Northeast Newark Regional Truck Study

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For

THE PORT AUTHORITY OF NY & NJ

Engineering Department
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EXECUTIVE SUMMARY

In 2013, the Port Authority and the City of Newark met to discuss truck traffic patterns within the Ironbound and surrounding Industrial District (study area). The City of Newark presented an interest to better understand these patterns and their associated impacts. Port Authority agreed to undertake this study to provide professional review of truck activities and recommendations to mitigate their impacts. A team of traffic experts reviewed traffic conditions by conducting a widespread data collection effort utilizing high-resolution aerial imagery captured from helicopters hovering over the study area in conjunction with ground mounted video cameras. The results of this study include traffic mitigation measures with a list of recommendations to: review existing truck route policies and regulations; enforce parking regulations; establish new truck routes; reduce truck volumes near schools and increase roadway capacity at the intersection of Stockton Street and Delancy Street.

A separate study, shown in **Appendix A,** was conducted to document truck traffic associated with the Port Authority New Jersey Marine Terminal Facilities. The purpose of this effort was to determine truck origin and destination patterns between the Ironbound Neighborhood and the access/egress points of the port. A primary conclusion of the study was that port-related trucks represent an estimated 5.1% (287 trucks) of all trucks entering or exiting the Ironbound Neighborhood during the nine-hour peak periods referenced in the study.

BACKGROUND

The Northeast Newark Regional Truck Study is a review of traffic conditions within the Ironbound Neighborhood and surrounding Industrial District to document trucking activity on public roads and streets. The study was completed by VHB in coordination with Skycomp Inc. The general study area is a four square mile neighborhood that consists of residential, commercial, and industrial uses in a densely populated urban context. Local streets are relatively narrow and on-street parking is limited. The study area for this study is bordered by McCarter Highway (Route NJ-21) to the west, Doremus Avenue to the east, Interstate 78 to the south, and the Passaic River to the north. The traffic data and analyses in this study are organized and reported for two separate study areas within the City of Newark, as illustrated in **Figure 1**: the Ironbound Neighborhood and the Industrial District.

The truck study includes a comprehensive data collection effort that was conducted on Tuesday, June 4, 2013 during the peak periods of 5:30 - 8:30 AM; 10:30 AM - 1:30 PM; and 2:30 - 5:30 PM. The data collected consisted of high resolution aerial imagery captured from helicopters hovering above the study area, ground video recordings of traffic activity at key roadway segments, and field inventories of traffic control devices and roadway geometric characteristics at key intersections. This data was utilized to perform capacity and LOS analysis at sixteen key intersections, and to conduct an analysis of truck traffic volumes, their origins and destinations, and routing/parking patterns within the study area.

SUMMARY OF FINDINGS

Truck Traffic Volumes

A sampling process was used to estimate truck traffic volumes circulating through local roadways in the study area, using available aerial imagery to trace trucks on a block by block basis as they traveled on public streets. This sample of truck trips was expanded to represent the population of trucks within the study area during the three peak study periods. Over the nine hours there were approximately 10,690 trucks in the overall study area. Of those, about 1,230 trucks were exclusively associated with the Ironbound Neighborhood, 4,560 trucks were exclusively associated with the Industrial District, and 4,900 were associated with both areas.

The designated Newark truck routes of Doremus Avenue, Raymond Boulevard, Stockton, and South Streets were the most heavily used by trucks within the study area, with 900 to 1,500 trucks each. Ferry Street, Wilson Avenue, Christie Street, and St. Charles Street, none of which are designated truck routes in the City of Newark, were estimated to carry 150 to 300 trucks each.

Capacity Analysis

Among the 16 intersections analyzed in this study, only one intersection was identified as operationally constrained. The intersection of Stockton Street and Delancey Street operates at level of service (LOS) F due to capacity shortfalls that cause average vehicular delays of about two minutes during the morning and evening peak hours. Mitigation measures required to improve the intersection LOS to acceptable levels consist of roadway widening, traffic signal retiming, and signal coordination.

Origin-Destination

Of the Ironbound Neighborhood truck trips estimated, 24% entered, 23% exited, 45% passed through, and 8% remained internal to the study area. The most trafficked ingress and egress point was Raymond Boulevard where 27% of all trucks enter or exit. The remaining trucks entered or exited via various side streets bordering McCarter Highway, the Town of Harrison, or the bordering Industrial Area.

Of the Industrial District truck trips estimated, 22% entered, 28% exited, 45% passed through, and 5% remained internal to the study area. The most trafficked ingress and egress point was Doremus Avenue. Its northern-most section (consisting of ramps connecting it to US Route 1&9) and southern-most section was utilized by 43% of all trucks entering or exiting.

Trucks Operating Outside Designated Truck Routes

Of the total trucks traced, 10% were flagged as "non-compliant."[1] A review of these "non-compliant" trips revealed that trucks avoiding South Street and using the other roadways perpendicular to McCarter Highway comprised 30% of all "non-compliant" trips in the study area. This could be attributed to a combination of low vertical clearances beneath the Amtrak Northeast Corridor Line railroad tracks that run parallel to McCarter Highway. The remaining 70% of trips flagged as "non-compliant" utilized a variety of local streets to cut through the study area along predominantly east-west local roadways such as Ferry Street, Wilson Street, Christie Street, and St. Charles Street.

Truck Activity near Schools

Eighteen schools were identified within the study area. A review of trucking activity in their vicinity found that large trucks rarely passed near those that are not located on an official truck route. The only two schools that are not located on an official truck route but had large trucks traced in their vicinity were Oliver Street Elementary School and East Side High School. Supplemental field observations during their opening and closing hours indicated that one to two large trucks passed their entrances during both peak hours at each school.

Parking

Within the Ironbound Neighborhood, a total of 4,609 trucks parked curbside and 650 double-parked during the nine-hour study period, each with an average duration of about five minutes. Prospect Street (between Ferry Street and Elm Street) had the most parking activity recorded within the neighborhood, with about 45 trucks parking curbside and 50 double-parking over the nine-hour period.

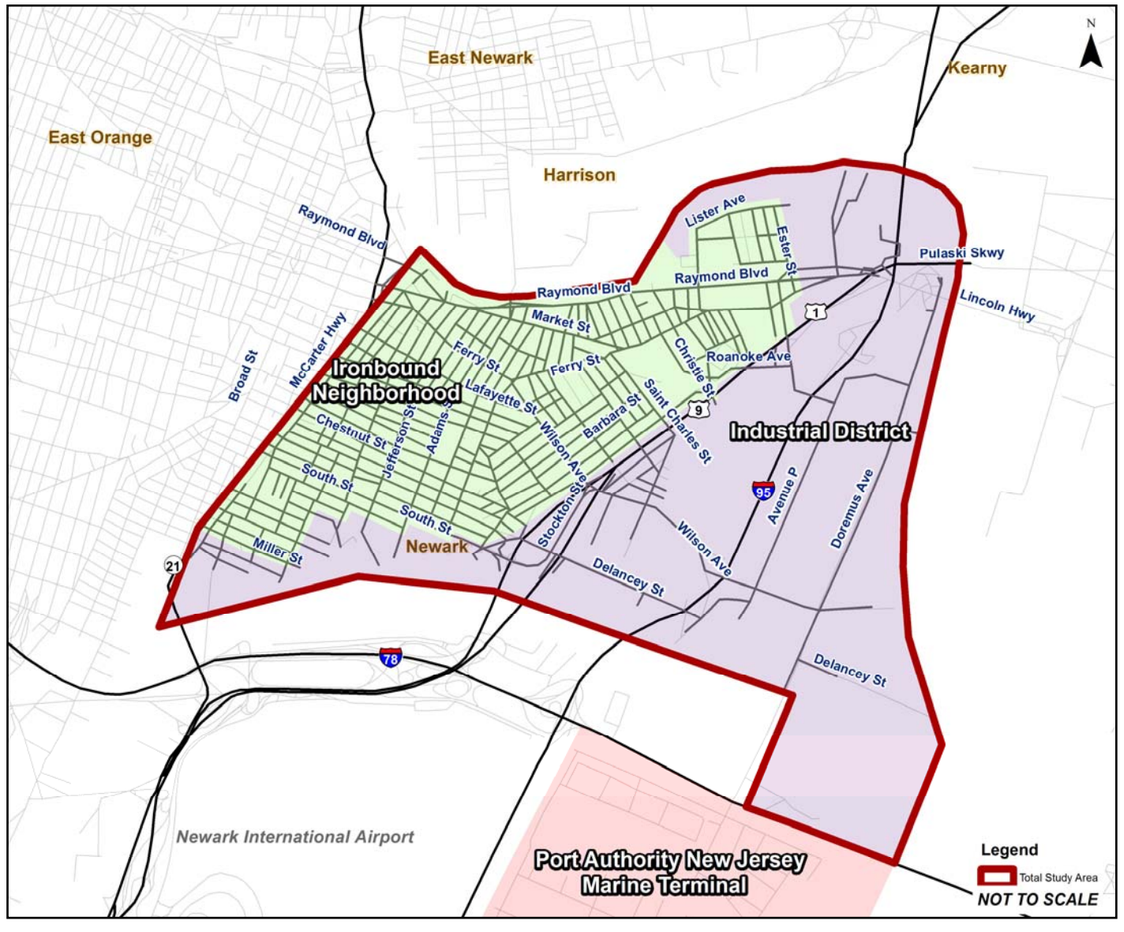
Within Newark's Industrial District, a total of 2,136 trucks parked curbside and 91 double-parked, with an average duration of about five and four minutes, respectively. Ferry Street (between Lockwood Street and Raymond Boulevard) had the most parking activity recorded within the Industrial District, with about 110 trucks parking curbside and 20 double-parking over the nine-hour period.

RECOMMENDATIONS

The following mitigation measures and studies are recommended to better manage the volume of trucks operating within the study area:

- All available information regarding designated truck routes in the City of Newark should be made accessible to transportation agencies, local stakeholders, law enforcement, and the public.
- Evaluate the possibility of designating an alternate truck route to South Street due to its low vertical clearance at McCarter Highway (NJ-21).
- Improve signing to identify truck routes.
- To the extent possible, local business establishments, motor carriers, and school officials should look to schedule deliveries outside of typical school opening and closing periods, to discourage large trucks from circulating near schools at these times.
- In reference to truck double-parking activities, the city could consider new parking regulations and additional police enforcement in sensitive areas.

Figure 1. Study Area and Traffic Count Locations



[1] Newark City Ordinance 23:4-1 requires trucks to remain on designated truck routes unless for the purpose of pickup and delivery of materials in the City of Newark. For the purposes of this study large and small truck trips were both flagged as "non-compliant" with truck route regulations when they crossed from one truck route segment to another truck route segment via non-truck routes without making a delivery between the two designated routes.

INTRODUCTION

The purpose of the study was to determine the travel patterns, route choices, local origins/destinations of trucks, document parking activities, identify operational deficiencies in the roadway network utilized by trucks, and develop mitigation strategies to help reduce the impact of trucks on the area.

To achieve the study objectives, Skycomp Inc. performed an aerial photographic survey of the Ironbound Neighborhood and the surrounding Industrial District on Tuesday, June 4, 2013. High resolution imagery was captured second-by-second with a camera system aboard helicopters hovering approximately one mile above the study area from 5:30 AM - 8:30 AM; 10:30 AM - 1:30 PM; and 2:30 PM - 5:30 PM.

A representative sample of trucks was selected, classified, and traced through the study area from the aerial imagery during the study's nine-hour duration. These trucks were traced by reviewing the imagery and recording each vehicle's exact location and time at different points along its trip. The data was then utilized to calculate operational metrics such as average speeds, trip duration within the study area, travel distance, parking duration, etc. Additionally, the imagery was used to calculate turning movement traffic volumes during the AM, Midday, and PM peak hours at sixteen key locations to perform a traffic operational analysis using Synchro, a roadway capacity modeling software.

DATA COLLECTION

Truck Tracing Data

On Tuesday, June 4, 2013 an aerial photographic survey was conducted of the Ironbound Neighborhood and the surrounding Industrial District within the City of Newark. High resolution imagery was obtained, through Skycomp Inc., with a camera system aboard helicopters hovering approximately one mile above the study area. The survey gathered data during the following three peak periods: AM Peak (5:30 - 8:30 AM), Midday Peak (10:30 AM - 1:30 PM), and PM Peak (2:30 - 5:30 PM), for a total of nine hours. In addition, eight ground-mounted cameras were installed at key locations to aid in vehicle classification counts.

Truck paths within the study area were identified by recording each truck's exact geographic location at different points in time throughout their trip from the Time-Lapse Aerial Photography (TLAP).

Turning Movement Counts

Turning movement classification counts were conducted at eleven signalized intersections, four unsignalized intersections, and one highway ramp. The purpose of these counts was two-fold: (1) to have a general understanding of the magnitude of the truck traffic volumes circulating through those locations during the peak periods; and (2) to perform a traffic operational analysis for the fifteen intersections to assess the level of service at which they operate. The sixteen count locations are listed in **Table 1** and shown in **Figure 1**.

The same images used for acquiring truck-tracing data were used to extract turning movement counts (TMCs). The procedure involved exporting small photo clips from the base imagery covering each of the intersections, and then using software to view the photos in sequence and manually counting the vehicles. The TMC volume data was then summarized in 15-minute intervals for each of the three 3-hour peak periods.

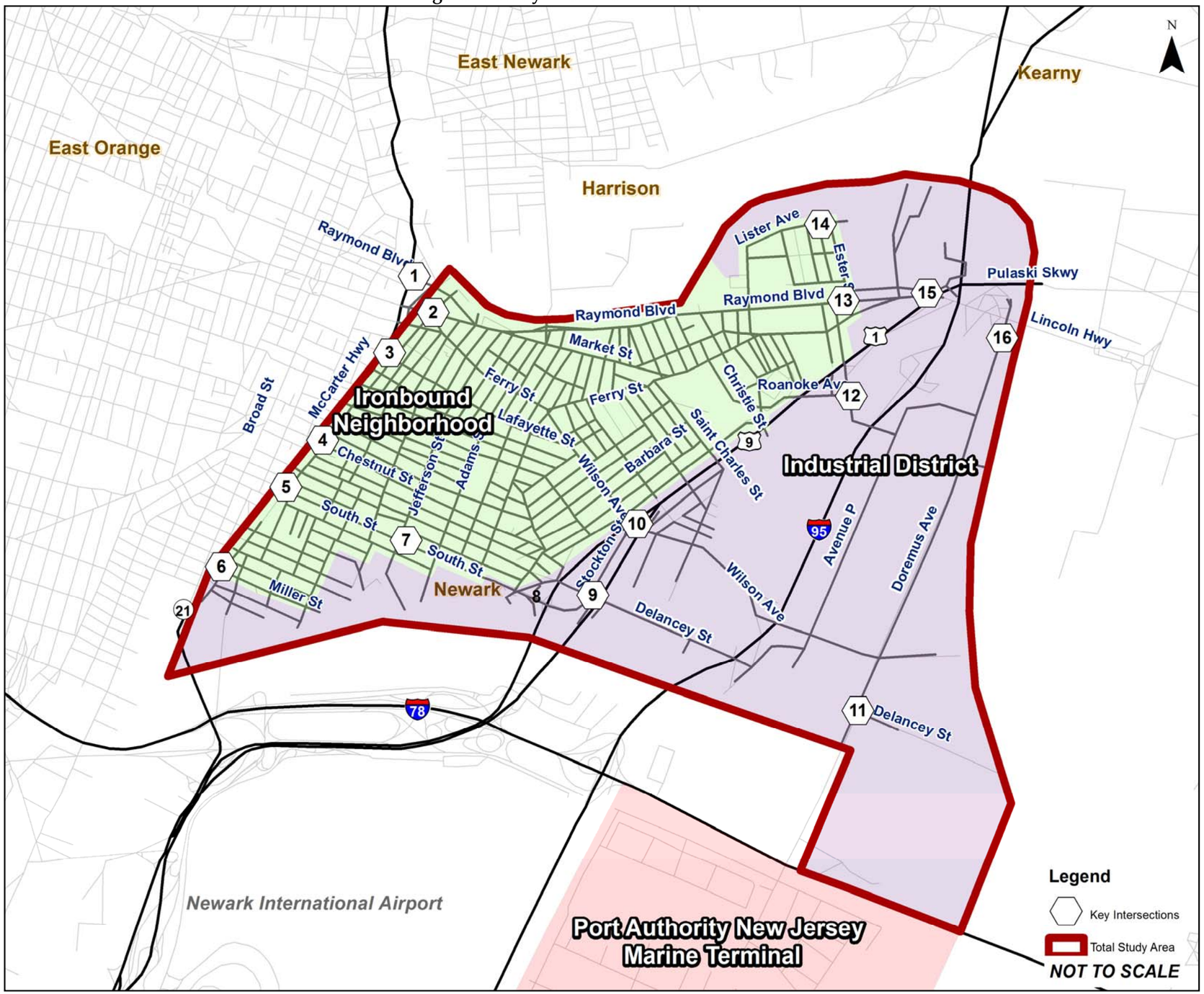
Table 1. List of Traffic Count Locations

Location ID	Description
1	McCarter Highway and Raymond Boulevard
2	Market Street and Ferry Street
3	McCarter Highway and Lafayette Street
4	McCarter Highway and Chestnut Street
5	McCarter Highway and South Street
6	McCarter Highway and Miller Street
7	South Street and Jefferson Street
8	South Street and Ramp to US Routes 1&9
9	South Street with Stockton & Delancey Streets
10	Stockton Street and Wilson Avenue
11	Delancey Street and Doremus Avenue
12	Foundry Street and Roanoke Avenue
13	Raymond Boulevard between Lockwood Street and Foundry Street
14	Lister Avenue and Esther Street
15	US Routes 1&9 at Raymond Boulevard
16	US Routes 1&9 and Doremus Avenue

Data Collection to Support Operational Analysis

An operational traffic analysis of the existing conditions was performed for the eleven signalized and four unsignalized intersections during the AM, Midday, and PM peak hours. For this analysis, physical inventories, timing plans, and existing level of service data were gathered in the field to support the development and calibration of an operational analysis model.

Figure 1. Study Area and Traffic Count Locations



Physical Inventories

Physical inventories of all analysis intersections were performed to document the geometric layouts, existing signing, and other pertinent information regarding traffic including, lane widths, and parking and traffic movement restrictions.

Signalized Intersections Timing Plans

Official (provided by the City of Newark) and field observed signal timing data were collected for the signalized intersections during each analysis period. This data included green times, clearance interval durations for all signal phases, cycle lengths, and offsets for those intersections that are part of a coordinated corridor.

Level of Service Observations

Level of service observations were conducted during the AM, Midday, and PM peak periods at the analysis locations to assist in the calibration of the analysis model. These observations included the number of vehicles processed for each lane group, average delays, and average queue lengths. Additionally, queue lengths captured by the aerial photography were also taken into account when calibrating the model.

ANALYSIS METHODOLOGY

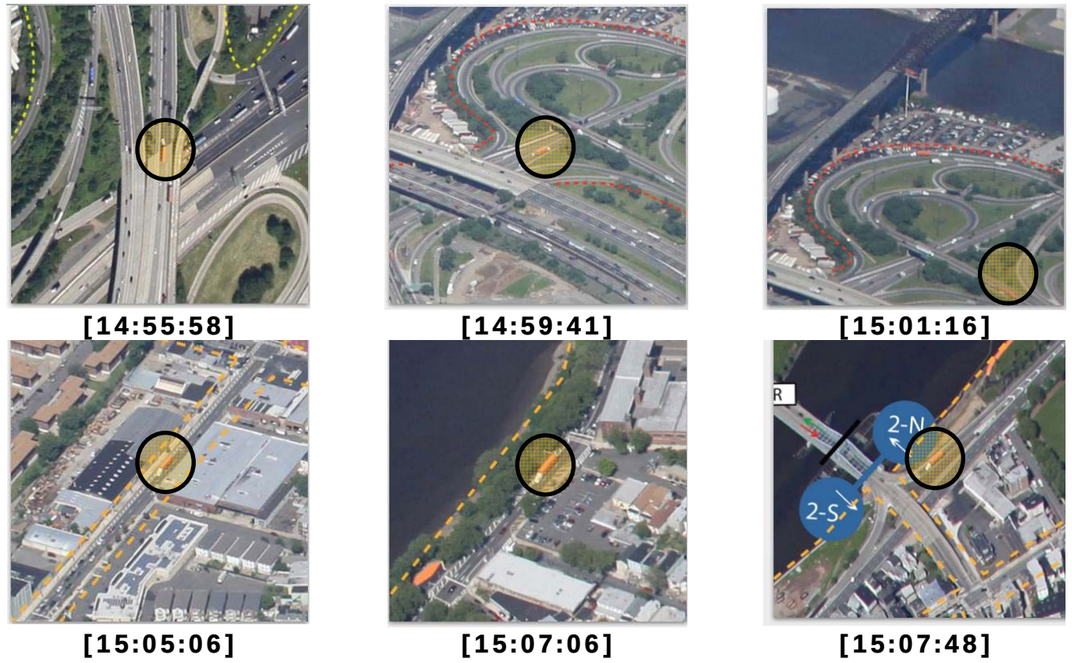
Truck Tracing Methodology

The purpose of the truck tracing process was to determine travel patterns, route choices and local origins and destinations of trucks traveling within the study area. This was accomplished by tracing a representative sample of trucks traversing through the study area.

Software designed specifically for this task was utilized by Skycomp, Inc. analysts to trace sampled trucks. Each sampled truck was traced backwards in time to determine its origin and forward in time to determine its destination. Each truck was traced for its entire trip within the study area until it exited the study area through the outer borders or a delivery bay, truck yard, or another similar facility.

To illustrate the truck tracing process, **Figure 2** shows an orange tractor-trailer (highlighted in yellow) as it was traced during its trip. Each photo clip shows the time and location of the truck.

Figure 2. Sample Photo Clips Used for Tracing an Orange Tractor Trailer
[Time format in HH:MM:SS]



Truck Sample Expansion

Overall, 59,741 data records for the 741 traced trucks were extracted from the aerial photography during the tracing process. Each record represents a timestamp containing a vehicle's exact location in the roadway network at different times along its trip through the study area.

An expansion factor was applied for each sampled truck to represent the entire population of trucks circulating within the total study area during the nine-hour analysis period. **Table 2** shows a breakdown of Traced Vehicle Volumes, Expansion Factors, and Expanded Volumes by vehicle type (large truck or small truck), and peak period. Large trucks include trucks with trailers consisting of shipping containers, empty chassis, box trailer, flat beds, auto carriers, dump trucks, and tankers, among others. Small trucks include single unit trucks, delivery vans (e.g. UPS, FedEx, food trucks), and dump trucks or unclassified working trucks. Examples of key truck types are show in **Figures 3a-f.**

As a result of the process the 741 sampled trucks were expanded to 10,686; representing about 7% of the total estimated trucks within the total study area.

Figure 3a. Flat Bed Truck

Figure 3b. Box Trailer Truck

Figure 3c. Delivery Truck

Figure 3d. Dump Truck

Figure 3e. Waste Container Truck

Figure 3f. Single Unit Truck

Table 2. Truck Expansion Factors

Vehicle Type	Traced Vehicles			Expansion Factor			Expanded Volume		
	AM	Midday	PM	AM	Midday	PM	AM	Midday	PM
Total Study Area: Northeast Region of Newark									
Large	128	180	133	18.6	16.1	11.2	2,307	2,882	1,465
Small	65	129	106	20.2	14.4	8.8	1,272	1,842	919
Total	**193**	**309**	**239**	**-**	**-**	**-**	**3,579**	**4,724**	**2,383**
	741			**-**			**10,686**		

To determine the validity of the expansion process, truck traffic volumes estimated with the expanded sample were compared with actual truck volume counts performed at the sixteen count locations shown in **Table 1**. The Geoffery E. Havers (GEH) Statistic was used as a validation measure. The GEH Statistic is a formula recommended by the Federal Highway Administration (*Traffic Analysis Toolbox Volume IV*, FHWA, 2007) to compare two sets of traffic volumes and determine if they are a good match.

FHWA recommends that 85% of count locations (for which actual and estimated truck volumes are compared) have a GEH value that is less than 5. The expanded data set achieved a GEH less than 5 at more than 89% of volume count locations and an overall average GEH less than 3.5 during all three peak periods. Thus, the sample size was determined to be sufficient to produce an acceptable level of accuracy.

Additionally, throughout this study trips were disaggregated as traversing two neighboring sub-study areas (as shown on **Figure 1**):

- The Ironbound Neighborhood – Truck trips that enter, exit, or pass through the Newark Planning Office (NPO)-defined neighborhood.

- The Industrial District – Trucks trips that enter, exit, or pass through areas bordering the Ironbound Neighborhood to its north, south, or east. These areas are primarily zoned for industrial land uses and have connections to US Truck Route 1&9 and the NJ Turnpike; two of the state's most heavily utilized truck routes.

Operational Analysis Methodology

The traffic simulation modeling program Synchro 7 was used to perform the operational analysis. This model calculates the level of service (LOS) based on average delay and volume-to-capacity (v/c) ratios for all movements at an intersection and for the intersection as a whole.

Inputs such as peak hour movement volumes, heavy vehicle percentages, peak hour factors, and intersection geometries, among other parameters, were entered for each analysis peak hour.

ANALYSIS FINDINGS

Truck Tracing

Over the nine-hour study period 10,686 trucks were estimated to be active within the total study area. About 3,579 trucks were estimated during the AM period (5:30 AM - 8:30 AM), 4,724 trucks during the Midday period (10:30 AM - 1:30 PM), and 2,383 trucks during the PM period (2:30 PM - 5:30 PM). About 1,230 trucks were exclusively associated with the Ironbound Neighborhood, 4,560 trucks were exclusively associated with the Industrial District, and 4,900 were associated with both. A summary of these volumes is shown in **Table 3**.

Table 3. Truck Volumes by Study Area

Peak Period	AM	Midday	PM	AM	Midday	PM	AM	Midday	PM
Study Area:	**ONLY - Ironbound Neighborhood**			**SHARED**			**ONLY - Industrial District**		
Large	103	159	56	931	1,012	678	1,274	1,711	731
Small	261	443	207	624	1,094	564	387	305	148
Total	**363**	**603**	**263**	**1,555**	**2,106**	**1,241**	**1,661**	**2,015**	**879**
	1,229			**4,902**			**4,555**		
	6,131								
				9,457					
	10,686								

Of the total estimated trucks active within both study areas, 53% were classified as large trucks, while the 47% were classified as small trucks. For the Ironbound Neighborhood, the percentage of large vs. small trucks is nearly equal with 48% large trucks and 52% small trucks. For the Industrial District, this large/small breakdown is 82% / 18%. A summary of large vs. small trucks is shown in **Table 4**.

Table 4. Percentage of Estimated Vehicles by Class

Vehicle Class	Analysis Period			Total
	AM	Midday	PM	
Total Study Area: Northeast Region of Newark				
Large	64%	61%	61%	53%
Small	36%	39%	39%	47%
Total % of Expanded Volume	**34%**	**44%**	**22%**	**100%**
ONLY - Ironbound Neighborhood & SHARED				
Large	54%	43%	49%	48%
Small	46%	57%	51%	52%
Total % of Expanded Volume	**30%**	**49%**	**21%**	**100%**
ONLY - Industrial District & SHARED				
Large	69%	66%	66%	82%
Small	31%	34%	34%	18%
Total % of Expanded Volume	**37%**	**44%**	**19%**	**100%**

Truck trips were classified by their origin and destination as follows:

- *External - Internal*: Trips originating outside the study area and ending within the study area.
- *Internal - External*: Trips originating within the study area and ending outside the study area
- *Internal - Internal*: Trips with both an origin and destination within the study area.
- *Through*: Trips that enter from outside of the study area and end outside the study area.

Of the truck trips estimated within the total study area, 29% entered, 32% exited, 21% passed through, and 18% remained internal. Within the Ironbound Neighborhood, 24% entered, 23% exited, 45% passed through, and 8% remained internal. Within the Industrial District, 22% entered, 28% exited, 45% passed through, and 5% remained internal. A review of trips by origin and destination type is shown in **Table 5**.

Table 5. Percentage of Estimated Trucks by Trip Type

Trip Class	Peak Period			Total[(1)]
	AM	Midday	PM	
Total Study Area: Northeast Region of Newark				
External - Internal	21%	29%	40%	29%
Internal - External	41%	28%	25%	32%
Internal - Internal	21%	18%	13%	18%
Through	17%	25%	22%	21%
Total	**34%**	**44%**	**22%**	**100%**
Ironbound Neighborhood				
External - Internal	17%	26%	30%	24%
Internal - External	29%	23%	18%	23%
Internal - Internal	8%	10%	6%	8%
Through	46%	41%	46%	45%
Total	**31%**	**44%**	**25%**	**100%**
Industrial District				
External - Internal	19%	23%	28%	22%
Internal - External	36%	25%	22%	28%
Internal - Internal	7%	4%	2%	5%
Through	38%	48%	48%	45%
Total	**34%**	**44%**	**22%**	**100%**

Notes: The "Total" column represents percent compositions of each trip type over the total nine-hour period.

Review of Port Trucks Entering or Exiting the Ironbound Neighborhood

To investigate concerns about port truck traffic within the Ironbound Neighborhood a separate comprehensive review of trucks associated with the Port Authority New Jersey Marine Terminal was conducted prior to this study (**Appendix A**). The purpose of this effort was to determine truck origin and destination patterns between the Ironbound Neighborhood and the access/ egress points of the port. For this effort a sample of trucks crossing the Ironbound Neighborhood's border were traced until they crossed the port's bounds or exited the study area limits. The primary conclusion of this study was that an estimated 5.1% (287) of all trucks were port-related trucks entering or exiting the Ironbound Neighborhood during the same nine-hour analysis period referenced in this study, **Table 6 & 7** summarize this finding.

Table 6. Percent of Port Truck Trips Entering/Exiting the Ironbound Neighborhood's Boundary

Truck Traffic Direction	Trucks Sampled	Trucks Identified as Port Associated	Percent of Port Associated Trucks
Trucks Exiting the Ironbound Neighborhood	1,238	61	4.9%
Trucks Entering the Ironbound Neighborhood	1,209	65	5.4%
Total Trucks Entering or Exiting the Ironbound Neighborhood	**2,447**	**126**	**5.1%**

Table 7. Calculation: Volume of Port Trucks Entering/Exiting the Ironbound Neighborhood

	Volume
Total Ironbound Neighborhood Trucks(1):	6,131
8.3%(2) Internal-Internal Truck Trip Reduction (3):	-509
Truck Trips Crossing Boundary:	5622
Port Trucks in the Ironbound Neighborhood: [5.1% of Total Truck Trips Crossing]	**287**

Notes: (1) Trucks for which at least one small portion of their trip occurred within the Ironbound Neighborhood.
*(2) 8.3% Internal-Internal Trips is rounded to 8% in **Table 4**.*
*(3) The "Port Commerce Truck Analysis," (**Appendix A**) concluded that 5.1% of all trucks entering or exiting the Ironbound Neighborhood are port-trucks. This percentage excluded all truck trips that occurred only within the boundaries of the Ironbound Neighborhood (Internal-Internal trips).*

Truck Volumes on Roadway Segments

Within the Ironbound Neighborhood the designated truck routes of Raymond Boulevard and Stockton/South Street were the most utilized roadways with 900 to 1,200 trucks each, during the nine-hour study period. The high volume non-designated truck routes of Ferry Street, Wilson Street, Christie Street, and St. Charles Street were estimated to carry 150 to 300 trucks each. The remaining local roadways were estimated to carry less than 150 trucks each. **Figure 4a** shows the estimated truck volumes within the study area during the nine-hour study (**Figure 4b** isolates large trucks).

The most heavily utilized roadway for trucks within the entire study area was Doremus Avenue, with 1,200 to 1,500 trucks estimated along the corridor during the nine-hour period. It is isolated within the Industrial District and provides access to the New Jersey Turnpike (I-95) and other major highways in the area. Other high traffic areas within the Industrial District are Delancey Street, Wilson Avenue, Avenue P, and the Ramp from US 1&9 to South Street; each estimated to have between 300 to 900 trucks. **Figure 5a** shows the estimated truck volumes within the Industrial District study area during the nine-hour study (**Figure 5b** isolates large trucks).

Average Speeds

Average speeds along Raymond Boulevard, Doremus Avenue, and Market Street were generally recorded in the range of 20 to 35 mph. Ferry Street, Stockton Street's southbound approach to Delancey Street, and many smaller local roads were identified to have speeds below 10 mph over the nine-hour period. Speeds below 10 mph along Ferry Street and Stockton can be attributed to delays caused by congestion, while speeds below 10 mph on smaller local roads are likely attributed to delays at signalized and stop-controlled intersections. Average speeds were generally similar within the Ironbound Neighborhood and the Industrial District. **Figures 6** and **7** show average speeds by roadway segments within each study area over the nine-hour period.

Parking Activity

During the nine-hour period an estimated 4,609 trucks parked curbside and 558 double parked within the Ironbound Neighborhood; within the Industrial District, only 2,136 trucks parked curbside and 91 double parked. A breakdown by peak period is shown in **Table 8,** while **Figures 8** and **9** show the parking and double parking activity by street throughout each study area.

Table 8. On-Street Truck Parking Activity Summary

Peak Period		AM	Midday	PM	Total
Ironbound Neighborhood					
On-Street Parking	Parked per Period	805	2,781	1,023	4,609
	Duration in Minutes	4.0	5.9	6.0	5.6
Double Parking	Parked per Period	106	283	170	558
	Duration in Minutes	8.0	3.7	5.4	5.0
The Industrial District					
On-Street Parking	Parked per Period	611	1,194	331	2,136
	Duration in Minutes	4.7	6.0	3.8	5.3
Double Parking	Parked per Period	17	50	24	91
	Duration in Minutes	12.7	2.7	0.9	4.1

Ferry Street between Lockwood Street and Raymond Boulevard had the most parking activity within the total study area; with an estimated 106 trucks parked curbside and 17 trucks double parked over the nine-hour period.

Specifically, within the Ironbound Neighborhood, Prospect Street (between Ferry Street and Elm Street) had the most parking activity recorded within the neighborhood with about 45 trucks parking curbside and 50 double parking. Furthermore, sections of Doremus Avenue are estimated to have as many as 80 trucks parked curbside over the nine-hour period. Other frequently utilized areas were Delancey Street, Ferry Street (between Wilson Street and Market Street), and road

segments below South Street. These areas had as many as 60 estimated trucks parked curbside during the nine-hour study period on one street block.

Double parking can drastically reduce the overall safety and capacity of a roadway; therefore, this analysis was supplemented by field observations at the following locations: (1) Astor Street & Goble Street, (2) Pulaski Street & Clifford Street, (3) Lafayette Street & Prospect Street, and (4) Lang Street & Wilson Avenue. In summary, large and small trucks were observed double parking at all locations. Durations varied from two minutes to two hours. Observed motives for double parking included (but may not be limited to): queuing on the street from industrial land uses, deliveries to local businesses, and deliveries to private residential properties without available street parking.

Study Area Entry and Exit Points

An estimated total of 3,985 trucks entered and 3,983 exited the Ironbound Neighborhood during the nine-hour analysis period. The most trafficked access and egress point was Raymond Boulevard with 27% of all trucks entering or exiting via this location. The summation of all trucks utilizing the side streets along McCarter Highway totaled 24%.

An estimated total of 6,826 trucks entered and 6,924 exited the Industrial District during the nine-hour analysis period. The most trafficked access and egress point was Doremus Avenue. Its northern-most section (consisting of ramps connecting it to US Route 1&9) and southern-most section was utilized by 43% of all trucks entering or exiting.

Table 9 shows a breakdown of truck volumes entering/exiting the study area by access point, while **Figure 10a and 11a** depict the movements graphically (**Figure 10b and 11b** isolate large trucks).

Table 9. Trucks Estimated Entering / Exiting the Study Area (Total for Nine-Hour Study Period)

Street / Road		Entering		Exiting		Total	
		Volume	%	Volume	%	Volume	%
Ironbound Neighborhood							
Raymond Blvd. (East)		1,123	28%	1,019	26%	2,142	27%
Town of Harrison		210	5%	180	5%	390	5%
Southern Industrial Area		628	16%	606	15%	1,234	15%
South St. (East)		375	9%	557	14%	932	12%
Eastern Industrial Area	North of Christie St	131	3%	152	4%	283	4%
	Christie St.	45	1%	22	1%	67	1%
	South of Christie St	584	15%	436	11%	1,020	13%
McCarter Highway	North of Lafayette St.	378	9%	525	13%	903	11%
	Between Lafayette St. and South St.	132	3%	185	5%	317	4%
	South of South St.	379	10%	301	8%	680	9%
Total		**3,985**	**100%**	**3,983**	**100%**	**7,968**	**100%**
Industrial District							
Raymond Blvd.(East)		1,019	15%	1,223	18%	2,242	16%
Doremus Ave.(North)		491	7%	1,366	20%	1,857	14%
Doremus Ave. (Ramp towards Route 1 & 9)		1,266	19%	565	8%	1,831	13%
Route 1 & 9 Ramps		744	11%	1,030	15%	1,774	13%
Dirt Road connecting Delancey St. and Port St.		117	2%	65	1%	182	1%
Doremus Avenue (Near Delancey St.)		1,116	16%	912	13%	2,028	15%
Southern Industrial Area		606	9%	628	9%	1,234	9%
South St. (East)		557	8%	375	5%	932	7%
Western Ironbound Neigh-borhood Border	North of Christie St.	152	2%	131	2%	283	2%
	Christie St.	22	<1%	45	1%	67	<1%
	South of Christie St	736	11%	584	8%	1,320	10%
Total		**6,826**	**100%**	**6,924**	**100%**	**13,750**	**100%**

Notes: (1) – "Through" trips were recorded as entering and exiting trips.
(2) – "Internal-Internal" Trips are not represented in this table.
(3) – Percentages do not sum to 100% due to rounding.
*(4) – Entry exit points vary from the points captured in, "Port Commerce Truck Analysis," study documented in **Appendix A**.*

Figure 4a. Ironbound Neighborhood - Truck Volume Map: ALL TRUCKS
(Nine-Hour Period)

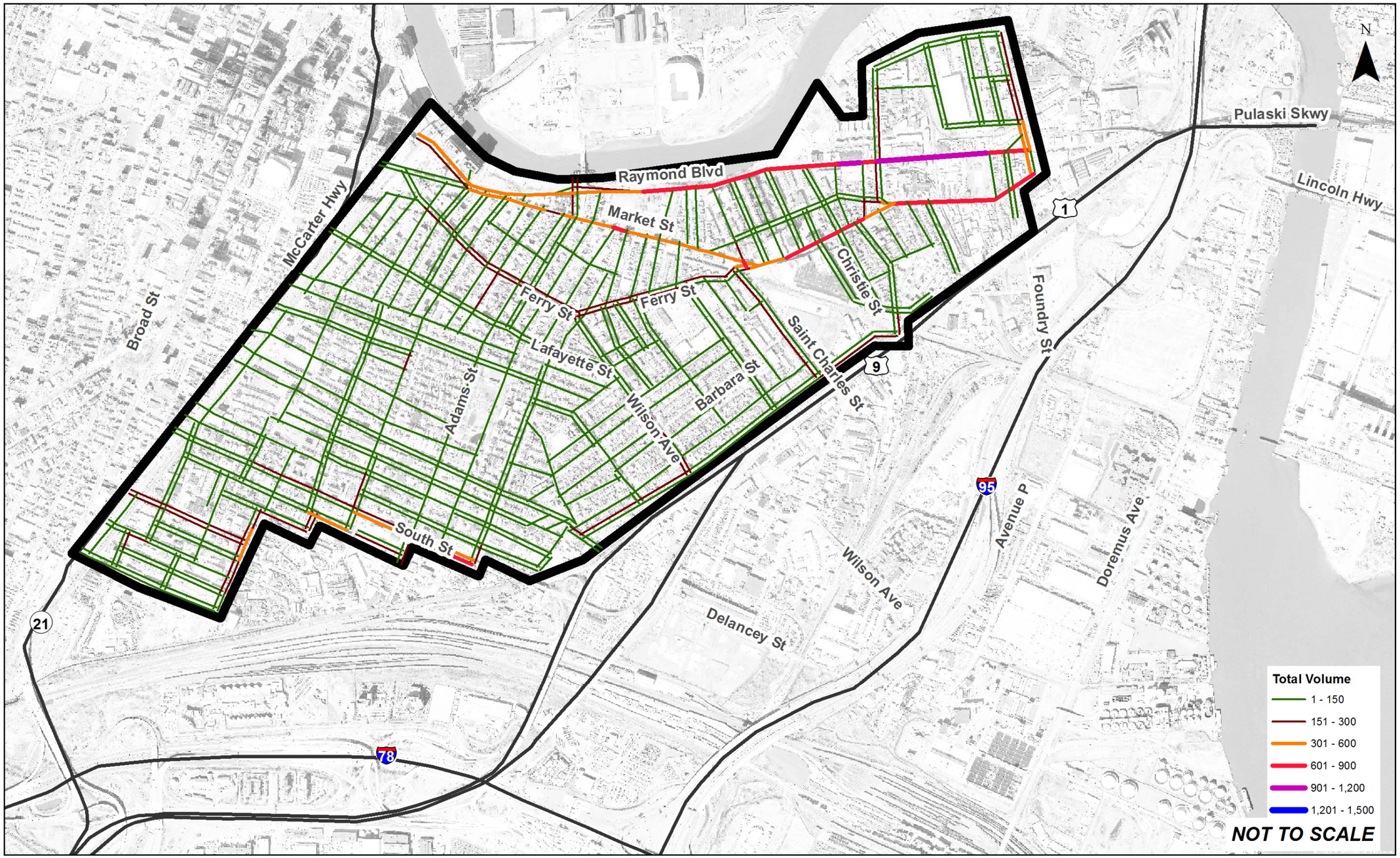


Figure 4b – Ironbound Neighborhood - Truck Volume Map: ONLY LARGE TRUCKS
(Nine-Hour Period)

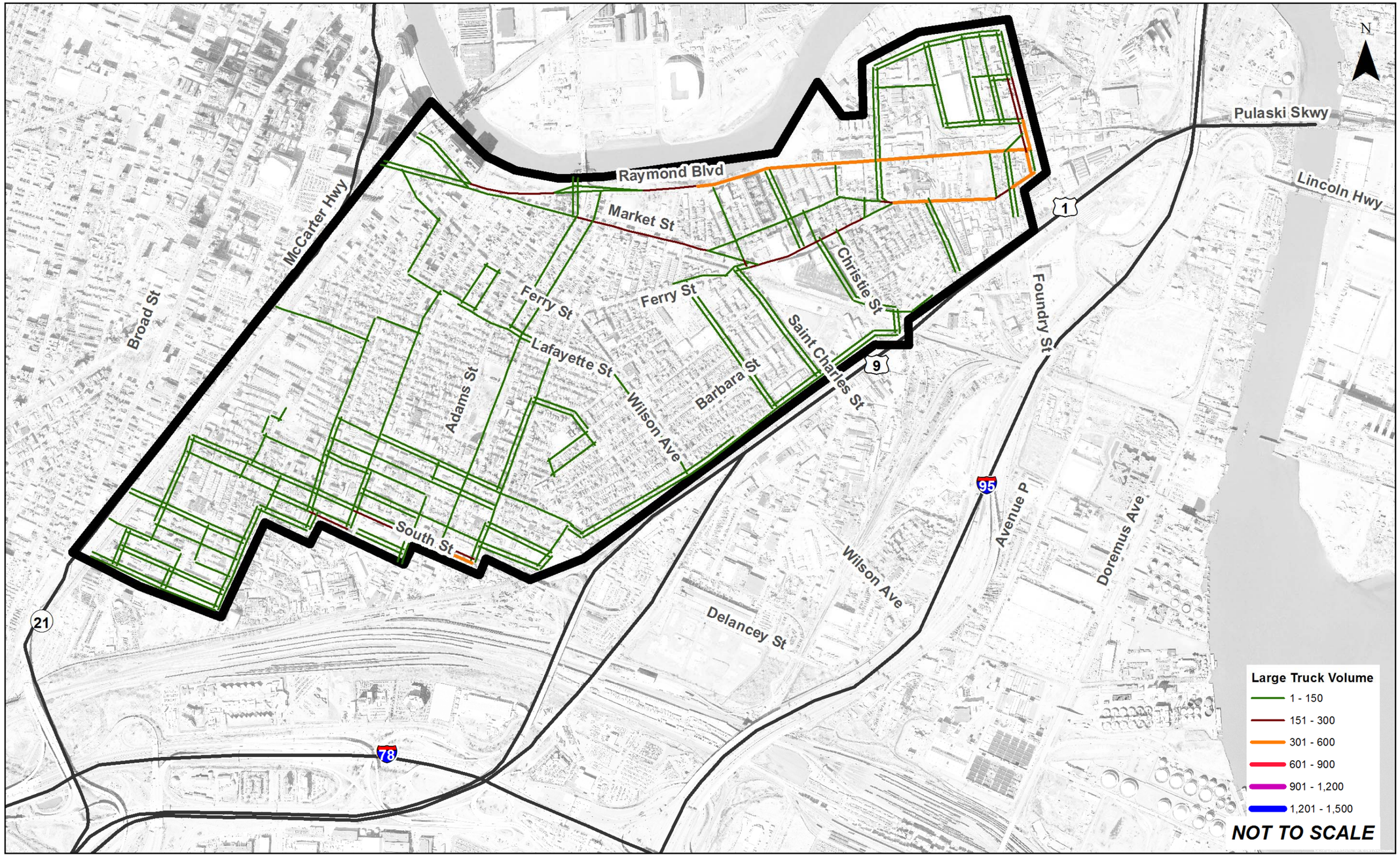


Figure 5a – Industrial District - Truck Volume Map: ALL TRUCKS
(Nine-Hour Period)

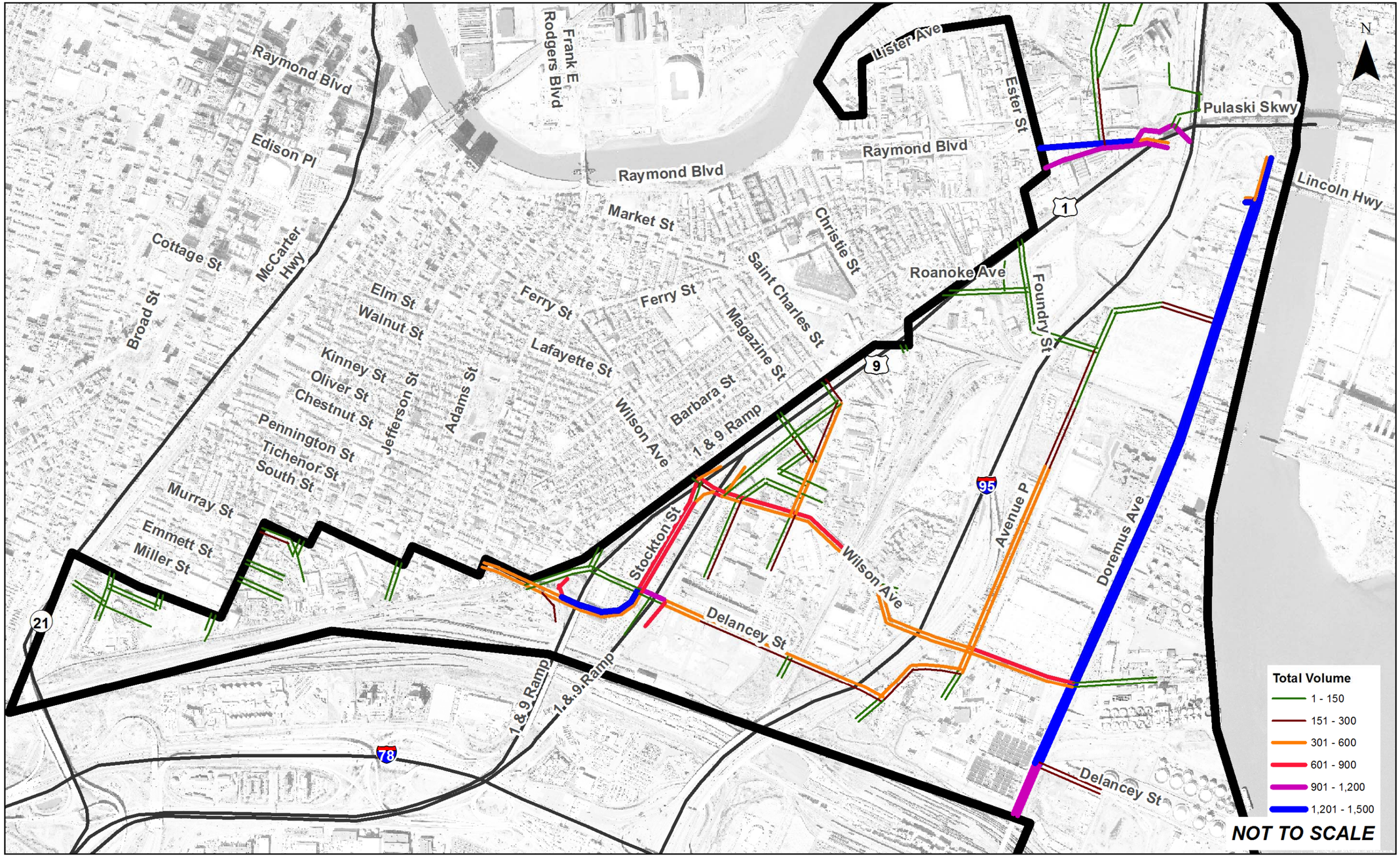


Figure 5b. Industrial District - Truck Volume Map: ONLY LARGE TRUCKS
(Nine-Hour Period)

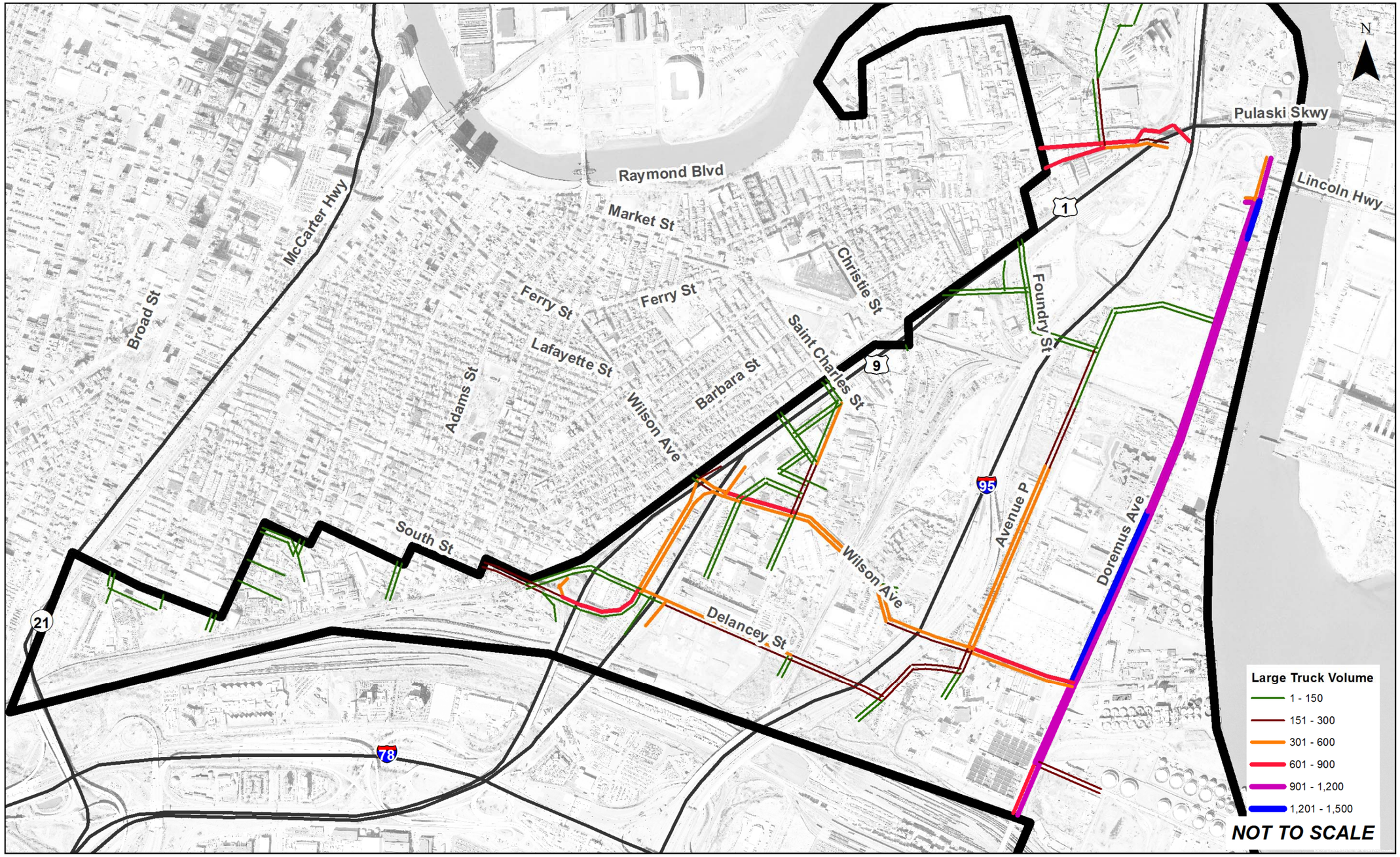


Figure 6. Ironbound Neighborhood – Average Truck Speeds: ALL TRUCKS (Nine-Hour Period)

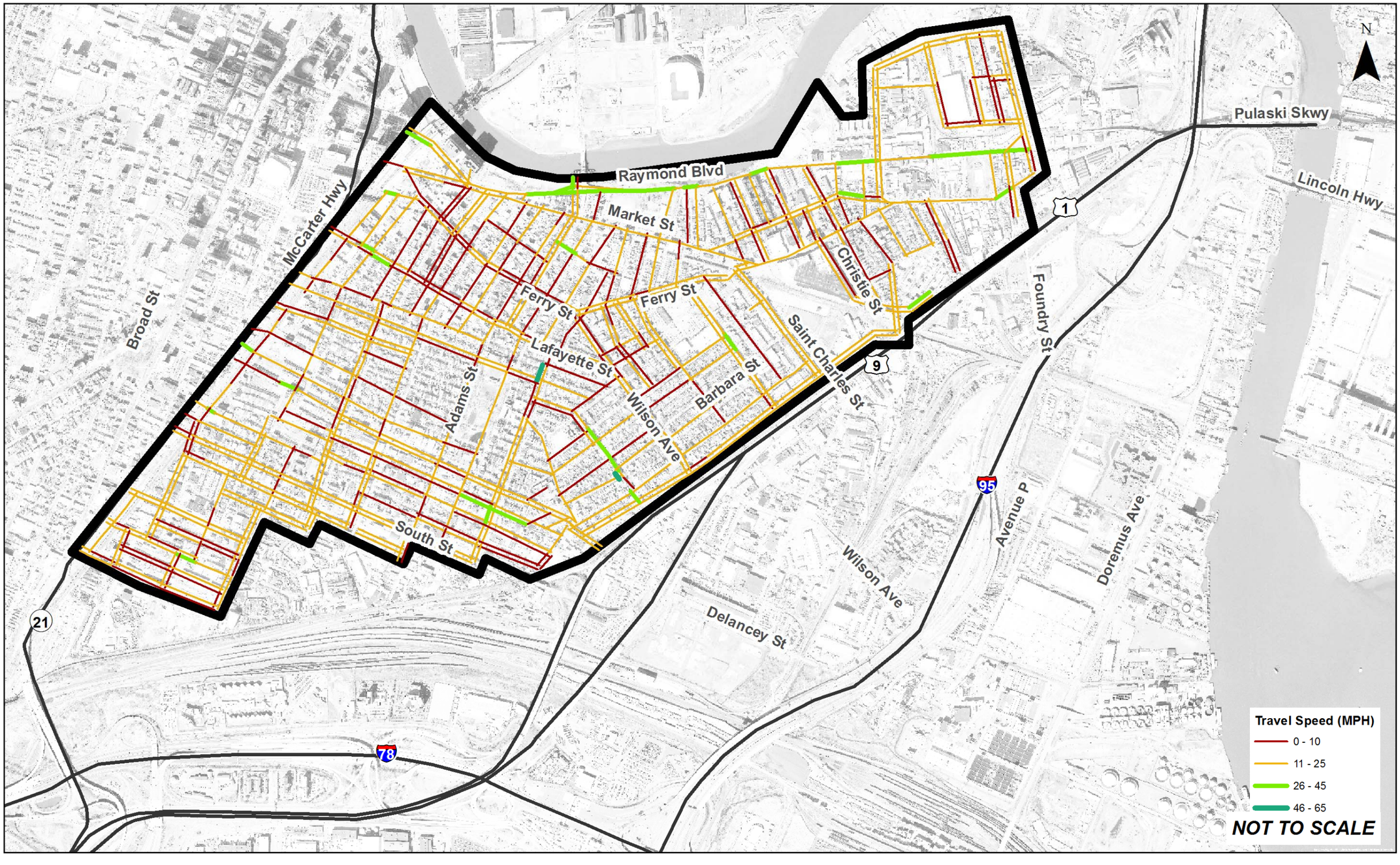


Figure 7. Industrial District – Average Truck Speeds: ALL TRUCKS
(Nine-Hour Period)

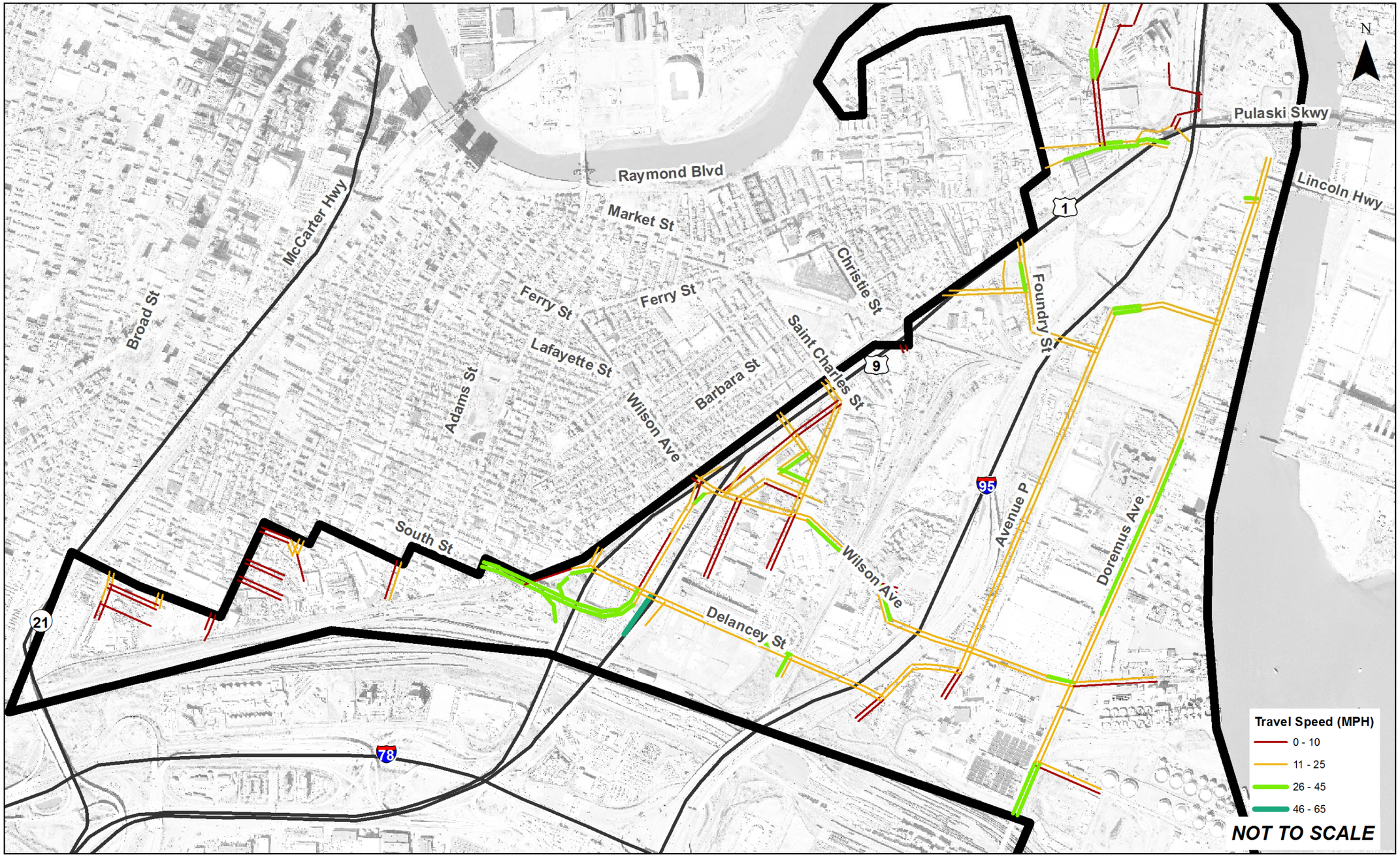


Figure 8. Ironbound Neighborhood – On-Street & Double Parking Truck Volume Density Map: ALL TRUCKS (Nine-Hour Period)

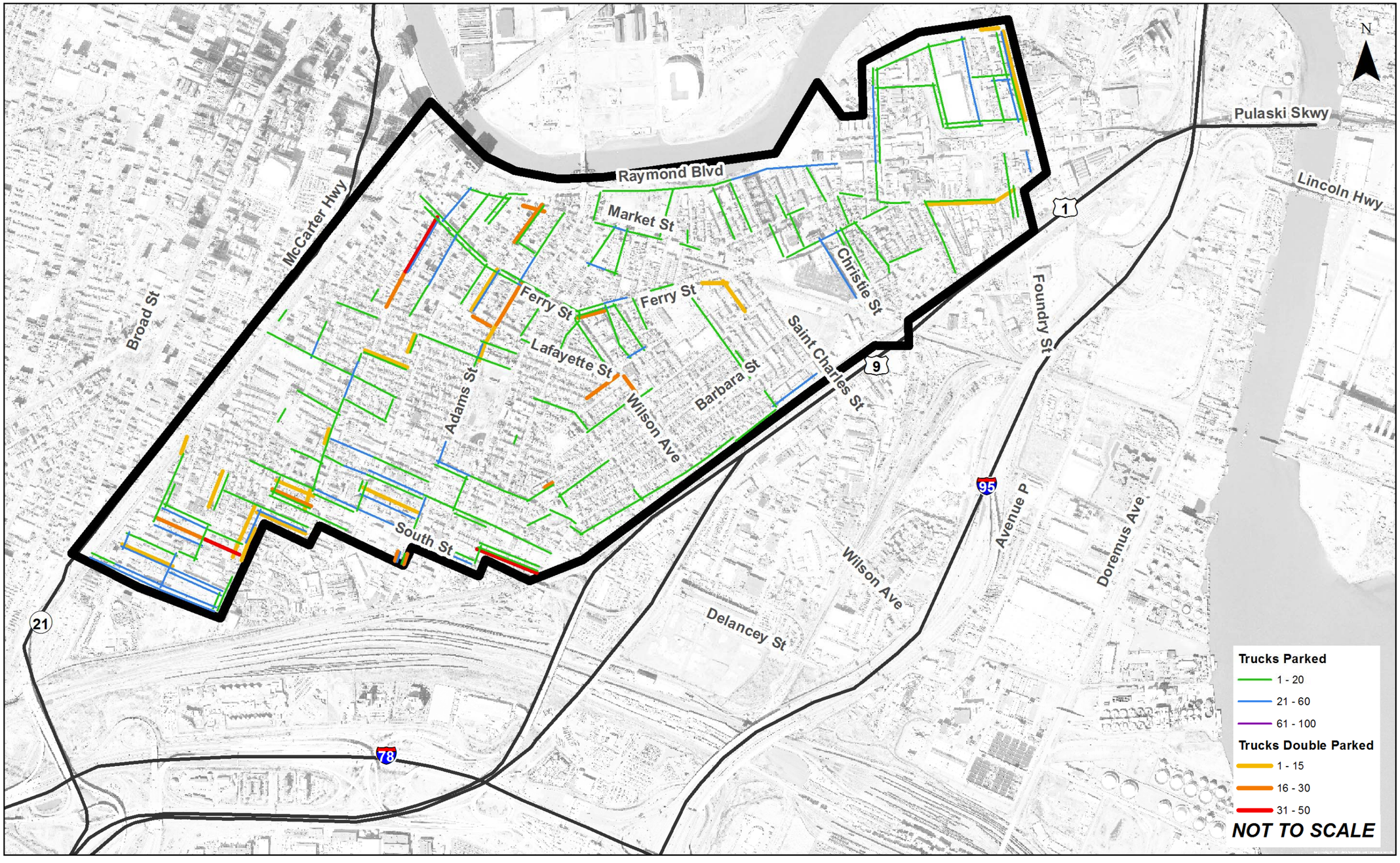


Figure 9. Industrial District – On-Street & Double Parking Truck Volume Density Map: ALL TRUCKS (Nine-Hour Period)

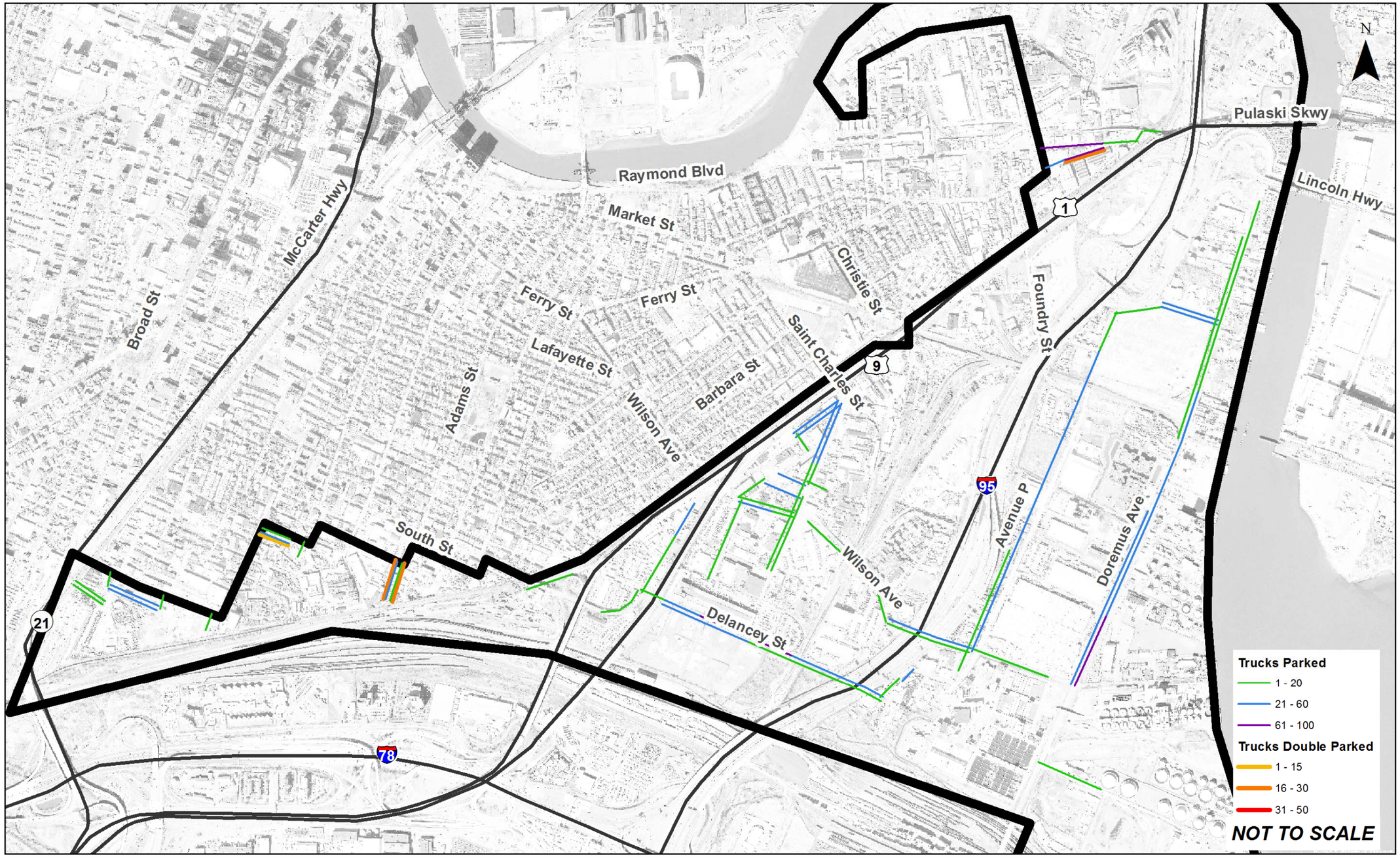


Figure 10a. Ironbound Neighborhood - Truck Volume Entering/Exiting the Study Area: ALL TRUCKS (Nine-Hour Period)

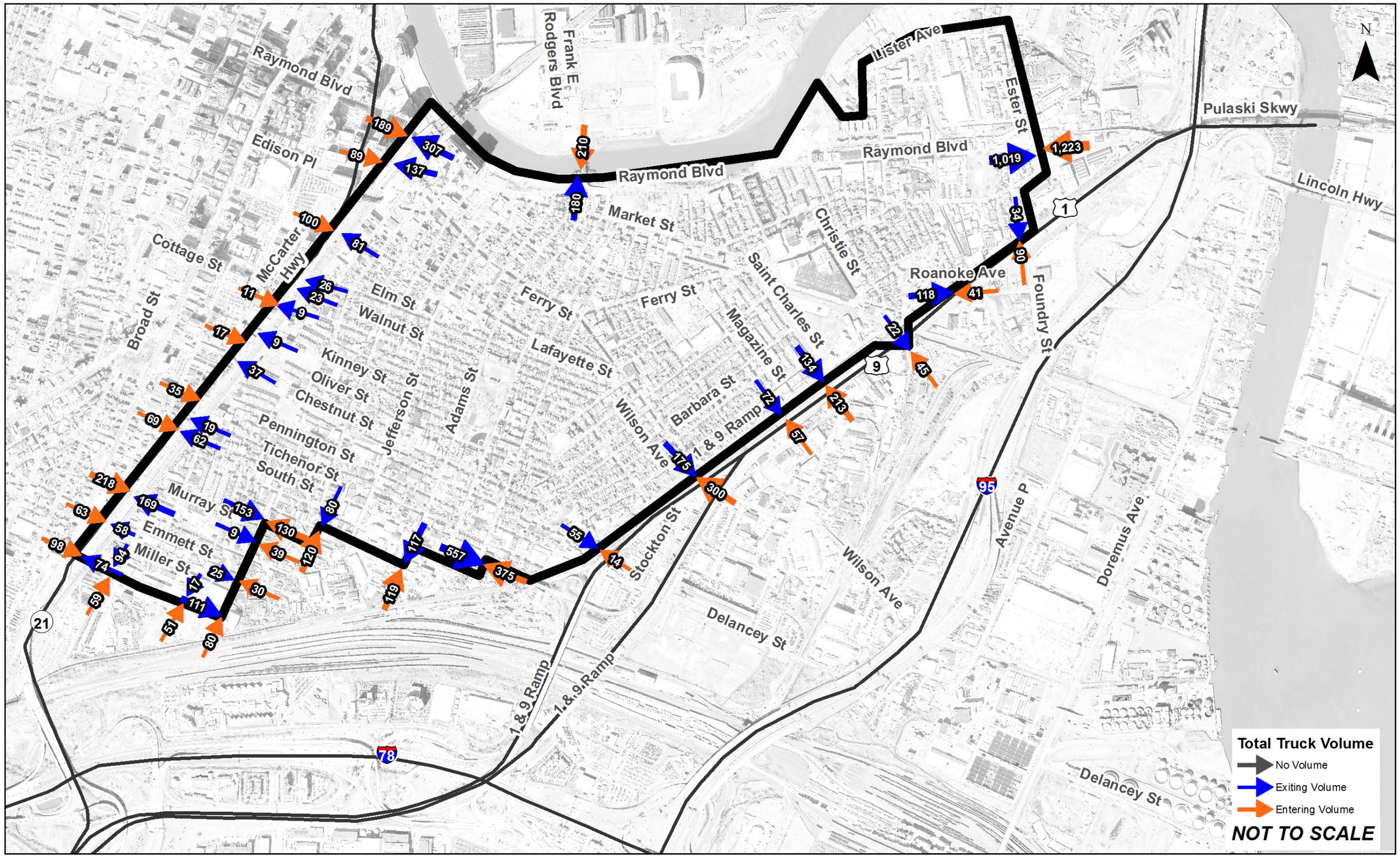


Figure 10b. Ironbound Neighborhood - Truck Volume Entering/Exiting the Study Area: ONLY LARGE TRUCKS (Nine-Hour Period)

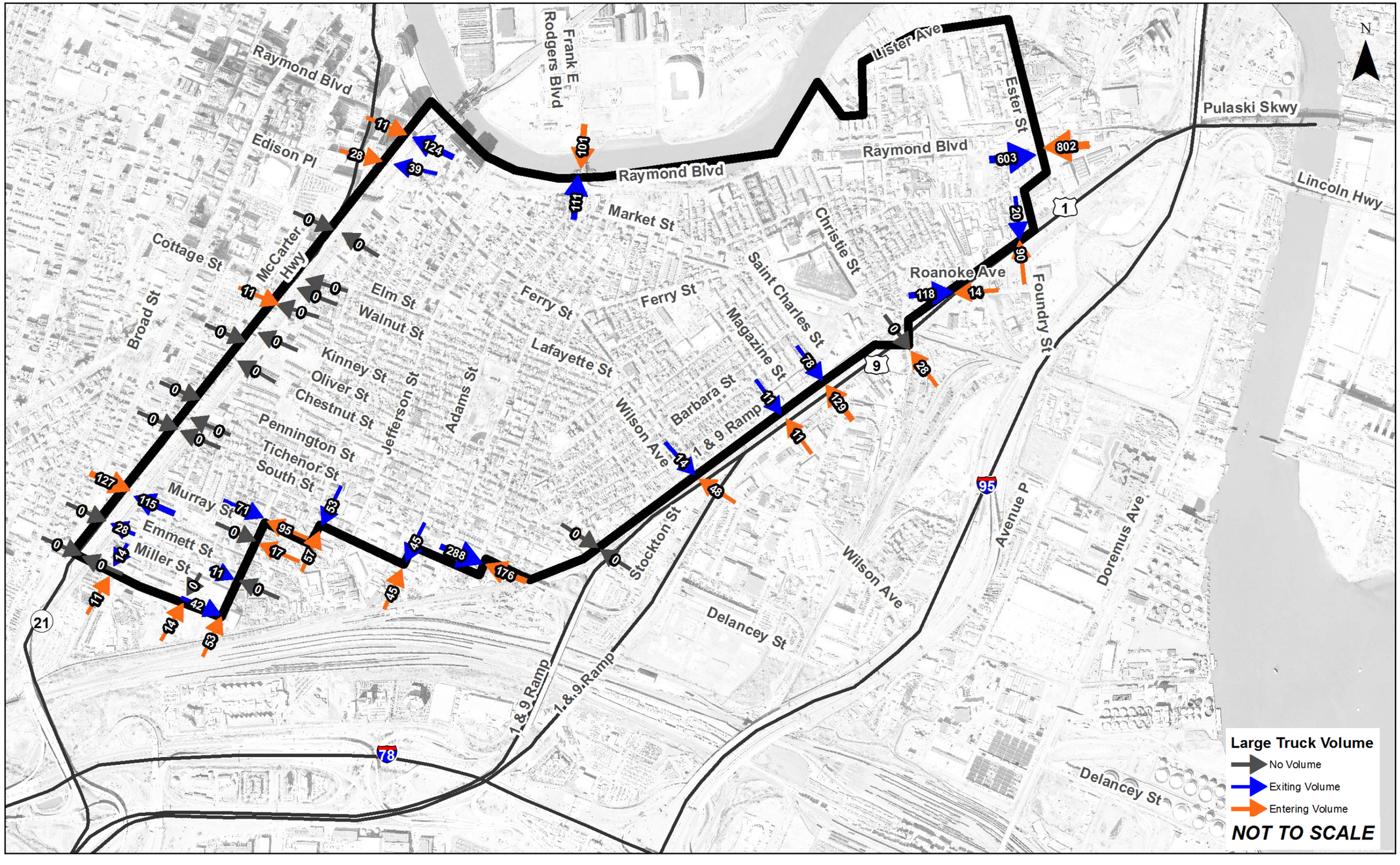


Figure 11a. Industrial District - Truck Volume Entering/Exiting the Study Area: ALL TRUCKS (Nine-Hour Period)

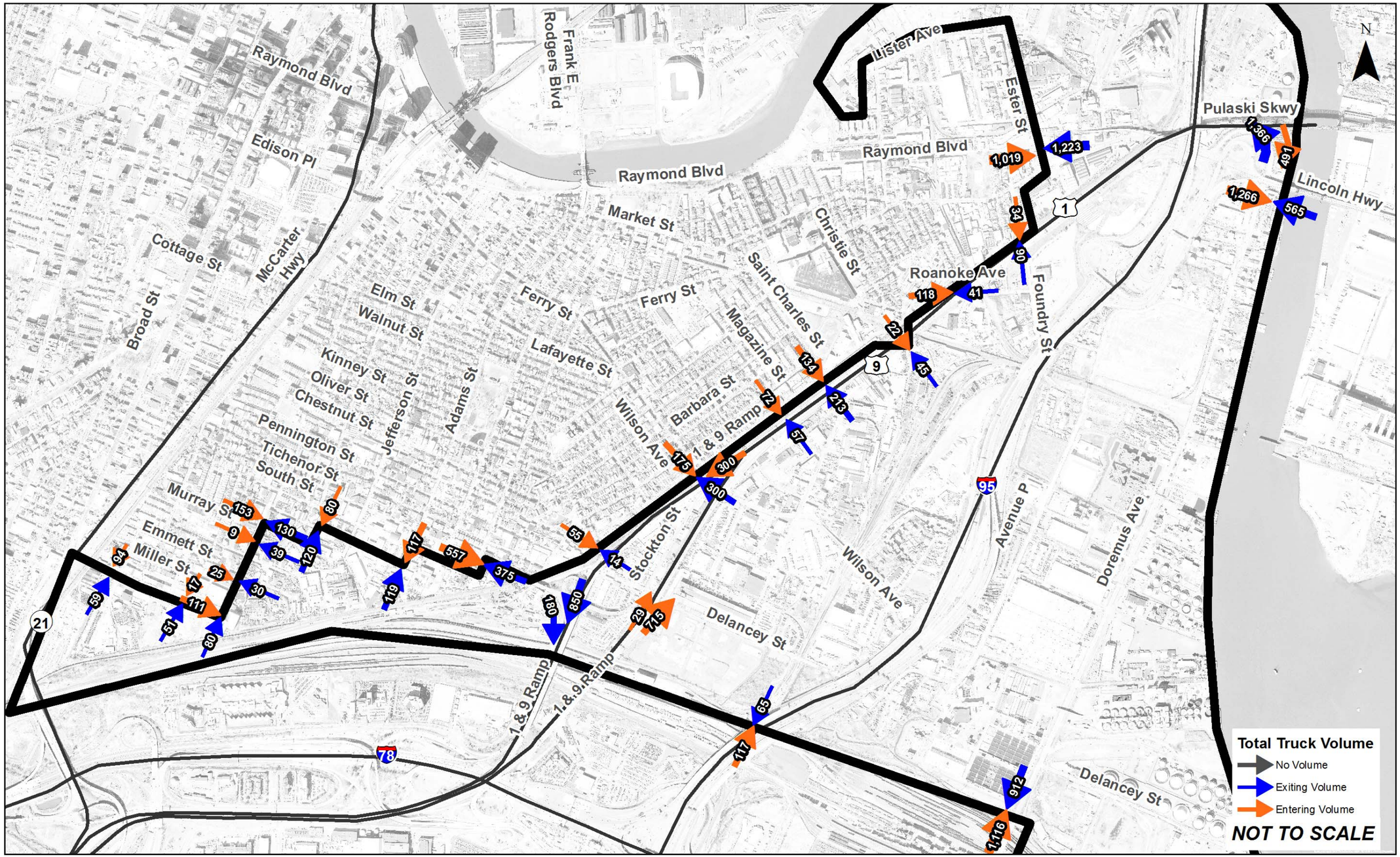
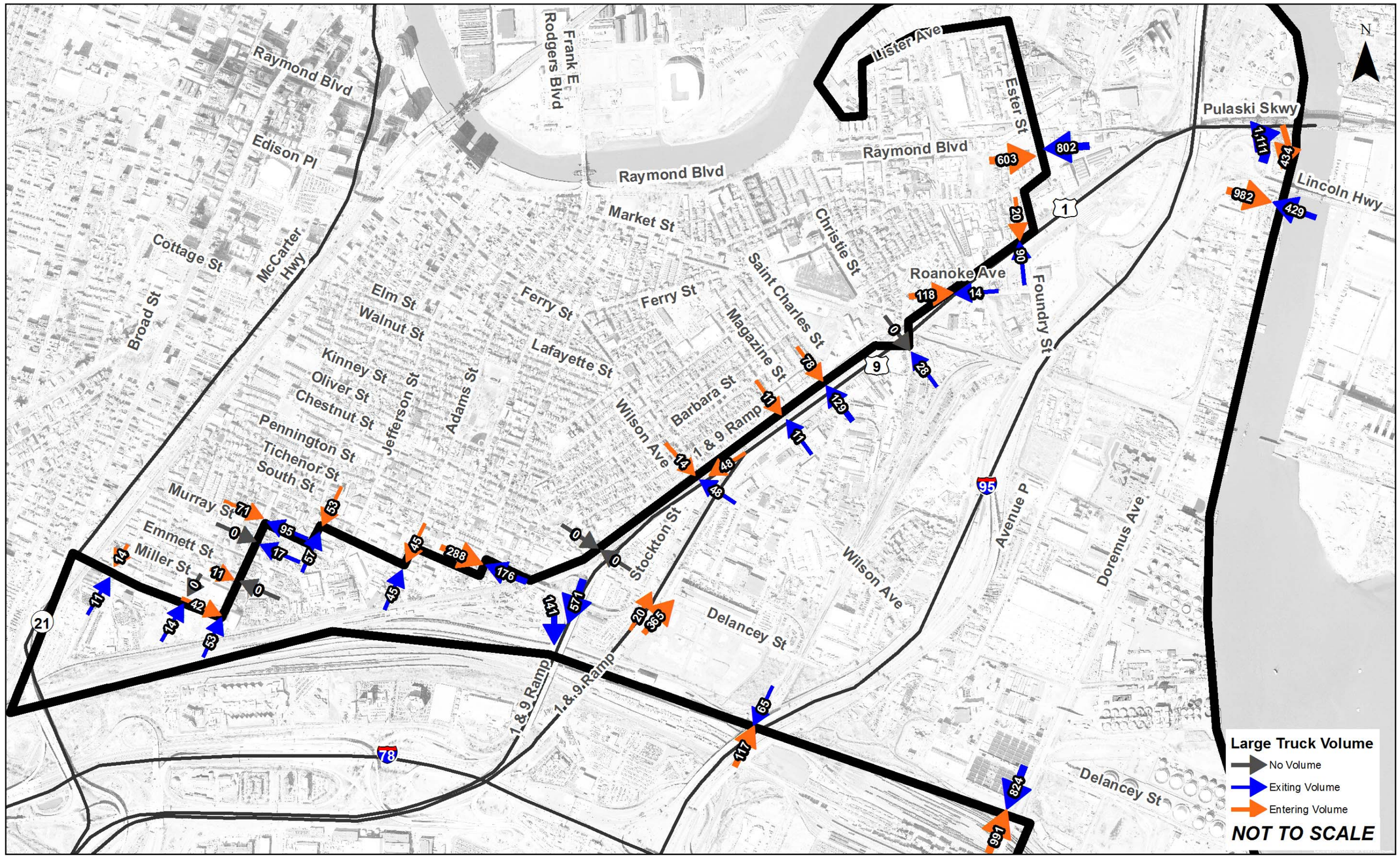


Figure 11b. Industrial District - Truck Volume Entering/Exiting the Study Area: ONLY LARGE TRUCKS (Nine-Hour Period)



Truck Route Compliance Analysis

The study area is bordered roughly on all four sides by designated truck routes: Raymond Boulevard/Market Street along its north, South Street along its south, McCarter Highway along its west, and Doremus Avenue along its east.[2] These routes are highlighted in **GREEN** on **Figures 13** and **14**

Newark's **City Ordinance 23:4-1. Truck Route for Trucks Over Four (4) Tons** states: "All trucks in total combined registered gross weight of vehicle plus load in excess of four (4) tons shall utilize those streets listed which form a part of the system of truck routes, excluding such trucks from all other streets except for the purpose of pickup and delivery of materials in the City of Newark." However, the gross weight of trucks traced in this study could not be determined from the available data set and the ordinance does not explicitly state how early in a trip a truck may deviate from a designated truck route to pick up or deliver materials. Consequently, for the purpose of this study large and small truck trips were both flagged as "Non-Compliant" when they crossed from one truck route segment to another truck route segment via non-truck routes.[3] **Table 10,** below, is a summary of all the possible Non-Compliant trips identified as large vs. small trucks.

Table 10 - Summation of All Non-Compliant Traced Truck Trips

Truck Type	Traced Trips	Classified as "Non-Compliant"	"Non-Compliant" as a Percent of Traced
Large Trucks	460	21	5%
Small Trucks	281	52	18%
Total	**741**	**73**	**10%**

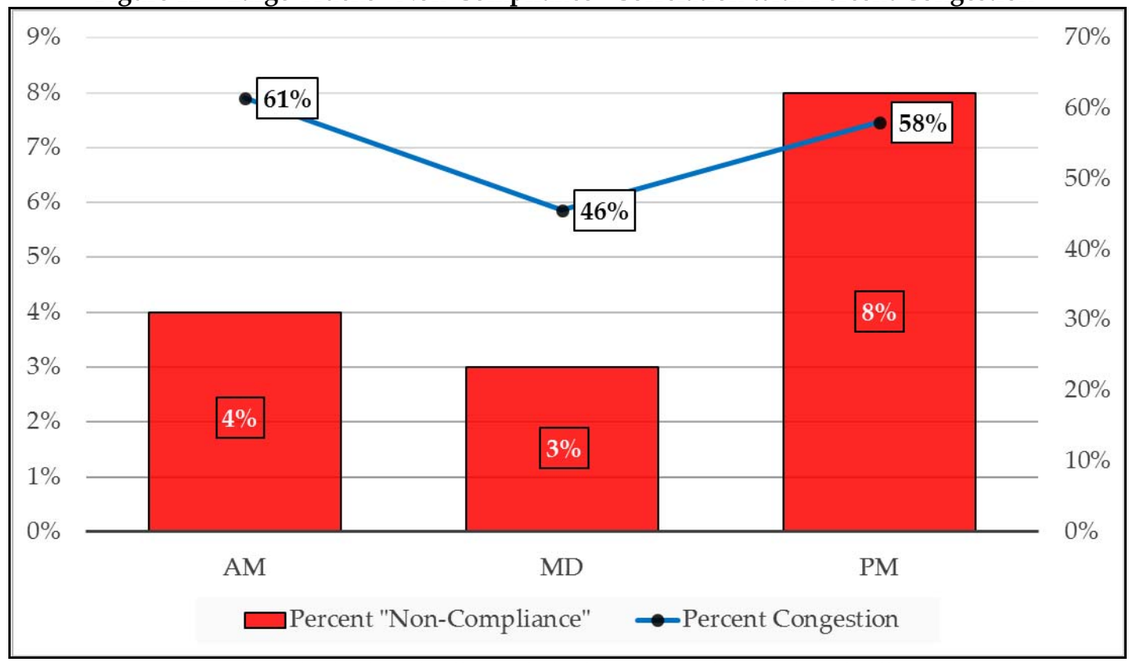
Notes: (1) - All volumes and percentages based on traced trips; not expanded volumes.

Of the 741 trucks that were traced, 73 (10%) were flagged as "Non-Compliant." It is important to note that small trucks were the most likely to be classified as "Non-Compliant" (18% of all small trucks were classified as "Non-Compliant" compared to 5% of all large trucks).

There is a strong correlation between congestion within the total study area and the percentage of large trucks that were flagged as "Non-Compliant." During the Midday period congestion levels and rates of "Non-Compliant" large trucks are low: 46% and 3%, respectively. During the AM and PM peak periods, congestion levels reach 61% and 58%, respectively, while "Non-Compliance" rates reach highs of 4% and 8%, respectively. This trend could indicate that trucks are exiting designated truck routes and cutting through the total study area on non-designated streets to avoid congestion. **Figure 12** graphically displays this correlation.

[2] The truck route designation information was provided by the City of Newark's Traffic Engineering Department.
[3] Trucks clearly flagged as parked or double parked between two truck route segments were assumed to be making required deliveries within the Ironbound Neighborhood; therefore they were excluded from this tabulation.

Figure 12 – Large Trucks "Non-Compliance" Correlation with Percent Congestion



Notes: (1) Percent Non-Compliance is based on the number of large trucks classified as "Non-Compliance" vs. the number of large trucks traced.
(2) Percent Congestion is tabulated by taking the average V/C ratio of all movements at each analysis intersection. Then weighting each ratio by the vehicular demand at each approach.

Seven truck pathways with high volumes of trips classified as "Non-Compliant" were isolated for further review. A summary of traced trips flagged as "Non-Compliant" with truck route guidelines along the isolated high concentration pathways are detailed in **Table 11** and graphically displayed in **Figure 13**.

Of the seven pathways isolated, traced trucks avoiding South Street emerged to be the most prevalent single offense, comprising 30% of all "Non-Compliant" trips. Of the 29 "Non-Compliant" trips, nine of the infractions were large trucks, comprising 50% of the total identified along a high concentration pathway (as classified in **Table 8**). These infractions are likely attributed to a combination of low vertical clearances below the Amtrak railroad tracks running along the east side of McCarter Highway and prohibited left-turn restrictions on southbound McCarter Highway, which causes trucks that have destinations in close proximity to South Street to find alternate routes via other local roads.

Wilson Avenue, St. Charles Street, and Christie Street are all parallel segments running in a northwest-to-southeast direction, allowing trucks to cut through between western truck routes (Wilson Avenue, Avenue L, Rome Street, and Roanoke Street) and northern/eastern truck routes

(McCarter Highway, Raymond Boulevard and Market Street). They comprise 39% of all trips flagged as possible violations along the isolated segments (Wilson Avenue - 20%, St. Charles Street - 11%, and, Christie Street - 8%). Furthermore, they are local roads that are surrounded by residential and community-based land uses.

Ferry Street's east and west sections comprise a total of 31% (16% and 15%, respectively), however not a single trip was flagged as utilizing Ferry Street as an end-to-end cut-through. This indicates that trucks are not utilizing Ferry Street as an alternative to the east-west Raymond Boulevard and Market Street truck routes, but a continuation of routes utilizing local roads parallel to Wilson Avenue, St. Charles Street, and Christie Street.

Table 11 - Pathways with High Concentrations of Traced Trips Classified as "Non-Compliant"

Roadway Segments/Pathways	ALL Trucks		Large Trucks		Small Trucks	
	Vol	%	Vol	%	Vol	%
Ferry St. (WEST): NJ Railroad Ave. to Wilson Ave.	14	15%	0	0%	14	18%
Ferry St. (EAST): Wilson Ave. to St Charles St.	15	16%	2	11%	13	17%
Ferry St. (End-End): NJ Railroad Ave. to St Charles St.	0	0%	0	0%	0	0%
Wilson Ave.: Ferry St. to Stockton St.	19	20%	2	11%	17	22%
St Charles St.: Ferry St. to Avenue L	11	11%	2	11%	9	12%
Christie St.: Ferry St. to Roanoke Ave.	8	8%	3	17%	5	6%
Bypassing South St. from McCarter Hwy./Delancey St.	29	30%	9	50%	20	25%
Total	**96**	**100%**	**18**	**100%**	**78**	**100%**

Notes: (1) - All volumes and percentages based on traced trips; not expanded volumes.
(2) - Trucks classified as "Non-Compliant" with established truck routes may utilize multiple segments.
(3) - "Bypassing South St. from McCarter Hwy./Delancey St." encompasses all local roadways crossing over South Street.

Trucks Traced Through School Analysis Areas

A review was conducted of the frequency that trucks pass within one block of each school inside the study area to screen for more detailed field observations. The analysis utilized the traced truck data gathered by Skycomp, Inc. and the location of each school within the total study area; with a focus on large trucks. Analysis areas were established surrounding each school extending one block in every direction. Each school's location, age groups serviced, and school identification number are graphically displayed in **Figure 14** and a summary of the number of truck trips that pass in the vicinity of each school is shown in **Table 12**.

Table 12 - Trucks Traced Through School Analysis Areas

#	School Name	Age Group	On Truck Route	Small Trucks				Large Trucks			
				AM	Midday	PM	Total	AM	Midday	PM	Total
1	St Justine II Preschool	Preschool	✓		4	4	8		2	2	4
2	Oliver Street Elementary School	Elementary			1	1	2			1	1
3	Links English Language	Institute			4	4	8				
4	Lafayette Street Elementary	Elementary		1	2	3	6				
5	Saint James School	High				2	2				
6	Newark Preschool Council INC	Preschool			7	8	15				
7	St Stevens Head Start	Preschool			7	8	15				
8	East Side High School	High		1	3	2	6	1			1
9	Ann Street School	Elementary				1	1				
10	Hawkins Street Elementary	Elementary	✓	1	5	5	11		1	3	4
11	Newark Preschool Council INC	Preschool			1		1				
12	Newark Preschool Council INC	Elementary			2	2	4				
13	Saint Casimir School	High			2	1	3				
14	Academy of Saint Benedict	Preschool			1		1				
15	Newark Preschool Council INC	Elementary			1		1				
16	Alpha and Omega	Preschool	✓	5	5	3	13			4	4
17	Interactive Educational Programs	Preschool	✓	5	5	3	13			4	4
18	South Street Elementary School	Elementary	✓	2	2	6	10		1		1

Notes: (1) - All volumes and percentages based on traced trips; not expanded volumes.

Alpha and Omega Preschool and Interactive Educational Programs Preschool (Schools 16 and 17) were subject to the highest volumes of trucking activity, totaling 17 trucks over the nine-hour period. However, Oliver Street Elementary School and East Side High School (Schools 2 and 8) were selected for further review because large trucks were traced through their analysis zones and due to their site being relatively distant from all surrounding truck routes. Supplemental field observations counted one to two large trucks passing at the vicinity of the schools during both the opening and closing hours at each school.

Figure 13 - Traced Truck Trips Classified as "Non-Compliant"
(Nine-Hour Period)

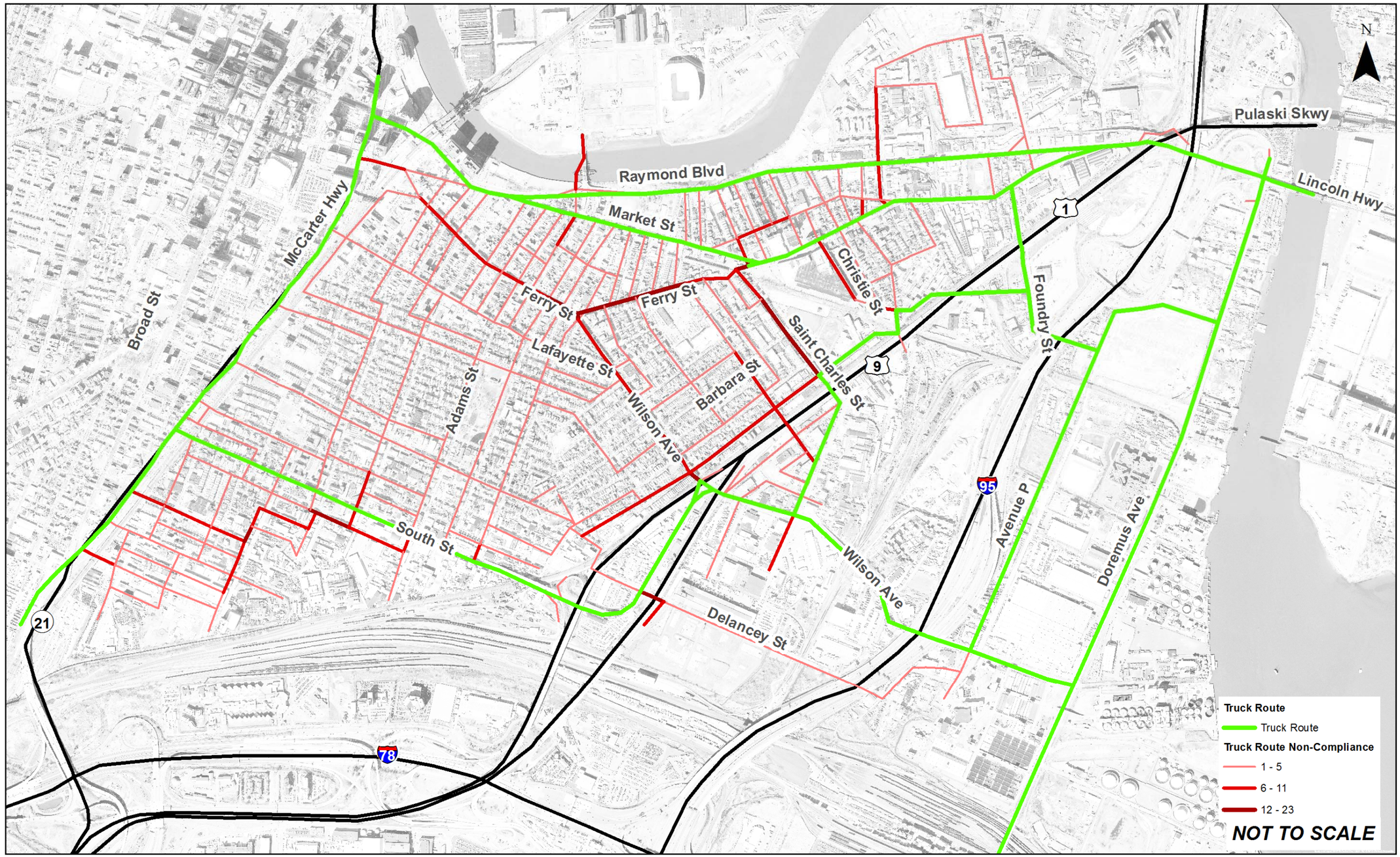
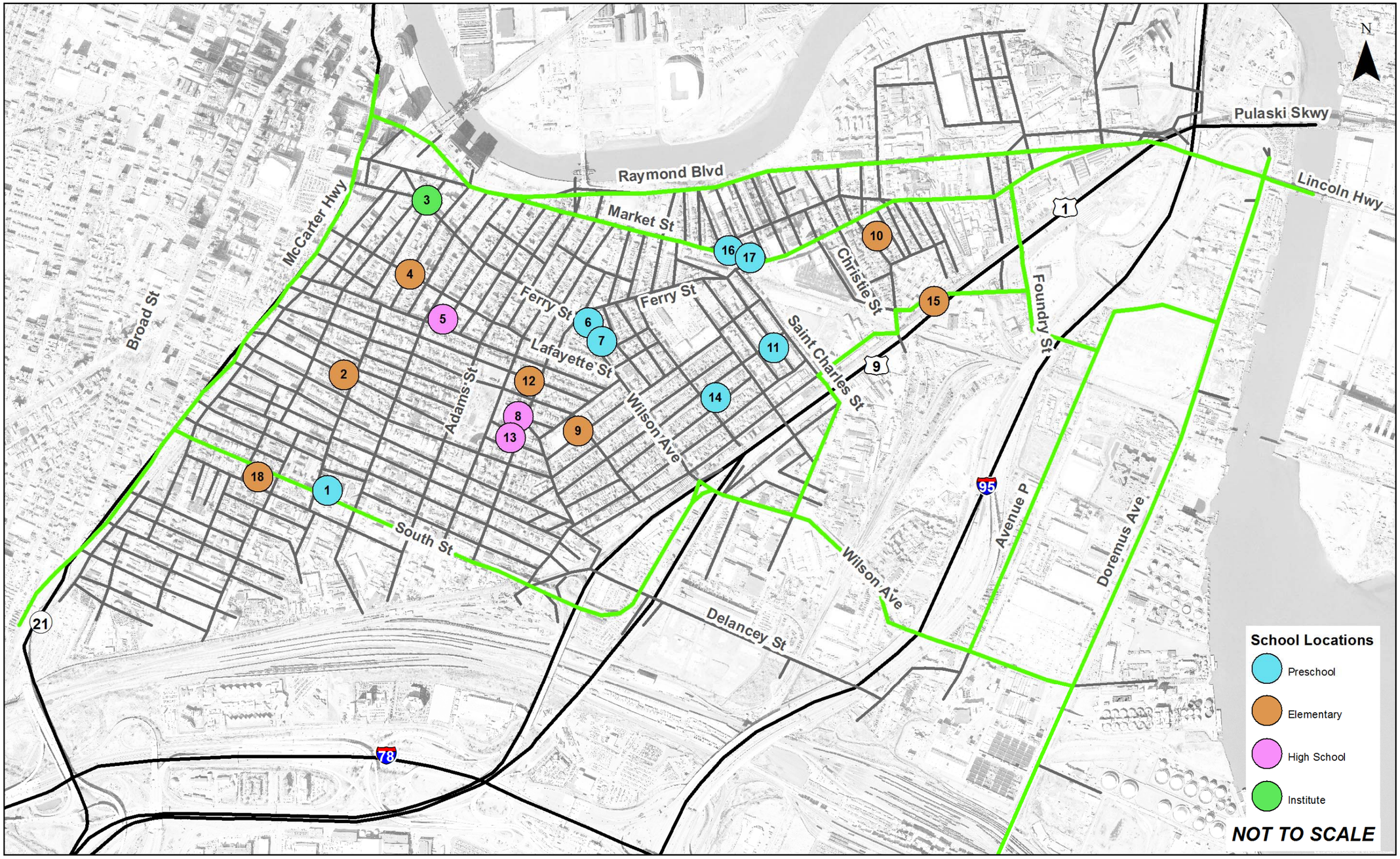


Figure 14 – School Locations



Operational Analysis Findings

To capture the different peaking characteristics of the analysis intersections, three distinct zones were created, as shown in **Figure 15**. Each zone was analyzed according to their own specific AM, Midday, and PM peak hours as shown in **Table 13.**

Figure 15 – Operational Analysis Locations

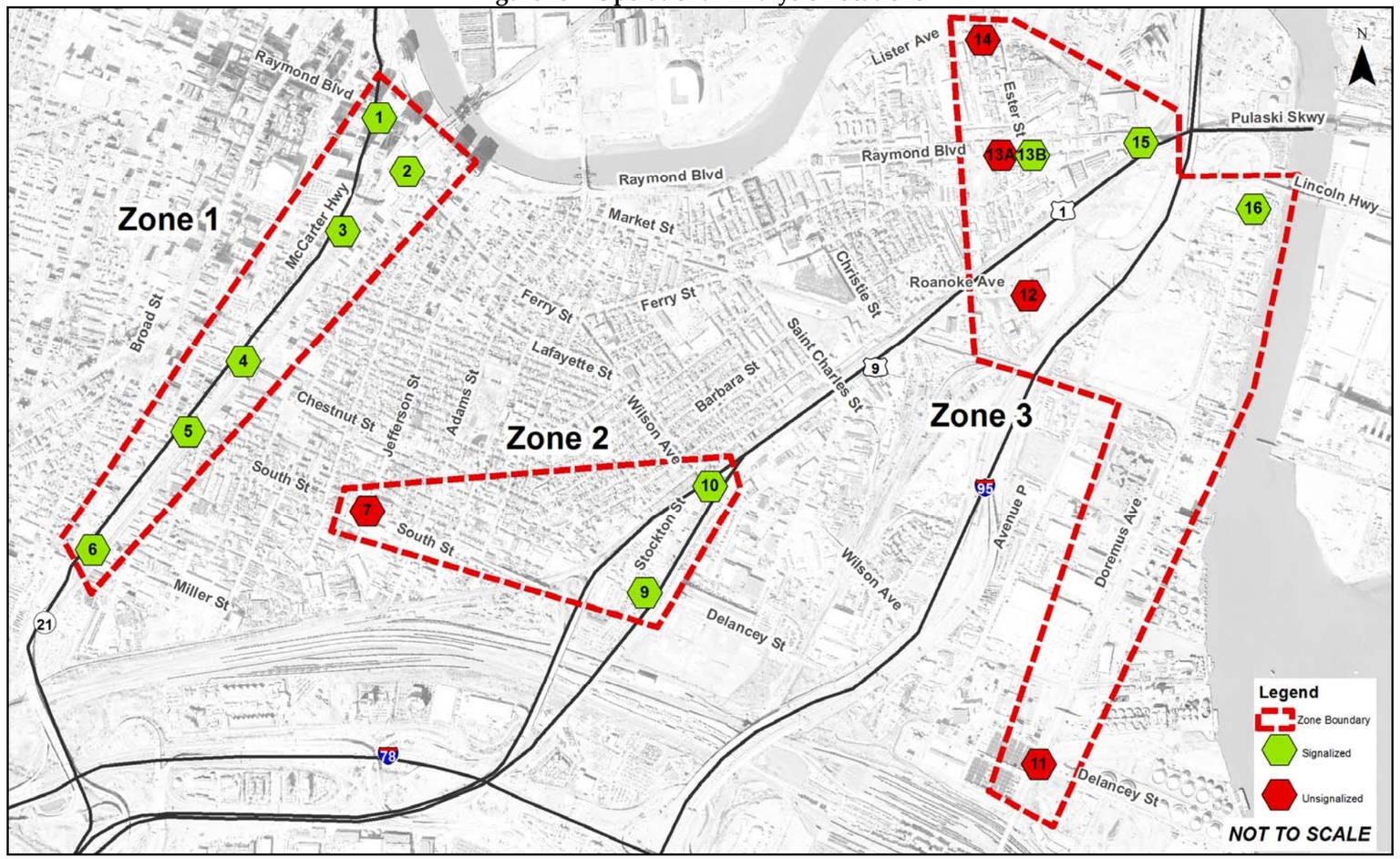


Table 13 – Peak Hours by Time Period and Zone

ZONE	Corridor/Location	Peak hour		
		AM	MD	PM
1	McCarter Highway (Route 21)	7:30 - 8:30	12:30-13:30	15:45 - 16:45
2	Stockton Street/South Street	7:15 - 8:15	11:45 - 12:45	16:30 - 17:30
3	Raymond Boulevard/Doremus Avenue	7:30 - 8:30	11:30 - 12:30	15:15 - 16:15

Zone 1: McCarter Highway (NJ Route 21) Corridor and Market / Ferry Streets

Intersections in this zone serve as the main entry and exit points to the Ironbound Neighborhood from Route US-22 and I-78 to the south, and from McCarter Highway and I-280 to the north. On average, 5% of vehicles circulating through these intersections during the analysis hours are trucks. The following intersections were analyzed as representatives of this zone:

- Location 1: Raymond Boulevard and McCarter Highway
- Location 2: Market Street and Ferry Street
- Location 3: Lafayette Street and McCarter Highway
- Location 4: Chestnut Street and McCarter Highway
- Location 5: South Street and McCarter Highway
- Location 6: Miller Street and McCarter Highway

Among all analysis locations, the movements with the highest truck percentages are: (1) the left turn from westbound Miller Street into southbound McCarter Highway, with 27% trucks during the AM peak hour; and (2) the right turn from northbound McCarter Highway onto eastbound Miller Street, with 22% trucks during the PM peak hour.

Overall, all analysis intersections operate at a Level of Service (LOS) D or better during the analysis hours, with a few specific movements operating at LOS F.

During the AM peak, the intersection of McCarter Highway with South Street operates at LOS D. However, its northbound approach operates 4% over capacity (v/c ratio = 1.04) at LOS E. This approach represents the "capacity pinch point" in the northbound direction, causing queues that spill back to the upstream intersections and extend on any typical day up to 2,000 feet from Miller Street onto the McCarter Highway viaduct. Additionally, during the AM peak the southbound left-turn movement at the intersection of McCarter Highway and Raymond Boulevard operates at LOS F with delays greater than two minutes.

During the Midday peak, only the intersection of McCarter Highway and South Street's eastbound movement operates at LOS F; average vehicle delays are greater than one minute.

During the PM peak, the southbound left-turn movement from McCarter Highway to Raymond Boulevard operates at LOS F with delays greater than one minute. Additionally, the intersection of McCarter Highway and South Street's eastbound and westbound left turn movements operate at LOS F with delays greater than one minute.

Table 14 summarizes the findings of the operational analysis conducted for Zone 1 intersections during the AM, Midday, and PM peak hours. Individual intersections along McCarter Highway may operate with acceptable levels of service during the AM and PM peak periods, but the corridor, as a whole, is congested and may have capacity constraints at intersections that were not analyzed.

Zone 2: Wilson Avenue, Stockton Street, and Delancey Street

Stockton Avenue, Wilson Avenue, Delancey Street and South Street are the most heavily trafficked roadways in the area as they provide ingress and egress to the southernmost section of the Ironbound Neighborhood and the Industrial District from key regional corridors such as McCarter Highway, US Routes 1&9 and Doremus Avenue. On average, 8% of vehicles circulating through these corridors during the analysis hours are trucks. The following intersections were analyzed as representatives of this zone:

- South Street and Jefferson Street
- South Street, Stockton Street, and Delancey Street
- Stockton Street and Wilson Avenue

The intersection of South and Jefferson Streets operates at LOS C or better during the AM, Midday, and PM peak hours. However, during the PM peak hour, the southbound approach at Jefferson Street operates 7% over capacity (v/c ratio = 1.07), and at LOS F. South Street is regularly utilized by trucks as it connects Stockton Street with McCarter Highway, and provides access to local factories, warehouses, and other trucking facilities located in the area. Jefferson Street crosses the Ironbound Neighborhood in the north/south direction and provides access to local residents to the regional arterial network.

The intersection of Stockton Street with Delancey Street provides access to the Ironbound Neighborhood and the Industrial District from Routes 1&9 North, and it is an alternate route to and from Doremus Avenue, causing it to be the most heavily traveled intersection among the three analysis intersections in the zone. This intersection operates at an overall LOS F during the AM and PM peak hours and processes between 2,100 and 2,400 vehicles per hour with one exclusive left-turn lane and one shared through-right lane in all of its approaches. The southbound and the westbound approaches experience LOS E and LOS F during the AM and PM peak hours, respectively. A significant part of these operational deficiencies can be attributed to the poor signal coordination with the upstream intersection (intersection of Delancey Street with the Routes 1&9 North Off-Ramp).

The intersection of Stockton Street with Wilson Avenue provides access from Routes 1&9 south. This intersection operates at LOS C during the AM, Midday, and PM peak hours.

Table 15 summarizes the findings of the operational analysis conducted for Zone 2 intersections during the AM, Midday, and PM peak hours.

Zone 3: Northeastern Section of Study Area

Intersections in this zone serve as a main ingress and egress into the northern/eastern section of the Ironbound Neighborhood and the Industrial District from the Pulaski Skyway, Truck Routes 1&9 (Lincoln Highway) and the New Jersey Turnpike. On average, 21% of vehicles circulating through these intersections during the analysis hours are trucks. The following intersections are located in this zone:

- Delancey Street and Doremus Avenue
- Foundry Street and Roanoke Avenue
- Raymond Boulevard between Lockwood Street and Foundry Street
- Lister Avenue and Esther Street
- Lincoln Highway and Raymond Boulevard
- Lincoln Highway and Doremus Avenue

In spite of the relatively high truck percentages observed in these intersections, overall traffic volumes are generally low. The highest intersection volume recorded was about 1,600 vehicles per hour at the intersection of Lincoln Highway and Raymond Boulevard, during the PM peak hour.

Overall, all intersections in this zone operate at LOS B or better, with a few specific movements operating at LOS C or LOS D.

Table 16 summarizes the findings of the operational analysis conducted for the Zone 3 intersections during the AM, Midday, and PM peak hours.

Figure 16 shows the overall Intersection Level of Service for all analysis intersections (Zones 1, 2, and 3) during the AM, Midday, and PM peak hours.

Table 14 – Operational Analysis Results: Zone 1
(McCarter Highway Corridor and Market Street / Ferry Street)

Loc. ID	Intersection	Peak Period and Hour:		AM 7:30 - 8:30				Midday 12:30 - 1:30				PM 3:45 - 4:45			
		Approach	Movt.	Hourly Volume	V/C Ratio[1]	Delay[2]	LOS[3,4]	Hourly Volume	V/C Ratio[1]	Delay[2]	LOS[3,4]	Hourly Volume	V/C Ratio[1]	Delay[2]	LOS[3,4]
1	McCarter Hwy and Raymond Blvd.	EB Raymond	TR	598	0.61	37.5	D	317	0.38	35.3	D	377	0.40	38.8	D
		WB Raymond	T	1,033	1.00	65.9	E	504	0.59	38.7	D	745	0.65	43.1	D
			R	440	0.81	35.4	D	252	0.48	25.3	C	495	0.87	47.7	D
			BUS	-	-	-	-	-	-	-	-	52	0.84	111.3	F
		NB McCarter	L	103	0.46	46.9	D	60	0.33	48.3	D	37	0.27	56.4	E
			TR	1,238	0.64	29.4	C	1,074	0.47	17.4	B	1,363	0.87	43.0	D
		SB McCarter	L	529	1.05	135.9	F	334	0.78	55.6	E	387	1.00	97.6	F
			TR	1,648	0.74	23.1	C	1,439	0.57	14.7	B	1,499	0.77	33.4	C
		Overall Intersection:		**5,589**	**0.83**	**40.5**	**D**	**3,980**	**0.60**	**24.9**	**C**	**4,955**	**0.91**	**45.7**	**D**
2	Market St. and Ferry St.	EB Market St.	LT	216	0.41	31.2	C	170	0.31	27.7	C	198	0.27	25.9	C
			TR	285	0.64	23.7	C	217	0.33	14.9	B	254	0.33	13.4	B
		WB Market St.	LT	357	0.49	31.1	C	215	0.25	26.1	C	252	0.25	25.0	C
		NJ Railroad Ave.	LTR	218	0.27	24.9	C	118	0.16	25.4	C	176	0.28	34.7	C
		WB Ferry St.	LTR	200	0.52	43.5	D	211	0.59	48.9	D	253	0.67	56.7	E
		Overall Intersection:		**1,276**	**0.49**	**30.2**	**C**	**931**	**0.32**	**28.6**	**C**	**1,133**	**0.39**	**31.8**	**C**
3	McCarter Hwy and Lafayette St.	EB Lafayette	LTR	181	0.38	34.1	C	104	0.19	28.0	C	136	0.34	37.9	D
		WB Lafayette	LTR	325	0.82	51.3	D	264	0.61	42.8	D	326	0.73	54.1	D
		NB McCarter	L	36	0.23	15.6	B	23	0.13	13.4	B	22	0.17	15.1	B
			TR	1,593	0.91	28.5	C	1,041	0.57	15.3	B	1,189	0.67	18.7	B
		SB McCarter	L	62	0.47	17.0	B	75	0.24	6.9	A	117	0.48	11.4	B
			TR	1,181	0.59	10.8	B	1,250	0.65	11.6	B	1,421	0.63	11.6	B
		Overall Intersection:		**3,378**	**0.91**	**25.0**	**C**	**2,757**	**0.64**	**16.8**	**B**	**3,211**	**0.70**	**20.3**	**C**
4	McCarter Hwy and Chestnut St.	WB Chestnut St.	LTR	301	0.47	36.2	D	191	0.43	42.5	D	300	0.51	46.5	D
		NB McCarter	L	97	0.76	47.3	D	47	0.20	6.1	A	69	0.72	49.5	D
			T	1,226	0.61	10.1	B	1,154	0.50	6.0	A	1,398	0.61	9.8	A
		SB McCarter	TR	1,331	0.65	10.7	B	1,197	0.50	6.0	A	1,684	0.70	11.0	B
		Overall Intersection:		**2,955**	**0.69**	**14.4**	**B**	**2,589**	**0.49**	**9.1**	**A**	**3,451**	**0.68**	**14.8**	**B**
5	McCarter Hwy and South St.	EB South St.	LTR	208	0.84	62.2	E	210	0.95	89.6	F	221	0.97	100.3	F
		WB South St.	L	65	0.50	48.2	D	72	0.64	65.2	E	82	0.82	96.3	F
			TR	242	0.91	71.9	E	144	0.53	46.8	D	192	0.69	59.5	E
		NB McCarter	L	24	0.36	15.7	B	26	0.23	14.0	B	19	0.39	33.1	C
			TR	1,955	1.04	61.4	E	1,279	0.69	16.7	B	1,639	0.81	21.1	C
		SB McCarter	L	95	0.68	33.2	C	90	0.39	8.8	A	98	0.80	51.2	D
			TR	1,321	0.66	13.8	B	1,384	0.62	10.9	B	2,008	0.82	46.5	D
		Overall Intersection:		**3,910**	**1.01**	**43.9**	**D**	**3,205**	**0.77**	**21.3**	**C**	**4,259**	**0.85**	**41.3**	**D**
6	McCarter Hwy and Miller St.	EB Miller St.	L	3	0.03	35.0	C	3	0.03	37.0	D	7	0.04	38.4	D
			TR	30	0.17	26.0	C	18	0.10	27.6	C	19	0.08	29.8	C
		WB Miller St.	LTR	73	0.44	43.8	D	108	0.58	47.8	D	181	0.81	66.4	E
		NB McCarter	T	2,819	0.88	16.9	B	1,457	0.45	7.7	A	1,964	0.62	12.4	B
			R	423	0.39	1.4	A	133	0.13	1.1	A	170	0.17	1.4	A
		SB McCarter	T	1,521	0.50	2.6	A	1,615	0.51	8.6	A	2,177	0.68	15.8	B
		Overall Intersection:		**4,869**	**0.79**	**11.5**	**B**	**3,334**	**0.52**	**9.6**	**A**	**4,518**	**0.71**	**16.4**	**B**

Notes:
(1) - Overall intersection V/C ratio is the critical lane group's V/C ratio, not the weighted average of all the movements.
(2) - Delays are measured in seconds per vehicle.
(3) - The level of service (LOS) for unsignalized intersections is based upon control delay per vehicle (sec/veh) for each approach in the 2000 Highway Capacity Manual.
(4) - The level of service (LOS) for signalized intersection is based upon average total delay per vehicle (sec/veh) for each lane group as listed in the 2000 Highway Capacity Manual

Table 15 – Operational Analysis Results: Zone 2
(Wilson Avenue, Stockton Avenue, and Delancey Street)

Loc. ID	Intersection	Peak Period and Hour:		AM 7:15 - 8:15				Midday 11:45 - 12:45				PM 4:30 - 5:30			
		Approach	Movt.	Hourly Volume	V/C Ratio[1]	Delay[2]	LOS[3,4]	Hourly Volume	V/C Ratio[1]	Delay[2]	LOS[3,4]	Hourly Volume	V/C Ratio[1]	Delay[2]	LOS[3,4]
7	South St. and Jefferson St.	EB South St.	LTR	451	0.03	0.9	A	387	0.05	1.7	A	647	0.06	1.6	A
		WB South St.	LTR	265	0.06	2.2	A	239	0.04	1.5	A	341	0.09	2.7	A
		NB Jefferson	LTR	94	0.21	11.9	B	65	0.12	11.0	B	100	0.30	17.4	C
		SB Jefferson	LTR	191	0.49	19.7	C	194	0.49	17.7	C	268	1.07	108.4	F
		Overall Intersection:		**1,001**	**-**	**6.2**	**A**	**885**	**-**	**6.2**	**A**	**1,356**	**-**	**24.4**	**C**
9	Stockton St. and Delancey St.	EB Delancey	L	10	0.24	23.3	C	34	0.19	15.7	B	11	0.18	17.8	B
			TR	343	0.58	20.9	C	215	0.35	16.5	B	447	0.71	25.4	C
		WB Delancey	L	274	0.73	36.2	D	257	0.55	14.7	B	289	0.85	75.1	E
			TR	912	1.04	208.1	F	622	0.69	17.9	B	900	0.89	200.9	F
		NB Stockton	LT	185	0.56	35.4	D	182	0.53	34.2	C	228	0.97	81.6	F
			R	49	0.15	26.5	C	41	0.16	27.2	C	24	0.08	25.8	C
		SB Stockton	L	39	0.22	28.8	C	35	0.24	29.9	C	34	0.23	30.6	C
			TR	292	0.88	56.7	E	317	0.87	56.4	E	453	1.09	103.7	F
		Overall Intersection:		**2,104**	**0.99**	**112.2**	**F**	**1,703**	**0.73**	**26.2**	**C**	**2,386**	**0.95**	**115.2**	**F**
10	Stockton St. and Wilson Ave.	EB Wilson	T	288	0.70	33.8	C	183	0.57	33.2	C	186	0.70	37.8	D
			R	138	0.30	5.2	A	161	0.38	7.3	A	168	0.45	7.8	A
		WB Wilson	L	148	0.70	30.5	C	170	0.63	25.7	C	194	0.61	21.3	C
			T	87	0.14	14.4	B	192	0.37	18.0	B	227	0.38	16.8	B
		NB Stockton	L	297	0.82	49.4	D	196	0.45	27.9	C	285	0.55	25.7	C
			R[5]	444	0.59	14.9	B	372	0.42	11.3	B	407	0.44	11.4	B
		SB Ramp from Rte. 1/9	LT	154	0.74	50.4	D	139	0.65	40.9	D	87	0.51	38.0	D
			R	111	0.39	9.3	A	113	0.37	9.2	A	258	0.66	12.3	B
		Overall Intersection:		**1,667**	**0.71**	**32.1**	**C**	**1,526**	**0.56**	**23.6**	**C**	**1,812**	**0.55**	**21.4**	**C**

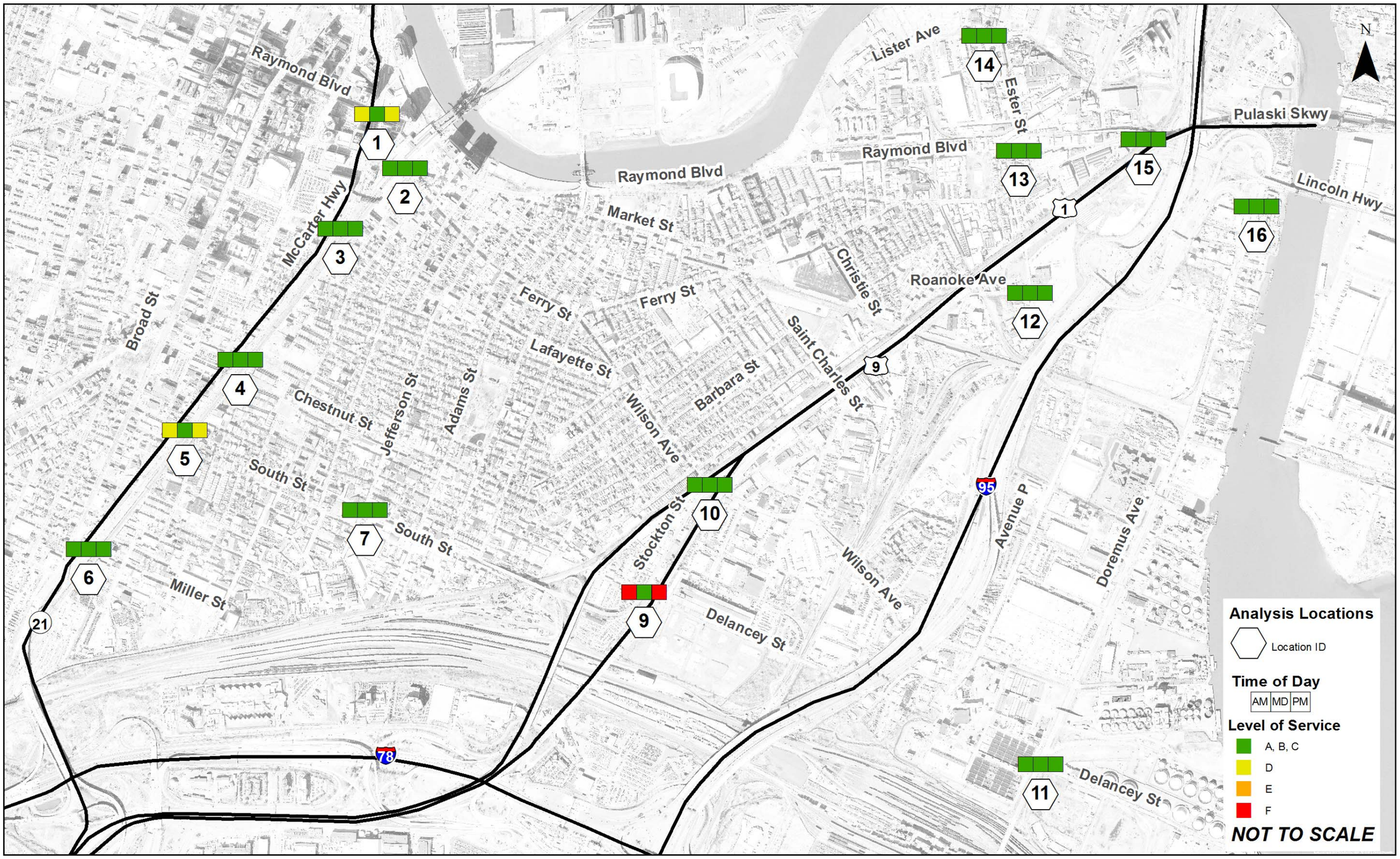
Notes:
(1) - Overall intersection V/C ratio is the critical lane group's V/C ratio, not the weighted average of all the movements.
(2) - Delays are measured in seconds per vehicle.
(3) - The level of service (LOS) for unsignalized intersections is based upon control delay per vehicle (sec/veh) for each approach in the 2000 Highway Capacity Manual.
(4) - The level of service (LOS) for signalized intersection is based upon average total delay per vehicle (sec/veh) for each lane group as listed in the 2000 Highway Capacity Manual
(5) – The right turn movement for this approach is a channelized yield operation.

Table 16 – Operational Analysis Results: Zone 3
(Ironbound Neighborhood Northeastern Section)

Loc. ID	Intersection	Peak Period and Hour:		AM 7:30 - 8:30				Midday 11:30 - 12:30				PM 3:15 - 4:15			
		Approach	Movt.	Hourly Volume	V/C Ratio[2]	Delay[3]	LOS[4,5]	Hourly Volume	V/C Ratio[2]	Delay[3]	LOS[4,5]	Hourly Volume	V/C Ratio[2]	Delay[3]	LOS[4,5]
11[1]	Delancey St. and Doremus Ave.	WB Delancey	LR	68	0.25	17.7	C	76	0.23	15.1	C	116	0.44	21.4	C
		NB Doremus	T	254	0.11	0.0	A	255	0.11	0.0	A	339	0.15	0.0	A
			TR	30	0.08	0.0	A	34	0.09	0.0	A	36	0.10	0.0	A
		SB Doremus	TL	43	0.06	3.9	A	38	0.05	3.7	A	27	0.05	2.6	A
			T	254	0.10	0.0	A	243	0.10	0.0	A	337	0.16	0.0	A
		Overall Intersection:		**649**	**-**	**3.1**	**A**	**646**	**-**	**2.8**	**A**	**855**	**-**	**3.9**	**A**
12[1]	Roanoke Ave. and Foundry St.	EB Roanoke	LR	42	0.08	9.3	A	41	0.07	10.1	B	47	0.13	12.2	B
		NB Foundry	LT	47	0.02	3.1	A	81	0.04	3.5	A	152	0.09	3.9	A
		SB Foundry	TR	53	0.04	0.0	A	76	0.05	0.0	A	106	0.08	0.0	A
		Overall Intersection:		**142**	**-**	**4.0**	**A**	**198**	**-**	**3.7**	**A**	**305**	**-**	**4.1**	**A**
13A	Raymond Blvd. and Lockwood St.	WB Raymond	LTR	1,191	0.39	6.5	A	767	0.26	5.3	A	896	0.31	6.1	A
		NB Lockwood	LT	34	0.13	20.7	C	51	0.25	22.7	C	35	0.11	20.3	C
		SB Lockwood	TR	60	0.42	25.7	C	88	0.38	23.4	C	138	0.51	26.5	C
		Overall Intersection:		**1,285**	**0.39**	**8.3**	**A**	**906**	**0.28**	**8.6**	**A**	**1,069**	**0.36**	**9.4**	**A**
13B[1]	Raymond Blvd. and Foundry St.	WB Raymond	LT	36	0.03	1.6	A	33	0.04	2.9	A	54	0.06	3.4	A
			T	1,042	0.19	0.0	A	656	0.12	0.0	A	754	0.14	0.0	A
		NB Foundry	L	37	0.27	32.8	D	57	0.26	23.7	C	83	0.54	30.3	D
		SB Foundry	TR	430	0.62	15.5	C	200	0.35	12.2	B	233	0.35	12.0	B
		Overall Intersection:		**1,545**	**-**	**5.9**	**A**	**946**	**-**	**4.9**	**A**	**1,124**	**-**	**6.7**	**A**
14[1]	Lister Ave. and Esther St.	EB Lister	LTR	23	0.03	0.0	A	43	0.00	0.4	A	36	0.03	0.0	A
		WB Lister	LTR	25	0.00	0.9	A	37	0.01	1.3	A	35	0.00	0.7	A
		NB Esther	LTR	3	0.00	9.3	A	13	0.02	9.5	A	5	0.02	8.9	A
		SB Esther	LTR	2	0.01	10.0	B	3	0.01	9.3	A	3	0.01	9.4	A
		Overall Intersection:		**53**	**-**	**1.3**	**A**	**96**	**-**	**2.2**	**A**	**79**	**-**	**2.5**	**A**
15	Lincoln Highway and Raymond Blvd.	EB Raymond	TR	595	0.30	5.8	A	560	0.29	5.6	A	694	0.34	5.9	A
		WB Lincoln	T	461	0.20	5.0	A	432	0.19	4.9	A	518	0.23	5.2	A
			R	3	0.01	3.0	A	12	0.02	2.1	A	3	0.00	2.7	A
		SB from NJTpk & Doremus	L	19	0.17	40.4	D	65	0.45	45.8	D	28	0.22	39.3	D
			R	494	0.94	34.9	C	286	0.69	13.0	B	361	0.80	19.2	B
		Overall Intersection:		**1,572**	**0.39**	**15.6**	**B**	**1,355**	**0.31**	**9.4**	**A**	**1,604**	**0.36**	**9.8**	**A**
16	Lincoln Highway and Doremus St.	EB from Lincoln	L	156	0.38	19.1	B	190	0.43	20.1	C	187	0.38	18.7	B
			R	304	0.25	0.5	A	210	0.20	0.4	A	168	0.18	0.4	A
		NB Doremus	L	88	0.30	12.8	B	117	0.34	13.6	B	118	0.40	13.8	B
			T	127	0.30	14.6	B	181	0.35	15.2	B	327	0.61	19.1	B
		SB Doremus	T	138	0.37	22.0	C	103	0.33	22.4	C	77	0.32	22.3	C
			R	4	0.01	11.2	B	9	0.03	9.7	A	6	0.03	9.8	A
		Overall Intersection:		**817**	**0.35**	**11.7**	**B**	**810**	**0.40**	**13.4**	**B**	**883**	**0.51**	**15.3**	**B**

Notes:
(1) – Unsignalized Intersection/Movement.
(2) – Overall intersection V/C ratio is the critical lane group's V/C ratio, not the weighted average of all the movements.
(3) – Delays are measured in seconds per vehicle.
(4) – The level of service (LOS) for unsignalized intersections is based upon control delay per vehicle (sec/veh) for each approach in the 2000 Highway Capacity Manual.
(5) – The level of service (LOS) for signalized intersection is based upon average total delay per vehicle (sec/veh) for each lane group as listed in the 2000 Highway Capacity Manual

Figure 16 - Operational Analysis Findings: Overall Intersection Level of Service for AM, Midday, and PM Peak Hours



CONCLUSION

- The two study areas are estimated to contain about 10,690 truck trips in the course of the three peak periods. Of those, about 1,230 trucks were associated with the Ironbound Neighborhood, 4,560 trucks were associated with the Industrial District, and 4,900 were associated with both. Both the Ironbound Neighborhood and the Industrial District, the large truck/small truck breakdown is 48%/52% and 82% / 18%, respectively.

- For the Ironbound Neighborhood truck trips estimated, 24% entered, 23% exited, 45% passed through, and 8% remained internal; while for the Industrial District, 22% entered, 28% exited, 45% passed through, and 5% remained internal.

- During the nine-hour study, the designated truck routes of Doremus Avenue, Raymond Boulevard, Stockton, and South Streets were the most heavily utilized within the entire study area with 900 to 1,500 trucks each. While the non-designated truck routes of Ferry Street, Wilson Street, Christie Street, and St. Charles Street were estimated to carry 150 to 300 trucks each.

- Average speeds along Raymond Boulevard, Doremus Avenue, and Market Street were generally recorded in the range of 20 to 35 mph. Ferry Street, Stockton Street's southbound approach to Delancey Street, and many smaller local roads were identified to have speeds below 10 mph over the nine-hour period. Speeds below 10 mph along Ferry Street and Stockton can be attributed to delays caused by congestion, while speeds below 10 mph on smaller local roads are likely attributed to delays at signalized and stop-controlled intersections. Average speeds were generally equivalent within the Ironbound Neighborhood and the Industrial District.

- The main operational deficiency identified among the analysis locations was the intersection of Stockton Street and Delancey Street, as it operates, overall, with LOS F conditions causing average delays of about two minutes to the roadway users during the AM and PM peak hours. This intersection processes a significant number of local trucks.

OVERALL STUDY AREA MITIGATIONS/RECOMMENDATONS

Review Existing Truck Route Policies and Regulations

For the purposes of this study, an attempt was made to get an "official" map encompassing all truck routes within the Ironbound Neighborhood and the Industrial District. However, all maps obtained from a variety of transportation agencies were judged out of date. Consequently, the truck routes utilized for this study were a result of coordination with the City of Newark's Division of Traffic and Signals. Due to the length of this process it is recommend that all information regarding commercial truck routes be compiled and distributed to all relevant transportation agencies, local stakeholders, law enforcement, and the public. This may support compliance and increase ease of enforcement.

Enforcement of Parking Regulations

It is recommended that the city revisit current parking regulations regarding on-street loading and unloading areas and increase police enforcement in the vicinity of observed double parking hotspots (1) Astor Street & Goble Street, (2) Pulaski Street & Clifford Street, (3) Lafayette Street & Prospect Street, and (4) Lang Street & Wilson Avenue. This would greatly improve overall capacity and safety of the roadway and its users, respectively.

Establish New Truck Routes

Trucks were traced along nearly all road segments within the study area during the three peak periods captured by Skycomp, Inc. They utilized a variety of routes to travel through the study area and gain access to businesses within it.

Of the seven pathways isolated, traced trucks avoiding South Street emerged to be the most prevalent single offense, comprising 30% of all "Non-Compliant" trips[4]. These infractions may be attributed to a combination of low vertical clearances below the Amtrak tracks running parallel to McCarter Highway and left-turn restrictions for vehicles traveling southbound on McCarter Highway. South Street at McCarter Highway has a vertical clearance of 12' 4'', therefore it does not provide enough vertical distance for a large truck to safely pass under it. It is recommend that alternative roadways intersecting with McCarter Highway be considered to substitute the western section of South Street. Several roadways in close proximity to South Street have a 13' 6'' vertical clearance (the minimum requirement for a large truck). It is recommended that a variety of alternative truck routes be considered and a more in depth analysis of the effects on the community, local businesses, and freight industry be conducted.

[4] Newark's City Ordinance 23:4-1 requires trucks to remain on designated truck routes unless for the purpose of pickup and delivery of materials in the City of Newark. For the purposes of this study large and small truck trips were both flagged as "Non-Compliant" with designated truck routes when they crossed from one truck route segment to another truck route segment via non-truck routes without making a delivery between the two designated routes.

Signing Program

Vertical Clearance Signing

A review of vertical clearance signs along McCarter Highway between Raymond Boulevard and Miller Street revealed that advanced warning signs are not uniformly applied. Specifically, McCarter Highway prior to South Street (official east-west truck route connection) lacks advanced warning vertical clearance signing; therefore decreasing trucks awareness of the 12" 6' vertical clearance limitation. **Figure 17** is a photograph taken on May 14, 2014 at the intersection of McCarter Highway and South Street of a truck failing to recognize the lack of clearance and subsequently colliding with the bridge supporting the Amtrak tracks running parallel to McCarter Highway. To further mitigate this issue, it is recommend that a more complete inventory of all vertical clearance signs be conducted for the aforementioned section of McCarter Highway and additional signing be installed to supplement existing signs to create a more complete and uniform system of warning signs for oversized vehicles along McCarter Highway.

Figure 17 - Tractor Trailer Collides with Amtrak Bridge at the McCarter Highway and South Street Intersection

Truck Route Designation Signing

Of the trucks that were traced, 10% were flagged as "Non-Compliant" with established truck route guidelines[5]. Therefore, a preliminary review of signs regulating truck activity within the study area was conducted and revealed that signs demarcating designated truck routes were rare. Positive and negative signing can be utilized to reduce the volume of trucks utilizing local roads to cut through the total study area. Common signs would be NO TRUCKS Signs (R5-2) or TRUCK ROUTE Signs (R14-1) as seen in **Figure 18**[6]. Therefore, it is recommended that a more widespread inventory of all truck route signing be completed to better assess the need for a more comprehensive signing program.

Figure 18 – Truck Specific Signing

R5-2

R14-1

Reduce Truck Volumes Near Schools

The aforementioned mitigations will reduce the truck traffic crossing into the established school zones. However, the school zone analysis revealed that the majority of truck traffic encroaching on school zones are either on a legal truck route or making a delivery in the vicinity of a school. Therefore, it is recommended that the trucking industry, local businesses, and each school coordinate to shift deliveries away from time periods that are sensitive to schools (e.g. openings and closings); this approach could be especially effective at Oliver Street Elementary and East Side High School.

Increase Intersection Capacity

Of the 16 intersections studied for capacity concerns, Stockton Street and Delancey Street was the only intersection that did not achieve an overall LOS C or better during all three peak periods. During the PM peak period the intersection overall operates with LOS D conditions. This intersection is located at the merging of two truck routes critical to the Ironbound Neighborhood

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[5] Newark's City Ordinance 23:4-1 requires trucks to remain on designated truck routes unless for the purpose of pickup and delivery of materials in the City of Newark. For the purposes of this study large and small truck trips were both flagged as "Non-Compliant" with designated truck routes when they crossed from one truck route segment to another truck route segment via non-truck routes without making a delivery between **the two designated routes**

[6] *2009 Manual of Uniform Traffic Control Devices*, Section 2B.36; Page 75.

and the Industrial District, Delancey Street and South Street, and Routes 1&9 off-ramps. Therefore it processes a significant number of local trucks in and out of the study area (ranging between 4.1 – 7.2% heavy vehicles during the three peak periods reviewed). Mitigating capacity issues will decrease truck volumes circumventing this intersection and, in turn, reduce the duration and number of trucks traveling within the area.

A three-part program is recommended to improve the current capacity issues at Stockton Street and Delancey Street:

1. Approach and Intersection Geometric Changes
    a. Widen and restripe the southbound approach and corresponding receiving lanes to accommodate two thru lanes, which will allow more vehicles to be processed
    b. Widen the intersection to facilitate the ability of tractor trailers to safely turn without impeding traffic flow at the intersection
2. Coordinate and Optimize Timing Plans
    a. Coordinate the intersection of Stockton Street and Delancey Street with the adjacent intersection of Routes 1&9 North Off-Ramp and Delancey Street
        i. An improved coordination between these two intersections will also minimize or eliminate moments of starvation (i.e. green time is showing for the approach but vehicles are stopped at the upstream intersection).
        ii. Effective coordination and signal timing optimization will also allow more vehicles to be processed through both intersections, and will reduce the queues at critical regions such as the northbound left turn movement from the Routes 1&9 Off-Ramp and the southbound Stockton Street approach once more green time is allocated to these signal phases.
3. Evaluate Vehicular Detection on the Continental Plaza Driveway at 400 Delancey Street (adjacent intersection)
    a. Active detection will eliminate unused green time given to the driveway when no vehicles are present for that approach. Additional green time may be shifted to other approaches.

Preliminary assessments of these mitigations show that overall LOS C conditions for both intersections may be achieved and all approaches at the intersection have the potential to operate with LOS D or better.

Northeast Newark Regional Truck Study

Appendix A

Port Commerce Truck Analysis

Port Commerce Truck Analysis

SUMMARY OF METHODOLOGY AND FINDINGS

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OVERVIEW

The Ironbound is a neighborhood in the east ward of Newark, NJ adjacent to major transportation facilities and industrial uses. Port Newark/Elizabeth Port Authority Marine Terminal (PN/EPAMT) and Newark Liberty International Airport (EWR) are two Port Authority of New York and New Jersey (PANYNJ) facilities situated directly to the south of the Ironbound, which also borders the New Jersey Turnpike (I-95), Doremus Avenue, and McCarter Highway (NJ Rt. 21).

To investigate concerns about truck traffic within the Ironbound, PANYNJ conducted a large-scale data collection effort and a comprehensive truck study. Using data extracted by Skycomp Inc., VHB performed a detailed analysis of the number of trucks generated by or destined to PN/EPAMT that travel through the Ironbound.

An estimated 5.1% of all trucks that entered or exited the Ironbound on the day of the study were associated with the port.

STUDY METHODOLOGY

The PANYNJ retained the services of Skycomp Inc. to conduct the aerial imaging within the Ironbound District as well as sections of the roadway network surrounding EWR and PN/EPAMT for a total of nine hours. This consisted of several planes and helicopters flying and hovering over the study area while recording truck movements entering, exiting and traveling within the study area. The aerial photography survey was conducted on June 4, 2013 during three 3-hour periods starting at 5:30 AM, 10:30 AM, and 2:30 PM.

The purpose of this effort is to determine truck origin and destination patterns between the Ironbound District and the access / egress points of PN/EPAMT (including access via interchange 13A of the NJ Turnpike). **Figure A.1** shows the study areas.

For analysis purposes, a truck is considered a Port truck if it meets any of the following criteria:

1. It crosses an imaginary line located just south of Port Street, and parallel to it. This line extends from the Port Street / Corbin Street ramp on the west to Doremus Avenue on the east. See **Figure A.2**.
2. It travels along Port Street, east of Doremus Avenue.
3. It travels along McLester Street, south of Polaris Street.

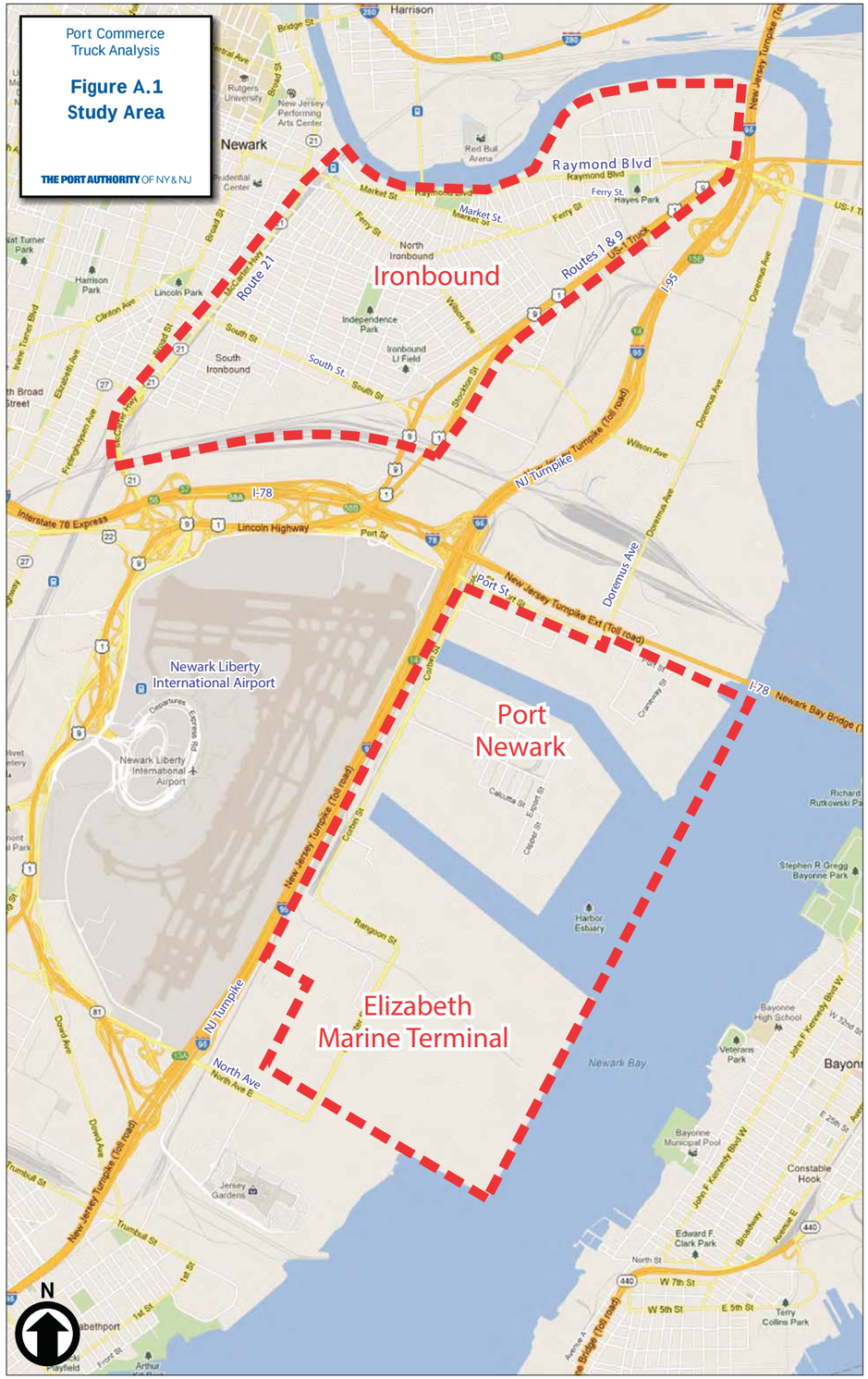
VHB, identified a statistically valid sample of 2,447 trucks entering or exiting the Ironbound at each access/egress point along the Ironbound's boarder; delineated by the red dashed line shown in **Figure A.3**. Skycomp Inc., traced each truck turn-by-turn and classified them as port or non-port associated trucks.

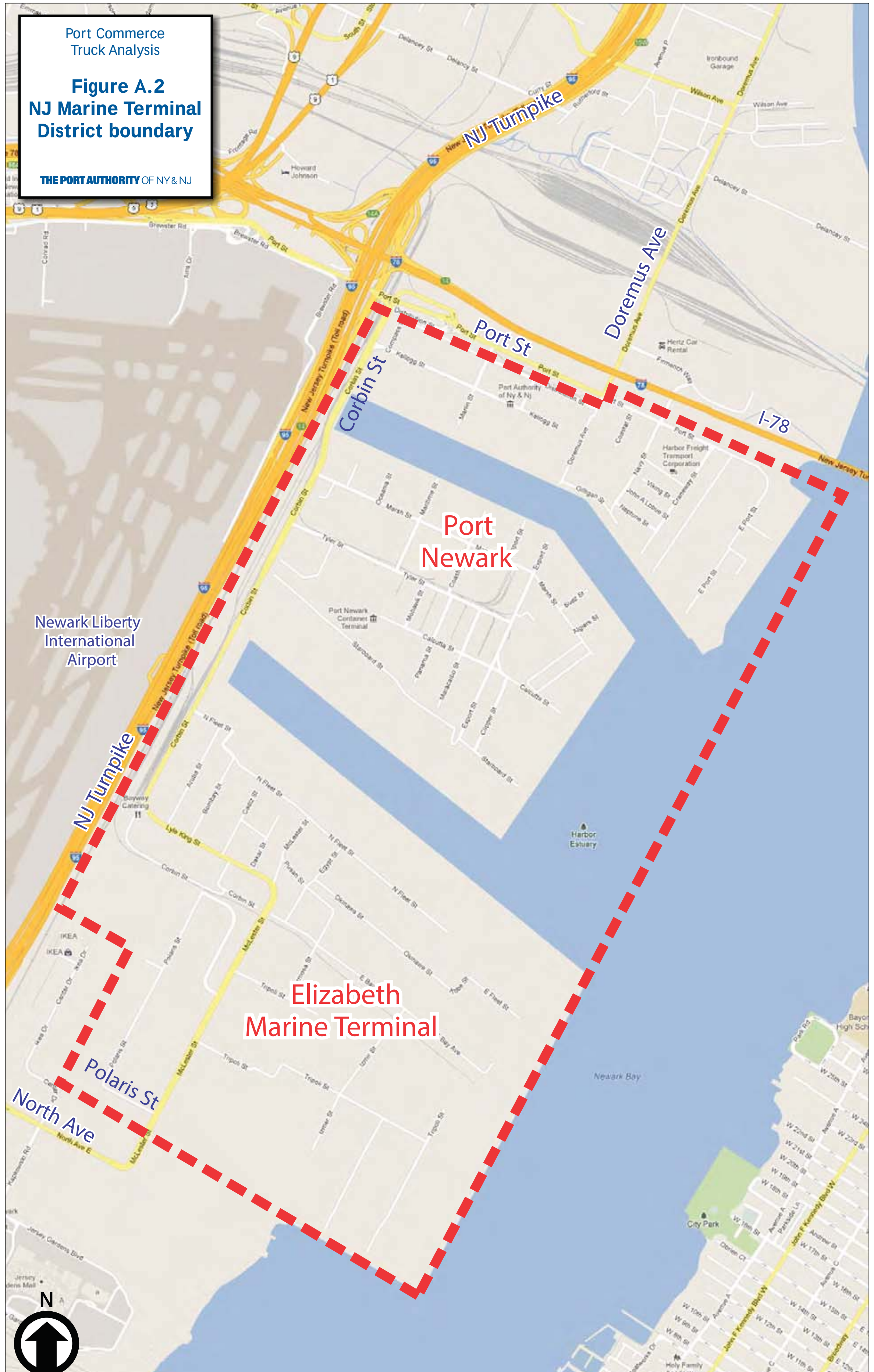
FINDINGS

From the trucks traced 5.1% were identified as Port Trucks. See **Table A.1** for a detailed breakdown by analysis period.

Table A.1. Ironbound District Trucks Sampled and Percentage of Port Trucks

Truck Traffic Direction	Peak Period	Total Traced Truck Volume	Port Trucks	
			Traced Volume	Percent of Mix [%]
Trucks Exiting the Ironbound Neighborhood	AM	398	18	4.5%
	Midday	445	25	5.6%
	PM	395	18	4.6%
	Total	1,238	61	4.9%
Trucks Entering the Ironbound Neighborhood	AM	303	11	3.6%
	Midday	457	21	4.6%
	PM	449	33	7.3%
	Total	1,209	65	5.4%
Trucks Entering and Exiting the Ironbound Neighborhood	AM	701	29	4.1%
	Midday	902	46	5.1%
	PM	844	51	6.0%
	Total	2,447	126	5.1%

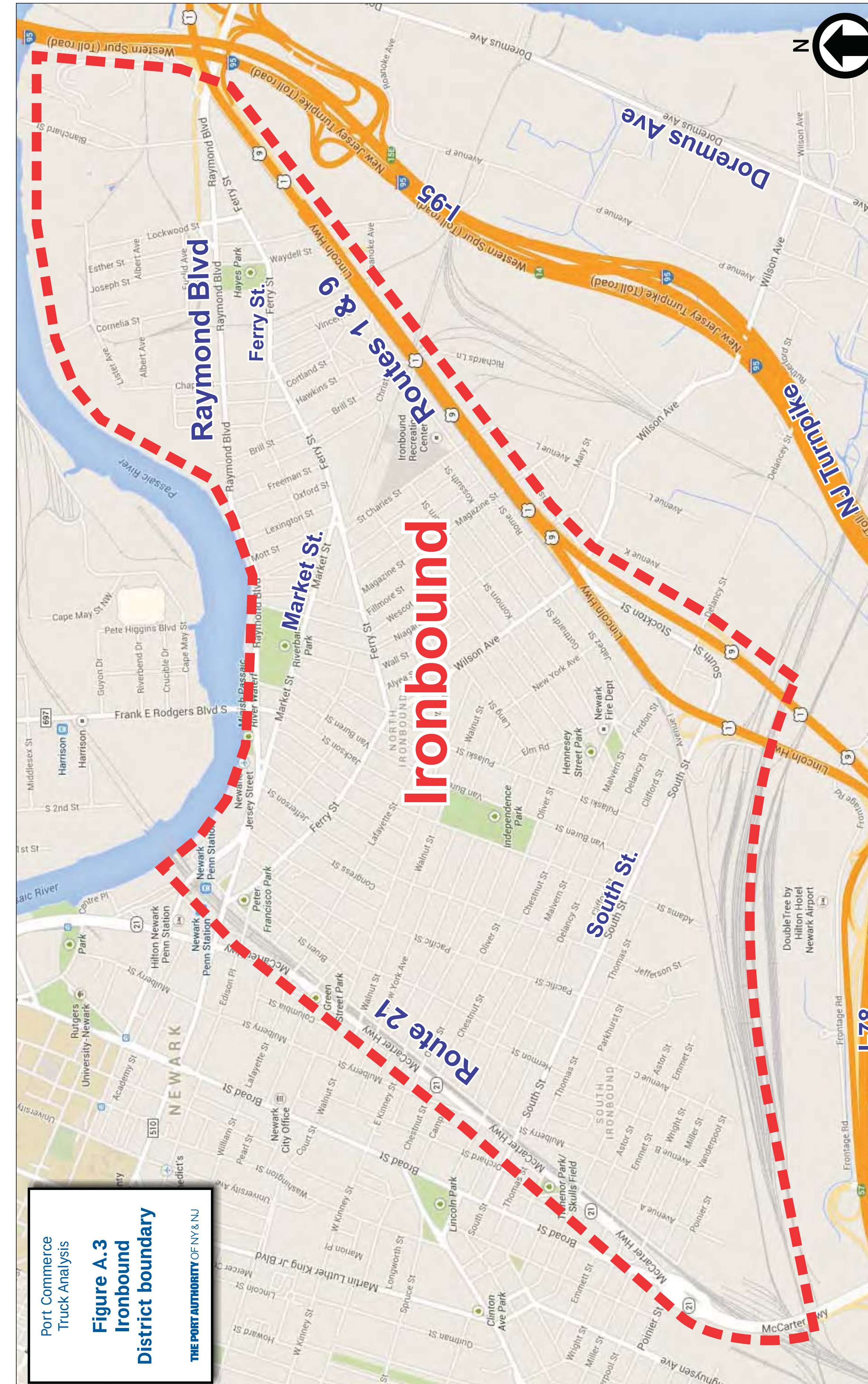




Port Commerce Truck Analysis

Figure A.2 NJ Marine Terminal District boundary

THE PORT AUTHORITY OF NY & NJ



Port Commerce Truck Analysis

Figure A.3 Ironbound District boundary

THE PORT AUTHORITY OF NY & NJ