							
	NBL	NBR	SBL	SBR	EBL	EBR	WBL	WBR
Build 2016 Friday Street Peak	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Build 2016 Friday Facility Peak Hour	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Build 2016 Saturday Facility Peak Hour	Yes	Yes	No	Yes	Yes	Yes	Yes	No

X. Signal Warrant Analysis

A traffic signal warrant analysis was carried out at the intersection of Richmond Street and Cumberland Street for the projected year 2016 traffic volumes and the traffic volumes generated by the proposed development. The warrant analysis was carried out based on the *Pennsylvania Manual on Uniform Traffic Control Devices for Streets and Highways*. The details of the signal warrant analysis results are included in **APPENDIX H. Table 15** summarizes the signal warrant analysis results. A signal is not warranted at this time based on this information.

Table 15. Signal Warrant Analysis Results

Warrant	Result
1. Eight-Hour Vehicular Volume	Data not available
2. Four-Hour Vehicular Volume	Data not available
3. Peak Hour	Not Met
4. Pedestrian Volume	Data not available
5. School Crossing	Not Applicable
6. Coordinated Signal System	Not Met
7. Crash Experience	Not Met
8. Roadway Network	Not Applicable
9. Intersection Near a Grade Crossing	Not Applicable
PA-1. ADT Volume Warrant	Not Applicable
PA-2. Midblock and Trail Crossings	Not Applicable

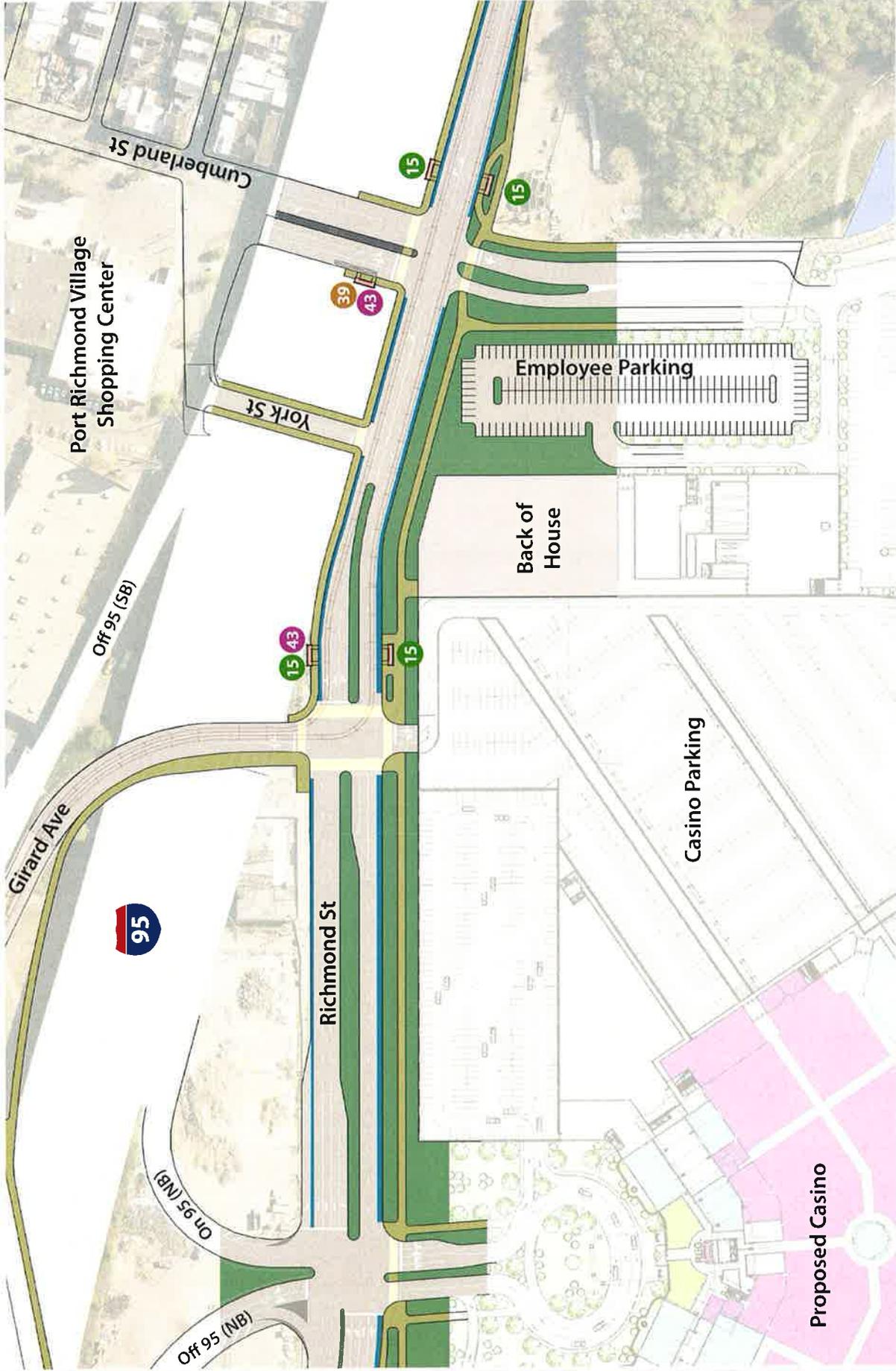
XI. Sight Distance Analysis

A sight distance analysis was performed for the three proposed driveways to the Wynn Development to determine the necessary distance needed to view conflicting traffic and safely perform turning movements. The three intersections on Richmond Street include driveways at Cumberland Street, Girard Avenue and Schirra Drive. The proposed lane configurations can be viewed in **Figure 20**. Analysis was conducted in accordance with the latest recommended methods as found in the 6th Edition of the AASHTO "A Policy on Geometric Design of Highways and Streets".

All three driveways are existing roadways providing access to several businesses. Currently, there are no sight distance concerns at any of the driveways. Under proposed conditions the required sight distance for a passenger vehicle are as follows:

- Richmond Street and Cumberland Street: ISD = 375 Feet
- Richmond Street and Girard Avenue: ISD = 355 Feet
- Richmond Street and Schirra Drive: ISD = 375 Feet

The current landscape provides adequate views of oncoming traffic along all approaches at the intersections. It is anticipated that traffic will be able to safely make turning maneuvers under proposed conditions.



	Sidewalks
	Bike Lanes
	Transit Shelters

**Figure 20 - Richmond Street
Proposed Configuration**

XII. Capacity Analysis

2010 Highway Capacity Manual (HCM) Level of Service (LOS):

Chapter 18 of the 2010 HCM describes a methodology for evaluation the capacity and quality of service provided to road users through a signalized intersection. It includes an array of performance measures that describe intersection operations for multiple travel modes. Chapter 19 presents concepts and procedures for analyzing intersections where one street – the major street – is uncontrolled, while the other streets – the minor streets – are controlled by STOP signs. **Table 16** provides the criteria of the HCM in determining the intersection LOS based on average vehicle delay.

Table 16. HCM Level of Service Criteria

Level of Service	Control Delay Per Vehicle (Seconds)	
	Signalized	Unsignalized
A	≤ 10	≤ 10
B	> 10 and ≤ 20	> 10 and ≤ 15
C	> 20 and ≤ 35	> 15 and ≤ 25
D	> 35 and ≤ 55	> 25 and ≤ 35
E	> 55 and ≤ 80	> 35 and ≤ 50
F	≥ 80	≥ 50

The 2010 HCM based software program **Synchro Version 8** was used to perform the capacity and queue analysis. Synchro is a macroscopic model that also has a Simulation component, SimTraffic. The simulation model can be helpful in further examining the study area intersection to identify any issues not otherwise shown in Synchro. The interaction between signalized intersections in a city environment is critical in performing a quality analysis, and thoroughly understanding the operations. This is particularly relevant when looking at queuing at signalized intersections. Each of the scenarios described in the following analysis section were examined using both models.

Capacity Analysis:

Due to the on-going construction in the study area, capacity analysis began with redistributing the existing traffic to the physical conditions anticipated in 2016. As a reference to guide the redistribution, the Delaware Valley Regional Planning Commission (DVRPC) report *I-95 Girard Avenue and I-676 Vine Expressway Interchanges, Section GIR Traffic Study* was utilized. These redistributed volumes were

then used to develop the 2016 no-build condition. To account for the on-going construction and continued developments in the area, a background growth rate of 1% per year was applied to the volumes.

For the design year of 2021, the report guided the redistribution, as well as provided volumes for comparison. The 2005 and 2025 volume diagrams for Option 7 in the DVRPC report were used to determine a reasonable estimate for anticipated volumes in 2021. Another DVRPC report, *I-95 Expressway Interchange Sections GIRVINE and AFC Traffic Study – Supplement Number 2*, was also used to compare volumes. This report provided volumes for 2030 in the Girard Avenue Interchange area as a result of the construction as well as a condominium development and full construction of the Sugarhouse and Foxwoods casinos. The 2030 DVRPC volumes were reduced by 1% per year to determine an estimate of volumes in 2021.

Both of the DVRPC values were compared to 2016 volumes grown out to 2021 at a rate of 1% per year. Generally, the DVRPC volumes for 2021 were lower or similar to the volumes determined by redistributing the turning movement count data collected in 2013. The movement for which the DVRPC volumes were higher than this study's 2021 volumes was for northbound Delaware Avenue to the I-95 northbound on-ramp. Comparisons of the 2005 volumes shown in the DVRPC report and actual 2013 volumes showed that the 2005 volumes were significantly higher than counted in 2012 and 2012, and therefore would produce higher volumes in the future than would actually be realized. In addition, the forecasts assumed that Foxwoods Casino and full buildout of Sugarhouse Casino would be complete. In the DVRPC report, this casino was shown to be approved for 5,000 slot machines and a 500-room hotel. This development would have been utilizing the northbound Delaware Avenue movement to access the Girard Avenue Interchange and using the trip generation rates developed earlier in this report, could account for up to 1,000 outbound trips in the Friday street peak hour. With the casino resort proposed for this project, these movements are occurring at the intersection instead of along Delaware Avenue, and would decrease the volumes using this movement. Therefore, the volumes in the DVRPC report were adjusted to enter the network at the proposed driveways, instead of northbound on Delaware Avenue.

APPENDIX J contains volume diagrams depicting the existing, future no-build, and future build traffic volumes.

A. 2016 No-Build

The 2016 no-build condition accounts for redistribution of the existing traffic volumes without development of the casino. This model serves as the base

condition for comparison with the build models that include the development of the casino. Major physical changes to the study area by 2016 include I-95 GIR construction through the GR3 phase, shown in **Figure 16**. Significant changes to existing conditions include the relocation of the I-95 northbound ramps and realignment of Delaware Avenue at its intersection with Aramingo Avenue. A notable design feature for GR3, is the inability for a driver to go from southbound I-95 to northbound Delaware Avenue/Richmond Street. Under current conditions, this would not be considered a significant travel pattern. The layouts of the proposed signals are included in **APPENDIX C**. Synchro analysis reports are included in **APPENDIX B**.

B. 2016 Build – No mitigation

Analysis for the 2016 build condition included adding trips generated by the construction of the casino. It was assumed that visitors coming from southbound I-95, 50% of vehicles would exit at Allegheny Avenue and proceed to Richmond Street to visit the casino. This is due to the lack of a left turn lane from the southbound Aramingo Avenue to northbound Richmond Street. It was also estimated that 30% would exit at the Girard Avenue Interchange, continue to Girard Avenue and access Delaware Avenue using Columbia Avenue. The remaining 20% of people would utilize other routes, such as Route 1, to get into Philadelphia and proceed on local roads to access the site. **Table 17** compares the no-build and build conditions during the Friday PM adjacent street peak for the driveway access intersections, as well as some key surrounding intersections. A table summarizing all of the intersections in the study area for all three peaks is included in **APPENDIX B**.

Compared to the 2016 no-build condition, the 2016 build condition without mitigation would result in lower levels of service for the following movements:

- Columbia Ave EB at its intersection with Delaware Ave
- Cumberland St WB at its intersection with Richmond St
- Allegheny Ave WB at its intersection with Allegheny Ave
- Casino Driveway EB & WB at the intersection with I-95 NB ramps
- Richmond St SB at its intersection with Girard Ave and Delaware Ave

Generally, it was noted that the volumes increased at each of these movements due to the casino visitor trips arriving from I-95 southbound. Due to the lack of a direct access from I-95 southbound to the casino, additional volumes cause more delay and a higher level of service on the local streets. While the Cumberland Street westbound approach is not accessed by visitors exiting I-95

southbound, the additional volumes from those using Richmond Street from I-95 southbound cause more delay at this approach due to the lower availability of gaps for vehicles to enter onto Richmond Street.

For the casino driveway approach adjacent to the I-95 northbound ramps, the signal timing proved to be the biggest problem in allowing visitors exiting the casino enough time to get through the signal. Existing volumes are essentially non-existent, so the addition of the casino trips requires more green time.

Table 17. LOS and Delay Summary – 2016 No-Build and Build Conditions

Intersection		2016		
		No-Build	Build No Mitigation	Build w/ Mitigation
Delaware Ave (N-S) & Columbia Ave (E-W)				
	NB	B(16)	B(19)	B(19)
	SB	B(11)	B(13)	A(10)
	EB	D(44)	E(57)	D(45)
	WB	C(22)	C(22)	C(22)
	Total	B(16)	C(21)	B(18)
Delaware Ave (N-SE) & Richmond St (W)				
	NB	D(36)	D(39)	C(32)
	SB	B(13)	C(29)	C(23)
	EB	D(51)	D(40)	C(21)
	Total	C(33)	D(36)	C(28)
Richmond St (N-S) & Cumberland St (E-W)				
	NBL	A(9)	A(9)	A(9)
	EB	C(18)	D(29)	C(22)
	WB	E(42)	F(221)	F(121)
Richmond St (N-S) & Allegheny Ave (E-W)				
	NB	C(35)	D(36)	D(36)
	SB	E(57)	E(62)	E(62)
	EB	C(22)	C(22)	C(22)
	WB	C(30)	E(64)	C(31)
	Total	C(33)	D(46)	C(35)
Aramingo Ave (N-S) & York St (E-W)				
	NB	C(32)	C(32)	C(33)
	SB	D(47)	D(52)	E(58)
	EB	F(84)	F(83)	E(59)
	WB	D(43)	D(43)	D(41)
	Total	D(45)	D(47)	D(46)
Richmond St (N-S) & I-95 NB Off-Ramp (W)				
	NB	C(32)	C(24)	C(29)
	SB	A(8)	B(11)	B(13)
	EB	C(24)	D(53)	C(32)
	WB	D(51)	F(133)	D(54)
	Total	C(22)	D(40)	C(28)
Richmond St (N-S) & Girard Ave (E)				
	NB	C(22)	C(25)	C(26)
	SB	C(32)	F(84)	C(34)
	EB	D(45)	D(44)	D(44)
	WB	-	C(29)	C(30)
	Total	C(34)	D(47)	C(34)

C. 2016 Build – With mitigation

The main purposes of the mitigation measures were to improve conditions at the impacted intersections. In order to mitigate the impacts of the trips generated by the casino, signal timing changes were made at the following intersections:

- Delaware Avenue & Aramingo Avenue
- Delaware Avenue & I-95 NB Ramps
- Delaware Avenue & Girard Avenue
- Aramingo Avenue & York Street
- Aramingo Avenue & I-95 SB off-ramp

The signal timings used to mitigate conditions at the driveway intersections are in the Synchro reports, which are included in **APPENDIX B**.

Another major concern was to improve access for those coming from I-95 southbound to reduce the impact on the local streets. In order to improve access here it was proposed that the Aramingo Avenue approach at the Aramingo Avenue and Delaware Avenue intersection be modified. Currently the proposed condition for 2016 has two exclusive right-turn lanes from Aramingo Avenue onto Delaware Avenue. It is recommended that one of these lanes be converted into an exclusive left-turn lane, with the remaining right-turn lane proceeding onto Delaware Avenue as a free movement onto an added lane, as shown in **Figure 21**. Also shown in the figure is another recommended modification to accommodate the increased volumes, which is to add a second right-turn lane from Delaware Avenue onto Aramingo Avenue. This move mitigates the increase in delay seen in the 2016 build without mitigation model.

The results of these proposed mitigation measures for the Friday PM adjacent street peak are summarized in **Table 17**. A table summarizing all of the intersections in the study area for all three peaks is included in **APPENDIX B**.

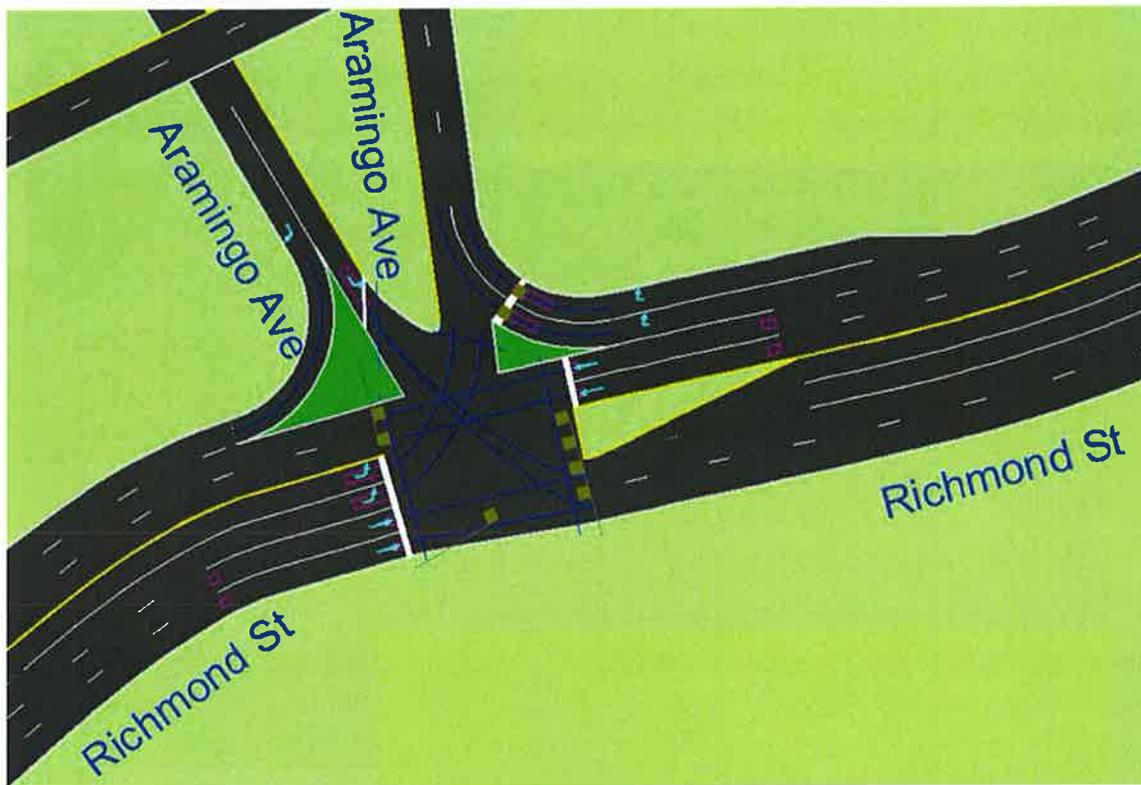


Figure 21. 2016 Proposed Aramingo Ave and Richmond St Configuration

D. 2021 No-Build

The horizon year analysis of 2021 anticipates that the I-95 Girard Avenue Interchange project will be completed through GR4, as shown in **Figure 16**. This construction would provide an exclusive left-turn lane on the Aramingo Avenue approach at the intersection of Delaware Avenue and Aramingo Avenue (*also a suggested mitigation measure for 2016 opening year*). The construction will also include lane additions along Aramingo Avenue and the relocation of the I-95 SB on-ramp. Due to the additional construction in the area and potential for developments, volumes for the 2021 no-build model reflect a 1% increase per year growth rate from the 2016 no-build model. **Table 18** summarizes the Level of Service and delay that is anticipated.

Table 18. LOS and Delay Summary – 2021 No-Build and Build Conditions

Intersection	2021	
	No-Build	Build
Delaware Ave (N-S) & Columbia Ave (E-W)		
NB	B(17)	C(21)
SB	B(12)	B(15)
EB	D(45)	D(46)
WB	C(23)	C(23)
Total	B(18)	C(21)
Delaware Ave (N-SE) & Richmond St (W)		
NB	C(27)	C(34)
SB	B(11)	B(18)
EB	C(25)	C(27)
Total	C(22)	C(28)
Richmond St (N-S) & Cumberland St (E-W)		
NBL	A(9)	A(9)
EB	C(21)	D(28)
WB	F(56)	F(195)
Richmond St (N-S) & Allegheny Ave (E-W)		
NB	D(37)	C(29)
SB	E(75)	D(38)
EB	C(22)	C(27)
WB	C(31)	D(47)
Total	D(37)	D(36)
Aramingo Ave (N-S) & York St (E-W)		
NB	D(36)	C(35)
SB	C(34)	D(41)
EB	F(93)	E(56)
WB	D(44)	D(38)
Total	D(43)	D(40)
Richmond St (N-S) & I-95 NB Off-Ramp (W)		
NB	D(36)	D(36)
SB	A(8)	B(14)
EB	C(24)	C(31)
WB	D(51)	D(54)
Total	C(24)	C(30)
Richmond St (N-S) & Girard Ave (E)		
NB	C(23)	C(28)
SB	C(33)	C(34)
EB	D(51)	D(55)
WB	-	C(26)
Total	D(36)	D(38)

E. 2021 Build

The 2021 build condition model includes volumes generated by casino construction. Generally, the timings were maintained from the 2016 build conditions model. **Table 18** summarizes the level of service and delay for the driveway intersections and some adjacent intersections. Generally the levels of service and delays were maintained within the 2021 no-build level of service or did not increase the delay by more than 10 seconds.

An important observation to note is implementation of a 120-second cycle along Delaware Avenue up to the I-95 northbound ramps. At times this increases the delay for vehicles on low-volume movements and yields a lower LOS and delay due to the signal completing its cycle rather than due to queues.

One intersection that may require additional examination based on the Synchro models is Richmond Street and Cumberland Avenue (the employee entrance/exit). While this intersection did not meet volume based signal warrants to justify implementation of a traffic signal, analysis for a traffic signal was performed due to the significant delay experienced by those exiting the casino employee driveway. Analysis was only performed for the 2021 build condition and the results are summarized in **Table 19**. Compared to any of the no-build or build conditions, the LOS and delay for both eastbound and westbound traffic is significantly better, while maintaining a LOS A for Richmond Street. Future coordination and approval by PennDOT will be required to pursue implementation of a traffic signal at this intersection. A signal at this location, would also provide an additional controlled crossing for pedestrians.

Table 19. LOS and Delay Summary – Richmond St and Cumberland St

Richmond St (N-S) & Cumberland St (E-W)	Build 2021
NB	A(8)
SB	A(8)
EB	C(21)
WB	B(18)
Intersection	A(9)

southbound and the proposed casino. The increase in queue for this direction is less than two car lengths in each of the other comparisons, indicating that the provision for a left-turn lane from Aramingo Ave onto Delaware Ave mitigates this queue.

Queue increases of more than two car lengths, but less than three, are also seen at the Delaware Ave northbound approach, most likely due to the application of the growth rate to existing traffic volumes.

Table 21. Queue Results Summary – Delaware Ave and Columbia Ave

Lane	2016 No-Build		2016 Build - no mitigation		2016 Build - mitigation		2021 No-Build		2021 Build	
	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile
EBT	154	245	221	# 372	162	255	163	257	170	266
WBT	27	67	27	66	27	67	29	69	29	69
NBT	464	192	522	218	522	218	505	190	561	215
SBL	0	m 57	21	m 55	10	# 73	10	69	25	# 89
SBT	82	98	102	119	84	106	70	100	115	141

Delaware Ave & Montgomery Ave

Table 22 shows a summary of the queue results at the intersection of Delaware Avenue and Columbia Avenue. There was no significant increase in queues at this intersection.

Table 22. Queue Results Summary – Delaware Ave and Montgomery Ave

Lane	2016 No-Build		2016 Build - no mitigation		2016 Build - mitigation		2021 No-Build		2021 Build	
	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile
EBR	*	9	*	10	*	10	*	8	*	9
NBT										
SBT										

Delaware Ave & Aramingo Ave

In general, the queues at the intersection of Delaware Avenue and Aramingo Avenue increase. **Table 23** shows a summary of the queue results at this intersection. Significant increases are seen on Aramingo Ave during the build conditions, likely due to the significant increase in traffic volumes at this approach. Longer queues are also seen along northbound and southbound Delaware Avenue. The combination of increased volumes due to casino visitors as well as the need to allocate additional time to the Aramingo Ave movement results in queue increases of approximately 10 car lengths. Synchro reports also indicate that queues for the Delaware Avenue southbound right and northbound lefts exceed the storage length of the leftmost left turn lane, but the turning movements do not extend beyond the rightmost storage bay.

becomes a shared thru-left lane in the build conditions, so comparisons between these lanes were made and indicated no significant increase in queues. The most significant queue change is in the southbound through movement between the 2016 no-build and 2016 build without mitigation. This increase results from casino visitors utilizing the Allegheny Ave exit from I-95 southbound to access Richmond St. In the mitigated conditions, this queue is reduced to within one car length of 2016 no-build condition queues.

Another significant increase in queues is seen to occur in the Richmond St northbound through lane, but this queue does not increase more than 75 feet, or approximately the length of three cars, in either comparison.

Table 25. Queue Results Summary – Richmond St and Girard Ave

Lane	2016 No-Build		2016 Build - no mitigation		2016 Build - mitigation		2021 No-Build		2021 Build	
	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile
EBL	45	81					46	82		
EBT			58	191	59	104			60	106
EBR	386	# 634	191	362	180	349	217	# 479	224	# 487
WBL			79	137	79	137			78	136
WBT			3	12	3	21			3	21
NBL	15	36	18	41	18	41	15	37	15	37
NBT	165	220	193	254	208	274	190	251	235	307
SBT	130	183	277	# 393	141	197	190	237	146	204

Richmond St & Cumberland St

Table 26 shows a summary of the queue results at the intersection of Richmond Street and Cumberland Street. Queues for the side streets do not exceed 100 feet, or approximately four cars, in any of the comparisons.

Table 26. Queue Results Summary – Richmond St and Cumberland St

Lane	2016 No-Build		2016 Build - no mitigation		2016 Build - mitigation		2021 No-Build		2021 Build	
	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile
EBL	*	19	*	35	*	27	*	24	*	38
EBT	*	37	*	88	*	47	*	44	*	61
WBT	*	23	*	97	*	73	*	31	*	91
NBL	*	8	*	11	*	11	*	9	*	14
NBT										
SBL			*	10	*	1				
SBT										

Richmond St & Lehigh Ave

Table 27 shows a summary of the queue results at the intersection of Richmond Street and Lehigh Avenue. There were no significant increases in queues at this intersection for either comparison.

Table 27. Queue Results Summary – Richmond St and Lehigh Ave

Lane	2016 No-Build		2016 Build - no mitigation		2016 Build - mitigation		2021 No-Build		2021 Build	
	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile
EBL	17	41	17	41	17	41	17	42	17	42
EBR	0	28	0	28	0	28	0	28	0	28
NBL	18	42	19	48	18	43	18	44	19	45
NBT	188	314	193	323	193	323	219 #	436	225 #	445
SBT	123	198	122	210	84	149	129	208	139	232

Richmond St & Somerset St

Table 28 shows a summary of the queue results at the intersection of Richmond Street and Somerset Street. There were no significant increases in queues at this intersection for either comparison.

Table 28. Queue Results Summary – Richmond St and Somerset St

Lane	2016 No-Build		2016 Build - no mitigation		2016 Build - mitigation		2021 No-Build		2021 Build	
	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile
NBT	*	7	*	8	*	7	*	7	*	7
SBT										
EBT	*	12	*	14	*	12	*	13	*	13

Richmond St & Allegheny Ave

Table 29 shows a summary of the queue results at the intersection of Richmond Street and Allegheny Avenue. The only direction in which significant changes in queues occurred was in the Allegheny Ave westbound left turn lane. The comparison in which the queues increased the most was between the 2016 no-build and 2016 build without mitigation. The significant increase in the queue for this movement is due to casino visitors utilizing the Allegheny Ave exit off of I-95 southbound to access Richmond St, and then the casino. This queue is reduced once mitigation occurs and does not increase more than 75 feet in any of the comparisons.

Generally in the Synchro results there are indications that the Allegheny Ave westbound left and Richmond Ave northbound and southbound approaches have queues that exceed capacity. The queues do not increase by more than 50 feet, other than noted

above. SimTraffic was also used to check queuing and spillback. Queuing issues were observed, but not in excess of existing queuing observed in the field during data collection efforts.

Table 29. Queue Results Summary – Richmond St and Allegheny Ave

Lane	2016 No-Build		2016 Build - no mitigation		2016 Build - mitigation		2021 No-Build		2021 Build	
	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile
EBL	31	68	31	68	31	68	32	71	36	80
EBT	160	245	160	245	160	245	166	254	181	277
WBL	116 #	250	~ 254	# 428	126 #	270	123 #	264	~ 157	# 318
WBT	175	267	175	267	175	267	181	276	198	301
NBT	343 #	564	351 #	577	351 #	577	360 #	591	335 #	552
SBL	57 #	143	57 #	144	57 #	144	60 #	151	53	117
SBT	56	100	59	105	59	105	57	103	55	98

Aramingo Ave & I-95 SB Off-Ramp

Table 30 shows a summary of the queue results at the intersection of Aramingo Avenue and the I-95 southbound off-ramp. The increases in queue lengths for any approach did not exceed 125 feet, or approximately five car lengths. In the 2016 conditions, Synchro reports indicated that the queue was being metered by the upstream signal of Aramingo Ave and York St. This was observed in the field, with York St having an exclusive pedestrian phase that was called almost every cycle. With I-95 Girard Avenue Interchange construction project improvements and signal timing modifications in the 2021 conditions, the queue is not metered and does not increase more than 100 feet between 2021 no-build and build conditions. Note that in 2021 the I-95 southbound on-ramp entrance will be relocated to the intersection and an additional lane will be available for those on Aramingo Ave making a right onto the ramp.

Table 30. Queue Results Summary – Aramingo Ave and I-95 SB Off-Ramp

Lane	2016 No-Build		2016 Build - no mitigation		2016 Build - mitigation		2021 No-Build		2021 Build	
	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile
WBL	75	106	91	127	153	202	95	153	157	242
SET	437	532	74	m 108	437	m 492	210	283	260	339
SER							292	442	424	570

Aramingo Ave & York St

Table 31 shows a summary of the queue results at the intersection of Aramingo Avenue and York Street. Only the comparison between the 2021 no-build and 2021 build conditions indicates an increase in queue for the southbound Aramingo Ave approach of more than 50 feet. Overall, Synchro results indicate all of the northbound and

southbound movements exceed capacity. SimTraffic was used to check queuing and spillback. Queuing issues were observed, but not in excess of queues currently existing in the field. The Aramingo Ave northbound left turn lane, southbound left turn lane, and York St eastbound and westbound left turn lanes exceed capacity in the field and impact through movements. With some signal timing adjustments queues were maintained within reason or decreased and overall delays were decreased.

Table 31. Queue Results Summary – Aramingo Ave and York St

Lane	2016 No-Build		2016 Build - no mitigation		2016 Build - mitigation		2021 No-Build		2021 Build	
	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile
EBL	~ 91	# 200	~ 90	# 198	~ 74	# 183	~ 98	# 209	73	# 187
EBT	63	# 151	63	# 151	62	# 127	67	# 161	64	120
EBR	56	# 134	56	# 134	53	90	60	# 149	53	88
WBL	42	84	42	84	41	83	44	87	42	83
WBT	94	162	94	162	92	159	99	169	95	161
NBL	~ 129	# 279	~ 128	# 278	~ 130	# 280	~ 144	# 297	~ 138	# 290
NBT	327	# 460	327	# 461	333	# 473	351	# 496	~ 404	# 533
SBL	28	# 93	28	# 95	29	# 98	30	# 104	~ 37	# 114
SBT	~ 465	# 591	~ 497	# 624	~ 509	# 636	~ 279	# 368	~ 351	# 440

Aramingo Ave & Cumberland St

Table 32 shows a summary of the queue results at the intersection of Aramingo Avenue and Cumberland Street. The queues for any comparison do not increase more than 100 feet, or approximately four car lengths. There is a Synchro indication that the southbound Aramingo Ave left onto Cumberland St exceeds capacity in the 2016 build without mitigation condition. It becomes apparent that this is due to the casino visitors rerouting to other roads due to the lack of easy access to the casino site from I-95 southbound. This capacity deficiency is mitigated in the 2016 build with mitigation condition due to the addition of a left-turn lane on Aramingo Ave at its intersection with Delaware Ave. The Synchro indication that the turn lane exceeds capacity does not reappear for the 2021 conditions.

Table 32. Queue Results Summary – Aramingo Ave and Cumberland St

Lane	2016 No-Build		2016 Build - no mitigation		2016 Build - mitigation		2021 No-Build		2021 Build	
	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile	50th Percentile	95th Percentile
EBT	127	198	125	190	131	202	134	207	139	214
EBR	0	34	0	34	0	34	3	37	3	37
WBT	72	136	4	m 25	126	209	77	145	125	217
SEL	47	103	85	# 205	50	111	50	116	54	126
SET	253	315	253	315	253	315	271	336	271	336
NWT	242	m 302	243	302	243	302	258	321	258	321

XIV. Multi-Modal Facilities

A. Existing Conditions

Pedestrian and Bicycle Facilities:

There are various ongoing projects that are connecting the streets and neighborhoods to the Delaware River Waterfront via pedestrian trails, and bike paths. **Figure 22** shows the existing and planned circulation for pedestrian and bicycles along the waterfront. In addition, pedestrian observations were performed at study area intersections during the data collection phase of the projects documenting activity during the counts. **Table 33** provides a summary of locations with observed pedestrian activity, and identification of pedestrian facilities. Some of the study area intersections are not in a developed area, or not attractive to pedestrians under existing conditions. With the addition of the trails, and some other waterfront developments, it is anticipated that pedestrian activity will increase. Many of the signalized intersections in the study area have updated pedestrian ramps, as well as pedestrian signal heads and crosswalks.

Table 33. Pedestrian Activity at Study Area Intersections

Intersection	Pedestrian Activity?	Pedestrian Facilities?
N. Delaware Avenue and E. Columbia Avenue	All directions	Yes
N. Delaware Avenue and E. Montgomery Avenue (Unsignalized)	Crossing side street	No
N. Delaware Avenue and Richmond Street/Aramingo Avenue	Minimal	No
Richmond Street and I-95 NB Off ramps/Casino Driveway	N/A (not existing condition)	N/A
Richmond Street and E. Girard Avenue	N/A (Closed for construction)	N/A
Richmond Street and E. Cumberland Street	Yes	No
Richmond Street and E. Lehigh Avenue	Yes	Yes
Richmond Street and E. Somerset Street (Unsignalized)	Yes	No
Richmond Street and E. Allegheny Avenue	Yes	Yes
Aramingo Avenue and E. York Street	Yes	Yes
Aramingo Avenue and E. Cumberland Street	Yes	Yes
Aramingo Avenue and I-95 on/off ramp	Minimal	No

Transit Facilities:

This area is usually well served by several SEPTA bus routes, as well as the Girard Avenue Trolley (#15). Due to the adjacent interchange construction, the trolley has been temporarily move to Frankford Avenue but is expected to be back in fall of 2013. **Figure 23** shows both the bus and trolley routes that are currently providing service this area.



	Existing Paths
	Proposed Paths

**Figure 22 -
Bicycle and Pedestrian Circulation**



● SEPTA Stops
 —●— SEPTA Routes

**Figure 23 -
 SEPTA Transit Routes**

B. Proposed Facilities

Although significant pedestrian activity related to the Casino is not anticipated, pedestrian facilities are being included as part of the design of the entrances to the Casino. Sidewalks will be provided along the south side of Richmond Street in front of the property. These will run the length of the property tying into existing (or planned) facilities on either end.

There are three planned entrances from Richmond Street into the Casino property. The main entrance/exit, which will be at a signalized intersection, opposite the I-95 northbound off ramps will not have pedestrian activity allowed on the north side of Richmond street (adjacent to the ramps), and pedestrians will be prohibited from crossing Richmond Street at this location. **Figure 24** shows the multi-modal facilities planned at the main entrance to the casino facility.

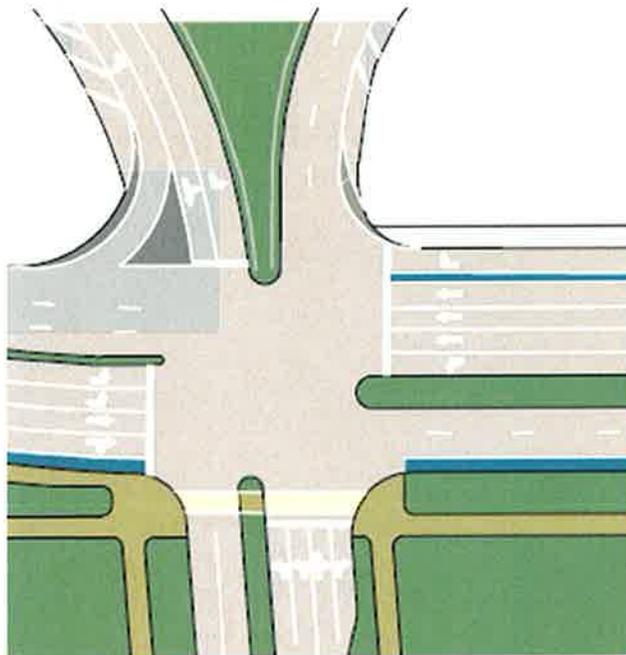


Figure 24. Multi-Modal Facilities at Main Entrance

An employee entrance is planned to be located opposite Cumberland Street, and will be signed as an employee and delivery only entrance. This intersection is not planned to be signalized at this time, based on the anticipated traffic volumes. Bus stops and trolley stops will be located on Richmond Street, and on Cumberland Street. **Figure 25** shows the multi-modal facilities planned at the employee and delivery-only entrance.

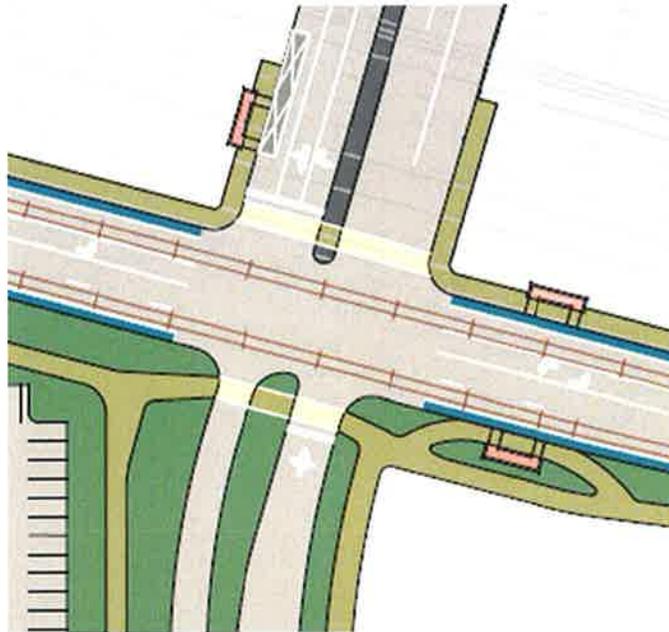


Figure 25. Multi-Modal Facilities at Employee Entrance

The garage entrance/exit will be at a signalized intersection opposite Girard Avenue. It is anticipated that this location will be the primary crossing point for pedestrians going to and from the Casino. It is a location for the Girard Avenue trolley stops, multiple SEPTA bus stops, as well as the connecting sidewalk to the nearby Frankford Avenue trail. **Figure 26** shows the multi-modal facilities planned at the casino garage entrance.

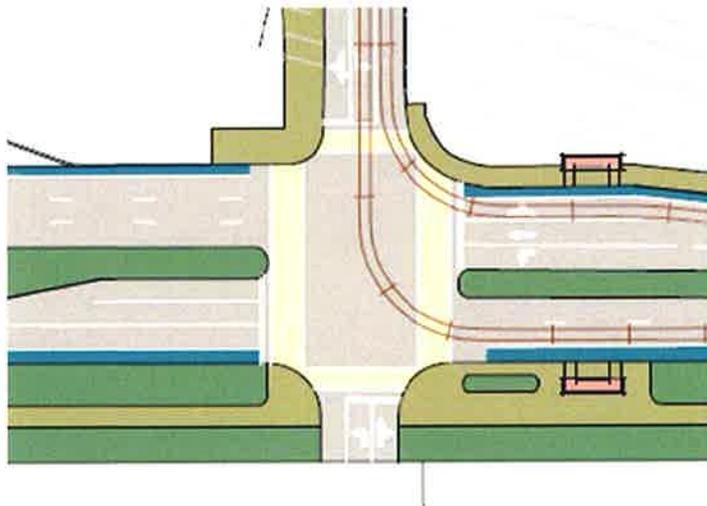


Figure 26. Multi-Modal Facilities at Garage Entrance

As requested, a pedestrian capacity analysis based on the 2010 Highway Capacity Manual was performed for the intersection of Richmond Street and Girard Avenue. There may be pedestrian activity at other locations as the project moves forward, however this was considered to be the best example, with the highest potential for pedestrian traffic. Pedestrian volumes projected in the DVRPC report "*I-95 Expressway Interchanges Sections GIR/VINE and AFC Traffic Study – Supplement Number 2*" were used for the analysis. Traffic volumes and intersection configuration for the 2016 Friday peak scenario were used as the basis for the analysis.

Analysis of pedestrian movements is relatively new, and the methodology is still evolving. The evaluation takes into account the "level of comfort" for the pedestrians, and their likelihood of compliance with the traffic signals. This is based on information including the width of the sidewalks, and crosswalks; the number of vehicles on the streets and number of turning vehicles; as well as the speeds.

The analysis results, provided in **Table 34** and **Appendix B** indicate that acceptable levels of service for the pedestrians could be anticipated for the proposed conditions, however the likelihood for compliance with the signal is anticipated to be "poor". Compliance is based on the delay experienced by pedestrians.

Table 34. 2010 HCM Pedestrian Capacity Analysis

HCM 2010 Signals-Pedestrians 5: Richmond St & Girard Ave

Approach	EB	WB	NB	SB
Crosswalk Length (ft)	44.9	48.3	72.5	60.3
Crosswalk Width (ft)	12.0	12.0	12.0	12.0
Total Number of Lanes Crossed	3	4	5	5
Number of Right-Turn Islands	0	0	0	0
Type of Control	Pretimed	Pretimed	Pretimed	Pretimed
Corresponding Signal Phase	6	2	4	8
Effective Walk Time (s)	20.0	20.0	20.0	20.0
Right Corner Size A (ft)	14.0	10.0	10.0	10.0
Right Corner Size B (ft)	10.0	10.0	10.0	10.0
Right Corner Curb Radius (ft)	10.0	10.0	10.0	10.0
Right Corner Total Area (sq.ft)	118.50	78.50	78.50	78.50
Ped. Left-Right Flow Rate (p/h)	27	26	17	6
Ped. Right-Left Flow Rate (p/h)	26	27	16	7
Ped. R. Sidewalk Flow Rate (p/h)	8	8	8	8
Veh. Perm. L. Flow in Walk (v/h)	49	22	212	137
Veh. Perm. R. Flow in Walk (v/h)	110	98	692	35
Veh. RTOR Flow in Walk (v/h)	11	10	69	3
85th percentile speed (mph)	30	35	35	35
Right Corner Area per Ped (sq.ft)	1110.7	931.5	728.3	930.8
Right Corner Quality of Service	A	A	A	A
Ped. Circulation Area (sq.ft)	254.2	281.2	97.2	1158.7
Crosswalk Circulation Code	A	A	A	A
Pedestrian Delay (s/p)	41.7	41.7	41.7	41.7
Pedestrian Compliance Code	Poor	Poor	Poor	Poor
Pedestrian Crosswalk Score	2.38	2.30	3.24	2.86
Pedestrian Crosswalk LOS	B	B	C	C

XV. Summary and Conclusions

The anticipated trips generated by the construction of a casino resort along the Delaware River waterfront adjacent to the I-95 Girard Avenue Interchange is not anticipated to have significant effects on the traffic signals and roadways in the area.

Using trip generation factors determined from the data of similar casinos in similar locations, the highest number of trips anticipated to be generated by the casino were approximately 2,000 in the Friday facility peak hour. These trips, added to the existing traffic in the local network required signal retiming and offset optimization to mitigate most of the effects caused by the addition of those vehicles.

In order to provide for motorists coming from I-95 southbound to access the site, the GR3 configuration of the intersection at Aramingo Ave and Delaware Ave intersection is recommended to be adjusted to reassign one of the southbound right turn lanes, as a left turn lane until the GR4 construction is complete. This will require some additional intersection modifications, including moving the stop bar for northbound Delaware Avenue traffic back to allow the left turn move to occur, and addressing pedestrian access across the ramps. **Table 35** summarizes recommendations for mitigating the addition of casino-generated trips.

Table 35. Recommendations

Intersection	Recommended Mitigation
N. Delaware Avenue and E. Columbia Avenue	<ul style="list-style-type: none"> • Retiming
N. Delaware Avenue and E. Montgomery Avenue (Unsignalized)	<ul style="list-style-type: none"> • No Change
N. Delaware Avenue and Richmond Street/Aramingo Avenue	<ul style="list-style-type: none"> • Alter GR design to have one southbound right turn lane on Aramingo, and one left turn lane instead of two right turn lanes. • Add a westbound right turn lane to Richmond Street. • Move northbound Delaware Avenue stop bar back to accommodate left-turn on Aramingo
Richmond Street and I-95 NB Off ramps/Casino Driveway	<ul style="list-style-type: none"> • Retiming
Richmond Street and E. Girard Avenue	<ul style="list-style-type: none"> • Add a westbound left turn lane to Richmond Street
Richmond Street and E. Cumberland Street	<ul style="list-style-type: none"> • Add Casino Employee Driveway
Richmond Street and E. Lehigh Avenue	<ul style="list-style-type: none"> • No Change
Richmond Street and E. Somerset Street (Unsignalized)	<ul style="list-style-type: none"> • No Change
Richmond Street and E. Allegheny Avenue	<ul style="list-style-type: none"> • Retiming
Aramingo Avenue and E. York Street	<ul style="list-style-type: none"> • Retiming
Aramingo Avenue and E. Cumberland Street	<ul style="list-style-type: none"> • Retiming
Aramingo Avenue and I-95 on/off ramp	<ul style="list-style-type: none"> • Retiming