Truck Origin-Destination Data Analysis

Long-Range Master Plan for the Port of New York and New Jersey

THE PORT AUTHORITY OF NY & NJ

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Long-Range Master Plan for the
Port of New York and New Jersey
Truck Origin-Destination Data Analysis
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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AGV ..... automated guided vehicle
ATRI ..... American Transportation Research Institute
Boro ..... borough
Co ..... County (Route)
Cty. ..... county
FHWA ..... Federal Highway Administration
GPS ..... Global Positioning System
I- ..... Interstate (Route)
Muni. ..... municipality
NJ ..... New Jersey (State Route)
NJDOT ..... New Jersey Department of Transportation
NY ..... New York (State Route)
O-D ..... origin-destination
PANYNJ ..... Port Authority of New York and New Jersey
PONYNJ ..... Port of New York and New Jersey
TEU ..... twenty-foot equivalent unit
US ..... U.S. (Route)

1.0 Introduction

In preparing a comprehensive master plan for the Port Authority of New York and New Jersey (PANYNJ), understanding the landside transportation network supporting overall operations of the port represents an essential first step. This Truck Origin-Destination Data Analysis report describes the approach and methodology used to evaluate these critical landside facilities, and serves as a support document in the development of the Long-Range Port Master Plan (Master Plan) for the PANYNJ.[1]

1.1 Purpose

Establishing current and future capacities of these key infrastructure elements of the port lays the foundation for evaluating and prioritizing the list of long-term investment options presented in the Master Plan. Hatch (Hatch Associates Consultants, Inc.) and STV (together, the Hatch Team) worked with PANYNJ, data providers, and additional stakeholders to gather available information about the current status of landside facilities (road).

1.2 Use

This document is intended for use as a basis for identifying the existing capacity limitations in the regional road network supporting PANYNJ Port facilities.

It presents the results of the Truck Origin-Destination Data Analysis and assessment of the near-terminal regional road network. This document also examines the implications of these results on future scenarios.

1.3 Existing Port-Related Plans and Studies

The information contained within this report has been developed by the Hatch Team based on an analysis of the existing roadway network and StreetLight Data, and interviews with PANYNJ and key project stakeholders.

Additional information has been obtained from existing external documentation commissioned by PANYNJ and provided to the Hatch Team. These sources are listed in Section 3.0.

1.4 Study Limitations

This report has been prepared by Hatch Associates Consultants, Inc. (Hatch) solely for the Port Authority of New York and New Jersey (PANYNJ). It has been based on information provided to Hatch by PANYNJ, terminal operators, and/or other parties, and has not been independently verified or checked beyond the agreed-upon scope of work. Hatch has made an assessment of this information based on our experience with similar information and data sets; however, Hatch cannot accept responsibility arising from the

[1] A note on terminology:
Through this report, the term Port Authority of New York and New Jersey (PANYNJ) refers to the bi-state Authority, inclusive of all assets (PATH, airport, ports, bridges, etc.). When specifically referencing those PANYNJ marine terminal assets managed by the Port Department, they are called out as “PANYNJ Port facilities” or similar.
The term Port of New York and New Jersey (PONYNJ) refers to the broader set of lands, uses, and users comprising and/or dependent on New York Harbor, its waterfront, and its tributaries.

accuracy, suitability, or availability of information provided, where it has been assumed herein that all documents, reports and information provided were up to date, complete, true, correct and accurate, and contained no omissions or material errors.

This report has been prepared solely for the purpose agreed between Hatch and PANYNJ under Agreement No. PCD-16-004. This report should not be used or relied upon by any other entity or person without the prior written consent of Hatch; such consent shall be granted only in conjunction with the execution of a Reliance Letter in such form and substance satisfactory to Hatch.

This report reflects only the knowledge of those staff of Hatch involved directly in the preparation of this report, at the time of the preparation of this report, and is strictly limited to the matters stated. This report does not apply to any other matters by implication. This report was substantially prepared prior to January 2018 and is based on the information reviewed at the time of preparation. Hatch disclaims responsibility for any changes that have occurred after this time.

2.0 Landside Transport Capacity (Road)

2.1 Introduction

For the landside transportation studies in the Port Master Plan, it is important to have a baseline understanding of port truck movements and destinations within the greater region. Knowledge of these patterns and volumes will help guide future scenarios in which new improvements would be defined to handle cargo growth.

Before the present (2017) analysis, the most recent study of the origins and destinations of port truck traffic was undertaken by PANYNJ in 2005 and was based on trucker survey responses. The 2017 analysis was performed using a new set of primary source data, from StreetLight Data, to supplement PANYNJ's other data sources (such as ATRI).

Though the approach is qualitative to the extent it relies on establishing current port truck travel patterns and does not utilize a predictive model, it does provide a reasonable basis for estimated assignment of volume and directional flow of port truck traffic.

As it has been 12 years since the last major container truck survey was performed, substantial changes have occurred in regional and national logistic industries, land access to and from the Port, technology, economic conditions, and most importantly, global trade patterns.

During the same period, the volume of containers handled at PANYNJ Port facilities increased over 30 percent, from 4.8 million TEU to 6.3 million TEU. This increase in freight volume has correspondingly introduced significantly more truck activity in the area, and the corresponding increase in on-dock rail lifts, from 303,000 lifts (11% of containers) in 2005 to 540,000 lifts (15% of containers) in 2016, has not offset the growth in truck volume.

This capacity analysis seeks to qualitatively assess PANYNJ Port facility truck traffic and its distribution on road networks through the surrounding region by addressing the following questions:

- What is the geographic distribution of traffic that leaves and arrives at the PANYNJ Port facilities?
- What is the distribution of port truck traffic along regional road networks?
- What is the ratio of port truck traffic to all traffic along major truck routes?
- Where do corridors with high percentages of port traffic align with congested roadways?

2.2 Terminology

The nomenclature used in this section is explained below.

- Corridor: a roadway that carries a significant amount of general traffic as well as port truck traffic. The major corridors identified in this report include I-95, I-287, I-78, I-80, I-280, I-278, US 1/9, NJ 17, NJ 24, and NJ 440.
- Corridor Segment: a stretch of roadway within a corridor that was individually analyzed. A corridor may be made up of several corridor segments.
- Zone: a total of 106 geographic areas were defined as zones to analyze traffic patterns. These zones consist of municipalities, counties, states, and non-administrative areas (including portions of counties and states).
- Destination: a zone with truck traffic that originated from a port.
- Middle Filter: point data along a corridor that measures through traffic. Middle filters are represented graphically by quantities on corridor segments.
- Origin: a zone with truck traffic destined for port facilities.
- Port Facility: a zone that consists of all or part of one of the five PANYNJ Port facilities (Port Newark, Elizabeth Marine Terminal, Port Jersey, Howland Hook Marine Terminal, and Brooklyn Marine Terminal).

2.3 Zone Traffic Analysis

This analysis assesses the geographic distribution of port truck traffic that originates from and is destined to PANYNJ Port facilities.

2.3.1 Methodology

Zones were defined within PANYNJ Port facilities. A total of eight zones were used to capture port activities, which include Port Newark (container), Port Newark (auto), Port Newark (other), Elizabeth Marine Terminal (Maher), Elizabeth Marine Terminal (APMT), Port Jersey, Howland Hook Marine Terminal, and Brooklyn Marine Terminal. Brooklyn Marine Terminal was not included in this analysis due to the extremely low traffic volume associated with this facility.

The geographic distribution area was defined as 106 zones (72 municipalities, 18 counties, 2 states, and 14 non-administrative areas[2]) across Pennsylvania, New Jersey, New York, and Connecticut (see Table 2-1). Locations in these four states were chosen because earlier analyses showed negligible volumes of traffic travelling directly between ports and locations in further states, such as Maryland, Ohio, Delaware, and Massachusetts. (Due to these earlier results no further analysis was deemed necessary outside of New Jersey, New York, Connecticut, and Pennsylvania.) Due to the low volume of port truck traffic in New York City, data was consolidated at the borough level.

Traffic data between the port facilities and the 106 zones were acquired from StreetLight Data, a big-data source that monitors automotive and truck travel patterns. In processing the original navigation-GPS data, a new trip was defined each time a commercial vehicle moved less than five (5) meters over a five (5) minute duration. The commercial data was tagged by Weight Class by StreetLight's data partner INRIX, which determines the Weight Class based on the dominant category in the mix of vehicles of the individual provider: Medium = 14,000-26,000 lbs, Heavy > 26,000 lbs. In this study, all port trucks have been classified as heavy commercial vehicles. For this report the parameters were set for geographic location (106 zones and port facilities), data period (January to December 2016), day type (average weekday: Monday to Friday), day part (All Day: 12 AM to 12 AM), and segmentation by commercial vehicle weight class (Medium and Heavy). Given these parameters, multiple origin-destination analyses were conducted.

The origin-destination analyses were then filtered to provide the origin and destination indices between each of the port facilities and the 106 zones.

[2] Including portions of counties and states.

Table 2-1: Zones Used for Zone Analysis

No.	Zone Name	Type
1	Bayonne City	Muni.
2	Berkeley Heights Twp.	Muni.
3	Bogota Boro	Muni.
4	Bronx	Cty.
5	Brooklyn (Kings)	Cty.
6	Carlstadt Boro	Muni.
7	Carteret Boro	Muni.
8	City of Orange Twp.	Muni.
9	Clark/Winfield	Other
10	Clifton City	Muni.
11	Connecticut	State
12	East Brunswick Twp.	Muni.
13	East Newark/Harrison	Other
14	East Orange City	Muni.
15	East Rutherford Boro	Muni.
16	Edison Township	Muni.
17	Elizabeth City	Muni.
18	Elmwood Park Boro	Muni.
19	Englewood City	Muni.
20	Englewood Cliffs Boro	Muni.
21	Fairfield Township	Muni.
22	Fort Lee Boro	Muni.
23	Garfield City	Muni.
24	Hackensack City	Muni.
25	Hasbrouck Heights Boro	Muni.
26	Highland Park Boro	Muni.
27	Hillside Township	Muni.
28	Hunterdon	Cty.
29	Irvington Township	Muni.
30	Jersey City	Muni.
31	Kearny Town	Muni.
32	Kenilworth Boro	Muni.
33	Leonia Boro	Muni.
34	Linden City	Muni.
35	Little Falls Township	Muni.
36	Little Ferry Boro	Muni.
37	Lodi Boro	Muni.
38	Lyndhurst Township	Muni.
39	Manhattan/New York	Cty.
40	Maplewood Township	Muni.
41	Maywood Boro	Muni.
42	Mercer	Cty.
43	Metuchen Boro	Muni.
44	Monmouth	Cty.
45	Moonachie Boro	Muni.
46	Morris	Cty.
47	Nassau	Cty.
48	New Brunswick City	Muni.
49	Newark City	Muni.
50	NJ 10	Other
51	NJ 11 (NJ 6-1)	Other
52	NJ 3	Other
53	NJ 4	Other
54	NJ 7	Other
55	NJ 8	Other
56	NJ 9	Other
57	North Arlington Boro	Muni.
58	North Bergen Twp.	Muni.
59	Ocean	Cty.
60	Old Bridge Township	Muni.
61	Palisades Park Boro	Muni.
62	Paramus Boro	Muni.
63	Passaic City	Muni.
64	Paterson City	Muni.
65	Pennsylvania	State
66	Perth Amboy City	Muni.
67	Piscataway Township	Muni.
68	Putnam	Cty.
69	Queens	Cty.
70	Rahway City	Muni.
71	Rest of Bergen	Other
72	Rest of Middlesex	Other
73	Rest of New York State	Other
74	Rest of Passaic	Other
75	Ridgefield Boro	Muni.
76	Ridgefield Park Village	Muni.
77	Rochelle Park Twp.	Muni.
78	Rockland	Cty.
79	Rutherford Boro	Muni.
80	Saddle Brook Twp.	Muni.
81	Sayreville Boro	Muni.
82	Secaucus Town	Muni.
83	Somerset	Cty.
84	South Amboy City	Muni.
85	South Hackensack Township	Muni.
86	South Jersey	Other
87	South Orange Village Township	Muni.
88	South Plainfield Boro	Muni.
89	South River Boro	Muni.
90	Springfield Township	Muni.
91	Staten Island/Richmond	Cty.
92	Suffolk	Cty.
93	Sussex	Cty.
94	Teaneck Township	Muni.
95	Teterboro Boro	Muni.
96	Totowa Boro	Muni.
97	Union Township	Muni.
98	Wallington Boro	Muni.
99	Warren	Cty.
100	Wayne Township	Muni.
101	Weehawken Township	Muni.
102	West Orange Twp.	Muni.
103	Westchester	Cty.
104	Woodbridge Township	Muni.
105	Woodland Park Boro	Muni.
106	Wood-Ridge Boro	Muni.

Note on abbreviations:
"Boro" (borough)
"Cty." (county)
"Muni." (municipality)
"Other" includes non-administrative regions such as portions of counties and states.

2.3.2 Results

Zone as Origin

2017 Analysis Results

The port truck traffic arriving at Port Newark, Elizabeth Marine Terminal, Port Jersey, Howland Hook Marine Terminal, and Brooklyn Marine Terminal was estimated and the distribution of this port truck traffic was assigned to the 106 analysis zones (see Figure 2-1).

The origin zone of trucks that arrive at the PANYNJ Port facilities tend to concentrate in the immediate vicinity of the New Jersey Port facilities in zones such as Newark City (19.6 percent), Carteret Boro (13.4 percent), Kearny Town (10.3 percent), Elizabeth City (8.0 percent), Woodbridge Township (6.9 percent), and Bayonne City (3.8 percent) (see Figure 2-2). A small percentage of port truck traffic also originates in Pennsylvania (4.6 percent) and other New York State (1.5 percent) (see Table 2-2). The traffic from the top 20 origins accounts for 88% of total incoming traffic.

Table 2-2: Port Truck Traffic: Top 20 Origin Zones

Rank	Zone Name	Percent
1	Newark City	19.6%
2	Carteret Boro	13.4%
3	Kearny Town	10.3%
4	Elizabeth City	8.0%
5	Woodbridge Twp	6.9%
6	Pennsylvania	4.6%
7	Bayonne City	3.8%
8	Hunterdon	3.4%
9	PANYNJ – Port Jersey	3.1%
10	Rest of Middlesex	2.5%
11	Linden City	1.8%
12	South Jersey	1.6%
13	Edison Twp	1.6%
14	Rest of New York State	1.5%
15	Morris	1.4%
16	Jersey City	1.3%
17	PANYNJ – Elizabeth – APM	1.0%
18	Somerset	1.0%
19	South Plainfield Boro	0.9%
20	Warren	0.5%

Source: StreetLight, 2017; STV Incorporated, 2017.

Comparison to 2005 Analysis

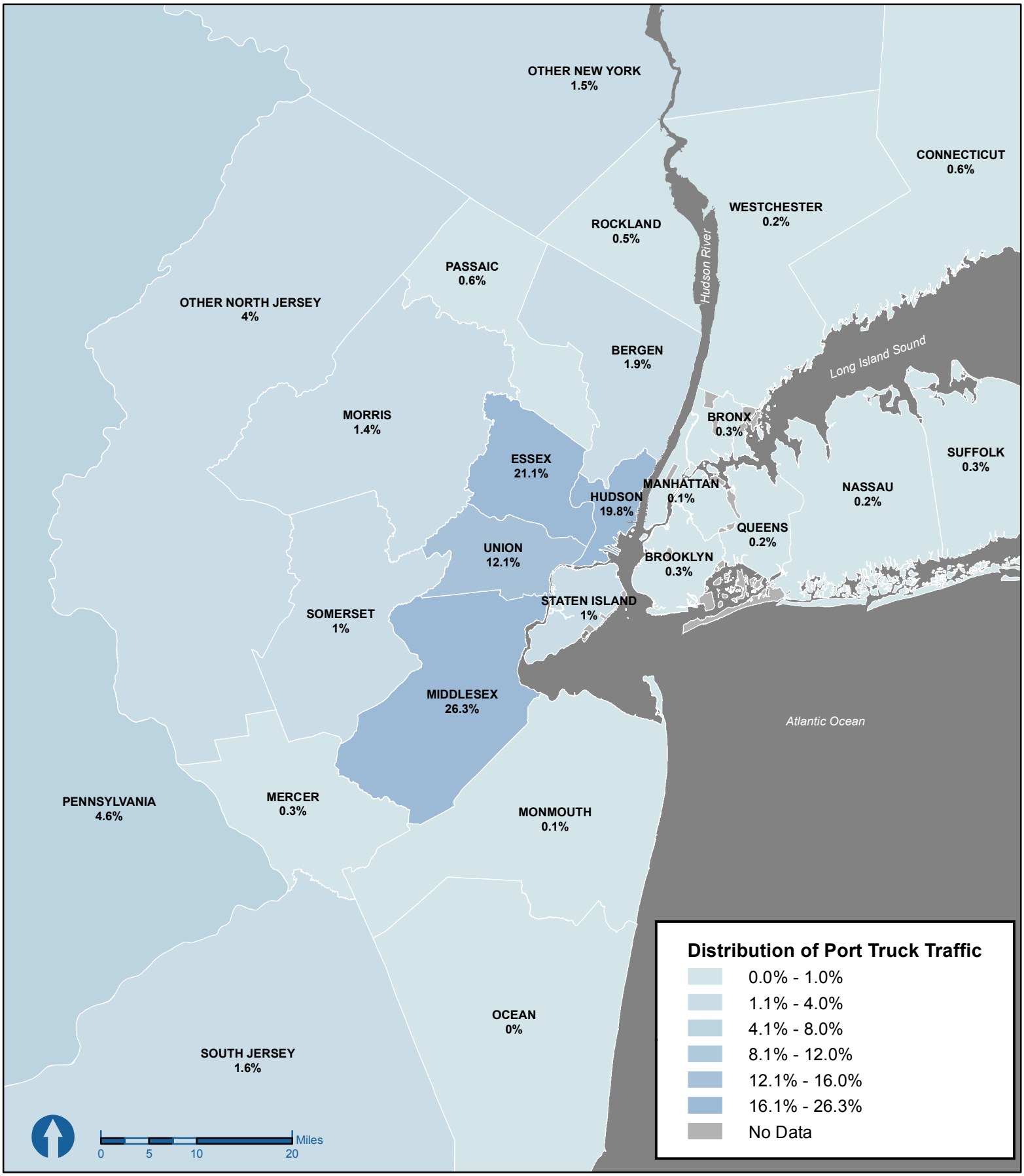
The 2005 analysis used zones that were larger than the 2017 analysis' zones; therefore, the zones for the 2017 analysis were aggregated to match the 2005 analysis zones for comparison. In the 2017 analysis, truck traffic from New Jersey made up 90.3 percent of port truck origins, including 79.4 percent from Middlesex, Essex, Hudson, and Union Counties. Truck traffic from New York State made up 4.5 percent of port truck origins, including 1.8 percent from New York City. These numbers in the 2005 analysis were 75 percent, 66 percent, 11 percent, and 8 percent, respectively, showing an increase in trucks originating from New Jersey, in particular the New Jersey counties closest to the ports, and a decrease in trucks originating from New York State.

The top five zones for port truck origins (Union County, Essex County, Hudson County, Middlesex County, and Pennsylvania) is consistent between the 2017 and 2005 analyses (see Figure 2-3). However, the 2017 analysis shows a notably higher percentage of port truck traffic originating in Middlesex County (26.3 percent in 2017 compared to 9 percent in 2005) (see Table 2-3).

Table 2-3: Distribution of Port Traffic by Origin in 2017 and 2005

Aggregated Zone Name	2017 Rank	2017 percent	2005 Rank	2005 Percent
Middlesex	1	26.3%	4	9%
Essex	2	21.1%	1	23%
Hudson	3	19.8%	2	22%
Union	4	12.2%	3	12%
Pennsylvania	5	4.6%	5	5%
Other New Jersey	6	4.0%	7	3%
Bergen	7	1.9%	8 (tied)	2%
South Jersey	8	1.6%	n/a	n/a
Other New York	9	1.6%	8 (tied)	2%
Morris	10	1.4%	10 (tied)	1%
Staten Island	11	1.0%	10 (tied)	1%
Somerset	12	1.0%	10 (tied)	1%
Connecticut	13	0.6%	10 (tied)	1%
Passaic	14	0.6%	10 (tied)	1%
Rockland	15	0.5%	20 (tied)	0%
Mercer	16	0.4%	20 (tied)	0%
Suffolk	17	0.3%	not ranked	0%
Brooklyn	18	0.3%	6	4%
Bronx	19	0.3%	10 (tied)	1%
Westchester	20	0.2%	20 (tied)	0%
Queens	21	0.2%	10 (tied)	1%
Nassau	22	0.2%	10 (tied)	1%
Monmouth	23	0.1%	10 (tied)	1%
Manhattan	24	0.1%	10 (tied)	1%
Ocean	25	< 0.1%	20 (tied)	0%

Source: StreetLight, 2017; STV Incorporated, 2017.



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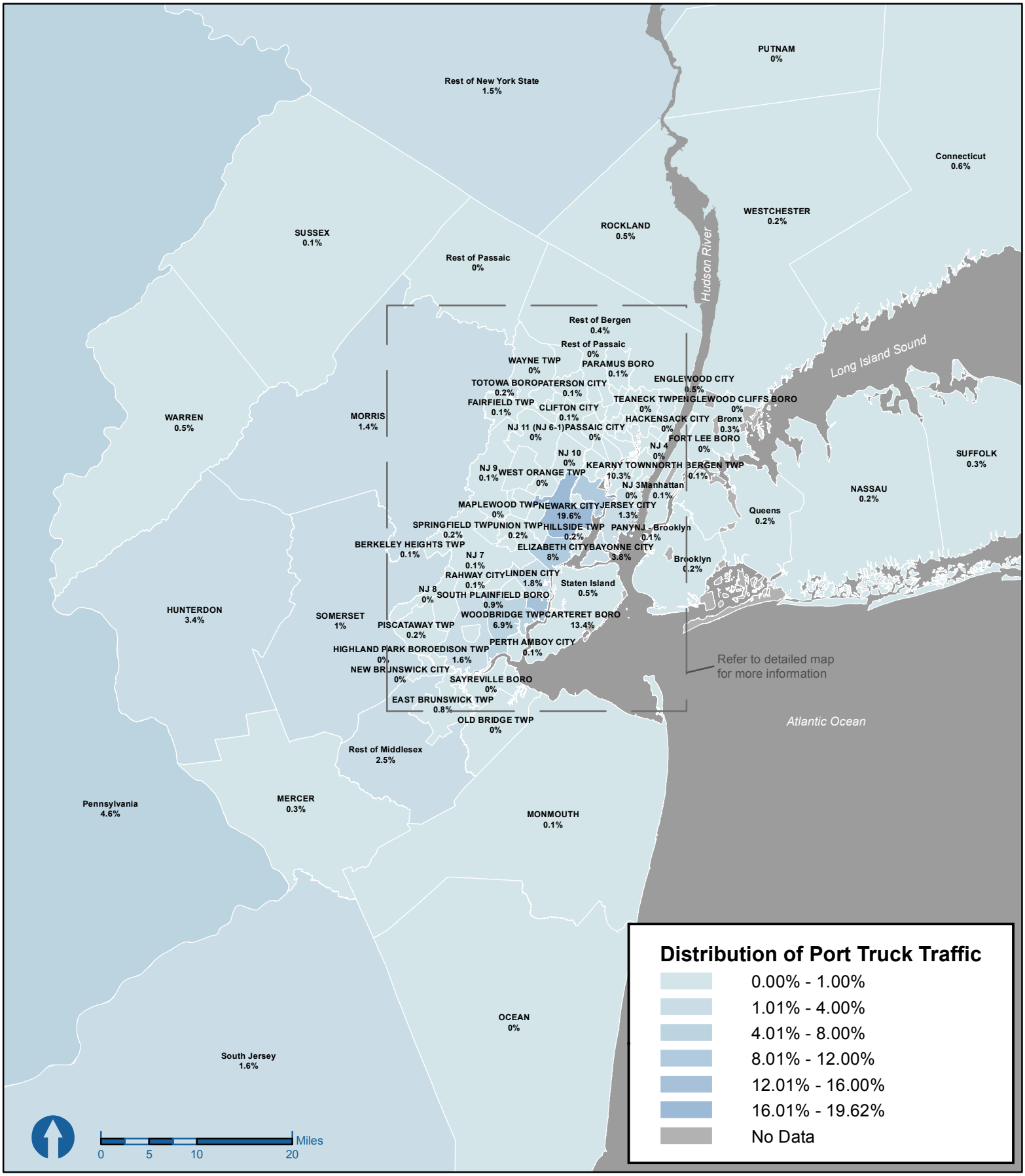
2-1: DISTRIBUTION OF PORT TRUCK TRAFFIC (ZONE AS ORIGIN)

Sources: StreetLight; NYC Open Data, NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS; US Census TIGER/Line Files; STV Incorporated, 2017.



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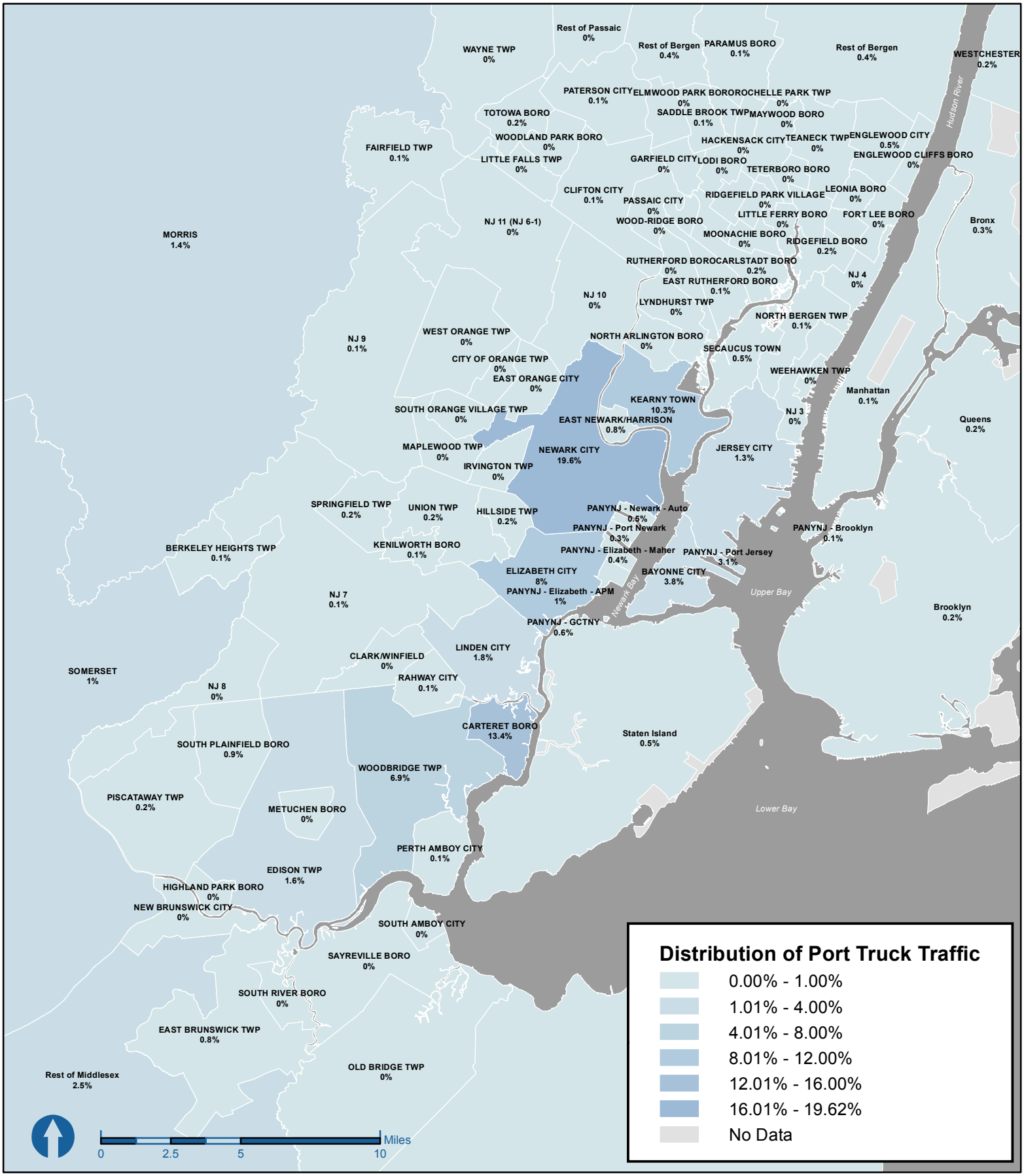
2-2: DISTRIBUTION OF PORT TRUCK TRAFFIC (ZONE AS ORIGIN)

Sources: StreetLight; NYC Open Data, NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS; US Census TIGER/Line Files; STV Incorporated, 2017.



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2-3: DETAILED DISTRIBUTION (ZONE AS ORIGIN)

Sources: StreetLight; NYC Open Data, NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS; US Census TIGER/Line Files; STV Incorporated, 2017.

Zone as Destination

2017 Analysis Results

The port truck traffic originating from Port Newark, Elizabeth Marine Terminal, Port Jersey, Howland Hook Marine Terminal, and Brooklyn Marine Terminal was estimated and the distribution of this port truck traffic was assigned to the 106 analysis zones (see Figure 2-4).

The destination zone of trucks that depart from the PANYNJ Port facilities, similar to that of the origin zone of trucks, tend to concentrate in the immediate vicinity of the New Jersey ports, such as Newark City (23.3 percent), Carteret Boro (12.2 percent), Pennsylvania (8.8 percent), Elizabeth City (7.1 percent), Kearny Town (5.5 percent), Woodbridge Township (4.9 percent), and Hunterdon County (4.5 percent) (see Figure 2-5). A notable percentage of port truck traffic is also destined to the rest of New York State (2.4 percent) (see Table 2-4).

Table 2-4: Port Truck Traffic: Top 20 Destination Zones

Rank	Zone Name	Percent
1	Newark City	23.3%
2	Carteret Boro	12.2%
3	Pennsylvania	8.8%
4	Elizabeth City	7.1%
5	Kearny Town	5.5%
6	Woodbridge Twp	4.9%
7	Hunterdon	4.5%
8	Linden City	2.5%
9	Rest of Middlesex	2.5%
10	Rest of New York State	2.4%
11	PANYNJ – Port Jersey	2.1%
12	Jersey City	1.9%
13	Bayonne City	1.8%
14	Warren	1.7%
15	Morris	1.6%
16	South Jersey	1.5%
17	PANYNJ – Elizabeth – APM	1.4%
18	Edison Twp	1.3%
19	South Plainfield Boro	1.1%
20	Somerset	1.0%

Source: StreetLight, 2017; STV Incorporated, 2017.

Comparison to 2005 Analysis

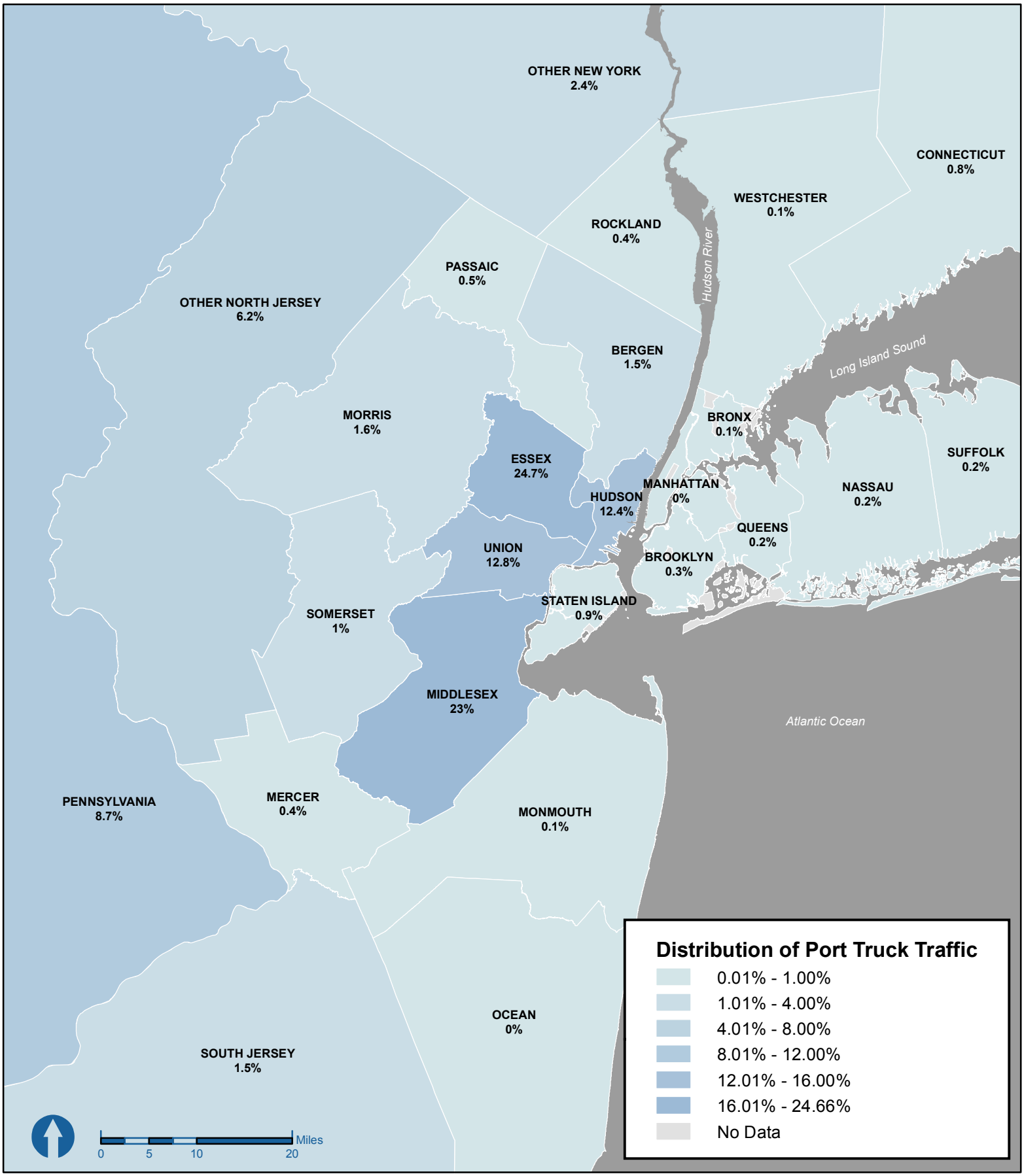
The 2005 analysis used zones that were larger than the 2017 analysis' zones; therefore, the zones for the 2017 analysis were aggregated to match the 2005 analysis zones for comparison. In the 2017 analysis, truck traffic to New Jersey made up 85.6 percent of port truck destinations, including 72.8 percent to Middlesex, Essex, Hudson, and Union Counties. Truck traffic to New York State made up 4.8 percent of port truck destinations, including 1.5 percent to New York City. These numbers in the 2005 analysis were 79 percent, 70 percent, 10 percent, and 7 percent, respectively. Similar to the results for origin zones, destination zones showed an increase in trucks travelling to New Jersey, in particular the New Jersey counties closest to the ports, and a decrease in trucks travelling to New York State.

The top five zones for port truck destinations (Union County, Essex County, Hudson County, Middlesex County, and Pennsylvania) are consistent between the 2017 and 2005 analyses (see Figure 2-6). However, the 2017 analysis shows a notably higher percentage of port truck traffic destined to Middlesex County (22.98 percent in 2017 and 10 percent in 2005), as well as a notably higher percentage of trips destined to Pennsylvania (8.8 percent in 2017 and 4 percent in 2005) (see Table 2-5).

Table 2-5: Distribution of Port Traffic by Destination in 2017 and 2005

Aggregated Zone Name	2017 Rank	2017 percent	2005 Rank	2005 Percent
Essex	1	24.7%	1 (tied)	23%
Middlesex	2	23.0%	4	10%
Union	3	12.8%	3	14%
Hudson	4	12.4%	1 (tied)	23%
Pennsylvania	5	8.8%	5	4%
Other New Jersey	6	6.2%	6 (tied)	3%
Other New York	7	2.5%	8 (tied)	2%
Morris	8	1.6%	10 (tied)	1%
Bergen	9	1.5%	8 (tied)	2%
South Jersey	10	1.5%	not ranked	n/a
Somerset	11	1.0%	10 (tied)	1%
Staten Island	12	0.9%	10 (tied)	1%
Connecticut	13	0.8%	10 (tied)	1%
Passaic	14	0.5%	10 (tied)	1%
Mercer	15	0.4%	10 (tied)	1%
Rockland	16	0.4%	20 (tied)	0%
Brooklyn	17	0.3%	6 (tied)	3%
Nassau	18	0.2%	10 (tied)	1%
Queens	19	0.2%	10 (tied)	1%
Suffolk	20	0.2%	20 (tied)	0%
Monmouth	21	0.1%	20 (tied)	0%
Westchester	22	0.1%	20 (tied)	0%
Bronx	23	0.1%	10 (tied)	1%
Manhattan	24	0.04%	10 (tied)	1%
Ocean	25	0.01%	20 (tied)	0%

Source: StreetLight, 2017; STV Incorporated, 2017.



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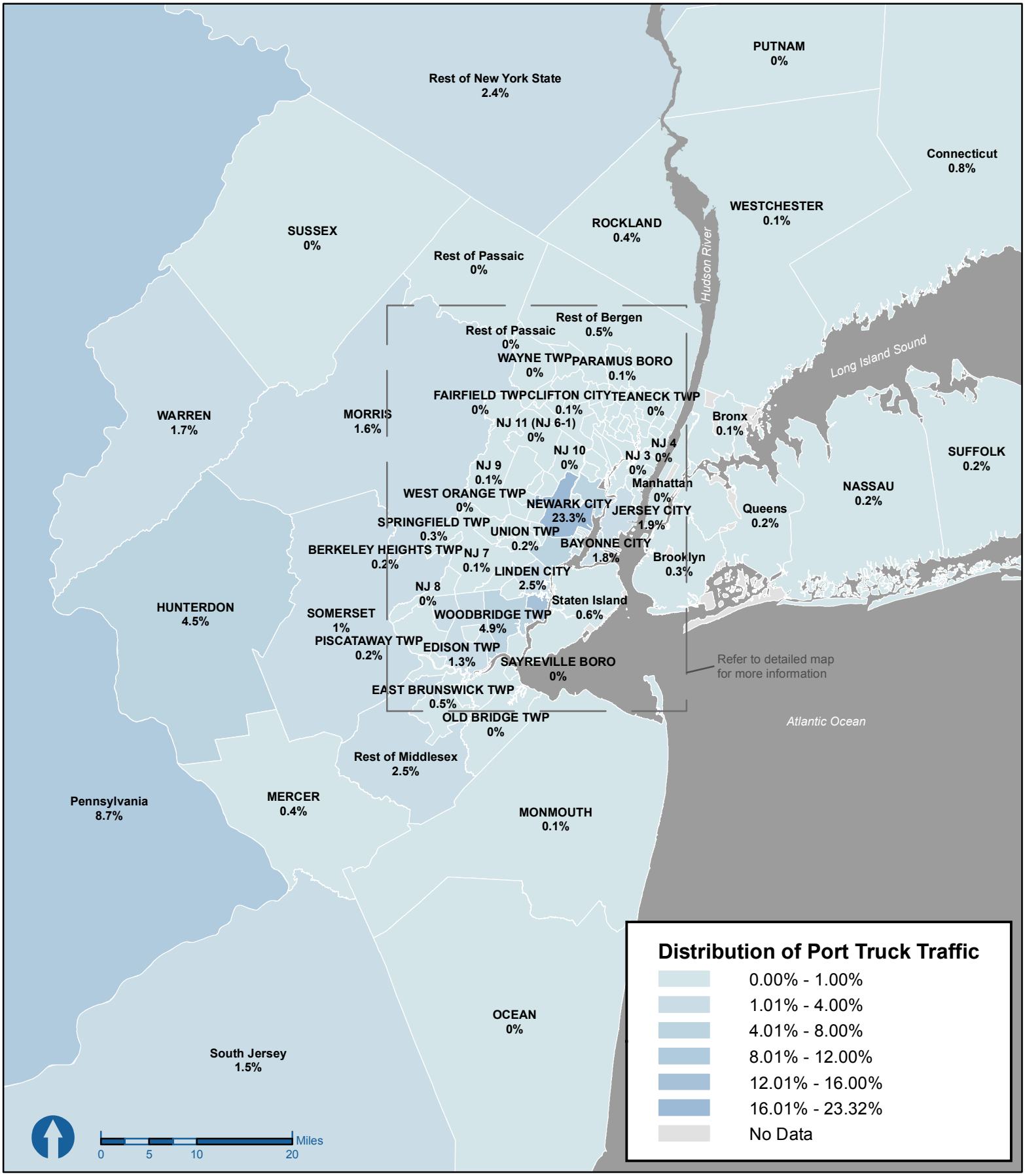
2-4: DISTRIBUTION OF PORT TRUCK TRAFFIC (ZONE AS DESTINATION)

Sources: StreetLight; NYC Open Data, NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS; US Census TIGER/Line Files; STV Incorporated, 2017.



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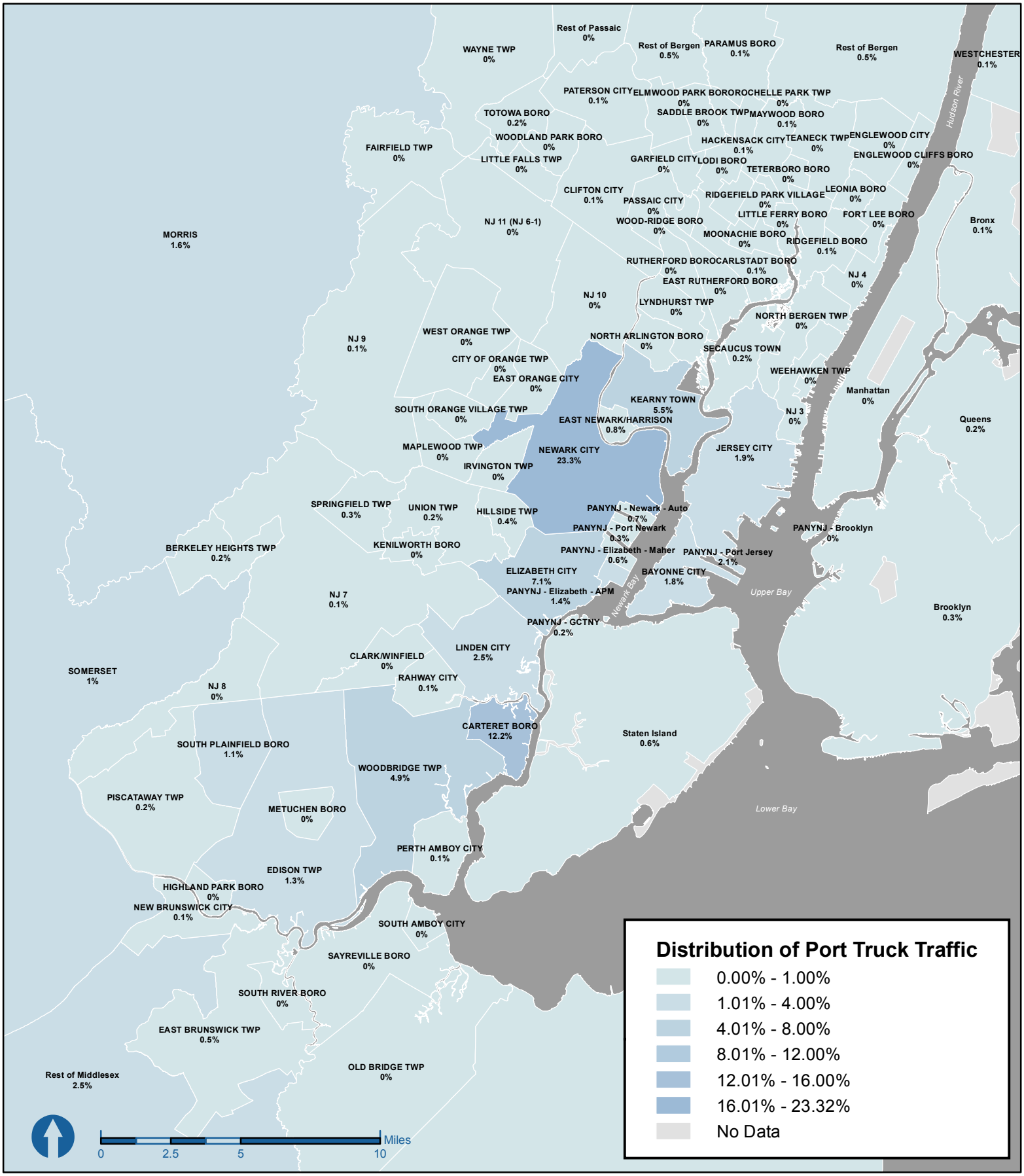
2-5: DISTRIBUTION OF PORT TRUCK TRAFFIC (ZONE AS DESTINATION)

Sources: StreetLight; NYC Open Data, NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS; US Census TIGER/Line Files; STV Incorporated, 2017.



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2-6: DETAILED DISTRIBUTION (ZONE AS DESTINATION)

Sources: StreetLight; NYC Open Data, NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS; US Census TIGER/Line Files; STV Incorporated, 2017.

2.4 Corridor Analysis

The corridor analysis aims to observe the distribution of port truck traffic that originates from and is destined to PANYNJ Port facilities along the regional truck routes.

2.4.1 Methodology

The PANYNJ Port facilities were defined the same as for the Zone Analysis. The corridors used for this analysis were designated truck routes that are reasonably proximate to Port facilities. Each of these corridors was divided into segments that measured traffic at specified points (see Table 2-6). Middle filters were set up at appropriate locations to capture port truck traffic passing through these points.

Table 2-6: Middle Filters along Corridors Used in Corridor Analysis

No.	Zone Name	# of Middle Filters
1	Co 173	1
2	Co 202	4
3	Co 206	1
4	Co 22	1
5	Co 46	1
6	Co 503	2
7	Co 507	1
8	Co 508	1
9	Co 509	3
10	Co 517	2
11	Co 527	1
12	Co 577	2
13	Co 649	1
14	NJ 21	2
15	I-278	6
16	I-280	11

No.	Zone Name (continued)	# of Middle Filters
17	I-287	16
18	I-78	12
19	I-80	19
20	I-95	14
21	NJ 15	2
22	NJ 17	2
23	NJ 183	1
24	NJ 19	3
25	NJ 20	2
26	NJ 23	2
27	NJ 24	1
28	NJ 27	1
29	NJ 3	1
30	NJ 94	1
31	NJ 17	2
32	NJ 208	1

No.	Zone Name (continued)	# of Middle Filters
33	NJ 23	2
34	NJ 24	1
35	NJ 35	2
36	NJ 139	1
37	NJ 173	1
38	NJ 21	1
39	NJ 22	1
40	NJ 3	2
41	NJ 31	2
42	NJ 440	7
43	US 202	5
44	US 1	1
45	US 1/9	10
46	US 206	2
47	US 46	20
48	US 9	2

Traffic data between Port facilities and corridors were acquired from StreetLight Data. For this analysis, the parameters were set the same as for the Zone Analysis, with the exception of geographic location. Whereas the zone analysis included trips between the 106 zones and Port facilities, this analysis included the middle filters as specified in Table 2-6.

These middle filters tracked trips as they travelled between the 106 zones and Port facilities. Given these parameters, an origin-destination analysis was conducted and subsequently downloaded from StreetLight Data. The origin-destination analysis was then filtered to provide the indices of port traffic traveling through the specified middle filters along corridors.

2.4.2 Results

The identified major corridors form a network that connects the origins and destinations of port truck traffic throughout the region (see Figure 2-7 and Figure 2-8).

The results show that I-95, US1/9, NJ 17, and a portion of I-287 are the major north-south corridors (see Figure 2-9).

The major east-west corridors include I-78, I-80, I-280, I-278, NJ 24, and NJ 440. These corridors provide access to areas west of I-95 to as far as Pennsylvania, as well as areas east to New York City and Long Island (see Figure 2-10).

North-South Corridors

These corridors move traffic through eastern New Jersey from South Jersey to New York State along I-95 and NJ 17, as well as the area in Somerset and Morris Counties along I-287 (see Figure 2-9).

I-95 is the corridor with the highest percentages of port truck traffic for both north-south and east-west corridors. This can be explained by its proximity to Port facilities, multiple connections to other major corridors, and its role as the only major highway in eastern New Jersey that provides north-south access for trucks.

A majority of northbound traffic would either use NJ 17 to access I-87 in New York or use the George Washington Bridge to continue their trip along I-95. NJ 17 serves as a connector for I-95 port traffic travelling north of Bergen County, heading to New York State.

The highest concentration of port truck traffic is in three continuous segments that, from north to south, contain 16 percent, 29 percent, and 25 percent of port traffic. These segments pass through, from north to south, Newark City, Elizabeth City, Linden City, and Carteret Boro. They also border Port Newark and Elizabeth Marine Terminal, and are in close proximity to Howland Hook Marine Terminal and Port Jersey.

To the north of these segments, port truck traffic declines to 8 percent and 9 percent as it passes through Kearny Town and Secaucus Town, and by the time it reaches Teaneck Township, port truck traffic has declined to 1 percent. South of Carteret Boro, port truck traffic declines from 25 percent to 11 percent as it passes through Woodbridge Township, and to 7 percent as it heads south of Edison Township.

The pattern of port truck traffic along I-95 suggests that origins and destinations are primarily located in close proximity to port facilities in Newark City, Elizabeth City, Linden City, Kearny Town, Woodbridge Township, Edison Township, and Carteret Boro.

I-287 differs from the other north-south corridors in that it is not used as a long distance route for port truck traffic, but rather it serves as a way to navigate to points immediately north and south of major intersections with east-west corridors in Morris and Somerset Counties.

In an effort to avoid the congested I-95 and NJ 17 corridors, a major portion of the I-287 port truck traffic utilizes east-west corridors first (NJ 24 via I-78, or I-280) before accessing I-287 in Morris County.

East-West Corridors

I-78 is the east-west corridor with the highest percentages of port truck traffic. This can be explained by its proximity to port facilities and access to western New Jersey and Pennsylvania. It is also a distributor that feeds traffic to access routes, including NJ 24 and NJ 22.

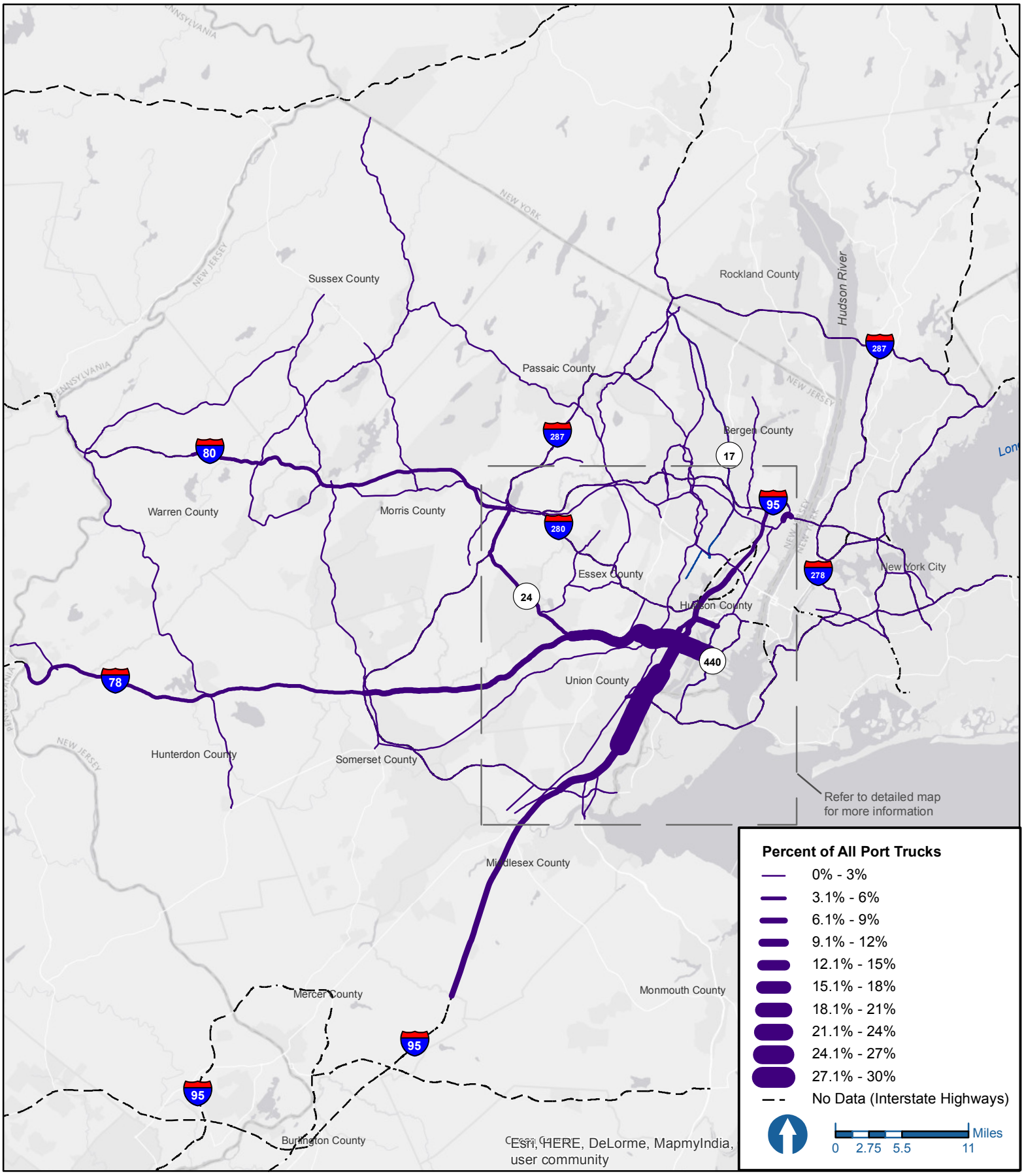
The highest concentration of port truck traffic along I-78 (25 percent) is in Newark City in close proximity to Port Newark and Elizabeth Marine Terminal. Port truck traffic heading west from Newark City remains strong with 17.3 percent passing through Union Township, 11.3 percent passing through Somerset County, 6.2 percent passing through Hunterdon County, and 4.1 percent reaching the Pennsylvania border.

The lowest concentration of port truck traffic (0.3 percent) is in Jersey City in close proximity to Port Jersey.

The overall pattern of port truck traffic along this corridor suggests a concentration of origin and destinations clustered near the ports, and to a lesser extent, a declining number of origins and destination heading west towards Pennsylvania (see Figure 2-10).

I-280 and I-80 serve a similar role to I-78, but to a lesser extent. It is not until I-280, I-80, and I-287 via NJ 24 intersect in Morris County that there is a concentration of port truck traffic along I-80 that is comparable to I-78. The segment of I-80 between NJ 17 and I-280 does not carry much port traffic.

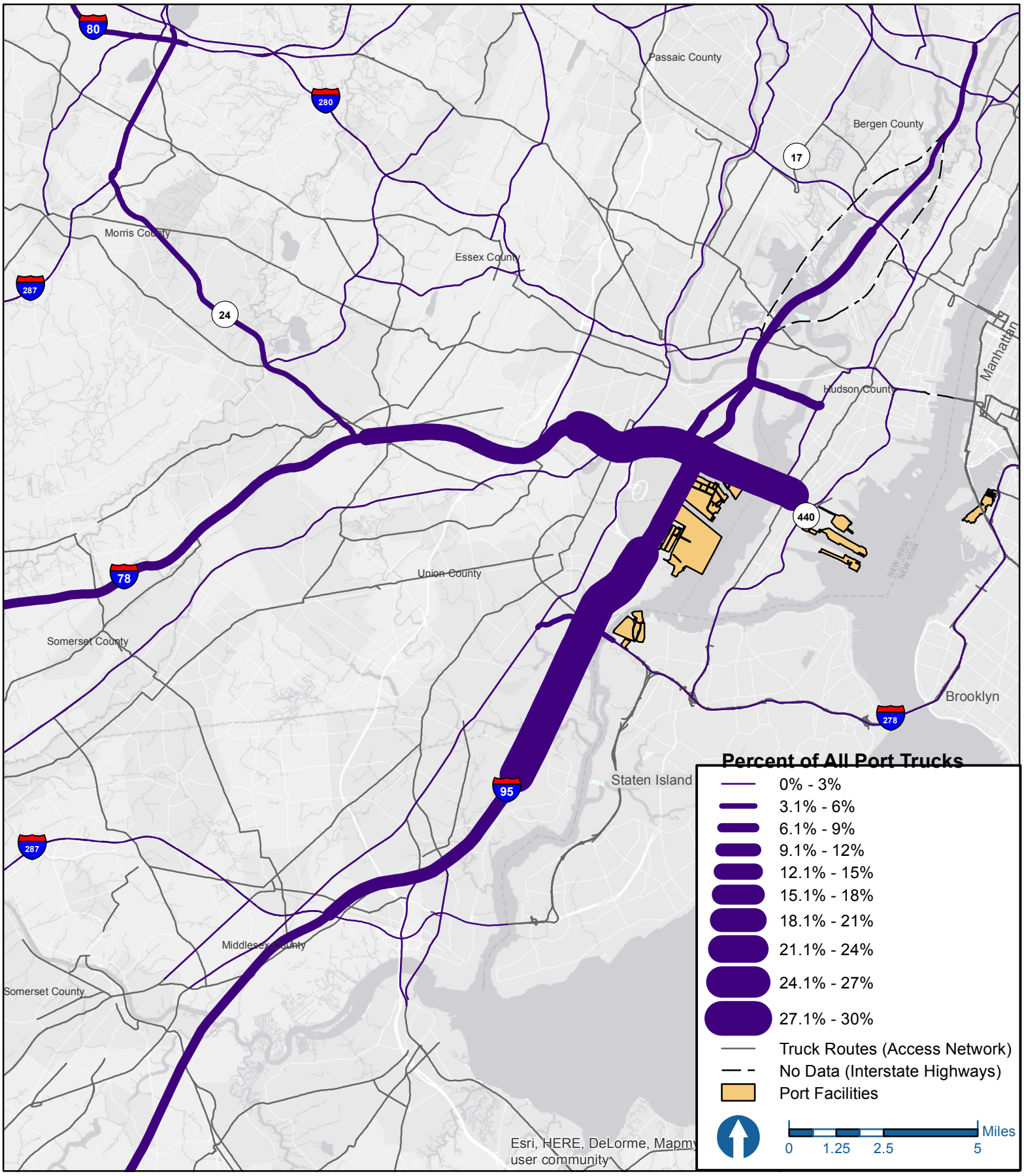
For traffic headed to New York City or Long Island, I-278 provides access to Brooklyn via Staten Island. I-95, to a lesser extent, provides access to Upper Manhattan and the Bronx.



THE PORT AUTHORITY OF NY & NJ

2-7: DISTRIBUTION OF TOTAL PORT TRUCK TRAFFIC

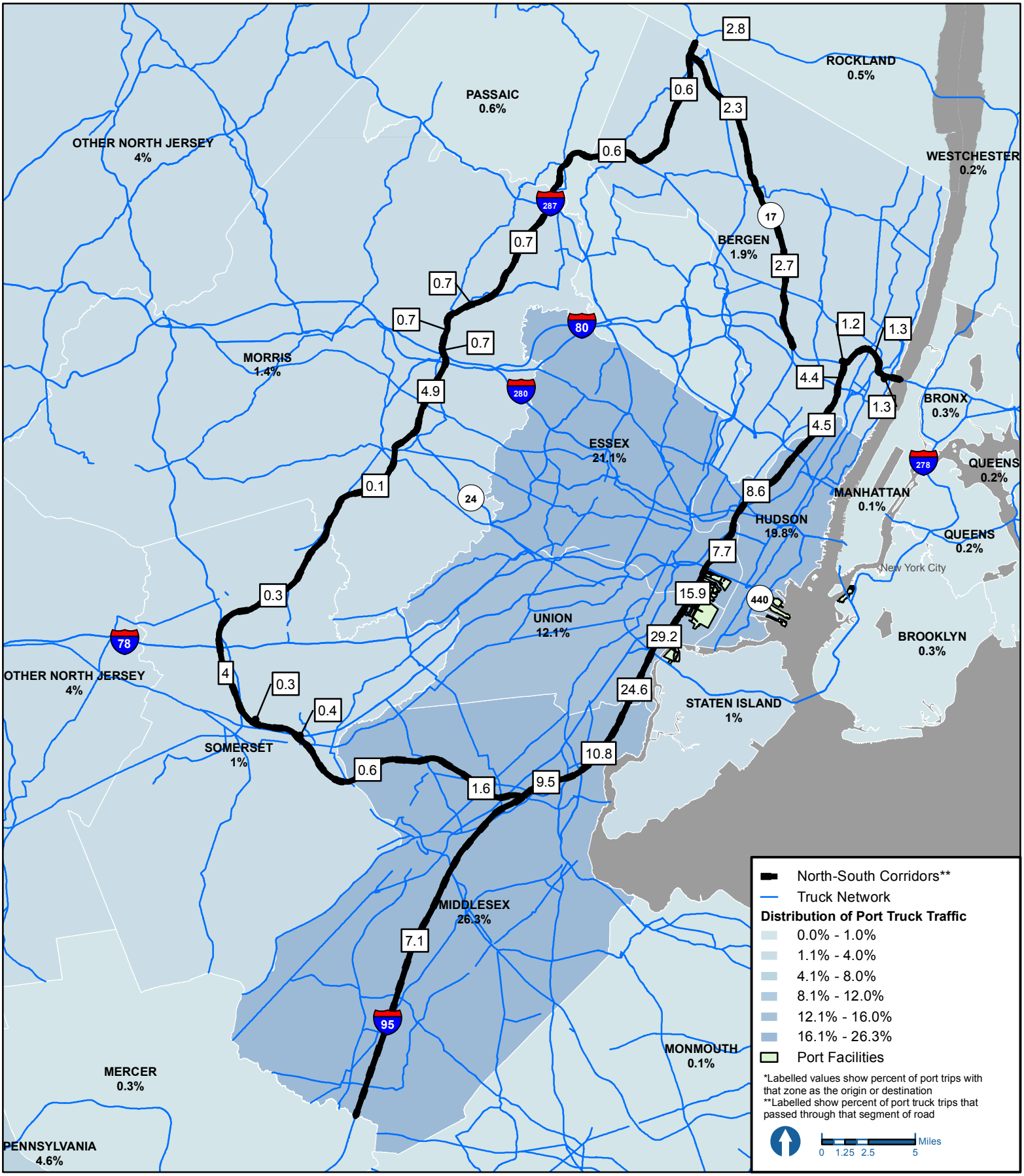
Sources: StreetLight; NYC Open Data,
NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS;
US Census TIGER/Line Files; STV Incorporated, 2017.



THE PORT AUTHORITY OF NY & NJ

2-8: DISTRIBUTION OF TOTAL PORT TRUCK TRAFFIC (DETAIL)

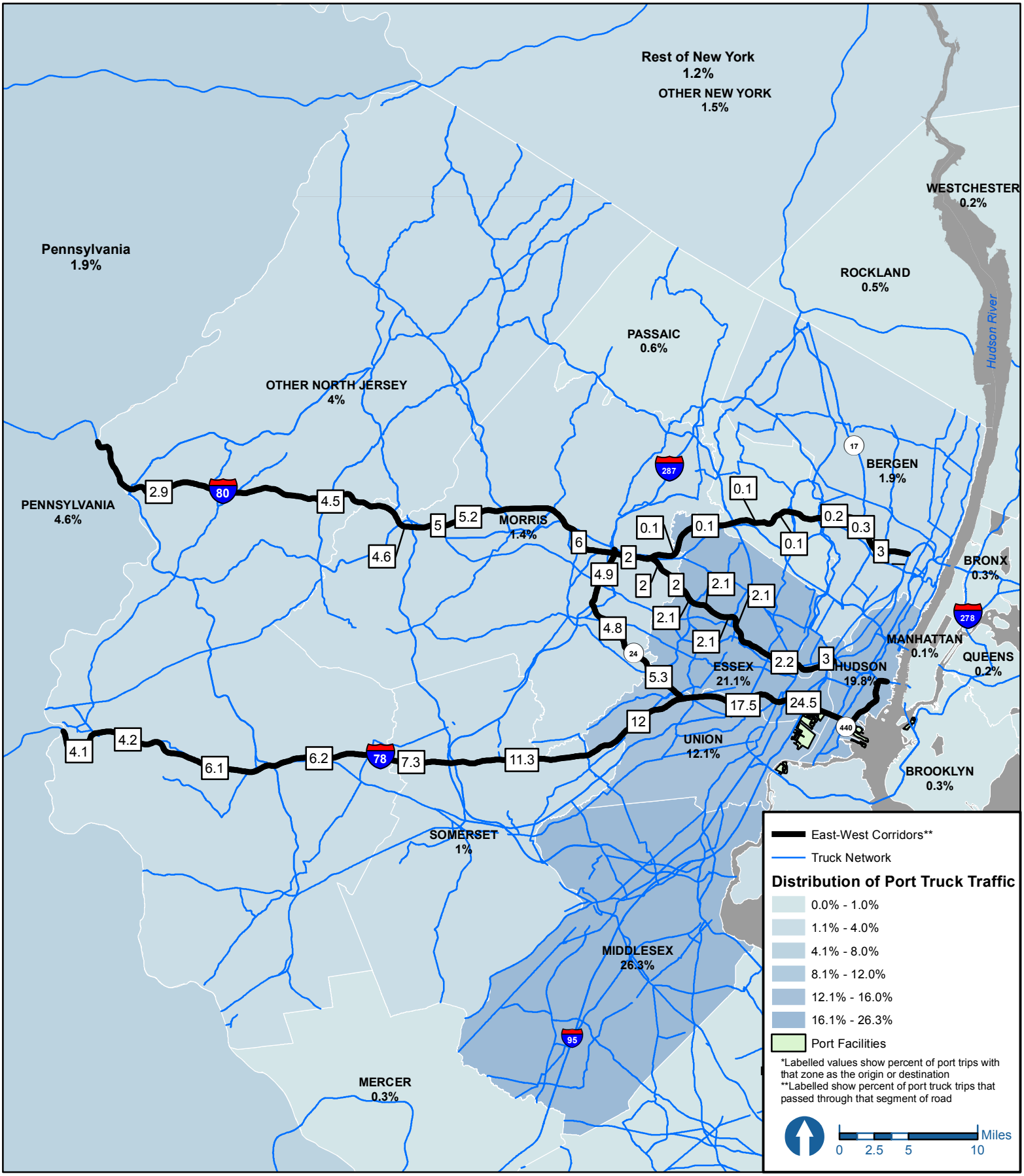
Sources: StreetLight; NJ Department of Transportation; NYC Open Data, NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS; US Census TIGER/Line Files; STV Incorporated, 2017.



THE PORT AUTHORITY OF NY & NJ

2-9: NORTH-SOUTH PORT TRUCK DISTRIBUTION

Sources: StreetLight; NYC Open Data,
NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS;
US Census TIGER/Line Files; STV Incorporated, 2017.



THE PORT AUTHORITY OF NY & NJ

2-10: EAST-WEST PORT TRUCK DISTRIBUTION

Sources: StreetLight; NYC Open Data,
NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS;
US Census TIGER/Line Files; STV Incorporated, 2017.

2.5 Port Truck to Total Traffic Analysis

This analysis aims to identify the ratios of port truck traffic to overall traffic along the major corridors. The results inform us about the impact of the port truck traffic on certain roadway segments and potentially the associated environmental impacts on communities.

2.5.1 Methodology

In order to analyze the ratio of port trucks to total vehicles on the corridor segments, an estimate of average total daily trucks entering and leaving the port facilities was made on the basis of previous studies and reports, including the 2003 NJDOT Portway Extensions Concept Development Study; 2005 PANYNJ Marine Container Terminal Truck Origin-Destination Survey; and 2014 PANYNJ Port Newark/Elizabeth Marine Terminal Traffic Data Collection Study.

It was estimated that, on an average weekday in 2016, Port Newark and Elizabeth Marine Terminal would generate 18,000 to 20,000 one-way truck trips, which is approximately 78% of total port truck movements. A total of 24,000 truck movements would be used to represent average weekday truck activities to/from the PANYNJ Port facilities.

Assuming an average daily volume of 24,000 trucks, a port truck count at each corridor segment can be estimated. This is done by multiplying the total port trucks by the ratio of the port truck index at each segment to the total port truck index. This port truck count can then be directly compared with the NJDOT and FHWA total traffic counts that were compiled for each corridor segment, resulting in a percent of port trucks to total traffic on each corridor segment.

2.5.2 Results

Overall port truck traffic makes up a small percentage of total traffic on the major corridors.

The area where port truck traffic makes up the largest percentage of total traffic (7.48 percent) is a segment along I-78 immediately to the west of Port Newark and Elizabeth Marine Terminal. Segments range from 7.48 percent to 0.02 percent truck volume. This range for I-78 is 7.48 percent to 0.28 percent, for I-80 is 1.51 percent to 0.02 percent, for I-95 is 2.91 percent to 0.11 percent, for I-280 is 1.10 percent to 0.36 percent, for I-278 is 0.88 percent, to 0.11 percent, for I-287 is 0.83 percent, to 0.02 percent, for NJ 440 is 1.6 percent to 0.03 percent, for NJ 17 is 0.63 percent to 0.53 percent, and for NJ 24 is 1.19 percent to 1.05 percent.

Other areas of significance include a segment of I-78 near the border of Union and Somerset Counties (3.02 percent), I-95 south of the Port Newark and Elizabeth Marine Terminal (2.91 percent), and I-80 west of I-287 (from 1.51 to 1.03 percent percent).

For the vast majority of segments where data was collected, port truck traffic was found to be less than 1 percent of total traffic (see Figure 2-11 and Figure 2-12). I-95, I-78, and I-280 are the corridors with the highest percentage of port truck traffic in total traffic. I-287 and the eastern portion of I-80 are the corridors with the lowest percentage of port truck traffic in total traffic.

North-South Corridors

The major north-south corridors include I-95, NJ 17, and I-287. Of these corridors, I-95 has the highest percentage of port truck traffic to total traffic. The highest percentage (2.91 percent) is located south of Port Newark and Elizabeth Marine Terminal, declining at a faster rate heading north than heading south.

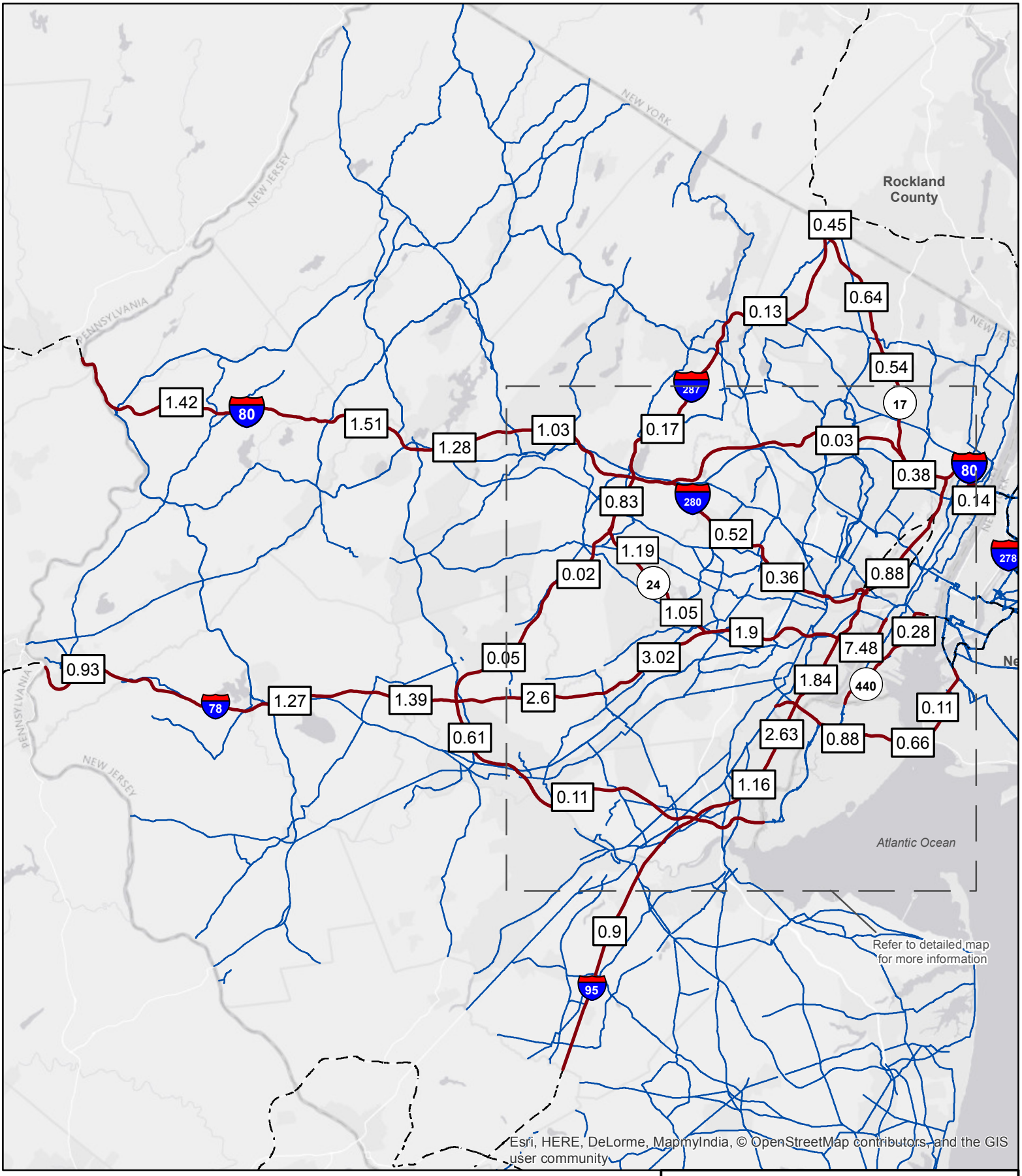
NJ 17 has a fairly low percentage of port truck traffic to total traffic with 0.54 percent to the south near I-95 and 0.64 percent to the north near the New York State border.

I-287, as discussed earlier, does not have a consistent flow of north-south traffic; rather, port truck traffic congregates at the intersections with I-95, I-78, I-80, and NJ 17. The pattern of the north-south corridors indicates that port truck traffic as percent of total traffic congregates near the ports and intersections with other major corridors.

East-West Corridors

The major east-west corridors consist of I-78, I-80, I-280, I-278, and NJ 24. The highest percentage of port truck traffic to total traffic are on I-78, I-80 west of the intersection with I-287, and I-280.

Of these routes, I-78 has the highest concentration of port truck traffic of any corridor, and its concentration of port truck traffic remains comparatively high throughout its length. As with the north-south corridors, the percentage of port truck traffic to total traffic is highest near Port Newark and Elizabeth Marine Terminal and near the intersections of major corridors. Unlike with the north-south corridors, the percentage of port truck traffic to total traffic follows a more linear traffic pattern with the percentage of port truck traffic gradually declining along routes rather than isolated peaks near intersections.



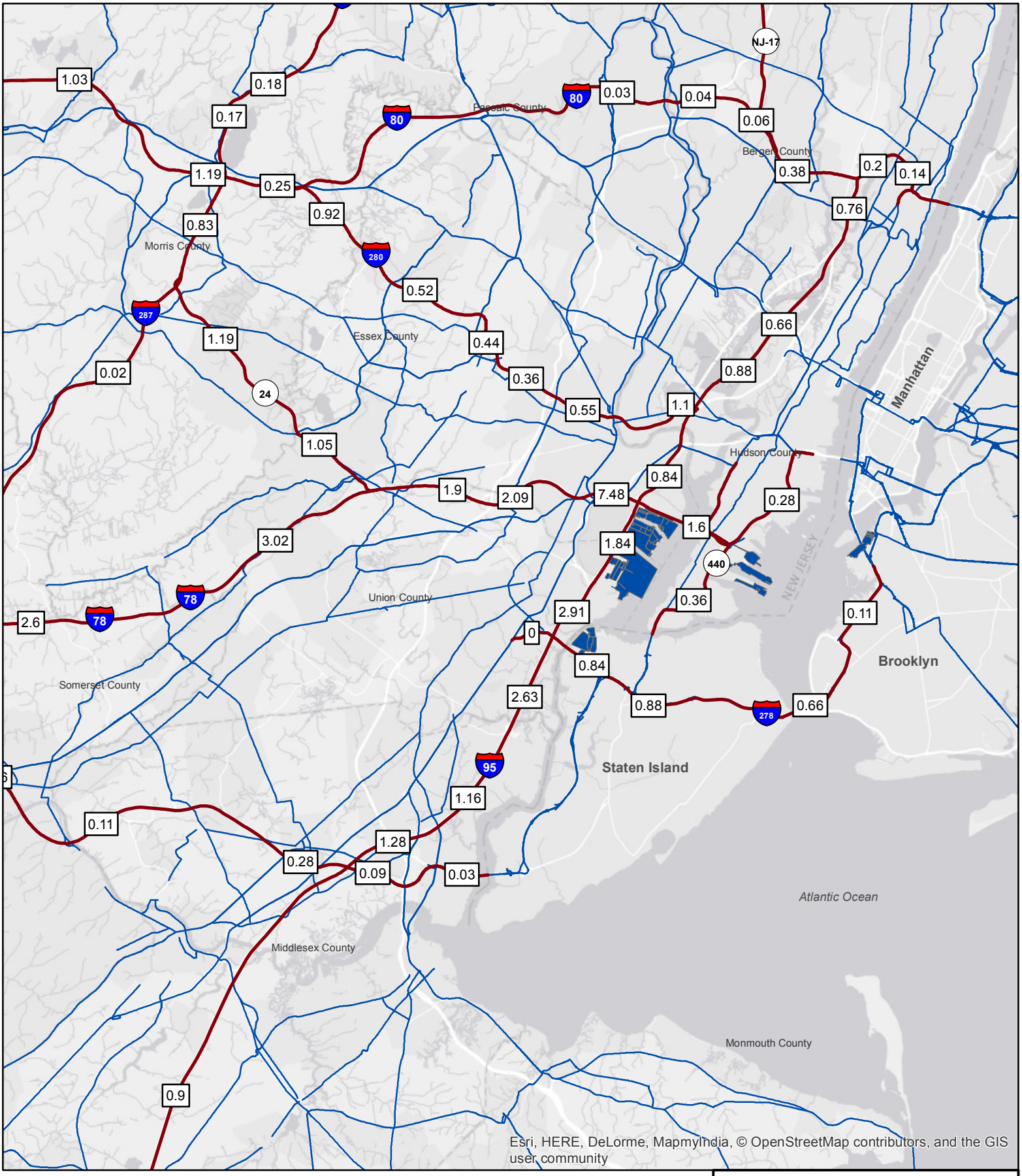
THE PORT AUTHORITY OF NY & NJ

2-11: PORT TRUCK TRAFFIC RATIOS (PORT TRUCKS AS PERCENT OF TOTAL TRAFFIC)

Sources: NYC Open Data, NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS; US Census TIGER/Line Files; NJ Department of Tranpsortation Traffic Counts; STV, 2017. | Date: March 2017

Major Corridors
Minor Corridors
No Data (Interstate Highways)
0.9 Percent of port trucks to overall traffic

Miles
0 2.5 5 10



THE PORT AUTHORITY OF NY & NJ

2-12: PORT TRUCK TRAFFIC RATIOS (DETAIL)

Sources: StreetLight; NYC Open Data, NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS; US Census TIGER/Line Files; NJ Department of Transportation Traffic Counts; STV Incorporated, 2017

Major Corridors
Minor Corridors
Port Facilities
0.9 Percent of port trucks to overall traffic

Miles
0 1.25 2.5 5

2.6 Corridor Congestion Analysis

This analysis identifies the segments of major corridors with both high percentages of port truck traffic and with congestion in peak periods.

2.6.1 Methodology

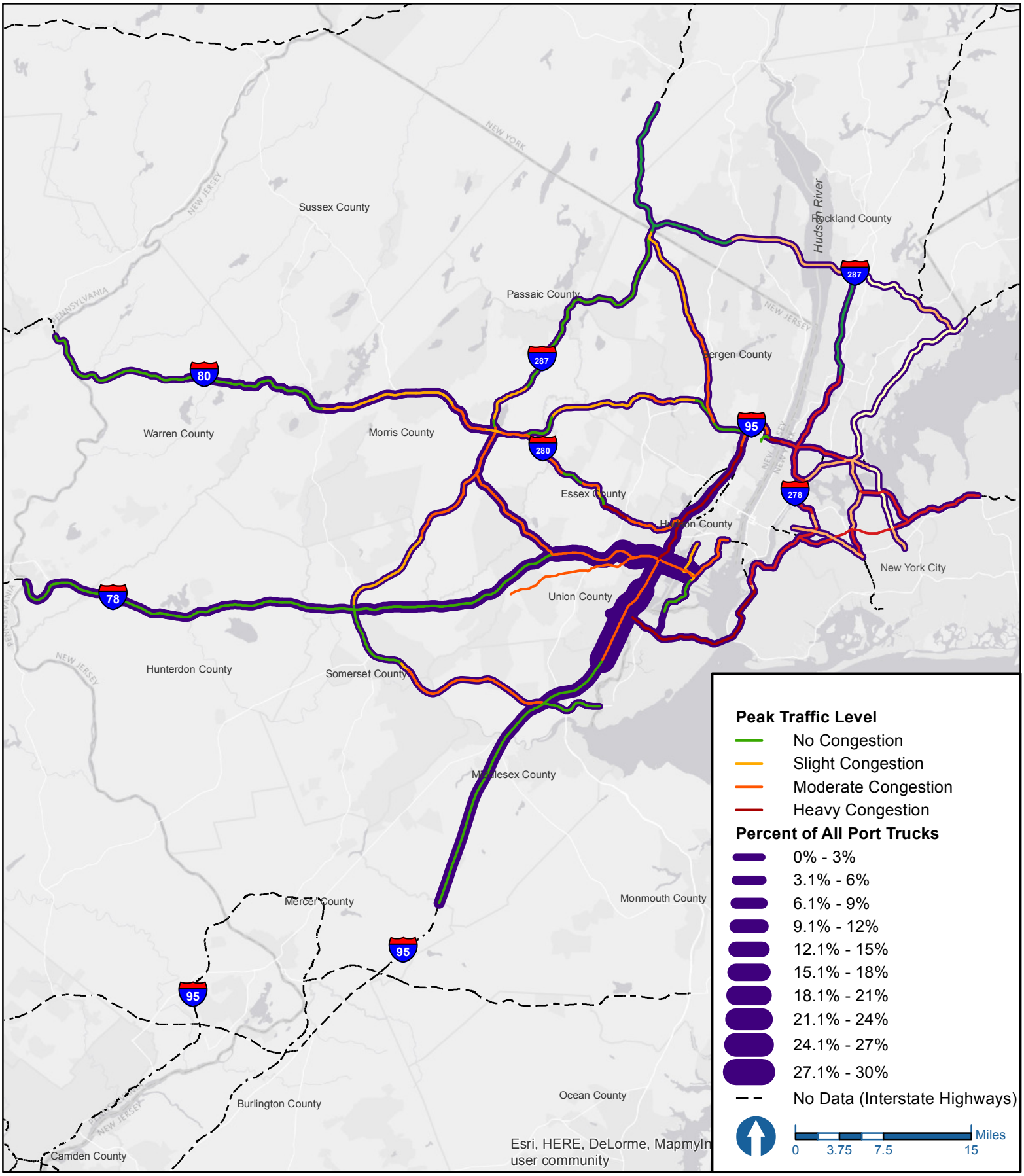
Data for the congestion analysis was obtained from Google Maps. Using the "Typical Traffic" feature, relative congestion values were obtained on a scale from 1 (no congestion) to 4 (heavy congestion), which were symbolized on Google Maps. Data was compiled for the AM peak hour (Tuesday, 9:00 AM) and the PM peak hour (Tuesday, 5:00 PM). The higher of the two was adopted as the condition of congestion level.

To assess the impact that congestion would have on port traffic, and vice-versa, congestion data was mapped with the percent of port trucks to overall traffic data (see Figure 2-13). With these data visualized together, the corridors and segments where increasing port truck traffic may negatively impact overall traffic, and where existing traffic and congestion may hinder port truck distribution, can be identified. Portions of corridors with high congestion and high ratios of port truck traffic were qualitatively selected based on these data.

2.6.2 Results

The goal of this analysis is to identify corridors where high ratios of port truck traffic to overall traffic align with high levels of congestion. The corridors closest to the ports – as well as to New York City – tended to be those with both heavy congestion and high port truck volumes. In particular, I-95 between I-80 and I-78 showed the highest percentage of port traffic combined with heavy congestion. I-78 between I-95 and NJ 24 also showed high percentages of port traffic, but moderate congestion. Other corridors with a heavy combination of port truck traffic and congestion include:

- I-278 in New York City;
- I-280;
- NJ 24/I-287 between I-78 and I-80; and
- NJ 17 between I-80 and I-287.



THE PORT AUTHORITY OF NY & NJ

2-13: TRAFFIC CONGESTION AND PORT TRUCK DISTRIBUTION

Sources: StreetLight; NYC Open Data,
NYC Dept of Planning, NYS GIS Clearing House; NJ Bureau of GIS;
US Census TIGER/Line Files; STV Incorporated, 2017.

2.7 Implications on Future Scenarios

As discussed above, both the origin-destination analysis and the truck route study showed that, though the fundamental spatial distribution of port truck movements did not shift significantly since 2005, there has been a marked shift of origins/destinations toward the south and west of the four-county area.[3] Additionally, there has been an overall increase in the percentage of origins/destinations in New Jersey and a corresponding decrease in New York City and Long Island. Following the trends since the 1980s, higher proportions of port trucks come from or go to facilities in the four-county area in 2016, particularly the cities and towns along the I-95 corridor. Their major truck routes are limited to I-95, I-78, and US 1/9 in the area close to the ports. Meanwhile, these routes are the busiest roads in the region, especially in the morning and afternoon peak periods.

If this situation continues in the future, it would result in more severe congestion in the port area which would not only adversely affect the quality of life for the neighboring communities, but also threaten the productivity of the ports and associated logistic industries. The results of the aforementioned analyses would assist the subsequent process of forming improvements in the future scenarios.

For future scenarios, it is expected that the volume of port truck traffic would increase significantly as the container trade in the ports could more than double in 30 years. Roadway improvements would be a direct but very expensive answer. For instance, considering the high proportions of port truck traffic as shown in Figure 2-12 and traffic conditions as shown in Figure 2-13, certain scenarios could necessitate the addition of lanes on I-95 north of Newark and on I-78 between Newark and Jersey City. The construction costs for expanding capacity on major bridges on these roadways would be very high.

Other solutions may include building new roadways or converting existing truck route segments to dedicated truck roads that reduce traffic impact on the congested corridors and facilitate the distribution of port truck traffic to multiple locations. The new infrastructure may include managed truck lanes, truck road, or truck toll road, or special roads allowing truck platooning or driverless trucks (or automated guided vehicles/AGVs). The analysis shows that dedicated truck roads should be either parallel to the major corridors such as I-95 and I-78 or be part of them, as those would provide access to the same origins and destinations of port trucks. It should be noted that dedicated truck roads may shift the truck route choice pattern. Further investigation with modeling of truck behavior would be needed to justify this need.

It should be noted that substantial capacity reserve would be available in off-peak periods. Figure 2-13 only presents the worst case of congestion level. In the future scenario, it is assumed that off-peak operations both at the ports and in logistic facilities in this region would allow a 24/7 operation of port trucks. The potential of shifting port truck peak periods would have big impacts on truck-related congestion and infrastructure needs.

The future scenarios would also encourage higher rail share in handling port containers, with a purpose of reducing trucks on roads. Both the total container volume at a specific port and the capability of building rail infrastructure at this port would affect the truck volume and the need of roadway improvements. Balancing the construction of additional road and rail capacity with shifts in mode share will be performed as part of the benefit-cost analysis to determine the most cost-effective means of adding landside capacity.

[3] Essex, Hudson, Middlesex, and Union Counties.

2.8 Characteristics of Port Truck Trips

The characteristics of port truck trips include travel time distribution and trip length distribution. These distributions demonstrate the major temporal and spatial patterns of truck activities and provide implications regarding the nature of these trips and their impacts on the surrounding communities.

Based on the trip attribute data from StreetLight, the travel time distribution of port trucks is shown in Figure 2-14. A significant portion of port truck trips from container terminals ends within one hour, with a peak in the duration of 10–20 minutes. Few port trucks take trips longer than one hour and their proportions are much lower. This signifies that a majority of port trucks from container terminals take short trips to their first destinations in this area.

The truck trips from both auto terminals and non-container terminals in Newark present a different pattern, in which the peak at the 10-to-20-minute duration is much lower and a significant portion of these trips lasts two and a half hours or longer. This shows that their first destinations are very likely out of this region, even after considering delays in traffic.

As a comparison, the travel time distributions of heavy trucks from some municipalities is shown in Figure 2-15. These municipalities accommodate major clusters of logistic industries in the region. The travel time distributions of trucks from these cities and towns are relatively consistent and can be seen as a combination of container and non-container trucks at ports. They include both a peak at the 10-to-20-minute duration and a peak for trips longer than two and a half hours. This implies that the container trucks from the port follow a special origin-destination (O-D) pattern that is different from that of the domestic heavy trucks.

The trip length distribution of port trucks is shown in Figure 2-16. There are three peaks in container truck trip length: 0–1 mile, 2–5 miles and 10–20 miles. A significant portion of truck trips from container terminals ends within 30 miles, and the proportion of long truck trips originating directly from the Port is very low.

Again, the truck trips from both auto terminals and non-container terminals in Newark present a different pattern, in which the peaks at 2–5 miles and 5–10 miles are much lower, while a significant portion of these trips are longer than 100 miles, meaning that their first destinations are very likely out of this region.

As a comparison, the trip length distributions of heavy trucks from some municipalities is shown in Figure 2-17. The trip length distributions of trucks from these cities and towns are relatively consistent, with a peak in the range from 5–10/10–20 miles. These municipalities also have a peak for trips longer than 100 miles. This implies that the heavy trucks from these municipalities serve both the local market at 5–20 miles range and the market more than 100 miles away. This again implies that the container trucks from the port follow a special O-D pattern that is different to that of the domestic heavy trucks.

The logistic clusters served by port trucks are close to the port, based on both the zonal O-D analysis and the travel time/trip-length analysis. From there, non-port trucks carry commodities to their final destinations that are further away. In studying the origins and destinations of the port trucks and drawing conclusions with the regional good movements and economic impact, cautious steps must be taken to differentiate the characteristics of port and non-port trucks, and patterns of associated markets and industries.

Figure 2-14: Travel Time Distribution of Port Trucks (Port as Origin)

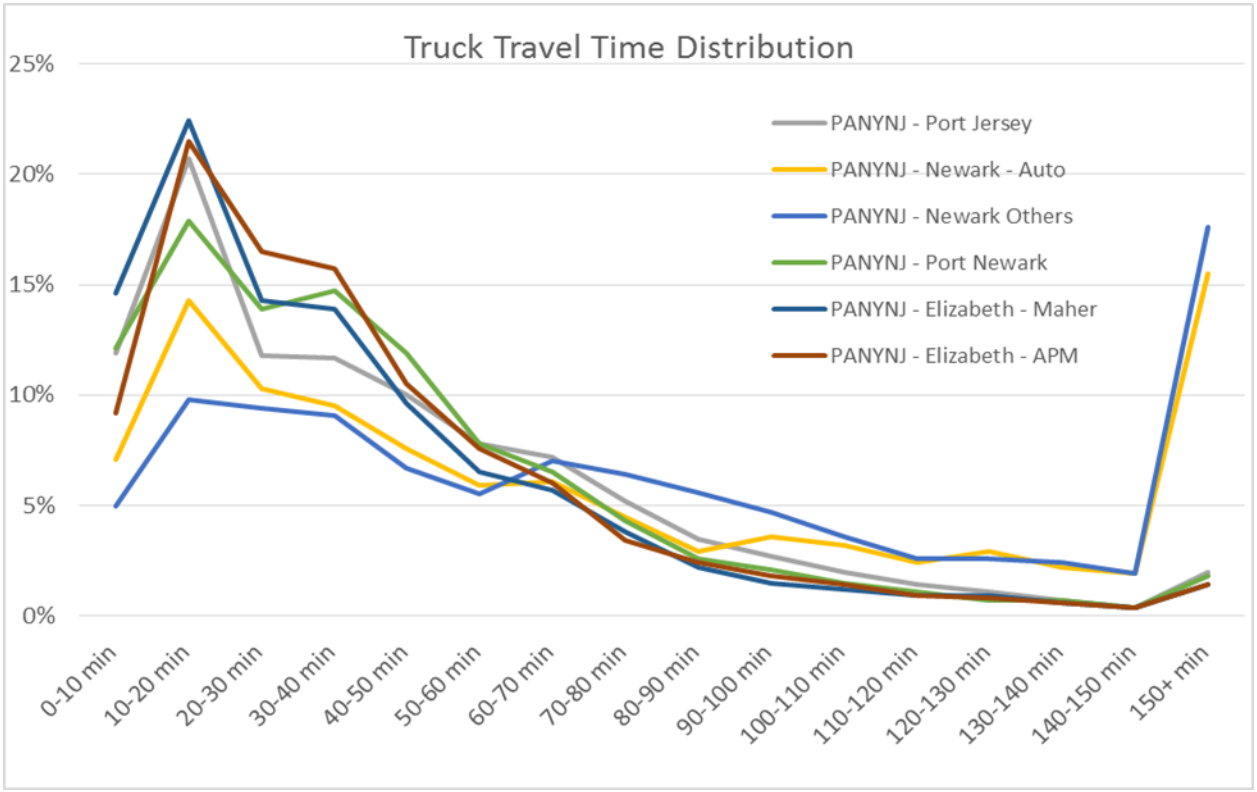


Figure 2-15: Travel Time Distribution of Heavy Trucks (Municipalities as Origin)

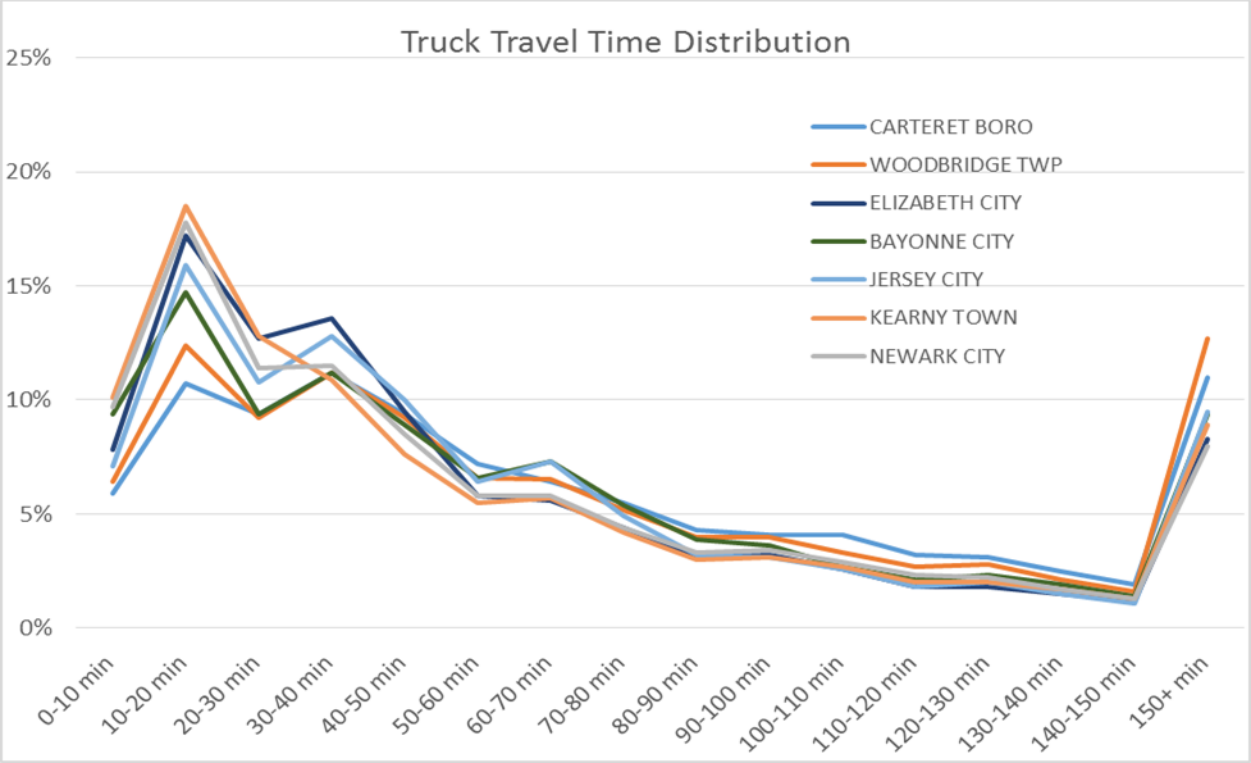


Figure 2-16: Trip Length Distribution of Port Trucks (Port as Origin)

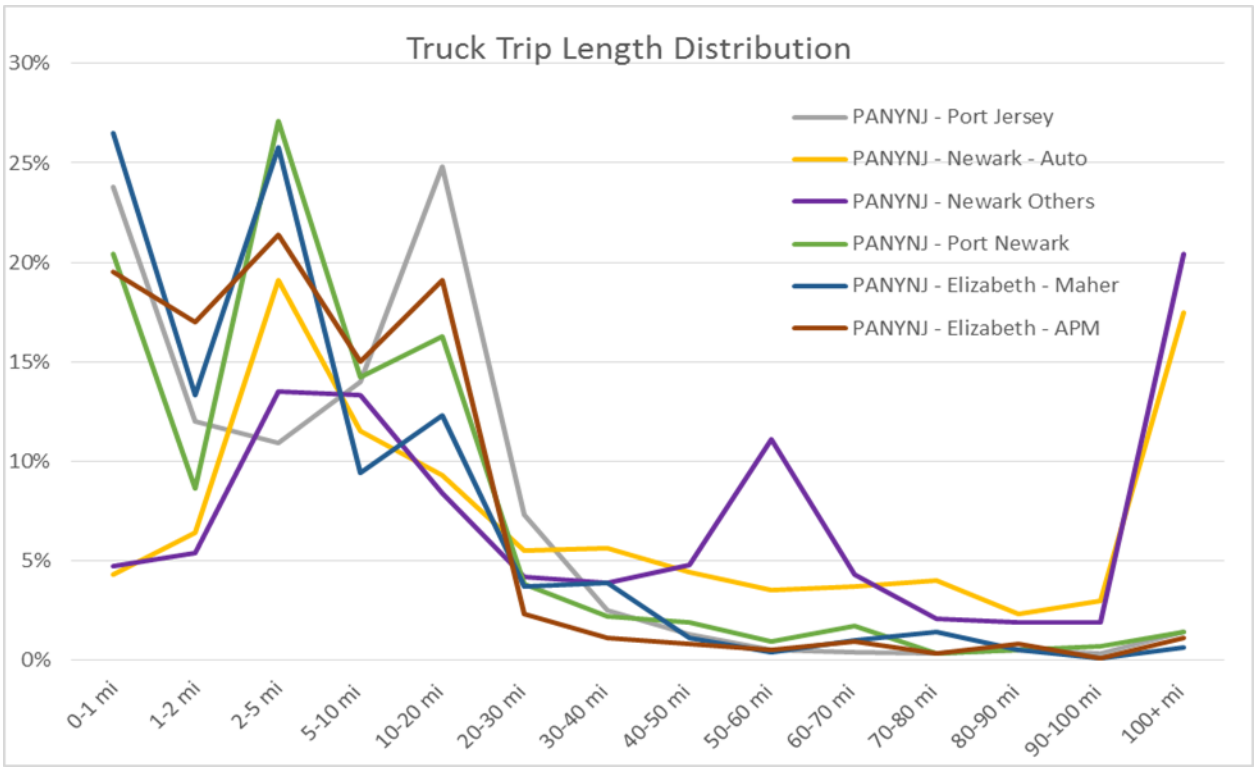
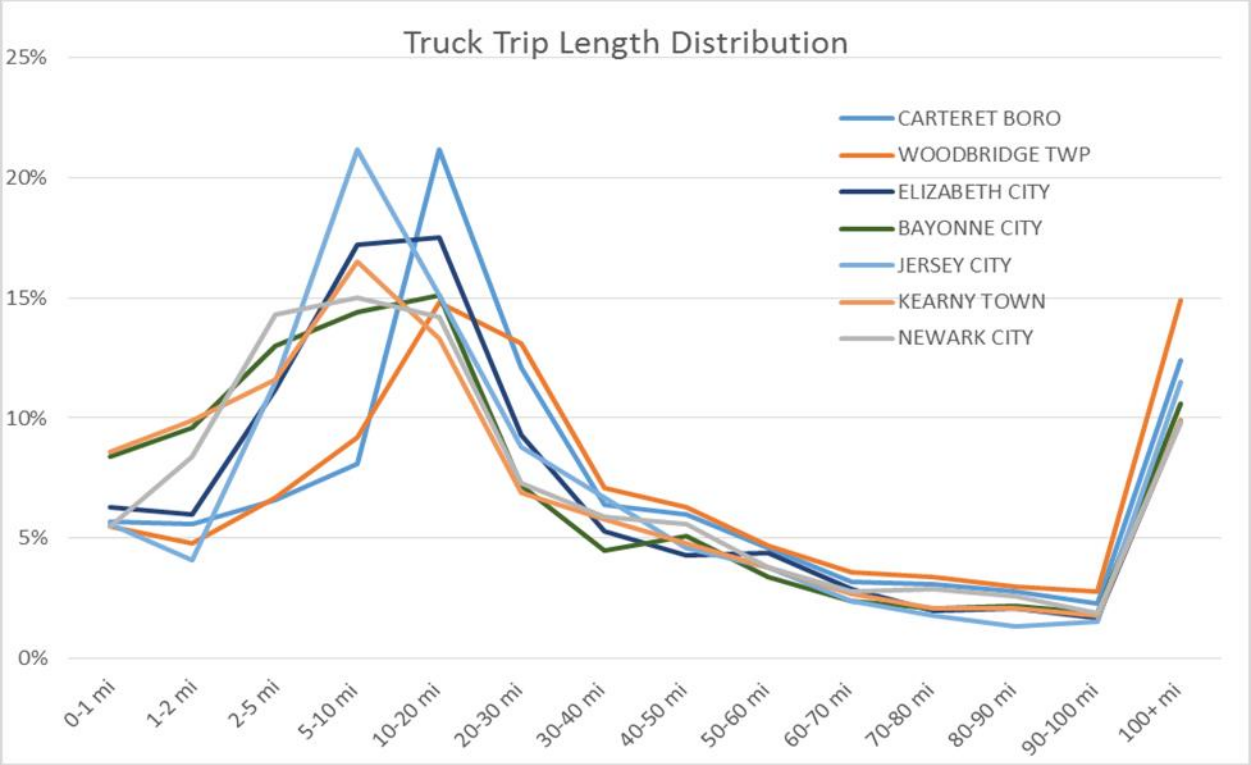


Figure 2-17: Trip Length Distribution of Heavy Trucks (Municipalities as Origin)



2.9 Landside Transport Capacity (Road) Conclusions

2.9.1 Zone Traffic Analysis

The percentage of port truck traffic, both as an origin and a destination, is highest in the zones immediately surrounding the New Jersey ports and along I-95 (NJ Turnpike), i.e. Newark City, Elizabeth City, Kearny Town, Woodbridge Township, Carteret Boro, Jersey City, and Bayonne City.

It is also apparent that, within the four-county area that accounts for a major portion of port truck traffic, a specific set of municipalities along the I-95 corridor receive most of the port truck traffic (see Figure 2-2 and Figure 2-5). Notable percentages of port truck traffic are also found in Pennsylvania and other northern New Jersey counties. Low percentages of port truck traffic are present in New York City.

These findings are largely consistent with the 2005 analysis. Notable differences between the 2017 and 2005 analyses include a higher percentage of port truck traffic in Union County, a higher percentage of port truck traffic in New Jersey, and a lower percentage of port truck traffic in Pennsylvania and New York State, in particular New York City. However, the decreases in New York State and increases in New Jersey port traffic are consistent with the trends observed in previous analyses conducted in 1992 and 2005.

2.9.2 Corridor Analysis

The port truck traffic travel patterns highlight a system that connects port facilities with municipalities along the I-95 corridor, New York State west of the Hudson River, western New Jersey, and Pennsylvania. A lower percentage of port truck traffic is present along corridors to New York City, Long Island, and New York State east of the Hudson River.

The results, particularly those of the I-95 and I-78 corridors, suggest that truck origins and destinations cluster in close proximity to the ports in and around Newark City, Elizabeth City, Linden City, Kearny Town, Woodbridge Township, Edison Township, and Carteret Boro. Although some port traffic is present in western New Jersey and Pennsylvania, the majority of trips made are within close proximity to the ports along I-95 and I-78. These results correspond to the distribution of port truck traffic among zones identified in the zone analysis.

2.9.3 Port Truck to Total Traffic Analysis

The percentage of port truck traffic to total traffic is highest along the segments or corridors near Port Newark and Elizabeth Marine Terminal in Newark City, Elizabeth City, Kearny Town, Linden City, and Carteret Boro.

The intersections of major corridors consistently show increases in the percentage of port truck traffic.

As for the corridors, the east-west corridors show a linear level of traffic that peaks and trails off, while the north-south corridor traffic peaks near intersections and the ports. Of all the corridors, I-78 has the highest percentage of port truck traffic to regular traffic. I-95 has the second highest percentage as it passes through Newark City, Elizabeth City, Carteret Boro, and Linden City. I-280 and I-80 west of the intersection with I-287 have moderate percentages.

The overall pattern of the percentage of port truck traffic to total traffic seems to indicate that port truck traffic congests at the ports, major corridor intersections, and along the I-78 corridor to Pennsylvania.

2.9.4 Corridor Congestion Analysis

The corridor segments identified in the results section of this analysis, including portions of I-95, I-78, I-278, NJ 24, and NJ 17, show high levels of congestion and port truck traffic.

3.0 References

New Jersey Department of Transportation. *Portway Extensions Concept Development Study.* 2003.

Port Authority of New York and New Jersey. Vollmer; Eng-Wong, Taub & Associates; Stump/Hausman; New Jersey Institute of Technology; Stevens Institute of Technology. *Port Authority Marine Container Terminals Truck Origin-Destination Survey 2005.* Draft Report. November 2005, revised February 27, 2006.

———. *Port Newark/Elizabeth Marine Terminal Traffic Data Collection Study.* 2014.