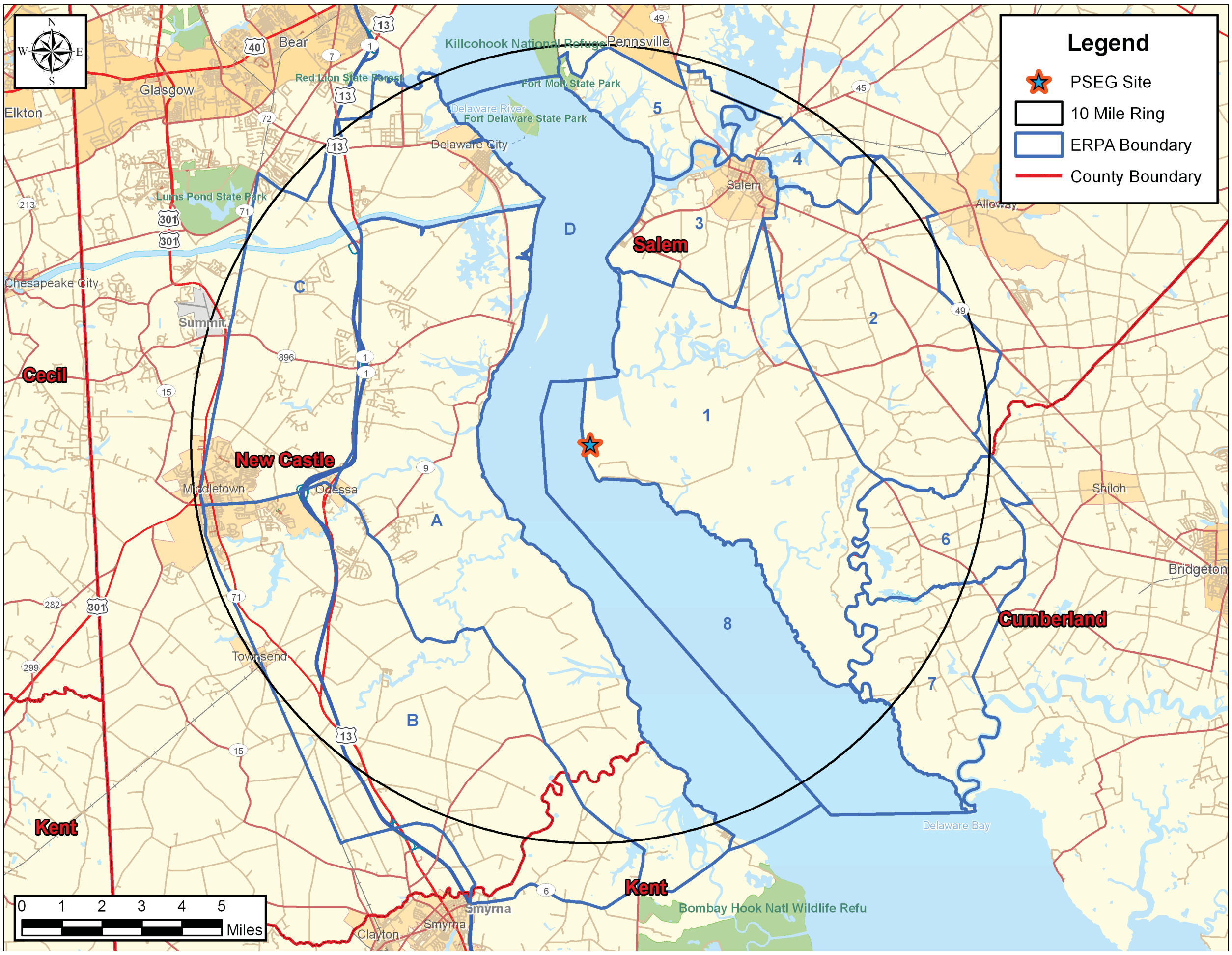
KLD ENGINEERING, P.C.

PSEG Site

Development of Evacuation Time Estimates



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EXECUTIVE SUMMARY

This report describes the analyses undertaken and the results obtained by a study to develop Evacuation Time Estimates (ETE) for the PSEG Site located in Salem County, New Jersey. Evacuation time estimates are part of the required planning basis and provide PSEG and State and local governments with site-specific information needed for Protective Action decision-making.

In the performance of this effort, guidance is provided by documents published by Federal Government agencies. Most important of these are:

- Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG-0654/FEMA-REP-1, Rev. 1, November 1980.
- Analysis of Techniques for Estimating Evacuation Times for Emergency Planning Zones, NUREG/CR-1745, November 1980.
- Development of Evacuation Time Estimates for Nuclear Power Plants, NUREG/CR-6863, January 2005.

Overview of Project Activities

This project began in March, 2009 and extended over a period of 5 months. The major activities performed are briefly described in chronological sequence:

- Attended “kick-off” meetings with PSEG personnel and emergency management personnel representing state and local governments.
- Accessed U.S. Census Bureau data files for the year 2000. Studied Geographical Information Systems (GIS) maps of the area in the vicinity of the PSEG Site, then conducted a detailed field survey of the highway network.
- Synthesized this information to create an analysis network representing the highway system topology and capacities within the Emergency Planning Zone (EPZ), plus a Shadow Region covering the region between the EPZ boundary and approximately 15 miles radially from the plant.
- Designed and sponsored a telephone survey of residents within the EPZ to gather focused data needed for this ETE study that were not contained within the census database. The survey instrument was reviewed and modified by State and county personnel prior to the survey.
- Data collection forms (provided to the counties at the kickoff meeting) were returned with data pertaining to employment, transients, and special facilities in each county.
- The traffic demand and trip-generation rates of evacuating vehicles were estimated from the gathered data. The trip generation rates reflected the

estimated mobilization time (i.e., the time required by evacuees to prepare for the evacuation trip) computed using the results of the telephone survey of EPZ residents.

- Following Federal guidelines, the EPZ is subdivided into 12 Emergency Response Planning Areas (ERPA). These ERPA are then grouped within circular areas or "keyhole" configurations (circles plus radial sectors) that define a total of 17 Evacuation Regions.
- The time-varying external circumstances are represented as Evacuation Scenarios, each described in terms of the following factors: (1) Season (Summer, Winter); (2) Day of Week (Midweek, Weekend); (3) Time of Day (Midday, Evening); and (4) Weather (Good, Rain, Snow). One special scenario involving the construction phase at the PSEG Site was considered.
- The Planning Basis for the calculation of ETE is:
  - A rapidly escalating accident at the PSEG Site that quickly assumes the status of General Emergency such that the Advisory to Evacuate is virtually coincident with the siren alert.
  - While an unlikely accident scenario, this planning basis will yield ETE, measured as the elapsed time from the Advisory to Evacuate until the last vehicle exits the impacted Region, that represent "upper bound" estimates. This conservative Planning Basis is applicable for all initiating events.
- If the emergency occurs while schools are in session, the ETE study assumes that the children will be evacuated by bus directly to reception centers located outside the EPZ. Parents, relatives, and neighbors are advised to not pick up their children at school prior to the arrival of the buses dispatched for that purpose. The ETE for schoolchildren are calculated separately.
- Evacuees who do not have access to a private vehicle will either ride-share with relatives, friends or neighbors, or be evacuated by buses provided as specified in the county evacuation plans. Those in special facilities will likewise be evacuated with public transit, as needed: bus, van, or ambulance, as required. Separate ETE are calculated for the transit-dependent evacuees and for those evacuated from special facilities.

<u>Computation of ETE</u>

A total of 255 ETE were computed for the evacuation of the general public. Each ETE quantifies the aggregate evacuation time estimated for the population within one of the 17 Evacuation Regions to completely evacuate from that Region, under the circumstances defined for one of the 15 Evacuation Scenarios (17 x 15 = 255). Separate ETE are calculated for transit-dependent evacuees, including schoolchildren for applicable scenarios.

Except for Region R03, which is the evacuation of the entire EPZ, only a portion of the people within the EPZ would be advised to evacuate. That is, the Advisory to Evacuate applies only to those people occupying the specified impacted region. It is assumed that 100 percent of the people within the impacted region will evacuate in response to this Advisory. The people occupying the remainder of the EPZ outside the impacted region may be advised to take shelter.

The computation of ETE assumes that a portion of the population within the EPZ but outside the impacted region, will elect to "voluntarily" evacuate. In addition, a portion of the population in the Shadow Region beyond the EPZ that extends from the EPZ boundary to a distance of approximately 15 miles from the PSEG Site, will also elect to evacuate. These voluntary evacuees could impede those who are evacuating from within the impacted region. The impedance that could be caused by voluntary evacuees is considered in the computation of ETE for the impacted region.

The computational procedure is outlined as follows:

- A link-node representation of the highway network is coded. Each link represents a unidirectional length of highway; each node usually represents an intersection or merge point. The capacity of each link is estimated based on the field survey observations and on established procedures.
- The evacuation trips are generated at locations called "zonal centroids" located within the EPZ. The trip generation rates vary over time reflecting the mobilization process, and from one location (centroid) to another depending on population density and on whether a centroid is within, or outside, the impacted area.
- The computer models compute the routing patterns for evacuating vehicles that are compliant with federal guidelines (outbound relative to the location of PSEG Site), then simulate the traffic flow movements over space and time. This simulation process estimates the rate that traffic flow exits the impacted region. The following federal guidelines were adhered to in computing the ETE presented in this study:
  - 10CFR50, Appendix E – "Emergency Planning and Preparedness for Production and Utilization Facilities"
  - Appendix 4 to NUREG-0654/FEMA-REP-1, Rev. 1 - "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants"
  - Supplement 2 to NUREG-0654/FEMA-REP-1, Rev. 1 – "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants - Criteria for Emergency Planning in an Early Site Permit Application"
  - NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" – Section 13.3 – "Emergency Planning"
  - NUREG/CR-6863 – "Development of Evacuation Time Estimate Studies for Nuclear Power Plants"

- Regulatory Guide 1.206 – "Combined License Applications for Nuclear Power Plants" – Section C.I.13.3 – "Emergency Planning"
- NUREG-0654/FEMA-REP-1, Rev. 1, Supp. 3 , "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants - Criteria for Protective Action Recommendations for Severe Accidents"

- The ETE statistics provide the elapsed times for 50 percent, 90 percent, 95 percent and 100 percent, respectively, of the population within the impacted region, to evacuate from within the impacted region. These statistics are presented in tabular and graphical formats. **The 90th percentile ETE should be considered when making protective action decisions because the 100th percentile ETE are prolonged by those relatively few people who take longer to mobilize.** Page 27 of NUREG/CR-6953, Volume 2 (NRC public telephone survey) indicates that an evacuation tail of approximately 10% of the EPZ population is appropriate for ETE studies. The evacuation tail prolongs the ETE as a result of those stragglers who take longer to mobilize. Thus, a tail of 10% would imply using the 90th percentile ETE.

  The use of a public outreach (information) program to emphasize the need for evacuees to minimize the time needed to prepare to evacuate (secure the home, assemble needed clothes, medicines, etc.) should also be considered.

<u>Traffic Management</u>

This study references the comprehensive traffic management plan provided by Delaware Emergency Management Agency and the State of New Jersey Radiological Emergency Response Plan, and identifies critical intersections.

<u>Selected Results</u>

A compilation of selected information is presented on the following pages in the form of Figures and Tables extracted from the body of the report; these are described below.

- Figure 6-1 displays a map of the PSEG Site showing the layout of the 12 Emergency Response Planning Areas (ERPA) that comprise, in aggregate, the EPZ.
- Table 3-1 presents the estimates of permanent resident population in each ERPA based on the 2000 Census data. Extrapolation to the year 2010 reflects population growth rates in each county derived from census data.
- Table 6-1 defines each of the 17 Evacuation Regions in terms of their respective groups of ERPA.
- Table 6-2 lists the Evacuation Scenarios.
- Tables 7-1B and 7-1D are compilations of ETE. These data are the times needed to *clear the indicated regions* of 90 and 100 percent of the population occupying these regions, respectively. These computed ETE include

consideration of mobilization time and of estimated voluntary evacuations from other regions within the EPZ and from the shadow region.

- Table 8-6A presents ETE for the schoolchildren in good weather.
- Table 8-8A presents ETE for the transit-dependent population in good weather.
- Figure H-8 presents an example of an Evacuation Region (Region R08) to be evacuated under the circumstances defined in Table 6-1. Maps of all regions are provided in Appendix H.

Conclusions

- General population ETE were computed for 255 unique cases – a combination of 17 unique Evacuation Regions and 15 unique Evacuation Scenarios. Tables 7-1A through 7-1D document these ETE for the 50th, 90th, 95th and 100th percentiles respectively. These ETE range from 2:00 (hr:min) to 2:55 at the 90th percentile.
- Inspection of Table 7-1B and 7-1D indicates that the ETE for the 100th percentile are nearly double those for the 90th percentile. This is the result of the long tail of the evacuation curve caused by those evacuees who take longer to mobilize. See Figure 7-6.
- Comparison of Scenarios 6 (winter, midweek, midday, year 2010, no construction) and 13 (winter, midweek, midday, year 2019, with construction and refueling outage) in Table 7-1B indicates that construction/refueling activities add approximately 30 minutes, on average, to the ETE. Note, however, that most of this increase in ETE is due to the growth of population in the Delaware portion of the EPZ between year 2010 and year 2019, not because of the construction/outage vehicles (see Table 3-1).
- PSEG is considering a proposed causeway connecting the new site with local roads in Elsinboro township, which will be used by construction workers and new plant personnel. As documented in Appendix N, the use of the proposed causeway reduces the ETE for the 2-mile Region (Region R01) and 5-mile Region (Region R02) by 40 and 10 minutes, respectively, at the 90th percentile and 40 and 25 minutes, respectively at the 95th percentile. The ETE for the full EPZ (Region R03) is unaffected by the use of the proposed causeway.
- Middletown, Delaware and Salem, New Jersey are the two most congested areas during an evacuation. The last location in the EPZ to exhibit traffic congestion is Salem; this is the result of a large number of vehicles evacuating through Salem, using a limited number of evacuation routes. All congestion within the EPZ clears by 3 hours after the Advisory to Evacuate. See Figures 7-3 through 7-5.
- Special population ETE were computed for schools, medical facilities, transit-dependent persons and homebound special needs persons. These ETE are within a similar range as the general population ETE, with the exception of the transit-dependent ETE which do exceed general population ETE for some bus routes. See Section 8.

- The general population ETE at the 100th percentile closely parallels the trip generation time…further evidence of the long evacuation tail. See Table I-1.
- The general population ETE is not significantly impacted by the voluntary evacuation of vehicles in the Shadow Region. See Table I-2.
- The use of gantry lights on the existing access road in order to provide an additional lane outbound during an evacuation has no impact on the ETE. The traffic signal at the intersection of the existing PSEG Site access road and Salem-Hancocks Bridge Road is a bottleneck for those vehicles evacuating the site; adding an additional outbound lane does not remove this bottleneck. See Table I-3.
- The use of Intelligent Transportation Systems (ITS) technologies and traffic management techniques may benefit the evacuation process and may decrease ETE. Conservatively, this study assumes that no ITS technologies or traffic management techniques are in place. See Section 9 and Appendix G.


Legend
PSEG Site
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundary
Figure 6-1. PSEG Site EPZ ERPAs
Cecil
New Castle
Salem
Cumberland
Kent
Kent
Elkton
Glasgow
Bear
Pennsville
Salem
Delaware City
Chesapeake City
Summit
Middletown
Odessa
Townsend
Smyrna
Clayton
Shiloh
Bridgeton
Killcohook National Refuge
Red Lion State Forest
Fort Mott State Park
Fort Delaware State Park
Lums Pond State Park
Bombay Hook Natl Wildlife Refu
Delaware Bay
A
B
C
D
1
2
3
4
5
6
7
8
0 1 2 3 4 5
Miles

Table 3-1. EPZ Permanent Resident Population		
ERPA	**2000 Population**	**2010 Population**
New Jersey		
1	844	862
2	2,992	3,067
3	6,900	6,595
4	241	242
5	431	437
6	446	491
7	279	299
8	**No Population**	
NJ Total	**12,133**	**11,993**
Delaware		
A	4,904	5,343
B	8,240	11,202
C	10,364	16,496
D	**No Population**	
DE Total	**23,508**	**33,041**
EPZ TOTAL	**35,641**	**45,034**
	EPZ Population Growth:	**26.4%**

Table 6-1. Description of Evacuation Regions*

Region	Description	ERPA											
		New Jersey								Delaware			
		1	2	3	4	5	6	7	8	A	B	C	D
R01	2-Mile	x							x				x
R02	5-Mile	x							x	x			x
R03	Entire EPZ	x	x	x	x	x	x	x	x	x	x	x	x
5-Mile Ring and Downwind to EPZ Boundary													
Region	**Wind Direction Towards:**	1	2	3	4	5	6	7	8	A	B	C	D
R04	NNW	x		x		x			x	x		x	x
R05	N	x		x	x	x			x	x		x	x
R06	NNE, NE	x	x	x	x	x			x	x			x
R07	ENE	x	x	x	x		x		x	x			x
R08	E, ESE	x	x				x	x	x	x			x
R09	SE	x					x	x	x	x			x
R10	SSE	x						x	x	x	x		x
R11	S, SSW, SW	x							x	x	x		x
R12	WSW, W, WNW	x							x	x	x	x	x
R13	NW	x							x	x		x	x
2-Mile Ring and Downwind to EPZ Boundary													
Region	**Wind Direction Towards:**	1	2	3	4	5	6	7	8	A	B	C	D
R14	NNE, NE	x	x	x	x	x			x				x
R15	ENE	x	x	x	x		x		x				x
R16	E, ESE	x	x				x	x	x				x
R17	SE	x					x	x	x				x
N/A	NNW	Refer to Region R04											
	N	Refer to Region R05											
	SSE	Refer to Region R10											
	S, SSW, SW	Refer to Region R11											
	WSW, W, WNW	Refer to Region R12											
	NW	Refer to Region R13											
2-Mile Ring and Downwind to 5 Miles													
Region	**Wind Direction Towards:**	1	2	3	4	5	6	7	8	A	B	C	D
N/A	NNE, NE, ENE, E, ESE, SE	Refer to Region R01											
N/A	N, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW	Refer to Region R02											
x = ERPA EVACUATES		ERPA SHELTERS IN PLACE											

***Adapted from Region definitions in County/State Radiological Emergency Plans**

Table 6-2. Evacuation Scenario Definitions

Scenario	Season[1]	Day of Week	Time of Day	Weather	Special	Year
1	Summer	Midweek	Midday	Good	None	2010
2	Summer	Midweek	Midday	Rain	None	2010
3	Summer	Weekend	Midday	Good	None	2010
4	Summer	Weekend	Midday	Rain	None	2010
5	Summer	Midweek, Weekend	Evening	Good	None	2010
6	Winter	Midweek	Midday	Good	None	2010
7	Winter	Midweek	Midday	Rain	None	2010
8	Winter	Midweek	Midday	Snow	None	2010
9	Winter	Weekend	Midday	Good	None	2010
10	Winter	Weekend	Midday	Rain	None	2010
11	Winter	Weekend	Midday	Snow	None	2010
12	Winter	Midweek, Weekend	Evening	Good	None	2010
13	Winter	Midweek	Midday	Good	New Plant Construction + Refueling	2019
14	Winter	Midweek	Midday	Good	Scenario 13 with Proposed Causeway	2019
15	Winter	Midweek	Midday	Good	Refueling Only	2019

[1] Winter assumes that school is in session (also applies to spring and autumn). Summer assumes that school is not in session.

Table 7-1B. Time to Clear the Indicated Area of *90* Percent of The Affected Population

	Summer		Summer		Summer		Winter			Winter			Winter		Winter		
	Midweek		Weekend		Midweek Weekend		Midweek			Weekend			Midweek Weekend		Midweek		
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario:	(13)	(14)	(15)
	Midday		Midday		Evening		Midday			Midday			Evening		Midday		
Region Wind Toward:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Toward:	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Region Wind Toward:	New Plant Construction + Refueling	Proposed Causeway	Refueling Only
Entire 2-Mile Region, 5-Mile Region, and EPZ																	
R01 2-mile ring	1:50	1:50	1:45	1:45	1:45	R01 2-mile ring	1:50	1:50	2:05	1:45	1:45	2:40	1:45	R01 2-mile ring	2:25	1:45	1:50
R02 5-mile ring	1:35	1:45	1:35	1:40	1:35	R02 5-mile ring	1:35	1:45	2:10	1:35	1:40	2:00	1:35	R02 5-mile ring	1:50	1:40	1:40
R03 Entire EPZ	2:15	2:25	2:00	2:10	2:00	R03 Entire EPZ	2:15	2:25	2:55	2:00	2:10	2:40	2:00	R03 Entire EPZ	2:45	2:45	2:40
5-Mile Ring and Downwind to EPZ Boundary																	
R04 NNW	2:10	2:15	1:50	2:00	1:55	R04 NNW	2:10	2:15	2:50	1:50	1:55	2:30	1:55	R04 NNW	2:35	2:35	2:30
R05 N	2:10	2:15	1:50	2:00	1:55	R05 N	2:10	2:15	2:50	1:50	1:55	2:30	1:55	R05 N	2:35	2:35	2:30
R06 NNE, NE	2:00	2:05	1:40	1:50	1:45	R06 NNE, NE	2:00	2:05	2:35	1:40	1:45	2:15	1:45	R06 NNE, NE	2:15	2:15	2:00
R07 ENE	1:55	2:00	1:40	1:45	1:40	R07 ENE	1:55	2:00	2:30	1:35	1:45	2:15	1:40	R07 ENE	2:15	2:15	1:55
R08 E, ESE	1:40	1:50	1:35	1:40	1:40	R08 E, ESE	1:40	1:50	2:15	1:35	1:40	2:05	1:40	R08 E, ESE	1:55	1:45	1:45
R09 SE	1:40	1:45	1:35	1:40	1:35	R09 SE	1:40	1:45	2:10	1:35	1:40	2:05	1:35	R09 SE	1:50	1:40	1:40
R10 SSE	2:00	2:10	1:50	2:00	1:50	R10 SSE	2:00	2:10	2:45	1:50	2:00	2:30	1:50	R10 SSE	2:20	2:15	2:15
R11 S, SSW, SW	2:00	2:10	1:50	2:00	1:50	R11 S, SSW, SW	2:00	2:10	2:45	1:50	2:00	2:30	1:50	R11 S, SSW, SW	2:20	2:15	2:15
R12 W, WSW, WNW	2:10	2:20	2:00	2:10	2:00	R12 W, WSW, WNW	2:10	2:20	2:55	2:00	2:10	2:40	2:00	R12 W, WSW, WNW	2:40	2:40	2:40
R13 NW	2:00	2:05	1:50	1:55	1:50	R13 NW	2:00	2:05	2:40	1:45	1:55	2:25	1:50	R13 NW	2:30	2:30	2:30
2-Mile Ring and Downwind to EPZ Boundary																	
R14 NNE, NE	2:25	2:35	1:55	2:05	2:00	R14 NNE, NE	2:30	2:35	3:05	1:55	2:05	2:40	2:00	R14 NNE, NE	2:45	2:45	2:25
R15 ENE	2:15	2:25	1:50	2:00	1:55	R15 ENE	2:20	2:25	2:55	1:50	1:55	2:40	1:55	R15 ENE	2:40	2:40	2:15
R16 E, ESE	2:00	2:00	1:40	1:40	1:50	R16 E, ESE	2:00	2:00	2:40	1:40	1:45	2:30	1:50	R16 E, ESE	2:25	1:55	2:05
R17 SE	2:00	2:00	1:50	1:50	1:55	R17 SE	2:00	2:00	2:30	1:55	1:55	2:45	1:50	R17 SE	2:25	1:50	2:00

Table 7-1D. Time to Clear the Indicated Area of *100* Percent of The Affected Population

	Summer		Summer		Summer		Winter			Winter			Winter		Winter		
	Midweek		Weekend		Midweek Weekend		Midweek			Weekend			Midweek Weekend		Midweek		
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario:	(13)	(14)	(15)
	Midday		Midday		Evening		Midday			Midday			Evening		Midday		
Region Wind Toward:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Toward:	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Region Wind Toward:	New Plant Construction + Refueling	Proposed Causeway	Refueling Only
Entire 2-Mile Region, 5-Mile Region, and EPZ																	
R01 2-mile ring	4:00	4:05	3:10	3:10	3:10	R01 2-mile ring	4:00	4:05	5:10	3:10	3:10	4:10	3:10	R01 2-mile ring	4:00	4:00	4:00
R02 5-mile ring	4:10	4:10	4:10	4:10	4:10	R02 5-mile ring	4:10	4:10	5:10	4:10	4:10	5:10	4:10	R02 5-mile ring	4:10	4:10	4:10
R03 Entire EPZ	6:10	6:10	6:00	6:00	6:00	R03 Entire EPZ	6:10	6:15	6:15	6:00	6:00	6:00	6:00	R03 Entire EPZ	6:10	6:10	6:10
5-Mile Ring and Downwind to EPZ Boundary																	
R04 NNW	6:05	6:10	4:10	4:10	4:10	R04 NNW	6:05	6:10	6:10	4:10	4:20	5:10	4:10	R04 NNW	6:10	6:10	6:10
R05 N	6:05	6:05	4:10	4:10	4:10	R05 N	6:05	6:10	6:10	4:10	4:20	5:10	4:10	R05 N	6:10	6:10	6:10
R06 NNE, NE	6:00	6:00	4:10	4:10	4:10	R06 NNE, NE	6:10	6:10	6:10	4:10	4:10	5:10	4:10	R06 NNE, NE	6:10	6:10	6:00
R07 ENE	6:00	6:00	4:10	4:10	4:10	R07 ENE	6:00	6:10	6:10	4:10	4:10	5:10	4:10	R07 ENE	6:00	6:00	6:00
R08 E, ESE	4:10	4:10	4:10	4:10	4:10	R08 E, ESE	4:10	4:10	5:10	4:10	4:10	5:10	4:10	R08 E, ESE	4:10	4:10	4:10
R09 SE	4:10	4:10	4:10	4:10	4:10	R09 SE	4:10	4:10	5:10	4:10	4:10	5:10	4:10	R09 SE	4:10	4:10	4:10
R10 SSE	6:10	6:10	6:00	6:00	6:00	R10 SSE	6:10	6:10	6:10	6:00	6:00	6:00	6:00	R10 SSE	6:10	6:10	6:10
R11 S, SSW, SW	6:10	6:10	6:00	6:00	6:00	R11 S, SSW, SW	6:10	6:10	6:10	6:00	6:00	6:00	6:00	R11 S, SSW, SW	6:10	6:10	6:10
R12 W, WSW, WNW	6:10	6:10	6:00	6:00	6:00	R12 W, WSW, WNW	6:10	6:10	6:15	6:00	6:00	6:00	6:00	R12 W, WSW, WNW	6:10	6:10	6:10
R13 NW	6:00	6:05	4:10	4:10	4:10	R13 NW	6:00	6:05	6:10	4:10	4:15	5:10	4:10	R13 NW	6:10	6:10	6:10
2-Mile Ring and Downwind to EPZ Boundary																	
R14 NNE, NE	6:00	6:00	4:10	4:10	4:10	R14 NNE, NE	6:10	6:10	6:10	4:10	4:10	5:10	4:10	R14 NNE, NE	6:10	6:10	6:00
R15 ENE	6:00	6:00	4:10	4:10	4:10	R15 ENE	6:00	6:10	6:10	4:10	4:10	5:10	4:10	R15 ENE	6:00	6:00	6:00
R16 E, ESE	4:10	4:10	4:10	4:10	4:10	R16 E, ESE	4:10	4:10	5:10	4:10	4:10	5:00	4:10	R16 E, ESE	4:10	4:10	4:10
R17 SE	4:10	4:10	3:10	3:10	3:10	R17 SE	4:10	4:10	5:10	3:10	3:10	4:10	3:10	R17 SE	4:10	4:10	4:10

Table 8-6A. School Evacuation Time Estimates - Good Weather										
School	Driver Mobilization Time(min)	Loading Time (min)	Dist. to EPZ Boundary (mi.)	Average Speed (mph)	Adjusted Speed (mph)	Travel Time to EPZ Bdry (min)	ETE (hr:min)	Dist. EPZ Bndry to R.C. (mi.)	Travel Time EPZ Bdry to RC (min)	ETE to R.C. (hr:min)
Salem County, NJ Schools										
Lower Alloways Creek Elementary School	90	15	4.61	48.89	45.00	7	**1:55**	10	14	**2:10**
Quinton Elementary School	90	15	4.16	55.23	45.00	6	**1:55**	10	14	**2:05**
Elsinboro Township Elementary School	90	15	5.35	37.95	37.95	9	**1:55**	8	11	**2:05**
John Fenwick Elementary School	90	15	4.28	8.57	8.57	30	**2:15**	10	14	**2:30**
Salem High School	90	15	4.78	9.30	9.30	31	**2:20**	10	14	**2:30**
Salem Middle School	90	15	3.80	12.33	12.33	19	**2:05**	10	14	**2:20**
The ARC of Salem County	90	15	1.22	49.77	45.00	2	**1:50**	10	14	**2:05**
Cumberland County, NJ Schools										
Stow Creek Township Elementary School	90	15	1.86	60.00	45.00	3	**1:50**	8	11	**2:00**
Woodland Country Day School	90	15	2.28	59.06	45.00	4	**1:50**	8	11	**2:00**
Morris Goodwin Elementary School	90	15	1.47	38.80	38.80	3	**1:50**	8	11	**2:00**
New Castle County, DE Schools										
Van Hook Walsh School Inc.	90	15	5.64	61.37	45.00	8	**1:55**	16	22	**2:15**
Everett Meredith Middle School	90	15	11.98	40.23	40.23	18	**2:05**	20	27	**2:30**
Groves Adult High Shool	90	15	11.98	40.23	40.23	18	**2:05**	13	18	**2:25**
Middletown High School	90	15	10.91	42.06	42.06	16	**2:05**	20	27	**2:30**
Silver Lake Elementary School	90	15	11.95	40.29	40.29	18	**2:05**	13	18	**2:25**
St. Andrew's School	90	15	8.90	16.18	16.18	34	**2:20**	20	27	**2:50**
St. Anne's Episcopal School	90	15	8.90	16.18	16.18	34	**2:20**	16	22	**2:45**
Townsend Elementary School	90	15	6.73	21.73	21.73	19	**2:05**	13	18	**2:25**
AdvoServ School	90	15	3.58	15.90	15.90	14	**2:00**	16	22	**2:25**
Alfred Waters Middle School	90	15	13.53	47.73	45.00	19	**2:05**	13	18	**2:25**
Brick Mill Elementary School	90	15	10.89	42.07	42.07	16	**2:05**	13	18	**2:20**
Cedar Lane Elementary School	90	15	13.53	47.73	45.00	19	**2:05**	13	18	**2:25**
Gunning Bedford Middle School	90	15	3.94	13.98	13.98	17	**2:05**	16	22	**2:25**
Kathleen H. Wilbur Elementary School	90	15	1.29	52.23	45.00	2	**1:50**	16	22	**2:10**
Louis L. Redding Middle School	90	15	11.76	40.68	40.68	18	**2:05**	20	27	**2:30**
Southern Elementary School	90	15	3.94	13.98	13.98	17	**2:05**	16	22	**2:25**
St. George's Technical High School	90	15	6.20	16.16	16.16	24	**2:10**	16	22	**2:35**
Appoquinimink Early Childhood Center	90	15	11.98	40.23	40.23	18	**2:05**	20	27	**2:30**
Cedar Lane Early Childhood Center	90	15	13.53	47.73	45.00	19	**2:05**	13	18	**2:25**
Townsend Early Childhood Center	90	15	6.73	21.73	21.73	19	**2:05**	13	18	**2:25**
						Maximum for EPZ:	**2:20**		**Maximum:**	**2:50**
						Average for EPZ:	**2:05**		**Average:**	**2:25**

Table 8-8A. Transit-Dependent Evacuation Time Estimates - Good Weather

Route Number	Bus Number	Single Wave: Mobilization (min)	Route Distance (mi.)	Average Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE	Second Wave: ETE to Rec. Ctr (min)	Unload (min)	Driver Rest (min)	Return time to EPZ (min)	Average Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE
1	1	105	18	17.70	61	30	3:20	130	5	10	13	38.57	28	30	3:40
2A	1	105	20	36.36	33	30	2:50	130	5	10	13	36.36	33	30	3:45
2B	1	105	23	32.09	43	30	3:00	130	5	10	13	37.30	37	30	3:45
3A	1	105	13	14.72	53	30	3:10	130	5	10	13	39.00	20	30	3:30
3B	1	105	4	8.67	37	30	2:55	130	5	10	13	12.63	19	30	3:30
4	1	105	10	37.50	16	30	2:35	130	5	10	13	37.50	16	30	3:25
5	1	105	8	34.29	14	30	2:30	130	5	10	13	34.29	14	30	3:25
6	1	105	18	37.24	29	30	2:45	130	5	10	13	37.24	29	30	3:40
7	1	105	16	36.92	26	30	2:45	130	5	10	13	36.92	26	30	3:35
Blue	1	105	21	20.00	63	30	3:20	150	5	10	22	38.18	33	30	4:10
	2	110	21	20.00	63	30	3:25	155	5	10	22	38.18	33	30	4:15
Green	1	90	24	32.00	45	30	2:45	150	5	10	22	38.92	37	30	4:15
	2	95	24	33.49	43	30	2:50	155	5	10	22	38.92	37	30	4:20
	3	100	24	33.49	43	30	2:55	160	5	10	22	38.92	37	30	4:25
	4	105	24	36.92	39	30	2:55	165	5	10	22	38.92	37	30	4:30
	5	110	24	36.92	39	30	3:00	170	5	10	22	38.92	37	30	4:35
	6	115	24	38.92	37	30	3:05	175	5	10	22	38.92	37	30	4:40
	7	120	24	38.92	37	30	3:10	180	5	10	22	38.92	37	30	4:45
	8	125	24	38.92	37	30	3:15	185	5	10	22	38.92	37	30	4:50
	9	130	24	38.92	37	30	3:20	190	5	10	22	38.92	37	30	4:55
	10	135	24	38.92	37	30	3:25	195	5	10	22	38.92	37	30	5:00
Red	1	90	26	28.36	55	30	2:55	150	5	10	22	37.14	42	30	4:20
	2	95	26	28.89	54	30	3:00	155	5	10	22	37.14	42	30	4:25
	3	100	26	28.89	54	30	3:05	160	5	10	22	37.14	42	30	4:30
	4	105	26	28.89	54	30	3:10	165	5	10	22	37.14	42	30	4:35
	5	110	26	28.89	54	30	3:15	170	5	10	22	37.14	42	30	4:40
Pink	1	105	30	38.30	47	30	3:05	150	5	10	22	38.30	47	30	4:25
	2	110	30	38.30	47	30	3:10	155	5	10	22	38.30	47	30	4:30
Purple	1	105	25	35.71	42	30	3:00	150	5	10	22	36.59	41	30	4:20
	2	110	25	35.71	42	30	3:05	155	5	10	22	36.59	41	30	4:25
Brown	1	90	33	36.67	54	30	2:55	150	5	10	22	36.67	54	30	4:35
	2	95	33	36.67	54	30	3:00	155	5	10	22	36.67	54	30	4:40
	3	100	33	36.67	54	30	3:05	160	5	10	22	36.67	54	30	4:45
	4	105	33	36.67	54	30	3:10	165	5	10	22	36.67	54	30	4:50
						Maximum ETE for Single Wave:	**3:25**							**Maximum ETE for Second Wave:**	**5:00**
						Average ETE for Single Wave:	**3:00**							**Average ETE for Second Wave:**	**4:20**

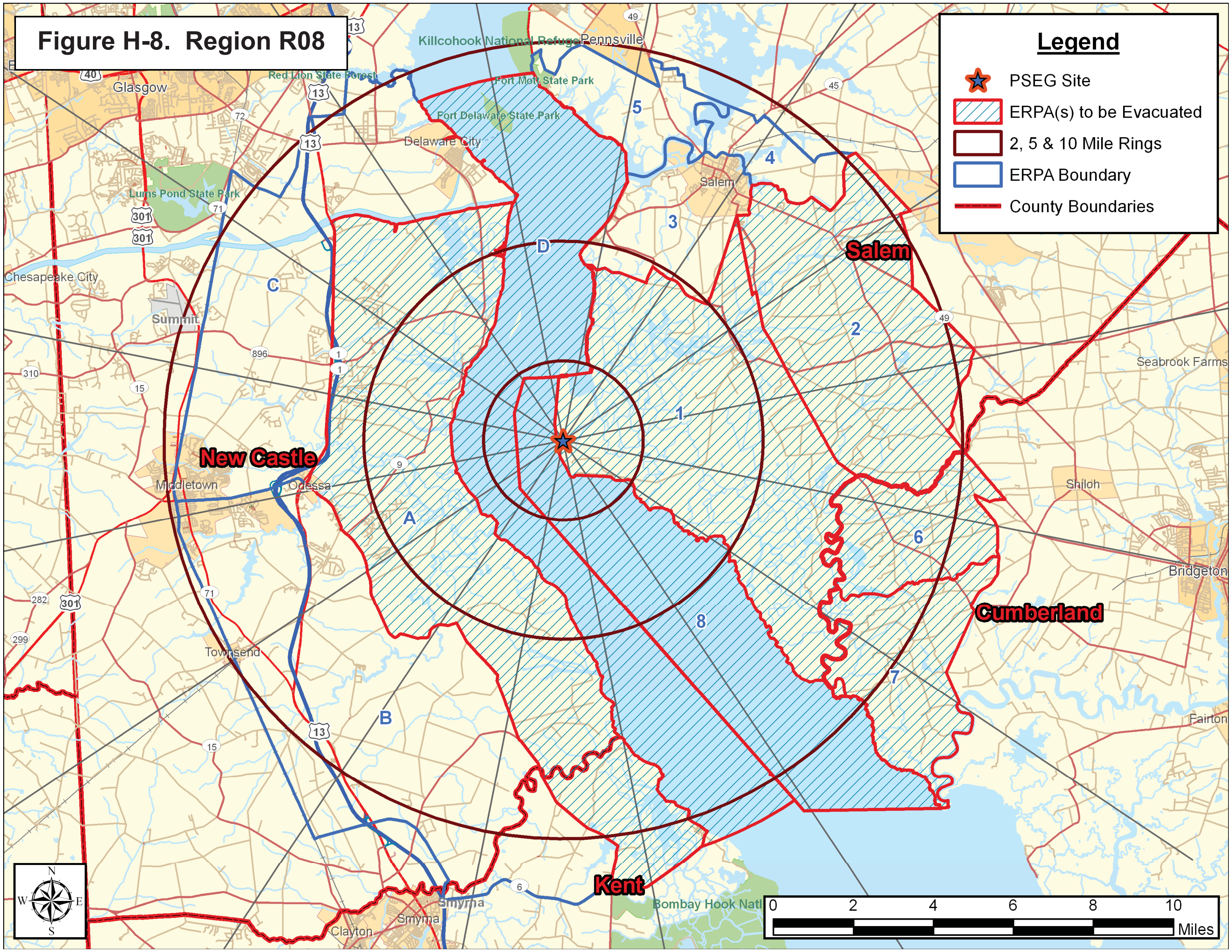
Figure H-8. Region R08
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
Salem
New Castle
Cumberland
Kent
Glasgow
Pennsville
Delaware City
Salem
Chesapeake City
Summit
Middletown
Odessa
Townsend
Smyrna
Clayton
Seabrook Farms
Shiloh
Bridgeton
Fairton
Killcohook National Refuge
Red Lion State Forest
Fort Mott State Park
Fort Delaware State Park
Lums Pond State Park
Bombay Hook Natl
A
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C
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Miles

1. INTRODUCTION

This report describes the analyses undertaken and the results obtained by a study to develop Evacuation Time Estimates (ETE) for the PSEG Site, located in Salem County, New Jersey. ETE provide State and local governments with site-specific information needed for Protective Action decision-making.

In the performance of this effort, guidance is provided by documents published by Federal Government agencies. Most important of these are:

- Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG 0654/FEMA-REP-1, Rev. 1, November 1980.
- Analysis of Techniques for Estimating Evacuation Times for Emergency Planning Zones, NUREG/CR-1745, November 1980.
- Development of Evacuation Time Estimates for Nuclear Power Plants, NUREG/CR-6863, January 2005.

We wish to express our appreciation to all the directors and staff members of the Delaware Emergency Management Agency (DEMA), the New Jersey State Police (NJSP) Emergency Management Section and local and state law enforcement agencies, who provided valued guidance and contributed information contained in this report.

1.1 Overview of the ETE Process

The following outline presents a brief description of the work effort in chronological sequence:

1. Information Gathering:
    - Defined the scope of work in discussions with representatives from Sargent & Lundy and from PSEG.
    - Attended meetings with emergency planners from DEMA and NJSP to identify issues to be addressed and resources available.
    - Conducted a detailed field survey of the Emergency Planning Zone (EPZ) highway system and of area traffic conditions.
    - Obtained demographic data from census and state agencies.
    - Conducted a random sample telephone survey of EPZ residents.

- Conducted a data collection effort to identify and describe schools, special facilities, major employers, transportation providers, and other important sources of information.

2. Estimated distributions of Trip Generation times representing the time required by various population groups (permanent residents, employees, and transients) to prepare (mobilize) for the evacuation trip. These estimates are primarily based upon the random sample telephone survey.
3. Defined Evacuation Scenarios. These scenarios reflect the variation in demand, in trip generation distribution and in highway capacities, associated with different seasons, day of week, time of day and weather conditions.
4. Defined a traffic management strategy. Traffic control is applied at specified Traffic Control Points (TCP) located within the Emergency Planning Zone (EPZ). Local and state police personnel have reviewed all traffic control plans.
5. Used existing Emergency Response Planning Areas (ERPA) to define Evacuation Areas or Regions. The EPZ is partitioned into 12 ERPA along political and geographic boundaries. "Regions" are groups of contiguous ERPA for which ETE are calculated. The configurations of these Regions reflect wind direction and the radial extent of the impacted area. Each Region, other than those that approximate circular areas, approximates a "key-hole section" within the EPZ as recommended by NUREG/CR-6863.
6. Estimated demand for transit services for persons at "Special Facilities" and for transit-dependent persons at home.
7. Prepared the input streams for the IDYNEV system.
   - Estimated the traffic demand, based on the available information derived from Census data, and from data provided by local and state agencies, PSEG and from the telephone survey.
   - Applied the procedures specified in the 2000 Highway Capacity Manual (HCM[1]) to the data acquired during the field survey, to estimate the capacity of all highway segments comprising the evacuation routes.

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[1] Highway Capacity Manual (HCM2000), Transportation Research Board, National Research Council, 2000.

- Developed the link-node representation of the evacuation network, which is used as the basis for the computer analysis that calculates the ETE.
- Calculated the evacuating traffic demands for each Region and for each Scenario.
- Specified the candidate destinations of evacuation travel consistent with outbound movement relative to the location of the PSEG Site.

8. Executed the IDYNEV models to provide the estimates of evacuation routing and ETE for all residents, transients and employees ("general population") with access to private vehicles. Generated a complete set of ETE for all specified Regions and Scenarios.
9. Documented ETE in formats in accordance with NUREG- 0654.
10. Calculated the ETE for all transit activities including those for special facilities (schools, health-related facilities, etc.) and for the transit-dependent population.

Steps 7 and 8 are iterated as described in Appendix D.

1.2 The PSEG Site Location

The PSEG Site is located on the southern part of Artificial Island on the east bank of the Delaware River in Lower Alloways Creek Township, Salem County, New Jersey. The site is approximately 18 miles south of Wilmington, Delaware and 30 miles southwest of Philadelphia, Pennsylvania. The Emergency Planning Zone (EPZ) consists of parts of Salem and Cumberland Counties in New Jersey, and parts of New Castle and Kent Counties in Delaware. Figure 1-1 displays the area surrounding the PSEG Site. This map identifies the communities in the area and the major roads.

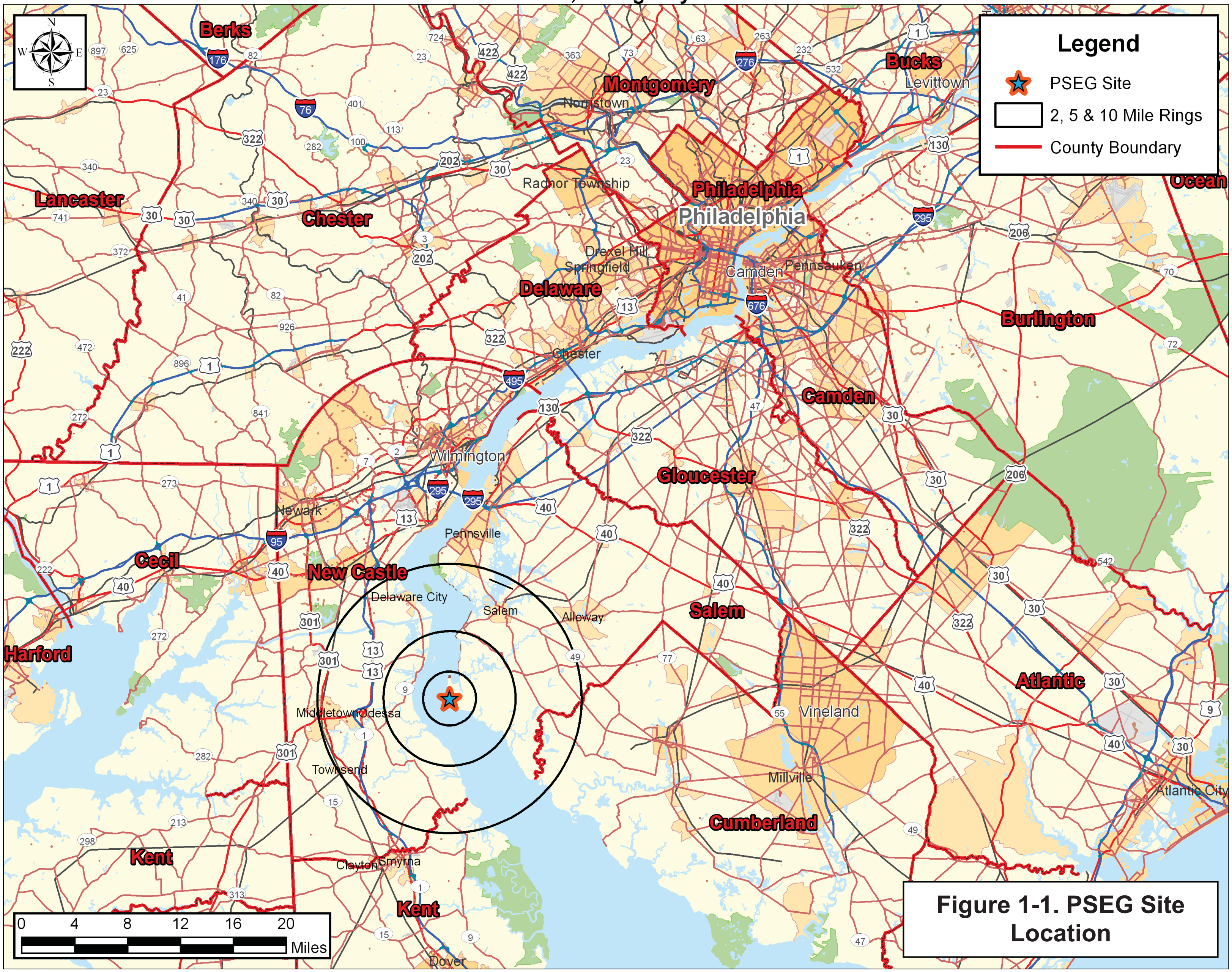

Figure 1-1. PSEG Site Location

1.3 Preliminary Activities

These activities are described below.

Field Surveys of the Highway Network

KLD personnel drove the entire highway system within the EPZ and the Shadow Region covering the region between the EPZ boundary and approximately 15 miles radially from the PSEG Site. The characteristics of each section of highway were recorded. These characteristics include:

• Number of lanes	• Posted speed
• Pavement Width	• Actual free speed
• Shoulder type & width	• Abutting land use
• Intersection configuration	• Control devices
• Lane channelization	• Interchange geometries
• Geometrics: Curves, grades	
• Unusual characteristics: Narrow bridges, sharp curves, poor pavement, flood warning signs, inadequate delineations, etc.	

Video and audio recording equipment were used to capture a permanent record of the highway infrastructure. No attempt was made to meticulously measure such attributes as lane width and shoulder width; estimates of these measures based on visual observation and recorded images were considered appropriate for the purpose of estimating the capacity of highway sections. For example, Exhibit 20-5 in the HCM indicates that a reduction in lane width from 12 feet (the "base" value) to 10 feet can reduce free flow speed (FFS) by 1.1 mph – not a material difference – for two lane highways. Exhibit 12-15 in the HCM shows no sensitivity for the estimates of Service Volumes at Level of Service (LOS) E (near capacity), with respect to FFS. The highway terrain (Level, Rolling, and Mountainous) is a far more important factor than lane and shoulder width when estimating capacity.

The data from the audio and video recordings were used to create detailed GIS shapefiles and databases of the roadway characteristics and of the traffic control devices observed during the road survey; this information was referenced while preparing the input stream for the IDYNEV System.

As documented on page 20-3 of the HCM, the capacity of a two-lane highway is 1700 passenger cars per hour for each direction of travel. For freeway sections, a value of 2250 vehicles per hour per lane is assigned. The road survey has identified several segments which are characterized by adverse geometrics which are reflected in reduced values for both capacity and speed. These estimates reflect the service volumes for LOS E presented in HCM Exhibit 12-15. These links may be identified by reviewing Appendix K. Link capacity is an input to IDYNEV which computes the ETE. Further discussion of roadway capacity is provided in Section 4 of this report.

Figure 1-2 presents the link-node analysis network that was constructed to model the evacuation roadway network in the EPZ and Shadow Region. The directional arrows on the links and the node numbers have been removed from Figure 1-2 to clarify the figure. The detailed figures provided in Appendix K depict the analysis network with directional arrows shown and node numbers provided. The observations made during the field survey were used to calibrate the analysis network.

Telephone Survey

A telephone survey was undertaken to gather information needed for the evacuation study. Appendix F presents the survey instrument, the procedures used and tabulations of data compiled from the survey returns.

These data were utilized to develop estimates of vehicle occupancy to estimate the number of evacuating vehicles during an evacuation and to estimate elements of the mobilization process. This database was also referenced to estimate the number of transit-dependent residents.

Developing the Evacuation Time Estimates

The overall study procedure is outlined in Appendix D. Demographic data were obtained from several sources, as detailed later in this report. These data were analyzed and converted into vehicle demand data. The vehicle demand was loaded onto appropriate links of the analysis network using Geographic Information System (GIS) mapping software. The IDYNEV system was then used to compute ETE for all Regions and Scenarios.

Analytical Tools

The IDYNEV System that was employed for this study is comprised of several integrated computer models. One of these is the PC-DYNEV (DYnamic Network EVacuation) macroscopic simulation model that was developed by KLD under contract with the Federal Emergency Management Agency (FEMA).

PC-DYNEV consists of three submodels:

- A macroscopic traffic simulation model (for details, see Appendix C).
- An intersection capacity model (for details, see Highway Research Record No. 772, Transportation Research Board, 1980, papers by Lieberman and McShane & Lieberman).

- A dynamic, node-centric routing model that adjusts the "base" routing in the event of an imbalance in the levels of congestion on the outbound links.

Another model of the IDYNEV System is the TRAD (TRaffic Assignment and Distribution) model. This model integrates an equilibrium assignment model with a trip distribution algorithm to compute origin-destination volumes and paths of travel designed to minimize travel time. For details, see Appendix B.

Still another software product developed by KLD, named UNITES (UNIfied Transportation Engineering System) was used to expedite data entry.

The procedure for applying the IDYNEV System within the framework of developing ETE is outlined in Appendix D. Appendix A is a glossary of terms.

For the reader interested in more details of the model than are provided in Appendices B, C and D, and in Highway Research Record No. 772 (discussed in Section 4 of this report), the following references are suggested:

- NUREG/CR-4873 – Benchmark Study of the I-DYNEV Evacuation Time Estimate Computer Code
- NUREG/CR-4874 – The Sensitivity of Evacuation Time Estimates to Changes in Input Parameters for the I-DYNEV Computer Code

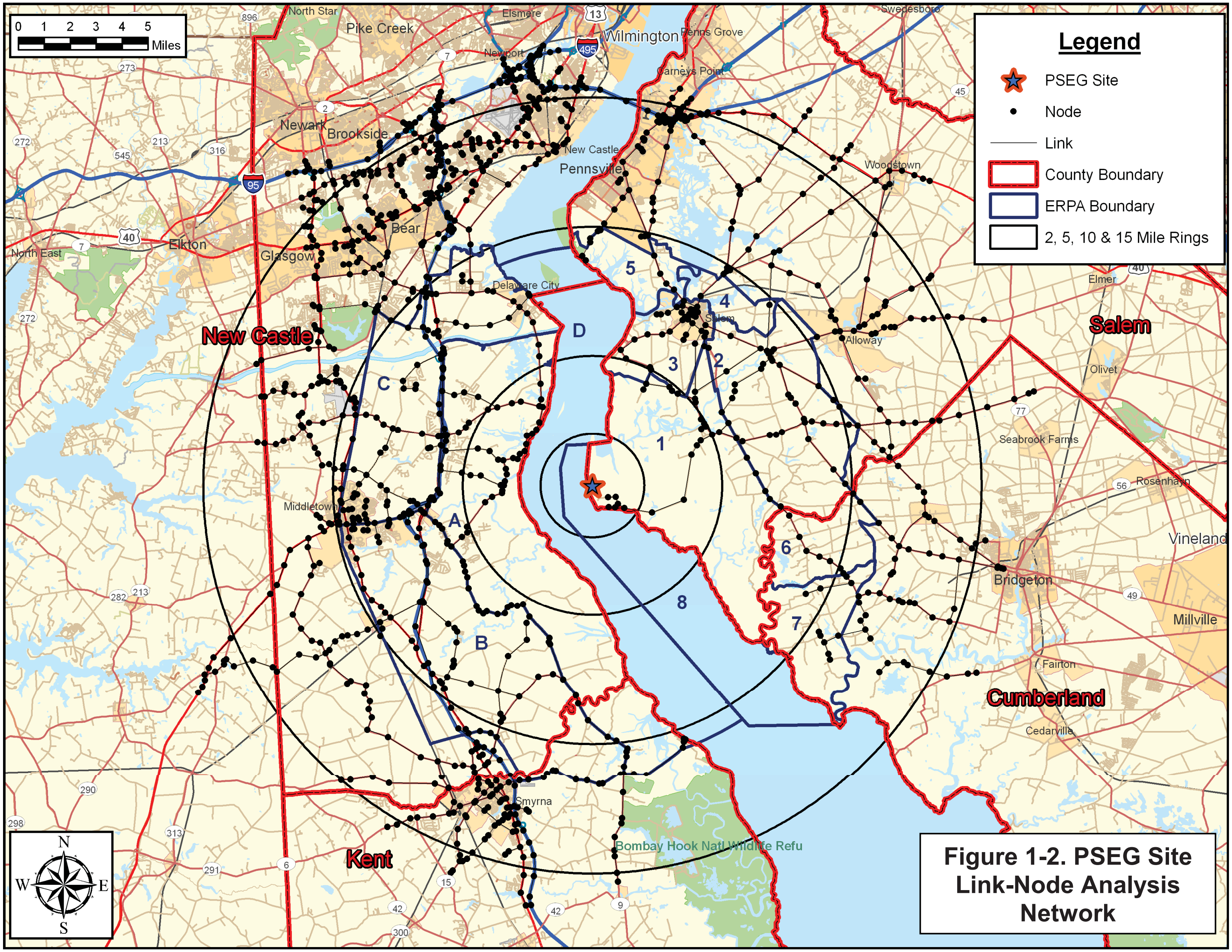

Figure 1-2. PSEG Site Link-Node Analysis Network

The evacuation analysis procedures are based upon the need to:

- Route traffic along paths of travel that will expedite their travel from their respective points of origin to points outside the EPZ.
- Restrict movement toward the PSEG Site to the extent practicable, and disperse traffic demand so as to avoid focusing demand on a limited number of highways.
- Move traffic in directions that are generally outbound, relative to the location of the PSEG Site.

A set of candidate destination nodes on the periphery of the EPZ is specified for each traffic origin (or centroid) within the EPZ. The TRAD model produces output that identifies the "best" traffic routing, subject to the design conditions outlined above. In addition to this information, rough estimates of travel time are provided, together with turn-movement data required by the PC-DYNEV simulation model.

The simulation model is then executed to provide a detailed description of traffic operations on the evacuation network. This description enables the analyst to identify bottlenecks and to develop countermeasures that are designed to expedite the movement of vehicles.

As outlined in Appendix D, this procedure consists of an iterative design-analysis-redesign sequence of activities. If properly done, this procedure converges to yield an evacuation plan which best services the evacuating public.

1.4 Comparison with Prior ETE Study

Table 1-1 presents a comparison of the present ETE study with the 2002 study. The major factors contributing to the differences between the ETE values obtained in this study and those of the previous study can be summarized as follows:

- An increase in permanent resident population.
- Vehicle occupancy and Trip-generation rates are based on the results of a telephone survey of EPZ residents.
- Voluntary and shadow evacuations are considered.
- The highway representation is far more detailed.

Table 1-1. ETE Study Comparisons		
Topic	Treatment	
	Previous ETE Study	Current ETE Study
Resident Population Basis	ArcGIS Software using 2000 US Census blocks; population extrapolated to 2003. Population = 37,956	ArcGIS Software using 2000 US Census blocks; area ratio method used; population extrapolated to 2010. Population = 45,034
Resident Population Vehicle Occupancy	Average household size for New Jersey and Delaware are 2.60 and 2.57 respectively, 1.25 evacuating vehicles per household, yielding: 2.08 and 2.06 persons/vehicle for New Jersey and Delaware respectively.	2.92 persons/household, 1.35 evacuating vehicles/household yielding: 2.16 persons/vehicle.
Employee Population	Employee estimates based on information provided about major employers in EPZ. 1.16 employees per vehicle derived from 2000 Census.	Employee estimates based on information provided about major employers in EPZ, supplemented by observations of commercial property in EPZ from aerial photography. 1.03 employees per vehicle based on telephone survey results.
Voluntary evacuation from within EPZ in areas outside region to be evacuated	Not considered.	50 percent of population within the circular portion of the region; 35 percent, in annular ring between the circle and the EPZ boundary (see Figure 2-1)
Shadow Evacuation	Not considered.	30% of people outside of the EPZ within the shadow area (see Figure 7-2)

Table 1-1. ETE Study Comparisons (cont.)		
Topic	Treatment	
	Previous ETE Study	Current ETE Study
Network Size	655 Links; 487 Nodes.	1,733 Links; 1,218 Nodes.
Roadway Geometric Data	Field surveys conducted in 2001. Road capacities based on 2000 HCM.	Field surveys conducted in April 2009. Major intersections were video archived. GIS shape-files of signal locations and roadway characteristics created during road survey. Road capacities based on 2000 HCM.
School Evacuation	Direct evacuation to designated Reception Center/Host School.	Direct evacuation to designated Reception Center/Host School.
Transit-Dependent Population	Census data used to provide an estimate of the number of people without access to personal transportation.	Transit-Dependent population estimated using population estimates and results of telephone survey.
Ridesharing	50 percent of transit-dependent persons will ride out with a neighbor or friend.	50 percent of transit-dependent persons will ride out with a neighbor or friend.

Table 1-1. ETE Study Comparisons (cont.)		
Topic	Treatment	
	Previous ETE Study	Current ETE Study
Trip Generation for Evacuation	Trip Generation curves adapted from telephone survey of Nine Mile Point EPZ in Oswego, New York.	Based on residential telephone survey of specific pre-trip mobilization activities: Residents with commuters returning leave between 30 and 300 minutes. Residents without commuters returning leave between 15 and 240 minutes. Employees and transients leave between 15 and 150 minutes. All times measured from the Advisory to Evacuate.
Weather	Normal, Rain, or Snow. The capacity and free flow speed of all links in the network are reduced by 15% in the event of rain and 25% for snow.	Normal, Rain, or Snow. The capacity and free flow speed of all links in the network are reduced by 10% in the event of rain and 20% for snow.
Modeling	IDYNEV System: TRAD and PC-DYNEV (version 1.0.0.1).	IDYNEV System: TRAD and PC-DYNEV (version 3.0.3.92).
Special Events	None considered.	One considered – construction of new plant coincident with refueling outage at existing unit.
Evacuation Cases	17 Regions (single sector wind direction used) and 10 Scenarios producing 170 unique cases.	17 Regions (central sector wind direction and each adjacent sector technique used) and 15 Scenarios producing 255 unique cases.

Table 1-1. ETE Study Comparisons (cont.)		
Topic	Treatment	
	Previous ETE Study	Previous ETE Study
Evacuation Time Estimates Reporting	ETE reported for 90th and 99th percentile population. Results presented by Region and Scenario.	ETE reported for 50th, 90th, 95th, and 100th percentile population. Results presented by Region and Scenario.
Evacuation Time Estimates for the entire EPZ, 90th percentile	Winter Weekday Midday, Good Weather: 2:05 Summer Weekend, Midday, Good Weather: 1:50	Winter Weekday Midday, Good Weather: 2:15 Summer Weekend, Midday, Good Weather: 2:00

2. STUDY ESTIMATES AND ASSUMPTIONS

This section presents the estimates and assumptions utilized in the development of the evacuation time estimates.

2.1 Data Estimates

1. Population estimates are based upon Census 2000 data, extrapolated to year 2010 using municipality specific population. Estimates of employees who commute into the EPZ to work are based upon the state Journey to Work database for 2000 and surveys of major employers in the EPZ.
2. Population estimates at special facilities are based on available data from state emergency management offices.
3. Roadway capacity estimates are based on field surveys and the application of the Highway Capacity Manual 2000.
4. Population mobilization times are based on a statistical analysis of data acquired from a random sample telephone survey of EPZ residents.
5. The relationship between resident population and evacuating vehicles is developed from the telephone survey. Average values of 2.92 persons per household and 1.35 evacuating vehicles per household are used. The relationship between persons and vehicles for special facilities is as follows:
   a. Employees: 1.03 employees per vehicle (telephone survey results) for all major employers, excluding PSEG
   b. Parks: 2.92 people per vehicle (average household size obtained from the telephone survey results, assuming 1 vehicle per family)
   c. Special Events: 1.30 construction workers per vehicle and 1.00 new plant employees per vehicle for Scenarios 13 and 14. Actual vehicle counts from Traffic Impact Analysis study, included in the Environmental Report, were used for background traffic (Salem/Hope Creek employees and supplemental contractors); therefore, a vehicle occupancy is not needed for these employees.
6. ETE are presented for the evacuation of the 100th percentile of population for each Region and for each Scenario. ETE are presented in tabular format and graphically showing the values of ETE associated with the 50th, 90th and 95th percentiles of population. A Region is defined as a group of Emergency Response Planning Areas (ERPA) that is issued an Advisory to Evacuate.

2.2 Study Methodological Assumptions

1. The ETE is defined as the elapsed time from the Advisory to Evacuate issued to a specific Region of the EPZ, to the time that Region is clear of people.

2. The ETE are computed and presented in a format compliant with NUREG 0654, CR-1745 and CR-6863. The ETE for each evacuation area ("Region" comprised of included ERPA) is presented in both statistical and graphical formats.

3. Evacuation movements (paths of travel) are generally outbound relative to the power station to the extent permitted by the highway network, as computed by the computer models. All major evacuation routes are used in the analysis.

4. Regions are defined by the underlying "keyhole" or circular configurations as specified in NUREG/CR-6863. These Regions, as defined, display irregular boundaries reflecting the geography of the ERPA included within these underlying configurations.

5. Voluntary evacuation is considered as indicated in the accompanying Figure 2-1. Within the circle defined by the distance to be evacuated but outside the Evacuation Region, 50 percent of the people not advised to evacuate are assumed to voluntarily evacuate within the same time-frame. In the outer annular area between the circle defined by the extent of the Evacuation Region and the EPZ boundary, it is assumed that 35 percent of people will voluntarily evacuate. In the area between the EPZ boundary and a 15-mile circular area centered at the plant (the Shadow Region), it is assumed that 30 percent of the people will evacuate voluntarily. Sensitivity studies explored the effect on ETE, of increasing the percentage of voluntary evacuees in the Shadow Region (see Appendix I). The basis of these assumptions on voluntary evacuation is testimony proffered by Dr. Dennis Miletti, a professor at Colorado State University, and one of the nation's top disaster response experts, at Atomic Safety and Licensing Board (ASLB) hearings[1], which were deemed acceptable by the ASLB. The numbers we use are Professor Miletti's best estimates based on his years of experience in evacuation planning and emergency preparedness.

[1] Atomic Safety and Licensing Board (ASLB) hearings on the Seabrook Power Station, December 30, 1988 – Docket Numbers 50-443-OL and 50-444-OL and ASLBP Number 82-471-02-OL.

6. A total of 15 "Scenarios" representing different temporal variations (season, time of day, day of week) and weather conditions are considered. These Scenarios are tabulated below:

Table 2-1. Evacuation Scenario Definitions

Scenario	Season[2]	Day of Week	Time of Day	Weather	Special	Year
1	Summer	Midweek	Midday	Good	None	2010
2	Summer	Midweek	Midday	Rain	None	2010
3	Summer	Weekend	Midday	Good	None	2010
4	Summer	Weekend	Midday	Rain	None	2010
5	Summer	Midweek, Weekend	Evening	Good	None	2010
6	Winter	Midweek	Midday	Good	None	2010
7	Winter	Midweek	Midday	Rain	None	2010
8	Winter	Midweek	Midday	Snow	None	2010
9	Winter	Weekend	Midday	Good	None	2010
10	Winter	Weekend	Midday	Rain	None	2010
11	Winter	Weekend	Midday	Snow	None	2010
12	Winter	Midweek, Weekend	Evening	Good	None	2010
13	Winter	Midweek	Midday	Good	New Plant Construction + Refueling	2019
14	Winter	Midweek	Midday	Good	Scenario 13 + Proposed Causeway	2019
15	Winter	Midweek	Midday	Good	Refueling Only	2019

7. The models of the IDYNEV System were recognized as state of the art by the Atomic Safety & Licensing Board (ASLB) in past hearings. (Sources: Atomic Safety & Licensing Board Hearings on Seabrook and Shoreham; Urbanik[3]). The models have continuously been refined and extended since those hearings and have been independently validated by a consultant retained by the NRC.

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[2] Winter assumes that school is in session (also applies to spring and autumn). Summer assumes that school is not in session.

[3] Urbanik, T., et. al. Benchmark Study of the I-DYNEV Evacuation Time Estimate Computer Code, NUREG/CR-4873, Nuclear Regulatory Commission, June, 1988.

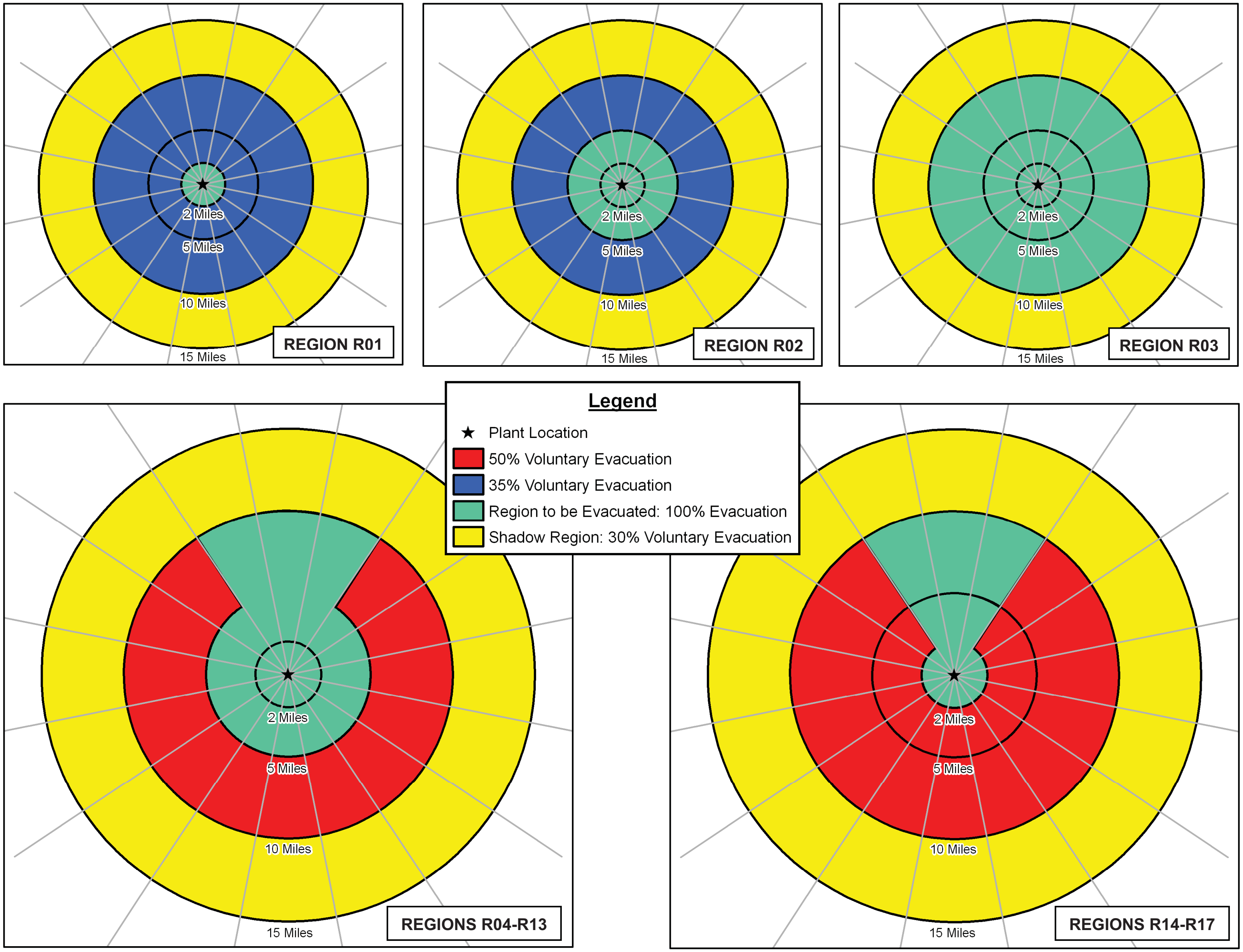


Figure 2-1. Voluntary Evacuation Methodology

2.3 Study Assumptions

1. The Planning Basis Assumption for the calculation of ETE is a rapidly escalating accident that requires evacuation, and includes the following:
   a. Advisory to Evacuate is announced coincident with the siren notification.
   b. Mobilization of the general population will commence within 15 minutes after siren notification.
   c. ETE are measured relative to the Advisory to Evacuate.

2. It is assumed that everyone within the group of ERPA forming a Region that is issued an Advisory to Evacuate will, in fact, respond and evacuate in general accord with the planned routes.

3. It is further assumed that 65 percent of the households in the EPZ have at least 1 commuter; 60 percent of those households with commuters will await the return of a commuter before beginning their evacuation trip, based on the telephone survey results. Therefore 39 percent (65% x 60% = 39%) of EPZ households will await the return of a commuter, prior to beginning their evacuation trip.

4. The ETE will also include consideration of "through" (External-External) trips during the time that such traffic is permitted to enter the evacuated Region. "Normal" traffic flow is assumed to be present within the EPZ at the start of the emergency.

5. Access Control Points (ACP) will be staffed within approximately 90 minutes following the siren notifications, to divert traffic attempting to enter the EPZ. Earlier activation of ACP locations would delay returning commuters. It is assumed that no traffic will enter the EPZ after this 90 minute time period.

6. Traffic Control Points (TCP) within the EPZ will be staffed over time, beginning at the Advisory to Evacuate. Their number and location will depend on the Region to be evacuated and resources available. The objectives of these TCP are:

   a. Facilitate the movements of all (mostly evacuating) vehicles at the location.

   b. Discourage inadvertent vehicle movements towards the power station.

   c. Provide assurance and guidance to any traveler who is unsure of the appropriate actions or routing.

   d. Act as local surveillance and communications center.

   e. Provide information to the emergency operations center (EOC) as needed, based on direct observation or on information provided by travelers.

In calculating ETE, it is assumed that drivers will act rationally, travel in directions identified in the plan, and obey all control devices and traffic guides. These TCP serve many useful functions, but are not considered in specifying the inputs to the I-DYNEV system used to calculate ETE. Consequently, the results presented in Section 7 and in Appendix J are conservative in that they do not reflect the presence of these TCP. The time needed to mobilize personnel or equipment to staff the TCP will not influence ETE results.

7. Buses will be used to transport those without access to private vehicles:
   a. If schools are in session, transport (buses) will evacuate students directly to the designated host schools.
   b. Day care facilities are required to have a detailed evacuation plan and to provide adequate transportation for all residents. Buses needed to evacuate day care facilities are provided through private contracting.
   c. Buses, wheelchair vans and ambulances will evacuate patients at medical facilities within the EPZ, as needed.
   d. Schoolchildren, if school is in session, are given priority in assigning transit vehicles.
   e. Bus mobilization time is considered in ETE calculations.
   f. Analysis of the number of required “waves” of evacuating transit vehicles is presented.

8. Provisions are made for evacuating the transit-dependent portion of the general population to reception centers by bus, based on the assumption that some of these people will ride-share with family, neighbors, and friends, thus reducing the demand for buses. We assume that the percentage of people who rideshare is 50 percent. This assumption is based upon reported experience for other emergencies[4], which cites previous evacuation experience.

9. Two types of adverse weather scenarios are considered. Rain may occur for either winter or summer scenarios; snow occurs in winter scenarios only. It is assumed that the rain or snow begins at about the same time the evacuation advisory is issued. Thus, transient populations are not affected. That is, no weather-related reduction in the number of transients who may be present in the EPZ is assumed. It is assumed that roads are passable and that the appropriate agencies are plowing the roads as they would normally when snowing.

[4] Institute for Environmental Studies, University of Toronto, THE MISSISSAUGA EVACUATION FINAL REPORT, June 1981. The report indicates that 6,600 people of a transit-dependent population of 8,600 people shared rides with other residents; a ride share rate of 76% (Page 5-10).

Adverse weather scenarios affect roadway capacity and the free flow highway speeds. The factors applied for the ETE study are based on recent research on the effects of weather on roadway operations[5]; the factors are:

Table 2-2. Model Adjustments for Adverse Weather			
Scenario	**Highway Capacity***	**Free Flow Speed***	**Mobilization Time for General Population**
Rain	90%	90%	No Effect
Snow	80%	80%	Clear driveway before leaving home (Source: Telephone Survey)
*Adverse weather capacity and speed values are given as a percentage of good weather conditions. Roads are assumed to be passable.			

10. School buses used to transport students are assumed to transport 70 students per bus for elementary schools and 46 students per bus for middle and high schools, based on discussions with state offices of emergency management. Transit buses used to transport the transit-dependent general population are assumed to transport 30 people per bus.

[5] Agarwal, M. et. Al. Impacts of Weather on Urban Freeway Traffic Flow Characteristics and Facility Capacity, Proceedings of the 2005 Mid-Continent Transportation Research Symposium, August, 2005.

3. DEMAND ESTIMATION

The estimates of demand, expressed in terms of people and vehicles, constitute a critical element in developing an evacuation plan. These estimates consist of three components:

1. An estimate of population within the Emergency Planning Zone (EPZ), stratified into groups (resident, employee, transient).
2. An estimate, for each population group, of mean occupancy per evacuating vehicle. This estimate is used to determine the number of evacuating vehicles.
3. An estimate of potential double-counting of vehicles.

Appendix E presents much of the source material for the population estimates. Our primary source of population data, the 2000 Census, however, is not adequate for directly estimating some transient groups.

Throughout the year, vacationers and tourists enter the EPZ. These non-residents may dwell within the EPZ for a short period (e.g. a few days or one or two weeks), or may enter and leave within one day. Estimates of the size of these population components must be obtained, so that the associated number of evacuating vehicles can be ascertained.

The potential for double-counting people and vehicles must be addressed. For example:

- A resident who works and shops within the EPZ could be counted as a resident, again as an employee and once again as a shopper.
- A visitor who stays at a hotel and spends time at a park, then goes shopping could be counted three times.

Furthermore, the number of vehicles at a location depends on time of day. For example, motel parking lots may be full at dawn and empty at noon. Similarly, parking lots at area parks, which are full at noon, may be almost empty at dawn. Estimating counts of vehicles by simply adding up the capacities of different types of parking facilities will tend to overestimate the number of transients and can lead to ETE that are too conservative.

Analysis of the population characteristics of the PSEG Site EPZ indicates the need to identify three distinct groups:

- Permanent residents - people who are year round residents of the EPZ.
- Transients - people who reside outside of the EPZ who enter the area for a specific purpose (shopping, recreation) and then leave the area.
- Employees - people who reside outside of the EPZ and commute to businesses within the EPZ on a daily basis.

Estimates of the population and number of evacuating vehicles for each of the population groups are presented for each ERPA and by polar coordinate representation (population rose). The PSEG Site EPZ has been subdivided into 12 ERPA. The EPZ is shown in Figure 3-1.

3.1 Permanent Residents

The primary source for estimating permanent population is the latest U.S. Census data. The average household size (2.92 persons/household – See Figure F-1) and the number of evacuating vehicles per household (1.35 vehicles/household – See Figure F-8) were adapted from the telephone survey results.

Population estimates are based upon Census 2000 data, extrapolated to year 2010 using municipality specific population growth rates and the compound growth formula. These growth rates were computed by comparing the Census 2000 data with the year 2007 Census estimates (the latest available on the Census website at the time of this study). Table 3-1 provides the permanent resident population within the EPZ, by ERPA, for year 2000 and year 2010. Table 3-1 shows that the EPZ population has increased 26.4 percent over the last 10 years. Table 3-2 shows the average annual growth rate for each municipality within the EPZ. As indicated, the population in the New Jersey portion of the EPZ is declining, while the population in the Delaware portion of the EPZ is growing rapidly.

The year 2010 permanent resident population is divided by the average household size and then multiplied by the average number of evacuating vehicles per household in order to estimate year 2010 vehicles. Permanent resident population and vehicle estimates for 2010 are presented in Table 3-3. Figures 3-2 and 3-3 present the permanent resident population and permanent resident vehicle estimates by sector and distance from the PSEG Site. This "rose" was constructed using GIS software.

The same population estimation methodology used for the Safety Analysis Report (SAR) was used for this study, including the same growth rates by municipality. Any differences in population estimates presented in the SAR and in the ETE are the result of the use of a 10-mile radius for SAR computations versus the use of the EPZ boundary for the ETE computations. As shown in Figure 3-1, there are several areas in the EPZ that extend beyond the 10-mile radius, as well as some areas where the EPZ boundary is less than 10 miles from the plant. Therefore, the population within the 10-

mile radius will differ from the population within the EPZ boundaries.

It can be argued that this estimate of permanent residents overstates, somewhat, the number of evacuating vehicles, especially during the summer. It is certainly reasonable to assert that some portion of the population would be on vacation during the summer and would travel elsewhere. A rough estimate of this reduction can be obtained as follows:

- Assume 50 percent of all households vacation for a two-week period over the summer.
- Assume these vacations, in aggregate, are uniformly dispersed over 10 weeks, i.e. 10 percent of the population is on vacation during each two-week interval.
- Assume half of these vacationers leave the area.

On this basis, the permanent resident population would be reduced by 5 percent in the summer and by a lesser amount in the off-season. Given the uncertainty in this estimate, we elected to apply no reductions in permanent resident population for the summer scenarios to account for residents who may be out of the area.

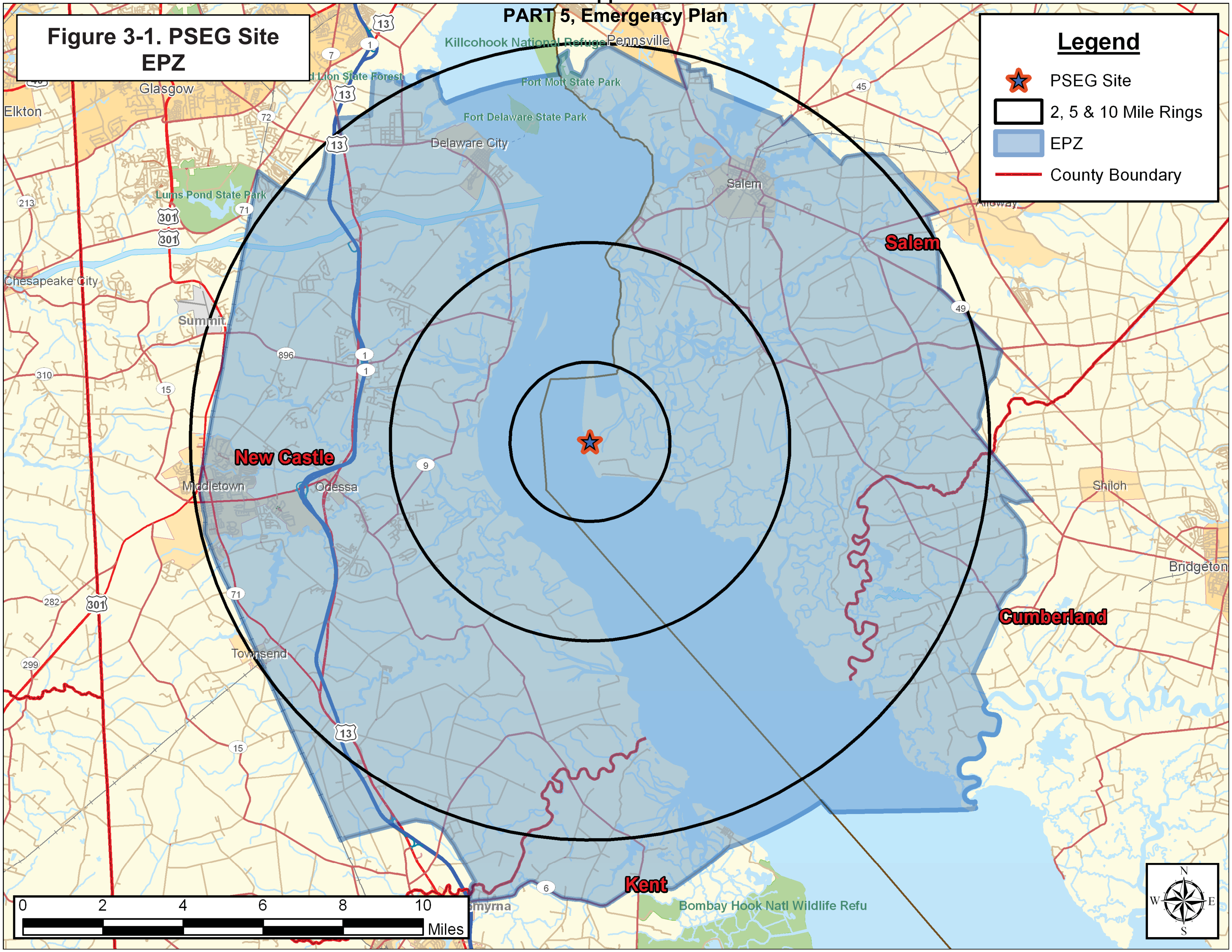


Figure 3-1. PSEG Site EPZ
Legend
PSEG Site
2, 5 & 10 Mile Rings
EPZ
County Boundary
Salem
New Castle
Cumberland
Kent
Killcohook National Refuge
Pennsville
Fort Mott State Park
Fort Delaware State Park
Delaware City
Salem
Glasgow
Elkton
Lums Pond State Park
Chesapeake City
Summit
Middletown
Odessa
Townsend
Shiloh
Bridgeton
Bombay Hook Natl Wildlife Refu
0 2 4 6 8 10
Miles

Table 3-1. EPZ Permanent Resident Population		
ERPA	**2000 Population**	**2010 Population**
New Jersey		
1	844	862
2	2,992	3,067
3	6,900	6,595
4	241	242
5	431	437
6	446	491
7	279	299
8	**No Population**	
NJ Total	**12,133**	**11,993**
Delaware		
A	4,904	5,343
B	8,240	11,202
C	10,364	16,496
D	**No Population**	
DE Total	**23,508**	**33,041**
EPZ TOTAL	**35,641**	**45,034**
	EPZ Population Growth:	**26.4%**

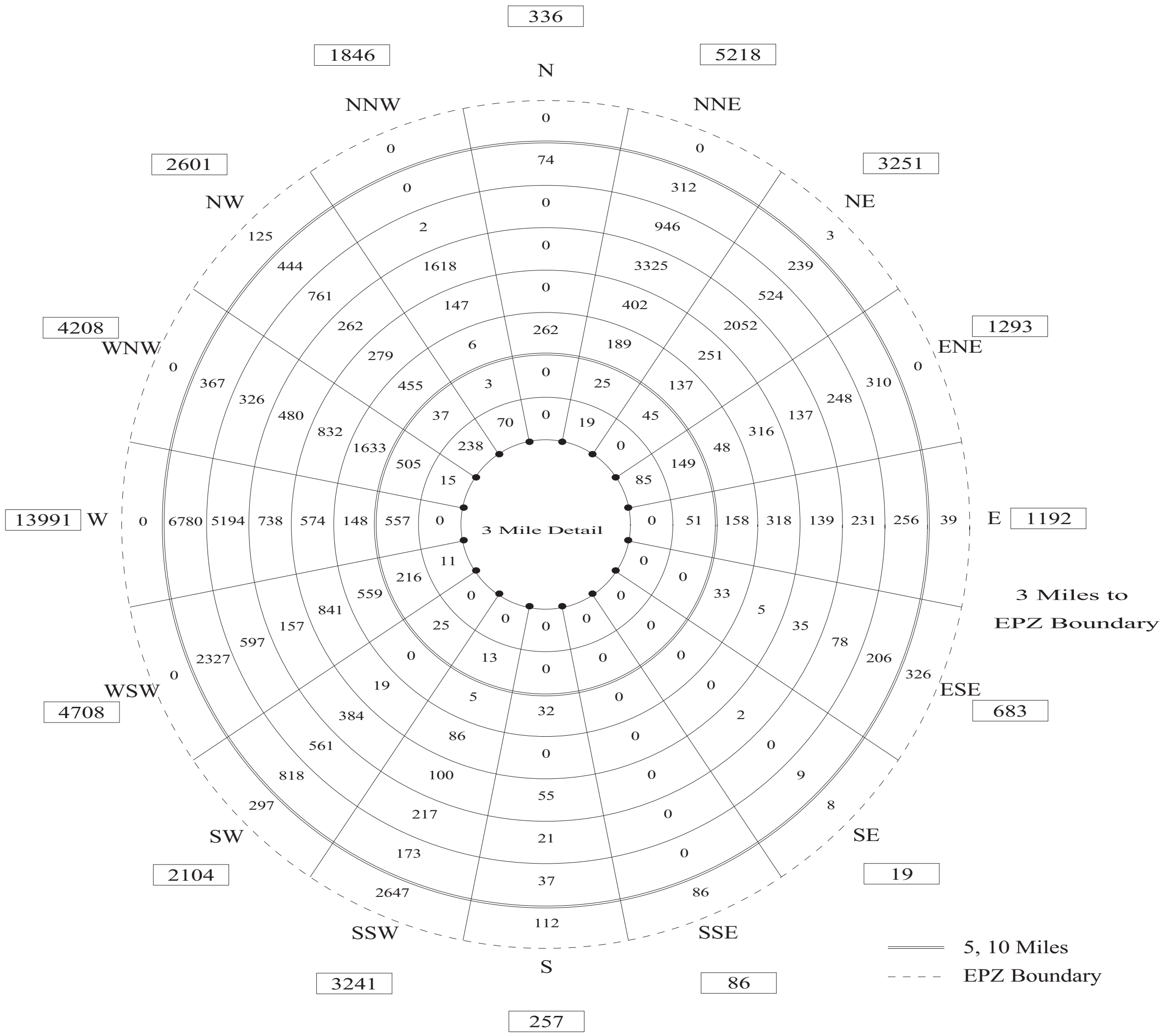
Table 3-2. Annual Population Growth Rates		
Municipality	**Annual Population Growth Rate***	**Population Growth Rate from 2000 to 2010**
New Jersey		
Lower Alloways Creek	0.00245	1.02479
Quinton	0.00265	1.02677
Elsinboro	-0.00505	0.95066
Salem (City)	-0.00442	0.95663
Mannington	-0.00037	0.99634
Pennsville	0.00182	1.01835
Stow Creek	0.00962	1.10042
Greenwich	0.00645	1.06642
Fairfield**	0.01025	1.10738
Shiloh Boro**	0.03073	1.35342
Hopewell**	0.01094	1.11498
Alloway**	0.01293	1.13707
Penns Grove Boro**	-0.00541	0.94721
Pilesgrove**	0.02028	1.22236
Carneys Point**	0.00439	1.04473
Delaware		
Odessa	0.02241	1.24812
Townsend	0.01272	1.13470
Middletown	0.08848	2.33454
Delaware City	0.00608	1.06251
New Castle**	0.00323	1.03277
Clayton**	0.01977	1.21628
Smyrna**	0.05430	1.69689
New Castle County	0.00780	1.08077
Kent County	0.02660	1.30019

*Growth rate was computed using the compound growth formula to compare Year 2000 Census data with Year 2007 Census estimates:

$$\text{Pop } 2007 = \text{Pop } 2000 \times (1 + \text{Growth Rate})^{7}$$
$$\text{Growth Rate} = (\text{Pop } 2007 \div \text{Pop } 2000)^{1/7} - 1$$

**Growth rate used exclusively for calculating shadow population

Table 3-3. Permanent Resident Population and Vehicles by ERPA		
ERPA	**2010 Population**	**2010 Vehicles**
New Jersey		
1	862	400
2	3,067	1,413
3	6,595	3,047
4	242	111
5	437	202
6	491	227
7	299	137
8	**No Population**	
NJ Total	**11,993**	**5,537**
Delaware		
A	5,343	2,467
B	11,202	5,172
C	16,496	7,625
D	**No Population**	
DE Total	**33,041**	**15,264**
TOTAL	**45,034**	**20,801**



Resident Population			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-1	0	0-1	0
1-2	0	0-2	0
2-3	50	0-3	50
3-4	438	0-4	488
4-5	1626	0-5	2114
5-6	3665	0-6	5779
6-7	4070	0-7	9849
7-8	9484	0-8	19333
8-9	9706	0-9	29039
9-10	12352	0-10	41391
10-EPZ	3643	0-EPZ	45034

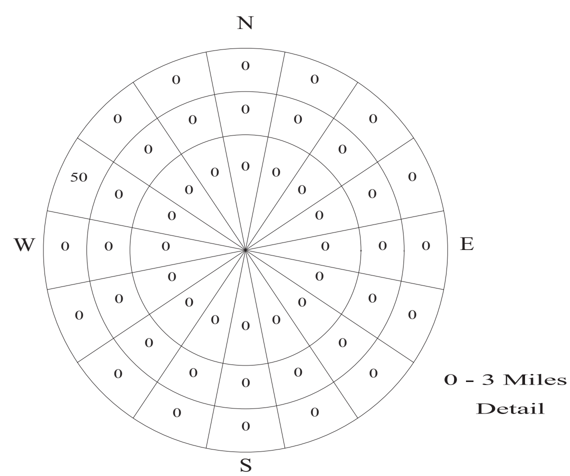
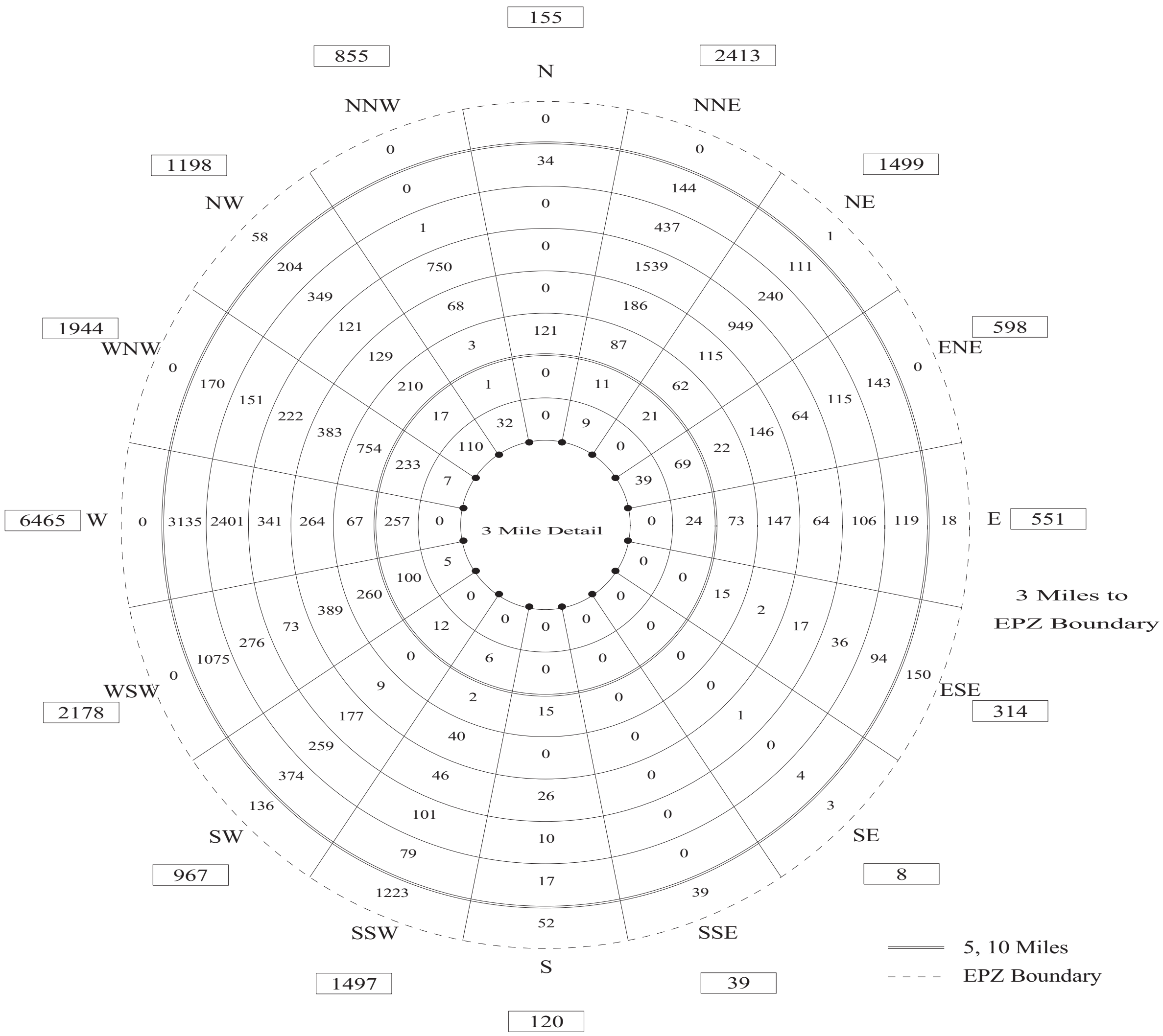


Figure 3-2. Permanent Residents by Sector



Resident Vehicles			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-1	0	0-1	0
1-2	0	0-2	0
2-3	24	0-3	24
3-4	202	0-4	226
4-5	751	0-5	977
5-6	1691	0-6	2668
6-7	1878	0-7	4546
7-8	4390	0-8	8936
8-9	4482	0-9	13418
9-10	5703	0-10	19121
10-EPZ	1680	0-EPZ	20801

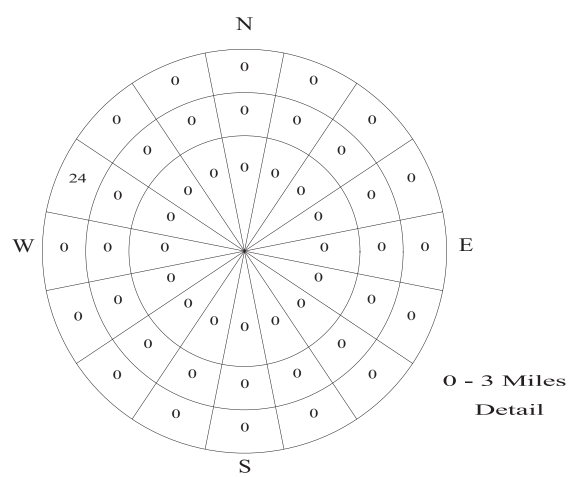


Figure 3-3. Permanent Resident Vehicles by Sector

3.2 Transient Population

Transient population groups are defined as those people (who are not permanent residents, nor commuting employees) who enter the EPZ for a specific purpose (shopping, recreation). Transients may spend less than one day or stay overnight at camping facilities, hotels and motels. The PSEG Site EPZ has a number of areas and facilities that attract transients, including:

- Lodging Facilities
- Marinas
- Wildlife Areas
- Fort Mott State Park
- Fort Delaware State Park

Surveys of lodging facilities within the EPZ were conducted to determine the number of rooms, percentage of occupied rooms, and the number of vehicles per room for each facility. These numbers were used to estimate the number of evacuating vehicles for transients at each of these facilities. A total of 121 transients in 56 vehicles are assigned to lodging facilities in the EPZ.

Fort Mott State Park and Fort Delaware State Park are both Civil War era Forts. Fort Mott State Park is located in New Jersey along the Delaware River and has hiking trails, picnicking facilities, and hosts civil war reenactments. Fort Delaware State Park is located on Pea Patch Island in the middle of the Delaware River. Ferries service the island from Delaware City. Fort Mott and Fort Delaware State Parks attract a peak attendance of 300 people and 200 people, respectively. It is assumed that those people visiting these parks will travel as a family in a single vehicle with an assumed occupancy of 2.92 (average household size within the EPZ according to telephone survey).

Most of the coastal area within the EPZ consists of marshland that is managed as wildlife refuges. There are also many lakes and creeks in the area. Our estimate of tourist population is based on a survey of tourist facilities and of recreational areas attracting day trips, on information provided by state emergency management agencies and on estimates made using overhead imagery of the facilities.

There are three golf courses and several marinas within the EPZ. It is assumed that transients visiting the golf course facilities travel two per vehicle. It is further assumed that transients visit marinas as a family, and a vehicle occupancy of 2.92 transients per vehicle is used (average household size within the EPZ according to telephone survey results). At boat ramps, two passenger car equivalents are used to model vehicles pulling trailers.

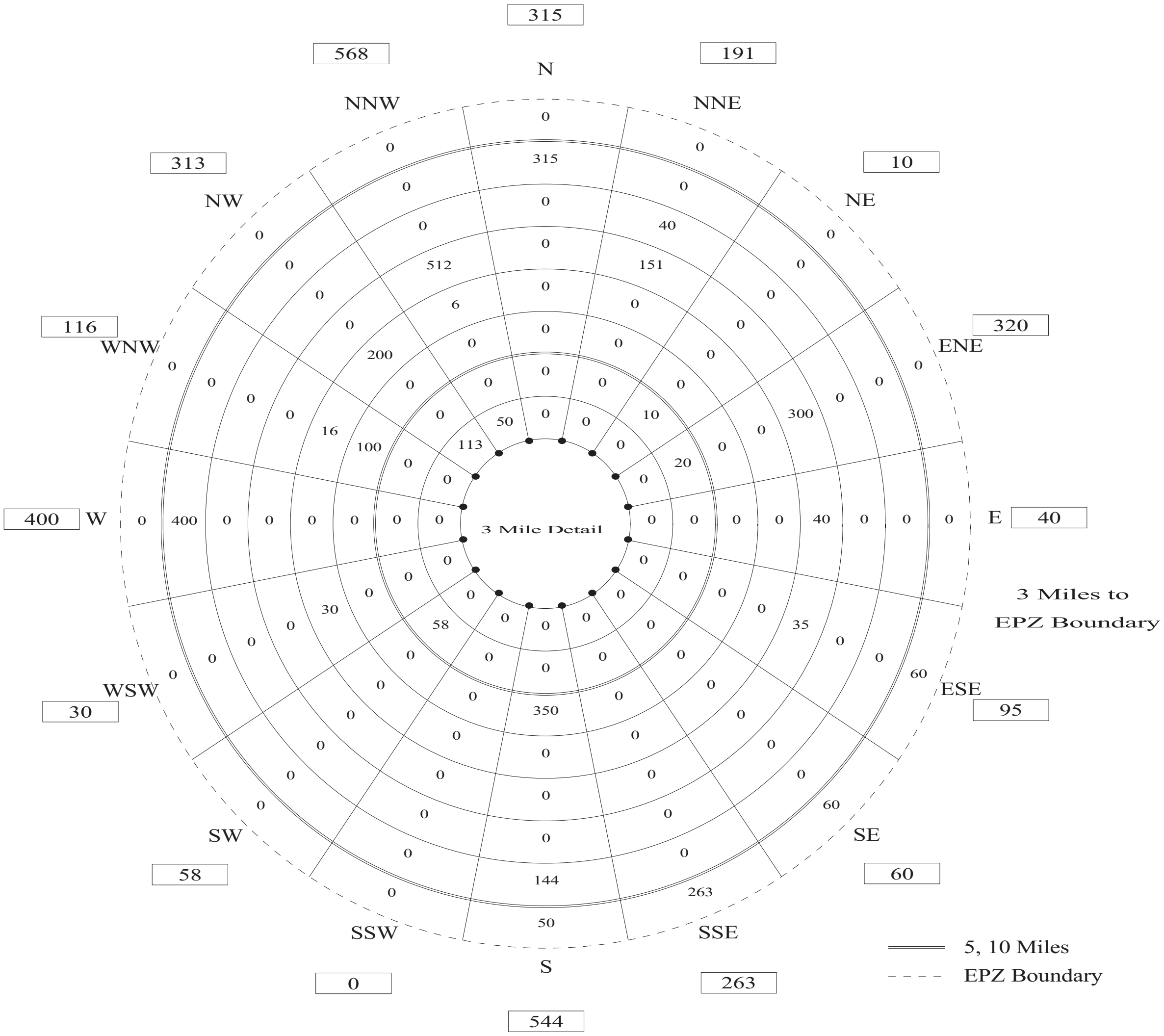
Appendix E summarizes the transient data that was estimated for the EPZ. Table E-5 presents the number of transients visiting recreational areas, while Table E-6 presents the number of transients at lodging facilities within the EPZ.

Table 3-4 presents transient population and transient vehicle estimates by ERPA. Figures 3-4 and 3-5 present these data by sector.

Table 3-4. Summary of Transients and Transient Vehicles

ERPA	2009 Transients*	Transient Vehicles
New Jersey		
1	55	19
2	340	164
3	151	79
4	**No Transients**	
5	355	121
6	10	6
7	120	42
8	**No Transients**	
NJ Total	**1,031**	**431**
Delaware		
A	1,128	592
B	330	118
C	834	382
D	**No Transients**	
DE Total	**2,292**	**1,092**
TOTAL	**3,323**	**1,523**

* Transient data were gathered in 2009 through telephone conversations with the transient facilities and through discussions with the New Jersey State Police and the Delaware Emergency Management Agency. Growth rates are not available for transient population as they are for permanent resident population through the Census. Therefore, 2009 was used as the base year for transient data.



Transient Population			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-1	0	0-1	0
1-2	0	0-2	0
2-3	0	0-3	0
3-4	163	0-4	163
4-5	88	0-5	251
5-6	450	0-6	701
6-7	252	0-7	953
7-8	1038	0-8	1991
8-9	40	0-9	2031
9-10	859	0-10	2890
10-EPZ	433	0-EPZ	3323

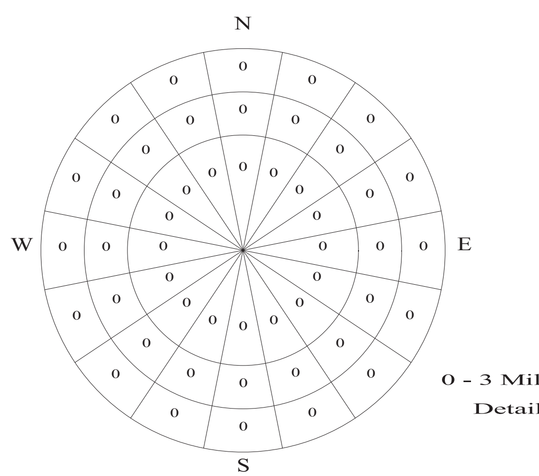
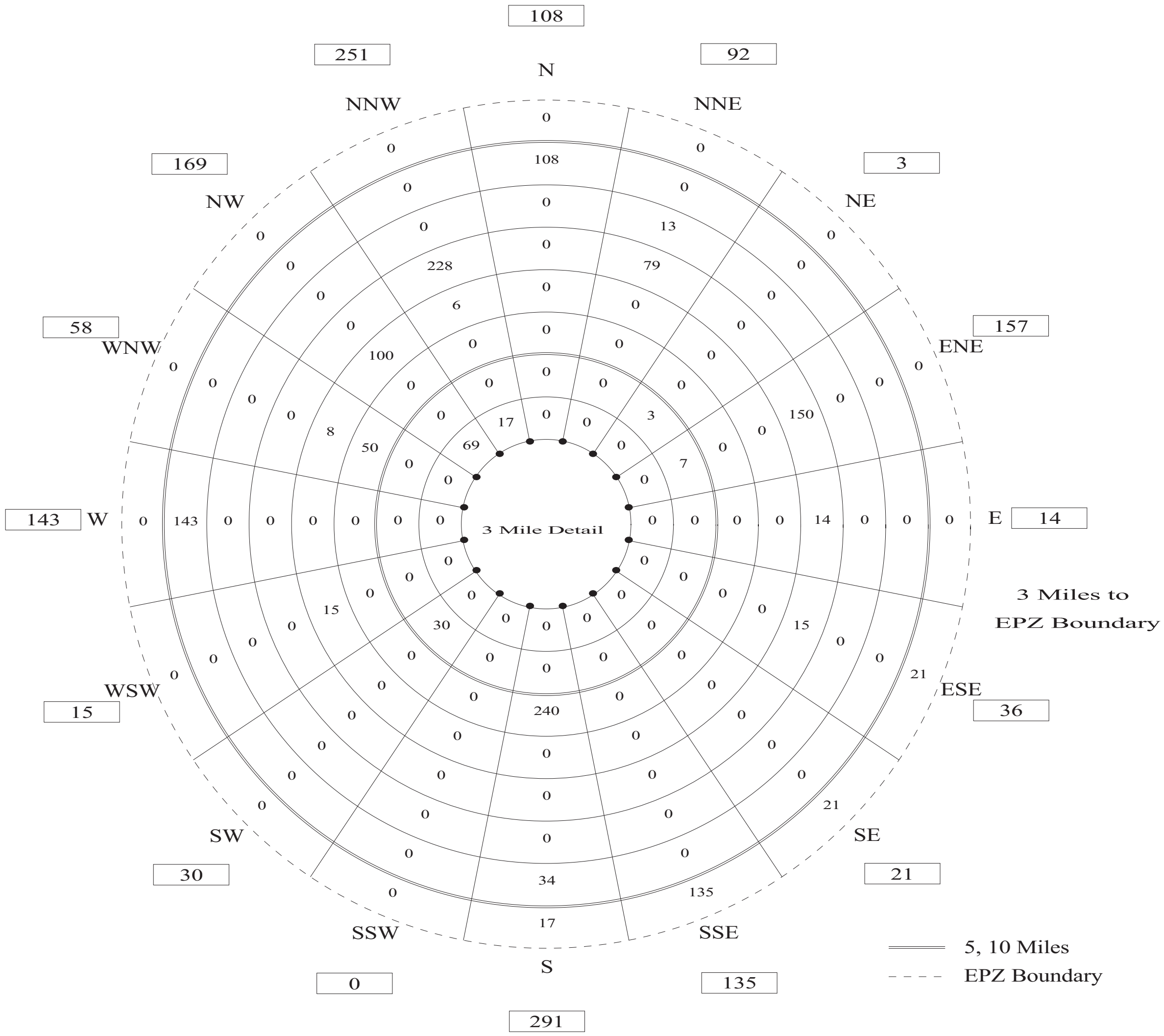


Figure 3-4. Transient Population by Sector



Transient Vehicles			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-1	0	0-1	0
1-2	0	0-2	0
2-3	0	0-3	0
3-4	86	0-4	86
4-5	40	0-5	126
5-6	290	0-6	416
6-7	129	0-7	545
7-8	486	0-8	1031
8-9	13	0-9	1044
9-10	285	0-10	1329
10-EPZ	194	0-EPZ	1523

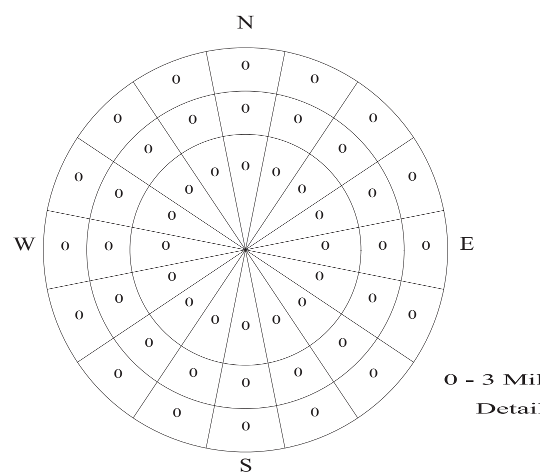


Figure 3-5. Transient Vehicles by Sector

3.3 Employees

Employees who work within the EPZ fall into two categories:

- Those who live and work in the EPZ
- Those who live outside of the EPZ and commute to jobs within the EPZ.

Those of the first category are already counted as part of the permanent resident population. To avoid double counting, we focus only on those employees commuting from outside the EPZ who will evacuate along with the permanent resident population.

Year 2000 Census journey to work data for New Jersey and Delaware was used to estimate the number of employees commuting into the EPZ. For New Jersey, this data defines the number of persons working in a specified municipality by their place of residence (origin-municipality). GIS software was used to estimate the percentage of population in each municipality that resides within the EPZ – these percentages are then applied to the journey to work data to estimate the number of people commuting to work in the New Jersey portion of the EPZ from areas outside of the EPZ. The resulting data indicates that, on average, 76% of workers in New Jersey commute to work from outside the EPZ. The municipality specific percentages are shown in Table E-7. PSEG provided the zip codes their employees commute from; a GIS analysis was done to estimate the percentage of PSEG employees commuting into the EPZ based on the zip code data provided.

The journey to work data available for Delaware is limited to origin and destination by county, not municipality. The State of Delaware only has three counties; therefore this data was not entirely useful. The majority of the population and employment in New Castle County is in Wilmington and Newark, neither of which is located within the EPZ. It is assumed that 75% of employees in the Delaware portion of the EPZ commute to work from outside the EPZ.

Table E-7 identifies the major employers within the EPZ. The names, locations, and the maximum number of employees per shift were identified through review of the local emergency plans, discussions with the New Jersey State Police and the Delaware Emergency Management Agency, and through Internet searches. The Employees (Max Shift) column in Table E-7 is multiplied by the % Non-EPZ factor discussed above to determine the number of employees who are not residents of the EPZ. This removes any employee within the EPZ who would already be counted as a permanent resident.

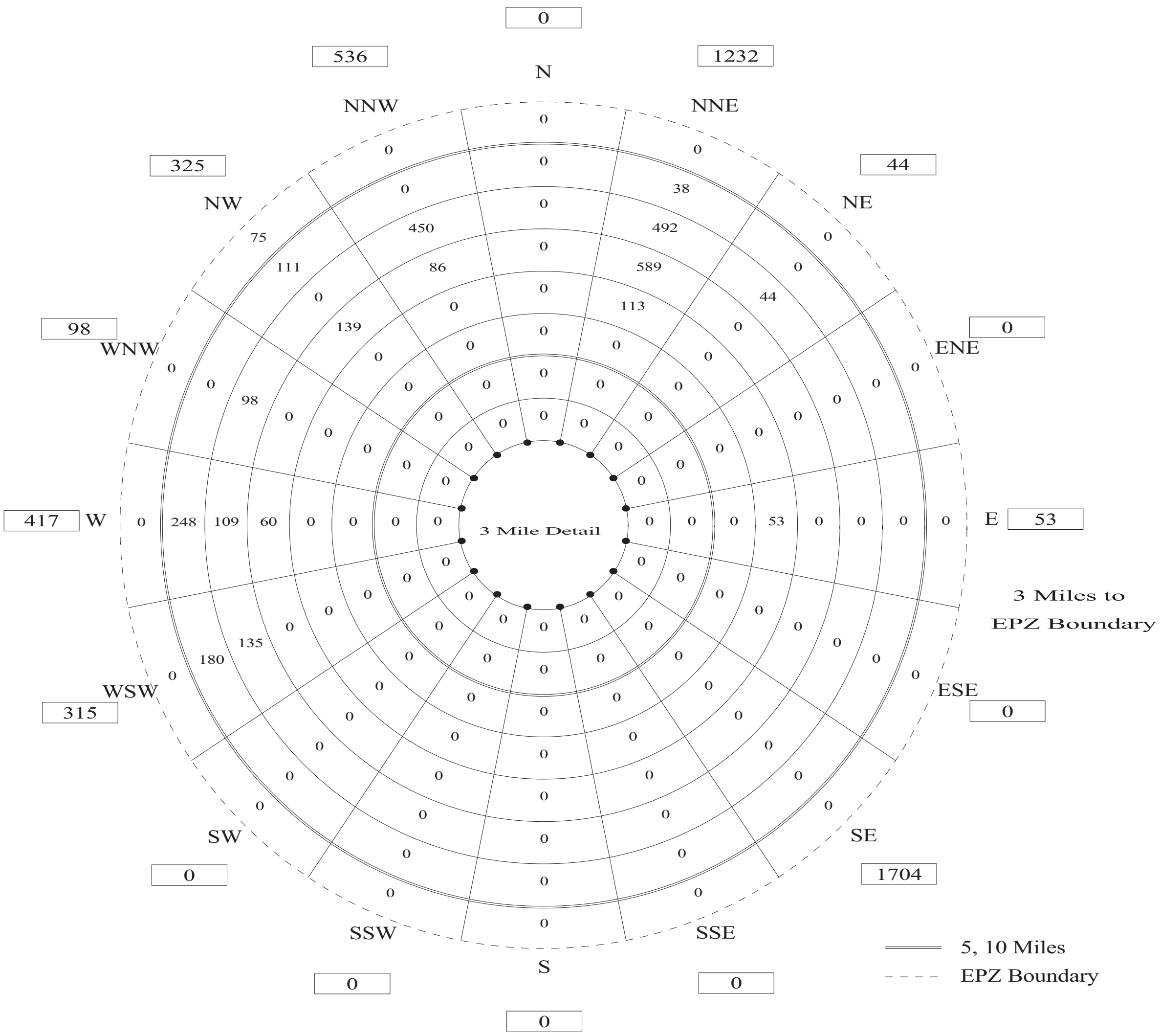
A vehicle occupancy of 1.03 employees per vehicle obtained from the telephone survey was used to determine the number of evacuating employee vehicles for all major employers, except PSEG, which is discussed in Section 3.6.

Table 3-5 presents non-EPZ Resident employee and vehicle estimates by ERPA. Figures 3-6 and 3-7 present these data by sector.

Table 3-5. Summary of Non-EPZ Employees and Employee Vehicles

ERPA	2009 Employees*	Employee Vehicles
New Jersey		
1	1,757	1,415
2	44	43
3	702	681
4	530	514
5	**No Employment**	
6		
7		
8		
NJ Total	**3,033**	**2,653**
Delaware		
A	**No Employment**	
B	469	456
C	1,222	1,184
D	**No Employment**	
DE Total	**1,691**	**1,640**
TOTAL	**4,724**	**4,293**

*Employment data were gathered in 2009 through telephone conversations with major employers and through discussions with the New Jersey State Police and the Delaware Emergency Management Agency. Growth rates are not available for employees as they are for permanent resident population through the Census. Therefore, 2009 was used as the base year for employment data.



Employees			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-1	1704	0-1	1704
1-2	0	0-2	1704
2-3	0	0-3	1704
3-4	0	0-4	1704
4-5	0	0-5	1704
5-6	0	0-6	1704
6-7	166	0-7	1870
7-8	874	0-8	2744
8-9	1328	0-9	4072
9-10	577	0-10	4649
10-EPZ	75	0-EPZ	4724

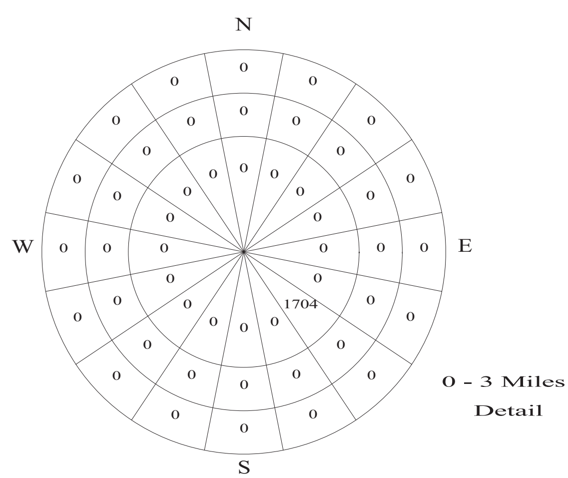
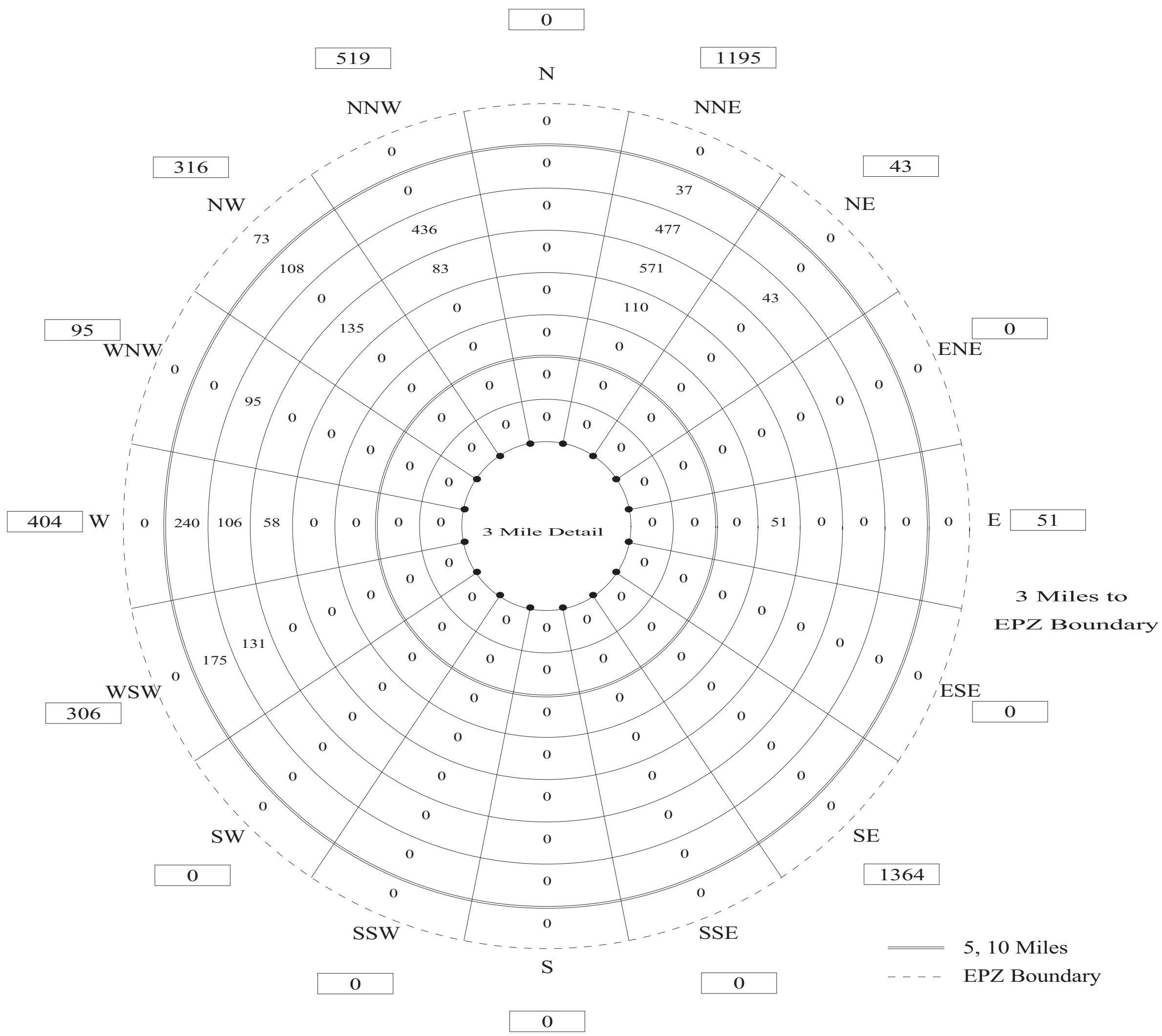


Figure 3-6. Employee Population by Sector



Employee Vehicles			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-1	1364	0-1	1364
1-2	0	0-2	1364
2-3	0	0-3	1364
3-4	0	0-4	1364
4-5	0	0-5	1364
5-6	0	0-6	1364
6-7	161	0-7	1525
7-8	847	0-8	2372
8-9	1288	0-9	3660
9-10	560	0-10	4220
10-EPZ	73	0-EPZ	4293

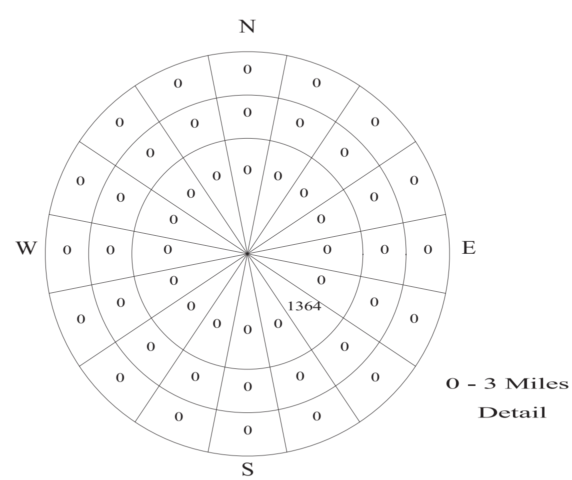


Figure 3-7. Employee Vehicles by Sector

3.4 Medical Facilities

Data was provided by the Delaware Emergency Management Agency for each of the medical facilities within the Delaware portion of the EPZ. Phone calls were made to each of the medical facilities within the New Jersey portion of the EPZ to obtain needed data. Chapter 8 details the evacuation of medical facilities and their patients. The number and type of evacuating vehicles that need to be provided depends on the patients' state of health. Buses can transport up to 30 people; wheelchair vans, up to 4 people; wheelchair buses up to 15 people; and ambulances, up to 2 people.

3.5 Total Demand in Addition to Permanent Population

Vehicles will be traveling through the EPZ (external-external trips) at the time of an accident. After the Advisory to Evacuate is announced, these through-travelers will also evacuate. These through vehicles are assumed to travel on the major routes traversing the EPZ – US Route 13, Delaware Route 1 and New Jersey Route 49. It is assumed that this traffic will continue to enter the EPZ during the first 90 minutes following the Advisory to Evacuate.

Average Annual Daily Traffic (AADT) data was obtained from the State DOT websites to estimate the number of vehicles per hour. The AADT was multiplied by the K-Factor, which is the proportion of the AADT on a roadway segment or link during the design hour, resulting in the design hour volume (DHV). The design hour is the 30th highest hourly traffic volume of the year, measured in vehicles per hour (vph). The DHV is then multiplied by the D-Factor, which is the proportion of the DHV occurring in the peak direction of travel (also known as the directional split). The resulting values are the directional design hourly volumes (DDHV), and are presented in Table 3-6, for each of the routes considered. The DDHV is then multiplied by 1.5 hours (access control points – ACP – are activated at 90 minutes after the advisory to evacuate) to estimate the total source vehicles loaded on the analysis network. As indicated, there are 13,587 vehicles entering the EPZ as external-external trips prior to the activation of the ACP.

3.6 Special Events

As noted in assumption 6 of Section 2.2, three special events (Scenarios 13, 14 and 15) were considered –construction of the new plant coincident with a refueling outage at one of the operational units at the site with the existing access road and with the proposed causeway, and a refueling outage only – all in the year 2019. Consistent with the Traffic Impact Analysis (TIA) study submitted with the Environmental Report, the peak construction period is estimated at October 2019, with workforce estimates of 4,100 total construction workers. There will be three construction shifts, with 2,460 workers (60% of total workforce) during the peak (midday) shift. There are 1,544 PSEG employees and 160 supplemental personnel (contractors) at the site during regular operations, for a total population of 1,704 employees at the site, which agrees with

Figure 3-6 and Table E-7. During an outage, the number of supplemental personnel increases to 850 total employees. Based on traffic count data collected for the TIA study during a 2009 outage and during regular daily operations, there are 1,364 vehicles onsite at the peak time during the midday during regular operations (Figure 11 of the TIA), and 1,293 vehicles onsite at the peak time during the midday during an outage (Figure 14 of the TIA). It is estimated that 600 new plant personnel (including NRC and PSEG personnel overseeing construction) will be at the new site during peak times. Using the data from Figure 14 of the TIA, 44.9% of the new plant personnel are present at the peak time midday. Thus, 269 new plant personnel (600 x 44.9%) are present for Scenarios 13 and 14.

Average vehicle occupancies of 1.30 construction workers per vehicle and 1.00 new plant personnel per vehicle are used to convert workers to vehicles, consistent with the TIA study. The vehicles for the existing unit personnel and outage personnel are taken directly from the traffic counts conducted for the TIA study, as noted above. Therefore, there is no vehicle occupancy factor applied to existing PSEG personnel and outage personnel. Applying the construction and new plant personnel occupancy factors results in 2,161 special event vehicles (2,460 ÷ 1.3 + 269 ÷ 1.0) for Scenarios 13 and 14. The outage vehicles present for Scenario 15 have been grouped with the existing PSEG employees as there is no way to differentiate outage vehicles from existing plant personnel vehicles in the TIA traffic counts. The existing access road was used as a single lane eastbound for the Scenarios 13 and 15. The proposed causeway, modeled as a single lane outbound connecting the PSEG Site to local roads in Elsinboro Township (see Appendix N for additional information), was used for Scenario 14. Permanent resident population and shadow population were extrapolated to 2019 for all special event scenarios. Table 3-7 summarizes the existing plant, new plant, outage and construction personnel and vehicles considered for the special event scenarios.

The existing access road is actually a three lane road with a single lane currently used for each direction of travel and the middle lane unused. In the past, during construction, the center lane was used and the direction of travel in that lane was reversed using gantry lights depending on the time of day. Appendix I explores the sensitivity of ETE for Scenario 13 when using gantry lights to add an additional lane outbound to the existing site access roadway to accommodate the additional traffic. Appendix N compares the ETE for Scenarios 13 and 14 in order to estimate the impact of building the proposed causeway. The ETE presented for Scenarios 13 and 15 are for current roadway conditions (a single lane outbound) on the existing access road.

The annual Olde Tyme Peach Festival in Middletown, Delaware attracts 2,500 additional transients into the EPZ during peak times. A sensitivity study was conducted, and it was found that the ETE are not affected by this event.

Table 3-6. PSEG Site External Traffic								
Delaware*								
Road Name	**Direction**	**Source Link**		**AADT**	**K-Factor**	**D-Factor**	**Hourly Volume (DDHV)**	**Source Vehicles**
		UpNode	**DnNode**					
US Route 13	SB	940	75	24,318	11.01	62.68	1,678	2,517
US Route 13	NB	23	738	17,092	11.01	62.68	1,180	1,770
State Route 1	SB	808	807	35,876	11.01	62.68	2,476	3,714
State Route 1	NB	857	27	40,405	11.01	62.68	2,788	4,182
							Delaware Total:	12,183
New Jersey**								
Road Name	**Direction**	**Source Link**		**AADT**	**K-Factor**	**D-Factor**	**Hourly Volume (DDHV)**	**Source Vehicles**
		UpNode	**DnNode**					
State Route 49	SB	265	266	NJDOT Provides Hourly Volumes			532	798
State Route 49	NB	288	286				404	606
							New Jersey Total:	1,404
							EPZ Total:	13,587

*http://www.deldot.gov/information/pubs_forms/manuals/traffic_counts/2008
** http://www.state.nj.us/transportation/refdata/roadway/traffic_counts

Table 3-7. Summary of Population and Vehicles at PSEG Site for Special Event Scenarios						
Personnel	**Scenarios 1 through 12**		**Scenarios 13 and 14**		**Scenario 15**	
	Population	**Vehicles**	**Population**	**Vehicles**	**Population**	**Vehicles**
Existing Plants	1,544	1,364	1,544	1,293	1,544	1,293
Supplemental Contractors (Outage)	160		850		850	
Construction	0	0	2,460	1,892	0	0
New Plant	0	0	269	269	0	0
TOTAL:	1,704	1,364	5,454	3,454	2,394	1,293

4. ESTIMATION OF HIGHWAY CAPACITY

The ability of the road network to service vehicle demand is a major factor in determining how rapidly an evacuation can be completed. The capacity of a road is defined as the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane of roadway during a given time period under prevailing roadway, traffic and control conditions as stated in the 2000 Highway Capacity Manual(HCM).

In discussing capacity, different operating conditions have been assigned alphabetical designations, A through F, to reflect the range of traffic operational characteristics. These designations have been termed "Levels of Service" (LOS). For example, LOS A connotes free-flow and high-speed operating conditions; LOS F represents a forced flow condition. LOS E describes traffic operating at or near capacity.

Another concept, closely associated with capacity, is “Service Volume” (SV). Service volume is defined as “The maximum hourly rate at which vehicles, bicycles or persons reasonably can be expected to traverse a point or uniform section of a roadway during an hour under specific assumed conditions while maintaining a designated level of service.” This definition is similar to that for capacity. The major distinction is that values of SV vary from one LOS to another, while capacity is the service volume at the upper bound of LOS E, only.

This distinction is illustrated in Exhibit 12-15 of the HCM. As indicated there, the SV varies with Free Flow Speed (FFS), Terrain and LOS. However, the SV at LOS E (which approximates capacity) varies only with Terrain. This Exhibit was referenced when estimating capacity for two-lane rural highways within the EPZ and Shadow Region; such highways are predominant within the analysis network.

Other factors also influence capacity. These include, but are not limited to:

- Lane Width
- Shoulder Width
- Pavement Condition
- Percent Truck Traffic
- Weather Conditions (rain, snow, fog, wind speed, ice)

These factors are considered during the road survey and in the capacity estimation process; some factors have greater influence on capacity than others. For example, lane and shoulder width have only a limited influence on free flow speed (FFS) according to Exhibit 20-5 of the HCM. Consequently, lane and shoulder widths at the narrowest points were observed during the road survey and these observations were recorded, but no detailed measurements of lane or shoulder width were taken. The estimated FFS were measured using the survey vehicle’s speedometer and observing local traffic.

As discussed in Section 2.3, it is necessary to adjust capacity figures to represent the prevailing conditions during inclement weather. Based on limited empirical data, weather conditions such as rain reduce the values of free speed and of highway capacity by approximately 10 percent. Over the last decade new studies have been made on the effects of rain on traffic capacity. These studies indicate a range of effects between 5 and 20 percent depending on wind speed and precipitation rates. As indicated in Section 2.3, we employ a reduction in free speed and in highway capacity of 10 percent and 20 percent for rain and snow, respectively.

Given the population density of Salem and Middletown and the limited number of evacuation routes servicing these areas, congestion arising from evacuation is likely to be significant within these cities. As such, estimates of roadway capacity must be determined with great care. Because of its importance, a brief discussion of the major factors that influence highway capacity is presented in this section.

Rural highways generally consist of: (1) one or more uniform sections with limited access (driveways, parking areas) characterized by "uninterrupted" flow; and (2) approaches to at-grade intersections where flow can be "interrupted" by a control device or by turning or crossing traffic at the intersection. Due to these differences, separate estimates of capacity must be made for each section. Often, the approach to the intersection is widened by the addition of one or more lanes (turn pockets or turn bays), to compensate for the lower capacity of the approach due to the factors there that can interrupt the flow of traffic. These additional lanes are recorded during the field survey and later entered as input to the I-DYNEV system.

4.1 Capacity Estimations on Approaches to Intersections

At-grade intersections are apt to become the first bottleneck locations under local heavy traffic volume conditions. This characteristic reflects the need to allocate access time to the respective competing traffic streams by exerting some form of control. During evacuation, control at critical intersections will often be provided by traffic control personnel assigned for that purpose, whose directions may supersede traffic control devices. The Traffic Management Plan identifies these locations (Traffic Control Points, TCP) and the management procedures applied.

The per-lane capacity of an approach to a signalized intersection can be expressed (simplistically) in the following form:

$$Q_{cap,m} = \left(\frac{3600}{h_m}\right) \bullet \left[\frac{G-L}{C}\right]_m = \left(\frac{3600}{h_m}\right) \bullet P_m$$

where:

Qcap,m	=	Capacity of a single lane of traffic on an approach, which executes movement, *m*, upon entering the intersection; vehicles per hour (vph)
h_m	=	Mean queue discharge headway of vehicles on this lane that are executing movement, *m*; seconds per vehicle

G	=	Mean duration of GREEN time servicing vehicles that are executing movement, m, for each signal cycle; seconds
L	=	Mean "lost time" for each signal phase servicing movement, m; seconds
C	=	Duration of each signal cycle; seconds
P_m	=	Proportion of GREEN time allocated for vehicles executing movement, m, from this lane. This value is specified as part of the control treatment.
m	=	The movement executed by vehicles after they enter the intersection: through, left-turn, right-turn, and diagonal.

The turn-movement-specific mean discharge headway h_m, depends in a complex way upon many factors: roadway geometrics, turn percentages, the extent of conflicting traffic streams, the control treatment, and others. A primary factor is the value of "saturation queue discharge headway", h_{sat}, which applies to through vehicles that are not impeded by other conflicting traffic streams. This value, itself, depends upon many factors including motorist behavior. Formally, we can write,

$$h_m = f_m\,(h_{sat}, F_1, F_2, ...)$$

where:

h_{sat}	=	Saturation discharge headway for through vehicles; seconds per vehicle
F_1, F_2	=	The various known factors influencing h_m
$f_m\,(\cdot)$	=	Complex function relating h_m to the known (or estimated) values of $h_{sat}, F_1, F_2, \ldots$

The estimation of h_m for specified values of $h_{sat}, F_1, F_2, ...$ is undertaken within the PC-DYNEV simulation model and within the TRAD model by a mathematical model[1]. The resulting values for h_m always satisfy the condition:

$$h_m \geq h_{sat}$$

That is, the turn-movement-specific discharge headways are always greater than, or equal to the saturation discharge headway for through vehicles. These headways (or its inverse equivalent, “saturation flow rate”), may be determined by observation or using the procedures of the Highway Capacity Manual.

The above discussion is necessarily brief given the scope of this ETE report and the complexity of the subject of intersection capacity. In fact, the two longest chapters in the HCM (16 and 17), each well over 100 pages, address this topic. The factors, F_1, F_2, …,

1 Lieberman, E., "Determining Lateral Deployment of Traffic on an Approach to an Intersection", McShane, W. & Lieberman, E., "Service Rates of Mixed Traffic on the far Left Lane of an Approach". Both papers appear in Transportation Research Record 772, 1980.

influencing saturation flow rate are indentified in equation (16-4) and Exhibit 16-7 of the HCM; Exhibit 10-12 identifies the required data and Exhibit 10-7 presents representative values of Service Volume.

The traffic signals within the EPZ and Shadow Region are modeled using a 75-second cycle length (C). The proportion of green time allocated (P) for each approach to each intersection is determined iteratively based on the expected traffic volumes on each approach during evacuation circumstances. The amount of green time (G) allocated ranges from 12 to 57 seconds; 2 seconds of yellow time are indicated for each signal phase and 1 second of all-red time is assigned between signal phases. A lost time (L) of 2.0 seconds is used for each intersection in the analysis.

4.2 Capacity Estimation Along Sections of Highway

The capacity of highway sections -- as distinct from approaches to intersections -- is a function of roadway geometrics, traffic composition (e.g. percent heavy trucks and buses in the traffic stream) and, of course, motorist behavior. There is a fundamental relationship which relates service volume (i.e. the number of vehicles serviced within a uniform highway section in a given time period) to traffic density. Figure 4-1 describes this relationship.

As indicated, there are two flow regimes: (1) Free Flow (left side of curve); and (2) Forced Flow (right side). In the Free Flow regime, the traffic demand is fully serviced; this service volume increases as demand volume and density increase, until the service volume attains its maximum value, which is the capacity of the highway section. As traffic demand and the resulting highway density increase beyond this "critical" value, the rate at which traffic can be serviced (i.e. the service volume) can actually decline below capacity. Therefore, in order to realistically represent traffic performance during congested conditions (i.e. when demand exceeds capacity), it is necessary to estimate the service volume, V_F, under congested conditions.

The value of V_F can be expressed as:

$$V_F = R \times \text{Capacity}$$

where R = Reduction factor which is less than unity.

We have employed a value of R=0.85. The advisability of such a capacity reduction factor is based upon empirical studies that identified a fall-off in the service flow rate when congestion occurs at “bottlenecks” or “choke points” on a freeway system. Zhang and Levinson[2] describe a research program that collected data from a computer-based surveillance system (loop detectors) installed on the Interstate Highway System, at 27 active bottlenecks in the twin cities metro area in Minnesota over a 7-week period. When flow breakdown occurs, queues are formed which discharge at lower flow rates than the

[2] Lei Zhang and David Levinson, “Some Properties of Flows at Freeway Bottlenecks,” Transportation Research Record 1883, 2004.

maximum capacity prior to observed breakdown. These queue discharge flow (QDF) rates vary from one location to the next and also vary by day of week and time of day based upon local circumstances. The cited reference presents a mean QDF of 2,016 passenger cars per hour per lane (pcphpl). This figure compares with the nominal capacity estimate of 2,250 pcphpl estimated for the ETE and indicated in Appendix K for freeway links. The ratio of these two numbers is 0.896 which translates into a capacity reduction factor of 0.90. The data collected in the cited reference indicates that the variation of QDF at a location is generally in the range of ±5% about the average QDF. That is, the lower tail of this distribution would be equivalent to a capacity reduction factor of 0.90 - 0.05 = 0.85, which is the figure adopted.

It is seen that a conservative view is taken in estimating the capacity at bottlenecks when congestion develops (this capacity, of course, is the QDF rate discussed above). One could argue that a more representative value for this capacity reduction factor could be 0.90 as discussed above. Given the emergency conditions, a conservative stance is justified. Therefore, a factor of 0.85 is applied only when flow breaks down, as determined by the simulation model.

Rural roads, like freeways, are classified as “uninterrupted flow” facilities. (This is in contrast with urban street systems which have closely spaced signalized intersections and are classified as “interrupted flow” facilities.) As such, traffic flow along rural roads is subject to the same effects as freeways in the event traffic demand exceeds the nominal capacity, resulting in queuing and lower QDF rates. As a practical matter, rural roads rarely break down at locations away from intersections. The breakdowns on rural roads which are experienced on this network occur at intersections where other model logic applies. Therefore, the application of a factor of 0.85 is appropriate on rural roads but rarely, if ever, activated.

The estimated value of capacity is based primarily upon the type of facility and on roadway geometrics. Sections of roadway with adverse geometrics are characterized by lower free-flow speeds and lane capacity. Table 12-15 in the Highway Capacity Manual was referenced to estimate saturation flow rates. The impact of narrow lanes and shoulders on free-flow speed and on capacity is not material, particularly when flow is predominantly in one direction.

The procedure used here was to estimate "section" capacity, V_E, based on observations made traveling over each section of the evacuation network, by the posted speed limits and travel behavior of other motorists and by reference to the 2000 Highway Capacity Manual. It was then determined for each highway section, represented as a network link, whether its capacity would be limited by the "section-specific" service volume, V_E, or by the intersection-specific capacity. For each link, the model selects the lower value of capacity.

4.3 Application to the PSEG Site EPZ

As part of the development of the PSEG Site EPZ traffic network, an estimate of roadway capacity is required. The source material for the capacity estimates presented herein is contained in:

2000 Highway Capacity Manual (HCM)
Transportation Research Board
National Research Council
Washington, D.C.

The highway system in the PSEG Site EPZ consists primarily of three categories of roads and, of course, intersections:

- Two-Lane roads: Local, State
- Multi-Lane Highways (at-grade)
- Freeways

Each of these classifications will be discussed.

4.3.1 Two-Lane Roads

Ref: HCM Chapters 12 and 20

Two lane roads comprise the majority of highways within the EPZ. The per-lane capacity of a two-lane highway is estimated at 1700 passenger cars per hour (pc/h). This estimate is essentially independent of the directional distribution of traffic volume except that, for extended distances, the two-way capacity will not exceed 3200 pc/h. The HCM procedures then estimate Level of Service (LOS) and Average Travel Speed. The evacuation simulation model accepts the specified value of capacity as input and computes average speed based on the time-varying demand: capacity relations.

Based on the field survey and on expected traffic operations associated with evacuation scenarios:

- Most sections of two-lane roads within the EPZ are classified as “Class I”, with "level terrain"; some are “rolling terrain”.
- “Class II” highways are mostly those within city limits (Middletown, Salem).

4.3.2 Multi-Lane Highway

Ref: HCM Chapters 12 and 21

Exhibit 21-3 of the HCM presents a set of curves that indicate a per-lane capacity ranging from approximately 1900 to 2200 pc/h, for free-speeds of 45 to 60 mph. Based on observation, the multi-lane highways outside of urban areas within the EPZ service traffic with free-speeds in this range. The actual time-varying speeds computed by the simulation model reflect the demand: capacity relationship and the impact of control at intersections. A conservative estimate of per-lane capacity of 1900 pc/h is adopted for this study for multi-lane highways outside of urban areas, as shown in Appendix K.

Chapter 12 presents the basic concepts underlying the procedures in Chapters 20 and 21.

4.3.3 Freeways

Ref: HCM Chapters 13, 22-25

Chapter 22 of the HCM describes a procedure for integrating the results obtained in Chapters 23, 24 and 25, which compute capacity and LOS for freeway components. The discussion also references Chapter 31, which presents a discussion on simulation models. The simulation model, PC-DYNEV, automatically performs this integration process.

Chapter 23 of the HCM presents procedures for estimating capacity and LOS for “Basic Freeway Segments". Exhibit 23-3 of the HCM2000 presents capacity vs. free speed estimates.

Free Speed:	55	60	65	70+
Per-Lane Capacity (pc/h):	2250	2300	2350	2400

The inputs to the simulation model are highway geometrics, free-speeds and capacity based on field observations. The simulation logic calculates actual time-varying speeds based on demand: capacity relationships.

Chapter 24 of the HCM presents procedures for estimating capacity, speed, density and LOS. The simulation model contains logic that relates speed to demand volume: capacity ratio. The value of capacity obtained from Exhibit 24-8 of the HCM depends on the "Type" and geometrics of the weaving segment and on the "Volume Ratio" (ratio of weaving volume to total volume).

Chapter 25 of the HCM presents procedures for estimating capacities of ramps and of "merge" areas. The capacity of a merge area "is determined primarily by the capacity of the downstream freeway segment". Values of this merge area capacity are presented in Exhibit 25-7 of the HCM, and depend on the number of freeway lanes and on the freeway free speed. The KLD simulation model logic simulates the merging operations of the ramp and freeway traffic. If congestion results from an excess of demand relative to capacity, then the model allocates service appropriately to the two entering traffic streams and produces LOS F conditions (The HCM does not address LOS F explicitly).

Chapter 13 presents basic concepts underlying the procedures in the later chapters.

4.3.4 Intersections

Ref: HCM Chapters 10, 16, 17

Procedures for estimating capacity and LOS for approaches to intersections are presented in Chapters 16 (signalized intersections) and 17 (un-signalized intersections). These are the two longest chapters in the HCM 2000, reflecting the complexity of these procedures. The simulation logic is likewise complex, but different; as stated on page 31-21 of the HCM2000:

> *"Assumptions and complex theories are used in the simulation model to represent the real-world dynamic traffic environment."*

Chapter 10 presents basic concepts underlying the procedures in the later chapters.

4.4 Simulation and Capacity Estimation

Chapter 31 of the HCM is entitled, "Simulation and other Models." The lead sentence on the subject of Traffic Simulation Models is:

> Traffic simulation models use numerical techniques on a digital computer to create a description of how traffic behaves over extended periods of time for a given transportation facility or system…by stepping through time and across space, tracking events as the system state unfolds. Traffic simulation models focus on the dynamic of traffic flow.

In general terms, this description applies to the PC-DYNEV model, which is further described in Appendix C. It is essential to recognize that simulation models do not replicate the methodology and procedures of the HCM – they *replace* these procedures by describing the complex interactions of traffic flow and computing Measures of Effectiveness (MOE) detailing the operational performance of traffic over time and by location.

All simulation models must be calibrated properly with field observations that quantify the performance parameters applicable to the analysis network. Two of the most important of these are: (1) Free flow speed (FFS); and (2) saturation headway, h_{sat}. The first of these is estimated by direct observation during the road survey; the second is estimated using the concepts of the HCM, as described earlier. These parameters are listed in Appendix K, for each network link.

The observations made during the road survey (see Section 1.3) were used to calibrate the model used for this study.

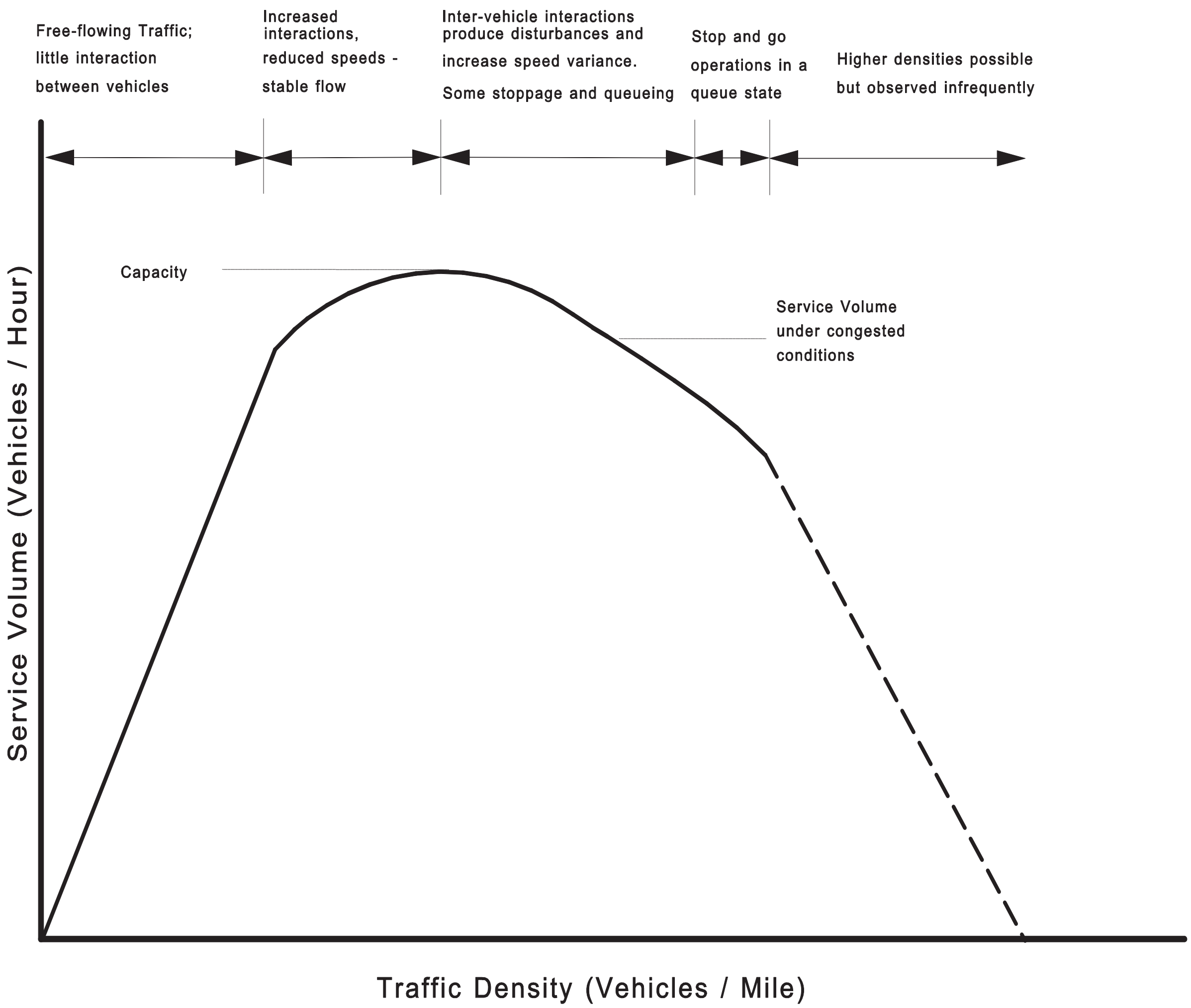


Figure 4-1. Fundamental Relationship between Volume and Density

5. ESTIMATION OF TRIP GENERATION TIME

Federal Government guidelines (see NUREG 0654, Appendix 4) specify that the planner estimate the distributions of elapsed times associated with mobilization activities undertaken by the public to prepare for the evacuation trip. The elapsed time associated with each activity is represented as a statistical distribution reflecting differences between members of the public. The quantification of these activity-based distributions relies largely on the results of the telephone survey. We define the sum of these distributions of elapsed times as the Trip Generation Time Distribution.

Background

In general, an accident at a nuclear power station is characterized by the following Emergency Action Classification Levels (see Appendix 1 of NUREG 0654 for details):

1. Unusual Event
2. Alert
3. Site Area Emergency
4. General Emergency

At each level, the Federal guidelines specify a set of Actions to be undertaken by the Licensee, and by State and Local offsite authorities. As a Planning Basis, we will adopt a conservative posture, in accordance with Federal Regulations, that a rapidly escalating accident will be considered in calculating the Trip Generation Time. We will assume:

a. The Advisory to Evacuate will be announced coincident with the emergency notification.

b. Mobilization of the general population will commence up to 10 minutes after the alert notification.

c. Evacuation Time Estimates (ETE) are measured relative to the Advisory to Evacuate.

d. Schools will be evacuated prior to the Advisory to Evacuate, if conditions permit.

We emphasize that the adoption of this planning basis is not a representation that these events will occur at the PSEG Site within the indicated time frame. Rather, these assumptions are necessary in order to:

- Establish a temporal framework for estimating the Trip Generation distribution in the format recommended in Appendix 4 of NUREG 0654.
- Identify temporal points of reference that uniquely define "Clear Time" and ETE.

It is more likely that a longer time will elapse between the various classes of an emergency at the PSEG Site.

For example, suppose one hour will elapse from the siren alert to the Advisory to Evacuate. In this case, it is reasonable to expect some degree of spontaneous evacuation by the public during this one-hour period. As a result, the population within the Emergency Planning Zone (EPZ) will be lower when the Advisory to Evacuate is announced, than at the time of the General Emergency. Thus, the time needed to evacuate the EPZ, after the Advisory to Evacuate will be somewhat less than the estimates presented in this report.

The notification process consists of two events:

- Transmitting information (e.g. using sirens, tone alerts, EAS broadcasts, loud speakers).
- Receiving and correctly interpreting the information that is transmitted.

The peak general population within the EPZ approximates 50,000 persons[1] who are deployed over an area of approximately 265 square miles and are engaged in a wide variety of activities. It must be anticipated that some time will elapse between the transmission and receipt of the information advising the public of an accident.

The amount of elapsed time will vary from one individual to the next depending on where that person is, what that person is doing, and related factors. Furthermore, some persons who will be directly involved with the evacuation process may be outside the EPZ at the time that the emergency is declared. These people may be commuters, shoppers and other travelers who reside within the EPZ and who will return to join the other household members upon receiving notification of an emergency.

As indicated in NUREG 0654, the estimated elapsed times for the receipt of notification can be expressed as a distribution reflecting the different notification times for different people within, and outside, the EPZ. By using time distributions, it is also possible to distinguish between different population groups and different day-of-week and time-of-day scenarios, so that accurate ETE may be obtained.

[1] According to Table 6-4, the peak vehicle population in the EPZ for non-special events occurs for Scenario 6. According to Table 6-3, there are 100% of the permanent resident population, 100% of the employees commuting into the EPZ and 5% of the transients visiting the EPZ present for this scenario. Applying these percentages to the values presented in Section 3 yields: 100% x 45,034 residents (Table 3-1) + 5% x 3,323 transients (Table 3-4) + 100% x 4,724 employees (Table 3-5) = 49,924 persons.

For example, people at home or at work within the EPZ will be notified by siren, and/or tone alert and/or radio. Those well outside the EPZ will be notified by telephone, radio, TV and word-of-mouth, with potentially longer time lags. Furthermore, the spatial distribution of the EPZ population will differ with time of day - families will be united in the evenings, but dispersed during the day. In this respect, weekends will differ from weekdays.

Generally, the information required can be obtained from a telephone survey of EPZ residents. Such a survey was conducted. Appendix F presents the raw survey results. It is important to note that the shape and duration of the evacuation trip mobilization distribution is important at sites where traffic congestion is not expected to cause the evacuation time estimate to extend in time well beyond the trip generation period. The remaining discussion will focus on the application of the trip generation data obtained from the telephone survey to the development of the PSEG Site ETE.

Fundamental Considerations

The environment leading up to the time that people begin their evacuation trips consists of a sequence of events and activities. Each event (other than the first) occurs at an instant in time and is the outcome of an activity.

Activities are undertaken over a period of time. Activities may be in "series" (i.e. to undertake an activity implies the completion of all preceding events) or may be in parallel (two or more activities may take place over the same period of time). Activities conducted in series are functionally dependent on the completion of prior activities; activities conducted in parallel are functionally independent of one-another. The relevant events associated with the public's preparation for evacuation are:

Event Number	Event Description
1	Notification
2	Aware of Situation
3	Depart Work
4	Arrive Home
5	Depart on Evacuation Trip

Associated with each sequence of events are one or more activities, as outlined below:

Table 5-1. Event Sequence for Evacuation Activities

Event Sequence	Activity	Distribution
1 → 2	Receive Notification	1
2 → 3	Prepare to Leave Work	2
2,3 → 4	Travel Home	3
2,4 → 5	Prepare to Leave to Evacuate	4
N/A	Snow Clearance	5

These relationships are shown graphically in Figure 5-1.

- An Event is a ‘state’ that exists at a point in time (e.g., depart work, arrive home)

- An Activity is a ‘process’ that takes place over some elapsed time (e.g., prepare to leave work, travel home)

As such, an Activity changes the ‘state’ of an individual (e.g. the activity, ‘travel home’ changes the state from ‘depart work’ to ‘arrive home’). Therefore, an Activity can be described as an ‘Event Sequence’; the elapsed times to perform an event sequence vary from one person to the next and are described as statistical distributions on the following pages.

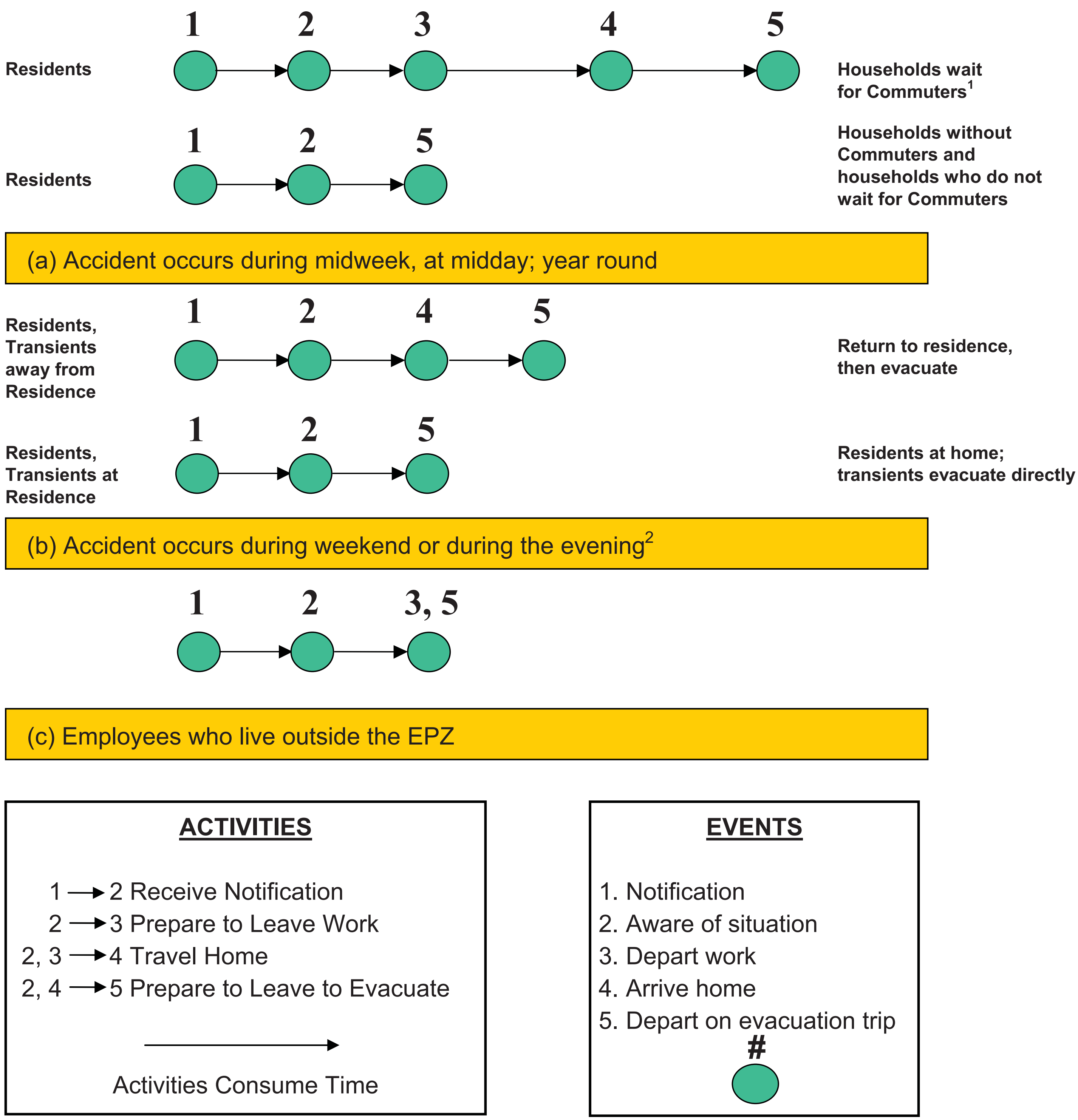
An employee who lives outside the EPZ will follow sequence (c) of Figure 5-1. A household within the EPZ that has one or more commuters at work, and will await their return before beginning the evacuation trip will follow the first sequence of Figure 5-1(a). A household within the EPZ that has no commuters at work, or that will not await the return of any commuters, will follow the second sequence of Figure 5-1(a), regardless of day of week or time of day.

Households with no commuters on weekends or in the evening/night-time, will follow the applicable sequence in Figure 5-1(b). Transients will always follow one of the sequences of Figure 5-1(b). Some transients away from their residence could elect to evacuate immediately without returning to the residence, as indicated in the second sequence.

It is seen from Figure 5-1, that the Trip Generation time (i.e. the total elapsed time from Event 1 to Event 5) depends on the scenario and will vary from one household to the next. Furthermore, Event 5 depends, in a complicated way, on the time distributions of all activities preceding that event. That is, to estimate the time distribution of Event 5, we must obtain estimates of the time distributions of all preceding events. For this study, we adopt the conservative posture that all activities will occur in sequence.

Estimated Time Distributions of Activities Preceding Event 5

The time distribution of an event is obtained by "summing" the time distributions of all prior contributing activities. (This "summing" process is quite different than an algebraic sum since we are operating on distributions – not scalar numbers).



[1] Applies for evening and weekends also if commuters are at work.
[2] Applies throughout the year for transients.

Figure 5-1. Events and Activities Preceding the Evacuation Trip

Time Distribution No. 1, Notification Process: Activity 1 → 2

It is assumed (based on the presence of sirens within the EPZ) that 85 percent of those within the EPZ will be aware of the accident within 30 minutes with the remainder notified within the following 20 minutes. The notification distribution is given below:

Table 5-2. Time Distribution for Notifying the Public

Elapsed Time (Minutes)	Percent of Population Notified
0	0.0
5	7.0
10	13.0
15	26.0
20	46.0
25	65.0
30	85.0
35	90.0
40	95.0
45	98.0
50	100.0

Distribution No. 2, Prepare to Leave Work: Activity 2 → 3

It is reasonable to expect that the vast majority of business enterprises within the EPZ will elect to shut down following notification and most employees would leave work quickly. Commuters, who work outside the EPZ could, in all probability, also leave quickly since facilities outside the EPZ would remain open and other personnel would remain. Personnel or farmers responsible for equipment would require additional time to secure their facility. The distribution of Activity 2 → 3 reflects data obtained by the telephone survey. This distribution is plotted in Figure 5-2 and listed below.

Table 5-3. Time Distribution for Employees to Prepare to Leave Work

Elapsed Time (Minutes)	Cumulative Percent Employees Leaving Work	Elapsed Time (Minutes)	Cumulative Percent Employees Leaving Work
0	0.0	55	85.8
5	29.5	60	91.5
10	42.2	65	93.6
15	51.4	70	95.7
20	57.5	75	97.8
25	60.7	80	98.4
30	72.1	85	98.9
35	76.4	90	99.5
40	79.3	95	99.6
45	83.8	100	99.8
50	84.5	105	100.0

NOTE: The survey data was normalized to distribute the "Don't know" response. That is, the sample was reduced in size to include only those returns which included responses to this question. The underlying assumption is that the distribution of this activity for the “Don’t know” responders, if the event takes place, would be the same as those responders who provided estimates.

Distribution No. 3, Travel Home: Activity 3 → 4

These data are provided directly by those households which responded to the telephone survey. This distribution is plotted in Figure 5-2 and listed below.

Table 5-4. Time Distribution for Commuters to Travel Home

Elapsed Time (Minutes)	Cumulative Percent Returning Home	Elapsed Time (Minutes)	Cumulative Percent Returning Home
0	0.0	45	90.2
5	11.8	50	91.8
10	24.9	55	92.0
15	35.2	60	96.6
20	46.8	65	97.6
25	53.5	70	98.5
30	70.6	75	99.5
35	76.9	80	100.0
40	84.4		

NOTE: The survey data was normalized to distribute the "Don't know" response

Distribution No. 4, Prepare to Leave Home: Activity 2, 4 → 5

These data are provided directly by those households which responded to the telephone survey. This distribution is plotted in Figure 5-2 and listed below.

Table 5-5. Time Distribution for Population to Prepare to Evacuate

Elapsed Time (Minutes)	Cumulative Percent Ready to Evacuate	Elapsed Time (Minutes)	Cumulative Percent Ready to Evacuate
0	0.0	85	92.9
5	10.1	90	93.4
10	20.2	95	93.5
15	30.3	100	93.5
20	42.0	105	93.6
25	53.7	110	94.7
30	65.4	115	95.8
35	68.0	120	96.9
40	70.6	125	97.8
45	73.2	130	98.7
50	76.8	135	99.6
55	80.5	140	99.6
60	84.1	145	99.6
65	86.7	150	99.6
70	89.3	155	99.7
75	92.0	160	99.9
80	92.4	165	100.0

NOTE: The survey data was normalized to distribute the "Don't know" response

Distribution No. 5, Snow Clearance Time Distribution

Inclement weather scenarios involving snowfall must address the time lags associated with snow clearance. It is assumed that snow equipment is mobilized and deployed during the snowfall to maintain passable roads. The general consensus is that the snow-plowing efforts are generally successful for all but the most extreme blizzards when the rate of snow accumulation exceeds that of snow clearance over a period of many hours.

Consequently, it is reasonable to assume that the highway system will remain passable – albeit at a lower capacity – under the vast majority of snow conditions. Nevertheless, for the vehicles to gain access to the highway system, it may be necessary for driveways and employee parking lots to be cleared to the extent needed to permit vehicles to gain access to the roadways. These clearance activities take time; this time must be incorporated into the trip generation time distributions. These data are provided by those households which responded to the telephone survey. This distribution is plotted in Figure 5-2 and listed below.

Table 5-6. Time Distribution for Population to Clear 6”-8” of Snow

Elapsed Time (Minutes)	Cumulative Pct. of Households Completing Activity	Elapsed Time (Minutes)	Cumulative Pct. of Households Completing Activity
0	0.0	85	92.3
5	11.6	90	93.2
10	23.2	95	93.2
15	34.7	100	93.3
20	44.9	105	93.4
25	55.0	110	94.2
30	65.2	115	95.0
35	68.3	120	95.9
40	71.5	125	97.1
45	74.7	130	98.3
50	77.5	135	99.5
55	80.4	140	99.5
60	83.2	145	99.6
65	85.7	150	99.7
70	88.2	155	99.8
75	90.7	160	100.0
80	91.5		

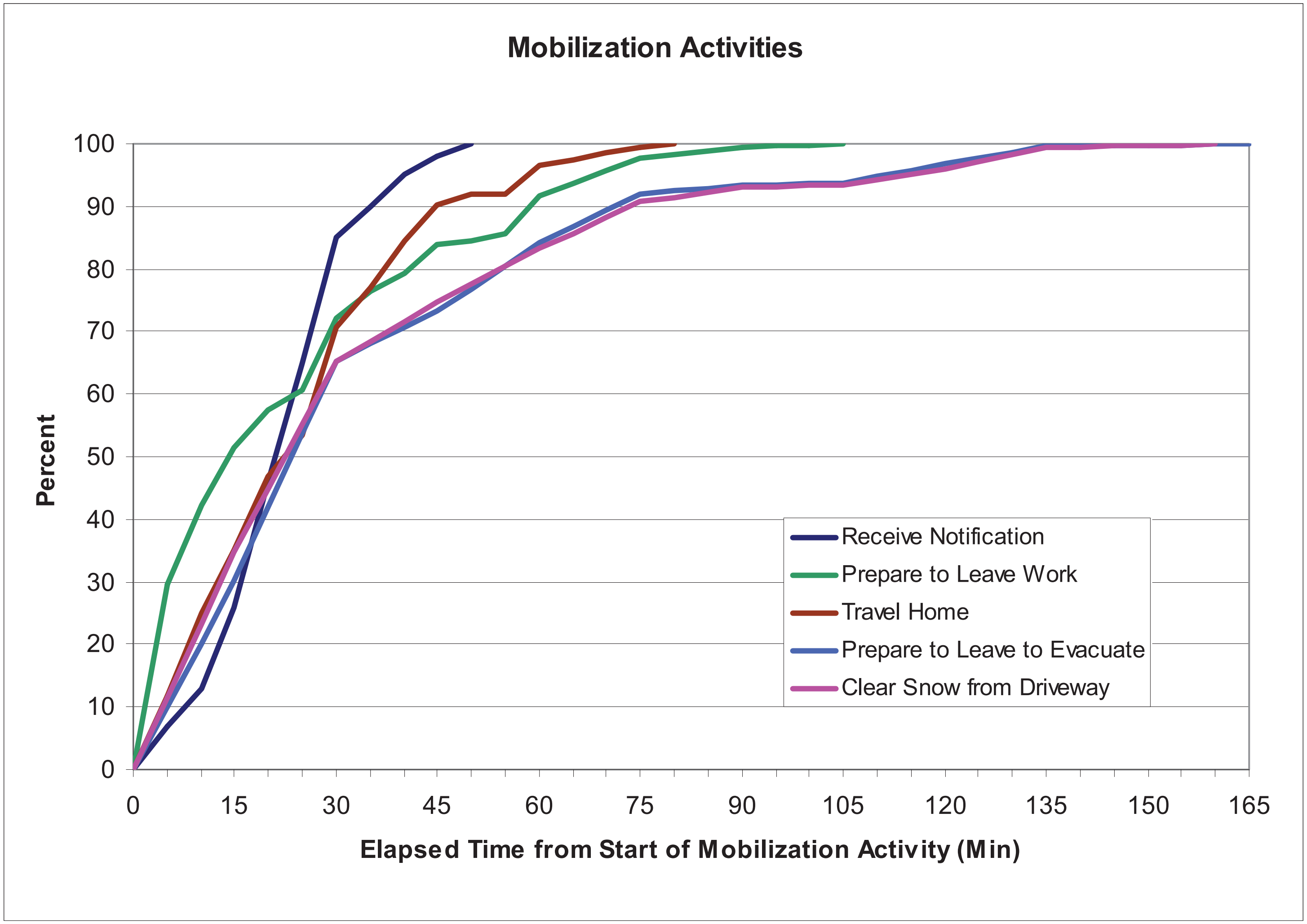


Figure 5-2. Evacuation Mobilization Activities

Calculation of Trip Generation Time Distribution

The time distributions for each of the mobilization activities presented herein must be combined to form the appropriate Trip Generation Distributions. We assume that the stated events take place in sequence such that all preceding events must be completed before the current event can occur. For example, if a household awaits the return of a commuter, the work-to-home trip (Activity 3 → 4) must precede Activity 4 → 5.

To calculate the time distribution of an event that is dependent on two sequential activities, it is necessary to "sum" the distributions associated with these prior activities. The distribution summing algorithm is applied repeatedly as shown to form the required distribution. As an outcome of this procedure, new time distributions are formed; we assign "letter" designations to these intermediate distributions to describe the procedure.

Table 5-7. Mapping Distributions to Events

Apply "Summing" Algorithm To:	Distribution Obtained	Event Defined
Distributions 1 and 2	Distribution A	Event 3
Distributions A and 3	Distribution B	Event 4
Distributions B and 4	Distribution C	Event 5
Distributions 1 and 4	Distribution D	Event 5
Distributions C and 5	Distribution E	Event 5
Distributions D and 5	Distribution F	Event 5

Table 5-8. Description of the Distributions

Distribution	Description
A	Time distribution of commuters departing place of work (Event 3). Also applies to employees who work within the EPZ who live outside, and to Transients within the EPZ.
B	Time distribution of commuters arriving home (Event 4).
C	Time distribution of residents with commuters leaving home to begin the evacuation trip (Event 5).
D	Time distribution of residents without commuters returning home to begin the evacuation trip (Event 5).
E	Time distribution of residents with commuters who return home, leaving home to begin the evacuation trip after snow clearance activities (Event 5).
F	Time distribution of residents with no commuters returning home, leaving to begin the evacuation trip after snow clearance activities (Event 5).

As shown in Figure 5-2 and in Appendix F, the mobilization activity distributions include outliers – generally, these represent anomalous responses to the survey question.

Following standard statistical practice, outliers were identified by (a) computing the estimated mean and standard deviation from the complete set of data, (b) computing value x_{LIMIT} as the mean plus 3.0 standard deviations, above which one expects 0.135% of the observations, (c) inspecting the gap between this limit value and the next-lowest observed value, (d) if that gap is sizable, classify the points above x_{LIMIT} as outliers and eliminate those points from the sample, (e) repeat the process from “a” to “d” until there are no outliers to consider.

The data sets and distributions are then used to construct distributions for the total mobilization times under different scenarios (e.g. commuter returning, no commuter returning, no snow or snow in each). In general, these are additive, using weighting based upon the probability distributions of each element; Figure 5-3 presents the combined trip generation distributions designated A, C, D, E and F. These distributions are presented on the same time scale. (The use of strictly additive activities is a conservative approach, because it makes all activities sequential – preparation for departure follows the return of the commuter; snow clearance follows the preparation for departure, and so forth. In practice, it is reasonable that some of these activities are done in parallel, at least to some extent – for instance, preparation to depart begins by a household member at home while the commuter is still on the road.)

Once the mobilization distributions are computed, they are not truncated, but rather used in their tabular/graphical form as direct inputs to later computations that lead to the ETE.

The PC-DYNEV simulation model is designed to accept varying rates of vehicle trip generation for each origin centroid, expressed in the form of histograms. These histograms, which represent Distributions A, C, D, E and F, properly displaced with respect to one another, are tabulated in Table 5-9 (Distribution B, Arrive Home, omitted for clarity).

The final time period (11) is 600 minutes long. This time period is added to allow the analysis network to clear, in the event congestion persists beyond the trip generation period. Note that there are no trips generated during this final time period.

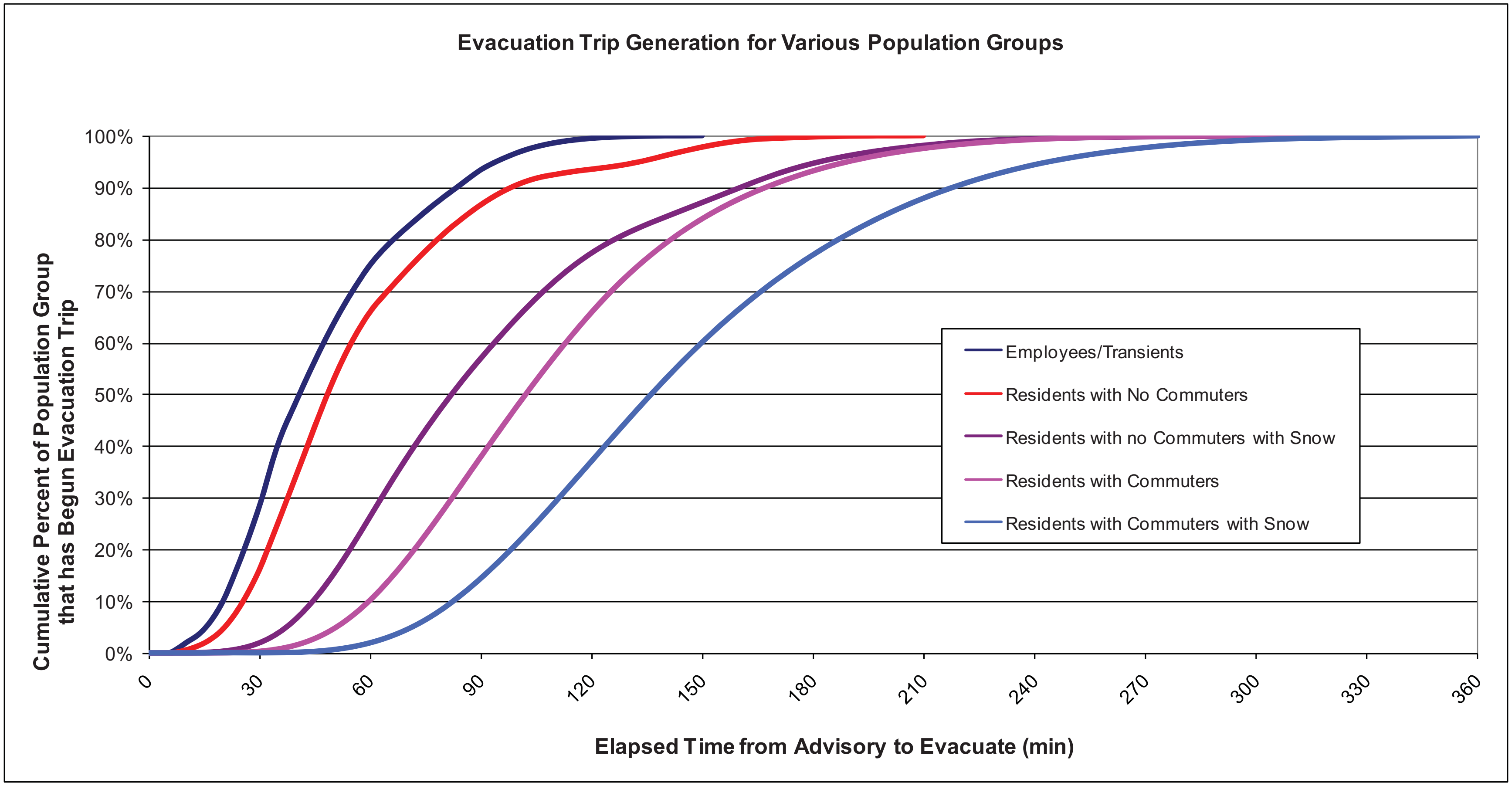


Figure 5-3. Comparison of Trip Generation Distributions

Table 5-9. Trip Generation Histograms for the EPZ Population

Time Period	Duration (Min)	Percent of Total Trips Generated Within Indicated Time Period					
		Employees (Distribution A)	Transients (Distribution B)	Residents with Commuters (Distribution C)	Residents Without Commuters (Distribution D)	Residents With Commuters Snow (Distribution E)	Residents Without Commuters Snow (Distribution F)
1	15	5	5	0	2	0	0
2	15	23	23	0	14	0	2
3	30	47	47	10	49	2	24
4	30	18	18	27	21	13	30
5	30	7	7	28	7	22	20
6	30	0	0	18	4	23	10
7	30	0	0	9	2	17	8
8	60	0	0	6	1	17	5
9	60	0	0	1	0	5	1
10	60	0	0	1	0	1	0
11	600	0	0	0	0	0	0

Notes:

- Shadow vehicles are loaded onto the analysis network (Figure 1-2) using Distributions D and E for good weather and snow, respectively.
- Special event (construction/outage) vehicles are loaded using Distribution A.
- School and transit buses are loaded at their mobilization time of 90 minutes.

6. DEMAND ESTIMATION FOR EVACUATION SCENARIOS

An evacuation "case" defines a combination of Evacuation Region and Evacuation Scenario. The definitions of "Region" and "Scenario" are as follows:

Region — A grouping of contiguous evacuation ERPAs, that forms either a "keyhole" sector-based area, or a circular area within the EPZ, that must be evacuated in response to a radiological emergency.

Scenario — A combination of circumstances, including time of day, day of week, season, and weather conditions. Scenarios define the number of people in each of the affected population groups and their respective mobilization time distributions.

A total of 17 Regions were defined which encompass all the groupings of ERPAs considered. These Regions are defined in Table 6-1. The ERPA configurations are identified in Figure 6-1. Each keyhole sector-based area consists of a central circle centered at the PSEG Site, and three adjoining sectors, each with a central angle of 22.5 degrees. The central sector coincides with the wind direction. These sectors extend to the EPZ boundary (Regions R04 through R13), or to 5 miles from the PSEG Site (Regions R14 through R17). Regions R01, R02 and R03 represent radial evacuations of 2, 5 and 10 miles, respectively.

A total of 15 Scenarios were evaluated for all Regions. Thus, there are a total of 15x17=255 evacuation cases. Table 6-2 is a description of all Scenarios.

Each combination of region and scenario implies a specific population to be evacuated. Table 6-3 presents the percentage of each population group assumed to evacuate for each scenario. Table 6-4 presents the vehicle counts for each scenario for an evacuation of Region R03 – the entire EPZ.

The vehicle estimates presented in Section 3 are peak values. These peak values are adjusted depending on the scenario and region being considered using scenario and region specific percentages; the scenario percentages are presented in Table 6-3, while the regional percentages are provided in Table H-1. The percentages presented in Table 6-3 were determined as follows:

The residents with commuters value during the week (when workforce is at its peak) is equal to the product of 60% (the number of households with at least one commuter) and 65% (the number of households with a commuter who would await the return of the commuter prior to evacuating). See assumption 3b in Section 2.3. It is assumed for weekend and evening scenarios that 10% of households with commuters will have a commuter at work during those times.

Employment is assumed to be at its peak during the winter, midweek, midday. Employment is reduced slightly (96%) for summer, midweek, midday scenarios. This is based on the assumption that 50% of the employees commuting into the EPZ will be on vacation for a week during the approximate 12 weeks of summer. It is further assumed that those taking vacation will be uniformly dispersed throughout the summer with approximately 4% of employees vacationing each week. Based on vehicle count data collected on the plant access road, the evening and weekend employment at the existing Salem/Hope Creek units is approximately 10% of the weekday employment. As shown in Table E-7, the existing PSEG units are the largest employer in the EPZ; therefore the value of 10% employment on weekends and evenings has been applied to the EPZ as a whole.

Transient activity is assumed to be at its peak during summer weekends and less (35%) during the week. As shown in Appendix E, few of the recreational areas in the EPZ have overnight accommodations; thus, transient activity is assumed to be low during evening hours – 5% for summer and 0% for winter. Transient activity on winter weekends is equal to 12% which is the ratio of hunters at wildlife management areas to the total transients in Table E-5.

As noted in the shadow footnote to Table 6-3, the shadow percentages are computed using a base of 30% (see assumption 5 in Section 2.2) voluntary evacuation multiplied by a scenario-specific proportion of employees to permanent residents in the shadow region. For example, using the values provided in Table 6-4 for Scenario 1, the shadow percentage is computed as follows:

$$30\% \times \left(1 + \frac{4{,}121}{8{,}113 + 12{,}688}\right) = 36\%$$

Three special events – construction of a new plant at the PSEG Site coincident with refueling at one of the existing units in Year 2019 with the existing access road and with the proposed causeway, and refueling only in Year 2019 – were considered as Scenarios 13, 14 and 15. Thus, the special event traffic is 100% evacuated for Scenarios 13, 14 and 15, and 0% for all other scenarios.

It is assumed that summer school enrollment is approximately 10% of enrollment during the regular school year for summer, midweek, midday scenarios. School is not in session during weekends and evening, thus no buses are needed under those circumstances. As discussed in Section 7, schools are assumed to be in session during the winter season, midweek, midday and 100% of buses will be needed under those circumstances. Transit buses are 100% evacuated for all scenarios as it is assumed that the transit-dependent population is present in the EPZ for all scenarios.

As discussed in Section 3, external traffic is assumed to be reduced by 40% during evening scenarios and is 100% for all other scenarios.

Table 6-1. Description of Evacuation Regions*

Region	Description	ERPA											
		New Jersey								Delaware			
		1	2	3	4	5	6	7	8	A	B	C	D
R01	2-Mile	x							x				x
R02	5-Mile	x							x	x			x
R03	Entire EPZ	x	x	x	x	x	x	x	x	x	x	x	x

5-Mile Ring and Downwind to EPZ Boundary

Region	Wind Direction Towards:	ERPA											
		New Jersey								Delaware			
		1	2	3	4	5	6	7	8	A	B	C	D
R04	NNW	x		x		x			x	x		x	x
R05	N	x		x	x	x			x	x		x	x
R06	NNE, NE	x	x	x	x	x			x	x			x
R07	ENE	x	x	x	x		x		x	x			x
R08	E, ESE	x	x				x	x	x	x			x
R09	SE	x					x	x	x	x			x
R10	SSE	x						x	x	x	x		x
R11	S, SSW, SW	x							x	x	x		x
R12	WSW, W, WNW	x							x	x	x	x	x
R13	NW	x							x	x		x	x

2-Mile Ring and Downwind to EPZ Boundary

Region	Wind Direction Towards:	ERPA											
		New Jersey								Delaware			
		1	2	3	4	5	6	7	8	A	B	C	D
R14	NNE, NE	x	x	x	x	x			x				x
R15	ENE	x	x	x	x		x		x				x
R16	E, ESE	x	x				x	x	x				x
R17	SE	x					x	x	x				x
N/A	NNW	Refer to Region R04											
	N	Refer to Region R05											
	SSE	Refer to Region R10											
	S, SSW, SW	Refer to Region R11											
	WSW, W, WNW	Refer to Region R12											
	NW	Refer to Region R13											

2-Mile Ring and Downwind to 5 Miles

Region	Wind Direction Towards:	ERPA											
		New Jersey								Delaware			
		1	2	3	4	5	6	7	8	A	B	C	D
N/A	NNE, NE, ENE, E, ESE, SE	Refer to Region R01											
N/A	N, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW	Refer to Region R02											

x = ERPA EVACUATES	ERPA SHELTERS IN PLACE

***Adapted from Region definitions in County/State Radiological Emergency Plans**

Figure 6-1. PSEG Site EPZ ERPAs

Table 6-2. Evacuation Scenario Definitions

Scenario	Season[1]	Day of Week	Time of Day	Weather	Special	Year
1	Summer	Midweek	Midday	Good	None	2010
2	Summer	Midweek	Midday	Rain	None	2010
3	Summer	Weekend	Midday	Good	None	2010
4	Summer	Weekend	Midday	Rain	None	2010
5	Summer	Midweek, Weekend	Evening	Good	None	2010
6	Winter	Midweek	Midday	Good	None	2010
7	Winter	Midweek	Midday	Rain	None	2010
8	Winter	Midweek	Midday	Snow	None	2010
9	Winter	Weekend	Midday	Good	None	2010
10	Winter	Weekend	Midday	Rain	None	2010
11	Winter	Weekend	Midday	Snow	None	2010
12	Winter	Midweek, Weekend	Evening	Good	None	2010
13	Winter	Midweek	Midday	Good	New Plant Construction + Refueling	2019
14	Winter	Midweek	Midday	Good	Scenario 13 with Proposed Causeway	2019
15	Winter	Midweek	Midday	Good	Refueling Only	2019

[1] Winter assumes that school is in session (also applies to spring and autumn). Summer assumes that school is not in session.

Table 6-3. Percent of Population Groups Evacuating for Various Scenarios

Scenario	Residents With Commuters in Household	Residents With No Commuters in Household	Employees	Transients	Shadow	Special Events	School Buses	Transit Buses	External Through Traffic
1	39%	61%	96%	35%	36%	0%	10%	100%	100%
2	39%	61%	96%	35%	36%	0%	10%	100%	100%
3	10%	90%	10%	100%	31%	0%	0%	100%	100%
4	10%	90%	10%	100%	31%	0%	0%	100%	100%
5	10%	90%	10%	5%	31%	0%	0%	100%	40%
6	39%	61%	100%	5%	36%	0%	100%	100%	100%
7	39%	61%	100%	5%	36%	0%	100%	100%	100%
8	39%	61%	100%	5%	36%	0%	100%	100%	100%
9	10%	90%	10%	12%	31%	0%	0%	100%	100%
10	10%	90%	10%	12%	31%	0%	0%	100%	100%
11	10%	90%	10%	12%	31%	0%	0%	100%	100%
12	10%	90%	10%	0%	31%	0%	0%	100%	40%
13	39%	61%	100%	5%	35%	100%	100%	100%	100%
14	39%	61%	100%	5%	35%	100%	100%	100%	100%
15	39%	61%	100%	5%	35%	100%	100%	100%	100%

Resident Households With Commuters .... Households of EPZ residents who await the return of commuters prior to beginning the evacuation trip.

Resident Households With No Commuters .... Households of EPZ residents who do not have commuters or will not await the return of commuters prior to beginning the evacuation trip.

Employees .... EPZ employees who live outside of the EPZ.

Transients .... People who are in the EPZ at the time of an accident for recreational or other (non-employment) purposes.

Shadow .... Residents and employees in the shadow region (outside of the EPZ) who will spontaneously decide to relocate during the evacuation. The basis for the values shown is a 30% relocation of shadow residents along with a proportional percentage of shadow employees. The percentage of shadow employees is computed using the scenario-specific ratio of EPZ employees to residents.

Special Events .... Additional vehicles at the PSEG Site for construction of the new plant and for refueling at one of the existing operational units.

School and Transit Buses .... Vehicle-equivalents present on the road during evacuation servicing schools and transit-dependent people (1 bus is equivalent to 2 passenger vehicles).

External Through Traffic .... Traffic on local highways and major arterial roads at the start of the evacuation. This traffic is stopped by access control approximately 90 minutes after the evacuation begins.

Table 6-4. Vehicle Estimates By Scenario*										
Scenario	Residents with Commuters	Residents without Commuters	Employees	Transients	Shadow	Special Events	School Buses	Transit Buses	External Traffic	Total Scenario Vehicles
1	8,113	12,688	4,121	533	26,761	-	61	68	13,587	65,932
2	8,113	12,688	4,121	533	26,761	-	61	68	13,587	65,932
3	811	19,990	429	1,523	22,797	-	-	68	13,587	59,205
4	811	19,990	429	1,523	22,797	-	-	68	13,587	59,205
5	811	19,990	429	76	22,797	-	-	68	5,435	49,606
6	8,113	12,688	4,293	76	26,946	-	606	68	13,587	66,377
7	8,113	12,688	4,293	76	26,946	-	606	68	13,587	66,377
8	8,113	12,688	4,293	76	26,946	-	606	68	13,587	66,377
9	811	19,990	429	183	22,797	-	-	68	13,587	57,865
10	811	19,990	429	183	22,797	-	-	68	13,587	57,865
11	811	19,990	429	183	22,797	-	-	68	13,587	57,865
12	811	19,990	429	-	22,797	-	-	68	5,435	49,530
13	10,354**	16,198**	4,206***	76	28,565**	2,161	606	68	13,587	75,821
14	10,354**	16,198**	4,206***	76	28,565**	2,161	606	68	13,587	75,821
15	10,354**	16,198**	4,206***	76	28,565**	0***	606	68	13,587	73,660

***The values presented are for an evacuation of the full EPZ (Region R03).**

****The peak construction year is currently estimated at 2019. The permanent resident population and shadow population have been extrapolated to 2019 using the estimated average yearly percentage growth rates presented in Section 3.**
*****As noted in Section 3.6, the outage vehicles have been included with the Salem/Hope Creek employees so as to use the traffic volumes measured as part of the Traffic Impact Analysis (TIA) study included in the Environmental Report.**

7. GENERAL POPULATION EVACUATION TIME ESTIMATES (ETE)

This section presents the current results of the computer analyses using the IDYNEV System described in Appendices B, C and D. These results cover 17 regions within the PSEG Site EPZ and the 15 Evacuation Scenarios discussed in Section 6.

The ETE for all Evacuation Cases are presented in Tables 7-1A through 7-1D. **These tables present the estimated times to clear the indicated population percentages from the Evacuation Regions for all Evacuation Scenarios.** Table 7-2 defines the Evacuation Regions considered. The tabulated values of ETE are obtained by interpolating the PC-DYNEV simulation model outputs which are generated at 10-minute intervals, then rounding these data to the nearest 5 minutes.

7.1 Voluntary Evacuation and Shadow Evacuation

We define “voluntary evacuees” as people who are within the EPZ in ERPAs for which an Advisory to Evacuate *has not* been issued, yet who nevertheless elect to evacuate. We define “shadow evacuation” as the movement of people from areas *outside* the EPZ for whom no protective action recommendation has been issued. Both voluntary and shadow evacuations are assumed to take place over the same time frame as the evacuation from within the impacted Evacuation Region.

The ETE for the PSEG Site addresses the issue of voluntary evacuees in the manner shown in Figure 7-1. Within the circle defined by the farthest radial distance of the Evacuation Region, 50 percent of those people located in ERPAs not advised to evacuate, are assumed to do so. Within the annular ring extending from the furthest distance of the Evacuation Region (if less than 10 miles), to the EPZ boundary, it is assumed that 35 percent of the people located there will elect to evacuate.

Figure 7-2 presents the area identified as the Shadow Evacuation Region. This region extends radially from the plant to cover a region between the EPZ boundary and approximately 15 miles. The population and number of evacuating vehicles in the Shadow Evacuation Region were estimated using the same methodology that was used for permanent residents within the EPZ (see page 3-2). It is estimated that 160,741 people reside in the Shadow Evacuation Region and that they will evacuate in 74,285 vehicles.

Traffic generated within this Shadow Evacuation Region, traveling away from the PSEG Site location, has a potential for impeding evacuating vehicles from within the Evacuation Region. We assume that the traffic volumes emitted within the Shadow Evacuation Region correspond to 30 percent of the residents there plus a proportionate number of employees in that region, as noted in the Shadow footnote to Table 6-3. **All ETE calculations include this shadow traffic movement.**

7.2 Patterns of Traffic Congestion During Evacuation

Figures 7-3 through 7-5 illustrate the patterns of traffic congestion that arise for the case when the entire EPZ (Region R03) is advised to evacuate during the winter, midweek, midday period under good weather conditions (Scenario 6).

Traffic congestion, as the term is used here, is defined as Level of Service (LOS) F. LOS F is defined as follows (2000 HCM):

> Level of Service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount that can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go waves, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level of Service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of vehicles or pedestrians discharged from the queue may be quite good. Nevertheless, it is the point at which arrival flow exceeds discharge flow, which causes the queue to form, and Level of Service F is an appropriate designation for such points.

This definition is general and conceptual in nature, and applies primarily to uninterrupted flow. Levels of Service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them.

All highway "links" which experience LOS F are delineated in these Figures by a red line; all others are lightly indicated. Congestion develops rapidly around concentrations of population and traffic bottlenecks. Residents of Salem City, NJ are limited to two evacuation routes – State Route 45 and State Route 49. Many of the employees at the three operational units at the PSEG Site also evacuate through Salem City. Each of these routes are a single lane in each direction with several signalized intersections within the city, and do not provide sufficient capacity to service evacuees traveling through Salem. Thus, these routes are congested for several hours after the Advisory to Evacuate (ATE) as shown in Figures 7-3 through 7-5. Middletown, DE, while more populated than Salem City, has several evacuation routes available – US Route 301, Delaware Route 71, US Route 13, and Delaware Route 1. The additional evacuation route capacity in Middletown allows congestion to dissipate quicker than in Salem City as shown in Figure 7-5.

Figure 7-3 presents the congestion pattern one hour after the ATE. Route 49 westbound through Salem City is congested, especially at the intersections with Route 45 and with Front Street. Congestion is also experienced at the signalized intersection of Route 49 and Hook Rd (County Route 551) as many evacuees will make a right turn to access Hook Rd and bypass Pennsville. Many of the routes leading out of Middletown are congested at one hour after the ATE. Congestion develops westbound on Route 299 at the signalized intersection with Route 301. Congestion also develops southbound on Route 71 at the signalized intersections with Route 299 in Middletown and with Main Street/Pine Tree Rd in Townsend as some Middletown evacuees are using Route 71 southbound to evacuate. Route 301 northbound is congested from Middletown to the signalized intersection with Route 896, where the road widens from a single lane in each direction to 2 lanes in each direction. After the road widens, there is sufficient available capacity and congestion dissipates. There is also congestion observed on Route 13 and Route 1 northbound and southbound in Delaware; however, the majority of this congestion is outside of the EPZ.

As shown in Figure 7-4, congestion patterns are similar at 2 hours after the ATE. Congestion persists within Salem City. Congestion is also observed eastbound along Route 45 approaching Woodstown; however, this congestion is outside the EPZ. Congestion along Route 299 in Middletown is beginning to clear. Congestion is still observed northbound on Route 301 and southbound on Route 71.

Figure 7-5 indicates that all of the congestion in the Delaware portion of the EPZ has cleared except for northbound Route 301 at the intersection with Route 896. This congestion clears at about 2 hours and 45 minutes after the ATE. Congestion also persists within Salem City; this congestion dissipates at 2 hours and 50 minutes after the ATE.

Most of the congestion in the EPZ has dissipated by 2 hours 30 minutes after the ATE, as seen in Figure 7-5. The absence of congestion on network links implies that traffic demand there has decreased below the roadway capacity for a period of time sufficient to dissipate any traffic queues. It does not imply that traffic has completely cleared from these roadway sections.

The congestion clears before the trip generation time of 6 hours (See Section 5); thus, the ETE for the 100th percentile evacuation is dictated by the trip generation time. **The 90th percentile ETE should be considered when making protective action decisions, in order to avoid the long tail of the 100th percentile ETE.** This observation is consistent with the findings of NUREG/CR-6953, Volume 2. The use of a public outreach (information) program to emphasize the need for evacuees to minimize the time needed to prepare to evacuate (secure the home, assemble needed clothes, medicines, etc.) should also be considered.

Table 7-3 provides a description of each congestion point identified in Figures 7-3 through 7-5, including the link (up node and down node combination) where congestion is observed. The average delay per vehicle at the identified congestion points during the designated times following the advisory to evacuate is also provided in Table 7-3. The delay is measured in minutes and is the delay observed over the previous simulation period of ten minutes. For example, congestion point #1 experiences 9.0 minutes of delay per vehicle at 1 hour after the ATE. This means that during the ten minutes of simulation from 50 minutes to 1 hour after the ATE, vehicles on link (901,148) experience 9.0 minutes of delay, on average.

7.3 Evacuation Rates

Evacuation is a continuous process, as implied by Figures 7-3 through 7-5. Another format for displaying the dynamics of evacuation is depicted in Figure 7-6. This plot indicates the rate at which traffic flows out of the indicated areas for the case of an evacuation of the full EPZ (Region R03) under the indicated conditions. Appendix J presents these plots for all Evacuation Scenarios for Region R03.

As indicated in Figure 7-6, there is typically a long "tail" to these distributions. Vehicles evacuate an area slowly at the beginning, as people respond to the Advisory to Evacuate at different rates. Then traffic demand builds rapidly (slopes of curves increase). When the system becomes congested, traffic exits the EPZ at rates somewhat below capacity until some evacuation routes have cleared. As more routes clear, the aggregate rate of egress slows since many vehicles have already left the EPZ. Towards the end of the process, relatively few evacuation routes service the remaining demand.

This decline in aggregate flow rate, towards the end of the process, is characterized by these curves flattening and gradually becoming horizontal. Ideally, it would be desirable to fully saturate all evacuation routes equally so that all will service traffic near capacity levels and all will clear at the same time. For this ideal situation, all curves would retain the same slope until the end – thus minimizing evacuation time. In reality, this ideal is generally unattainable reflecting the variation in population density and in highway capacity over the EPZ.

Comparison of Scenarios 13 and 14 in Tables 7-1B and 7-1C indicates that the proposed causeway reduces ETE at the 90th and 95th percentiles for the 2-mile and 5-mile Regions (Region R01 and R02). The proposed causeway provides additional capacity which enables these regions to evacuate more efficiently. Note, however, that the ETE for the full EPZ (Region R03) is unaffected. The aforementioned bottlenecks in Salem City dictate the ETE for Region R03 at the 90th and 95th percentiles. The proposed causeway moves traffic to Salem City more quickly; however, the bottlenecks within the city still exist and ETE are unchanged. Appendix N discusses the benefits of the proposed causeway in more detail.

Comparison of ETE for Regions R01, R02 and R03 present anomalies at the 50th, 90th and 95th percentiles wherein ETE for Regions R02 and R03 are less than those for Region R01, contrary to what one may expect. These anomalies are a result of the differing number of evacuating vehicles for each Region. As shown in Table 7-2, the 5-mile region includes ERPAs 1, 8, A and D, while the 2-mile region includes ERPAs 1, 8 and D. According to the output files for Scenario 6, there are 18,783 vehicles evacuating for Region R02 and 2,002 vehicles evacuating for Region R01. Suppose that 100 vehicles are delayed due to congestion along the access road within the 2-mile region. These 100 vehicles constitute 5% (100 ÷ 2,002) of the evacuating vehicles for Region R01, while they only constitute 0.5% (100 ÷ 18,783) of the evacuating vehicles for Region R02. Thus, these 100 vehicles could impact the 95th percentile ETE for Region

R01, whereas they would have no effect on Region R02. This anomaly explains why ETE for Region R02 and R03 are less than those for Region R01 for certain scenarios and percentiles. Note, however, that this anomaly does not exist at the 100th percentile.

7.4 Guidance on Using ETE Tables

Tables 7-1A through 7-1D present the ETE values for all 17 Evacuation Regions and all 15 Evacuation Scenarios. They are organized as follows:

Table	Contents
7-1A	ETE represents the elapsed time required for **50** percent of the population within a Region, to evacuate from that Region.
7-1B	ETE represents the elapsed time required for **90** percent of the population within a Region, to evacuate from that Region.
7-1C	ETE represents the elapsed time required for **95** percent of the population within a Region, to evacuate from that Region.
7-1D	ETE represents the elapsed time required for **100** percent of the population within a Region, to evacuate from that Region.

The user first determines the percentile of population for which the ETE is sought. The applicable value of ETE within the chosen Table may then be identified using the following procedure:

1. Identify the applicable **Scenario**:
   - Season
     - Summer
     - Winter (also Autumn and Spring)
   - Day of Week
     - Midweek
     - Weekend
   - Time of Day
     - Midday
     - Evening
   - Weather Condition
     - Good Weather
     - Rain
     - Snow
   - Special Event
     - New Plant Construction + Refueling

While these Scenarios are designed, in aggregate, to represent conditions throughout the year, some further clarification is warranted:

- The conditions of a summer evening (either midweek or weekend) and rain are not explicitly identified in Tables 7-1A through 7-1D. For these conditions, Scenario (4) applies.
- The conditions of a winter evening (either midweek or weekend) and rain are not explicitly identified in Tables 7-1A through 7-1D. For these conditions, Scenarios (7) and (10) for rain apply.
- The conditions of a winter evening (either midweek or weekend) and snow are not explicitly identified in Tables 7-1A through 7-1D. For these conditions, Scenarios (8) and (11) for snow apply.
- The seasons are defined as follows:
  - Summer assumes that public schools are *not* in session.
  - Winter, Spring and Autumn imply that public schools *are* in session.
- Time of Day: Midday implies the time over which most commuters are at work.

2. With the Scenario identified, now identify the **Evacuation Region**:
   - Determine the projected azimuth direction of the plume (coincident with the wind direction). This direction is expressed in terms of compass orientation: *towards* N, NNE, NE, …
   - Determine the distance that the Evacuation Region will extend from the PSEG Site. The applicable distances and their associated candidate Regions are given below:
     - 2 Miles (Region R01)
     - 5 Miles (Region R02)
     - to EPZ Boundary (Regions R03 through R17)
   - Enter Table 7-2 and identify the applicable group of candidate Regions based on the distance that the selected Region extends from the PSEG Site. Select the Evacuation Region identifier in that row from the first column of the Table.

3. Determine the **ETE for the Scenario** identified in Step 1 and the Region identified in Step 2, as follows:
   - The columns of Table 7-1 are labeled with the Scenario numbers. Identify the proper column in the selected Table using the Scenario number determined in Step 1.
   - Identify the row in this table that provides ETE values for the Region identified in Step 2.
   - The unique data cell defined by the column and row so determined contains the desired value of ETE expressed in Hours:Minutes.

Example

It is desired to identify the ETE for the following conditions:

- Sunday, August 10th at 4:00 AM.
- It is raining.
- Wind direction is *toward* the northeast (NE).
- Wind speed is such that the distance to be evacuated is judged to be a 5-mile radius and downwind to 10 miles (to EPZ boundary).
- The desired ETE is that value needed to evacuate 90 percent of the population from within the impacted Region.

Table 7-1B is applicable because the 90th-percentile population is desired. Proceed as follows:

1. Identify the Scenario as summer, weekend, evening and raining. Entering Table 7-1B, it is seen that there is no match for these descriptors. However, the clarification given above assigns this combination of circumstances to Scenario 4.

2. Enter Table 7-2 and locate the Region described as “5-Mile Ring and Downwind to EPZ boundary” for wind direction toward the NE and read REGION R06 in the first column of that row.

3. Enter Table 7-1B to locate the data cell containing the value of ETE for Scenario 4 and Region R06. This data cell is in column (4) and in the row for Region R06; it contains the ETE value of **1:50**.

Table 7-1A. Time to Clear the Indicated Area of _50_ Percent of The Affected Population

	Summer		Summer		Summer		Winter			Winter			Winter		Winter		
	Midweek		Weekend		Midweek Weekend		Midweek			Weekend			Midweek Weekend		Midweek		
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario:	(13)	(14)	(15)
	Midday		Midday		Evening		Midday			Midday			Evening		Midday		
Region Wind Toward:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Toward:	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Region Wind Toward:	New Plant Construction + Refueling	Proposed Causeway	Refueling Only
Entire 2-Mile Region, 5-Mile Region, and EPZ																	
R01 2-mile ring	0:55	0:55	0:55	0:55	0:55	R01 2-mile ring	0:55	0:55	1:05	0:55	0:55	1:20	0:55	R01 2-mile ring	1:25	1:00	0:55
R02 5-mile ring	0:55	0:55	0:50	0:55	0:55	R02 5-mile ring	0:55	0:55	1:05	0:50	0:55	1:05	0:55	R02 5-mile ring	1:00	0:55	0:55
R03 Entire EPZ	1:10	1:15	1:05	1:10	1:05	R03 Entire EPZ	1:10	1:15	1:30	1:05	1:10	1:25	1:05	R03 Entire EPZ	1:20	1:20	1:20
5-Mile Ring and Downwind to EPZ Boundary																	
R04 NNW	1:05	1:10	1:00	1:05	1:00	R04 NNW	1:05	1:10	1:25	1:00	1:05	1:15	1:00	R04 NNW	1:15	1:15	1:10
R05 N	1:05	1:10	1:00	1:05	1:00	R05 N	1:05	1:10	1:20	1:00	1:05	1:15	1:00	R05 N	1:15	1:15	1:10
R06 NNE, NE	1:00	1:05	0:55	1:00	0:55	R06 NNE, NE	1:00	1:05	1:15	0:55	1:00	1:10	0:55	R06 NNE, NE	1:05	1:05	1:00
R07 ENE	1:00	1:05	0:55	1:00	0:55	R07 ENE	1:00	1:05	1:15	0:55	1:00	1:10	0:55	R07 ENE	1:05	1:05	1:00
R08 E, ESE	0:55	1:00	0:55	0:55	0:55	R08 E, ESE	0:55	1:00	1:10	0:55	0:55	1:05	0:55	R08 E, ESE	1:00	1:00	0:55
R09 SE	0:55	1:00	0:55	0:55	0:55	R09 SE	0:55	1:00	1:05	0:55	0:55	1:05	0:55	R09 SE	1:00	0:55	0:55
R10 SSE	1:00	1:05	1:00	1:00	1:00	R10 SSE	1:05	1:05	1:20	1:00	1:00	1:15	1:00	R10 SSE	1:10	1:05	1:05
R11 S, SSW, SW	1:00	1:05	1:00	1:00	1:00	R11 S, SSW, SW	1:05	1:05	1:20	1:00	1:00	1:15	1:00	R11 S, SSW, SW	1:10	1:05	1:05
R12 W, WSW, WNW	1:10	1:10	1:05	1:10	1:05	R12 W, WSW, WNW	1:10	1:15	1:25	1:05	1:10	1:25	1:05	R12 W, WSW, WNW	1:20	1:15	1:20
R13 NW	1:05	1:05	1:00	1:00	1:00	R13 NW	1:05	1:05	1:20	1:00	1:00	1:15	1:00	R13 NW	1:10	1:10	1:10
2-Mile Ring and Downwind to EPZ Boundary																	
R14 NNE, NE	1:10	1:15	1:00	1:05	1:05	R14 NNE, NE	1:10	1:15	1:30	1:00	1:05	1:25	1:05	R14 NNE, NE	1:25	1:20	1:10
R15 ENE	1:10	1:10	1:00	1:00	1:00	R15 ENE	1:10	1:15	1:25	1:00	1:00	1:20	1:00	R15 ENE	1:20	1:20	1:10
R16 E, ESE	1:00	1:05	0:55	0:55	0:55	R16 E, ESE	1:00	1:05	1:15	0:55	0:55	1:15	0:55	R16 E, ESE	1:15	1:05	1:00
R17 SE	1:00	1:00	0:55	0:55	0:55	R17 SE	1:00	1:00	1:10	0:55	0:55	1:25	0:55	R17 SE	1:25	1:00	1:00

Table 7-1B. Time to Clear the Indicated Area of _90_ Percent of The Affected Population

	Summer		Summer		Summer		Winter			Winter			Winter		Winter		
	Midweek		Weekend		Midweek Weekend		Midweek			Weekend			Midweek Weekend		Midweek		
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario:	(13)	(14)	(15)
	Midday		Midday		Evening		Midday			Midday			Evening		Midday		
Region Wind Toward:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Toward:	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Region Wind Toward:	New Plant Construction + Refueling	Proposed Causeway	Refueling Only
Entire 2-Mile Region, 5-Mile Region, and EPZ																	
R01 2-mile ring	1:50	1:50	1:45	1:45	1:45	R01 2-mile ring	1:50	1:50	2:05	1:45	1:45	2:40	1:45	R01 2-mile ring	2:25	1:45	1:50
R02 5-mile ring	1:35	1:45	1:35	1:40	1:35	R02 5-mile ring	1:35	1:45	2:10	1:35	1:40	2:00	1:35	R02 5-mile ring	1:50	1:40	1:40
R03 Entire EPZ	2:15	2:25	2:00	2:10	2:00	R03 Entire EPZ	2:15	2:25	2:55	2:00	2:10	2:40	2:00	R03 Entire EPZ	2:45	2:45	2:40
5-Mile Ring and Downwind to EPZ Boundary																	
R04 NNW	2:10	2:15	1:50	2:00	1:55	R04 NNW	2:10	2:15	2:50	1:50	1:55	2:30	1:55	R04 NNW	2:35	2:35	2:30
R05 N	2:10	2:15	1:50	2:00	1:55	R05 N	2:10	2:15	2:50	1:50	1:55	2:30	1:55	R05 N	2:35	2:35	2:30
R06 NNE, NE	2:00	2:05	1:40	1:50	1:45	R06 NNE, NE	2:00	2:05	2:35	1:40	1:45	2:15	1:45	R06 NNE, NE	2:15	2:15	2:00
R07 ENE	1:55	2:00	1:40	1:45	1:40	R07 ENE	1:55	2:00	2:30	1:35	1:45	2:15	1:40	R07 ENE	2:15	2:15	1:55
R08 E, ESE	1:40	1:50	1:35	1:40	1:40	R08 E, ESE	1:40	1:50	2:15	1:35	1:40	2:05	1:40	R08 E, ESE	1:55	1:45	1:45
R09 SE	1:40	1:45	1:35	1:40	1:35	R09 SE	1:40	1:45	2:10	1:35	1:40	2:05	1:35	R09 SE	1:50	1:40	1:40
R10 SSE	2:00	2:10	1:50	2:00	1:50	R10 SSE	2:00	2:10	2:45	1:50	2:00	2:30	1:50	R10 SSE	2:20	2:15	2:15
R11 S, SSW, SW	2:00	2:10	1:50	2:00	1:50	R11 S, SSW, SW	2:00	2:10	2:45	1:50	2:00	2:30	1:50	R11 S, SSW, SW	2:20	2:15	2:15
R12 W, WSW, WNW	2:10	2:20	2:00	2:10	2:00	R12 W, WSW, WNW	2:10	2:20	2:55	2:00	2:10	2:40	2:00	R12 W, WSW, WNW	2:40	2:40	2:40
R13 NW	2:00	2:05	1:50	1:55	1:50	R13 NW	2:00	2:05	2:40	1:45	1:55	2:25	1:50	R13 NW	2:30	2:30	2:30
2-Mile Ring and Downwind to EPZ Boundary																	
R14 NNE, NE	2:25	2:35	1:55	2:05	2:00	R14 NNE, NE	2:30	2:35	3:05	1:55	2:05	2:40	2:00	R14 NNE, NE	2:45	2:45	2:25
R15 ENE	2:15	2:25	1:50	2:00	1:55	R15 ENE	2:20	2:25	2:55	1:50	1:55	2:40	1:55	R15 ENE	2:40	2:40	2:15
R16 E, ESE	2:00	2:00	1:40	1:40	1:50	R16 E, ESE	2:00	2:00	2:40	1:40	1:45	2:30	1:50	R16 E, ESE	2:25	1:55	2:05
R17 SE	2:00	2:00	1:50	1:50	1:55	R17 SE	2:00	2:00	2:30	1:55	1:55	2:45	1:50	R17 SE	2:25	1:50	2:00

Table 7-1C. Time to Clear the Indicated Area of *95* Percent of The Affected Population

Scenario:	(1)	(2)	(3)	(4)	(5)
	Summer		Summer		Summer
	Midweek		Weekend		Midweek Weekend
	Midday		Midday		Evening
Region Wind Toward:	Good Weather	Rain	Good Weather	Rain	Good Weather
Entire 2-Mile Region, 5-Mile Region, and EPZ					
R01 2-mile ring	2:05	2:05	2:05	2:05	2:05
R02 5-mile ring	1:50	2:00	1:40	1:50	1:50
R03 Entire EPZ	2:35	2:40	2:15	2:25	2:20
5-Mile Ring and Downwind to EPZ Boundary					
R04 NNW	2:30	2:35	2:05	2:15	2:15
R05 N	2:30	2:35	2:05	2:10	2:15
R06 NNE, NE	2:25	2:30	1:55	2:05	2:05
R07 ENE	2:20	2:25	1:50	2:00	2:00
R08 E, ESE	2:00	2:05	1:45	1:55	1:55
R09 SE	1:55	2:00	1:45	1:55	1:50
R10 SSE	2:25	2:30	2:05	2:15	2:10
R11 S, SSW, SW	2:20	2:30	2:05	2:15	2:10
R12 W, WSW, WNW	2:30	2:35	2:15	2:25	2:20
R13 NW	2:25	2:25	2:05	2:10	2:10
2-Mile Ring and Downwind to EPZ Boundary					
R14 NNE, NE	2:45	2:50	2:10	2:20	2:15
R15 ENE	2:30	2:40	2:10	2:15	2:15
R16 E, ESE	2:25	2:25	2:05	2:05	2:15
R17 SE	2:20	2:20	2:10	2:15	2:15

Scenario:	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Winter			Winter			Winter
	Midweek			Weekend			Midweek Weekend
	Midday			Midday			Evening
Region Wind Toward:	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather
Entire 2-Mile Region, 5-Mile Region, and EPZ							
R01 2-mile ring	2:05	2:05	2:40	2:05	2:05	2:55	2:05
R02 5-mile ring	1:50	2:00	2:30	1:40	1:50	2:20	1:50
R03 Entire EPZ	2:35	2:45	3:25	2:15	2:25	3:00	2:20
5-Mile Ring and Downwind to EPZ Boundary							
R04 NNW	2:30	2:35	3:20	2:05	2:10	2:55	2:15
R05 N	2:30	2:35	3:15	2:05	2:10	2:55	2:15
R06 NNE, NE	2:25	2:30	3:05	1:50	2:00	2:40	2:05
R07 ENE	2:20	2:25	3:00	1:50	2:00	2:35	2:00
R08 E, ESE	2:00	2:05	2:45	1:45	1:55	2:25	1:55
R09 SE	1:55	2:00	2:35	1:45	1:55	2:25	1:50
R10 SSE	2:25	2:30	3:10	2:05	2:15	2:50	2:10
R11 S, SSW, SW	2:20	2:30	3:05	2:05	2:15	2:50	2:10
R12 W, WSW, WNW	2:30	2:40	3:20	2:15	2:25	3:00	2:20
R13 NW	2:25	2:25	3:10	2:00	2:10	2:50	2:10
2-Mile Ring and Downwind to EPZ Boundary							
R14 NNE, NE	2:45	2:50	3:30	2:10	2:15	3:05	2:20
R15 ENE	2:35	2:40	3:20	2:10	2:15	3:05	2:15
R16 E, ESE	2:25	2:25	3:10	2:05	2:05	3:00	2:15
R17 SE	2:20	2:20	3:00	2:15	2:15	3:00	2:15

Scenario:	(13)	(14)	(15)
	Winter		
	Midweek		
	Midday		
Region Wind Toward:	New Plant Construction + Refueling	Proposed Causeway	Refueling Only
Entire 2-Mile Region, 5-Mile Region, and EPZ			
R01 2-mile ring	2:35	1:55	2:05
R02 5-mile ring	2:15	1:50	1:55
R03 Entire EPZ	3:05	3:05	3:05
5-Mile Ring and Downwind to EPZ Boundary			
R04 NNW	3:00	3:00	2:55
R05 N	3:00	3:00	2:55
R06 NNE, NE	2:45	2:45	2:25
R07 ENE	2:40	2:40	2:20
R08 E, ESE	2:20	2:05	2:05
R09 SE	2:15	1:55	2:00
R10 SSE	2:35	2:35	2:35
R11 S, SSW, SW	2:35	2:35	2:35
R12 W, WSW, WNW	3:05	3:05	3:05
R13 NW	2:55	2:55	2:55
2-Mile Ring and Downwind to EPZ Boundary			
R14 NNE, NE	3:05	3:05	2:40
R15 ENE	2:55	2:55	2:30
R16 E, ESE	2:35	2:15	2:30
R17 SE	2:35	2:05	2:25

Table 7-1D. Time to Clear the Indicated Area of *100* Percent of The Affected Population

	Summer		Summer		Summer		Winter			Winter			Winter		Winter		
	Midweek		Weekend		Midweek Weekend		Midweek			Weekend			Midweek Weekend		Midweek		
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario:	(13)	(14)	(15)
	Midday		Midday		Evening		Midday			Midday			Evening		Midday		
Region Wind Toward:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Toward:	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Region Wind Toward:	New Plant Construction + Refueling	Proposed Causeway	Refueling Only
Entire 2-Mile Region, 5-Mile Region, and EPZ																	
R01 2-mile ring	4:00	4:05	3:10	3:10	3:10	R01 2-mile ring	4:00	4:05	5:10	3:10	3:10	4:10	3:10	R01 2-mile ring	4:00	4:00	4:00
R02 5-mile ring	4:10	4:10	4:10	4:10	4:10	R02 5-mile ring	4:10	4:10	5:10	4:10	4:10	5:10	4:10	R02 5-mile ring	4:10	4:10	4:10
R03 Entire EPZ	6:10	6:10	6:00	6:00	6:00	R03 Entire EPZ	6:10	6:15	6:15	6:00	6:00	6:00	6:00	R03 Entire EPZ	6:10	6:10	6:10
5-Mile Ring and Downwind to EPZ Boundary																	
R04 NNW	6:05	6:10	4:10	4:10	4:10	R04 NNW	6:05	6:10	6:10	4:10	4:20	5:10	4:10	R04 NNW	6:10	6:10	6:10
R05 N	6:05	6:05	4:10	4:10	4:10	R05 N	6:05	6:10	6:10	4:10	4:20	5:10	4:10	R05 N	6:10	6:10	6:10
R06 NNE, NE	6:00	6:00	4:10	4:10	4:10	R06 NNE, NE	6:10	6:10	6:10	4:10	4:10	5:10	4:10	R06 NNE, NE	6:10	6:10	6:00
R07 ENE	6:00	6:00	4:10	4:10	4:10	R07 ENE	6:00	6:10	6:10	4:10	4:10	5:10	4:10	R07 ENE	6:00	6:00	6:00
R08 E, ESE	4:10	4:10	4:10	4:10	4:10	R08 E, ESE	4:10	4:10	5:10	4:10	4:10	5:10	4:10	R08 E, ESE	4:10	4:10	4:10
R09 SE	4:10	4:10	4:10	4:10	4:10	R09 SE	4:10	4:10	5:10	4:10	4:10	5:10	4:10	R09 SE	4:10	4:10	4:10
R10 SSE	6:10	6:10	6:00	6:00	6:00	R10 SSE	6:10	6:10	6:10	6:00	6:00	6:00	6:00	R10 SSE	6:10	6:10	6:10
R11 S, SSW, SW	6:10	6:10	6:00	6:00	6:00	R11 S, SSW, SW	6:10	6:10	6:10	6:00	6:00	6:00	6:00	R11 S, SSW, SW	6:10	6:10	6:10
R12 W, WSW, WNW	6:10	6:10	6:00	6:00	6:00	R12 W, WSW, WNW	6:10	6:10	6:15	6:00	6:00	6:00	6:00	R12 W, WSW, WNW	6:10	6:10	6:10
R13 NW	6:00	6:05	4:10	4:10	4:10	R13 NW	6:00	6:05	6:10	4:10	4:15	5:10	4:10	R13 NW	6:10	6:10	6:10
2-Mile Ring and Downwind to EPZ Boundary																	
R14 NNE, NE	6:00	6:00	4:10	4:10	4:10	R14 NNE, NE	6:10	6:10	6:10	4:10	4:10	5:10	4:10	R14 NNE, NE	6:10	6:10	6:00
R15 ENE	6:00	6:00	4:10	4:10	4:10	R15 ENE	6:00	6:10	6:10	4:10	4:10	5:10	4:10	R15 ENE	6:00	6:00	6:00
R16 E, ESE	4:10	4:10	4:10	4:10	4:10	R16 E, ESE	4:10	4:10	5:10	4:10	4:10	5:00	4:10	R16 E, ESE	4:10	4:10	4:10
R17 SE	4:10	4:10	3:10	3:10	3:10	R17 SE	4:10	4:10	5:10	3:10	3:10	4:10	3:10	R17 SE	4:10	4:10	4:10

Table 7-2. Description of Evacuation Regions*

Region	Description	ERPA											
		New Jersey								Delaware			
		1	2	3	4	5	6	7	8	A	B	C	D
R01	2-Mile	x							x				x
R02	5-Mile	x							x	x			x
R03	Entire EPZ	x	x	x	x	x	x	x	x	x	x	x	x
5-Mile Ring and Downwind to EPZ Boundary													
Region	Wind Direction Towards:	ERPA											
		New Jersey								Delaware			
		1	2	3	4	5	6	7	8	A	B	C	D
R04	NNW	x		x		x			x	x		x	x
R05	N	x		x	x	x			x	x		x	x
R06	NNE, NE	x	x	x	x	x			x	x			x
R07	ENE	x	x	x	x		x		x	x			x
R08	E, ESE	x	x				x	x	x	x			x
R09	SE	x					x	x	x	x			x
R10	SSE	x						x	x	x	x		x
R11	S, SSW, SW	x							x	x	x		x
R12	WSW, W, WNW	x							x	x	x	x	x
R13	NW	x							x	x		x	x
2-Mile Ring and Downwind to EPZ Boundary													
Region	Wind Direction Towards:	ERPA											
		New Jersey								Delaware			
		1	2	3	4	5	6	7	8	A	B	C	D
R14	NNE, NE	x	x	x	x	x			x				x
R15	ENE	x	x	x	x		x		x				x
R16	E, ESE	x	x				x	x	x				x
R17	SE	x					x	x	x				x
N/A	NNW	Refer to Region R04											
	N	Refer to Region R05											
	SSE	Refer to Region R10											
	S, SSW, SW	Refer to Region R11											
	WSW, W, WNW	Refer to Region R12											
	NW	Refer to Region R13											
2-Mile Ring and Downwind to 5 Miles													
Region	Wind Direction Towards:	ERPA											
		New Jersey								Delaware			
		1	2	3	4	5	6	7	8	A	B	C	D
N/A	NNE, NE, ENE, E, ESE, SE	Refer to Region R01											
N/A	N, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW	Refer to Region R02											
x = ERPA EVACUATES		ERPA SHELTERS IN PLACE											

***Adapted from Region definitions in County/State Radiological Emergency Plans**

Table 7-3. Average Delay for Selected Roadways in the PSEG Site Analysis Network						
	Link			Average Delay per Vehicle (min/veh) at Indicated Time after the Advisory to Evacuate		
CP #	From Node	To Node	Roadway	1 Hour	2 Hours	2 Hours 30 Minutes
1	901	148	Route 299 Westbound approach to US 301	9.0	9.4	0.0
2	275	273	Route 49 Westbound approach to Route 45	1.2	0.6	0.4
3	350	276	Yorke St Eastbound approach to Route 49	10.0	4.5	0.0
4	866	141	Route 301 Northbound at Route 896	2.8	9.3	9.2
5	678	679	Route 71 Southbound at Main St/Pine Tree Rd	3.6	3.6	0.2
6	836	350	Salem-Hancocks Bridge Rd/Yorke St at Grieves Pkwy	9.6	4.8	0.0
7	833	272	Route 49 Westbound approach to Front St	0.0	0.0	0.0
8	446	272	Front St Eastbound approach to Route 49	2.4	2.4	2.2
9	266	265	Route 49 Westbound approach to Hook Rd	3.5	9.0	9.0
10	667	668	Route 71 Southbound to Route 299	3.5	0.0	0.0
11	410	411	W Main St Eastbound approach to Telegraph Rd (Alloway)	0.3	0.0	0.0
12	312	313	Route 45 Eastbound approach to Route 40 (Woodstown)	3.7	7.7	4.7

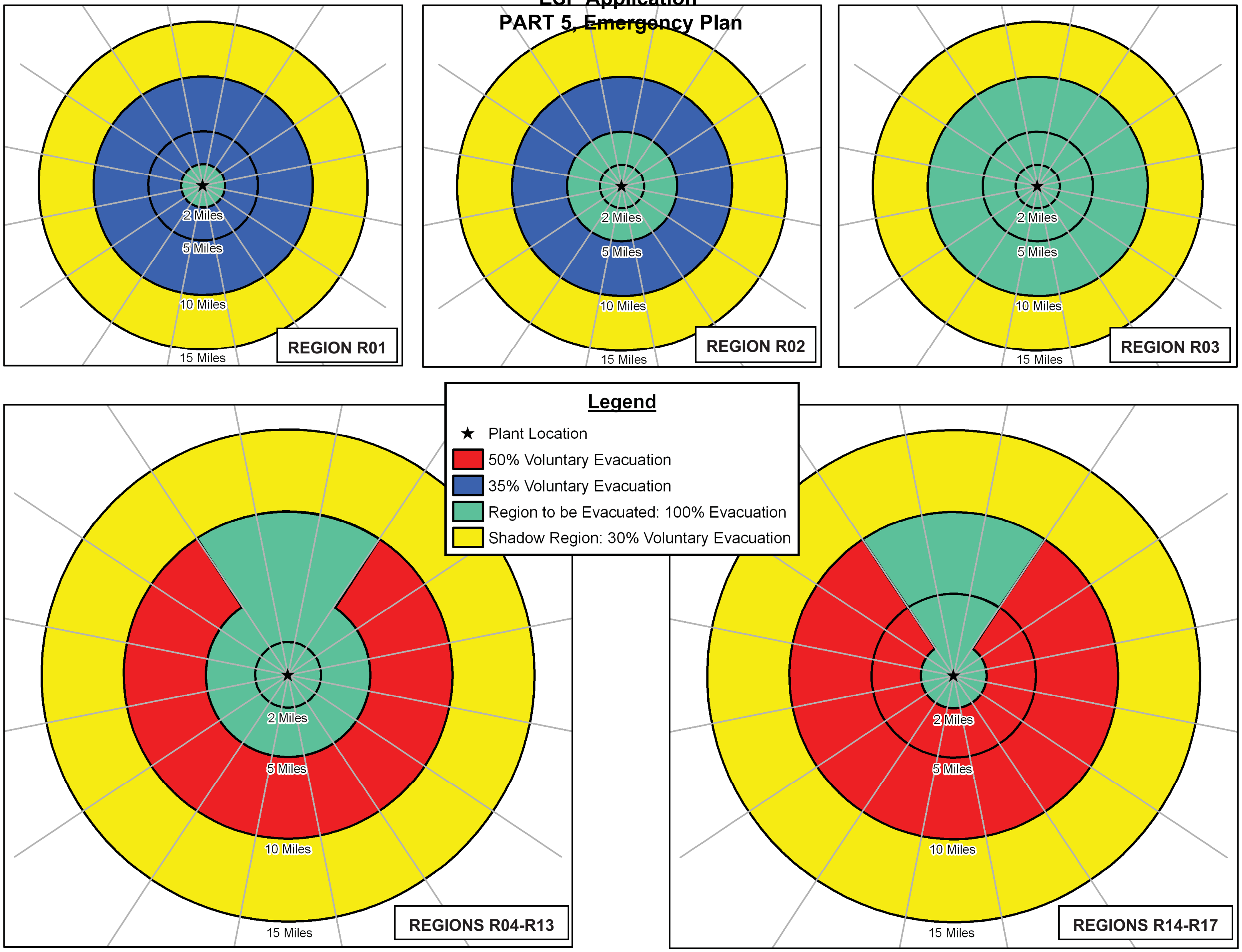


Figure 7-1. Voluntary Evacuation Methodology

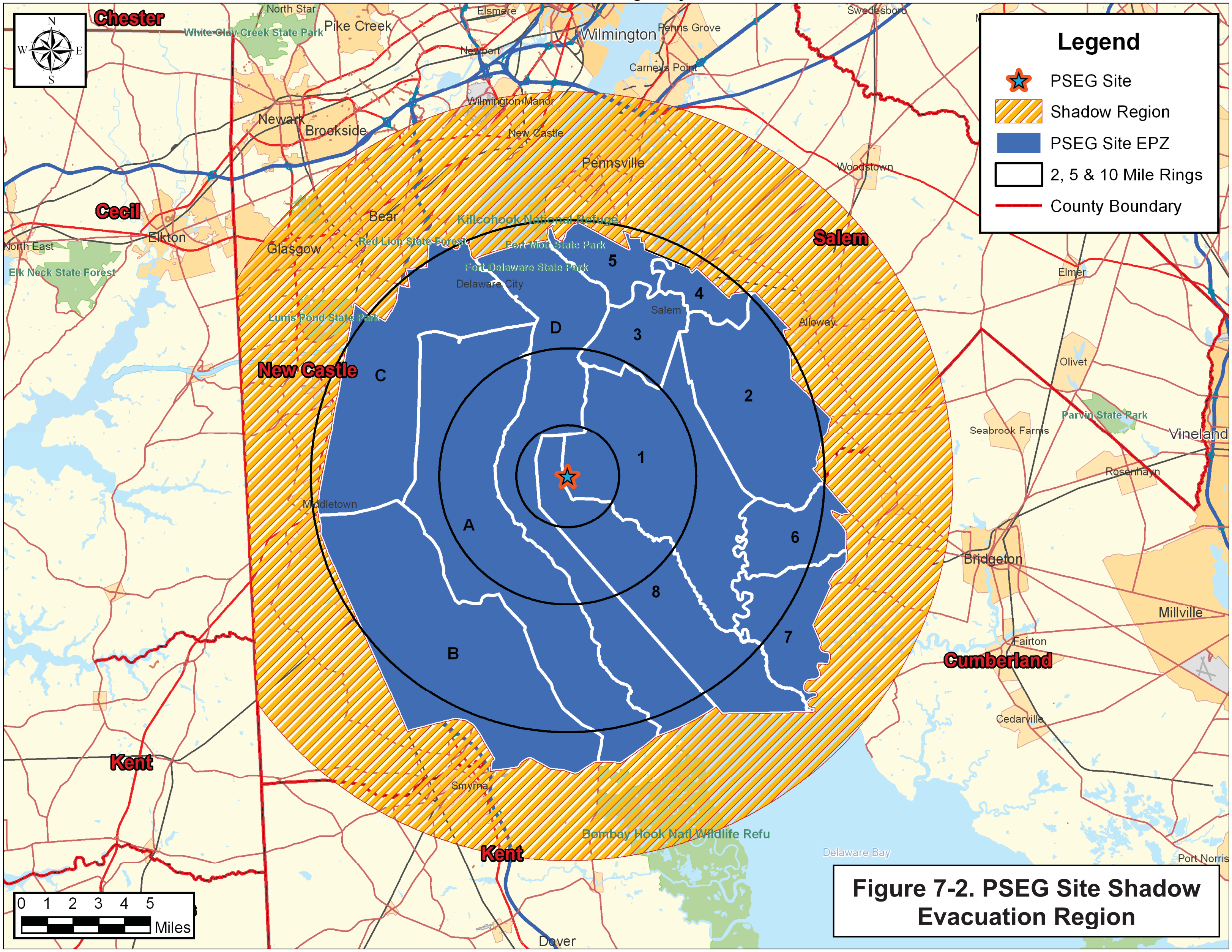


Figure 7-2. PSEG Site Shadow Evacuation Region

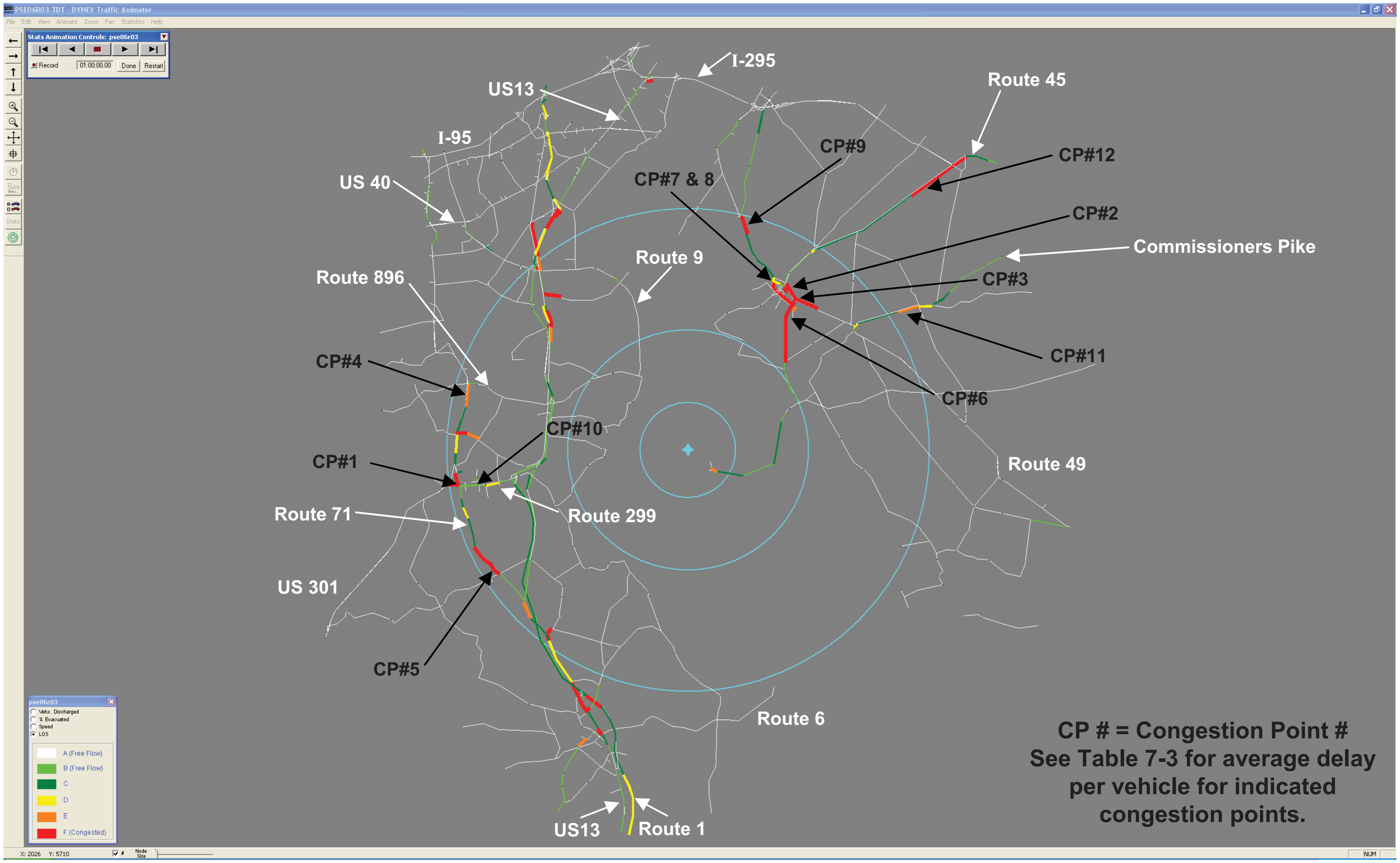


Figure 7-3. Areas of Traffic Congestion *1 Hour* after the Advisory to Evacuate (Scenario 6, Region R03)

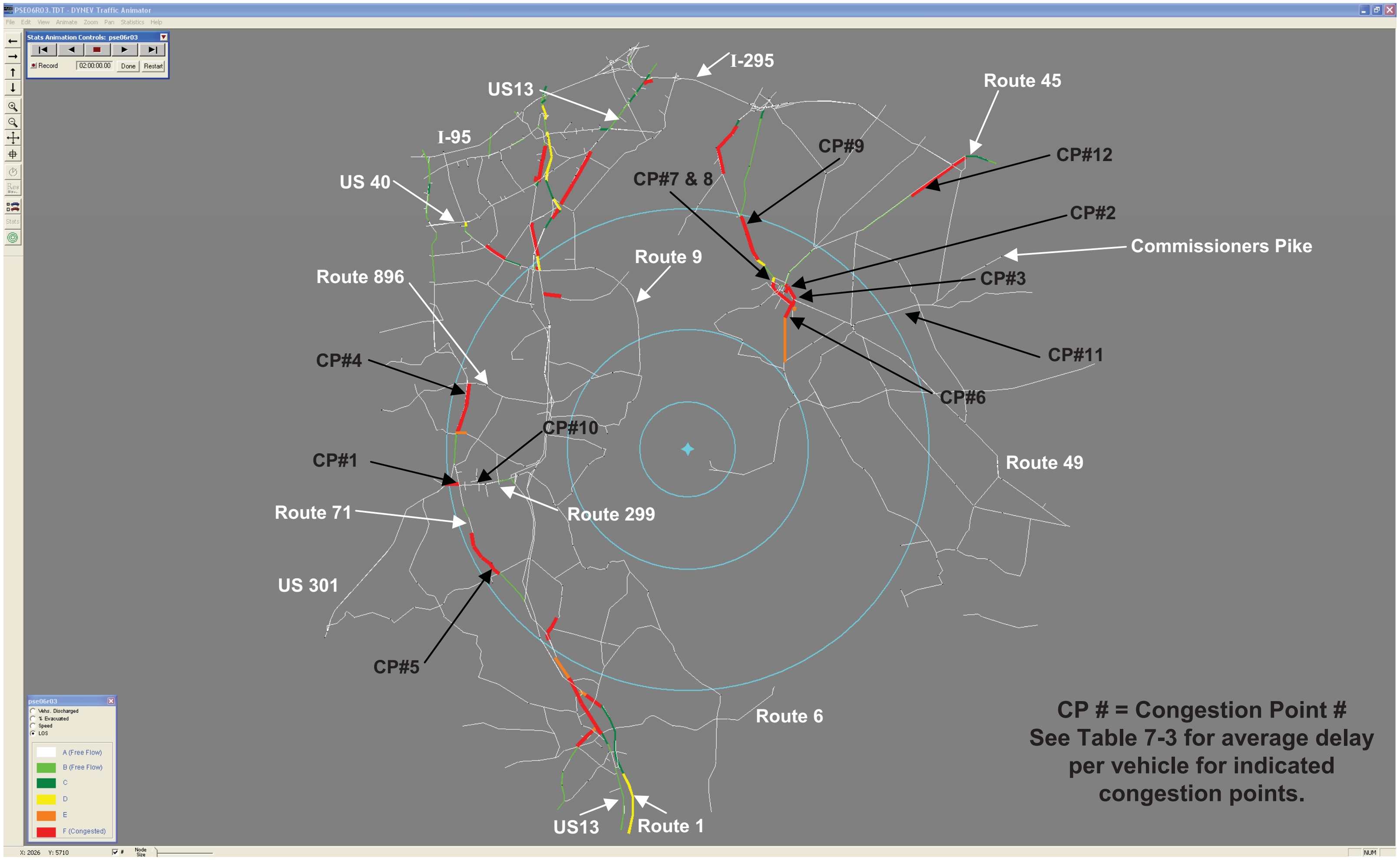


Figure 7-4. Areas of Traffic Congestion *2 Hours* after the Advisory to Evacuate (Scenario 6, Region R03)

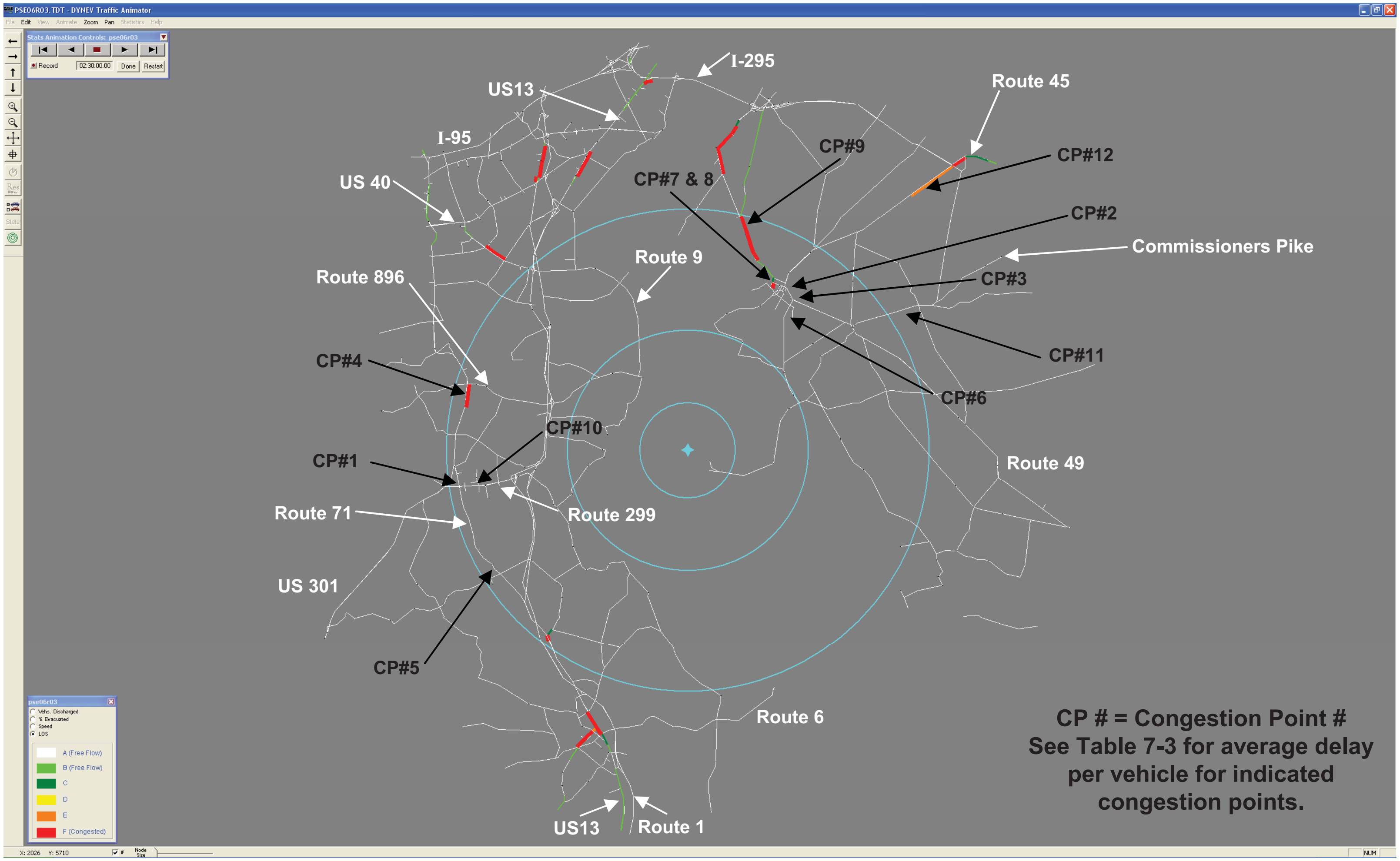


Figure 7-5. Areas of Traffic Congestion *2 Hours and 30 Minutes* after the Advisory to Evacuate (Scenario 6, Region R03)

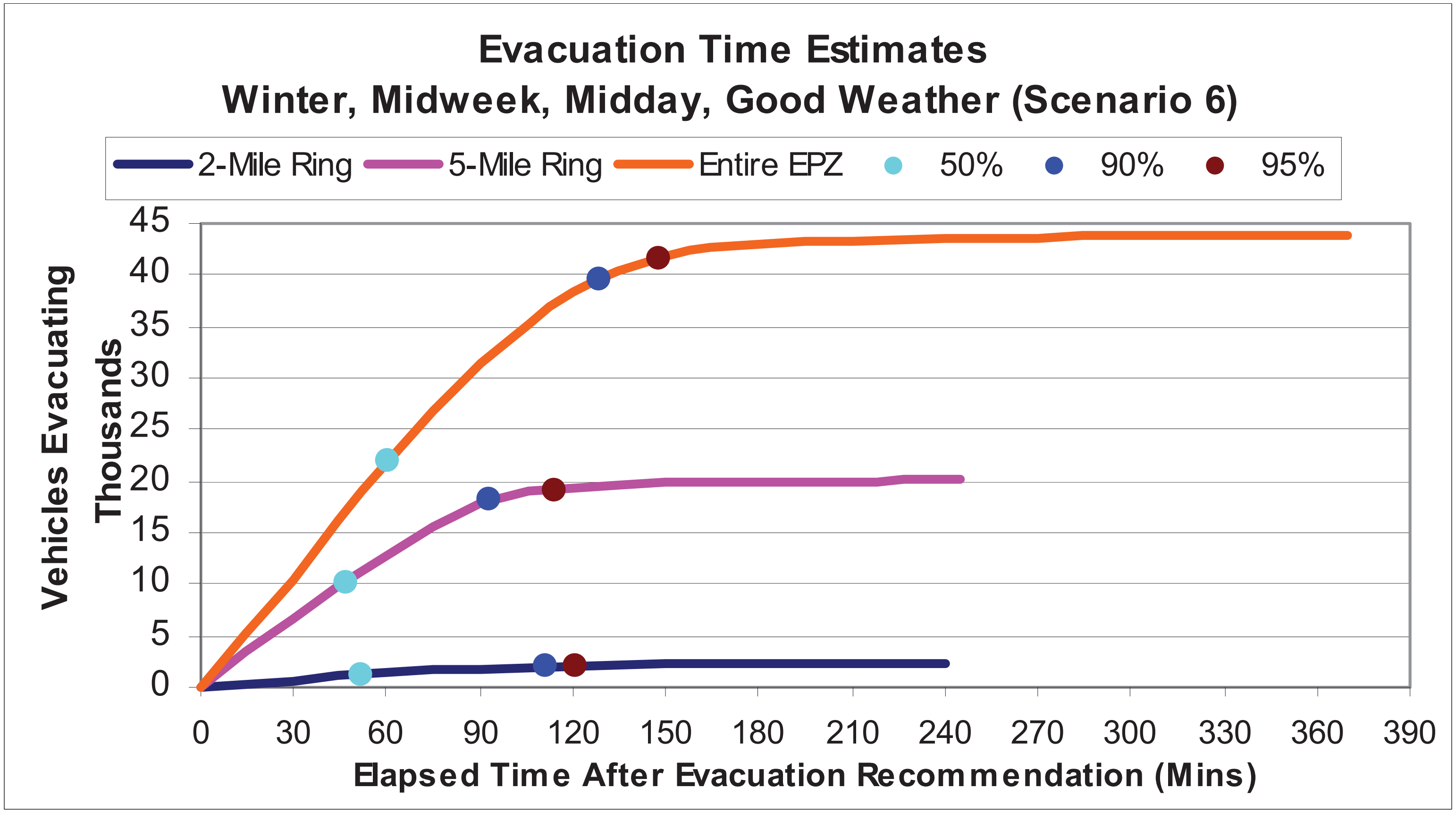


Figure 7-6. Evacuation Time Estimates for the PSEG Site Winter, Midweek, Midday, Good Weather, Evacuation of Region R03 (Entire EPZ)

8. TRANSIT-DEPENDENT AND SPECIAL FACILITY EVACUATION TIME ESTIMATES

This section details the analyses applied and the results obtained in the form of evacuation time estimates for transit vehicles (buses). The demand for transit service reflects the needs of two population groups: (1) residents with no vehicles available; and (2) residents of special facilities such as schools and health-support facilities.

These transit vehicles merge into and become a part of the general evacuation traffic environment that is comprised mostly of "passenger cars" (pc's). The presence of each transit vehicle in the evacuating traffic stream is represented within the modeling paradigm described in Appendix D as equivalent to two pc's. This equivalence factor represents the longer size and more sluggish operating characteristics of a transit vehicle, relative to those of a pc.

Transit vehicles must be mobilized in preparation for their respective evacuation missions. Specifically:

- Bus drivers must be alerted
- They must travel to the bus depot
- They must be briefed there and assigned to a route or facility

These activities consume time. Based on experience at other plants, it is estimated that bus mobilization time will average approximately 90 minutes extending from the Advisory to Evacuate to the time when buses arrive at the facility to be evacuated.

During this mobilization period, other mobilization activities are taking place. One of these is the action taken by parents, neighbors, relatives and friends to pick up children from school prior to the arrival of buses, so that they may join their families. Virtually all studies of evacuations have concluded that this "bonding" process of uniting family units is universally prevalent during emergencies and should be anticipated in the planning process. The current emergency plan information disseminated to residents of the Salem & Hope Creek Nuclear Generating Stations EPZ indicates that parents should not pick up children at school, rather, they should pick up children at the host school. Picking up children at school could add to traffic congestion at the schools, delaying the departure of the buses evacuating schoolchildren, which may have to return to the EPZ and evacuate the transit-dependent population. We provide estimates of buses under the assumption that no children will be picked up, to present an upper bound estimate. It is assumed that children at day-care centers are picked up by parents or guardians and that the time to perform this activity is captured in the trip generation times discussed in Section 5.

The procedure is:

- Estimate demand for transit service
- Estimate time to perform all transit functions
- Estimate route travel times to the EPZ boundary and to the school reception centers

8.1 Transit-Dependent People - Demand Estimate

The telephone survey (see Appendix F) results were used to estimate the portion of the population requiring transit service:

- Those persons in households that do not have a vehicle available.
- Those persons in households that do have vehicle(s) that would not be available at the time the evacuation is advised.

In the latter group, the vehicle(s) may be used by a commuter(s) who does not return (or is not expected to return) home to evacuate the household.

Table 8-1 presents estimates of transit-dependent people. Note:

- Estimates of persons requiring transit vehicles include schoolchildren. For those evacuation scenarios where children are at school when an evacuation is ordered, separate transportation is provided for the schoolchildren. The actual need for transit vehicles by residents is thereby less than the given estimates. However, we will not reduce our estimates of transit vehicles since it would add to the complexity of the implementation procedures.
- It is reasonable and appropriate to consider that many transit-dependent persons will evacuate by ride-sharing with neighbors, friends or family. For example, nearly 80 percent of those who evacuated from Mississauga, Ontario who did not use their own cars, shared a ride with neighbors or friends. Other documents report that approximately 70 percent of transit-dependent persons were evacuated via ride-sharing[1]. **We will adopt a conservative estimate that 50 percent of transit-dependent persons will ride-share.**

The estimated number of bus trips needed to service transit-dependent persons is based on an estimate of average bus occupancy of 30 persons at the conclusion of the bus run. Transit vehicle seating capacities typically equal or exceed 60 children (roughly equivalent to 40 adults). If transit vehicle evacuees are two-thirds adults and one-third children, then the number of “adult seats” taken by 30 persons is 20 + (2/3

[1] Jones, J., et. al. Review of NUREG-0654, Supplement 3, “Criteria for Protective Action Recommendations for Severe Accidents” - Focus Groups and Telephone Survey, NUREG/CR-6953, Vol. 2, Sandia National Laboratories, Page 45.

x10) = 27. On this basis, the average load factor anticipated is (27/40) x 100 = 68 percent. Thus, if the actual demand for service exceeds the estimates of Table 8-1 by 50 percent, the demand for service can still be accommodated by the available bus seating capacity.

$$\left(20+\left(\frac{2}{3}\times 10\right)\right)\div 40\times 1.5=1.00$$

Table 8-1 indicates that transportation must be provided for 1,029 people. Therefore, a total of 34 bus runs are required to transport this population to reception centers.

To illustrate this estimation procedure, we calculate the number of persons, P, requiring public transit or ride-share, and the number of buses, B, required for the PSEG Site EPZ:

$$P=15{,}423\times(0.035\times 1.38+0.216\times(1.93-1)\times 0.65\times 0.40+0.455\times(3.07-2)\times(0.65\times 0.40)^2)=15{,}423\times 0.134=2{,}058$$
$$B=(0.5\times P)\div 30=34$$

These calculations are explained as follows:

- All members (1.38 avg.) of households (HH) with no vehicles (3.5%) will evacuate by public transit or ride-share. The term 15,423 (number of households) x 0.035 x 1.38, accounts for these people.
- The members of HH with 1 vehicle away (21.6%), who are at home, equal (1.93-1). The number of HH where the commuter will not return home is equal to (15,423 x 0.216 x 0.65 x 0.40), as 65% of EPZ households have a commuter, 40% of which would not return home in the event of an emergency. The number of persons who will evacuate by public transit or ride-share is equal to the product of these two terms.
- The members of HH with 2 vehicles that are away (45.5%), who are at home, equal (3.07 – 2). The number of HH where neither commuter will return home is equal to 15,423 x 0.455 x $(0.65 \text{ x } 0.40)^2$. The number of persons who will evacuate by public transit or ride-share is equal to the product of these two terms (the last term is squared to represent the probability that *neither* commuter will return).
- Households with 3 or more vehicles are assumed to have no need for transit vehicles.
- The total number of persons requiring public transit is the sum of such people in HH with no vehicles, or with 1 or 2 vehicles that are away from home.

The estimate of transit-dependent population in Table 8-1 far exceeds the number of registered transit-dependent persons in the EPZ as provided in the State Radiological

Emergency Plans. This is consistent with the findings of NUREG/CR-6953, Volume 2[2], in that a large majority of the transit-dependent population within the EPZs of U.S. nuclear plants do not register with their local emergency response agency.

8.2 School Population – Transit Demand

Table 8-2 presents the school population and transportation requirements for the direct evacuation of all schools within the EPZ for the 2008-2009 school year. The column in Table 8-2 entitled "Bus Runs Required" specifies the number of buses required for each school under the following set of assumptions and estimates:

- No students will be picked up by their parents prior to the arrival of the buses.
- Bus capacity, expressed in students per bus, is set to 70 for primary schools and 46 for middle and high schools.
- Those staff members who do not accompany the students will evacuate in their private vehicles.
- No allowance is made for student absenteeism typically 3 percent daily.

Consideration should be given that the counties in the EPZ introduce procedures whereby the schools are contacted prior to the dispatch of buses from the depot (approximately one hour after the Advisory to Evacuate), to ascertain the current estimate of students to be evacuated. In this way, the number of buses dispatched to the schools will reflect the actual number needed. Those buses originally allocated to evacuate schoolchildren that are not needed due to children being picked up by their parents, can be gainfully assigned to service other facilities or those persons who do not have access to private vehicles or to ride-sharing.

Table 8-3 presents a list of the school reception centers for each school in the EPZ. Students will be transported to these centers where they will be subsequently retrieved by their respective families.

8.3 Special Facility Demand

Table 8-4 presents the census of special facilities in the EPZ. Approximately 392 people have been identified as living in, or being treated in, these facilities. This census also indicates the number of wheelchair-bound people and the number of bed-ridden people at each facility. The transportation requirements for this group are also presented. The number of ambulance runs is determined by assuming that 2 patients can be accommodated per ambulance trip; the number of wheelchair van runs assumes 4

[2] Jones, J., et. al. Review of NUREG-0654, Supplement 3, "Criteria for Protective Action Recommendations for Severe Accidents" - Focus Groups and Telephone Survey, NUREG/CR-6953, Vol. 2, Sandia National Laboratories, Pages viii, ix and 33.

wheelchairs per trip; the number of wheelchair bus runs assumes 15 wheelchairs per trip and the number of bus runs estimated assumes 30 ambulatory patients per trip.

8.4 Evacuation Time Estimates for Transit-Dependent People

EPZ bus resources are assigned to evacuating schoolchildren as the first priority in the event of an emergency. In the event that the allocation of buses dispatched from the depots to the various facilities and to the bus routes is somewhat “inefficient”, or if there is a shortfall of available drivers, then there may be a need for some buses to return to the EPZ from the reception center after completing their first evacuation trip, to complete a “second wave” of providing transport service to evacuees. For this reason, the ETE for the transit-dependent population will be calculated for both a one wave transit evacuation and for two waves. Of course, if the impacted Evacuation Region is other than R03 (the entire EPZ), then there will likely be ample transit resources relative to demand in the impacted Region and this discussion of a second wave would likely not apply.

When school bus needs are satisfied, subsequent assignments of buses to service the transit-dependent should be sensitive to their mobilization time. Clearly, the buses should be dispatched after people have completed their mobilization activities and are in a position to board the buses when they arrive at the pick-up points.

Evacuation Time Estimates for Transit Trips were developed using both good weather and adverse weather conditions. Figure 8-1 presents the chronology of events relevant to transit operations. The elapsed time for each activity will now be discussed with reference to Figure 8-1.

Activity: Mobilize Drivers (A→B→C)

Mobilization is the elapsed time from the Advisory to Evacuate until the time the buses arrive at the facility to be evacuated. It is assumed that for a rapidly escalating radiological emergency with no observable indication before the fact, drivers would likely require 90 minutes to be contacted, to travel to the depot, be briefed, and to travel to the transit-dependent facilities. Mobilization time is slightly longer – 100 minutes – when raining.

Activity: Board Passengers (C→D)

Based on discussions with offsite agencies, a loading time of 15 minutes (20 minutes for rain) for school buses is used.

For multiple stops along a pick-up route (transit-dependent bus routes) we must allow for the additional delay associated with stopping and starting at each pick-up point. The time, t, required for a bus to decelerate at a rate, “a”, expressed in ft/sec/sec, from a speed, “v”, expressed in ft/sec, to a stop, is $t = v/a$. Assuming the same acceleration rate and final speed following the stop yields a total time, T, to service boarding passengers:

$$T = t + B + t = B + 2t = B + \frac{2v}{a},$$

Where B = Dwell time to service passengers. The total distance, “s” in feet, travelled during the deceleration and acceleration activities is: $s = v^2/a$. If the bus had not stopped to service passengers, but had continued to travel at speed, v, then its travel time over the distance, s, would be: s/v, or $(v^2/a)/v = v/a$. Then the total delay (i.e. pickup time, P) to service passengers is:

$$P = T - \frac{v}{a} = B + \frac{v}{a}$$

Assigning reasonable estimates:

- B = 50 seconds: a generous value for a single passenger, carrying personal items, to board per stop
- v = 25 mph = 37 ft/sec
- a = 4 ft/sec/sec, a moderate average rate

Then, P ≈ 1 minute per stop. Allowing 30 minutes pick-up time per bus run implies 30 stops per run, for good weather. It is assumed that bus acceleration and speed will be less in rain; loading time is 40 minutes per bus in rain.

Activity: Travel to EPZ Boundary (D→E)

School Evacuation

Information provided in the state radiological emergency plans and discussions with state emergency management officials indicate the following bus resources, by school/school district:

- Elsinboro Elementary School: 3 Buses
- Salem City Schools: 25 Buses
- Quinton Twp. Schools: 6 Buses
- Lower Alloways Creek School: 6 Buses
- Appoquinimink Schools: 109 Buses

- Colonial School District: 130 Buses

Comparison of the available bus resources with the number of buses needed in Table 8-2 indicates that Appoquinimink School District and Salem City Schools do not have sufficient bus resources to evacuate school children in a single wave. However, it is assumed that these school districts will be assisted through Memoranda of Understanding and Mutual Aid Agreements, as outlined in Attachment 3 to the State of New Jersey Radiological Emergency Response Plan.

The buses servicing the schools are ready to begin their evacuation trips at 105 minutes after the advisory to evacuate – 90 minutes mobilization time plus 15 minutes loading time. The UNITES software discussed in Section 1.3 was used to define bus routes along the most likely path from a school being evacuated to the EPZ boundary, traveling toward the appropriate reception center. This is done in UNITES by interactively selecting the series of nodes from the school to the EPZ boundary. The bus route is given an identification number and is written to the I-DYNEV input stream. UNITES computes the route length and DYNEV outputs the average speed for each 10 minute interval for each bus route input. The bus routes input are documented in Table 8-5 (refer to the maps of the link-node analysis network in Appendix K for node locations). Data from 100 to 110 minutes after the advisory to evacuate were used. The average speed along the path using the data generated by DNYEV was computed as follows:

$$Average\ Speed\left(\frac{mi.}{hr.}\right)=\left(\frac{\sum_{i=1}^{n} length\ of\ link\ i\ (mi)}{\sum_{i=1}^{n} Delay\ on\ link\ i\ (\text{min.})+\dfrac{length\ of\ link\ i\ (mi.)}{free\ flow\ speed\ on\ link\ i\left(\frac{mi.}{hr.}\right)}\times\dfrac{60\ \text{min.}}{1\ hr.}}\right)\times\frac{60\ \text{min.}}{1\ hr.}$$

The average speed computed (using this methodology) for the buses servicing each of the schools in the EPZ is shown in Tables 8-6A and B, and in Tables 8-8A and B for the transit vehicles evacuating transit-dependent persons, which are discussed later. The travel time to the EPZ boundary was computed for each bus using the computed average speed and the distance to the EPZ boundary along the most likely route out of the EPZ. The travel time from the EPZ boundary to the Reception Center was computed assuming an average speed of 45 mph and 40 mph for good weather and rain respectively. Speeds were reduced in Tables 8-6 and 8-8 to 45 mph (40 mph for rain) for those calculated bus speeds which exceed 45 mph, as it is unlikely that school buses would be traveling at speeds greater than that.

Tables 8-6A (good weather) and 8-6B (rain) present the following evacuation time estimates (rounded up to the nearest 5 minutes) for schools in the EPZ: (1) The elapsed time from the Advisory to Evacuate until the bus exits the EPZ; and (2) The elapsed time until the bus reaches the School Reception Center. The evacuation time out of the EPZ can be computed as the sum of travel times associated with Activities A→B→C, C→D, and D→E (For example: 90 min. + 15 + 31 = 2:20 for Salem High School, with good weather, rounded up to the nearest 5 minutes). The evacuation time to the School Reception Center is determined by adding the time associated with Activity E→F (discussed below), to this EPZ evacuation time.

Evacuation of Transit-Dependent Population

The buses dispatched from the depots to service the transit-dependent evacuees will be scheduled so that they arrive at their respective routes after their passengers have completed their mobilization. As shown in Figure 5-3 (Residents without Commuters), 90 percent of the evacuees will complete their mobilization when the buses will begin their routes, approximately 105 minutes after the Advisory to Evacuate. Headways of 5 minutes are used for those routes which require multiple buses; buses begin traversing some of these routes at 90 minutes to service those people who may mobilize more quickly.

Those buses servicing the transit-dependent evacuees will first travel along their pick-up routes, then proceed out of the EPZ. Buses will travel along the major routes in the EPZ as described in Table 8-7 and shown graphically in Appendix M. These routes were taken from the state radiological emergency plans. There are 9 bus routes in New Jersey, and 6 bus routes in Delaware.

As previously discussed, a pickup time of 30 minutes is estimated for 30 individual stops to pick up passengers, with an average of one minute of delay associated with each stop.

The travel distance along the respective pick-up routes within the EPZ is estimated using the UNITES software. Bus travel times within the EPZ are computed using average speeds computed by DYNEV, using the aforementioned methodology that was used for school evacuation.

Tables 8-8A and 8-8B present the transit-dependent population evacuation time estimates for each bus route calculated using the above procedures for good weather and rain, respectively. For example, the ETE for New Jersey Bus Route Number 3A is computed as 105 + 53 + 30 = 3:10 for good weather (rounded to nearest 5 minutes). Here, 53 minutes is the time to travel 13 miles at 14.72 mph, the average speed output by the model for this route at 105 minutes. The ETE for a second wave (discussed below) is presented in the event there is a shortfall of available buses or bus drivers.

Activity: Travel to School Reception Centers (E→F)

The distances from the EPZ boundary to the school reception centers are measured using Geographical Information Systems (GIS) software along the most likely route from the EPZ to the reception center. The reception centers are identified in Table 8-3. For a one-wave evacuation, this travel time outside the EPZ does not contribute to the ETE. For a two-wave evacuation, the ETE for buses must be considered separately, since it could exceed the ETE for the general public. Assumed bus speeds of 45 mph and 40 mph for good weather and rain, respectively, will be applied for this activity.

Activity: Passengers Leave Bus (F→G)

A bus can empty within 5 minutes. The driver takes a 10 minute break.

Activity: Bus Returns to Route for Second Wave Evacuation (G→C)

The buses assigned to return to the EPZ to perform a “second wave” evacuation of transit-dependent evacuees will be those that evacuated the schoolchildren. These buses are assigned since they will be the first buses to complete their evacuation service and are therefore the first to be available for the second wave. The schoolchildren depart the bus, and the bus then returns to the EPZ, travels to its route and proceeds to pick up transit-dependent evacuees along the route. The travel time back to the EPZ is calculated using distances estimated from GIS and the assumed bus travel speeds.

The second-wave ETE for the Delaware Red Line Bus Route is computed as follows for good weather:

- Bus arrives at reception center at 2:30 in good weather (average of column “Return to EPZ” for New Castle County in Table 8-6A).
- Bus discharges passengers (5 minutes) and driver takes a 10-minute rest: 15 minutes.
- Bus returns to EPZ: 22 minutes (average of column “Travel Time EPZ Bdry to RC (min)” for New Castle County in Table 8-6A).
- Bus completes pick-ups along route and departs EPZ: 30 minutes + 42 minutes (26 miles @ 37.14 mph) = 72 minutes.
- Bus exits EPZ at time 2:30 + 0:15 + 0:22 + 1:12 = 4:20 (rounded to nearest 5 minutes) after the Advisory to Evacuate.

The ETE for the completion of the second wave for all transit-dependent bus routes are provided in Tables 8-8A and 8-8B. These tables should be considered when making Protective Action Decisions since the ETE for transit-dependent people exceed the ETE for the general population at the 90^{th} percentile.

Evacuation of Ambulatory Persons from Special Facilities

The bus operations for this group are similar to those for school evacuation except:

- Buses are assigned on the basis of 30 patients to allow for staff to accompany the patients.
- The passenger loading time will be longer at approximately one minute per patient to account for the time to move patients from inside the facility to the vehicles.

As is done for the schools, it is estimated that mobilization time averages 90 minutes. In the event there is a shortfall of transit vehicles for a “single-wave” evacuation, then buses used to evacuate schools will have to return to evacuate the special facilities. The school ETE to the Reception Centers is 2:25 (145 minutes) on average, and about 25 minutes of additional inbound travel time to the special facility from the reception center would be required. It follows, therefore, that about 80 minutes (145 + 25 – 90) would have to be added to the calculated ETE for special facilities, in the event they are evacuated as a “second wave”.

Based on the locations of the medical facilities in Figure E-2, it is estimated that buses will have to travel 3 miles, on average, to leave the EPZ. The average speed output by the model at 90 minutes for Region 3, Scenario 6 is 34.48 mph; thus, travel time out of the EPZ is approximately 5 minutes.

The ETE for buses evacuating ambulatory patients at medical facilities is the sum of the mobilization time, total passenger loading time, and travel time out of the EPZ. For example, the calculation of ETE for the Midtown Rest Haven with 19 ambulatory residents is:

ETE: 90 + 19 x 1 + 5 = 114 min. or 1:55 rounded up.

Table 8-4 indicates that 15 bus runs, 7 wheelchair bus runs and 6 wheelchair van runs are needed for the entire EPZ. Loading times are estimated at 2 minutes per wheelchair bound person as staff will have to assist them in boarding the bus. For example, the ETE for the wheelchair bound at Broadmeadow Healthcare is:

ETE: 90 + 60 x 2 + 5 = 3:35 (rounded up to the nearest 5 minutes).

8.5 Special Needs Population

Based on data provided by the state emergency management agencies, there are an estimated 16 homebound special needs people within the Delaware portion of the EPZ and 34 people within the New Jersey portion of the EPZ who require special transportation to evacuate. All 16 people registered in Delaware require a wheelchair van to be evacuated. In the New Jersey portion of the EPZ, there are 2 people that require an ambulance, 11 that require a wheelchair van and 21 that require a bus to evacuate.

ETE for Homebound Special Needs Persons

Wheel-Chair Vans

Section 8.3 identifies a wheelchair van capacity of 4 wheelchairs per trip. As discussed above, there are 27 homebound special needs persons within the EPZ requiring wheelchair van transportation; therefore 7 wheelchair vans are needed. Assuming one special needs person per household, each wheelchair van will service about 4 households. It is conservatively assumed that the households are spaced 5 miles apart and that van speeds approximate 20 mph between households.

a. Assumed mobilization time for wheelchair van resources to arrive at first household: 1:30

b. Loading time at first household: 15 minutes

c. Travel to next household: 3 @ 15 minutes (5 miles @ 20 mph) = 45 minutes

d. Loading time: 3 @ 15 minutes = 45 minutes

e. Travel time to EPZ boundary at 3:15: 5 miles @ 20 mph = 15 minutes

ETE: 1:30 + 15 + 45 + 45 + 15 = 3:30

Buses

Assuming no more than one special needs person per household implies that 21 households (HH) need to be serviced. While only 1 bus is needed from a capacity perspective, if 4 buses are deployed to service these special needs HH, then each would require about 5 stops. The following outlines the ETE calculations:

1. Assume 4 buses are deployed, each with about 5 stops, to service a total of 21 HH.

2. The ETE is calculated as follows:

   a. Buses arrive at the first pickup location: 90 minutes

   b. Load HH members at first pickup: 5 minutes

   c. Travel to subsequent pickup locations: 4 @ 6 minutes = 24 minutes

   d. Load HH members at subsequent pickup locations: 4 @ 5 minutes = 20 minutes

   e. Travel to EPZ boundary (assume 8 miles): 24 minutes.

ETE: 90 + 5 + 24 + 20 + 24 = 2:45

Rain ETE: 100 + 5 + 28 + 20 + 26 = 3:00

The estimated travel time between pickups is based on a distance of 2 miles @ 20 mph = 6 minutes. If planned properly, the pickup locations for each bus run should be clustered within the same general area. The estimated travel time to the EPZ boundary is based on a distance of 8 miles @ 20 mph = 24 minutes. It is assumed that mobilization time to first pickup is 10 minutes longer in rain = 100 minutes. Travel time to the EPZ boundary in rain from the last pickup requires 23 minutes (8 miles @ 18 mph - Travel speeds are 10% less in rain) and that travel time between pickups is 7 minutes (2 miles @ 18 mph). All ETE are rounded to nearest 5 minutes.

Assuming all HH members (avg. HH size equals 2.92 persons) travel with the disabled person yields 5 x 2.92 = 15 persons per bus. From the perspective of bus capacity, fewer buses could be deployed. For example, 2 buses, each servicing about 10 HH could accommodate 2.92 x 10 = 30 people, but the additional 5 stops would add 5 x (6 + 5) = 55 minutes to the ETE. The ETE would equal 3:40 with good weather and 3:55 for rain using 2 buses.

Ambulances

It is estimated that 1 ambulance run will be needed to evacuate the 2 homebound bed-ridden persons within Salem County.

As shown in Table B-6 in Attachment 22, Element B of the State of New Jersey Radiological Emergency Response Plan, there are sufficient ambulance resources in the EPZ to evacuate the institutionalized and homebound bed-ridden populations in a single wave.

Mobilization time and loading time are assumed to be 30 minutes each per ambulance. Each ambulance servicing the homebound bed-ridden population will make 2 stops with an estimated distance of 5 miles between stops and an estimated distance of 5 miles to the EPZ boundary after the final stop. It is conservatively assumed that ambulances will travel at 30 mph within the EPZ. Mobilization time is 5 minutes longer and travel speed is 10% less in rain – 27 mph. All ETE are rounded to nearest 5 minutes.

The ETE are computed as follows:

a. Ambulance arrives at first household: 30 minutes

b. Loading time at first household: 30 minutes

c. Ambulance travels to second household: 5 miles @ 30 mph = 10 minutes

d. Loading time at second household: 30 minutes

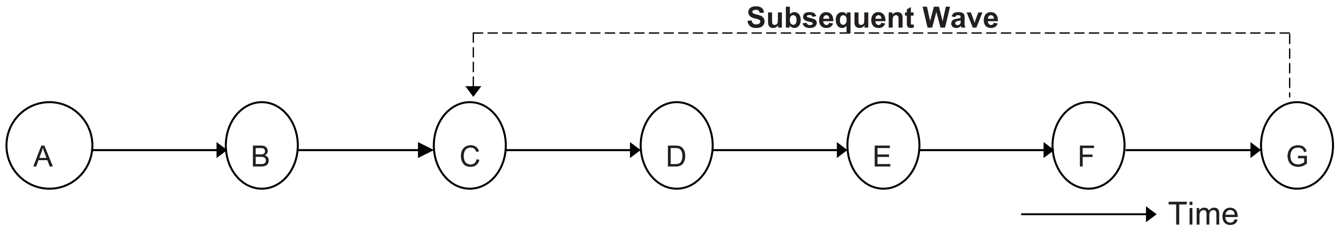
e. Travel time to EPZ boundary: 5 miles @ 30 mph = 10 minutes

ETE: 30 + 30 + 10 + 30 + 10 = 1:50

Rain ETE: 35 + 30 + 11 + 30 + 11 = 2:00

8.6 Correctional Facilities

As detailed in Table E-4, there are two correctional facilities within the EPZ – the Central Violation of Patrol Probation Center and the James T. Vaughn Correctional Center. The total inmate population at these facilities is 2,750 persons. Both of these facilities are located in close proximity to the EPZ boundary and are beyond 10 miles from the PSEG Site, as shown in Figure E-2. As stated in Standard Operating Procedure (SOP) 1000-D of the Delaware Radiological Emergency Plan, these facilities will shelter-in-place in the event of an incident at the PSEG Site. This plan was reiterated in discussions with the Delaware Emergency Management Agency. As such, evacuation time estimates need not be considered for the correctional facilities within the EPZ.



Event

A	Advisory to Evacuate
B	Bus Dispatched from Depot
C	Bus Arrives at Facility/Pick-up Route
D	Bus Departs for Reception Center
E	Bus Exits Region
F	Bus Arrives at School Reception Center
G	Bus Available for “Second Wave” Evacuation Service

Activity

A→B	Driver Mobilization
B→C	Travel to Facility or to Pick-up Route
C→D	Passengers Board the Bus
D→E	Bus Travels Towards Region Boundary
E→F	Bus Travels Towards School Reception Center Outside the EPZ
F→G	Passengers Leave Bus; Driver Takes a Break

Figure 8-1. Chronology of Transit Evacuation Operations

Table 8-1. Transit-Dependent Population Estimates														
Facility Name	2010 EPZ Population	Survey Average Household Size With Indicated No. of Vehicles			Estimated Number of Households	Survey Percent Households With			Survey Percent Households With Commuters	Survey Percent Households With Non-Returning Commuters	Total People Requiring Transport	Estimated Ridesharing Percentage	People Requiring Public Transit	Percent of Population Requiring Public Transit
		0	1	2		0 Veh-icle	1 Veh-icle	2 Veh-icle						
PSEG Site	45,034	1.38	1.93	3.07	15,423	3.5%	21.6%	45.5%	65%	40%	2,058	50%	1,029	2.3%

Table 8-2. School Population Demand Estimates

ERPA	Distance (miles)	Direc-tion	School Name	Municipality	Enroll-ment	Staff	Bus Runs Required
Salem County, NJ Schools							
1	7.0	E	Lower Alloways Creek Elementary School	Salem	222	78	4
2	8.4	NE	Quinton Elementary School	Quinton	358	61	6
3	5.4	NNE	Elsinboro Township Elementary School	Salem	108	17	2
3	7.4	NNE	John Fenwick Elementary School	Salem	300	80	5
3	6.8	NNE	Salem High School	Salem	600	110	14
3	7.6	NNE	Salem Middle School	Salem	580	110	13
4	9.0	NNE	The ARC of Salem County	Salem	147	28	4
				Salem County Totals:	**2,315**	**484**	**48**
Cumberland County, NJ Schools							
6	10.6	E	Stow Creek Township Elementary School	Bridgeton	135	20	2
6	10.2	E	Woodland Country Day School	Bridgeton	159	38	3
7	11.6	ESE	Morris Goodwin Elementary School	Greenwich	77	12	2
				Cumberland County Totals:	**371**	**70**	**7**
New Castle County, DE Schools							
A	5.8	NW	Van Hook Walsh School Inc.	Middletown	4	3	1
B	9.6	WSW	Everett Meredith Middle School	Middletown	1,250	95	28
B	9.6	WSW	Groves Adult High Shool	Middletown	160	20	4
B	8.3	W	Middletown High School	Middletown	1,707	145	38
B	9.3	W	Silver Lake Elementary School	Middletown	670	60	10
B	8.5	WSW	St. Andrew's School	Middletown	270	125	6
B	8.9	WSW	St. Anne's Episcopal School	Middletown	325	55	8
B	9.6	WSW	Townsend Elementary School	Townsend	315	55	5
C	9.4	NW	AdvoServ School	Bear	123	140	3
C	8.1	WNW	Alfred Waters Middle School	Middletown	777	60	17
C	7.9	W	Brick Mill Elementary School	Middletown	770	80	11
C	8.0	WNW	Cedar Lane Elementary School	Middletown	670	70	10
C	7.8	NW	Gunning Bedford Middle School	New Castle	950	85	21
C	10.0	NW	Kathleen H. Wilbur Elementary School (formerly Wrangle Hill Elementary School)	Bear	1,150	100	17
C	9.1	W	Louis L. Redding Middle School	Middletown	800	70	18
C	7.7	NW	Southern Elementary School	New Castle	1,065	100	16
C	7.7	WNW	St. George's Technical High School	Middletown	1,035	135	23
C	8.0	WNW	Cedar Lane Early Childhood Center	Middletown	331	30	5
B	9.6	WSW	Appoquinimink Early Childhood Center	Middletown	260	40	4
B	9.5	SW	Townsend Early Childhood Center	Townsend	202	26	3
				New Castle County Totals:	**12,834**	**1,494**	**248**
				EPZ Totals:	**15,520**	**2,048**	**303**

Table 8-3. School Reception Centers	
School	**Reception Center**
Elsinboro Township Elementary School	**Mary Shoemaker School**
Lower Alloways Creek Township Elementary School	**Schalick High School**
Quinton Township Elementary School	
John Fenwick School	**Penns Grove Middle School**
Salem City High School	**Penns Grove High School**
Salem City Middle School	
Morris Goodwin School	**Cumberland County Regional High School**
Stow Creek Township School	
Woodland Country Day School	
AdvoServ School	**Brandywine High School**
St. Georges Technical High School	
Gunning Bedford Middle School	**Mount Pleasant High School**
Kathleen H. Wilbur Elementary School (formerly Wrangle Hill Elementary School)	
Southern Elementary School	
Van Hook Walsh School	**Ben Rohe Residence**
Cedar Lane Elementary School	**Dover High School**
Silver Lake Elementary School	
Townsend Elementary School	
Alfred Waters Middle School	
Groves Adult High School	
Brick Mill Elementary School	
Cedar Lane Early Childhood Center	
Townsend Early Childhood Center	
Middletown High School	**Caesar Rodney High School**
Everett Meredith Middle School	
Appoquinimink Early Childhood Center	
Redding Middle School	
St. Andrew's School	

Table 8-4. Special Facility Transit Demand											
ERPA	Facility Name	Municipality	Cap-acity	Current Census	Ambu-latory	Wheel-chair Bound	Bed-ridden	Wheel-chair Bus Runs	Wheel-chair Van Runs	Bus Runs
SALEM COUNTY, NJ										
3	Homecare & Hospicecare of South Jersey	Salem	52	52	42	10	0	0	3	2
2	Lower Alloways Creek Twp: Leisure Arms Complex Kitchen	Salem	36	30	29	1	0	0	1	1
5	Lindsay House	Pennsville	16	16	13	3	0	0	1	1
3	Midtown Rest Haven	Salem	23	19	19	0	0	0	0	1
		Salem County Totals:	*127*	*117*	*103*	*14*	*0*	*0*	*5*	*5*
NEW CASTLE COUNTY, DE										
C	Gateway Foundation (Cottage 2)	Delaware City	72	72	72	0	0	0	0	3
C	Silver Lake Day Treatment Center	Middletown	26	26	26	0	0	0	0	1
N/A	People's Place Residential Group Home**	Townsend	8	8	8	0	0	0	0	1
B	Broadmeadow Healthcare	Middletown	117	77	17	60	0	4	0	1
B	Blackbird Landing Group Home	Townsend	8	8	8	0	0	0	0	1
C	Cornerstone Residential	Delaware City	15	15	15	0	0	0	0	1
C	Middletown Residential Treatment Center	Middletown	10	10	10	0	0	0	0	1
C	Governor Bacon Health Center	Delaware City	80	59	12	47	0	3	1	1
		New Castle County Totals:	*336*	*275*	*168*	*107*	*0*	*7*	*1*	*10*
		Total:	**463**	**392**	**271**	**121**	**0**	**7**	**6**	**15**

**The exact location of this facility is not known.

Table 8-5: Bus Route Descriptions

Bus Route Number	Description	Nodes Traversed from Route Start to EPZ Boundary
1	Delaware - Blue Route	576, 575, 574, 573, 572, 571, 570, 569, 562, 561, 560, 559, 558, 557, 556, 722, 723, 724, 725, 789, 726, 727, 790
2	Delaware - Green Route	854, 867, 667, 668, 681, 682, 683, 684, 856, 45, 44, 855, 804, 42, 803, 41, 787, 39, 37, 861, 33, 728, 32, 30
3	Delaware - Red Route	673, 674, 675, 676, 677, 678, 679, 861, 33, 728, 32, 30
4	Delaware - Pink Route	546, 545, 544, 543, 542, 731, 732, 730, 733, 734, 735, 739, 740, 21, 911, 23, 738, 26, 29, 30
5	Delaware - Purple Route	51, 52, 873, 511, 863, 862, 64, 65, 66, 67, 69, 771, 70
6	Delaware - Brown Route	593, 594, 596, 597, 598, 599, 600, 601, 602, 70
7	NJ - Route 1	485, 484, 483, 482, 481, 480, 479, 837, 836, 350, 276, 275, 273, 274, 304, 819
8	NJ - Route 2A	391, 392, 393, 394, 335, 395, 396, 397, 398, 286
9	NJ - Route 2B	359, 838, 839, 840, 841, 842, 843, 844, 280, 279, 278, 820, 276, 275, 273, 274, 304, 819
10	NJ - Route 3A	475, 476, 478, 479, 837, 836, 350, 276, 275, 273, 274, 304, 819
11	NJ - Route 3B	350, 831, 443, 442, 446, 272, 833, 445, 273, 274, 271, 270, 269, 270, 269, 268, 266, 265
12	NJ - Route 4	274, 304, 819, 305, 307, 310
13	NJ - Route 5	454, 455, 456, 457, 459, 460
14	NJ - Route 6	367, 368, 369, 370, 371, 372, 373, 374, 375
15	NJ - Route 7	825, 375, 377, 378, 379, 381, 382, 383
16	Elsinboro Township Elementary School	741, 438, 437, 439, 440, 441, 443, 444, 830, 273, 274, 304, 819
17	Quinton Township Elementary School	281, 282, 283, 284, 285, 286
18	Lower Alloways Creek Elementary School	391, 392, 393, 394, 335, 395, 396, 397, 398, 286
19	John Fenwick Elementary School	831, 834, 275, 273, 445, 833, 272, 271, 270, 269, 268, 266, 265
20	Salem Middle School	444, 445, 833, 272, 271, 270, 269, 268, 266, 265
21	Salem High School	473, 831, 834, 275, 273, 445, 833, 272, 271, 270, 269, 268, 266, 265
22	The ARC of Salem County	304, 819
23	Morris Goodwin School	823, 822, 821, 377, 378
24	Stow Creek Township	340, 341, 342
25	Woodland Country Day School	339, 340, 341, 342
26	Southern Elementary School, Gunning Bedford Elementary School	663, 664, 648, 771,70, 72, 74, 807
27	Cedar Lane Elementary School, Alfred Waters Middle School, Cedar Lane Early Childhood Center	56, 55, 48, 801, 47, 46, 785, 40, 786, 38, 36, 35, 28, 27, 857
28	Silver Lake Elementary School	903, 681, 682, 683, 684, 856, 45, 46, 785, 40, 786, 38, 36, 35, 28, 27, 857
29	Townsend Elementary School, Townsend Early Childhood Center	709, 679, 680, 861, 33, 728, 32, 30, 29, 26, 23, 24
30	Redding Middle School	681, 682, 683, 684, 856, 45, 46, 785, 40, 786, 38, 36, 35, 28, 27, 857
31	Middletown High School	683, 684, 856, 45, 46, 785, 40, 786, 38, 36, 35, 28, 27, 857
32	AdvoServ	67, 69, 771, 70, 75, 940
33	St. Andrew's School, St. Anne's Episcopal School	673, 674, 675, 676, 677, 678, 679, 680, 861, 33, 728, 32, 30, 29, 26, 23
34	Everett Meredith Middle School, Groves Adult High School, Appoquinimink Early Childhood Center	668, 681, 682, 683, 684, 856, 45, 46, 785, 40, 786, 38, 36, 35, 28, 27, 857
35	Van Hook Walsh School	876, 875, 874, 873, 511, 863, 59, 62, 800, 68, 73, 74
37	Kathleen H. Wilbur Elementary School	603, 806, 71, 72, 74, 807
38	Brick Mill Elementary School	812, 684, 856, 45, 46, 785, 40, 786, 38, 36, 35, 28, 27, 857
39	St. George's Technical High School	277, 809, 142, 241, 244, 267, 302, 303, 309, 64, 65, 66, 67, 69, 771, 70, 75, 940

Table 8-6A. School Evacuation Time Estimates - Good Weather

School	Driver Mobilization Time(min)	Loading Time (min)	Dist. to EPZ Boundary (mi.)	Average Speed (mph)	Adjusted Speed (mph)	Travel Time to EPZ Bdry (min)	ETE (hr:min)	Dist. EPZ Bndry to R.C. (mi.)	Travel Time EPZ Bdry to RC (min)	ETE to R.C. (hr:min)
Salem County, NJ Schools										
Lower Alloways Creek Elementary School	90	15	4.61	48.89	45.00	7	**1:55**	10	14	**2:10**
Quinton Elementary School	90	15	4.16	55.23	45.00	6	**1:55**	10	14	**2:05**
Elsinboro Township Elementary School	90	15	5.35	37.95	37.95	9	**1:55**	8	11	**2:05**
John Fenwick Elementary School	90	15	4.28	8.57	8.57	30	**2:15**	10	14	**2:30**
Salem High School	90	15	4.78	9.30	9.30	31	**2:20**	10	14	**2:30**
Salem Middle School	90	15	3.80	12.33	12.33	19	**2:05**	10	14	**2:20**
The ARC of Salem County	90	15	1.22	49.77	45.00	2	**1:50**	10	14	**2:05**
Cumberland County, NJ Schools										
Stow Creek Township Elementary School	90	15	1.86	60.00	45.00	3	**1:50**	8	11	**2:00**
Woodland Country Day School	90	15	2.28	59.06	45.00	4	**1:50**	8	11	**2:00**
Morris Goodwin Elementary School	90	15	1.47	38.80	38.80	3	**1:50**	8	11	**2:00**
New Castle County, DE Schools										
Van Hook Walsh School Inc.	90	15	5.64	61.37	45.00	8	**1:55**	16	22	**2:15**
Everett Meredith Middle School	90	15	11.98	40.23	40.23	18	**2:05**	20	27	**2:30**
Groves Adult High Shool	90	15	11.98	40.23	40.23	18	**2:05**	13	18	**2:25**
Middletown High School	90	15	10.91	42.06	42.06	16	**2:05**	20	27	**2:30**
Silver Lake Elementary School	90	15	11.95	40.29	40.29	18	**2:05**	13	18	**2:25**
St. Andrew's School	90	15	8.90	16.18	16.18	34	**2:20**	20	27	**2:50**
St. Anne's Episcopal School	90	15	8.90	16.18	16.18	34	**2:20**	16	22	**2:45**
Townsend Elementary School	90	15	6.73	21.73	21.73	19	**2:05**	13	18	**2:25**
AdvoServ School	90	15	3.58	15.90	15.90	14	**2:00**	16	22	**2:25**
Alfred Waters Middle School	90	15	13.53	47.73	45.00	19	**2:05**	13	18	**2:25**
Brick Mill Elementary School	90	15	10.89	42.07	42.07	16	**2:05**	13	18	**2:20**
Cedar Lane Elementary School	90	15	13.53	47.73	45.00	19	**2:05**	13	18	**2:25**
Gunning Bedford Middle School	90	15	3.94	13.98	13.98	17	**2:05**	16	22	**2:25**
Kathleen H. Wilbur Elementary School	90	15	1.29	52.23	45.00	2	**1:50**	16	22	**2:10**
Louis L. Redding Middle School	90	15	11.76	40.68	40.68	18	**2:05**	20	27	**2:30**
Southern Elementary School	90	15	3.94	13.98	13.98	17	**2:05**	16	22	**2:25**
St. George's Technical High School	90	15	6.20	16.16	16.16	24	**2:10**	16	22	**2:35**
Appoquinimink Early Childhood Center	90	15	11.98	40.23	40.23	18	**2:05**	20	27	**2:30**
Cedar Lane Early Childhood Center	90	15	13.53	47.73	45.00	19	**2:05**	13	18	**2:25**
Townsend Early Childhood Center	90	15	6.73	21.73	21.73	19	**2:05**	13	18	**2:25**
						Maximum for EPZ:	**2:20**		**Maximum:**	**2:50**
						Average for EPZ:	**2:05**		**Average:**	**2:25**

Table 8-6B. School Evacuation Time Estimates - Rain										
School	**Driver Mobilization Time(min)**	**Loading Time (min)**	**Dist. to EPZ Boundary (mi.)**	**Average Speed (mph)**	**Adjusted Speed (mph)**	**Travel Time to EPZ Bdry (min)**	**ETE (hr:min)**	**Dist. EPZ Bndry to R.C. (mi.)**	**Travel Time EPZ Bdry to RC (min)**	**ETE to R.C. (hr:min)**
Salem County, NJ Schools										
Lower Alloways Creek Elementary School	100	20	4.61	44.18	40.00	7	**2:10**	10	15	**2:25**
Quinton Elementary School	100	20	4.16	49.77	40.00	7	**2:10**	10	15	**2:25**
Elsinboro Township Elementary School	100	20	5.35	34.61	34.61	10	**2:10**	8	12	**2:25**
John Fenwick Elementary School	100	20	4.28	8.42	8.42	31	**2:35**	10	15	**2:50**
Salem High School	100	20	4.78	9.13	9.13	32	**2:35**	10	15	**2:50**
Salem Middle School	100	20	3.80	12.11	12.11	19	**2:20**	10	15	**2:35**
The ARC of Salem County	100	20	1.22	45.00	40.00	2	**2:05**	10	15	**2:20**
Cumberland County, NJ Schools										
Stow Creek Township Elementary School	100	20	1.86	53.86	40.00	3	**2:05**	8	12	**2:15**
Woodland Country Day School	100	20	2.28	53.06	40.00	4	**2:05**	8	12	**2:20**
Morris Goodwin Elementary School	100	20	1.47	35.05	35.05	3	**2:05**	8	12	**2:15**
New Castle County, DE Schools										
Van Hook Walsh School Inc.	100	20	5.64	45.63	40.00	9	**2:10**	16	24	**2:35**
Everett Meredith Middle School	100	20	11.98	30.93	30.93	24	**2:25**	20	30	**2:55**
Groves Adult High Shool	100	20	11.98	30.93	30.93	24	**2:25**	13	20	**2:45**
Middletown High School	100	20	10.91	31.59	31.59	21	**2:25**	20	30	**2:55**
Silver Lake Elementary School	100	20	11.95	30.95	30.95	24	**2:25**	13	20	**2:45**
St. Andrew's School	100	20	8.90	14.06	14.06	38	**2:40**	20	30	**3:10**
St. Anne's Episcopal School	100	20	8.90	14.06	14.06	38	**2:40**	16	24	**3:05**
Townsend Elementary School	100	20	6.73	23.14	23.14	18	**2:20**	13	20	**2:40**
AdvoServ School	100	20	3.58	17.08	17.08	13	**2:15**	16	24	**2:40**
Alfred Waters Middle School	100	20	13.53	36.40	36.40	23	**2:25**	13	20	**2:45**
Brick Mill Elementary School	100	20	10.89	31.58	31.58	21	**2:25**	13	20	**2:45**
Cedar Lane Elementary School	100	20	13.53	36.40	36.40	23	**2:25**	13	20	**2:45**
Gunning Bedford Middle School	100	20	3.94	9.71	9.71	25	**2:25**	16	24	**2:50**
Kathleen H. Wilbur Elementary School	100	20	1.29	22.04	22.04	4	**2:05**	16	24	**2:30**
Louis L. Redding Middle School	100	20	11.76	31.12	31.12	23	**2:25**	20	30	**2:55**
Southern Elementary School	100	20	3.94	9.71	9.71	25	**2:25**	16	24	**2:50**
St. George's Technical High School	100	20	6.20	12.15	12.15	31	**2:35**	16	24	**2:55**
Appoquinimink Early Childhood Center	100	20	11.98	30.93	30.93	24	**2:25**	20	30	**2:55**
Cedar Lane Early Childhood Center	100	20	13.53	36.40	36.40	23	**2:25**	13	20	**2:45**
Townsend Early Childhood Center	100	20	6.73	23.14	23.14	18	**2:20**	13	20	**2:40**
						Maximum for EPZ:	**2:40**		**Maximum:**	**3:10**
						Average for EPZ:	**2:20**		**Average:**	**2:40**

Table 8-7. Summary of Transit-Dependent Bus Routes for the PSEG Site

Route	Number of Buses	Route Description	Length (mi.)
1	1	New Jersey – Services ERPA 1	18
2A	1	New Jersey – Services the Southern half of ERPA 2	20
2B	1	New Jersey – Services the Northern half of ERPA 2	23
3A	1	New Jersey – Services the Southern half of ERPA 3	13
3B	1	New Jersey – Services the Northern half of ERPA 3, encompassing Salem	4
4	1	New Jersey - Services ERPA 4	10
5	1	New Jersey - Services ERPA 5	8
6	1	New Jersey - Services ERPA 6	18
7	1	New Jersey - Services ERPA 7	16
Blue	2	Delaware – Services Route 9 in New Castle County in the northern portion of the EPZ	21
Green	10	Delaware – Services mainly Routes 299 and 71 in Middletown	24
Red	5	Delaware – Services mainly Route 71 and Caldwell Corner Road in Townsend	26
Pink	2	Delaware – Services Route 9 and the outskirts of Smyrna in the southern portion of the EPZ	30
Purple	2	Delaware – Services mainly Lorewood Grove Rd and Cox Neck Road	25
Brown	4	Delaware – Services Delaware City, Route 9 north of the C&D Canal, and Route 896 south of the C&D Canal.	33

Table 8-8A. Transit-Dependent Evacuation Time Estimates - Good Weather															
		Single Wave						Second Wave							
Route Number	Bus Number	Mobilization (min)	Route Distance (mi.)	Average Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE	ETE to Rec. Ctr (min)	Unload (min)	Driver Rest (min)	Return time to EPZ (min)	Average Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE
1	1	105	18	17.70	61	30	3:20	130	5	10	13	38.57	28	30	3:40
2A	1	105	20	36.36	33	30	2:50	130	5	10	13	36.36	33	30	3:45
2B	1	105	23	32.09	43	30	3:00	130	5	10	13	37.30	37	30	3:45
3A	1	105	13	14.72	53	30	3:10	130	5	10	13	39.00	20	30	3:30
3B	1	105	4	8.67	37	30	2:55	130	5	10	13	12.63	19	30	3:30
4	1	105	10	37.50	16	30	2:35	130	5	10	13	37.50	16	30	3:25
5	1	105	8	34.29	14	30	2:30	130	5	10	13	34.29	14	30	3:25
6	1	105	18	37.24	29	30	2:45	130	5	10	13	37.24	29	30	3:40
7	1	105	16	36.92	26	30	2:45	130	5	10	13	36.92	26	30	3:35
Blue	1	105	21	20.00	63	30	3:20	150	5	10	22	38.18	33	30	4:10
	2	110	21	20.00	63	30	3:25	155	5	10	22	38.18	33	30	4:15
Green	1	90	24	32.00	45	30	2:45	150	5	10	22	38.92	37	30	4:15
	2	95	24	33.49	43	30	2:50	155	5	10	22	38.92	37	30	4:20
	3	100	24	33.49	43	30	2:55	160	5	10	22	38.92	37	30	4:25
	4	105	24	36.92	39	30	2:55	165	5	10	22	38.92	37	30	4:30
	5	110	24	36.92	39	30	3:00	170	5	10	22	38.92	37	30	4:35
	6	115	24	38.92	37	30	3:05	175	5	10	22	38.92	37	30	4:40
	7	120	24	38.92	37	30	3:10	180	5	10	22	38.92	37	30	4:45
	8	125	24	38.92	37	30	3:15	185	5	10	22	38.92	37	30	4:50
	9	130	24	38.92	37	30	3:20	190	5	10	22	38.92	37	30	4:55
	10	135	24	38.92	37	30	3:25	195	5	10	22	38.92	37	30	5:00
Red	1	90	26	28.36	55	30	2:55	150	5	10	22	37.14	42	30	4:20
	2	95	26	28.89	54	30	3:00	155	5	10	22	37.14	42	30	4:25
	3	100	26	28.89	54	30	3:05	160	5	10	22	37.14	42	30	4:30
	4	105	26	28.89	54	30	3:10	165	5	10	22	37.14	42	30	4:35
	5	110	26	28.89	54	30	3:15	170	5	10	22	37.14	42	30	4:40
Pink	1	105	30	38.30	47	30	3:05	150	5	10	22	38.30	47	30	4:25
	2	110	30	38.30	47	30	3:10	155	5	10	22	38.30	47	30	4:30
Purple	1	105	25	35.71	42	30	3:00	150	5	10	22	36.59	41	30	4:20
	2	110	25	35.71	42	30	3:05	155	5	10	22	36.59	41	30	4:25
Brown	1	90	33	36.67	54	30	2:55	150	5	10	22	36.67	54	30	4:35
	2	95	33	36.67	54	30	3:00	155	5	10	22	36.67	54	30	4:40
	3	100	33	36.67	54	30	3:05	160	5	10	22	36.67	54	30	4:45
	4	105	33	36.67	54	30	3:10	165	5	10	22	36.67	54	30	4:50
						Maximum ETE for Single Wave:	**3:25**							**Maximum ETE for Second Wave:**	**5:00**
						Average ETE for Single Wave:	**3:00**							**Average ETE for Second Wave:**	**4:20**

Table 8-8B. Transit-Dependent Evacuation Time Estimates - Rain

Route Number	Bus Number	Single Wave						Second Wave							
		Mobilization (min)	Route Distance (mi.)	Average Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE	ETE to Rec. Ctr (min)	Unload (min)	Driver Rest (min)	Return time to EPZ (min)	Average Speed (mph)	Route Travel Time (min)	Pickup Time (min)	ETE
1	1	115	18	15.88	68	40	3:45	150	5	10	14	33.75	32	40	4:15
2A	1	115	20	31.58	38	40	3:15	150	5	10	14	31.58	38	40	4:20
2B	1	115	23	23.79	58	40	3:35	150	5	10	14	32.86	42	40	4:25
3A	1	115	13	13.45	58	40	3:35	150	5	10	14	33.91	23	40	4:05
3B	1	115	4	5.85	41	40	3:20	150	5	10	14	15.00	16	40	3:55
4	1	115	10	33.33	18	40	2:55	150	5	10	14	33.33	18	40	4:00
5	1	115	8	30.00	16	40	2:55	150	5	10	14	30.00	16	40	3:55
6	1	115	18	31.76	34	40	3:10	150	5	10	14	31.76	34	40	4:15
7	1	115	16	32.00	30	40	3:05	150	5	10	14	32.00	30	40	4:10
Blue	1	115	21	18.81	67	40	3:45	170	5	10	24	33.16	38	40	4:50
	2	120	21	18.81	67	40	3:50	175	5	10	24	33.16	38	40	4:55
Green	1	100	24	29.39	49	40	3:10	170	5	10	24	34.29	42	40	4:55
	2	105	24	29.39	49	40	3:15	175	5	10	24	34.29	42	40	5:00
	3	110	24	29.39	49	40	3:20	180	5	10	24	34.29	42	40	5:05
	4	115	24	28.80	50	40	3:25	185	5	10	24	34.29	42	40	5:10
	5	120	24	28.80	50	40	3:30	190	5	10	24	34.29	42	40	5:15
	6	125	24	30.64	47	40	3:35	195	5	10	24	34.29	42	40	5:20
	7	130	24	30.64	47	40	3:40	200	5	10	24	34.29	42	40	5:25
	8	135	24	34.29	42	40	3:40	205	5	10	24	34.29	42	40	5:30
	9	140	24	34.29	42	40	3:45	210	5	10	24	34.29	42	40	5:35
	10	145	24	34.29	42	40	3:50	215	5	10	24	34.29	42	40	5:40
Red	1	100	26	24.00	65	40	3:25	170	5	10	24	31.84	49	40	5:00
	2	105	26	23.64	66	40	3:35	175	5	10	24	31.84	49	40	5:05
	3	110	26	23.64	66	40	3:40	180	5	10	24	31.84	49	40	5:10
	4	115	26	23.64	66	40	3:45	185	5	10	24	31.84	49	40	5:15
	5	120	26	23.64	66	40	3:50	190	5	10	24	31.84	49	40	5:20
Pink	1	115	30	30.51	59	40	3:35	170	5	10	24	33.33	54	40	5:05
	2	120	30	30.51	59	40	3:40	175	5	10	24	33.33	54	40	5:10
Purple	1	115	25	30.00	50	40	3:25	170	5	10	24	31.91	47	40	5:00
	2	120	25	30.00	50	40	3:30	175	5	10	24	31.91	47	40	5:05
Brown	1	100	33	31.43	63	40	3:25	170	5	10	24	31.43	63	40	5:15
	2	105	33	31.43	63	40	3:30	175	5	10	24	31.43	63	40	5:20
	3	110	33	31.43	63	40	3:35	180	5	10	24	31.43	63	40	5:25
	4	115	33	31.43	63	40	3:40	185	5	10	24	31.43	63	40	5:30
						Maximum ETE for Single Wave:	**3:50**							**Maximum ETE for Second Wave:**	**5:40**
						Average ETE for Single Wave:	**3:30**							**Average ETE for Second Wave:**	**4:55**

9. TRAFFIC MANAGEMENT STRATEGY

This section presents the suggested traffic control and management strategy that is designed to expedite the movement of evacuating traffic. The resources required to implement this strategy include:

- Personnel with the capabilities of performing the planned control functions of traffic guides (preferably, not necessarily, law enforcement officers).
- Traffic Control Devices to assist these personnel in the performance of their tasks. These devices should comply with the guidance of the Manual of Uniform Traffic Control Devices (MUTCD) published by the Federal Highway Administration (FHWA) of the U.S.D.O.T. All state and most county transportation agencies have access to the MUTCD (also available online). Applicable devices include, with reference to the MUTCD:
    - Traffic Barriers: Chapter 6F, section 6F.61, 62 and Figure 6F-4.
    - Traffic Cones: Chapter 3F and section 6F.56.
    - Signs: Chapter 2I
- A plan that defines all necessary details and is documented in a format that is readily understood by those assigned to perform traffic control.

The functions to be performed in the field are:

1. Facilitate evacuating traffic movements that serve to expedite travel out of the EPZ along routes that the analysis has found to be most effective.
2. Discourage traffic movements that permit evacuating vehicles to travel in a direction which takes them significantly closer to the power station, or which interferes with the efficient flow of other evacuees.

We employ the terms "facilitate" and "discourage" rather than "enforce" and "prohibit" to indicate the need for flexibility in performing the traffic control function. There are always legitimate reasons for a driver to prefer a direction other than that indicated. For example:

- A driver may be traveling home from work or from another location, to join other family members preliminary to evacuating.
- An evacuating driver may be taking a detour from the evacuation route in order to pick up a relative, or other evacuees.
- The driver may be an emergency worker en route to perform an important activity.

The implementation of a plan must also be flexible enough for the application of sound judgment by the traffic guide.

The traffic management strategy is the outcome of the following process:

1. A field survey of these critical locations.
   The schematics describing traffic control, which are presented in Appendix G, are based on data collected during field surveys, upon large-scale maps, and on overhead photos.
2. Computer analysis of the evacuation traffic flow environment.
   This analysis identifies the best routing and those locations that experience pronounced congestion.
3. Consultation with emergency management and enforcement personnel.
   Trained personnel who are experienced in controlling traffic and are aware of the likely evacuation traffic patterns have reviewed these control tactics.
4. Prioritization of TCPs.
   Application of traffic control at some TCPs will have a more pronounced influence on expediting traffic movements than at other TCPs. For example, TCPs controlling traffic originating from areas in close proximity to the power plant could have a more beneficial effect on minimizing potential exposure to radioactivity than those TCPs located far from the power plant. Thus, during the mobilization of personnel to respond to the emergency situation, those TCPs which are assigned a higher priority should be manned earlier. These priorities have been reviewed by state/county emergency management representatives and by law enforcement personnel.

The control tactic at each TCP is presented in each schematic that appears in Appendix G. The traffic management plan has been reviewed by the state and county emergency planners with local and state police. Specifically the number and locations of the suggested TCP and ACP have been reviewed in detail, and the indicated resource requirements have been reconciled with current assets.

The use of Intelligent Transportation Systems (ITS) technologies can reduce manpower and equipment needs, while still facilitating the evacuation process. Dynamic Message Signs (DMS) can be placed within the EPZ to provide information to travelers regarding traffic conditions, route selection, and reception center information. DMS can also be placed outside of the EPZ to warn motorists to avoid using routes that may conflict with the flow of evacuees away from the power plant. Highway Advisory Radio (HAR) can be used to broadcast information to evacuees en route through their vehicle stereo systems. Automated Traveler Information Systems (ATIS) can also be used to provide evacuees with information. Internet websites can provide traffic and evacuation route information before the evacuee begins his trip, while on board navigation systems (GPS units), cell phones, and pagers can be used to provide information en route. These are only several examples of how ITS technologies can benefit the evacuation process. Consideration should be given that ITS technologies be used to facilitate the evacuation process, and any additional signage placed should consider evacuation needs.

Chapter 2I of the MUTCD presents guidance on Emergency Management signing. Specifically, the Evacuation Route sign, EM-1 on page 2I-3, with the word “Hurricane” removed, could be installed selectively within the EPZ, if considered advisable by local and state authorities. Similar comments apply to sign EM-3 which identifies TCP locations.

As discussed in Section 2.3, these TCP are not credited in calculating the ETE results. Access control points (ACP) are deployed near the periphery of the EPZ to divert “through” trips. The ETE calculations reflect the assumptions that all “external-external” trips are interdicted after 90 minutes have elapsed after the advisory to evacuate (ATE).

All transit trips and other responders entering the EPZ to support the evacuation are assumed to be unhindered by personnel manning TCP.

Study Assumptions 5 and 6 in Section 2.3 discuss ACP and TCP staffing schedules and operations.

10. EVACUATION ROUTES

Evacuation routes are comprised of two distinct components:

- Routing from an ERPA being evacuated to the boundary of the Evacuation Region and thence out of the Emergency Planning Zone (EPZ).
- Routing of evacuees from the EPZ boundary to reception centers.

Evacuees should be routed within the EPZ in such a way as to *minimize their exposure to risk*. This primary requirement is met by routing traffic to move away from the location of the PSEG Site, to the extent practicable, and by delineating evacuation routes that expedite the movement of evacuating vehicles. This latter objective is addressed by developing evacuation routes to achieve a balancing of traffic demand relative to the available highway capacity to the extent possible, subject to satisfying the primary requirement noted above. This is achieved by carefully specifying candidate destinations for all origin centroids where evacuation trips are generated, and applying the TRAD model effectively. See Appendices A-D for further discussion.

The routing of evacuees from the EPZ boundary to reception centers should be responsive to several considerations:

- Minimize the amount of travel outside the EPZ, from the points where these routes cross the EPZ boundary, to the reception centers.
- Relate the anticipated volume of traffic destined to the reception center, to the capacity of the reception center facility.

Figure 10-1 presents a map showing the general population reception centers. The major evacuation routes for the four quadrants of the EPZ are presented in Figures 10-2 through 10-5.

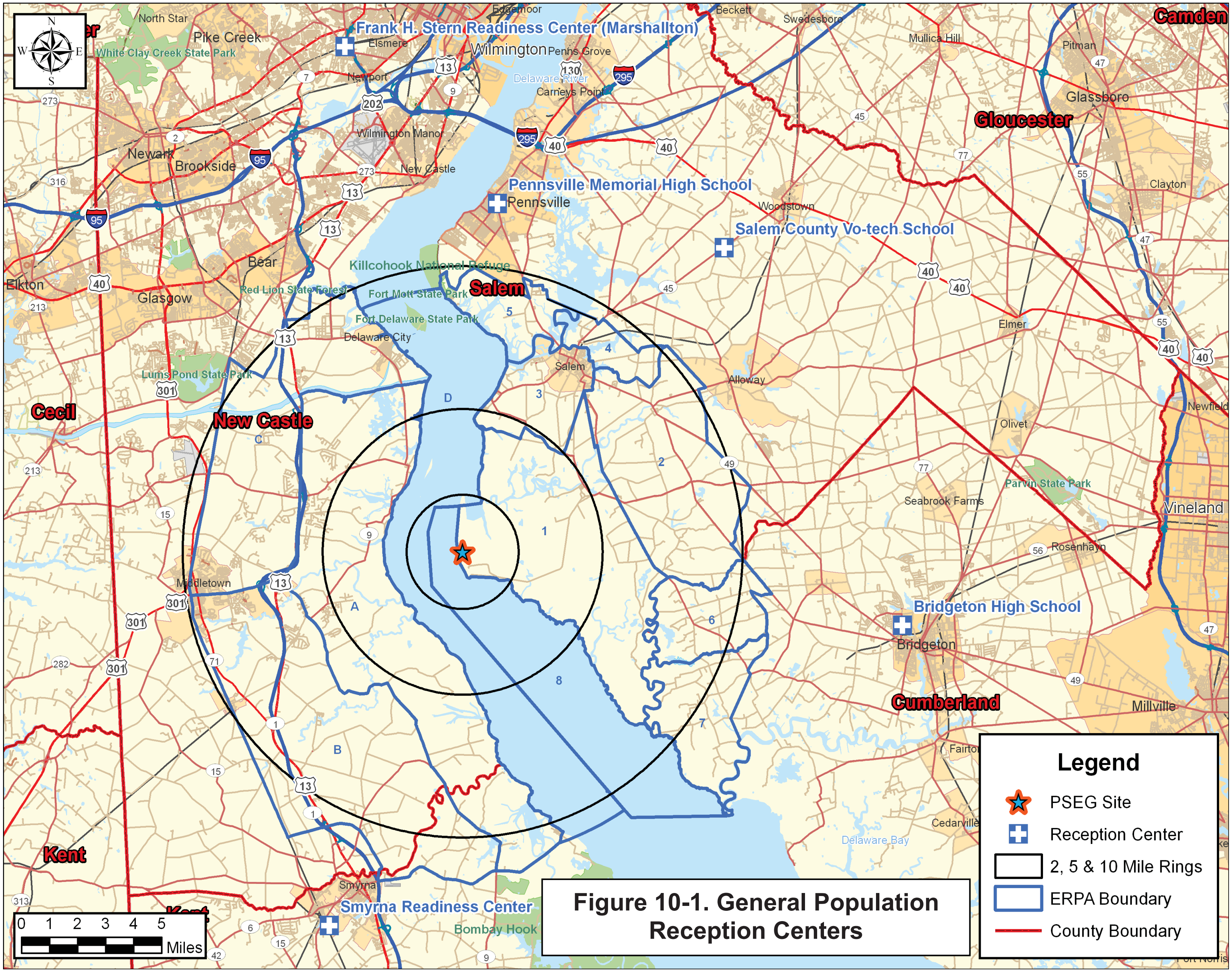


Figure 10-1. General Population Reception Centers

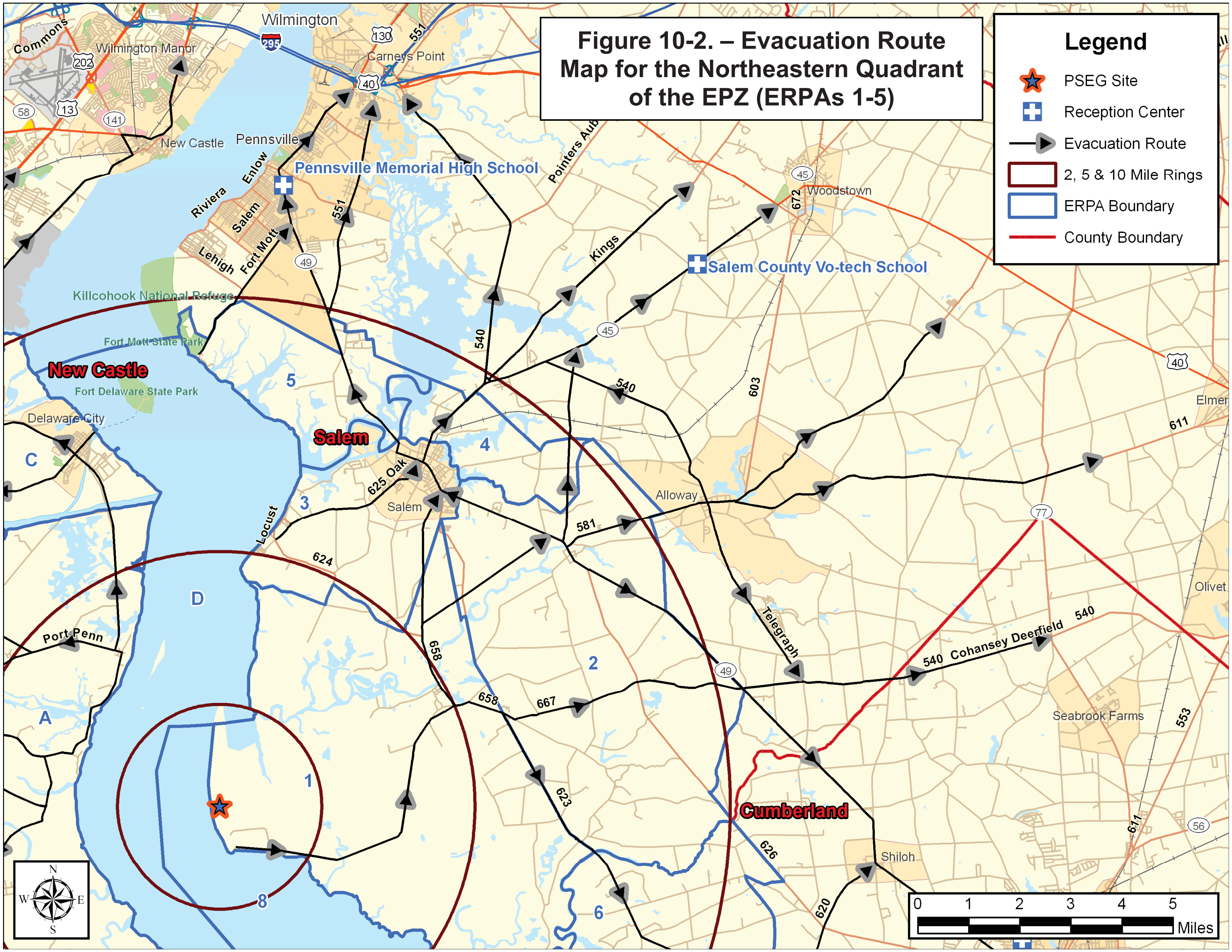


Figure 10-2. – Evacuation Route Map for the Northeastern Quadrant of the EPZ (ERPAs 1-5)
Legend
PSEG Site
Reception Center
Evacuation Route
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundary
Wilmington
Wilmington Manor
Carneys Point
New Castle
Pennsville
Pennsville Memorial High School
Salem County Vo-tech School
Woodstown
Killcohook National Refuge
Fort Mott State Park
New Castle
Fort Delaware State Park
Delaware City
Salem
Alloway
Cumberland
Seabrook Farms
Shiloh
Elmer
Olivet
Port Penn
Cohansey Deerfield
Telegraph
Kings
Pointers Aub
Riviera
Enlow
Lehigh
Fort Mott
Locust
Oak
1
2
3
4
5
6
8
A
C
D
0 1 2 3 4 5
Miles

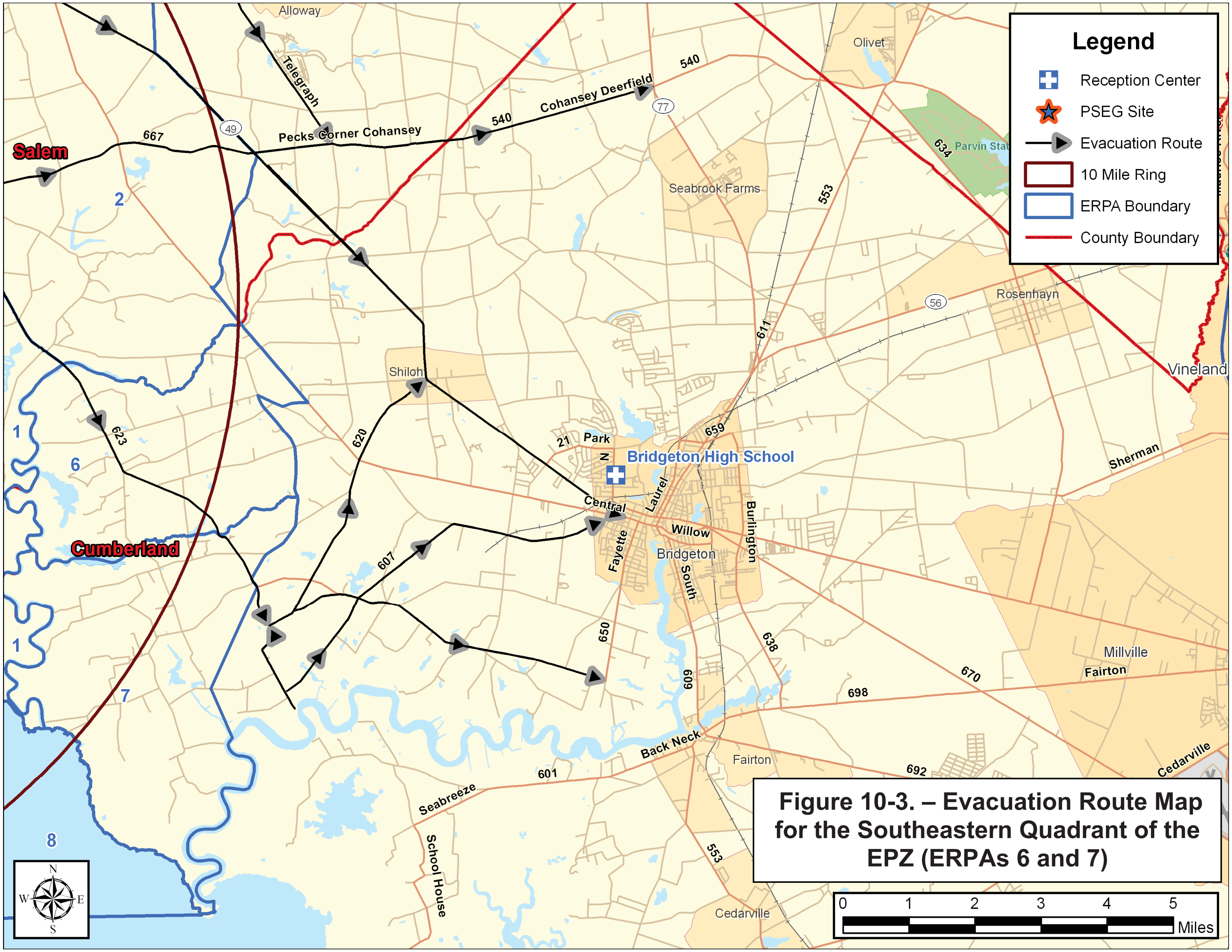


Figure 10-3. – Evacuation Route Map for the Southeastern Quadrant of the EPZ (ERPAs 6 and 7)

Figure 10-4. – Evacuation Route Map for the Northwestern Quadrant of the EPZ (ERPA C)

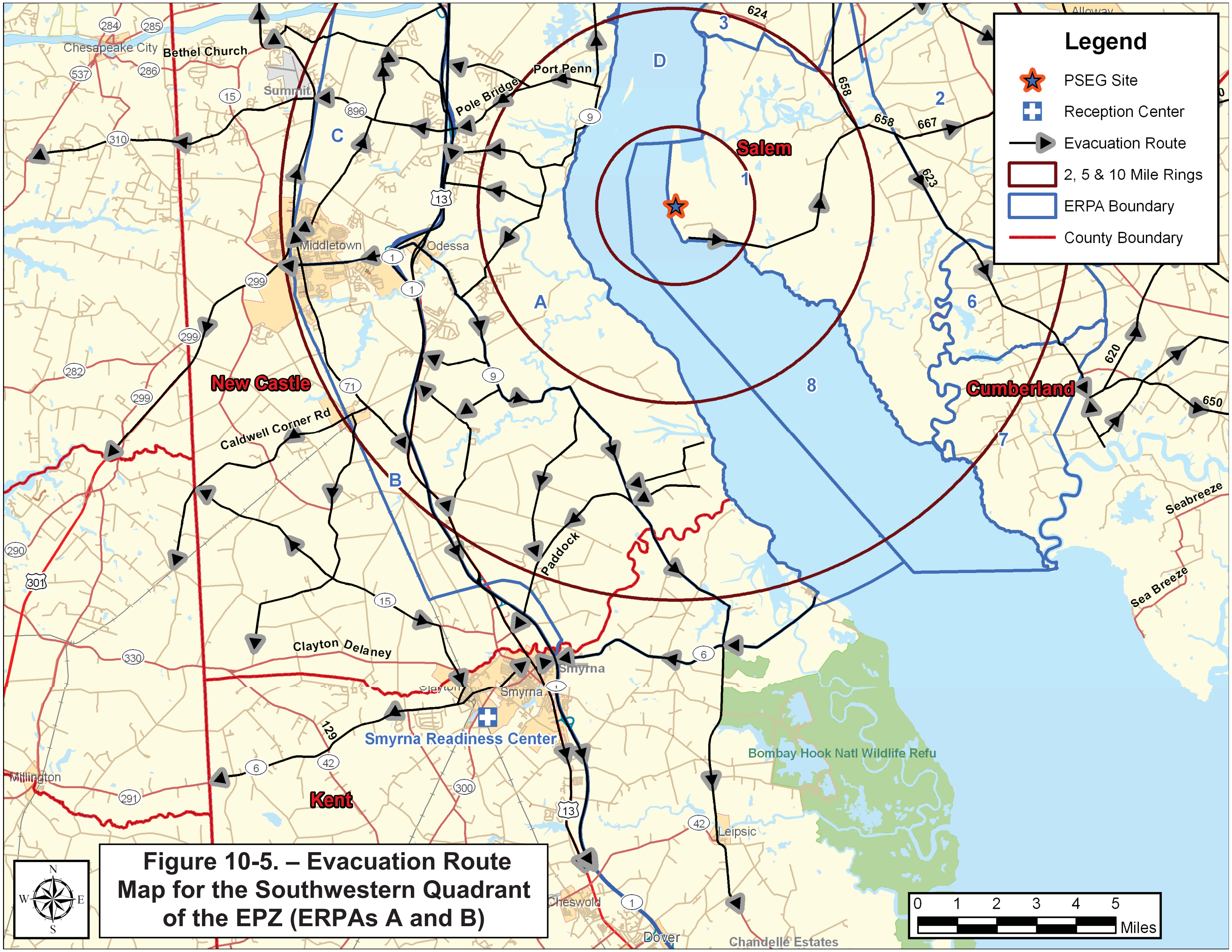


Figure 10-5. – Evacuation Route Map for the Southwestern Quadrant of the EPZ (ERPAs A and B)

11. SURVEILLANCE OF EVACUATION OPERATIONS

There is a need for surveillance of traffic operations during the evacuation. There is also a need to clear any blockage of roadways arising from accidents or vehicle disablement. Surveillance can take several forms.

1. Traffic control personnel, located at Traffic Control and Access Control points, provide fixed-point surveillance.
2. Ground patrols may be undertaken along well-defined paths to ensure coverage of those highways that serve as major evacuation routes.
3. Aerial surveillance of evacuation operations may also be conducted using helicopter or fixed-wing aircraft.
4. Cellular phone calls (if cellular coverage exists) from motorists may also provide direct field reports of road blockages.

These concurrent surveillance procedures are designed to provide coverage of the entire EPZ as well as the area around its periphery. It is the responsibility of the Counties to support an emergency response system that can receive messages from the field and be in a position to respond to any reported problems in a timely manner. This coverage should quickly identify, and expedite the response to any blockage caused by a disabled vehicle.

Tow Vehicles

In a low-speed traffic environment, any vehicle disablement is likely to arise due to a low-speed collision, mechanical failure or the exhaustion of its fuel supply. In any case, the disabled vehicle can be pushed onto the shoulder, thereby restoring traffic flow. Past experience in other emergencies indicates that evacuees who are leaving an area often perform activities such as pushing a disabled vehicle to the side of the road without prompting.

While the need for tow vehicles is expected to be low under the circumstances described above, it is still prudent to be prepared for such a need. Consideration should be given that tow trucks with a supply of gasoline be deployed at strategic locations within, or just outside, the EPZ. These locations should be selected so that:

- They permit access to key, heavily loaded, evacuation routes.
- Responding tow trucks would most likely travel counter-flow relative to evacuating traffic.

Consideration should also be given that the state emergency management agencies encourage gas stations to remain open during the evacuation.

12. CONFIRMATION TIME

It is necessary to confirm that the evacuation process is effective in the sense that the public is complying with the Advisory to Evacuate. Consideration should be given that the counties and states in the EPZ develop procedures for confirmation of the evacuation. Should procedures not already exist, we suggest an alternative or complementary approach.

The procedure we suggest employs a stratified random sample and a telephone survey. The size of the sample is dependent on the expected number of households that do not comply with the Advisory to Evacuate. We believe it is reasonable to assume, for the purpose of estimating sample size that at least 80 percent of the population within the EPZ will comply with the Advisory to Evacuate. On this basis, an analysis could be undertaken (see Table 12-1) to yield an estimated sample size of approximately 300.

The confirmation process should start at about 3 hours after the Advisory to Evacuate, which is when 90 percent of evacuees have completed their mobilization activities (see Table 5-9). At this time, virtually all evacuees will have departed on their respective trips and the local telephone system will be largely free of traffic.

As indicated in Table 12-1, approximately 7½ person hours are needed to complete the telephone survey. If six people are assigned to this task, each dialing a different set of telephone exchanges (e.g., each person can be assigned a different set of ERPAs), then the confirmation process will extend over a time frame of about 75 minutes. Thus, the confirmation should be completed well before the evacuated area is cleared. Of course, fewer people would be needed for this survey if the Evacuation Region were only a portion of the EPZ. Use of modern automated computer controlled dialing equipment can significantly reduce the manpower requirements and the time required to undertake this type of confirmation survey.

If this method is indeed used by the EPZ counties, consideration should be given that a list of telephone numbers within the EPZ be kept in the Emergency Operations Center (EOC) at all times. Such a list could be purchased from vendors and should be periodically updated. As indicated above, the confirmation process should not begin until 3 hours after the Advisory to Evacuate, to ensure that households have had enough time to mobilize. This 3-hour timeframe will enable telephone operators to arrive at their workplace, obtain a call list and prepare to make the necessary phone calls.

Should the number of telephone responses (i.e., people still at home) exceed 20 percent, then the telephone survey should be repeated after an hour's interval until the confirmation process is completed.

TABLE 12-1
ESTIMATED NUMBER OF TELEPHONE CALLS REQUIRED FOR CONFIRMATION OF EVACUATION

Problem Definition

Estimate number of phone calls, n, needed to ascertain the proportion, F of households that have not evacuated.

Reference: Burstein, H., Attribute Sampling, McGraw Hill, 1971

Given:

No. of households plus other facilities, N, within the EPZ (est.) = 15,500
Est. proportion, F, of households that will not evacuate = 0.20
Allowable error margin, e: 0.05
Confidence level, α: 0.95 (implies A = 1.96)

Applying Table 10 of cited reference,

$$p = F + e = 0.25;\ q = 1 - p = 0.75$$

$$n = \frac{A^2 pq + e}{e^2} = 308$$

Finite population correction:

$$n_F = \frac{nN}{n + N - 1} = 302$$

Thus, some 300 telephone calls will confirm that approximately 20 percent of the population has not evacuated. If only 10 percent of the population does not comply with the Advisory to Evacuate, then the required sample size, n_F = 213.

Est. Person Hours to complete 300 telephone calls

Assume: Time to dial using touch-tone (random selection of listed numbers): 30 seconds
Time for 6 rings (no answer): 36 seconds
Time for 4 rings plus short conversation: 60 sec.
Interval between calls: 20 sec.

Person Hours: 300[30+0.8(36)+0.2(60)+20]/3600 = 7.6

13. OBSERVATIONS

The following considerations are offered:

1. The traffic management plan has been reviewed by state and county emergency planners with local and state police (See Section 9 and Appendix G). Specifically…
   - The number and locations of suggested Traffic Control Points (TCP) and Access Control Points (ACP) have been reviewed in detail.
   - The indicated resource requirements (personnel, cones, barriers, etc.) have been reconciled with current assets.
2. Intelligent Transportation Systems (ITS) such as Dynamic Message Signs (DMS), Highway Advisory Radio (HAR), Automated Traveler Information Systems (ATIS), etc. should be used to facilitate the evacuation process (See Section 9). The placement of additional signage should consider evacuation needs.
3. Counties/states should implement procedures whereby schools are contacted prior to dispatch of buses from the depots to get an accurate count of students needing transportation and the number of buses required (See Section 8).
4. Average school ETE (Tables 8-6A and 8-6B) do not exceed the ETE for the general population at the 90th percentile for an evacuation of the entire EPZ (Region R03). The ETE for transit-dependent people (Tables 8-8A and 8-8B) do exceed the ETE for the general population at the 90th percentile. Thus, Tables 8-8A and 8-8B should be considered when making Protective Action Decisions.
5. Counties/states should establish strategic locations to position tow trucks provided with gasoline containers in the event of a disabled vehicle during the evacuation process (see Section 11) and should encourage gas stations to remain open during the evacuation.
6. Counties/states should establish a system to confirm that the Advisory to Evacuate is being adhered to (see the approach suggested by KLD in Section 12).
   - Should the approach offered by KLD in Section 12 be used, consideration should be given to keep a list of telephone numbers within the EPZ in the Emergency Operations Center (EOC) at all times.
7. Examination of the general population ETE in Section 7 and in Appendix J shows that the ETE for 100 percent of the population is generally 3 to 3½ hours longer than for 90 percent of the population. Specifically, the additional time needed for the last 10 percent of the population to evacuate can be as much as double the time needed to evacuate 90 percent of the population. This non-linearity reflects the fact that these relatively few stragglers require significantly more time to mobilize (i.e. prepare for the evacuation trip) than their neighbors. This leads to two considerations:
   - The public outreach (information) program should emphasize the need for evacuees to minimize the time needed to prepare to evacuate (secure the home, assemble needed clothes, medicines, etc.).

- The decision makers should reference Table 7-1B or Table J-1B which list the time needed to evacuate 90 percent of the population, when preparing recommended protective actions.

APPENDIX A

Glossary of Traffic Engineering Terms

APPENDIX A: GLOSSARY OF TRAFFIC ENGINEERING TERMS

Term	Definition
Link	A network link represents a specific, one-directional section of roadway. A link has both physical (length, number of lanes, topology, etc.) and operational (turn movement percentages, service rate, free-flow speed) characteristics.
Measures of Effectiveness	Statistics describing traffic operations on a roadway network.
Node	A network node generally represents an intersection of network links. A node has control characteristics, i.e., the allocation of service time to each approach link.
Origin	A location attached to a network link, within the EPZ or shadow region, where trips are generated at a specified rate in vehicles per hour (vph). These trips enter the roadway system to travel to their respective destinations.
Network	A graphical representation of the geometric topology of a physical roadway system, which is comprised of directional links and nodes.
Prevailing Roadway and Traffic Conditions	Relates to the physical features of the roadway, the nature (e.g., composition) of traffic on the roadway and the ambient conditions (weather, visibility, pavement conditions, etc.).
Service Rate	Maximum rate at which vehicles, executing a specific turn maneuver, can be discharged from a section of roadway at the prevailing conditions, expressed in vehicles per second (vps) or vehicles per hour (vph).
Service Volume	Maximum number of vehicles which can pass over a section of roadway in one direction during a specified time period with operating conditions at a specified Level of Service (The Service Volume at the upper bound of Level of Service, E, equals Capacity). Service Volume is usually expressed as vehicles per hour (vph).
Signal Cycle Length	The total elapsed time to display all signal indications, in sequence. The cycle length is expressed in seconds.
Signal Interval	A single combination of signal indications. The interval duration is expressed in seconds. A signal phase is comprised of a sequence of signal intervals.
Signal Phase	A set of signal indications (and intervals) which services a particular combination of traffic movements on selected approaches to the intersection. The phase duration is expressed in seconds.

Term	Definition
Traffic (Trip) Assignment	A process of assigning traffic to paths of travel in such a way as to satisfy all trip objectives (i.e., the desire of each vehicle to travel from a specified origin in the network to a specified destination) and to optimize some stated objective or combination of objectives. In general, the objective is stated in terms of minimizing a generalized "cost". For example, "cost" may be expressed in terms of travel time.
Traffic Density	The number of vehicles that occupy one lane of a roadway section of specified length at a point in time, expressed as vehicles per mile (vpm).
Traffic (Trip) Distribution	A process for determining the destinations of all traffic generated at the origins. The result often takes the form of a Trip Table, which is a matrix of origin-destination traffic volumes.
Traffic Simulation	A computer model designed to replicate the real-world operation of vehicles on a roadway network, so as to provide statistics describing traffic performance. These statistics are called Measures of Effectiveness.
Traffic Volume	The number of vehicles that pass over a section of roadway in one direction, expressed in vehicles per hour (vph). Where applicable, traffic volume may be stratified by turn movement.
Travel Mode	Distinguishes between private auto, bus, rail, pedestrian and air travel modes.
Trip Table or Origin-Destination Matrix	A rectangular matrix or table, whose entries contain the number of trips generated at each specified origin, during a specified time period, that are attracted to (and travel toward) each of its specified destinations. These values are expressed in vehicles per hour (vph) or in vehicles.
Turning Capacity	The capacity associated with that component of the traffic stream which executes a specified turn maneuver from an approach at an intersection.

APPENDIX B

Traffic Assignment Model

APPENDIX B: TRAFFIC ASSIGNMENT MODEL

This section describes the integrated trip assignment and distribution model named TRAD that is expressly designed for use in analyzing evacuation scenarios. This model employs equilibrium traffic assignment principles and is one of the models of the IDYNEV System.

To apply TRAD, the analyst must specify the highway network, link capacity information, the volume of traffic generated at all origin centroids, a set of accessible candidate destination nodes on the periphery of the EPZ for each origin, and the capacity (i.e., "attraction") of each destination node. TRAD calculates the optimal trip distribution and the optimal trip assignment (i.e., routing) of the traffic generated at each origin node, traveling to the associated set of candidate destination nodes, so as to minimize evacuee travel times.

Overview of Integrated Distribution and Assignment Model

The underlying premise is that the selection of destinations and routes is intrinsically coupled in an evacuation scenario. That is, people in vehicles seek to travel out of an area of potential risk as rapidly as possible by selecting the "best" route. The model is designed to identify these "best" routes in a manner that distributes vehicles from origins to destinations and routes them over the highway network, in a consistent and optimal manner.

The approach we adopt is to extend the basic equilibrium assignment methodology to embrace the distribution process, as well. That is, the selection of destination nodes by travelers from each origin node, and the selection of the connecting paths of travel, are both determined by the integrated model. This determination is subject to specified capacity constraints, so as to satisfy the stated objective function. This objective function is the statement of the User Optimization Principle by Wardrop[1].

To accomplish this integration, we leave the equilibrium assignment model intact, changing only the form of the objective function. It will also be necessary to create a "fictional" augmentation of the highway network. This augmentation will consist of Pseudo-Links and Pseudo-Nodes, so configured as to embed an equilibrium Distribution Model within the fabric of the Assignment Model.

[1] Wardrop, J.G., 1952. Some Theoretical Aspects of Road Traffic Research, *Proceedings, Institute of Civil Engineers*, Part II, Vol. 1, pp. 325-378.

Specification of TRAD Model Inputs

The user must specify, for each origin node, the average hourly traffic volume generated, as well as a set of candidate accessible destinations. A destination is "accessible" to traffic originating at an origin node if there is at least one path connecting the origin to the destination node. There must be at least one destination node specified for each origin centroid. The number of trips generated at the origin node, which are distributed to each specified, accessible destination node within this set, is determined by the model in a way as to satisfy the network-wide objective function (Wardrop's Principle).

The user must also specify the total number of trips which can be accommodated by each destination node. This value reflects the capacities of the road(s) immediately servicing the destination node. We call this number of trips, the "attraction" of the destination node, consistent with conventional practice. Clearly, we require that the total number of trips traveling to a destination, j, from all origin nodes, i, cannot exceed the attraction of destination node, j. By summing over all destination nodes, this constraint also states that the total trips generated at all origin nodes must not exceed the total capacity to accommodate these trips at all of the specified destinations.

In summary, the user must specify the total trips generated at each of the origin nodes, the maximum number of trips that can be accommodated by each of the specified destination nodes and the highway network attributes which include the traffic control tactics. The TRAD model includes a function which expresses travel time on each network link in terms of traffic volume and link capacity. This function drives the underlying trip distribution and trip assignment decision-making process. Thus, the TRAD model satisfies the objectives of evacuees to select destination nodes and travel paths to minimize evacuation travel time. As such, this integrated model is classified as a behavioral model.

At the outset, it may appear that we have an intractable problem:

- If TRAD retains the basic assignment algorithm, it must be provided a Trip Table as input.
- On the other hand, if the distribution model is embedded within the assignment model, rather than preceding it, a Trip Table is not available as input.

The resolution of this problem is as follows:

1. We construct an "augmentation" network that allows the user to specify only the volume for each origin node. The allocation of trips from the origin node to each candidate destination node is not specified and will be determined internally by the model.
2. We construct pseudo-links which enforce the specified values of attraction, A_j, for all destination nodes, j, by suitably calibrating the relationship of the travel time vs. volume and capacity.

This augmented network is comprised of three subnetworks:

1. The highway subnetwork, which consists of "Class I" Links and Nodes.
2. A subnetwork of "Class II" Pseudo-Links which acts as an interface between the highway subnetwork and the network augmentation.
3. The subnetwork of "Class III" Pseudo-Links and Nodes which comprises the network augmentation described above.

The need for these Class II links will become clear later. The classifications are described below:

Class I Links and Nodes

These links and nodes represent the physical highway network: sections of highway and intersections. Trips generated at each Origin [Centroid] Node are assigned to a specified Class I link via a "connector" link. These connector links are transparent to the user and offer no impedance to the traveler; they represent the aggregation of local streets which service the centroidal generated trips and feed them onto the highway network. The real-world destination nodes are part of this network. The immediate approaches to these destination nodes are Class I links.

Class II Links

These pseudo-links are constructed so as to connect each specified destination node with its Class III Pseudo-Node (P-N) counterpart on a one-to-one basis. The capacities of these Class II links are set equal to the capacities at their respective destination nodes.

Class III Links and Nodes

Class III links and nodes form the augmentation to the basic network. These Pseudo-Links provide paths from the Class II links servicing traffic traveling from the specified [real] destination nodes, to the Super-Nodes which represent the user-specified set of destination nodes associated with each origin node.
Each Class of links provides a different function:

- Class I links represent the physical highway network. As such, each link has a finite capacity, a finite length and an estimated travel time for free-flowing vehicles. The nodes generally represent intersections, interchanges and, possibly, changes in link geometry. The topology of the Class I network represents that of the physical highway system.
- The Class II links represent the interface between the real highway subnetwork and the augmentation subnetwork. These pseudo-links are needed to represent the specified "attractions" of each destination node, i.e.,

the maximum number of vehicles that can be accommodated by each destination node. Instead of explicitly assigning a capacity limitation to the destination nodes, we assign this capacity limitation of the Class II Pseudo-Links. This approach is much more suitable, computationally.

- The topology of the network augmentation (i.e., Class III Links and Nodes) is designed so that all traffic from an origin node can only travel to the single "Super-Node" by flowing through its set of real destination nodes, thence along the links of the augmented network.

The Class II Pseudo-Links and the network augmentation of Class III Pseudo-Nodes and Links represent logical constructs of fictitious links created internally by the model that allows the user to specify the identity of all destination nodes in each origin-based set, without specifying the distribution of traffic volumes from the origin to each destination node in that set.

Calculation of Capacities and Impedances

Each class of links exhibits different properties. Specifically, the relationship between travel impedance (which is expressed in terms of travel time) and both volume and capacity will differ:

- For Class I links, the capacity represents the physical limitation of the highway sections. Travel impedance is functionally expressed by relating travel time with respect to the traffic volume-link capacity relationship.
- For Class II links, link capacity represents the maximum number of vehicles that can be accommodated at the [real] destination nodes that form the upstream nodes of each Class II link. Since Class II links are Pseudo-Links, there should be virtually no difference in impedance to traffic along Class II links when the assigned traffic volume on these links is below their respective capacities. That is, the assignment of traffic should not be influenced by differences in travel impedance on those Class II links where the assigned volumes do not exceed their respective capacities.
- For Class III links, both capacity and impedance have no meaning. Since the Class II links limit the number of vehicles entering the Class III subnetwork at all entry points (i.e., at the Class II Pseudo-Nodes) and since all these links are Pseudo-Links, it follows that the Class III network is, by definition, an uncapacitated network.

Specification of the Objective Function

It is computationally convenient to be able to specify a single impedance (or "cost") function relating the travel time on a link, to its capacity and assigned traffic volume, for all classes of links. To achieve this, we will adopt the following form based on the original "BPR Formula[2]":

$$T = T_o\{\alpha[1 + a_1(\frac{v}{c})^{b_1}] + \beta[1 + a_2(\frac{v}{c})^{b_2}]\} + I$$

Where, as for the present traffic assignment model in TRAD,

T	=	Link travel time, sec.
T_o	=	Unimpeded link travel time, sec.
V	=	Traffic volume on the link, veh/hr
C	=	Link capacity, veh/hr
a_i, b_i	=	Calibration parameters
α, ß	=	Coefficients defined below
I	=	Impedance term, expressed in seconds, which could represent turning penalties or any other factor which is justified in the user's opinion

The assignment of coefficients varies according to the Class in which a link belongs:

Class	α	ß	T_o
I	1	0	L/U_f
II	0	1	W
III	0	0	1

Here, L is a highway link length and U_f is the free-flow speed of traffic on a highway link. The values of a_1 and b_1, which are applicable only for Class I links, are based on experimental data:

$a_1 = 0.8$ $b_1 = 5.0$

The values of a_2 and b_2, which are applicable for each Class II link, are based upon the absolute requirement that the upstream destination node can service no more traffic than the user-specified value of the maximum "attraction". In addition, these parameters must be chosen so that these Pseudo-Links all offer the same impedance to traffic when their assigned volumes are less than their respective specified maximum attractions.

The weighting factor, W, is computed internally by the software.

[2] Bureau of Public Roads (1964). Traffic Assignment Manual. U.S. Dept. of Commerce, Urban Planning Division, Washington D.C.

Of course, it is still possible for the assignment algorithm within TRAD to distribute more traffic to a destination node than that node can accommodate. For emergency planning purposes, this is a desirable model feature. Such a result will be flagged by the model to alert the user to the fact that some factor is strongly motivating travelers to move to that destination node, despite its capacity limitations. This factor can take many forms: inadequate highway capacity to other destinations, improper specification of candidate destinations for some of the origins, or some other design inadequacy. The planner can respond by modifying the control tactics, changing the origin-destination distribution pattern, providing more capacity at the overloaded destinations, etc.

APPENDIX C

Traffic Simulation Model: PC-DYNEV

APPENDIX C: TRAFFIC SIMULATION MODEL: PC-DYNEV

A model, named PC-DYNEV, is an adaptation of the TRAFLO Level II simulation model, developed by KLD for the Federal Highway Administration (FHWA). Extensions in scope were introduced to expand the model's domain of application to include all types of highway facilities, to represent the evacuation traffic environment and to increase its computational efficiency. This model produces the extensive set of output Measures of Effectiveness (MOE) shown in Table C-1.

The traffic stream is described internally in the form of statistical flow profiles. These profiles, expressed internally as statistical histograms, describe the platoon structure of the traffic stream on each network link. The simulation logic identifies five types of histograms:

- The ENTRY histogram which describes the platoon flow at the upstream end of the subject link. This histogram is simply an aggregation of the appropriate OUTPUT turn-movement-specific histograms of all feeder links.
- The INPUT histograms which describe the platoon flow pattern arriving at the stop line. These are obtained by first disaggregating the ENTRY histogram into turn-movement-specific component ENTRY histograms. Each such component is modified to account for the platoon dispersion which results as traffic traverses the link. The resulting INPUT histograms reflect the specified turn percentages for the subject link.
- The SERVICE histogram which describes the service rates for each turn movement. These service rates reflect the type of control device servicing traffic on this approach; if it is a signal, then this histogram reflects the specified movement-specific signal phasing. A separate model estimates service rates for each turn movement, given that the control is GO.

These data are provided for each network link and are also aggregated over the entire network.

- The QUEUE histograms that describe the time-varying ebb and growth of the queue formation at the stop line. These histograms are derived from the interaction of the respective IN histograms with the SERVICE histograms.
- The OUT histograms that describe the pattern of traffic discharging from the subject link. Each of the IN histograms is transformed into an OUT histogram by the control applied to the subject link. Each of these OUT histograms is added into the (aggregate) ENTRY histogram of its receiving link. This approach provides the model with the ability to identify the characteristics of each turn-movement-specific component of the traffic stream. Each component is serviced at a different saturation flow rate as is the case in the real world. The logic recognizes when one component of the traffic flow encounters saturation conditions even if the others do not.

Algorithms provide estimates of delay and stops reflecting the interaction of the IN histograms with the SERVICE histograms. The logic also provides for properly treating spillback conditions reflecting queues extending from its host link, into its upstream feeder links.

A valuable feature is the ability to internally generate functions that relate mean speed to density on each link, given user-specified estimates of free-flow speed and saturation service rates for each link. Such relationships are essential in order to simulate traffic operations on freeways and rural roads, where signal control does not exist or where its effect is not the dominant factor in impeding traffic flow.

All traffic simulation models are data-intensive. Table C-2 outlines the input data elements. This input describes:

- Topology of the roadway system
- Geometrics of each roadway component
- Channelization of traffic on each roadway component
- Motorist behavior that, in aggregate, determines the operational performance of vehicles in the system
- Specification of the traffic control devices and their operational characteristics
- Traffic volumes entering and leaving the roadway system
- Traffic composition.

To provide an efficient framework for defining these specifications, the physical environment is represented as a network. The unidirectional links of the network generally represent roadway components: either urban streets or freeway segments. The nodes of the network generally represent urban intersections or points along the freeway where a geometric property changes (e.g. a lane drop, change in grade or ramp).

Figure C-1 is an example of a small network representation. The freeway is defined by the sequence of links, (20,21), (21,22), and (22,23). Links (8001, 19) and (3, 8011) are Entry and Exit links, respectively. An arterial extends from node 3 to node 19 and is partially subsumed within a grid network. Note that links (21,22) and (17,19) are grade-separated.

Table C-1. Measures of Effectiveness Output by PC-DYNEV	
Measure	**Units**
Travel	Vehicle-Miles and Vehicle-Trips
Moving Time	Vehicle-Minutes
Delay Time	Vehicle-Minutes
Total Travel Time	Vehicle-Minutes
Efficiency: Moving Time/Total Travel Time	Percent
Mean Travel Time per Vehicle	Seconds
Mean Delay per Vehicle	Seconds
Mean Delay per Vehicle-Mile	Seconds/Mile
Mean Speed	Miles/Hour
Mean Occupancy	Vehicles
Mean Saturation	Percent
Vehicle Stops	Percent

Table C-2. Input Requirements for the PC-DYNEV Model

GEOMETRICS

- Links defined by upstream downstream node numbers
- Links lengths
- Number of lanes (up to 6)
- Turn pockets
- Grade
- Network topology defined in terms of target nodes for each receiving link

TRAFFIC VOLUMES

- On all entry links and sink/source nodes stratified by vehicle type: auto, car pool, bus, truck
- Link-specific turn movements

TRAFFIC CONTROL SPECIFICATIONS

- Traffic signals: link-specific, turn movement specific
- Signal control treated as fixed time
- Stop and Yield signs
- Right-turn-on-red (RTOR)
- Route diversion specifications
- Turn restrictions
- Lane control (e.g. lane closure, movement-specific)

DRIVER'S AND OPERATIONAL CHARACTERISTICS

- Drivers (vehicle-specific) response mechanisms: free-flow speed, aggressiveness, discharge headway
- Link-specific mean speed for free-flowing (unimpeded) traffic
- Vehicle-type operational characteristics: acceleration, deceleration
- Such factors as bus route designation, bus station location, dwell time, headway, etc.

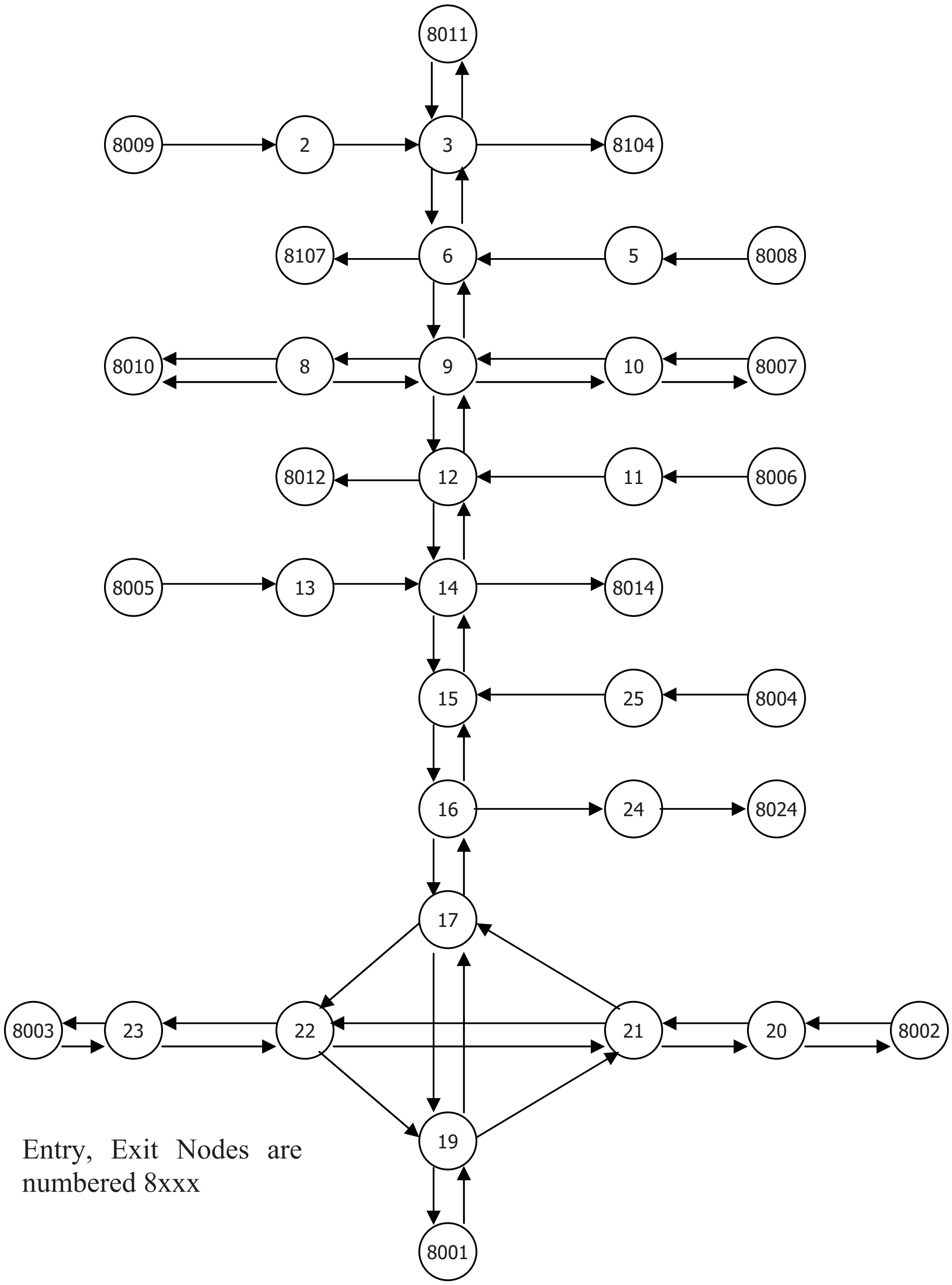


Figure C-1: Representative Analysis Network

APPENDIX D

Detailed Description of Study Procedure

APPENDIX D: DETAILED DESCRIPTION OF STUDY PROCEDURE

This appendix describes the activities that were performed to compute accurate Evacuation Time Estimates (ETE). The individual steps of this effort are represented as a flow diagram in Figure D-1. Each numbered step in the description that follows corresponds to the numbered element in this flow diagram.

Step 1.
The first activity is to obtain data defining the spatial distribution and demographic characteristics of the population within the Emergency Planning Zone (EPZ). These data were obtained from U.S. Census files and from the telephone survey results. Employee data were estimated by referencing state Journey-to-Work data provided by the U.S. Census, from phone calls to major employers and from assumptions based on parking lot capacities observed from overhead imagery. Transient data were obtained from local sources of information and State Emergency Management Agencies.

Step 2.
The next activity is to examine large-scale maps of the EPZ in both hard-copy form and using Geographical Information System (GIS) software. These maps were used to identify the analysis highway network and the access roads from each residential development to the adjoining elements of this network. This information is used to plan a field survey of the highway system and later, to assign generated evacuation trips to the correct links of the network.

Step 3.
The next step is to conduct a physical survey of the roadway system. The purpose of this survey is to determine the geometric properties of the highway elements, the channelization of lanes on each section of roadway, whether there are any turn restrictions or special treatment of traffic at intersections, the type and functioning of traffic control devices and to make the necessary observations needed to estimate realistic values of roadway capacity.

Step 4.
With this information, develop the evacuation network representation of the physical roadway system.

Step 5.
With the network drawn, proceed to estimate the capacities of each link and to locate the origin centroids where trips would be generated during the evacuation process.

Step 6.
With this information at hand, the data are entered into the computer to create the input stream for the TRaffic Assignment and Distribution (TRAD) model. This model is designed to be compatible with the PC-DYNEV traffic simulation model used later in the project; the input stream required for one model is entirely compatible with the input stream required by the other. Using a software system developed by KLD named UNITES, the data entry activity is performed interactively directly on the computer.

Step 7.
The TRAD model contains software that performs diagnostic testing of the input stream. These assist the user in identifying and correcting errors in the input stream.

Step 8.
After creating the input stream, execute the TRAD model to compute evacuating traffic routing patterns consistent with the guidelines of NUREG 0654, Appendix 4. The TRAD model also provides estimates of traffic loading on each highway link as well as rough estimates of operational performance.

Step 9.
Critically examine the statistics produced by the TRAD model. This is a labor-intensive activity, requiring the direct participation of skilled engineers who possess the necessary practical experience to interpret the results and to determine the causes of any problems reflected in the results.

Essentially, the approach is to identify those "hot spots" in the network that represent locations where congested conditions are pronounced and to identify the cause of this congestion. This cause can take many forms, either as excess demand due to improper routing, as a shortfall of capacity, or as a quantitative error in the way the physical system was represented in the input stream. This examination leads to one of two conclusions:

- The results are as satisfactory as could be expected at this stage of the analysis process; or
- The input stream must be modified accordingly.

This decision requires, of course, the application of the user's judgment based upon the results obtained in previous applications of the TRAD model and a comparison of the results of this last case with the previous ones. If the results are satisfactory in the opinion of the user, then the process continues with Step 12. Otherwise, proceed to Step 10.

Step 10.
There are many "treatments" available to the user in resolving such problems. These treatments range from decisions to reroute the traffic by imposing turn restrictions where they can produce significant improvements in capacity, changing the control treatment at critical intersections so as to provide improved service for one or more movements, or in

prescribing specific treatments for channelizing the flow so as to expedite the movement of traffic along major roadway systems or changing the trip table. Such "treatments" take the form of modifications to the original input stream.

Step 11.
As noted above, the changes to the input stream must be implemented to reflect the modifications undertaken in Step 10. At the completion of this activity, the process returns to Step 8 where the TRAD model is again executed.

Step 12.
The output of the TRAD model includes the computed turn movements for each link. These data are required – and – accessed by the PC-DYNEV simulation model. This step completes the specification of the PC-DYNEV input stream.

Step 13.
After the PC-DYNEV input stream has been debugged, the simulation model is executed to provide detailed estimates, expressed as statistical Measures of Effectiveness (MOE), which describe the detailed performance of traffic operations on each link of the network.

Step 14.
In this step, the detailed output of the simulation model is examined to identify whether problems exist on the network. The results of the simulation model are extremely detailed and far more accurately describe traffic operations than those provided by the TRAD model. Thus, it is possible to identify the cause of any problems by carefully studying the output.

Again, one can implement corrective treatments designed to expedite the flow of traffic on the network in the event that the results are considered to be less efficient than is possible to achieve. If input changes are needed, the analysis process proceeds to Step 15. On the other hand, if the results are satisfactory, then one can decide whether to return to Step 8 to again execute the TRAD model and repeat the whole process, or to accept the simulation results. If there were no changes indicated by the activities of Step 14, because the results were satisfactory, we can then proceed to document them in Step 17. Otherwise, return to Step 8 to determine the effects of the changes implemented in Step 14 on the optimal routing patterns over the network. This determination can be ascertained by executing the TRAD model.

Step 15.
This activity implements the changes in control treatments or in the assignment of destinations associated with one or more origins in order to improve the representation of traffic flow over the network. These treatments can also include the consideration of adding roadway segments to the existing analysis network to improve the representation of the physical system.

Step 16.
Once the treatments have been identified, it is necessary to modify the simulation model input stream accordingly. At the completion of this effort, the procedure returns to Step 13 to execute the simulation model again.

Step 17.
The simulation results are analyzed, tabulated and graphed. The results are then documented, as required.

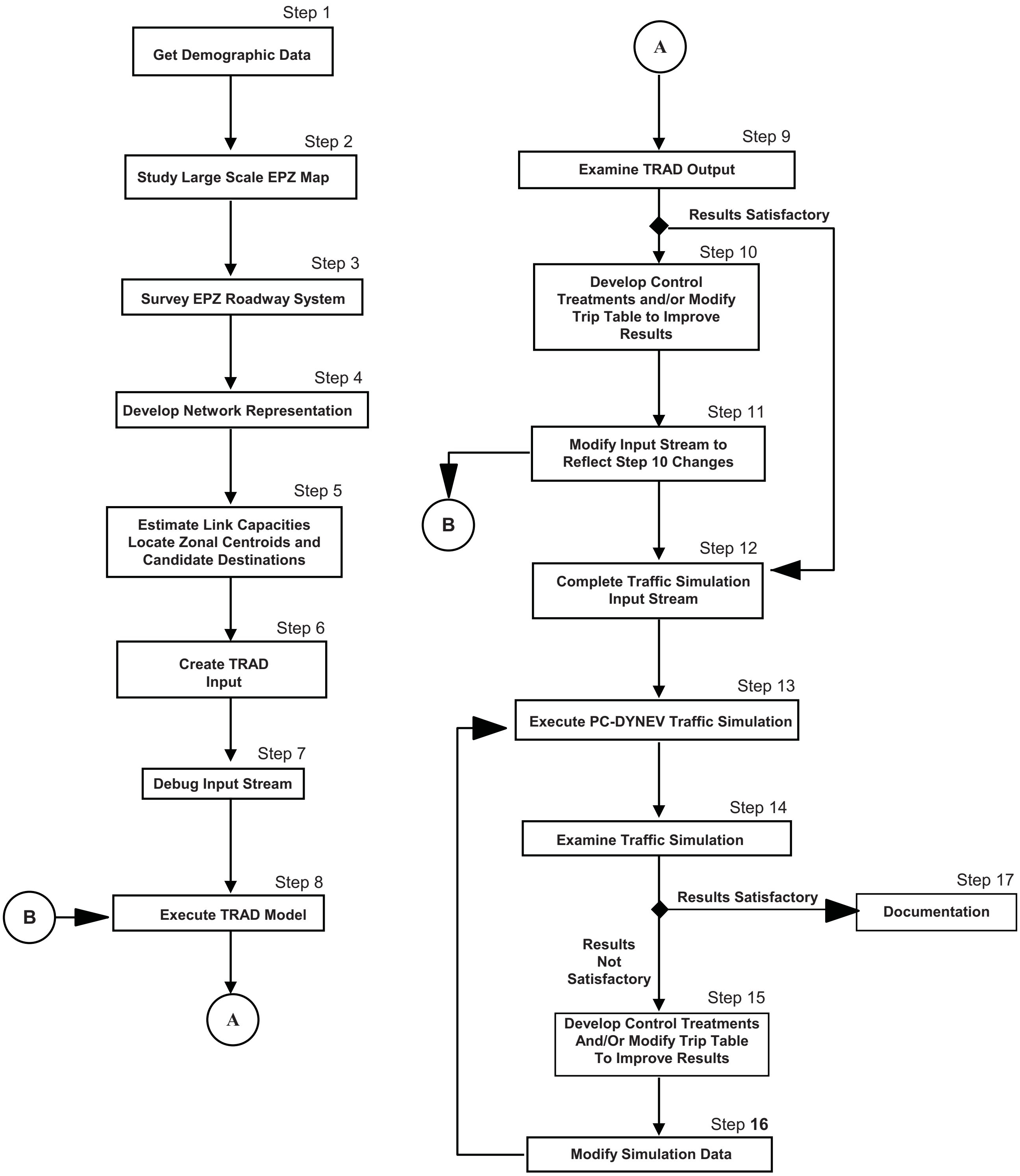


Figure D-1. Flow Diagram of Activities

APPENDIX E

Special Facility Data

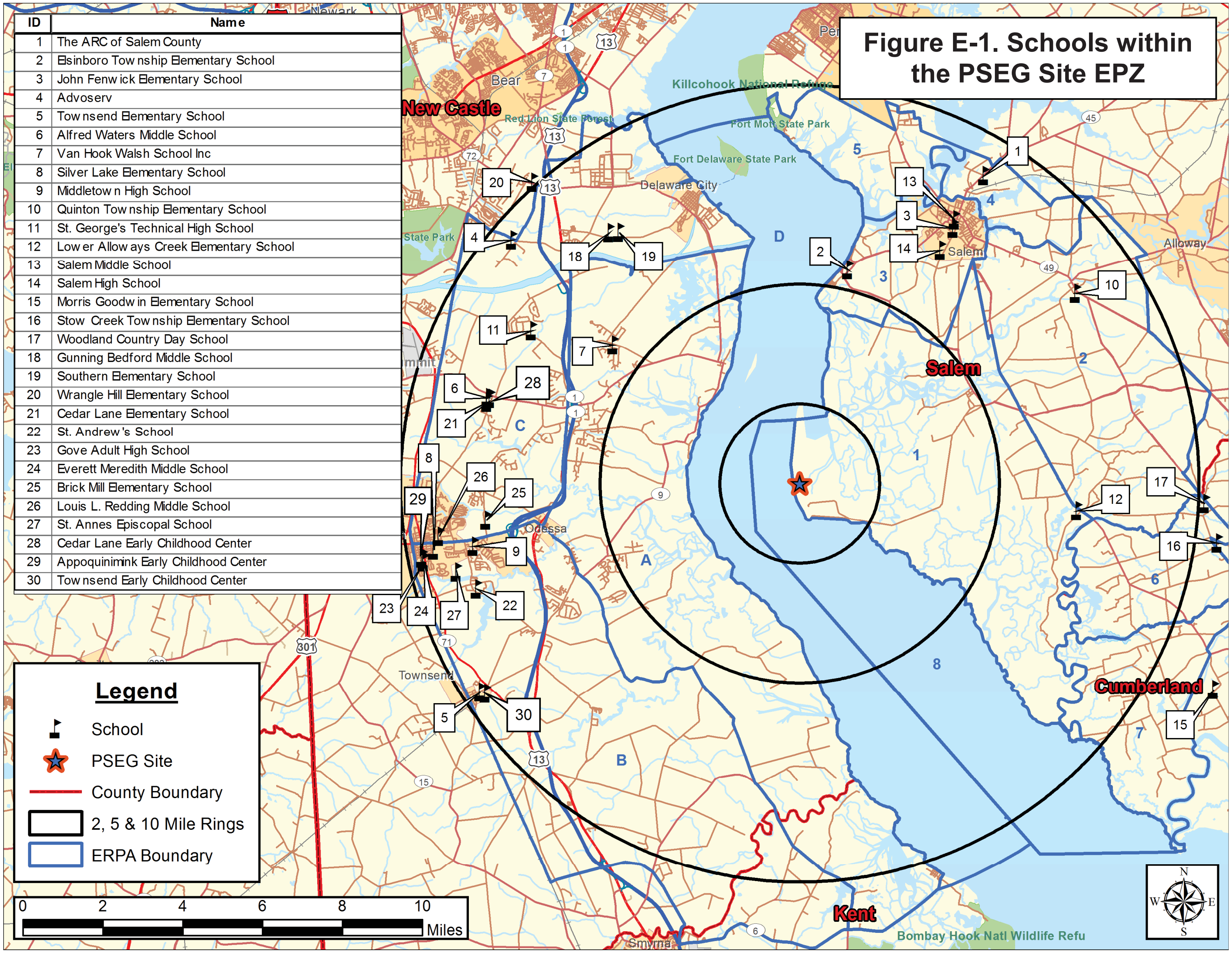
APPENDIX E: SPECIAL FACILITY DATA

The following tables list population information, as of May 2009, for special facilities that are located within the PSEG Site EPZ. Special facilities are defined as schools, day care centers, hospitals and other medical care facilities and correctional facilities. Transient population data is included in the tables for recreational areas and lodging facilities. Each table is grouped by county and state. The location of the facility is defined by its straight-line distance (miles) and direction (magnetic bearing) from the center point of the PSEG Site.

Two schools, Stow Creek Elementary School and Morris Goodwin Elementary School, are both located just outside of the EPZ. Based on discussions with the New Jersey State Police Office of Emergency Management, these schools will be evacuated due to their close proximity to the EPZ boundary. These schools have been included within the ERPA closest to their location.

Table E-1. Schools within the PSEG Site EPZ

ERPA	Distance (miles)	Direction	School Name	Street Address	Municipality	Phone	Enrollment	Staff
SALEM COUNTY, NJ								
1	7.0	E	Lower Alloways Creek Elementary School	967 Main Street	Salem	(856) 935-2707	222	78
2	8.4	NE	Quinton Elementary School	8 Robinson Street	Quinton	(856) 935-2379	358	61
3	5.4	NNE	Elsinboro Township Elementary School	631 Salem - Ft Elfsborg Rd	Salem	(856) 935-3817	108	17
3	7.4	NNE	John Fenwick Elementary School	183 Smith Street	Salem	(856) 935-4100	300	80
3	6.8	NNE	Salem High School	219 Walnut St	Salem	(856) 935-3900	600	110
3	7.6	NNE	Salem Middle School	51 New Market St	Salem	(856) 935-2700	580	110
4	9.0	NNE	The ARC of Salem County	150 SR 45	Salem	(856) 935-3600	147	28
						Salem County Total:	**2,315**	**484**
CUMBERLAND COUNTY, NJ								
6	10.6	E	Stow Creek Township Elementary School	11 Gum Tree Corner Rd	Bridgeton	(856) 455-1717	135	20
6	10.2	E	Woodland Country Day School	1216 Roadstown Rd	Bridgeton	(856) 453-8499	159	38
7	11.6	ESE	Morris Goodwin Elementary School	839 Ye Greate St	Greenwich	(856) 451-5513	77	12
						Cumberland County Total:	**371**	**70**
NEW CASTLE COUNTY, DE								
A	5.8	NW	Van Hook Walsh School Inc.	554 Port Penn Rd	Middletown	(302) 834-4404	4	3
B	9.6	WSW	Appoquinimink Early Childhood Center	502 S Broad St	Middletown	(302) 376-4400	260	40
B	9.6	WSW	Everett Meredith Middle School	504 S Broad St	Middletown	(302) 378-5001	1,250	95
B	9.6	WSW	Groves Adult High Shool	504 S Broad St	Middletown	(302) 378-5037	160	20
B	8.3	W	Middletown High School	120 Silver Lake Rd	Middletown	(302) 376-4145	1,707	145
B	9.3	W	Silver Lake Elementary School	200 E Cochran St	Middletown	(302) 378-5023	670	60
B	8.5	WSW	St. Andrew's School	350 Noxontown Rd	Middletown	(302) 285-4213	270	125
B	8.9	WSW	St. Anne's Episcopal School	211 Silver Lake Rd	Middletown	(302) 378-3179	325	55
B	9.5	SW	Townsend Early Childhood Center	10 Brook Ramble Ln	Townsend	(302) 378-9960	202	26
B	9.6	WSW	Townsend Elementary School	126 Main St	Townsend	(302) 378-5020	315	55
C	9.4	NW	AdvoServ School	4185 Cukirkwood - St George's Rd	Bear	(302) 834-7018	123	140
C	8.1	WNW	Alfred Waters Middle School	1235 Cedar Lane Rd	Middletown	(302) 376-4128	777	60
C	7.9	W	Brick Mill Elementary School	378 Brick Mill Rd	Middletown	(302) 378-5288	770	80
C	8.0	WNW	Cedar Lane Early Childhood Center	1221 Cedar Lane Rd	Middletown	(302) 449-5873	331	30
C	8.0	WNW	Cedar Lane Elementary School	1259 Cedar Lane Rd	Middletown	(302) 378-5045	670	70
C	7.8	NW	Gunning Bedford Middle School	801 Cox Neck Rd	New Castle	(302) 832-6280	950	85
C	10.0	NW	Kathleen H. Wilbur Elementary School (formerly Wrangle Hill Elementary School)	4050 Wrangle Hill Rd	Bear	(302) 832-6330	1,150	100
C	9.1	W	Louis L. Redding Middle School	201 New St	Middletown	(302) 378-5030	800	70
C	7.7	NW	Southern Elementary School	795 Cox Neck Rd	New Castle	(302) 832-6300	1,065	100
C	7.7	WNW	St. George's Technical High School	555 Hyetts Corner Rd	Middletown	(302) 638-3772	1,035	135
						New Castle County Total:	**12,834**	**1,494**
						EPZ Total:	**15,520**	**2,048**



ID	Name
1	The ARC of Salem County
2	Elsinboro Township Elementary School
3	John Fenwick Elementary School
4	Advoserv
5	Townsend Elementary School
6	Alfred Waters Middle School
7	Van Hook Walsh School Inc
8	Silver Lake Elementary School
9	Middletown High School
10	Quinton Township Elementary School
11	St. George's Technical High School
12	Lower Alloways Creek Elementary School
13	Salem Middle School
14	Salem High School
15	Morris Goodwin Elementary School
16	Stow Creek Township Elementary School
17	Woodland Country Day School
18	Gunning Bedford Middle School
19	Southern Elementary School
20	Wrangle Hill Elementary School
21	Cedar Lane Elementary School
22	St. Andrew's School
23	Gove Adult High School
24	Everett Meredith Middle School
25	Brick Mill Elementary School
26	Louis L. Redding Middle School
27	St. Annes Episcopal School
28	Cedar Lane Early Childhood Center
29	Appoquinimink Early Childhood Center
30	Townsend Early Childhood Center

Figure E-1. Schools within the PSEG Site EPZ

Table E-2. Day Care Facilities within the PSEG Site EPZ								
ERPA	**Distance (miles)**	**Dir-ection**	**Name**	**Street Address**	**Municipality**	**Phone**	**Enroll-ment**	**Empl-oyees**
Salem County, NJ								
1	4.8	ENE	Sugar & Spice Pre School Day Care Center	82 Main St	Hancocks Bridge	(856) 935-7259	25	3
3	7.4	NNE	Children's Space Child Care*	118 Walnut St	Salem	(856) 935-2788	100	14
3	7.7	NNE	Community Center*	Westside Ct	Salem	N/A	20	3
3	7.7	NE	Community Center*	Anderson Dr	Salem	N/A	20	3
3	7.6	NE	Noah's Ark	424 E. Broadway	Salem	N/A	14	4
3	7.8	NNE	Salvation Army Services Center	115 W Broadway, #5	Salem	(856) 936-0305	20	3
3	7.8	NNE	St. John's Pentecostal Out Reach Day Care Center	22 New Market St	Salem	(856) 935-1445	10	5
						Salem County Total:	**209**	**35**
New Castle County, DE								
B	9.6	W	ABC1 Child Care Learning	14 West Main St	Middletown	(302) 449-2413	70	20
B	9.4	W	Bethesda Child Development Center	116 E Main St	Middletown	(302) 378-8435	210	32
C	8.0	WNW	Bright Beginnings Pre School	1125 Jamison Corner Rd	Middletown	(302) 376-8001	47	6
C	6.5	W	Green Acres Pre School	23 N 6th St	Odessa	(302) 378-9250	174	16
						New Castle County Total:	**501**	**74**
						EPZ Total:	**710**	**109**

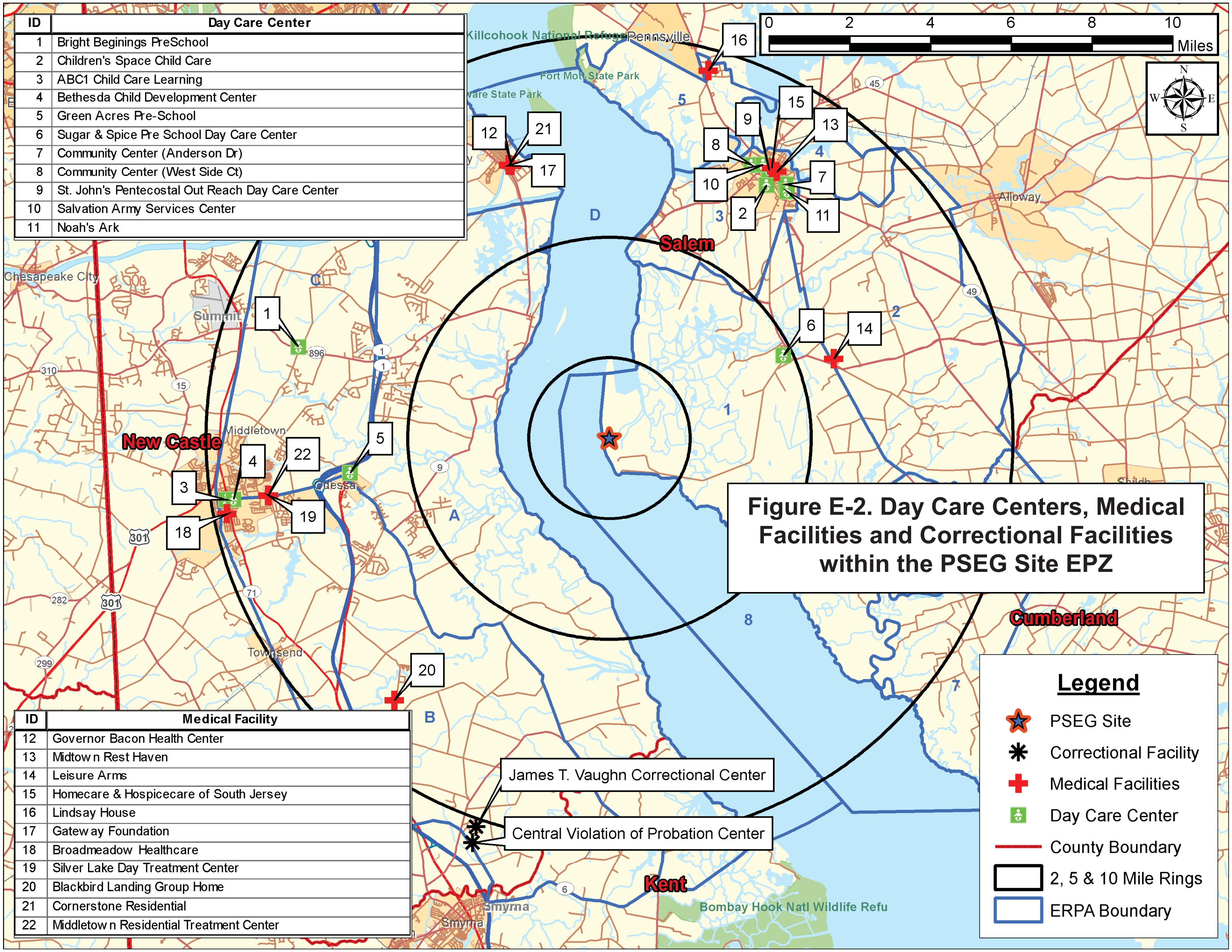
*Employment data not provided. Average enrollment/employee for facilities that did provide data was used.

N/A – not available

Table E-3. Medical Facilities and Assisted Living Facilties within the PSEG Site EPZ												
ERPA	**Distance (miles)**	**Dir-ection**	**Name**	**Street Address**	**Municipality**	**Phone**	**Capacity**	**Current Census**	**Wheel-chair Patients**	**Bed-ridden Patients**	**Ambul-atory Patients**	**Employees**
SALEM COUNTY, NJ												
2	5.9	ENE	Lower Alloways Creek Twp: Leisure Arms Complex Kitchen	622 New Bridge Rd	Salem	(856) 935-8122	36	30	1	0	29	3
3	7.8	NNE	Homecare & Hospicecare of South Jersey	Broadway & Walnut	Salem	(888) 628-7900	52	52	10	0	42	35
3	7.8	NNE	Midtown Rest Haven	258 E Broadway	Salem	(856) 935-4567	23	19	0	0	19	5
5	9.5	NNE	Lindsay House	39 Supawna Rd	Pennsville	(856) 339-0100	16	16	3	0	13	5
						Salem County Total:	**127**	**117**	**14**	**0**	**103**	**48**
NEW CASTLE COUNTY, DE												
B	8.4	SW	Blackbird Landing Group Home	994 Blackbird Landing Rd	Townsend		8	8	0	0	8	6
B	9.7	WSW	Broadmeadow Healthcare	500 S Broad St	Middletown	(302) 449-3400	117	77	60	0	17	91
C	7.2	NNW	Cornerstone Residential	171 New Castle Ave	Delaware City	(302) 836-8260	15	15	0	0	15	6
C	7.2	NNW	Gateway Foundation (Cottage 2)	171 New Castle Ave	Delaware City	(302) 836-2000	72	72	0	0	72	25
C	7.2	NNW	Governor Bacon Health Center	P.O. Box 559	Delaware City	(302) 836-2550	80	59	47	0	12	115
C	8.6	W	Middletown Residential Treatment Center	495 E Main St	Middletown	(302) 378-5224	10	10	0	0	10	20
C	8.6	W	Silver Lake Day Treatment Center	493 E Main St	Middletown	(302) 378-5238	26	26	0	0	26	8
N/A	N/A	N/A	People's Place Residential Group Home**	N/A	Townsend	(302) 422-8033	8	8	0	0	8	8
						New Castle County Total:	**336**	**275**	**107**	**0**	**168**	**279**
						EPZ Total:	**463**	**392**	**121**	**0**	**271**	**327**

**Address not available.

Table E-4. Correctional Facilities within the PSEG Site EPZ							
ERPA	Distance (miles)	Dir-ection	Name	Street Address	Municipality	Phone	Cap-acity
New Castle, DE							
B	10.6	SSW	Central Violation of Probation Center	875 Smyrna Landing Rd	Smyrna	(302) 659-6100	250
B	10.2	SSW	James T. Vaughn Correctional Center (formerly Delaware Correctional Center)	1181 Paddock Rd	Smyrna	(302) 653-9261	2,500
						EPZ Total:	2,750



ID	Day Care Center
1	Bright Beginings PreSchool
2	Children's Space Child Care
3	ABC1 Child Care Learning
4	Bethesda Child Development Center
5	Green Acres Pre-School
6	Sugar & Spice Pre School Day Care Center
7	Community Center (Anderson Dr)
8	Community Center (West Side Ct)
9	St. John's Pentecostal Out Reach Day Care Center
10	Salvation Army Services Center
11	Noah's Ark

ID	Medical Facility
12	Governor Bacon Health Center
13	Midtown Rest Haven
14	Leisure Arms
15	Homecare & Hospicecare of South Jersey
16	Lindsay House
17	Gateway Foundation
18	Broadmeadow Healthcare
19	Silver Lake Day Treatment Center
20	Blackbird Landing Group Home
21	Cornerstone Residential
22	Middletown Residential Treatment Center

Figure E-2. Day Care Centers, Medical Facilities and Correctional Facilities within the PSEG Site EPZ

Table E-5: Recreational Areas within the PSEG Site EPZ								
ERPA	Distance (miles)	Dir-ection	Facility Name	Street Address	Municipality	Phone	Per-sons	Total Vehicles
SALEM COUNTY, NJ								
1	4.4	NE	Abbots Farm	Abbots Farm Rd	N/A	N/A	10	3
1	4.9	ENE	Hancock House	3 Front St	Hancocks Bridge	N/A	20	7
1	7.1	ESE	Mad Horse Creek Wildlife Management Area	Stowneck Rd	Lower Alloways Creek	(609) 984-0547	25	9
2	7.8	E	Meadow View Acres Campground	69 Buckhorn Rd	Salem	(856) 935-4710	40	14
2	7.4	ENE	Wild Oaks Country Club	75 Wild Oaks Dr	Salem	(856) 935-0705	300	150
3	7.5	NNE	Barber's Basin Inc	108 Tilbury Rd	Salem	(865) 935-1261	50	17
3	7.3	NNE	Salem Public Ramp (PSEG)	Frienship Dr	Salem	N/A	60	41
5	9.0	N	Fort Mott State Park	454 Fort Mott Rd	Pennsville	(856) 935-3218	300	103
5	8.0	NNE	Penn-Salem Marina	Rte 49	Salem	(856) 935-2628	10	3
5	8.2	NNE	Salem Boat Club	SR 45	Salem	N/A	30	10
5	9.5	N	Supawna Meadows NWR	CR 632		N/A	15	5
						Salem County Total:	**860**	**362**
CUMBERLAND COUNTY, NJ								
6	7.3	ESE	Stow Creek State Park	Stow Creek Rd	Stow Creek Landing	(856) 785-0455	10	6
7	11.9	ESE	Greenwich Boat Works	1 Pier Rd	Greenwich	(856) 451-7777	60	21
7	11.8	SE	Hancock Harbor Marina	30 Hancock Harbor Rd	Greenwich	(856) 455-2610	60	21
						Cumberland County Total:	**130**	**48**
NEW CASTLE COUNTY, DE								
A	9.9	S	Aquatic Resources Education Center	4876 Hay Point Landing Rd	Smyrna	(302) 653-2882	110	22
A	3.1	NW	Augustine Beach Boat Ramp	N/A	Port Penn	N/A	88	60
A	3.6	NNW	Augustine Wildlife Area	503 N. Congress St	Port Penn	(302) 834-8433	50	17
A	6.0	S	Cedar Swamp: Collins Beach	Collins Beach Rd	Smyrna	N/A	350	240
A	4.1	SW	Cedar Swamp: The Rock Tract	Steve's Landing Rd	Middletown	N/A	58	30
A	3.7	NW	Port Penn Interpretive Center	1 W Market St	Port Penn	(302) 836-2533	25	9
A	5.8	WNW	Vandergrift Golf Club	631 Bayview Rd	Middletown	(302) 378-3665	100	50
B	9.2	W	Silver Lake Park	N/A	Middletown	(302) 378-4975	300	103
C	6.7	NW	Chesapeake & Delaware Canal	N/A	N/A	(410) 885-5622	200	100
C	7.4	NNW	Delaware City Marina	302 Canal St	Delaware City	(302) 834-4172	20	10
C	7.9	NNW	Fort Delaware State Park	45 Clinton St	Delaware City	(302) 834-7941	200	68
C	7.2	NNW	Fort DuPont State Park	P.O. Box 170	Delaware City	(302) 834-7941	292	150
C	9.1	W	Frog Hollow Golf Club	1 Wittington Way	Middletown	(302) 376-6500	100	40
C	6.6	NNW	Grass Dale Center	108 Old Reedy Pt. Bridge Rd	Delaware City	(302) 834-7941	6	6
						New Castle County Total:	**1,899**	**905**
KENT COUNTY, DE								
A	10.8	SSE	Smyrna River Boat Ramp	N/A	Woodland Beach	N/A	117	60
A	10.3	S	Woodland Beach Wildlife Refuge	Florio Rd	Smyrna	N/A	50	17
A	10.4	SSE	Woodland Beach	N/A	Woodland Beach	N/A	146	75
						Kent County Total:	**313**	**152**
						EPZ Total:	**3,202**	**1,467**

Table E-6. Lodging Facilities within the PSEG Site EPZ								
ERPA	**Distance (miles)**	**Dir-ection**	**Facility Name**	**Street Address**	**Municipality**	**Phone**	**Per-sons**	**Veh-icles**
SALEM COUNTY, NJ								
3	7.8	NNE	Salem Motor Lodge	235 E Broadway	Salem	(856) 935-1212	41	21
						Salem County Total:	**41**	**21**
NEW CASTLE COUNTY, DE								
A	9.9	S	Mallard Lodge	5128 Hay Pt. Landing Rd	Smyrna	(302) 653-2882	34	12
B	6.9	WSW	Pleasant Hill Motel	3155 DuPont Pkwy	Townsend	(302) 378-2468	30	15
C	6.2	WNW	Parkway Motel	2397 Dupont Pkwy	Middletown	(302) 378-2228	16	8
						New Castle County Total:	**80**	**35**
						EPZ Total:	**121**	**56**

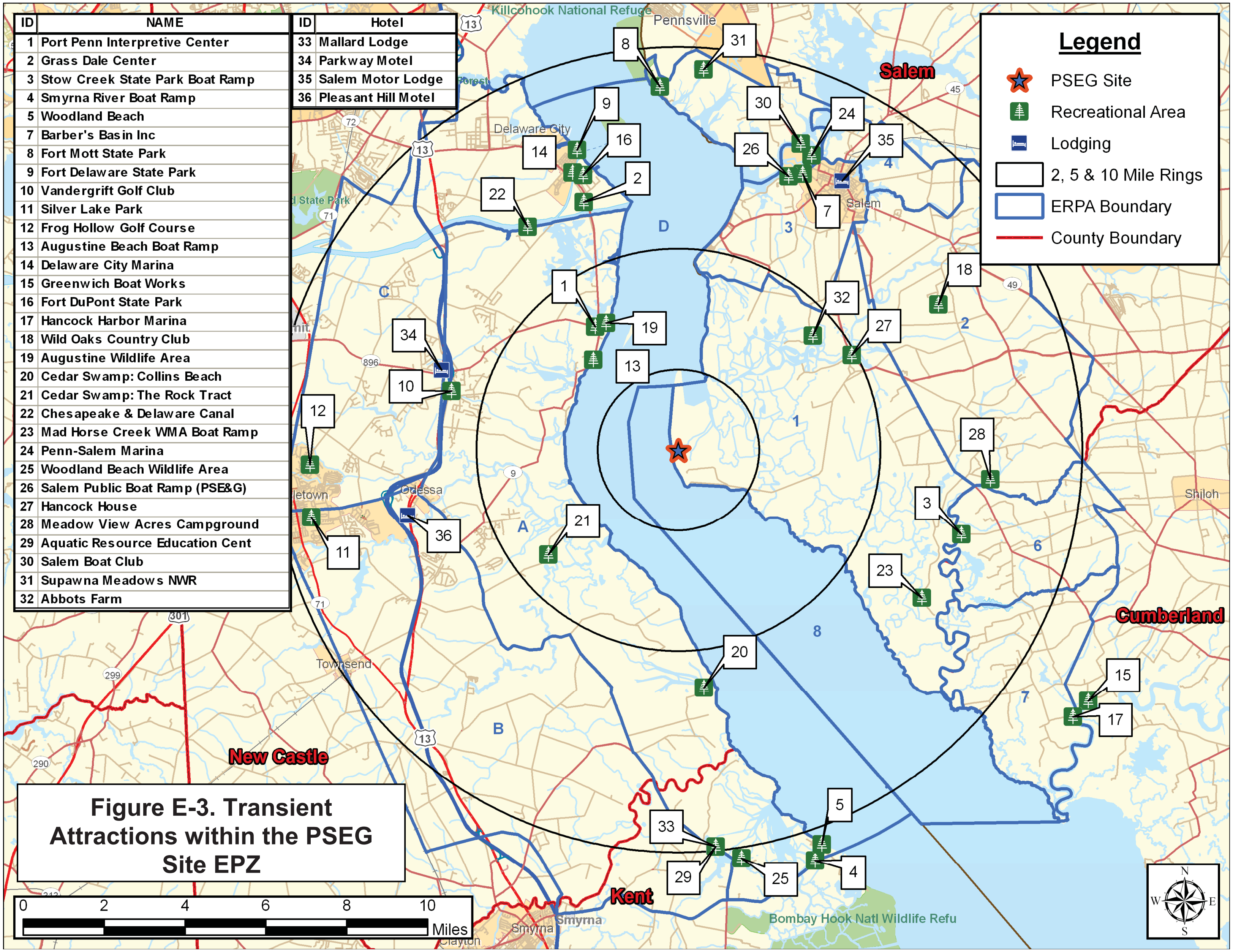
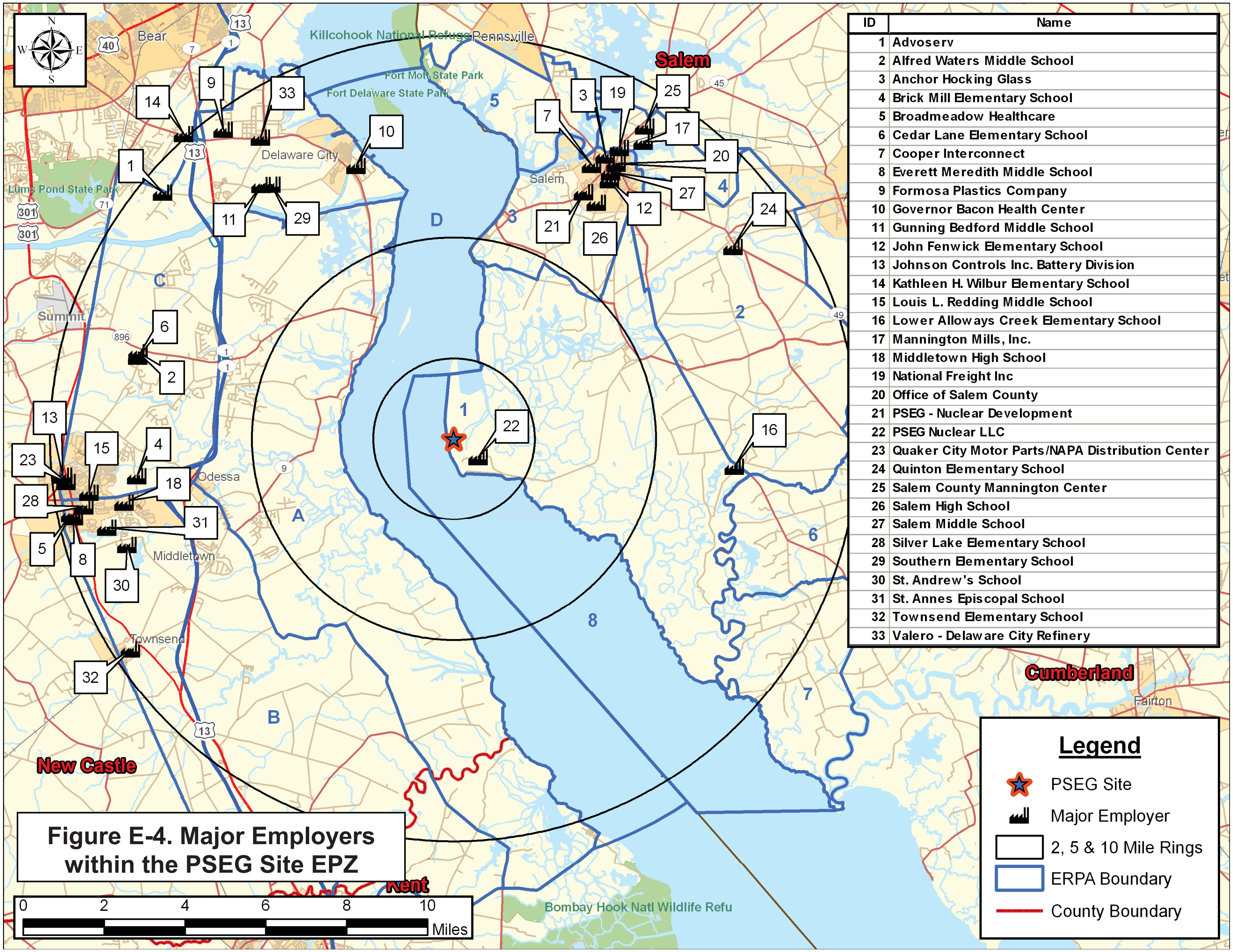


Figure E-3. Transient Attractions within the PSEG Site EPZ

Table E-7. Major Employers within the PSEG Site EPZ									
ERPA	Distance (miles)	Dir-ection	Facility Name	Street Address	Municipality	Phone	Employees (Max Shift)	% Non-EPZ	Employees (Non EPZ)
SALEM COUNTY, NJ									
1	7.0	E	Lower Alloways Creek Elementary School	967 Main Street	Salem	(856) 935-2707	78	67.33%	53
1	-	-	PSEG Nuclear LLC	-	Lower Alloways Creek	N/A	1,704	100.00%	1,704
2	8.4	NE	Quinton Elementary School	8 Robinson Street	Quinton	(856) 935-2379	61	71.61%	44
3	8.0	NNE	Anchor Hocking Glass	83 Griffith St	Salem	(856) 835-4000	130	67.33%	88
3	7.6	NNE	Cooper Interconnect	23 S Front St	Salem	(856) 935-7560	114	37.00%	42
3	7.4	NNE	John Fenwick Elementary School	183 Smith Street	Salem	(856) 935-4100	80	67.33%	54
3	7.9	NNE	Office of Salem County	92 Market St	Salem	(856) 935-9036	491	67.33%	331
3	6.9	NNE	PSEG - Nuclear Development	244 Chestnut St	Salem	N/A	39	100.00%	39
3	6.8	NNE	Salem High School	219 Walnut St	Salem	(856) 935-3900	110	67.33%	74
3	7.6	NNE	Salem Middle School	51 New Market St	Salem	(856) 935-2700	110	67.33%	74
4	8.7	NNE	Mannington Mills, Inc.	75 Mannington Mills Rd	Mannington	(856) 935-3000	550	75.67%	416
4	8.3	NNE	National Freight Inc	5 Route 45	Mannington	(856) 339-9257	100	75.67%	76
4	9.1	NNE	Salem County Mannington Center	165 SR 45	Mannington	N/A	50	75.67%	38
						Salem County Total:	3,617		3,033
NEW CASTLE COUNTY, DE									
B	9.7	WSW	Broadmeadow Healthcare	500 S Broad St	Middletown	(302) 449-3400	91	75.00%	68
B	9.6	WSW	Everett Meredith Middle School	504 S Broad St	Middletown	(302) 378-5001	95	75.00%	71
B	8.3	W	Middletown High School	120 Silver Lake Rd	Middletown	(302) 376-4145	145	75.00%	109
B	9.3	W	Silver Lake Elementary School	200 E Cochran St	Middletown	(302) 378-5023	60	75.00%	45
B	8.5	WSW	St. Andrew's School	350 Noxontown Rd	Middletown	(302) 285-4213	125	75.00%	94
B	8.9	WSW	St. Anne's Episcopal School	211 Silver Lake Rd	Middletown	(302) 378-3179	55	75.00%	41
B	9.6	WSW	Townsend Elementary School	126 Main St	Townsend	(302) 378-5020	55	75.00%	41
C	9.4	NW	AdvoServ School	4185 Cukirkwood - St George's Rd	Bear	(302) 834-7018	140	75.00%	105
C	8.1	WNW	Alfred Waters Middle School	1235 Cedar Lane Rd	Middletown	(302) 376-4128	60	75.00%	45
C	7.9	W	Brick Mill Elementary School	378 Brick Mill Rd	Middletown	(302) 378-5288	80	75.00%	60
C	8.0	WNW	Cedar Lane Elementary School	1259 Cedar Lane Rd	Middletown	(302) 378-5045	70	75.00%	53
C	9.6	NW	Formosa Plastics Company	780 School House Rd	Delaware City	(302) 836-2200	56	10.00%	6
C	7.2	NNW	Governor Bacon Health Center	P.O. Box 559	Delaware City	(302) 836-2550	115	75.00%	86
C	7.8	NW	Gunning Bedford Middle School	801 Cox Neck Rd	New Castle	(302) 832-6280	85	75.00%	64
C	9.7	W	Johnson Controls Inc. Battery Division	700 N Broad St	Middletown	(302) 378-9885	113	75.00%	85
C	10.0	NW	Kathleen H. Wilbur Elementary School (formerly Wrangle Hill Elementary School)	4050 Wrangle Hill Rd	Bear	(302) 832-6330	100	75.00%	75
C	9.1	W	Louis L. Redding Middle School	201 New St	Middletown	(302) 378-5030	70	75.00%	53
C	9.7	W	Quaker City Motor Parts/NAPA Distribution Center	678 N Broad St	Middletown	(302) 378-9583	86	75.00%	65
C	7.7	NW	Southern Elementary School	795 Cox Neck Rd	New Castle	(302) 832-6300	100	75.00%	75
C	8.9	NNW	Valero - Delaware City Refinery	4442 Wrangle Rd	Delaware City	(302) 834-2314	600	75.00%	450
						New Castle County Total:	2,301		1,691
						EPZ Total:	5,918		4,724



ID	Name
1	Advoserv
2	Alfred Waters Middle School
3	Anchor Hocking Glass
4	Brick Mill Elementary School
5	Broadmeadow Healthcare
6	Cedar Lane Elementary School
7	Cooper Interconnect
8	Everett Meredith Middle School
9	Formosa Plastics Company
10	Governor Bacon Health Center
11	Gunning Bedford Middle School
12	John Fenwick Elementary School
13	Johnson Controls Inc. Battery Division
14	Kathleen H. Wilbur Elementary School
15	Louis L. Redding Middle School
16	Lower Alloways Creek Elementary School
17	Mannington Mills, Inc.
18	Middletown High School
19	National Freight Inc
20	Office of Salem County
21	PSEG - Nuclear Development
22	PSEG Nuclear LLC
23	Quaker City Motor Parts/NAPA Distribution Center
24	Quinton Elementary School
25	Salem County Mannington Center
26	Salem High School
27	Salem Middle School
28	Silver Lake Elementary School
29	Southern Elementary School
30	St. Andrew's School
31	St. Annes Episcopal School
32	Townsend Elementary School
33	Valero - Delaware City Refinery

Figure E-4. Major Employers within the PSEG Site EPZ

APPENDIX F

Telephone Survey

APPENDIX F: TELEPHONE SURVEY

1. INTRODUCTION

The development of evacuation time estimates for the Emergency Planning Zone (EPZ) of the PSEG Site requires the identification of travel patterns, car ownership and household size of the population within the EPZ. Demographic information is obtained from Census data. The use of this data has several limitations when applied to emergency planning. First, the census data do not encompass the range of information needed to identify the time required for preliminary activities that must be undertaken prior to evacuating the area. Secondly, census data do not contain attitudinal responses needed from the population of the EPZ and consequently may not accurately represent the anticipated behavioral characteristics of the evacuating populace.

These concerns are addressed by conducting a telephone survey. The survey is designed to elicit information from the public concerning family demographics and estimates of response times to well defined events. The design of the survey includes a limited number of questions of the form “What would you do if …?” and other questions regarding activities with which the respondent is familiar (“How long does it take you to …?”)

2. SURVEY INSTRUMENT AND SAMPLING PLAN

Attachment A presents the final survey instrument. A draft of the instrument was submitted for comment. Comments were received and the survey instrument was modified accordingly, prior to conducting the survey.

Following the completion of the instrument, a sampling plan was developed. A sample size of approximately 600 **completed** survey forms yields results with an acceptable sampling error. The sample must be drawn from the EPZ population. Consequently, a list of EPZ zip codes was developed. This list is shown in Table F-1. Along with each zip code, an estimate of the population and number of households in each area was determined by overlaying Census data and the EPZ boundary using Geographical Information Systems (GIS) software. The proportional number of desired completed survey interviews for each area was identified, as shown in Table F-1.

The completed survey adhered to the sampling plan.

Table F-1. PSEG Site Telephone Survey Sampling Plan

Zip Code	Population within EPZ (2000)	Households	Required Sample
19709	14,451	4,967	238
19734	3,282	1,208	58
19977	2,890	481	23
19720	2,283	818	39
19701	602	169	8
08070	361	136	7
08079	11,046	4,450	214
08323	235	81	4
08302	491	193	9
Totals:	**35,641**	**12,502**	**600**
		Average Household Size:	**2.85**
		Total Sample Required:	**600**

3. SURVEY RESULTS

The results of the survey fall into two categories. First, the household demographics of the area can be identified. Demographic information includes such factors as household size, automobile ownership, and automobile availability. The distributions of the time to perform certain pre-evacuation activities are the second category of survey results. These data are processed to develop the trip generation distributions used in the evacuation modeling effort.

A review of the survey instrument reveals that several questions have a "don't know" (DK) entry for a response. It is accepted practice in conducting surveys of this type to accept the answers of a respondent who offers a DK response for a few questions or who refuses to answer a few questions. To address the issue of occasional DK/refused responses from a large sample, the practice is to assume that the distribution of these responses is the same as the underlying distribution of the positive responses. In effect, the DK/refused responses are ignored and the distributions are based upon the positive data that is acquired.

Household Demographic Results

Household Size

Figure F-1 presents the distribution of household size within the EPZ. The average household contains 2.92 people. The estimated household size (2.85 persons) used to determine the survey sample (Table F-1) was drawn from Census data. The close agreement between the average household size obtained from the survey and from the Census is an indication of the reliability of the survey.

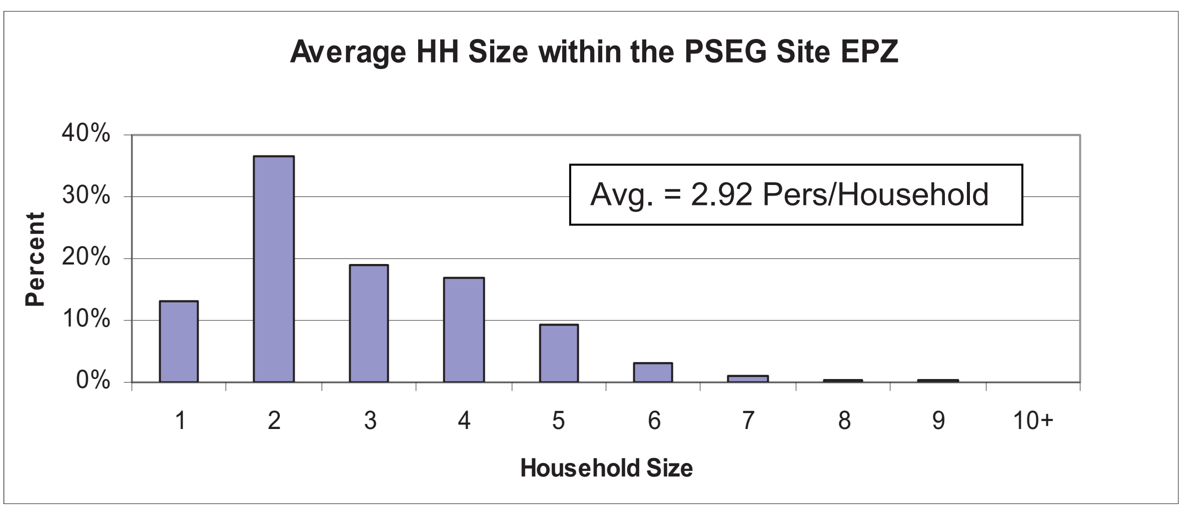


Figure F-1. Household Size in the EPZ

Automobile Ownership

The average number of automobiles per household in the EPZ is 2.14. It should be noted that approximately 3.5 percent of households do not have access to an automobile. The distribution of automobile ownership is presented in Figure F-2. Figures F-3 and F-4 present the automobile availability by household size. Note that the majority of households without access to a car are single person households. As expected, nearly all households of 2 or more people have access to at least one vehicle.

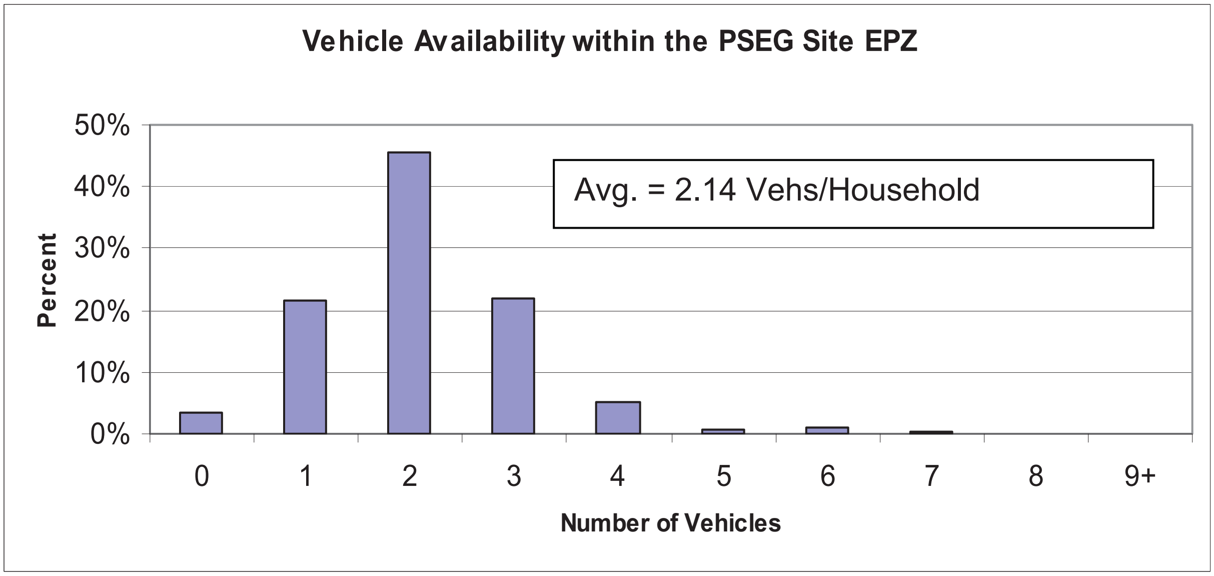


Figure F-2. Household Vehicle Availability

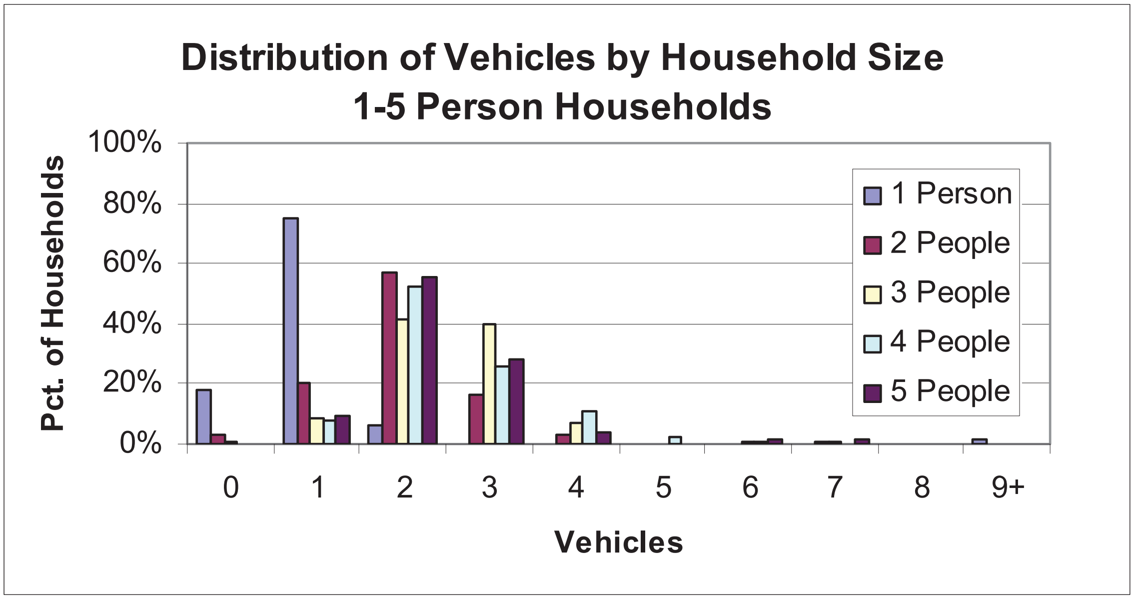


Figure F-3. Vehicle Availability – 1 to 5 Person Households

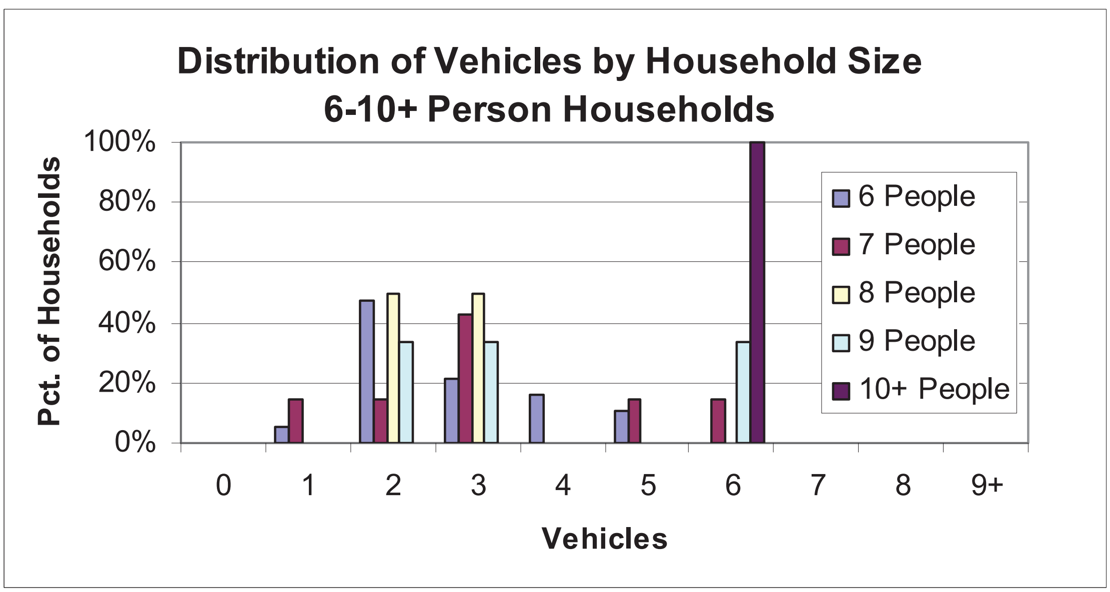


Figure F-4. Vehicle Availability – 6 to 10+ Person Households

Schoolchildren

The average number of schoolchildren per household identified by the survey is 0.75. Figure F-5 presents the distribution of schoolchildren.

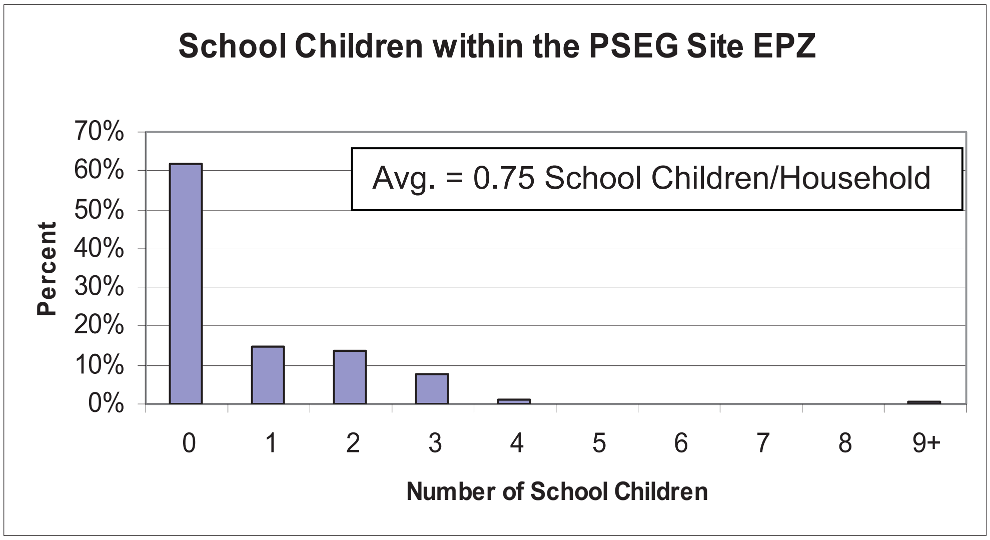


Figure F-5. Schoolchildren in Households

Commuters

Figure F-6 presents the distribution of the number of commuters in each household. The data shows an average of 1.17 commuters in each household in the EPZ.

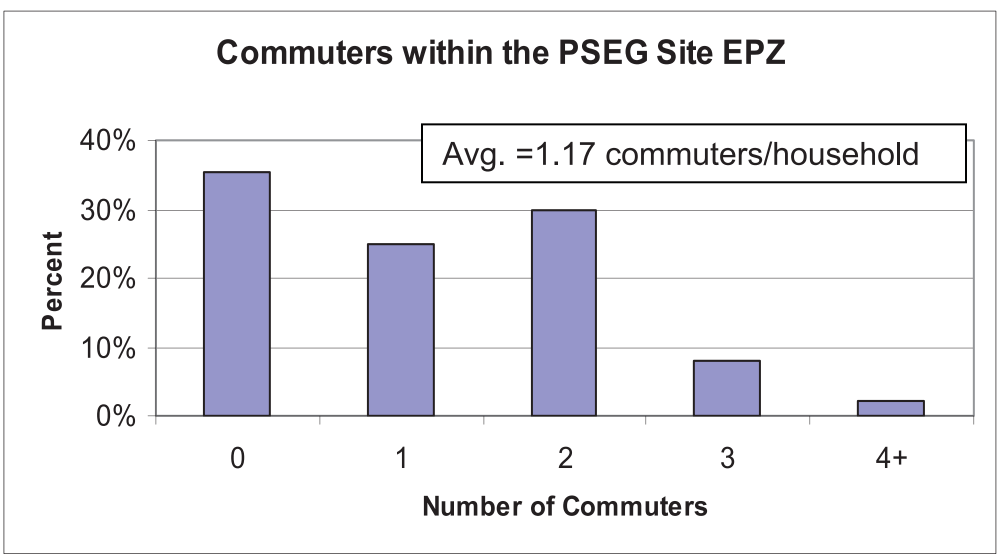


Figure F-6. Commuters in Households in the EPZ

Commuter Travel Modes

Figure F-7 presents the mode of travel that commuters use on a daily basis. The vast majority of commuters use their private automobiles to travel to work.

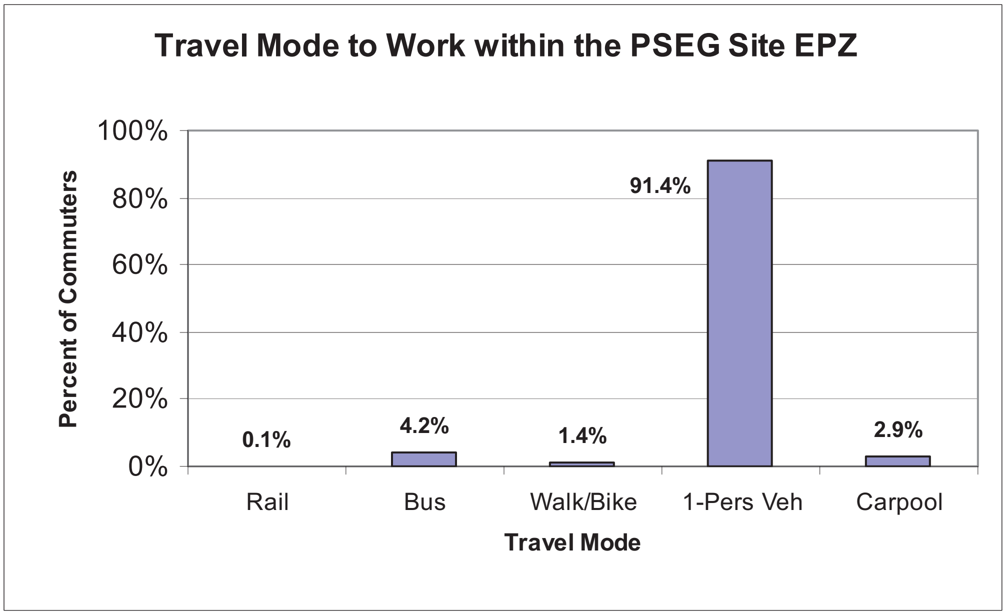


Figure F-7. Modes of Travel in the EPZ

Evacuation Response

Several questions were asked which are used to gauge the population's response to an emergency. The first of these asked "How many of the vehicles that are usually available to the household would your family use during an evacuation?" The response is shown in Figure F-8. On average, 1.35 vehicles per household would be used for evacuation purposes.

The second evacuation response question asked was "When the commuters are away from home, is there a vehicle at home that is available for evacuation during an emergency?" Of the survey participants who responded, 60 percent said that there was another vehicle available to evacuate, while 40 percent answered that there would be no vehicle available for evacuation.

The third evacuation response question was "Would your family await the return of other family members prior to evacuating the area?" Of the survey participants who responded, 60 percent said they would await the return of other family members before evacuating and 40 percent indicated that they would not await the return of other family members.

The fourth evacuation response question was “Would you take household pets with you if you were asked to evacuate the area?” As shown in Figure F-9, 62 percent of respondents said they would take their pets; 8 percent would not. The remaining 30 percent either did not have a pet, or did not give a definitive answer.

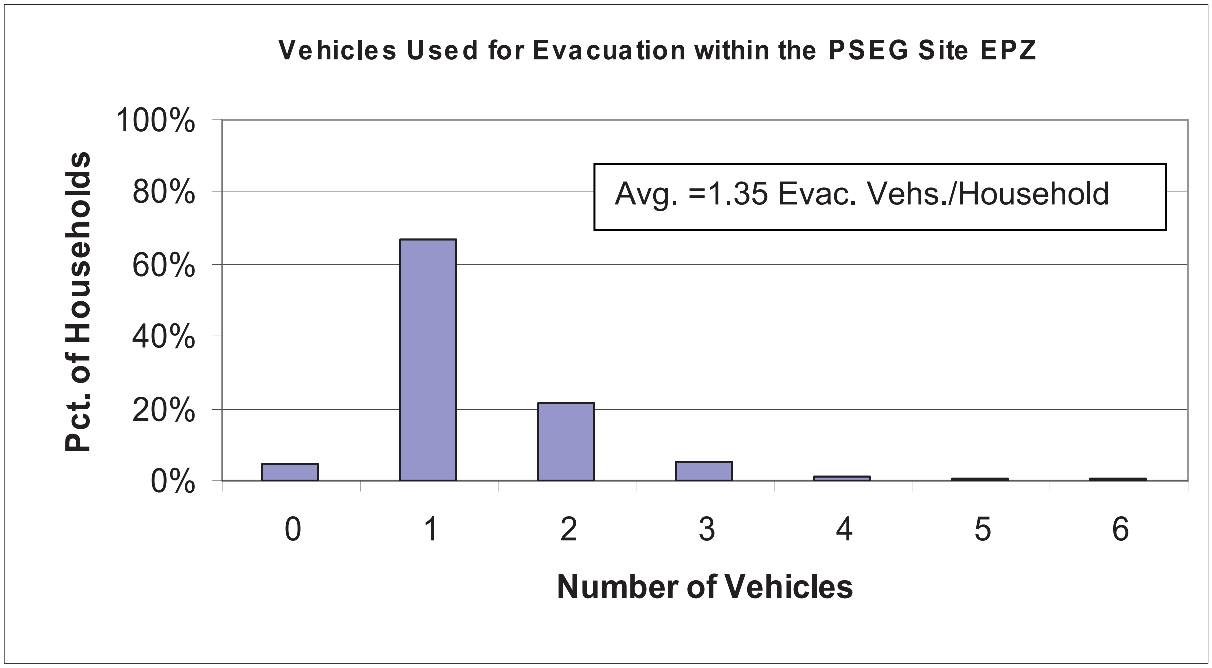


Figure F-8. Number of Vehicles Used for Evacuation

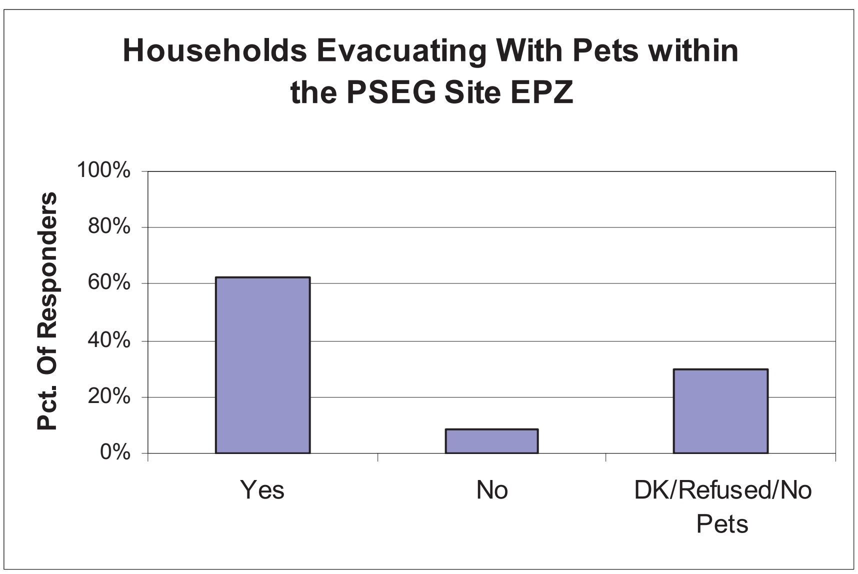


Figure F-9. Households Evacuating with Pets

Time Distribution Results

The survey asked several questions about the amount of time it takes to perform certain pre-evacuation activities. These activities involve actions taken by residents during the course of their day-to-day lives. Thus, the answers fall within the realm of the responder's experience.

How long does it take the commuter to complete preparation for leaving work?

Figure F-10 presents the cumulative distribution; in all cases, the activity is completed by about 120 minutes. Fifty percent can leave within 15 minutes.

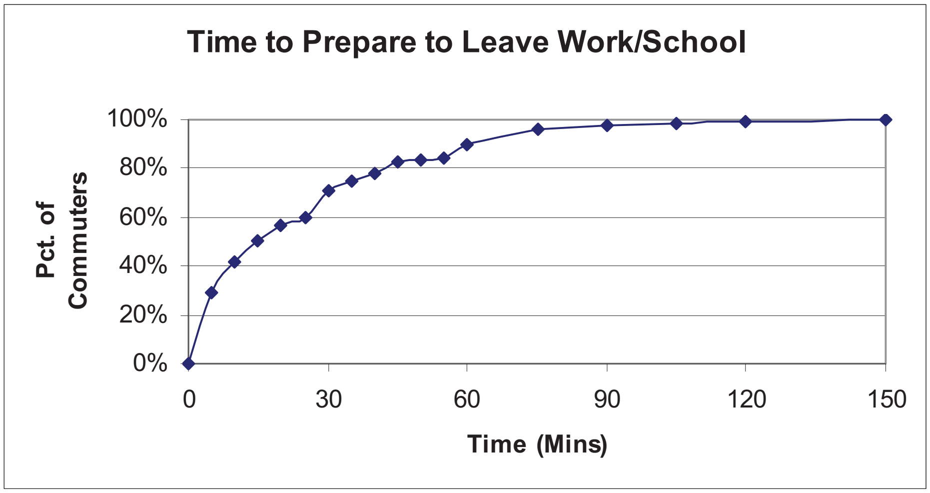


Figure F-10. Time Required to Prepare to Leave Work/School

How long would it take the commuter to travel home?

Figure F-11 presents the work to home travel time for the EPZ. About 70 percent of commuters can arrive home within about 30 minutes of leaving work; nearly all within 90 minutes.

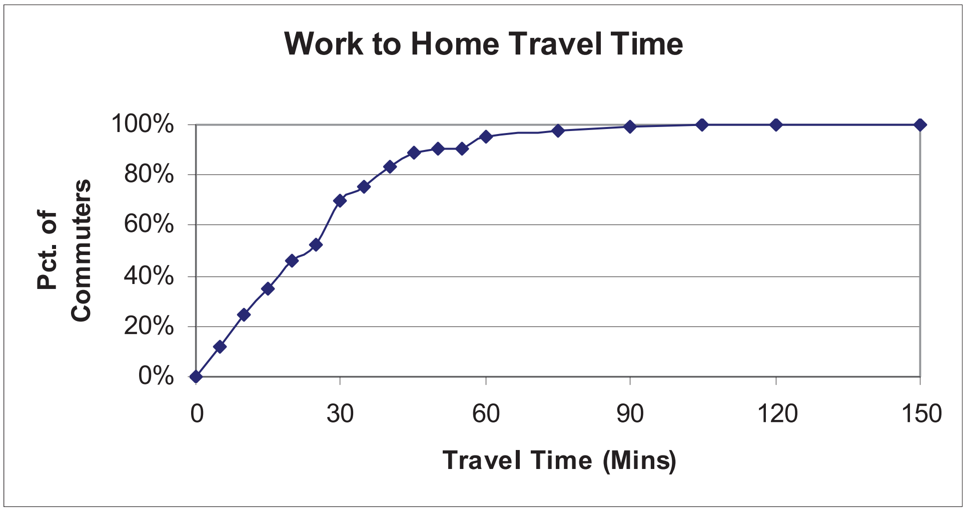


Figure F-11. Work to Home Travel Time

How long would it take the family to pack clothing, secure the house, and load the car?

Figure F-12 presents the time required to prepare for leaving on an evacuation trip. In many ways this activity mimics a family's preparation for a short holiday or weekend away from home. Hence, the responses represent the experience of the responder in performing similar activities.

The distribution shown in Figure F-12 has a long "tail." Over 90 percent of households can be ready to leave home within an hour and a half; the remaining households require up to an additional four and a half hours.

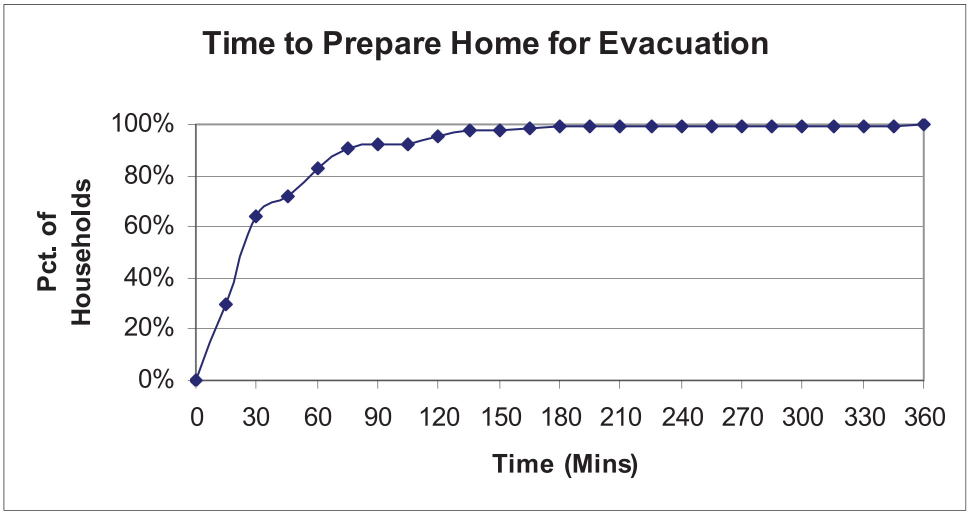


Figure F-12. Time to Prepare Home for Evacuation

How long would it take you to clear 6 to 8 inches of snow from your driveway?

During adverse, snowy weather conditions an additional activity must be performed before residents can depart on the evacuation trip. Although snow scenarios assume that the roads and highways have been plowed and are passable (albeit at lower speeds and capacities), it would be necessary to clear a private driveway prior to leaving the home so that the vehicle can access the street. Figure F-13 presents the time distribution for removing 6 to 8 inches of snow from a driveway. The time distribution for clearing the driveway has a long tail; about 90 percent of driveways are passable within one hour. However, the last driveway is cleared three and a half hours after the start of this activity.

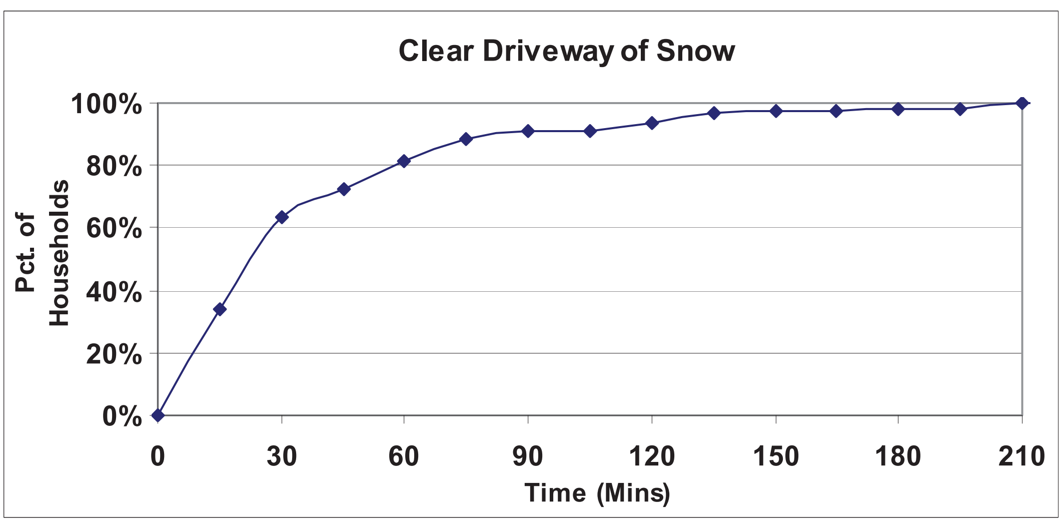


Figure F-13. Time to Clear Driveway of 6”-8” of Snow

4. CONCLUSIONS

The telephone survey provides valuable, relevant data associated with the PSEG Site that have been used to quantify “mobilization time” which can influence evacuation time estimates.

ATTACHMENT A

Telephone Survey Instrument

Survey Instrument

Hello, my name is _______________ and I'm working on a survey being made for [insert marketing firm name] designed to identify local travel patterns in your area. The information obtained will be used in a traffic engineering study and will be shared with County Officials for their consideration in enhancing county emergency response plans for all hazards. Your participation in this survey will greatly enhance the county's emergency preparedness program.

COL.1 Unused
COL.2 Unused
COL.3 Unused

COL.4 Unused
COL.5 Unused

Sex **COL. 8**
1 Male
2 Female

INTERVIEWER: ASK TO SPEAK TO THE HEAD OF HOUSEHOLD OR THE SPOUSE OF THE HEAD OF HOUSEHOLD. (Terminate call if not a residence)

DO NOT ASK:

1A. Record area code. To Be Determined

COL. 9-11

1B. Record exchange number. To Be Determined

COL. 12-14

---

2. What is your home Zip Code **Col. 15-19**

---

3. In total, how many cars, or other vehicles are usually available to the household? (DO NOT READ ANSWERS.)

COL.20
1 ONE
2 TWO
3 THREE
4 FOUR
5 FIVE
6 SIX
7 SEVEN
8 EIGHT
9 NINE OR MORE
0 ZERO (NONE)
X REFUSED

---

4. How many people usually live in this household? (DO NOT READ ANSWERS.)

COL.21	**COL.22**
1 ONE	0 TEN
2 TWO	1 ELEVEN
3 THREE	2 TWELVE
4 FOUR	3 THIRTEEN
5 FIVE	4 FOURTEEN
6 SIX	5 FIFTEEN
7 SEVEN	6 SIXTEEN
8 EIGHT	7 SEVENTEEN
9 NINE	8 EIGHTEEN
	9 NINETEEN OR MORE
	X REFUSED

5. How many children living in this household go to local public, private, or parochial schools? (DO NOT READ ANSWERS.)

COL.23
0 ZERO
1 ONE
2 TWO
3 THREE
4 FOUR
5 FIVE
6 SIX
7 SEVEN
8 EIGHT
9 NINE OR MORE
X REFUSED

---

6. How many people in the household commute to a job, or to college, at least 4 times a week?

COL.24	SKIP TO
0 ZERO	Q. 12
1 ONE	Q. 7
2 TWO	Q. 7
3 THREE	Q. 7
4 FOUR OR MORE	Q. 7
5 DON'T KNOW/REFUSED	Q. 12

INTERVIEWER: For each person identified in Question 6, ask Questions 7, 8, 9, and 10.

7. Thinking about commuter #1, how does that person usually travel to work or college? (REPEAT QUESTION FOR EACH COMMUTER.)

	Commuter #1 **COL.25**	Commuter #2 **COL.26**	Commuter #3 **COL.27**	Commuter #4 **COL.28**
Rail	1	1	1	1
Bus	2	2	2	2
Walk/Bicycle	3	3	3	3
Driver Car/Van	4	4	4	4
Park & Ride (Car/Rail, Xpress_bus)	5	5	5	5
Driver Carpool-2 or more people	6	6	6	6
Passenger Carpool-2 or more people	7	7	7	7
Taxi	8	8	8	8
Refused	9	9	9	9

---

8. What is the name of the city, town or community in which Commuter #1 works or attends school? (REPEAT QUESTION FOR EACH COMMUTER.) (FILL IN ANSWER.)

COMMUTER #1			COMMUTER #2			COMMUTER #3			COMMUTER #4		
City/Town		State	City/Town		State	City/Town		State	City/Town		State
COL.29	**COL.30**	**COL.31**	**COL.32**	**COL.33**	**COL.34**	**COL.35**	**COL.36**	**COL.37**	**COL.38**	**COL.39**	**COL.40**
0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9

9. How long, on average, would it take Commuter #1 to travel home from work or college? (REPEAT QUESTION FOR EACH COMMUTER.) (DO NOT READ ANSWERS.)

COMMUTER #1

COL.41	**COL.42**
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)
9 41-45 MINUTES	9
	0
	X DON'T KNOW/REFUSED

COMMUTER #2

COL.43	**COL.44**
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)
9 41-45 MINUTES	9
	0
	X DON'T KNOW/REFUSED

COMMUTER #3

COL.45	**COL.46**
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES –
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)
9 41-45 MINUTES	9
	0
	X DON'T KNOW/REFUSED

COMMUTER #4

COL.47	**COL.48**
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)
9 41-45 MINUTES	9
	0
	X DON'T KNOW/REFUSED

10. Approximately how long does it take Commuter #1 to complete preparation for leaving work or college prior to starting the trip home? (REPEAT QUESTION FOR EACH COMMUTER.) (DO NOT READ ANSWERS.)

COMMUTER #1

COL. 49	COL. 50
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)
9 41-45 MINUTES	9
	0
	X DON'T KNOW/REFUSED

COMMUTER #2

COL.51	COL. 52
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)
9 41-45 MINUTES	9
	0
	X DON'T KNOW/REFUSED

COMMUTER #3

COL. 53	COL. 54
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES –
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)
9 41-45 MINUTES	9
	0
	X DON'T KNOW/REFUSED

COMMUTER #4

COL. 55	COL. 56
1 5 MINUTES OR LESS	1 46-50 MINUTES
2 6-10 MINUTES	2 51-55 MINUTES
3 11-15 MINUTES	3 56 - 1 HOUR
4 16-20 MINUTES	4 OVER 1 HOUR, BUT LESS THAN 1 HOUR 15 MINUTES
5 21-25 MINUTES	5 BETWEEN 1 HOUR 16 MINUTES AND 1 HOUR 30 MINUTES
6 26-30 MINUTES	6 BETWEEN 1 HOUR 31 MINUTES AND 1 HOUR 45 MINUTES
7 31-35 MINUTES	7 BETWEEN 1 HOUR 46 MINUTES AND 2 HOURS
8 36-40 MINUTES	8 OVER 2 HOURS (SPECIFY _____)
9 41-45 MINUTES	9
	0
	X DON'T KNOW/REFUSED

---

11. When the commuters are away from home, is there a vehicle at home that is available for evacuation during any emergency?

Col. 57
1 Yes
2 No
3 Don't Know/Refused

---

12. Would you await the return of family members prior to evacuating the area?

Col. 58
1 Yes
2 No
3 Don't Know/Refused

13. How many of the vehicles that are usually available to the household would your family use during an evacuation? (DO NOT READ ANSWERS.)

COL.59
1 ONE
2 TWO
3 THREE
4 FOUR
5 FIVE
6 SIX
7 SEVEN
8 EIGHT
9 NINE OR MORE
0 ZERO (NONE)
X REFUSED

---

14. How long would it take the family to pack clothing, secure the house, load the car, and complete preparations prior to evacuating the area? (DO NOT READ ANSWERS.)

COL.60
1 LESS THAN 15 MINUTES
2 15-30 MINUTES
3 31-45 MINUTES
4 46 MINUTES - 1 HOUR
5 1 HOUR TO 1 HOUR 15 MINUTES
6 1 HOUR 16 MINUTES TO 1 HOUR 30 MINUTES
7 1 HOUR 31 MINUTES TO 1 HOUR 45 MINUTES
8 1 HOUR 46 MINUTES TO 2 HOURS
9 2 HOURS TO 2 HOURS 15 MINUTES
0 2 HOURS 16 MINUTES TO 2 HOURS 30 MINUTES
X 2 HOURS 31 MINUTES TO 2 HOURS 45 MINUTES
Y 2 HOURS 46 MINUTES TO 3 HOURS

COL.61
1 3 HOURS TO 3 HOURS 15 MINUTES
2 3 HOURS 16 MINUTES TO 3 HOURS 30 MINUTES
3 3 HOURS 31 MINUTES TO 3 HOURS 45 MINUTES
4 3 HOURS 46 MINUTES TO 4 HOURS
5 4 HOURS TO 4 HOURS 15 MINUTES
6 4 HOURS 16 MINUTES TO 4 HOURS 30 MINUTES
7 4 HOURS 31 MINUTES TO 4 HOURS 45 MINUTES
8 4 HOURS 46 MINUTES TO 5 HOURS
9 5 HOURS TO 5 HOURS 15 MINUTES
0 5 HOURS 16 MINUTES TO 5 HOURS 30 MINUTES
X 5 HOURS 31 MINUTES TO 5 HOURS 45 MINUTES
Y 5 HOURS 46 MINUTES TO 6 HOURS

COL.62
1 DON'T KNOW

---

15. How long, on average, would it take you to clear 6-8" of snow to move the car from the driveway or curb to begin the evacuation trip? Assume the roads are passable. (DO NOT READ RESPONSES.)

COL.63
1 LESS THAN 15 MINUTES
2 15-30 MINUTES
3 31-45 MINUTES
4 46 MINUTES - 1 HOUR
5 1 HOUR TO 1 HOUR 15 MINUTES
6 1 HOUR 16 MINUTES TO 1 HOUR 30 MINUTES
7 1 HOUR 31 MINUTES TO 1 HOUR 45 MINUTES
8 1 HOUR 46 MINUTES TO 2 HOURS
9 2 HOURS TO 2 HOURS 15 MINUTES
0 2 HOURS 16 MINUTES TO 2 HOURS 30 MINUTES
X 2 HOURS 31 MINUTES TO 2 HOURS 45 MINUTES
Y 2 HOURS 46 MINUTES TO 3 HOURS

COL.64
1 MORE THAN 3 HOURS
2 DON'T KNOW

16. Would you take household pets with you if you were asked to evacuate the area?

Col. 65
1 Yes
2 No
3 Don’t Know/Refused

Thank you very much. ___________________________

(TELEPHONE NUMBER CALLED)

IF REQUESTED:
For Additional information, contact your State Emergency Management Agency

County	EMO Phone
New Jersey	1-800-792-8314
Delaware	1-877-729-3362

APPENDIX G

Traffic Management Plan

APPENDIX G: TRAFFIC MANAGEMENT PLAN

As discussed in Section 7.2, the most critical intersections in the EPZ are listed in Table G-1 below, and are geographically displayed in Figures G-1 and G-2.

Table G-1. Critical Intersections in the PSEG Site EPZ

Critical Intersection ID	Description
1	NJ Route 49 and NJ Route 45
2	NJ Route 49 and Front Street
3	NJ Route 49 and Hook Rd (CR 551)
4	NJ Route 49 and Yorke St
5	Salem-Hancocks Bridge Rd/Yorke St and Grieves Parkway
6	DE Route 299 and US Route 301
7	DE Route 299 and DE Route 71
8	US Route 301 and DE Route 896
9	DE Route 71 and Main St/Pine Tree Rd

These critical intersections are suggested as traffic control points (TCP) during evacuation, which would be controlled by a police officer who would guide evacuees in the proper direction and facilitate the flow of traffic through the intersection. While there are many intersections that could potentially be TCPs, manpower and equipment are typically not sufficient to carry out all functions during an evacuation. Therefore, the investment of manpower and equipment at these critical intersections would be most beneficial to the evacuation process. Table G-2 summarizes the manpower and equipment needed to perform the traffic control duties at these suggested TCP. Figure G-3 through G-11 provide detailed schematics of the suggested actions to be taken at the TCP.

With reference to the discussion of Section 2.3, these TCP serve many useful functions, but are not considered in specifying the inputs to the I-DYNEV system used to calculate ETE. Consequently, the results presented in Section 7 and in Appendix J do not credit the presence of these TCP.

It is assumed that access control points (ACP) will be established within 90 minutes of the advisory to evacuate to discourage through travelers from using US Route 13 and DE Route 1 in Delaware and NJ Route 49 in New Jersey to traverse the EPZ. Figure G-12 maps the suggested ACP needed to divert traffic from entering the EPZ along the aforementioned routes. Table G-3 summarizes the manpower and equipment needed to implement access control, while Figures G-13 through G-18 provide detailed schematics of the suggested actions to be taken at the ACP.

The States of New Jersey and Delaware have existing traffic management plans to be used in the event of an evacuation of the EPZ due to an incident at one of the three operational units at the PSEG Site. It is likely that these plans would be used in support of the new plant as well, when active.

Detailed information about the existing TCP and ACP can be found in the Delaware State Plan, SOP700, “Traffic and Access Control”, and in Appendix 5 of Attachment 22 to the State of New Jersey Salem/Hope Creek Nuclear Generating Stations Radiological Emergency Response Plan. Table G-4 compares the suggested TCP and ACP with the existing TCP and ACP. Those TCP and ACP which are not currently identified in the state plans should be considered in future revisions to the state plans. The traffic management plan detailed in this appendix has been reviewed by state and county emergency planners with local and state police.

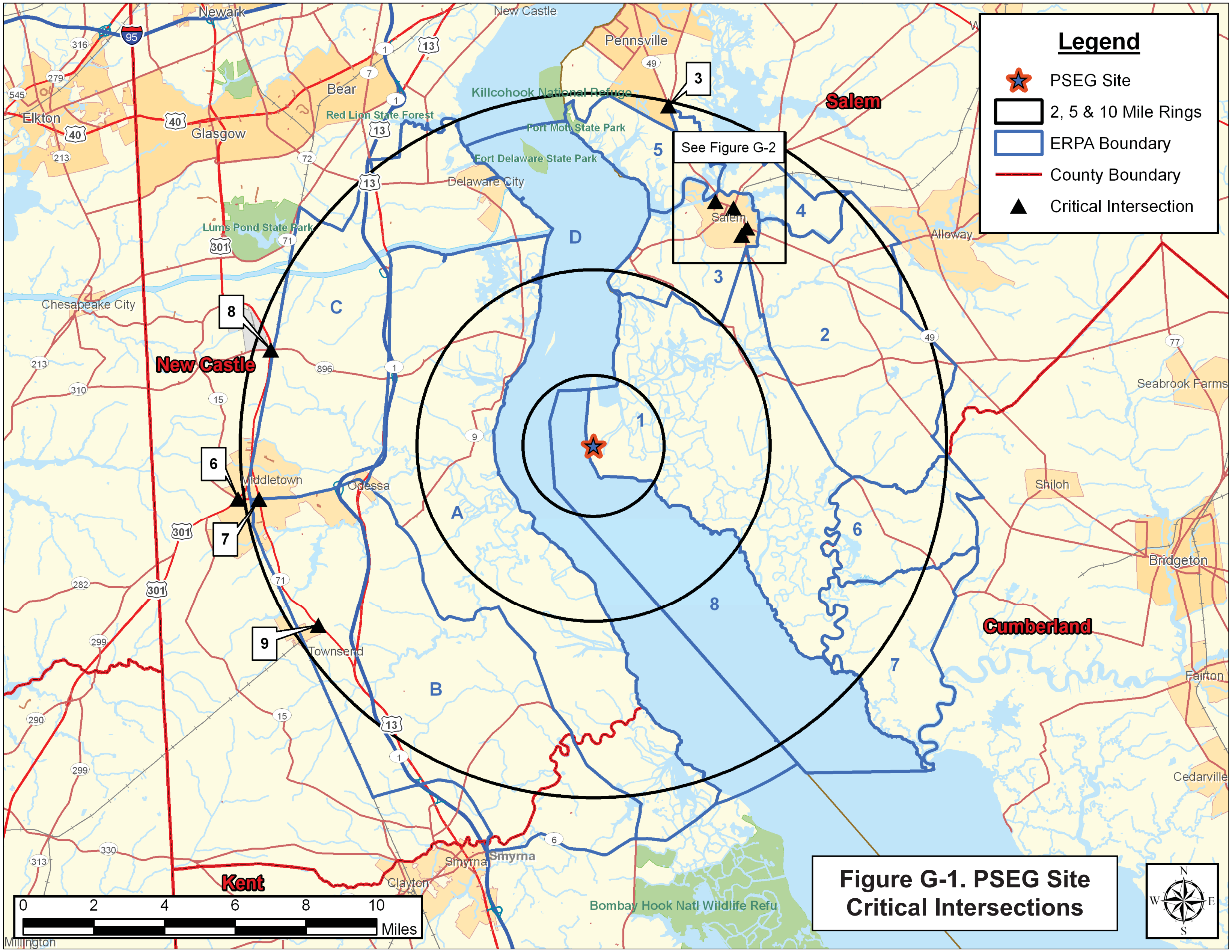


Figure G-1. PSEG Site Critical Intersections

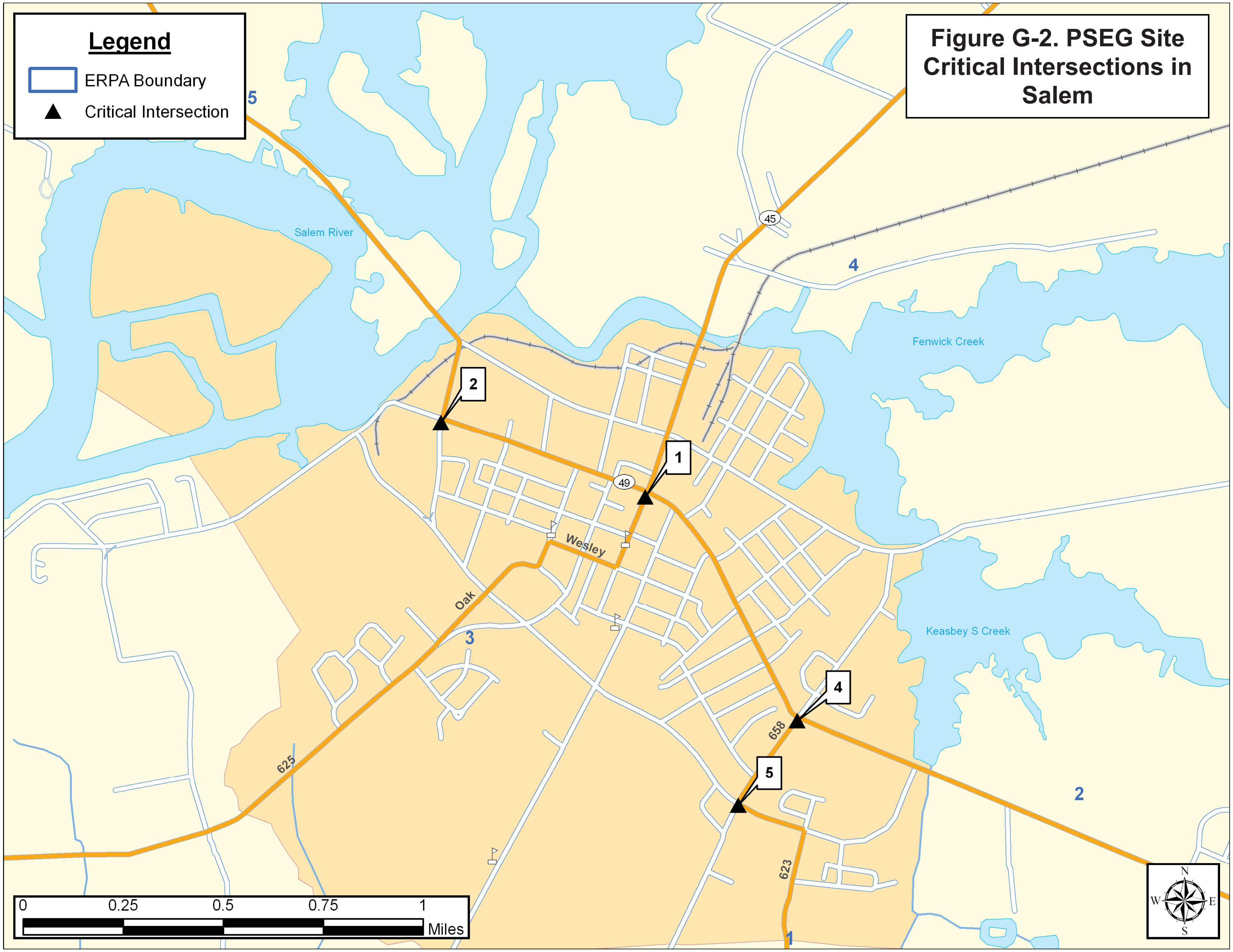

Legend
ERPA Boundary
Critical Intersection
Figure G-2. PSEG Site Critical Intersections in Salem
Salem River
Fenwick Creek
Keasbey S Creek
Wesley
Oak
45
49
625
658
623
1
2
3
4
5
0
0.25
0.5
0.75
1
Miles
N
S
E
W

Table G-2. Summary of Suggested Traffic Control Points					
ID	**Municipality**	**Intersection Location**	**Priority**	**# of Guides**	**# of Cones**
SALEM COUNTY, NJ					
1	Salem City	NJ Route 49 & NJ Route 45	1	1	3
2	Salem City	NJ Route 49 & Front St	1	1	6
3	Pennsville	NJ Route 49 & S. Hook Rd (CR 551)	1	2	3
4	Salem City	NJ Route 49 & Keasbey/Yorke St	2	1	6
5	Salem City	Salem-Hancocks Bridge Rd/Yorke St & Grieves Pkwy	1	1	3
Total Equipment/Manpower for Salem County:				**6**	**21**
NEW CASTLE COUNTY, DE					
6	Middletown	DE Route 299 & US 301	1	2	3
7	Middletown	DE Route 299 & DE Route 71	1	2	3
8	Summit Bridge	US 301 & DE Route 896	1	2	12
9	Townsend	DE Route 71 & Main St/Pine Tree Rd	2	2	9
Total Equipment/Manpower for New Castle County:				**8**	**27**
TOTAL EQUIPMENT/MANPOWER FOR ENTIRE EPZ:				**14**	**48**

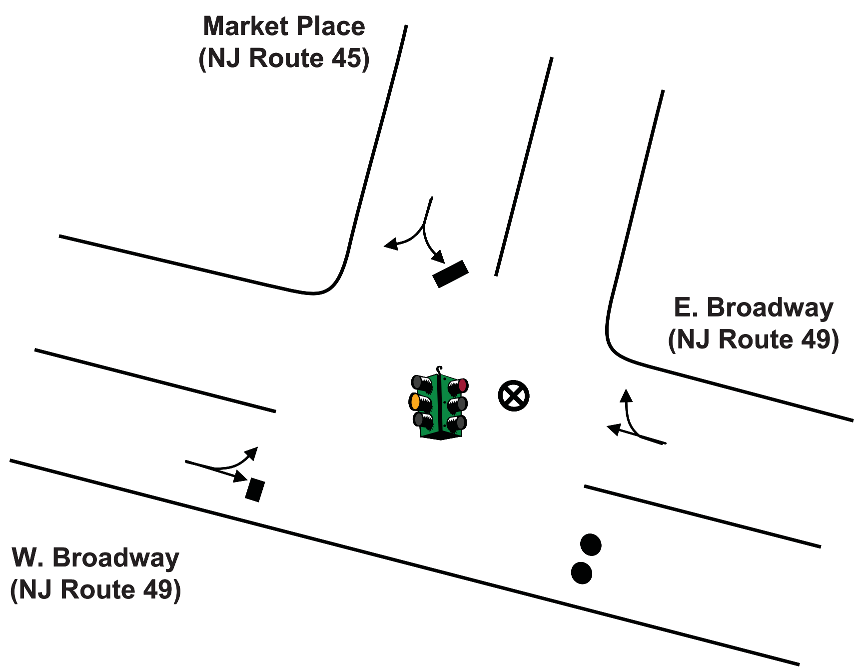
TCP

MUNICIPALITY: Salem City

LOCATION: NJ Route 49 & NJ Route 45

ID: 1

ERPA: 3



Traffic Guide should position himself safely

Key

- MOVEMENT FACILITATED
- MOVEMENT DISCOURAGED/DIVERTED
- TRAFFIC GUIDE
- STOP SIGN
- TRAFFIC BARRICADE (2 ft × 3 ft)
  - 2 PER LANE (LOCAL ROADS AND RAMPS)
  - 4 PER LANE (FREEWAY AND RAMPS)
- TRAFFIC SIGNAL
- TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE): 8 ft

ACTIONS TO BE TAKEN

1. Discourage eastbound traffic on New Jersey Route 49

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
3 Traffic Cones

LOCATION PRIORITY

1

Figure G-3. Schematic of TCP 1

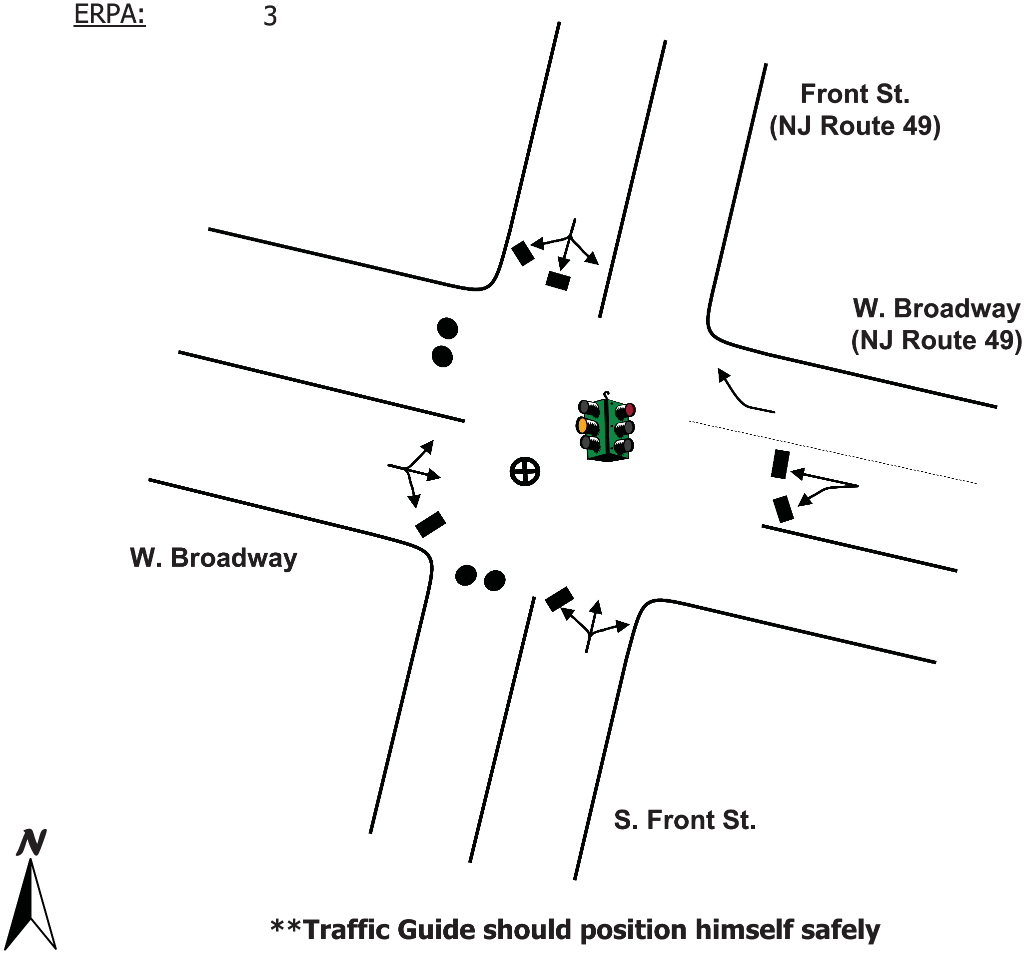
TCP

MUNICIPALITY: Salem City

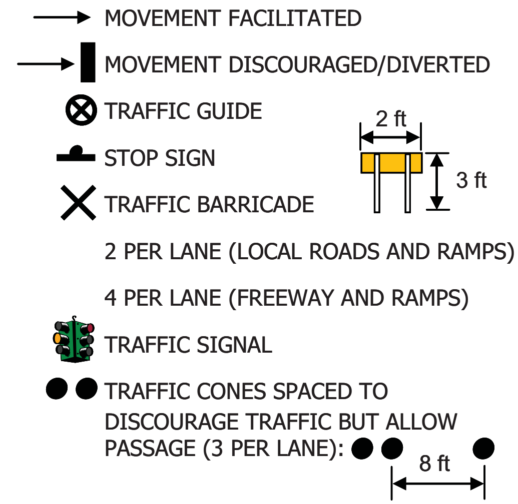
LOCATION: NJ Route 49 & Front St

ID: 2

ERPA: 3



Key



ACTIONS TO BE TAKEN

1. Discourage westbound traffic on W. Broadway
2. Discourage southbound traffic on S. Front Street

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

1

Figure G-4. Schematic of TCP 2

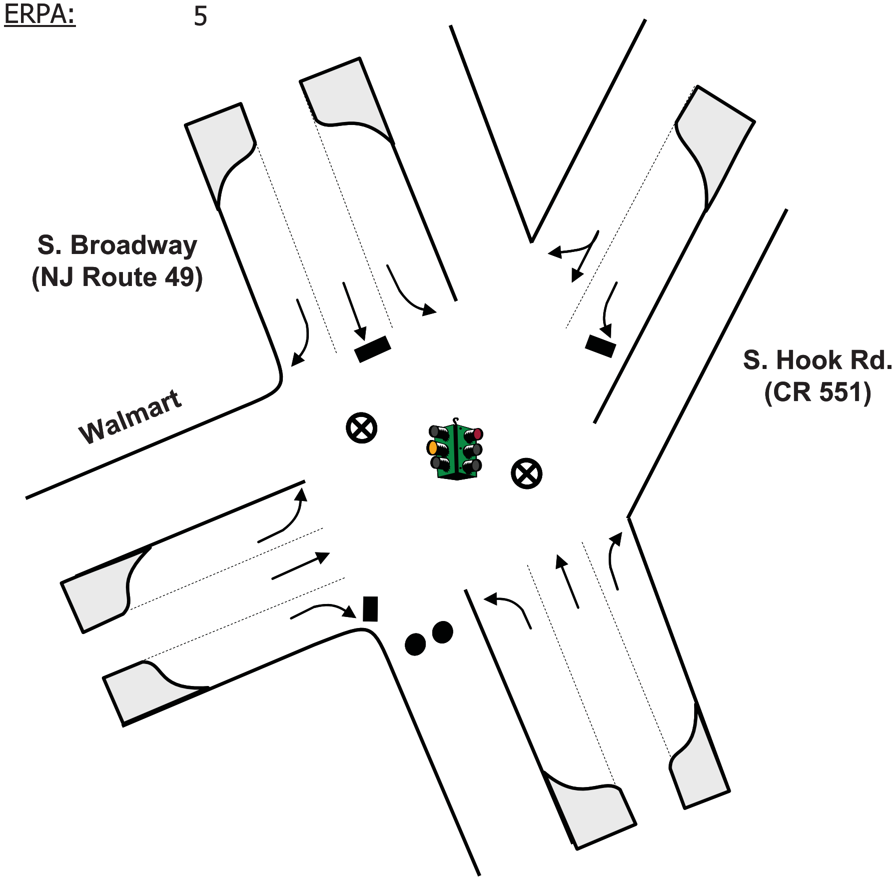
TCP

MUNICIPALITY: Pennsville

LOCATION: NJ Route 49 & S. Hook Rd (CR 551)

ID: 3

ERPA: 5



****Traffic Guide should position himself safely**

Key

- MOVEMENT FACILITATED
- MOVEMENT DISCOURAGED/DIVERTED
- TRAFFIC GUIDE
- STOP SIGN
- TRAFFIC BARRICADE (2 ft, 3 ft)
  - 2 PER LANE (LOCAL ROADS AND RAMPS)
  - 4 PER LANE (FREEWAY AND RAMPS)
- TRAFFIC SIGNAL
- TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE): (8 ft)

ACTIONS TO BE TAKEN

1. Discourage eastbound traffic on New Jersey Route 49

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
3 Traffic Cones

LOCATION PRIORITY

1

Figure G-5. Schematic of TCP 3

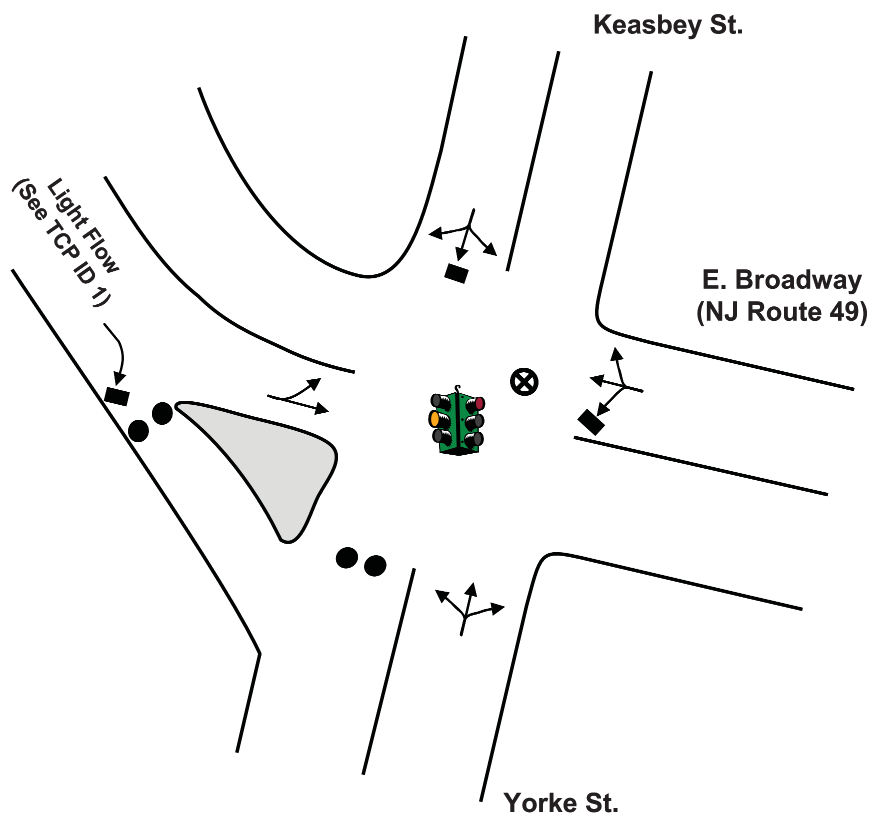
TCP

MUNICIPALITY: Salem City

LOCATION: NJ Route 49 & Keasbey/Yorke St

ID: 4

ERPA: 3



**Traffic Guide should position himself safely

Key

- MOVEMENT FACILITATED
- MOVEMENT DISCOURAGED/DIVERTED
- TRAFFIC GUIDE
- STOP SIGN
- TRAFFIC BARRICADE (2 ft, 3 ft)
  - 2 PER LANE (LOCAL ROADS AND RAMPS)
  - 4 PER LANE (FREEWAY AND RAMPS)
- TRAFFIC SIGNAL
- TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE): 8 ft

ACTIONS TO BE TAKEN

1. Discourage southbound traffic on Yorke Street

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

2

Figure G-6. Schematic of TCP 4

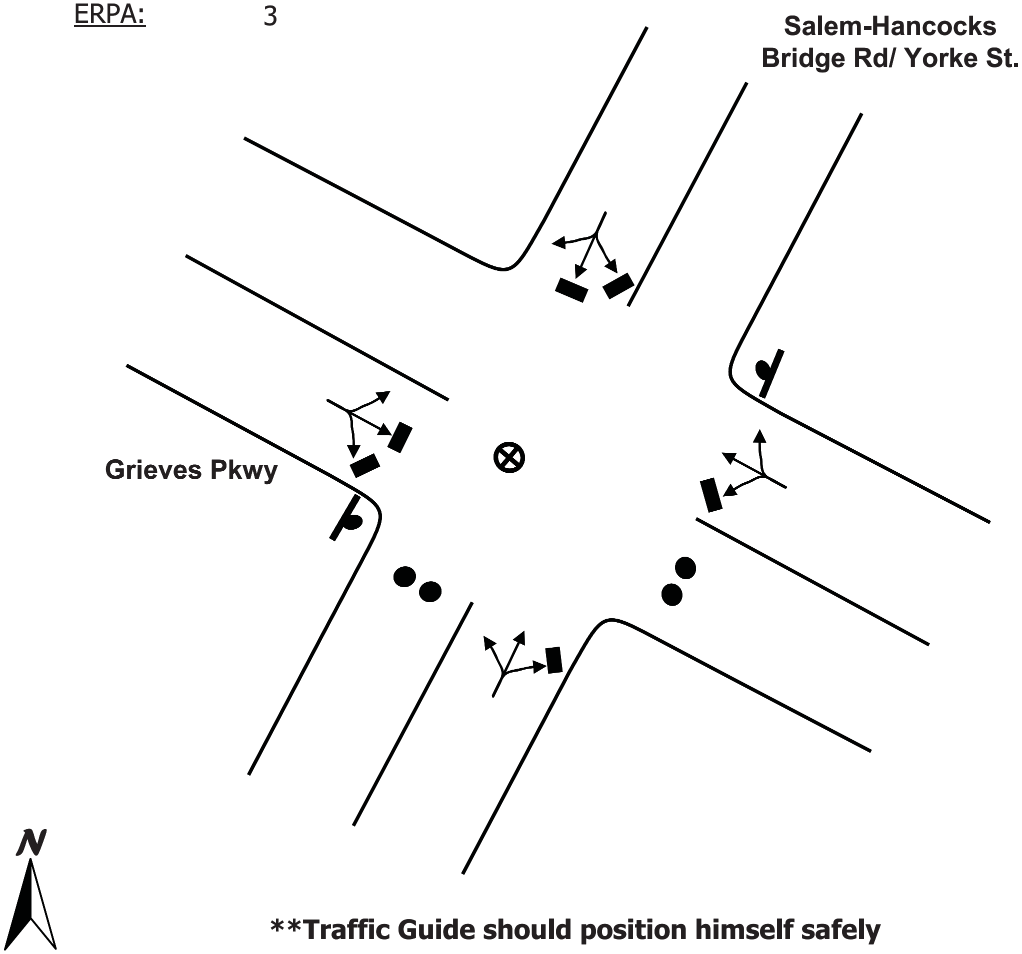
TCP

MUNICIPALITY: Salem City

LOCATION: Salem-Hancocks Bridge Rd/Yorke St & Grieves Pkwy

ID: 5

ERPA: 3



Key

- MOVEMENT FACILITATED
- MOVEMENT DISCOURAGED/DIVERTED
- TRAFFIC GUIDE
- STOP SIGN
- TRAFFIC BARRICADE (2 ft, 3 ft)
  - 2 PER LANE (LOCAL ROADS AND RAMPS)
  - 4 PER LANE (FREEWAY AND RAMPS)
- TRAFFIC SIGNAL
- TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE): 8 ft

ACTIONS TO BE TAKEN

1. Discourage southbound traffic on Yorke St.
2. Discourage eastbound traffic on Grieves Pkwy

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
3 Traffic Cones

LOCATION PRIORITY

1

Figure G-7. Schematic of TCP 5

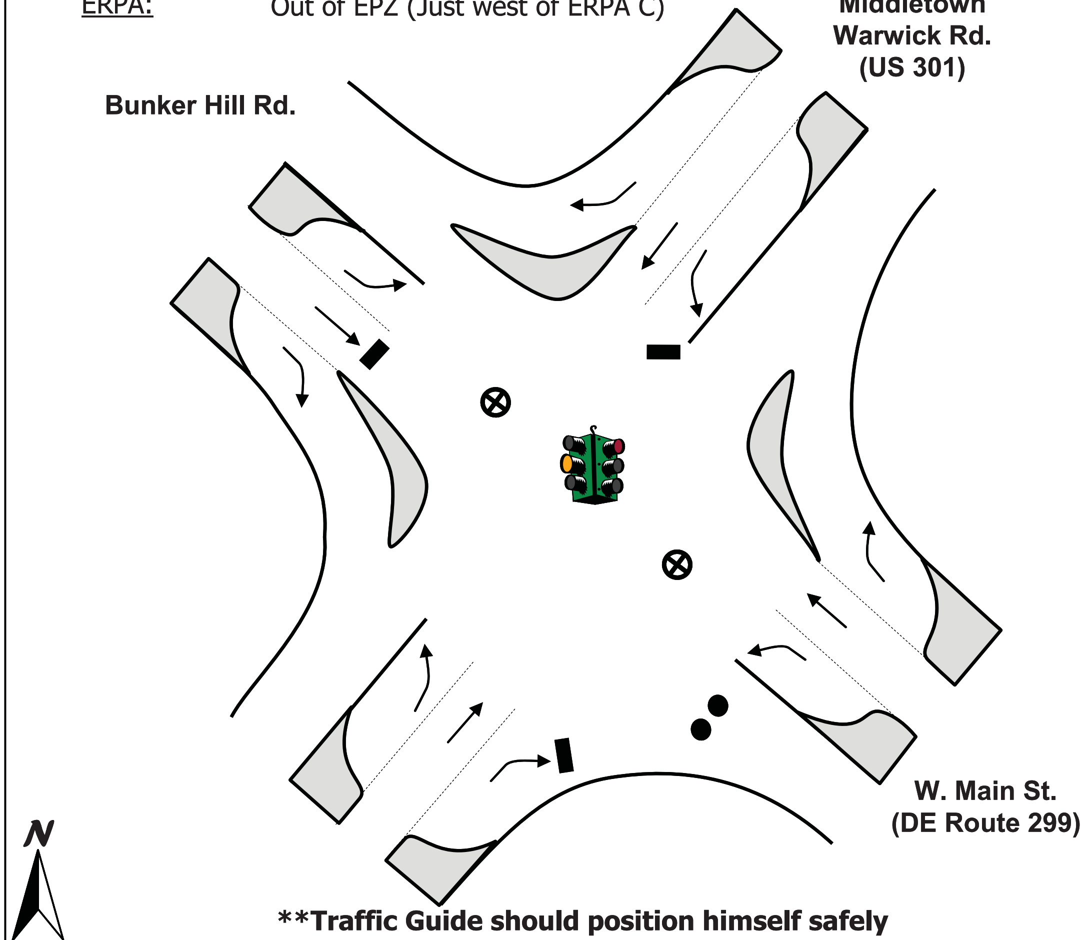
TCP

MUNICIPALITY: Middletown

LOCATION: DE Route 299 & US 301

ID: 6

ERPA: Out of EPZ (Just west of ERPA C)



Key

- MOVEMENT FACILITATED
- MOVEMENT DISCOURAGED/DIVERTED
- TRAFFIC GUIDE
- STOP SIGN
- TRAFFIC BARRICADE (2 ft, 3 ft)
  - 2 PER LANE (LOCAL ROADS AND RAMPS)
  - 4 PER LANE (FREEWAY AND RAMPS)
- TRAFFIC SIGNAL
- TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE): 8 ft

ACTIONS TO BE TAKEN

1. Discourage eastbound traffic on DE Route 299

MANPOWER/EQUIPMENT ESTIMATE

2	Traffic Guide(s)
3	Traffic Cones

LOCATION PRIORITY

1

Figure G-8. Schematic of TCP 6

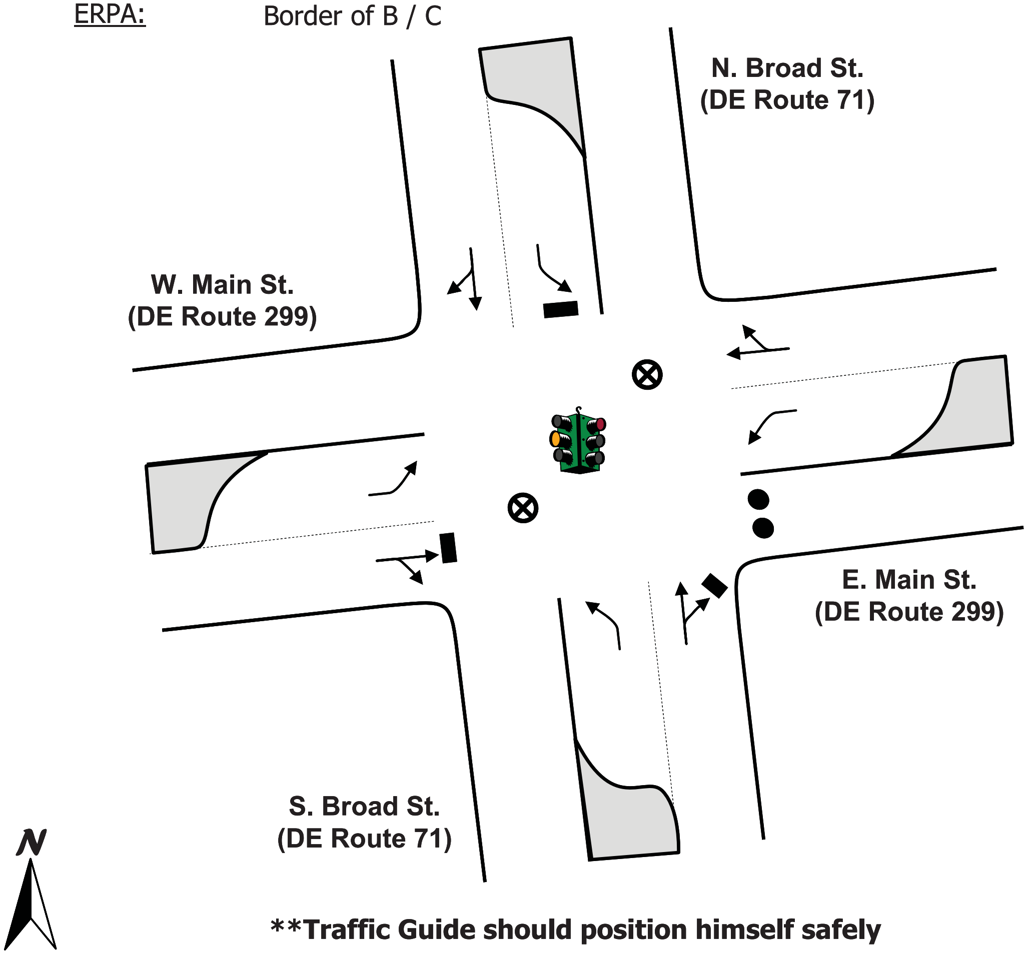
TCP

MUNICIPALITY: Middletown

LOCATION: DE Route 299 & DE Route 71

ID: 7

ERPA: Border of B / C



****Traffic Guide should position himself safely**

Key

MOVEMENT FACILITATED
MOVEMENT DISCOURAGED/DIVERTED
TRAFFIC GUIDE
STOP SIGN
TRAFFIC BARRICADE
2 ft
3 ft
2 PER LANE (LOCAL ROADS AND RAMPS)
4 PER LANE (FREEWAY AND RAMPS)
TRAFFIC SIGNAL
TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE):
8 ft

ACTIONS TO BE TAKEN

1. Discourage eastbound traffic on Delaware Route 299

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
3 Traffic Cones

LOCATION PRIORITY

1

Figure G-9. Schematic of TCP 7

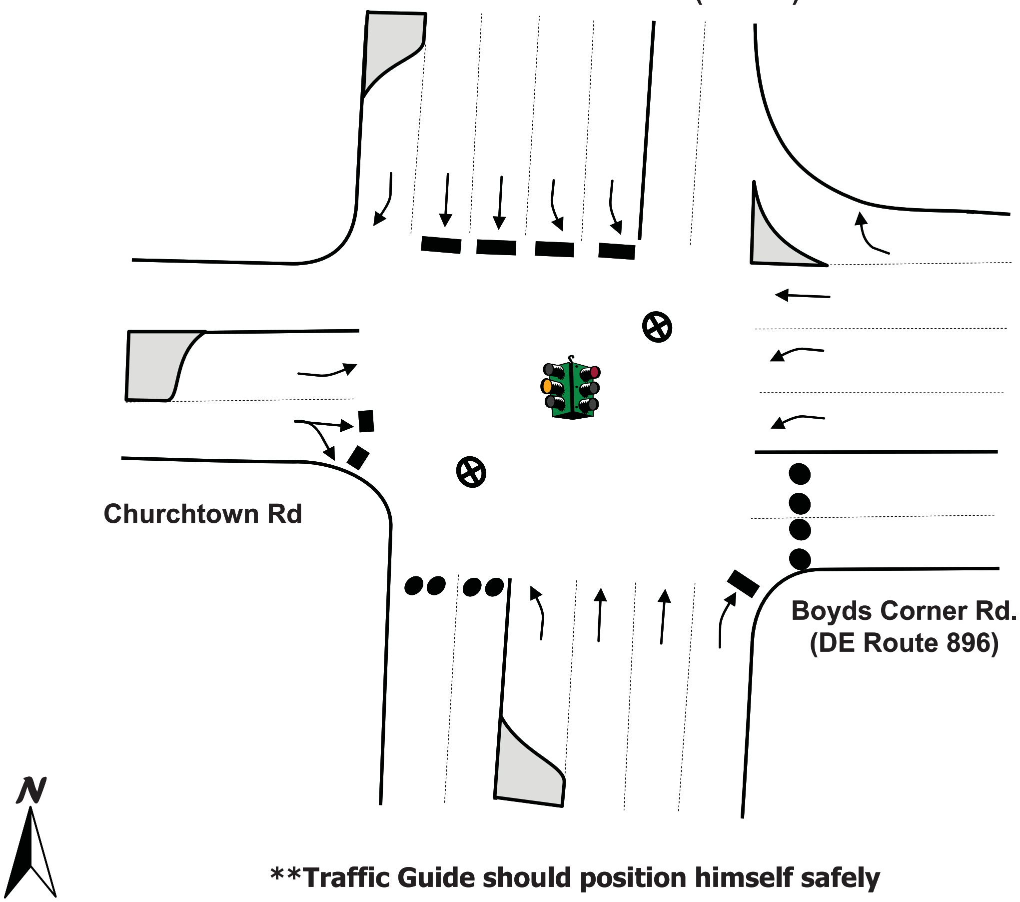
TCP

MUNICIPALITY: Summit Bridge

LOCATION: US 301 & DE Route 896

ID: 8

ERPA: C



Key

- MOVEMENT FACILITATED
- MOVEMENT DISCOURAGED/DIVERTED
- TRAFFIC GUIDE
- STOP SIGN
- TRAFFIC BARRICADE (2 ft, 3 ft)
  - 2 PER LANE (LOCAL ROADS AND RAMPS)
  - 4 PER LANE (FREEWAY AND RAMPS)
- TRAFFIC SIGNAL
- TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE): 8 ft

ACTIONS TO BE TAKEN

1. Discourage eastbound traffic on Delaware Route 896
2. Discourage southbound traffic on US 301

MANPOWER/EQUIPMENT ESTIMATE

2	Traffic Guide(s)
12	Traffic Cones

LOCATION PRIORITY

1

Figure G-10. Schematic of TCP 8

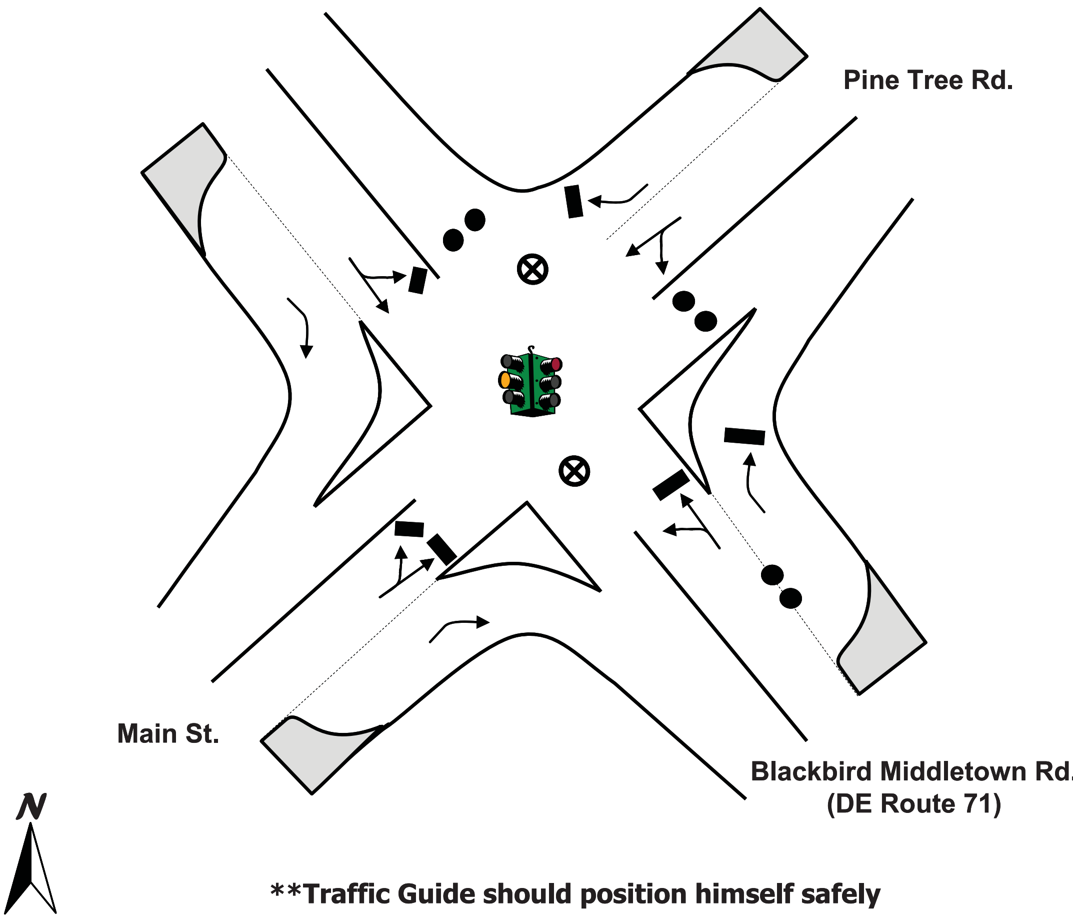
TCP

MUNICIPALITY: Townsend

LOCATION: DE Route 71 & Main St/Pine Tree Rd

ID: 9

ERPA: B



Key

- MOVEMENT FACILITATED
- MOVEMENT DISCOURAGED/DIVERTED
- TRAFFIC GUIDE
- STOP SIGN
- TRAFFIC BARRICADE
  - 2 PER LANE (LOCAL ROADS AND RAMPS)
  - 4 PER LANE (FREEWAY AND RAMPS)
  - 2 ft
  - 3 ft
- TRAFFIC SIGNAL
- TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE):
  - 8 ft

ACTIONS TO BE TAKEN

1. Discourage eastbound traffic on Pine Tree Road
2. Discourage northbound traffic on DE Route 71

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
9 Traffic Cones

LOCATION PRIORITY

2

Figure G-11. Schematic of TCP 9

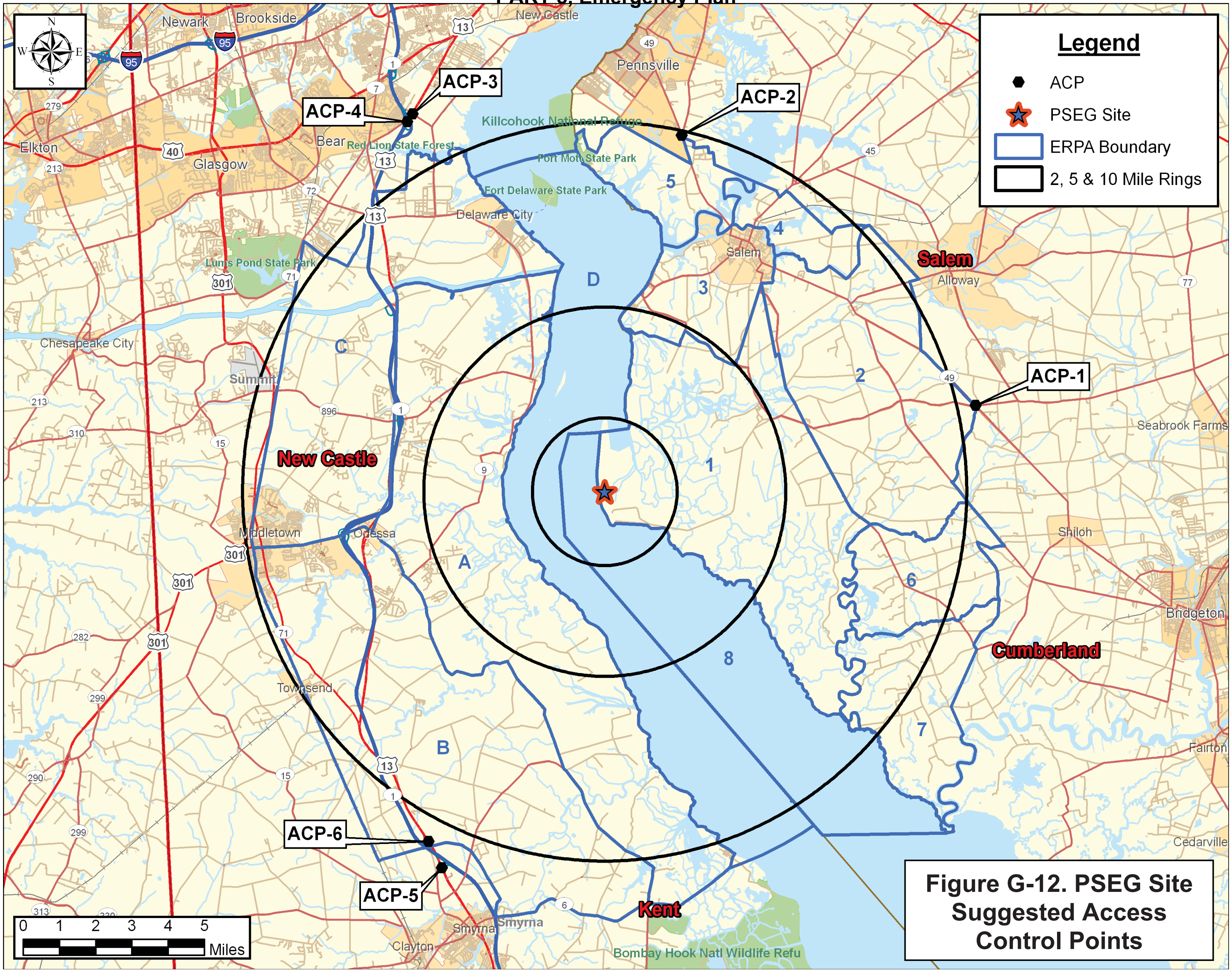


Figure G-12. PSEG Site Suggested Access Control Points

Table G-3. Summary of Suggested Access Control Points					
ID	**Municipality**	**Intersection Location**	**Priority**	**# of Guides**	**# of Barricades**
SALEM COUNTY, NJ					
ACP-1	Pecks Corner	NJ Route 49 & Harmersville Pecks Corner Rd/Cohansey Rd	1	1	4
ACP-2	Pennsville	NJ Route 49 & S. Hook Rd (CR 551)	1	1	2
			Total Equipment/Manpower for Salem County:	**2**	**6**
NEW CASTLE COUNTY, DE					
ACP-3	Bear	Bear Rd/Hamburg Rd & US 13	1	3	8
ACP-4	Bear	US 13 & DE Route 1 & DE Route 71	1	3	16
ACP-5	Smyrna	US 13 & DE Route 486 & DE Route 1	1	3	6
ACP-6	Smyrna	US 13 & DE Route 1	1	3	12
			Total Equipment/Manpower for New Castle County:	**12**	**42**
			TOTAL EQUIPMENT/MANPOWER FOR ENTIRE EPZ:	**14**	**48**

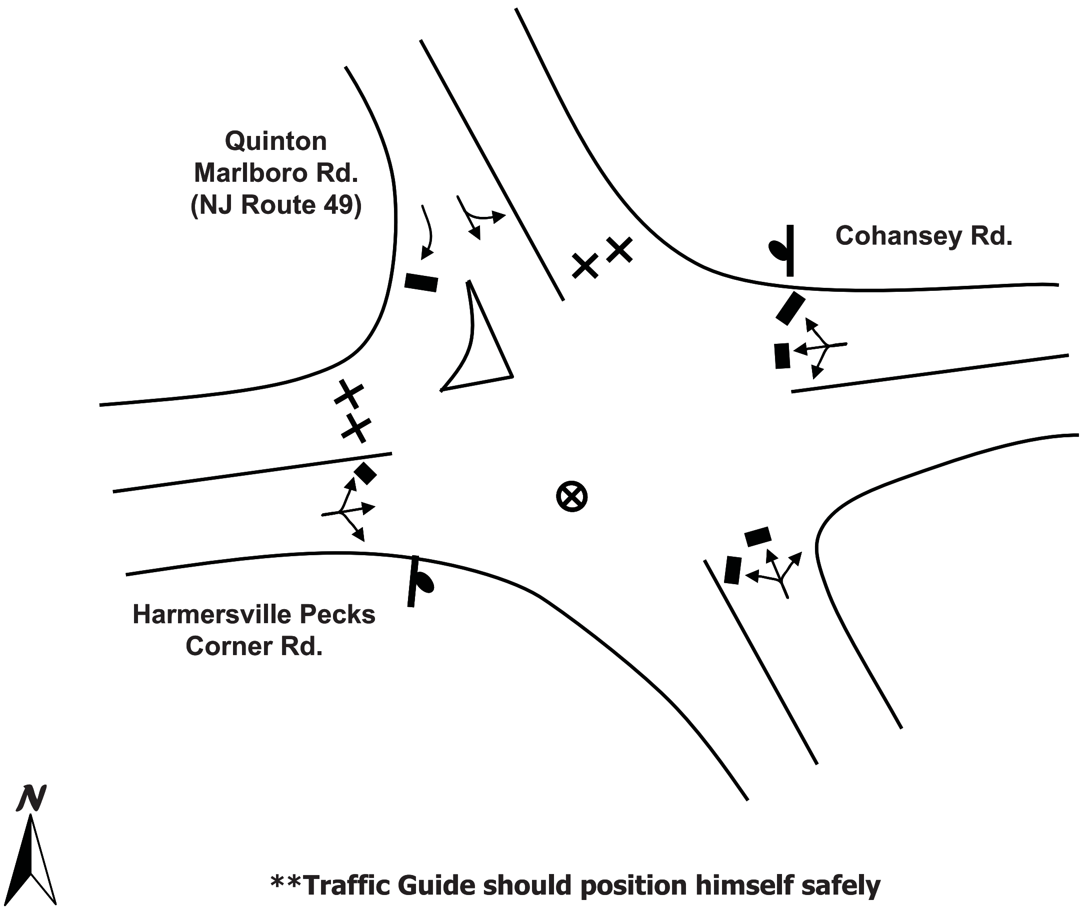
ACP

TOWN: Pecks Corner

LOCATION: NJ Route 49 & Harmersville Pecks Corner Rd. / Cohansey Rd.

ACP ID: ACP-1

ERPA: 2



Key

- MOVEMENT FACILITATED
- MOVEMENT DISCOURAGED/DIVERTED
- TRAFFIC GUIDE
- STOP SIGN
- TRAFFIC BARRICADE (2 ft × 3 ft)
  - 2 PER LANE (LOCAL ROADS AND RAMPS)
  - 4 PER LANE (FREEWAY AND RAMPS)
- TRAFFIC SIGNAL
- TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE): 8 ft

ACTIONS TO BE TAKEN

1. Interdict and divert westbound traffic on New Jersey Route 49
2. Interdict and divert westbound traffic on Harmersville Pecks Corner Road

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
4 Traffic Barricades

LOCATION PRIORITY

1

Figure G-13. Schematic of ACP 1

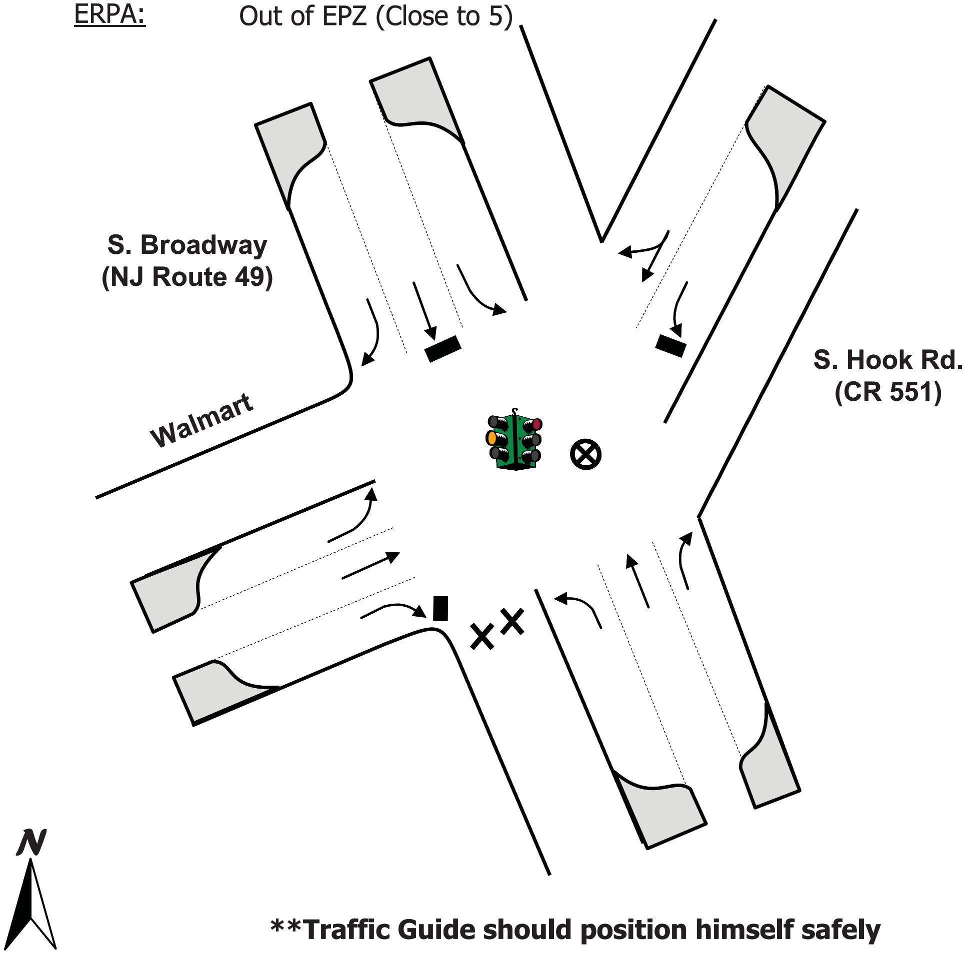
ACP

TOWN: Pennsville

LOCATION: NJ Route 49 & S. Hook Rd (CR 551)

ACP ID: ACP-2

ERPA: Out of EPZ (Close to 5)



Traffic Guide should position himself safely

Key

- MOVEMENT FACILITATED
- MOVEMENT DISCOURAGED/DIVERTED
- TRAFFIC GUIDE
- STOP SIGN
- TRAFFIC BARRICADE (2 ft × 3 ft)
  - 2 PER LANE (LOCAL ROADS AND RAMPS)
  - 4 PER LANE (FREEWAY AND RAMPS)
- TRAFFIC SIGNAL
- TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE): 8 ft

ACTIONS TO BE TAKEN

1. Interdict and divert southbound traffic on New Jersey Route 49

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
2 Traffic Barricades

LOCATION PRIORITY

1

Figure G-14. Schematic of ACP 2

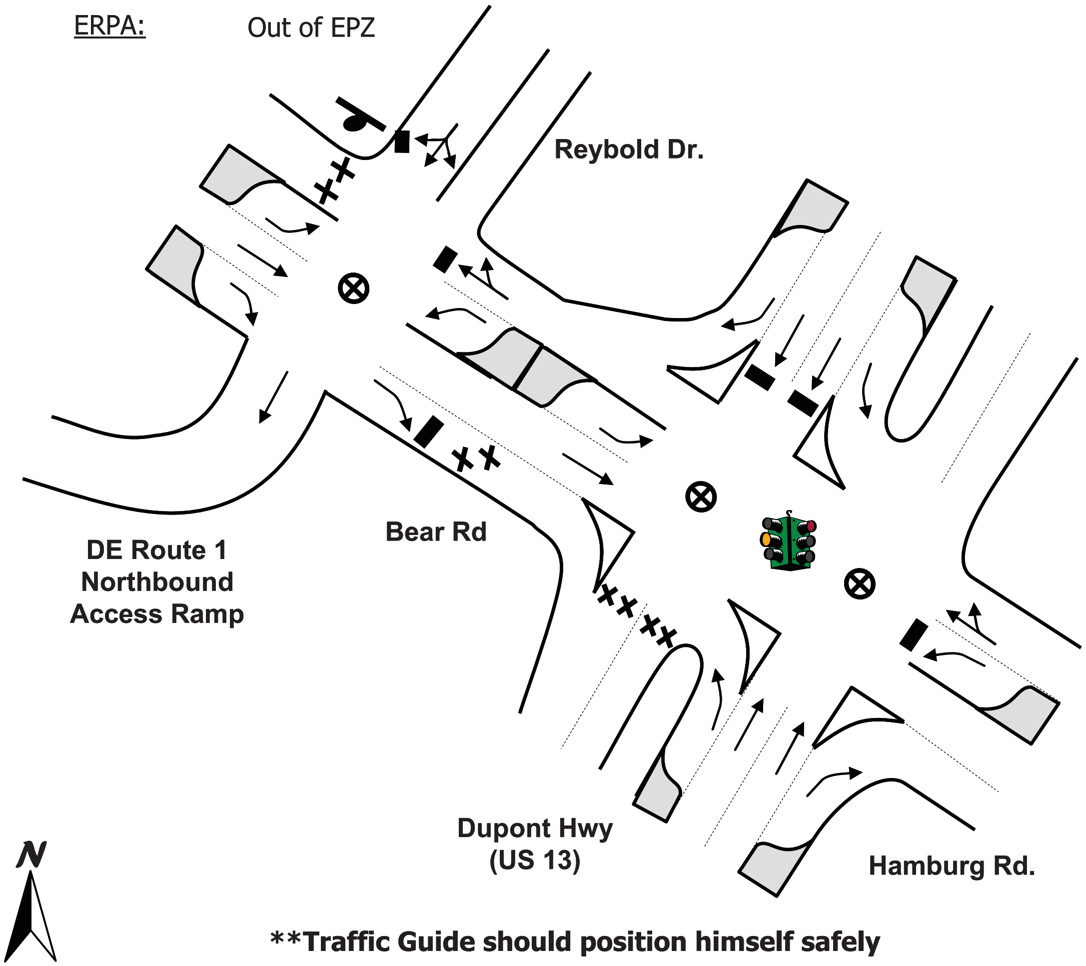
ACP

TOWN: Bear

LOCATION: Bear Rd / Hamburg Rd & US 13

ACP ID: ACP-3

ERPA: Out of EPZ



Key

MOVEMENT FACILITATED

MOVEMENT DISCOURAGED/DIVERTED

TRAFFIC GUIDE

STOP SIGN

TRAFFIC BARRICADE

2 ft

3 ft

2 PER LANE (LOCAL ROADS AND RAMPS)

4 PER LANE (FREEWAY AND RAMPS)

TRAFFIC SIGNAL

TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE):

8 ft

ACTIONS TO BE TAKEN

1. Interdict and divert southbound traffic on US 13
2. Interdict and divert westbound traffic on Bear Road

MANPOWER/EQUIPMENT ESTIMATE

3 Traffic Guide(s)

8 Traffic Barricades

LOCATION PRIORITY

1

Figure G-15. Schematic of ACP 3

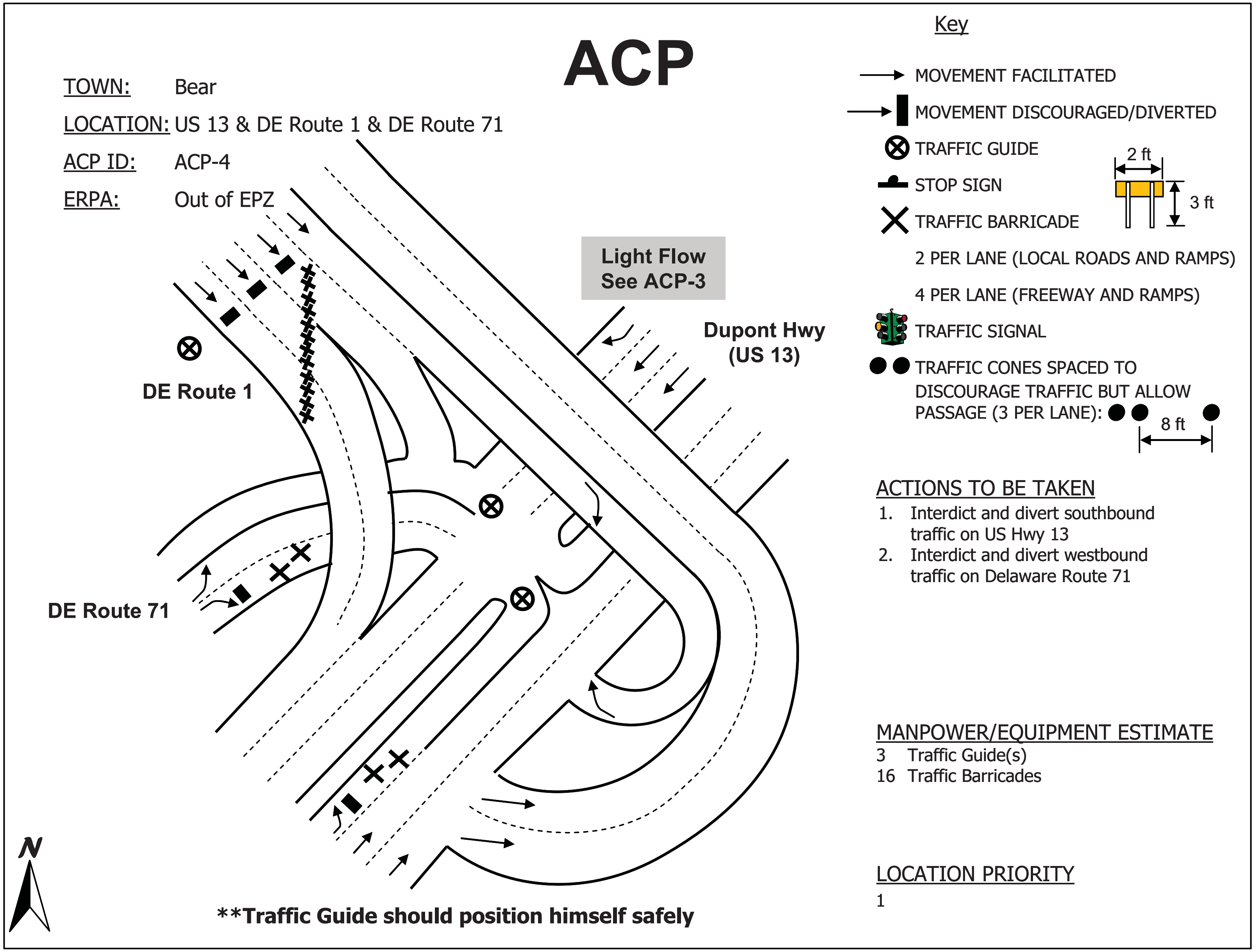


Figure G-16. Schematic of ACP 4

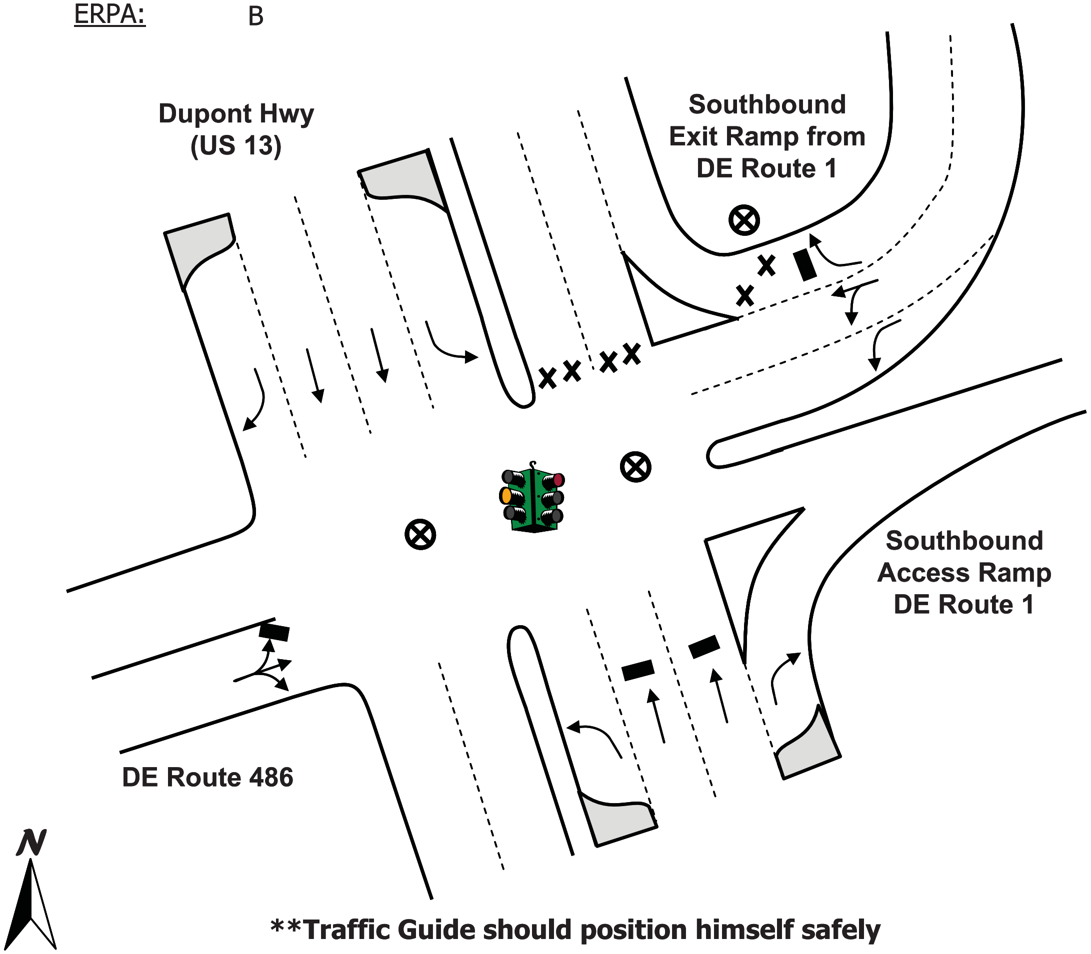
ACP

TOWN: Smyrna

LOCATION: US 13 & DE Route 486 & DE Route 1

ACP ID: ACP-5

ERPA: B



Key

- MOVEMENT FACILITATED
- MOVEMENT DISCOURAGED/DIVERTED
- TRAFFIC GUIDE
- STOP SIGN
- TRAFFIC BARRICADE
  - 2 PER LANE (LOCAL ROADS AND RAMPS)
  - 4 PER LANE (FREEWAY AND RAMPS)
- TRAFFIC SIGNAL
- TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE):

2 ft
3 ft
8 ft

ACTIONS TO BE TAKEN

1. Interdict and divert northbound traffic on US Hwy 13
2. Facilitate southbound traffic on Delaware Route 1

MANPOWER/EQUIPMENT ESTIMATE

3 Traffic Guide(s)
6 Traffic Barricades

LOCATION PRIORITY

1

Figure G-17. Schematic of ACP 5

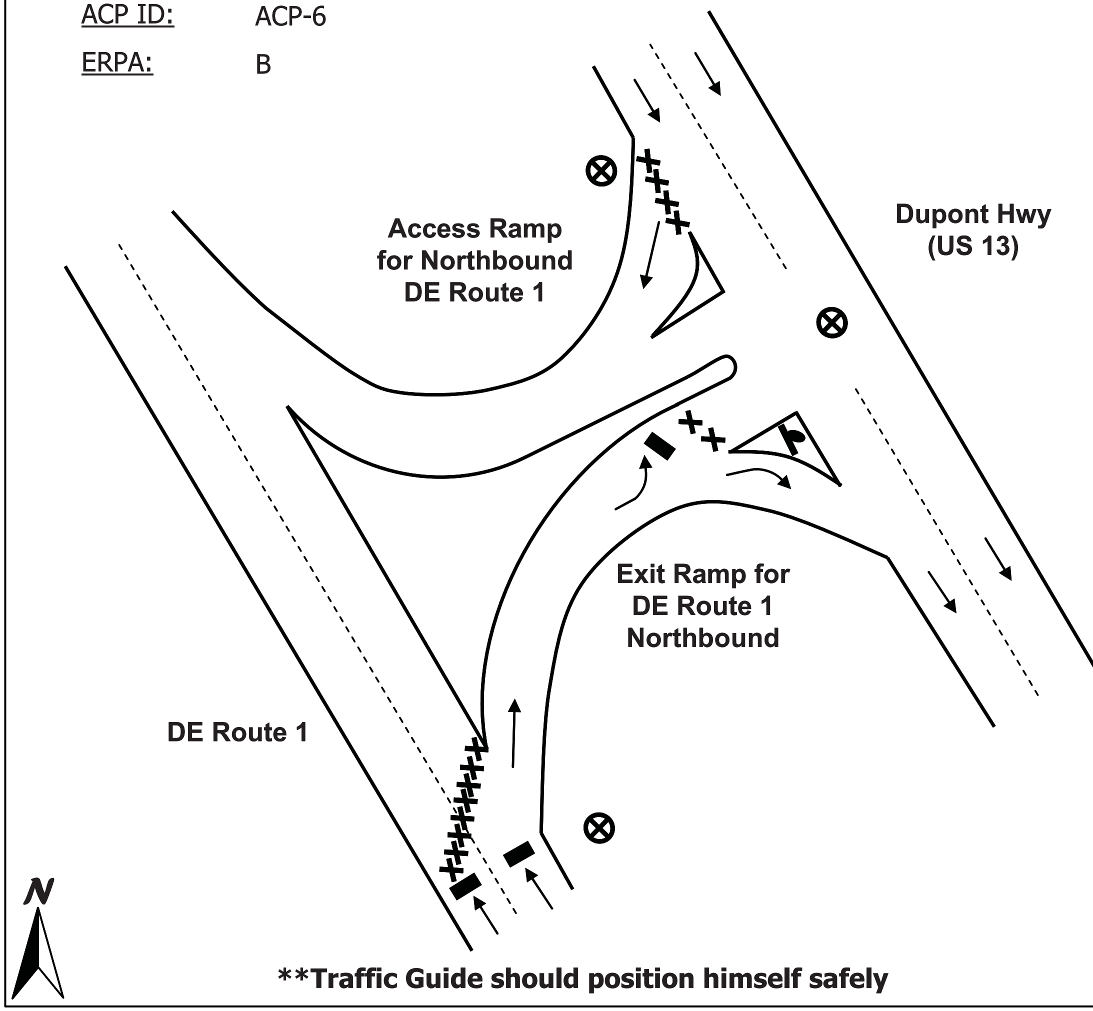
ACP

TOWN: Smyrna

LOCATION: US 13 & DE Route 1

ACP ID: ACP-6

ERPA: B



****Traffic Guide should position himself safely**

Key

- MOVEMENT FACILITATED
- MOVEMENT DISCOURAGED/DIVERTED
- TRAFFIC GUIDE
- STOP SIGN
- TRAFFIC BARRICADE (2 ft, 3 ft)
  - 2 PER LANE (LOCAL ROADS AND RAMPS)
  - 4 PER LANE (FREEWAY AND RAMPS)
- TRAFFIC SIGNAL
- TRAFFIC CONES SPACED TO DISCOURAGE TRAFFIC BUT ALLOW PASSAGE (3 PER LANE): (8 ft)

ACTIONS TO BE TAKEN

1. Interdict and divert northbound traffic on Delaware Route 1
2. Facilitate southbound traffic on US Hwy 13

MANPOWER/EQUIPMENT ESTIMATE

3 Traffic Guide(s)
12 Traffic Barricades

LOCATION PRIORITY

1

Figure G-18. Schematic of ACP 6

Table G-4. Comparison of Suggested TCP/ACP with Existing State Plans	
TCP ID	**State Plan ID**
1	Post #1
2	Not Identified
3	1B
4	Not Identified
5	Post #18
6	B-13
7	T-12
8	B-10
9	T-10
ACP ID	**State Plan ID**
1	9B
2	1B
3	Not Identified
4	B-3
5	Not Identified
6	Not Identified

APPENDIX H

Evacuation Regions

APPENDIX H: EVACUATION REGIONS

This appendix presents the assumed voluntary evacuation percentages for each Evacuation Region (Table H-1) and maps of all Evacuation Regions. The percentages presented in Table H-1 are based on the methodology discussed in assumption 5 of Section 2.2 and shown in Figure 2-1.

Table H-1. Percent of ERPA Population Evacuating for Each Region

ERPA	Region																
	2-Mile Ring, 5-Mile Ring, Entire EPZ			5-Mile Radius and Downwind to EPZ Boundary										2-Mile Radius and Downwind to EPZ Boundary			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2	35%	35%	100%	50%	50%	100%	100%	100%	50%	50%	50%	50%	50%	100%	100%	100%	50%
3	35%	35%	100%	100%	100%	100%	100%	50%	50%	50%	50%	50%	50%	100%	100%	50%	50%
4	35%	35%	100%	50%	100%	100%	100%	50%	50%	50%	50%	50%	50%	100%	100%	50%	50%
5	35%	35%	100%	100%	100%	100%	50%	50%	50%	50%	50%	50%	50%	100%	50%	50%	50%
6	35%	35%	100%	50%	50%	50%	100%	100%	100%	50%	50%	50%	50%	50%	100%	100%	100%
7	35%	35%	100%	50%	50%	50%	50%	100%	100%	100%	50%	50%	50%	50%	50%	100%	100%
8	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
A	35%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	50%	50%	50%	50%
B	35%	35%	100%	50%	50%	50%	50%	50%	50%	100%	100%	100%	50%	50%	50%	50%	50%
C	35%	35%	100%	100%	100%	50%	50%	50%	50%	50%	50%	100%	100%	50%	50%	50%	50%
D	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

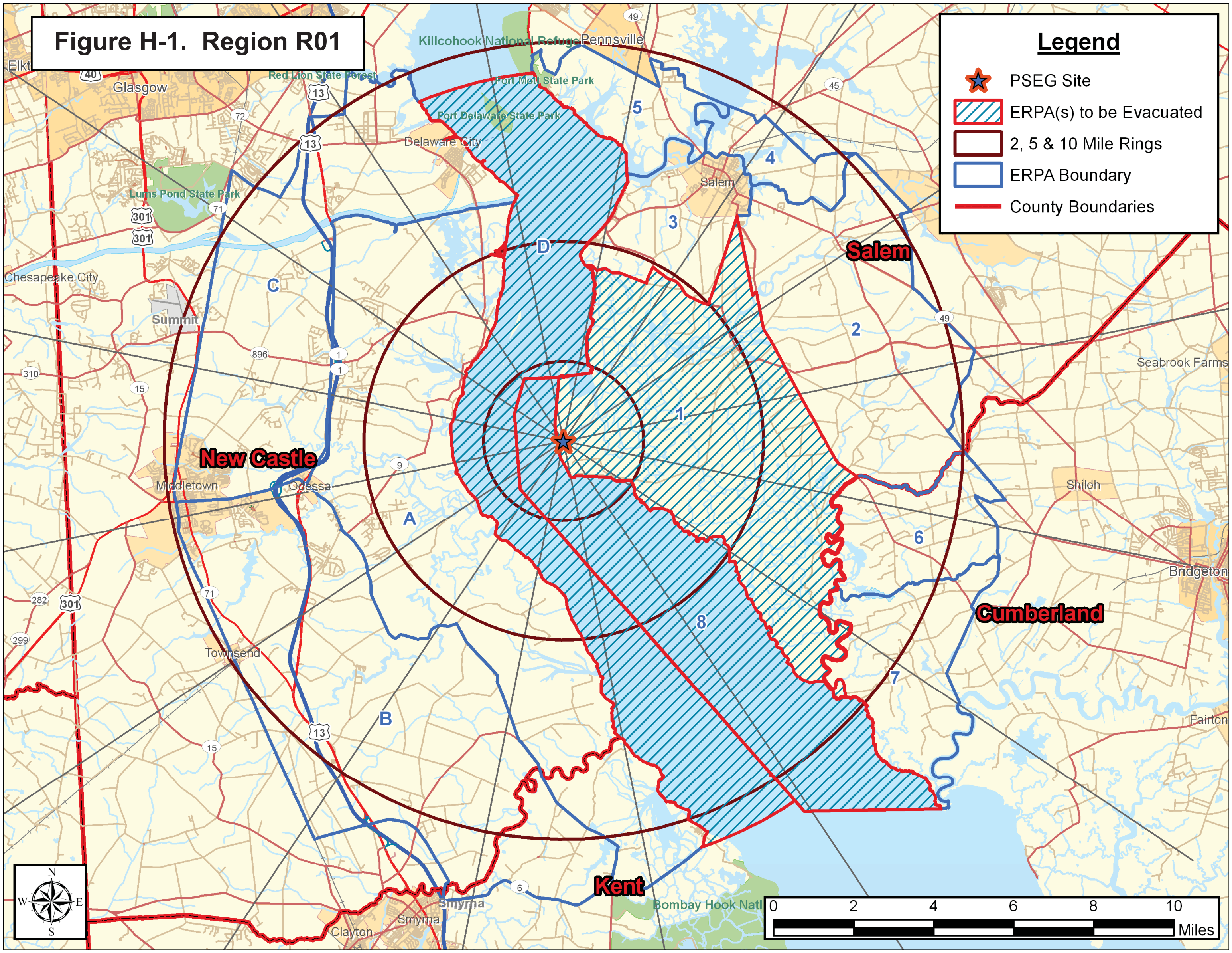


Figure H-1. Region R01
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
New Castle
Salem
Cumberland
Kent
Pennsville
Salem
Delaware City
Glasgow
Middletown
Odessa
Townsend
Smyrna
Clayton
Shiloh
Bridgeton
Seabrook Farms
Fairton
Chesapeake City
Summit
Killcohook National Refuge
Fort Mott State Park
Fort Delaware State Park
Red Lion State Forest
Lums Pond State Park
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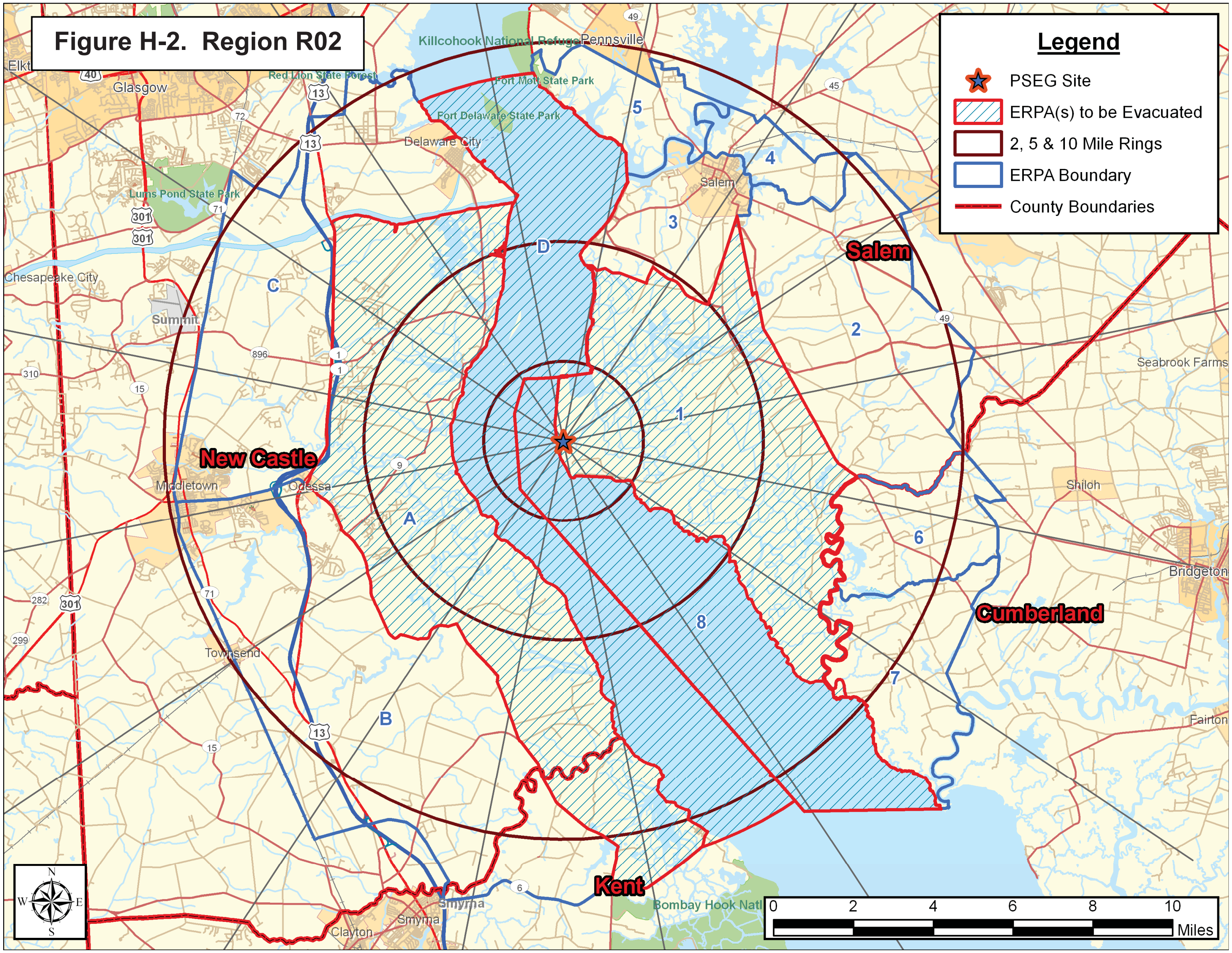
Miles

Figure H-2. Region R02



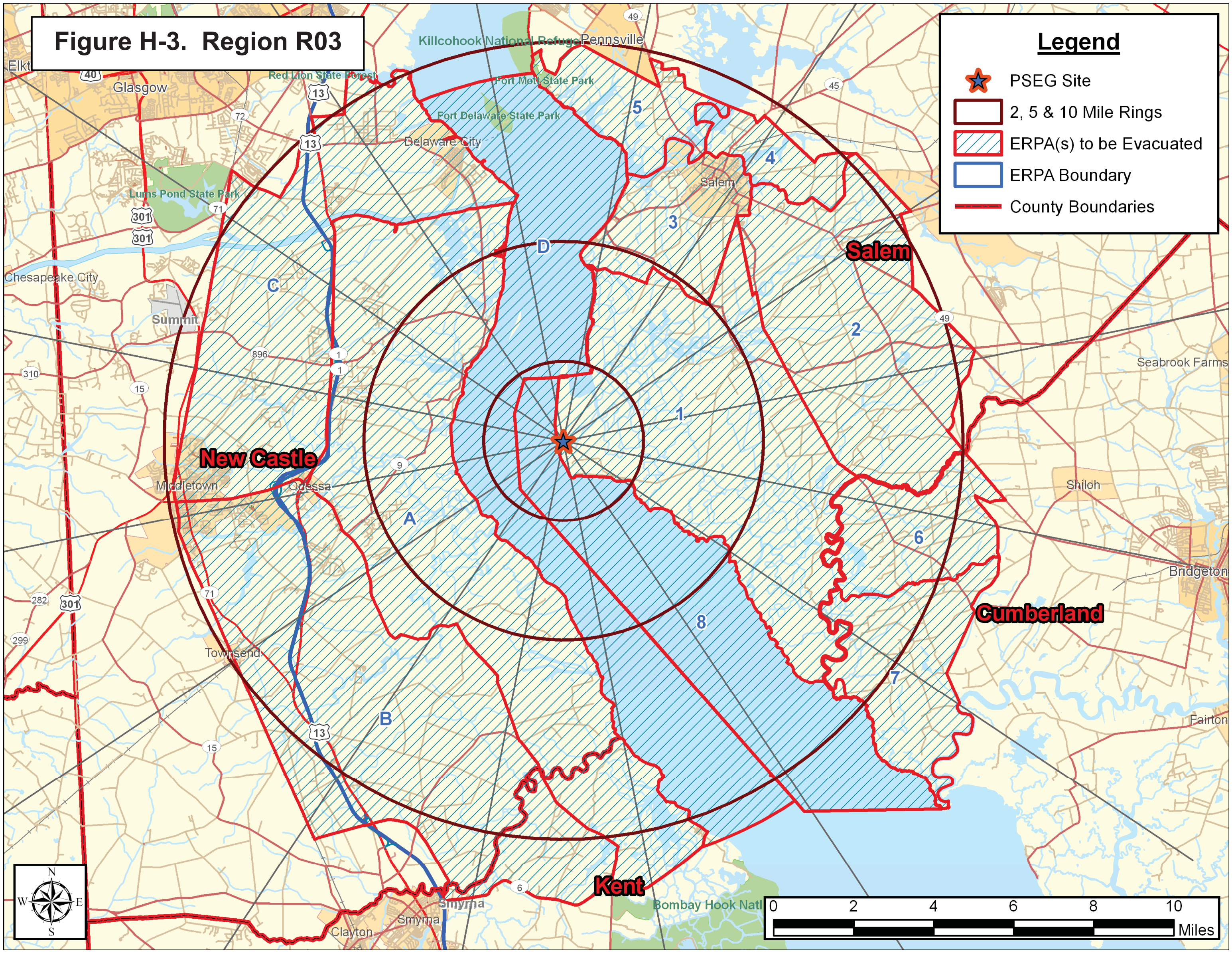


Figure H-3. Region R03

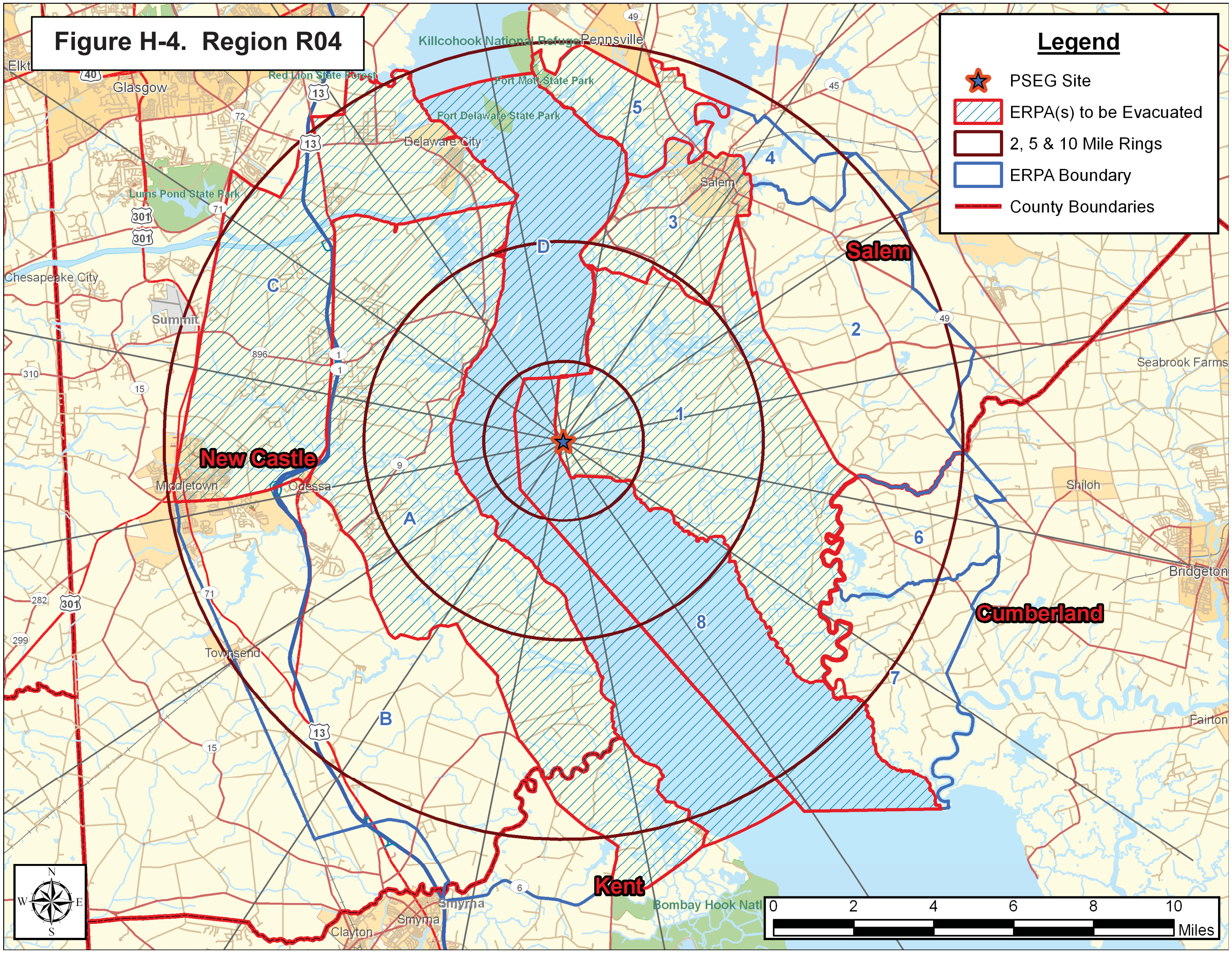


Figure H-4. Region R04
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
New Castle
Salem
Cumberland
Kent
Glasgow
Delaware City
Pennsville
Salem
Middletown
Odessa
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Smyrna
Clayton
Chesapeake City
Summit
Shiloh
Bridgeton
Seabrook Farms
Fairton
Killcohook National Refuge
Fort Mott State Park
Fort Delaware State Park
Red Lion State Forest
Lums Pond State Park
Bombay Hook Natl
0 2 4 6 8 10 Miles

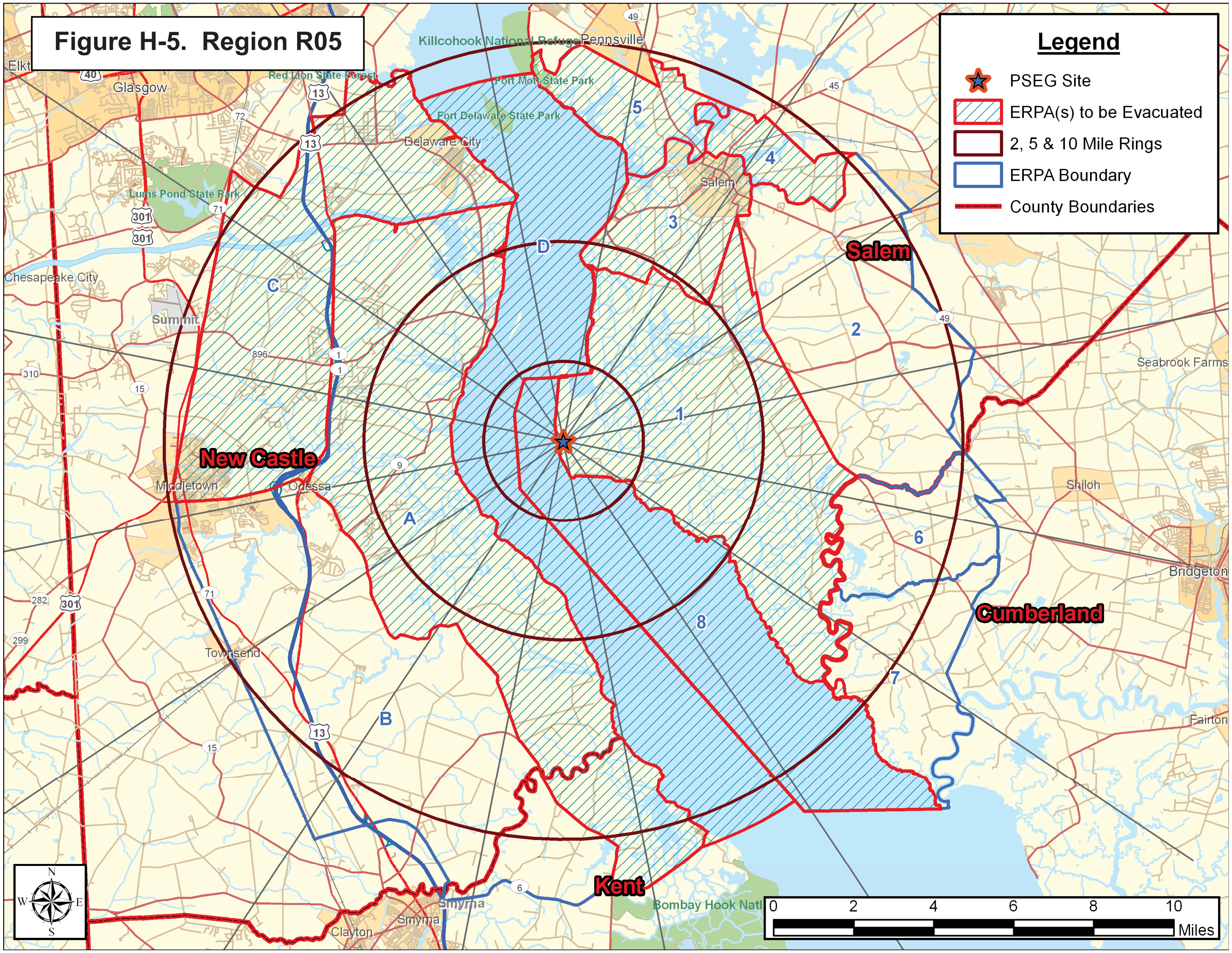
Figure H-5. Region R05
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
New Castle
Salem
Cumberland
Kent
Glasgow
Chesapeake City
Summit
Middletown
Odessa
Townsend
Smyrna
Clayton
Delaware City
Pennsville
Salem
Seabrook Farms
Shiloh
Bridgeton
Fairton
Killcohook National Refuge
Red Lion State Forest
Fort Mott State Park
Fort Delaware State Park
Lums Pond State Park
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Miles

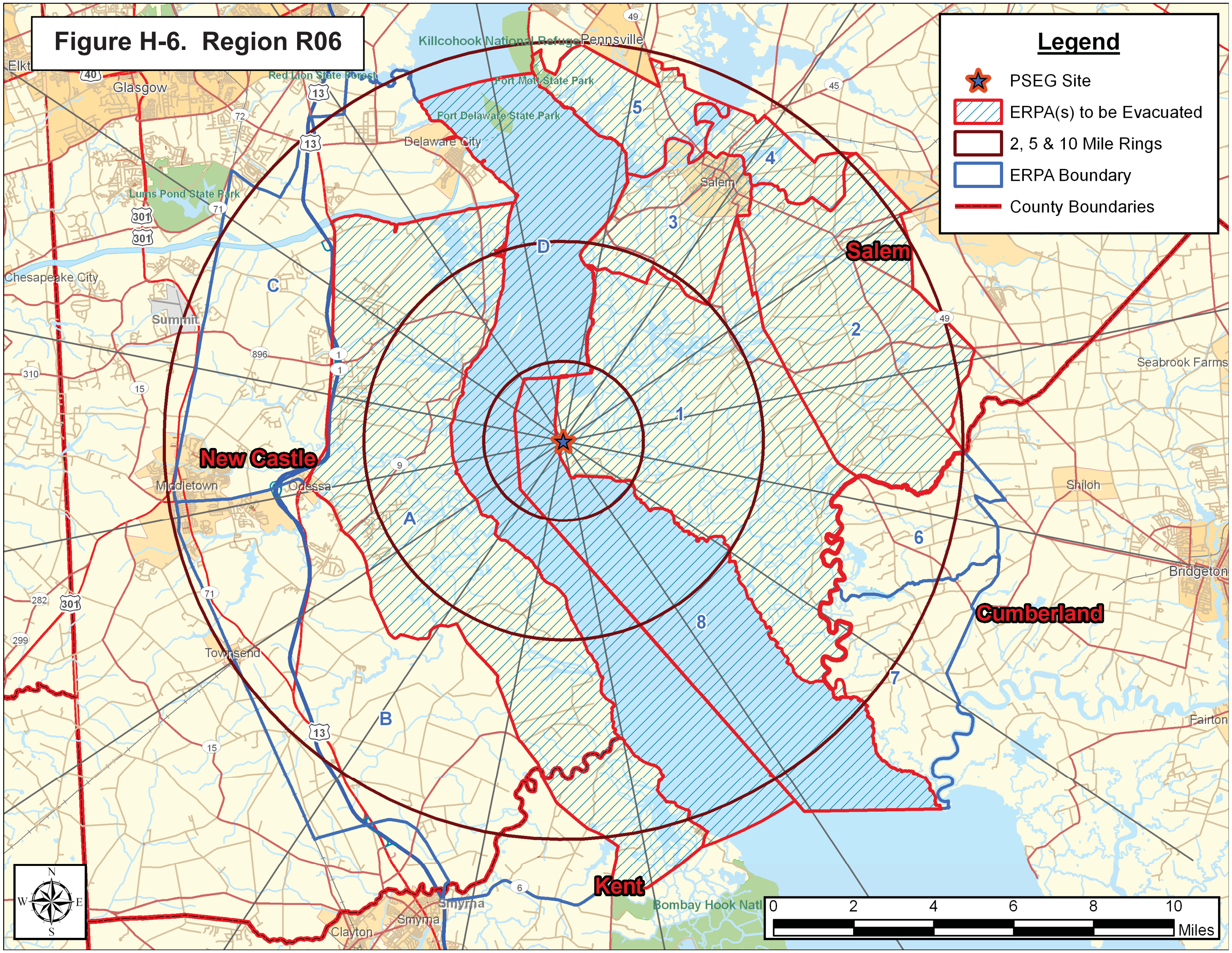
Figure H-6. Region R06
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
New Castle
Salem
Cumberland
Kent
Glasgow
Killcohook National Refuge
Pennsville
Red Lion State Forest
Fort Mott State Park
Fort Delaware State Park
Delaware City
Lums Pond State Park
Salem
Chesapeake City
Summit
Middletown
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Smyrna
Clayton
Bombay Hook Natl
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Miles

Figure H-7. Region R07

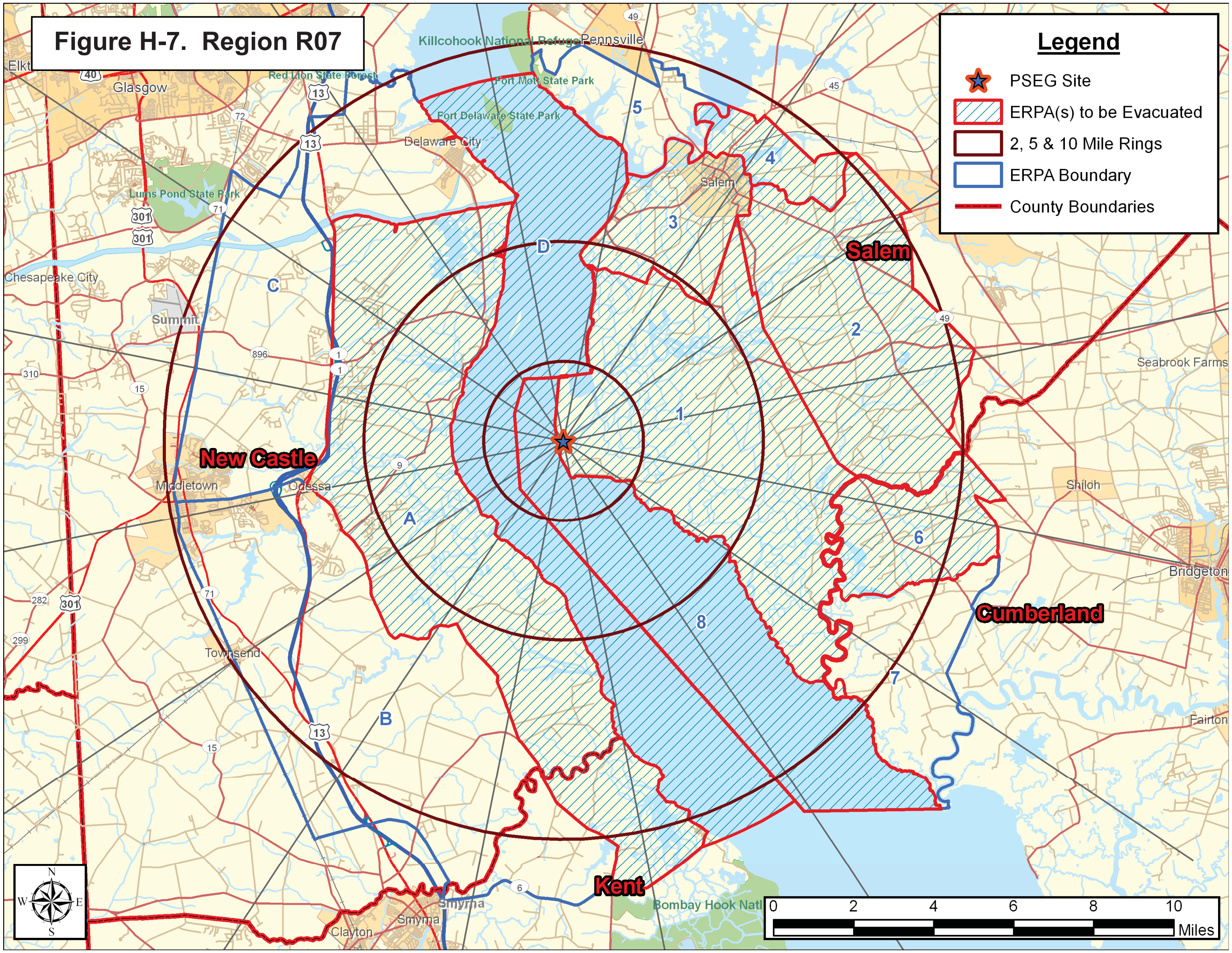
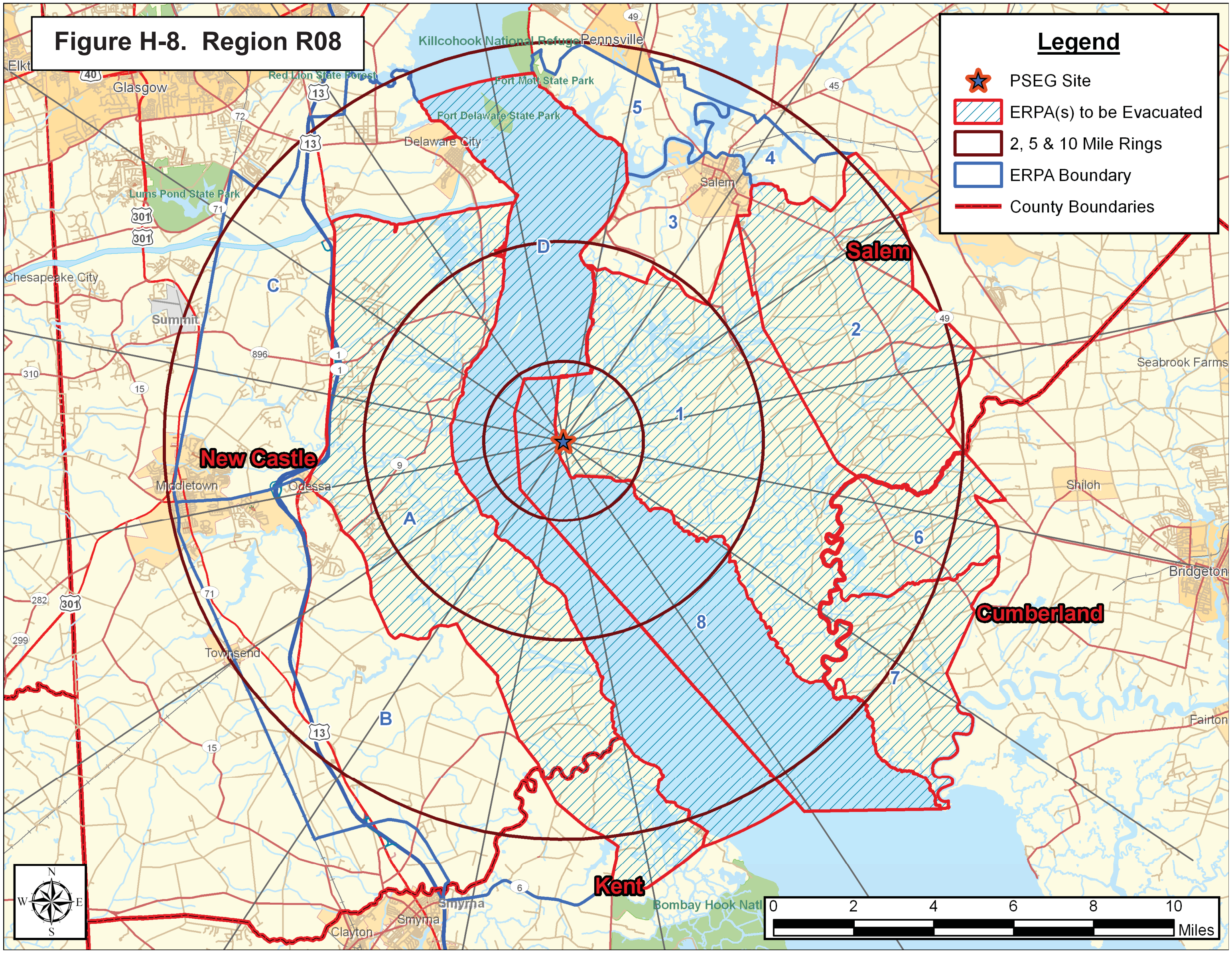


Figure H-8. Region R08



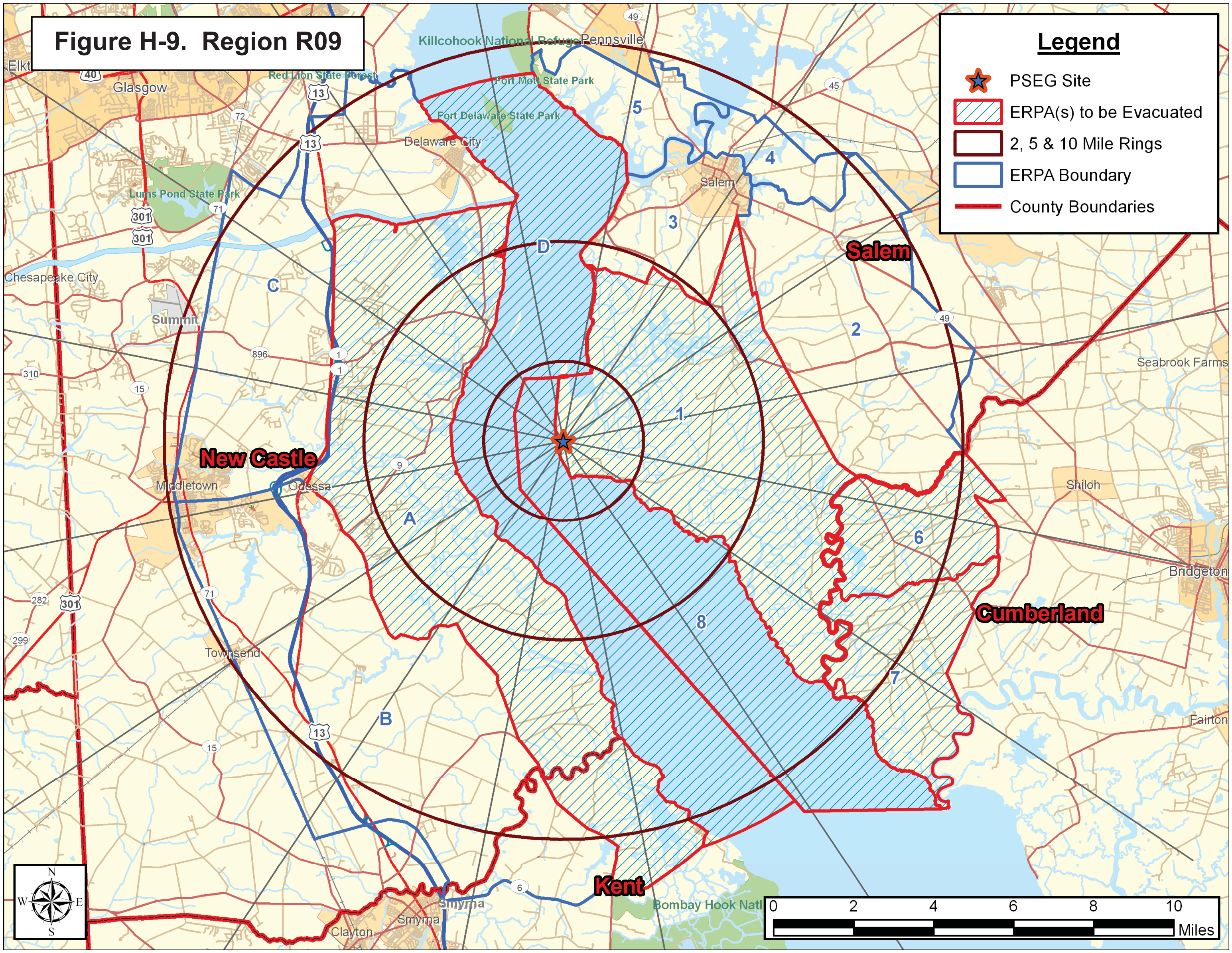


Figure H-9. Region R09
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
Salem
New Castle
Cumberland
Kent
Killcohook National Refuge
Pennsville
Red Lion State Forest
Fort Mott State Park
Fort Delaware State Park
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Glasgow
Lums Pond State Park
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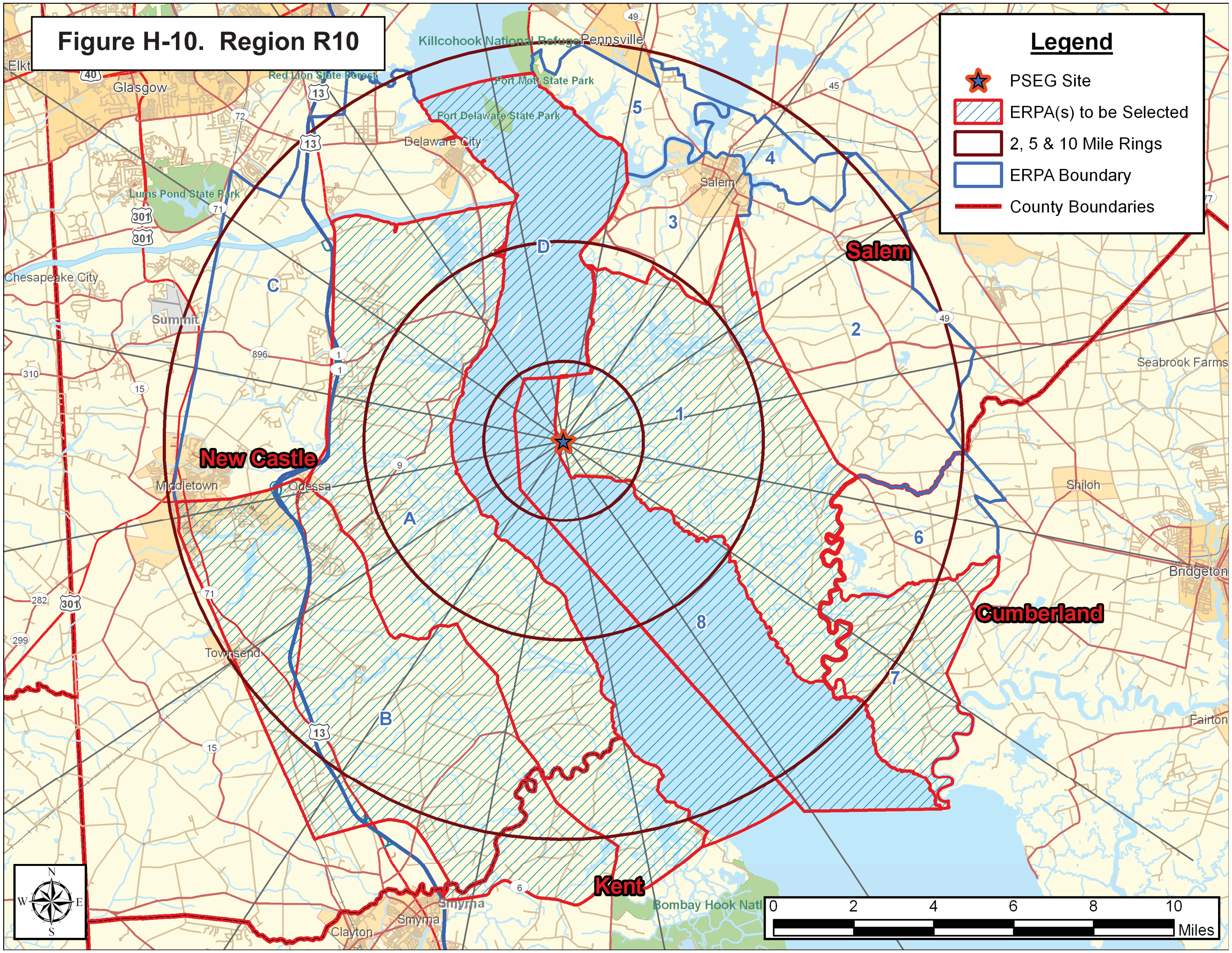
Figure H-10. Region R10
Legend
PSEG Site
ERPA(s) to be Selected
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
New Castle
Salem
Cumberland
Kent
Glasgow
Killcohook National Refuge
Pennsville
Red Lion State Forest
Fort Mott State Park
Fort Delaware State Park
Delaware City
Lums Pond State Park
Salem
Chesapeake City
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Smyrna
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Bombay Hook Natl
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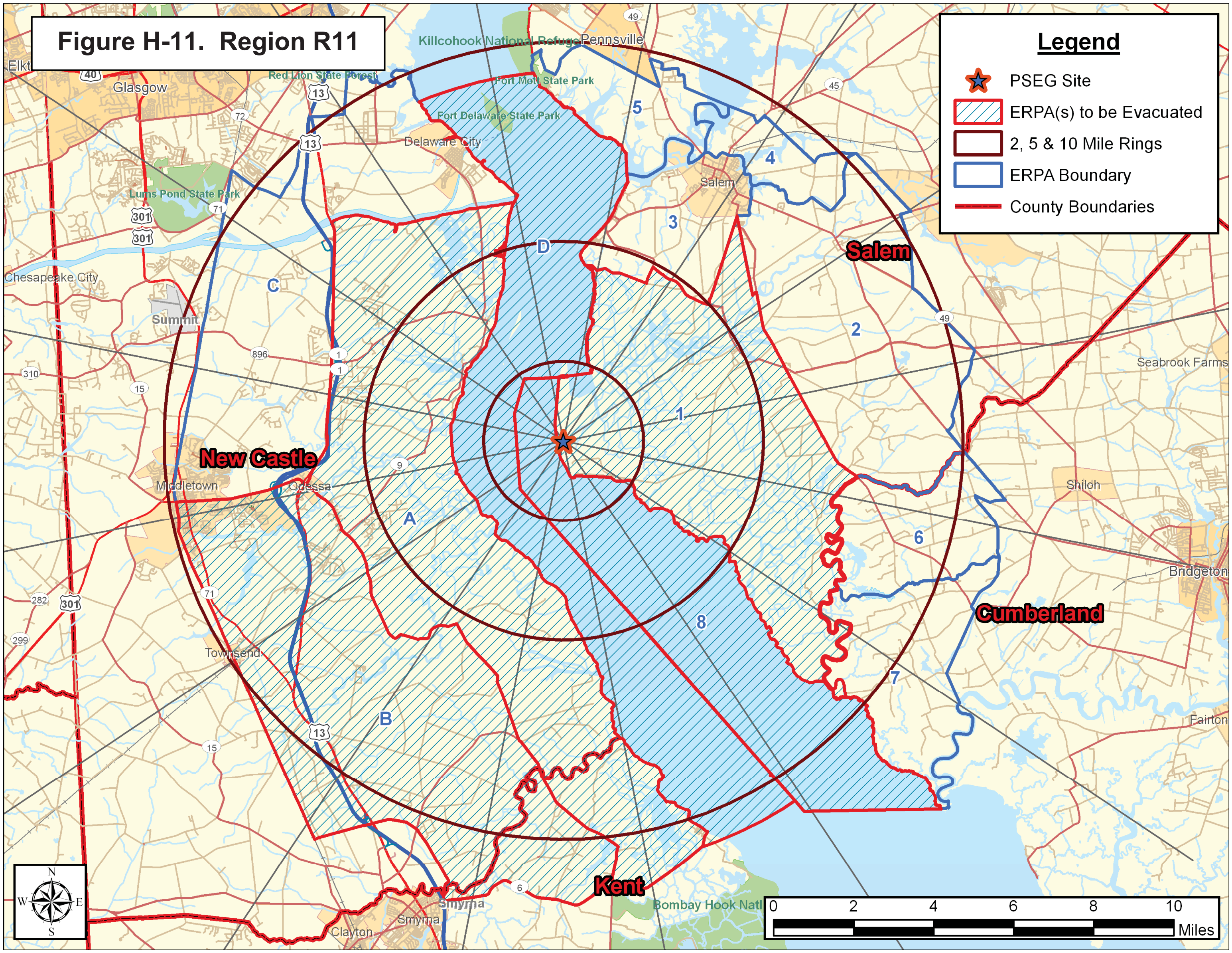
Figure H-11. Region R11
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
Salem
New Castle
Cumberland
Kent
Killcohook National Refuge
Pennsville
Red Lion State Forest
Fort Mott State Park
Fort Delaware State Park
Delaware City
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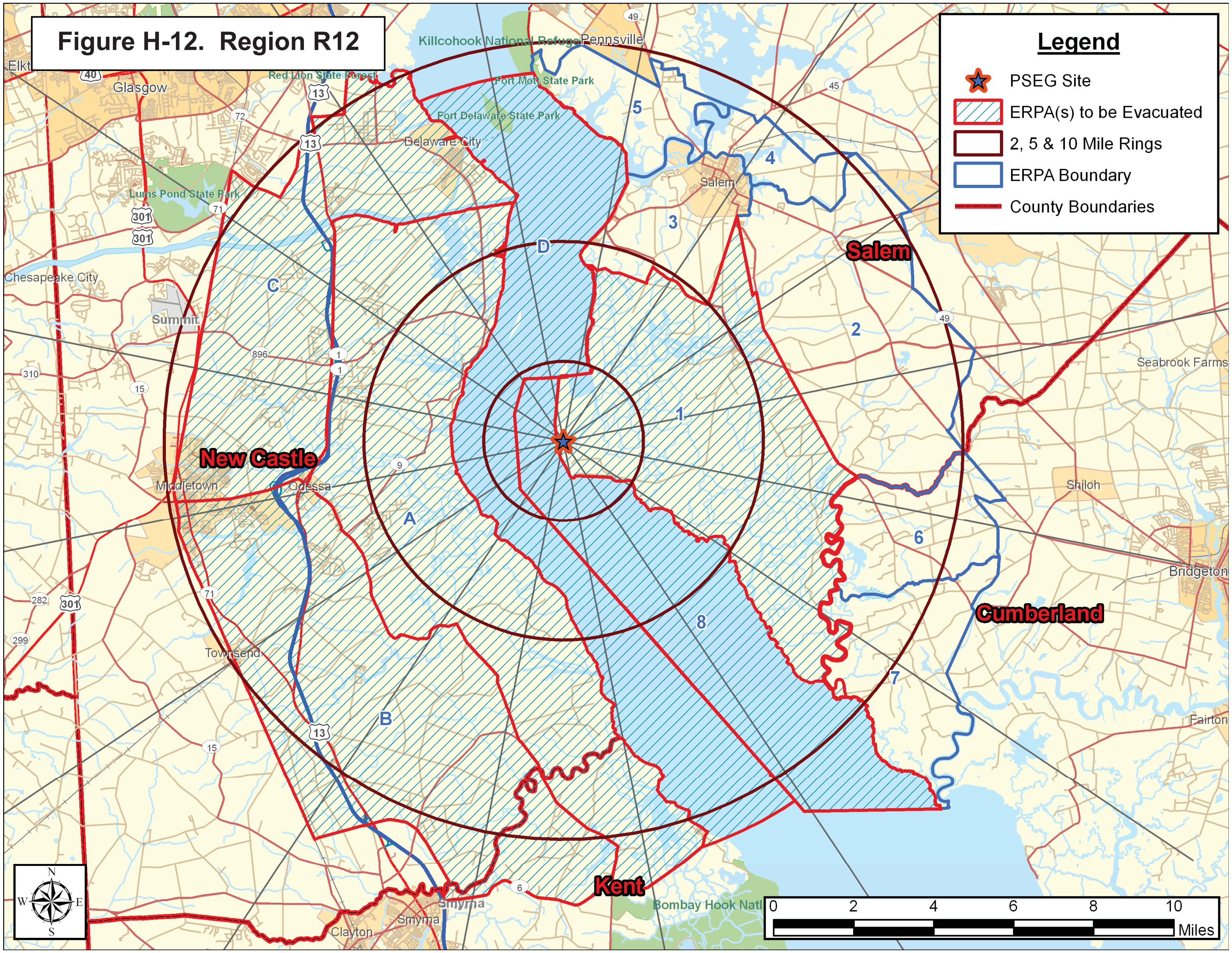
Figure H-12. Region R12
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
New Castle
Salem
Cumberland
Kent
Glasgow
Chesapeake City
Summit
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Delaware City
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Shiloh
Bridgeton
Fairton
Killcohook National Refuge
Red Lion State Forest
Fort Mott State Park
Fort Delaware State Park
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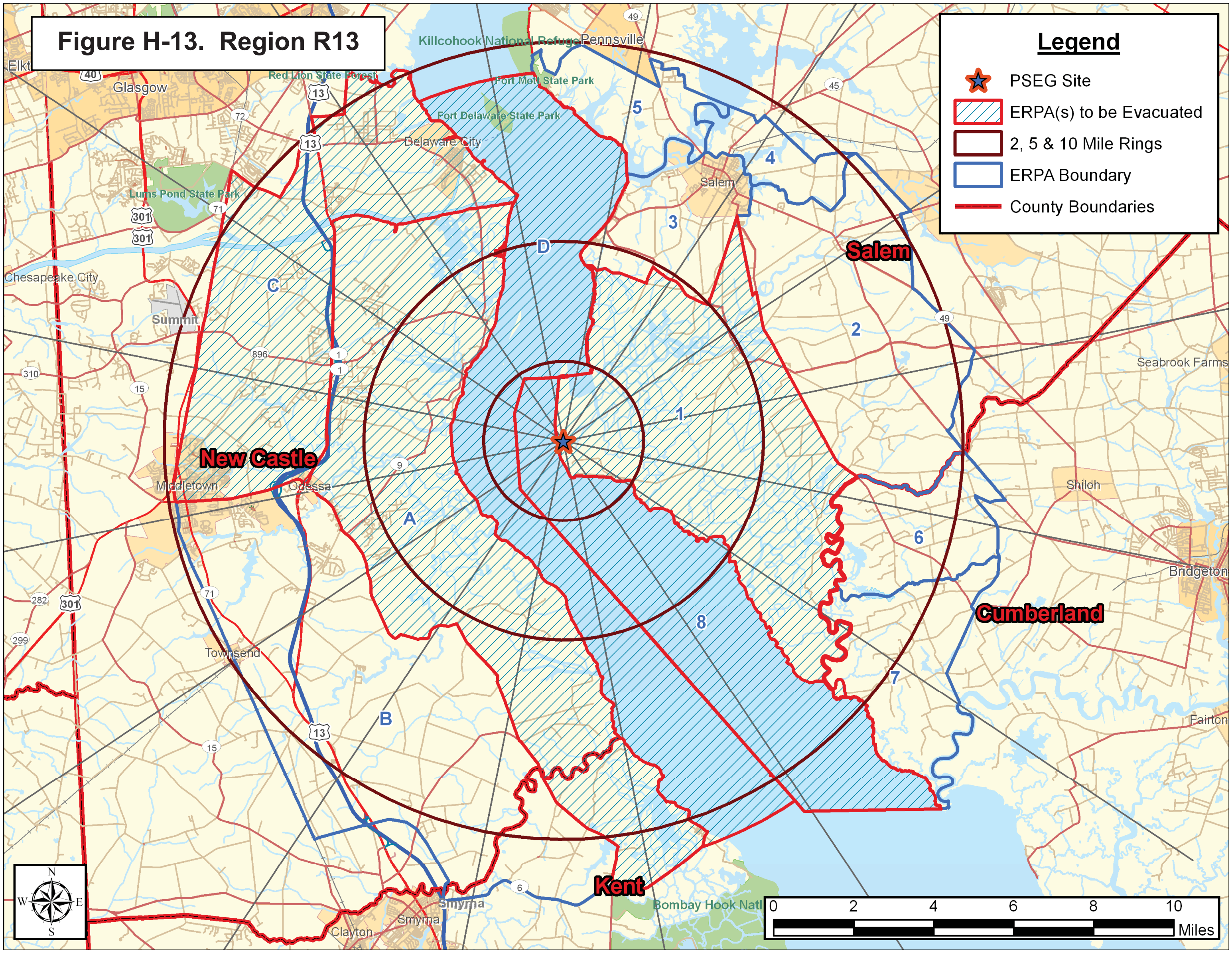
Figure H-13. Region R13
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
New Castle
Salem
Cumberland
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Killcohook National Refuge
Red Lion State Forest
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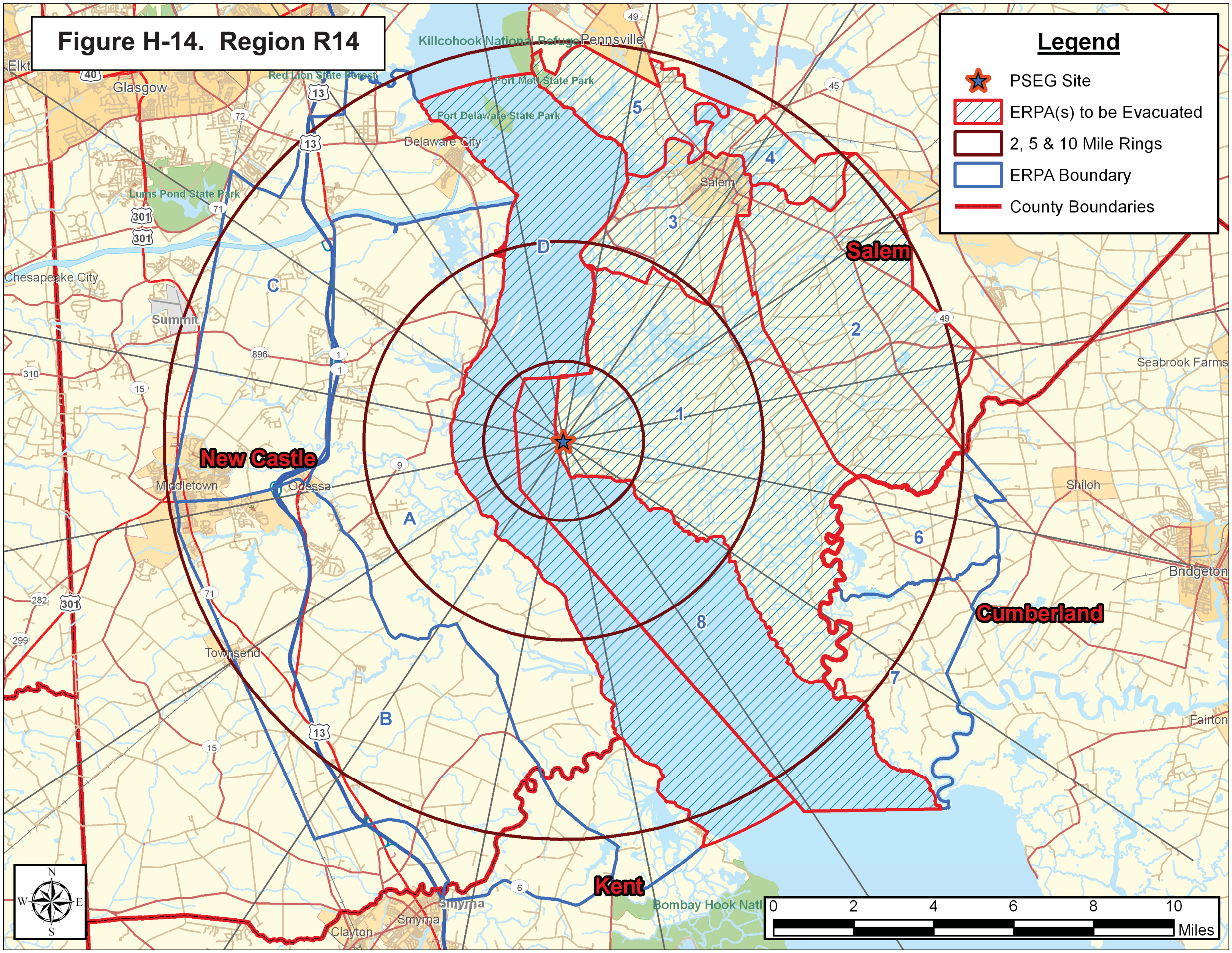
Figure H-14. Region R14
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
Salem
New Castle
Cumberland
Kent
0
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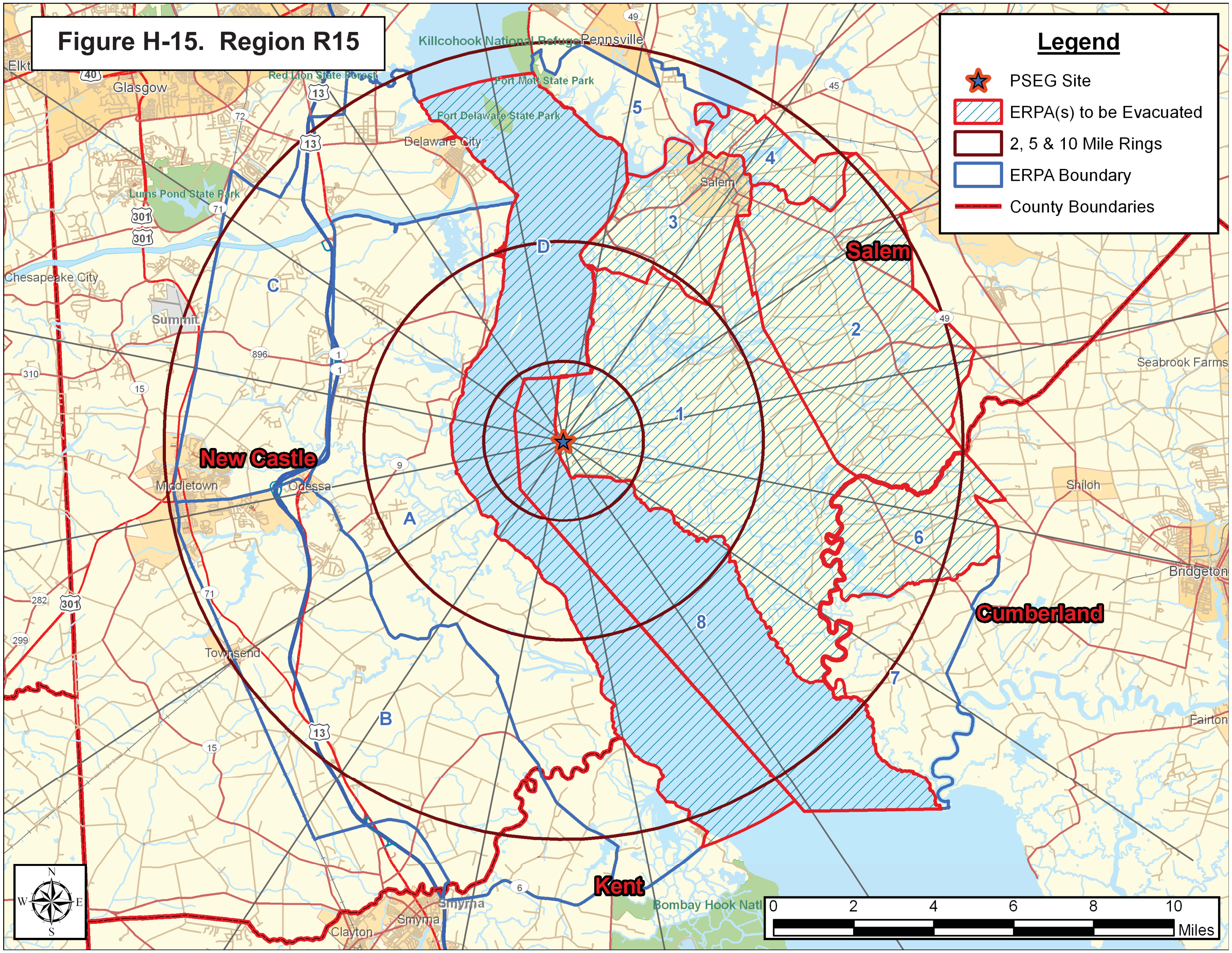
Figure H-15. Region R15



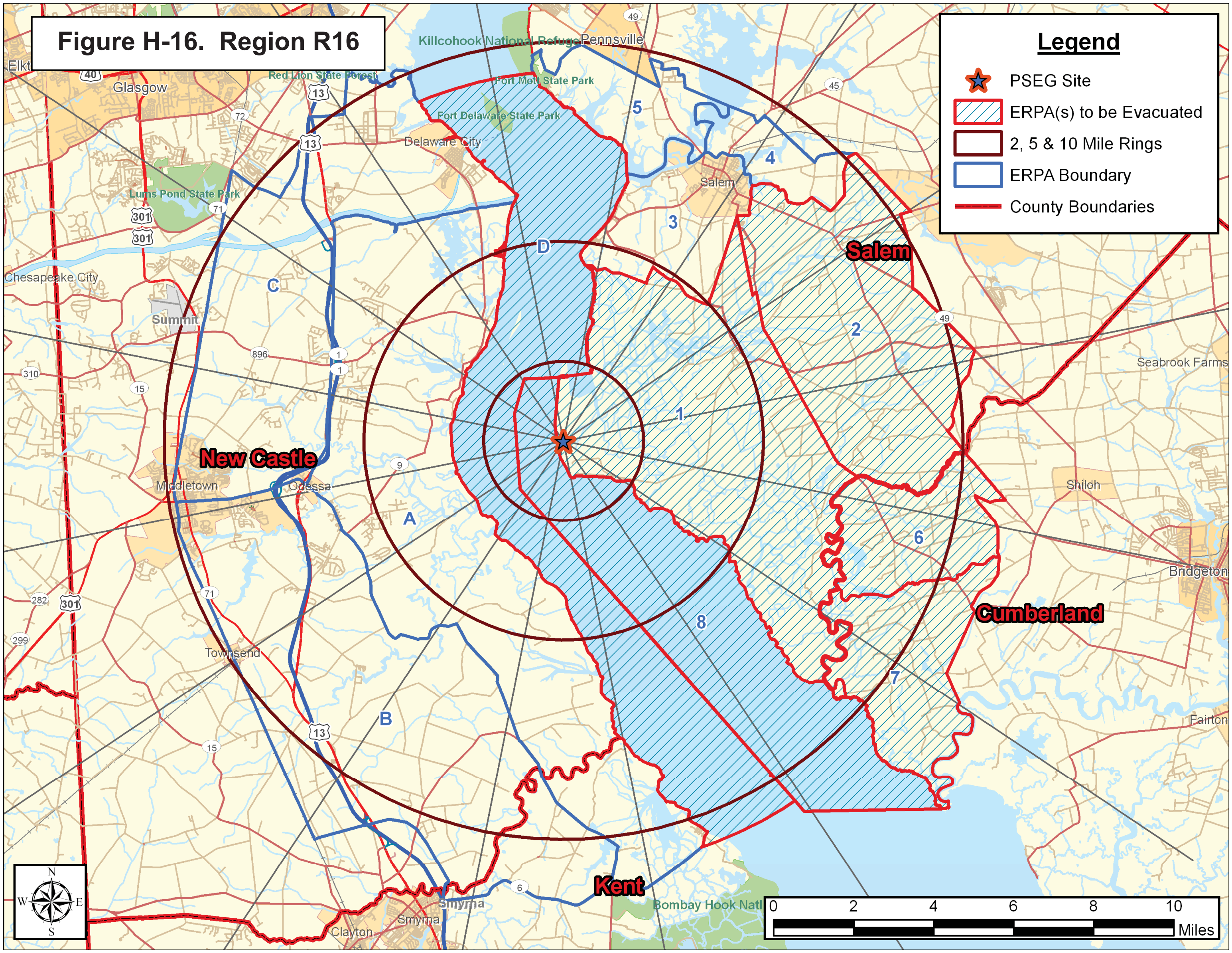


Figure H-16. Region R16
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
New Castle
Salem
Cumberland
Kent
Glasgow
Chesapeake City
Summit
Middletown
Odessa
Townsend
Smyrna
Clayton
Delaware City
Pennsville
Salem
Seabrook Farms
Shiloh
Bridgeton
Fairton
Killcohook National Refuge
Fort Mott State Park
Fort Delaware State Park
Red Lion State Forest
Lums Pond State Park
Bombay Hook Natl
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Miles

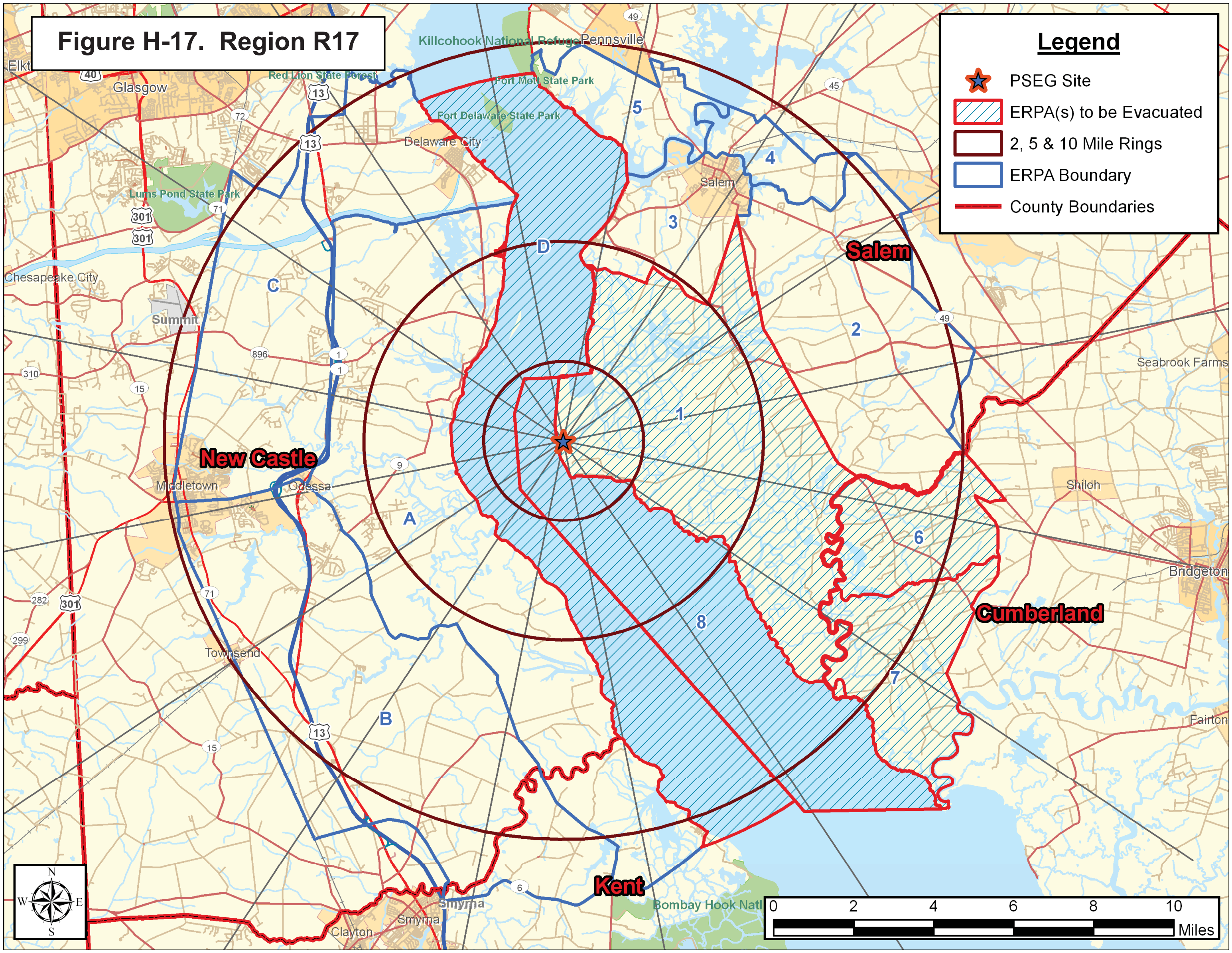
Figure H-17. Region R17
Legend
PSEG Site
ERPA(s) to be Evacuated
2, 5 & 10 Mile Rings
ERPA Boundary
County Boundaries
Salem
New Castle
Cumberland
Kent
Glasgow
Delaware City
Pennsville
Middletown
Odessa
Townsend
Smyrna
Clayton
Shiloh
Bridgeton
Seabrook Farms
Fairton
Chesapeake City
Summit
Killcohook National Refuge
Fort Mott State Park
Fort Delaware State Park
Red Lion State Forest
Lums Pond State Park
Bombay Hook Natl
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Miles

APPENDIX I

Evacuation Sensitivity Studies

APPENDIX I: EVACUATION SENSITIVITY STUDIES

A sensitivity study was performed to determine whether changes in the estimated trip generation time have an effect upon the evacuation time estimate (ETE) for the entire EPZ. The case considered was Scenario 6, Region 3; a winter, midweek, midday, good weather evacuation of the entire EPZ. Table I-1 presents the results of this study.

Table I-1. Evacuation Time Estimates for Trip Generation Sensitivity Study

Trip Generation Period	Evacuation Time Estimate for Entire EPZ		
	90th Percentile	95th Percentile	100th Percentile
4 Hours	2:15	2:35	4:10
5 Hours	2:15	2:35	5:10
6 Hours (Base)	2:15	2:35	6:10

The results confirm the importance of accurately estimating the trip generation times. The evacuation time estimates for the 100th percentile closely mirror the values for the time the last evacuation trip is generated. As indicated in Section 7.2, congestion within the EPZ clears by 3 hours after the Advisory to Evacuate. The results indicate that programs to educate the public and encourage them toward faster responses for a radiological emergency can enhance county emergency planning programs.

A sensitivity study was conducted to determine the effects on ETE of changes in the percentage of people who decide to relocate from the Shadow Region. The case considered was Scenario 6, Region 3; a winter, midweek, midday, good weather evacuation for the entire EPZ. The movement of people in the Shadow Region has the potential to impede vehicles evacuating from an Evacuation Region within the EPZ. Refer to Section 7.1 for additional information on population within the shadow region.

Table I-2 presents the evacuation time estimates for each of these cases. The results show that the ETE is slightly sensitive to shadow evacuation. Doubling the shadow percentage increases the ETE by 10 and 15 minutes at the 90th and 95th percentiles, respectively. Reducing the shadow evacuation percentage to 15 or 0 percent has no effect on ETE. The Shadow Region is densely populated to the north of the EPZ; the additional shadow evacuees do somewhat inhibit those people evacuating from within the EPZ.

Table I-2. Evacuation Time Estimates for Shadow Sensitivity Study

Percent Shadow Evacuation	Evacuating Shadow Vehicles	Evacuation Time Estimate for Entire EPZ		
		90th Percentile	95th Percentile	100th Percentile
0	0	2:15	2:35	6:10
15	13,473	2:15	2:35	6:10
30 (Base)	26,946	2:15	2:35	6:10
60	53,892	2:25	2:50	6:10

A sensitivity study was conducted to determine the effect on ETE of adding an additional travel lane to the existing site access road with the use of gantry lights (see page 3-19 for additional information). The cases considered were Scenario 13, Regions 1, 2 and 3; winter, midweek, midday, good weather evacuations for the two-mile region, five-mile region and entire EPZ during peak construction of the new plant coincident with refueling of one of the operational units. As expected, the additional access lane does not have an effect on ETE. As discussed in Section 7.2, the bottleneck for traffic evacuating in the New Jersey portion of the EPZ is Salem City. The construction workers, for the most part, are evacuating northbound on Salem-Hancocks Bridge Rd into Salem City, and then out of the EPZ. Doubling the capacity on the access road gets the workers to Salem-Hancocks Bridge Rd more efficiently; however, without improvements in Salem City and along Salem-Hancocks Bridge Rd, adding an additional lane to the access road has no benefit from an ETE standpoint.

Table I-3. Evacuation Time Estimates for a 2-Lane Site Access Road

Case	Evacuation Time Estimate for Region R01		
	90th Percentile	95th Percentile	100th Percentile
Construction (base)	2:25	2:35	4:00
2 Lane Access Road	2:25	2:35	4:00
Case	**Evacuation Time Estimate for Region R02**		
	90th Percentile	**95th Percentile**	**100th Percentile**
Construction (base)	1:50	2:15	4:10
2 Lane Access Road	1:50	2:15	4:10
Case	**Evacuation Time Estimate for Region R03**		
	90th Percentile	**95th Percentile**	**100th Percentile**
Construction (base)	2:45	3:05	6:10
2 Lane Access Road	2:45	3:05	6:10

APPENDIX J

Evacuation Time Estimates for All Evacuation Regions and Scenarios
And
Evacuation Time Graphs for Region R03, for all Scenarios

APPENDIX J: EVACUATION TIME ESTIMATES FOR ALL EVACUATION REGIONS AND SCENARIOS

AND

EVACUATION TIME GRAPHS FOR REGION R03, FOR ALL SCENARIOS

This appendix presents the ETE Results for all 17 Regions and all 15 Scenarios (Tables J-1A through J-1D), and plots of Evacuating Vehicles vs. Elapsed Time leaving the 2-mile and 5-mile circular areas and the entire EPZ for Region R03, for all 15 scenarios. Each plot has points indicating the evacuation times corresponding to the 50th, 90th, and 95th percentiles of evacuated vehicles.

J.1 Guidance on Using ETE Tables

Tables J-1A through J-1D present the ETE values for all 17 Evacuation Regions and all 15 Evacuation Scenarios. They are organized as follows:

Table	Contents
J-1A	ETE represents the elapsed time required for **50** percent of the population within a Region, to evacuate from that Region.
J-1B	ETE represents the elapsed time required for **90** percent of the population within a Region, to evacuate from that Region.
J-1C	ETE represents the elapsed time required for **95** percent of the population within a Region, to evacuate from that Region.
J-1D	ETE represents the elapsed time required for **100** percent of the population within a Region, to evacuate from that Region.

The user first determines the percentile of population for which the ETE is sought. The applicable value of ETE within the chosen Table may then be identified using the following procedure:

1. Identify the applicable **Scenario**:
   - Season
     - Summer
     - Winter (also Autumn and Spring)
   - Day of Week
     - Midweek
     - Weekend
   - Time of Day
     - Midday

- Evening
- Weather Condition
  - Good Weather
  - Rain
  - Snow
- Special Event
  - New Plant Construction + Refueling

While these Scenarios are designed, in aggregate, to represent conditions throughout the year, some further clarification is warranted:

- The conditions of a summer evening (either midweek or weekend) and rain are not explicitly identified in Tables J-1A through J-1D. For these conditions, Scenario (4) applies.
- The conditions of a winter evening (either midweek or weekend) and rain are not explicitly identified in Tables J-1A through J-1D. For these conditions, Scenarios (7) and (10) for rain apply.
- The conditions of a winter evening (either midweek or weekend) and snow are not explicitly identified in Tables J-1A through J-1D. For these conditions, Scenarios (8) and (11) for snow apply.
- The seasons are defined as follows:
  - Summer assumes that public schools are *not* in session.
  - Winter, Spring and Autumn imply that public schools *are* in session.
- Time of Day: Midday implies the time over which most commuters are at work.

2. With the Scenario identified, now identify the **Evacuation Region**:
   - Determine the projected azimuth direction of the plume (coincident with the wind direction). This direction is expressed in terms of compass orientation: *towards* N, NNE, NE, …
   - Determine the distance that the Evacuation Region will extend from the PSEG Site. The applicable distances and their associated candidate Regions are given below:
     - 2 Miles (Region R01)
     - 5 Miles (Region R02)
     - to EPZ Boundary (Regions R03 through R17)
   - Enter Table J-2 and identify the applicable group of candidate Regions based on the distance that the selected Region extends from the PSEG Site. Select the Evacuation Region identifier in that row from the first column of the Table.

3. Determine the **ETE for the Scenario** identified in Step 1 and the Region identified in Step 2, as follows:
   - The columns of Table J-1 are labeled with the Scenario numbers. Identify the proper column in the selected Table using the Scenario number

determined in Step 1.

- Identify the row in this table that provides ETE values for the Region identified in Step 2.
- The unique data cell defined by the column and row so determined contains the desired value of ETE expressed in Hours:Minutes.

Example

It is desired to identify the ETE for the following conditions:

- Sunday, August 10th at 4:00 AM.
- It is raining.
- Wind direction is *toward* the northeast (NE).
- Wind speed is such that the distance to be evacuated is judged to be 10 miles (to EPZ boundary).
- The desired ETE is that value needed to evacuate 90 percent of the population from within the impacted Region.

Table J-1B is applicable because the 90th-percentile population is desired. Proceed as follows:

1. Identify the Scenario as summer, weekend, evening and raining. Entering Table J-1B, it is seen that there is no match for these descriptors. However, the clarification given above assigns this combination of circumstances to Scenario 4.

2. Enter Table J-2 and locate the Region described as "5-Mile Ring and Downwind to EPZ Boundary" for wind direction to the NE and read REGION R06 in the first column of that row.

3. Enter Table J-1B to locate the data cell containing the value of ETE for Scenario 4 and Region R06. This data cell is in column (4) and in the row for Region R06; it contains the ETE value of **1:50**.

Table J-1A. Time to Clear the Indicated Area of _50_ Percent of The Affected Population

	Summer		Summer		Summer		Winter			Winter			Winter		Winter		
	Midweek		Weekend		Midweek Weekend		Midweek			Weekend			Midweek Weekend		Midweek		
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario:	(13)	(14)	(15)
	Midday		Midday		Evening		Midday			Midday			Evening		Midday		
Region Wind Toward:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Toward:	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Region Wind Toward:	New Plant Construction + Refueling	Proposed Causeway	Refueling Only
Entire 2-Mile Region, 5-Mile Region, and EPZ																	
R01 2-mile ring	0:55	0:55	0:55	0:55	0:55	R01 2-mile ring	0:55	0:55	1:05	0:55	0:55	1:20	0:55	R01 2-mile ring	1:25	1:00	0:55
R02 5-mile ring	0:55	0:55	0:50	0:55	0:55	R02 5-mile ring	0:55	0:55	1:05	0:50	0:55	1:05	0:55	R02 5-mile ring	1:00	0:55	0:55
R03 Entire EPZ	1:10	1:15	1:05	1:10	1:05	R03 Entire EPZ	1:10	1:15	1:30	1:05	1:10	1:25	1:05	R03 Entire EPZ	1:20	1:20	1:20
5-Mile Ring and Downwind to EPZ Boundary																	
R04 NNW	1:05	1:10	1:00	1:05	1:00	R04 NNW	1:05	1:10	1:25	1:00	1:05	1:15	1:00	R04 NNW	1:15	1:15	1:10
R05 N	1:05	1:10	1:00	1:05	1:00	R05 N	1:05	1:10	1:20	1:00	1:05	1:15	1:00	R05 N	1:15	1:15	1:10
R06 NNE, NE	1:00	1:05	0:55	1:00	0:55	R06 NNE, NE	1:00	1:05	1:15	0:55	1:00	1:10	0:55	R06 NNE, NE	1:05	1:05	1:00
R07 ENE	1:00	1:05	0:55	1:00	0:55	R07 ENE	1:00	1:05	1:15	0:55	1:00	1:10	0:55	R07 ENE	1:05	1:05	1:00
R08 E, ESE	0:55	1:00	0:55	0:55	0:55	R08 E, ESE	0:55	1:00	1:10	0:55	0:55	1:05	0:55	R08 E, ESE	1:00	1:00	0:55
R09 SE	0:55	1:00	0:55	0:55	0:55	R09 SE	0:55	1:00	1:05	0:55	0:55	1:05	0:55	R09 SE	1:00	0:55	0:55
R10 SSE	1:00	1:05	1:00	1:00	1:00	R10 SSE	1:05	1:05	1:20	1:00	1:00	1:15	1:00	R10 SSE	1:10	1:05	1:05
R11 S, SSW, SW	1:00	1:05	1:00	1:00	1:00	R11 S, SSW, SW	1:05	1:05	1:20	1:00	1:00	1:15	1:00	R11 S, SSW, SW	1:10	1:05	1:05
R12 W, WSW, WNW	1:10	1:10	1:05	1:10	1:05	R12 W, WSW, WNW	1:10	1:15	1:25	1:05	1:10	1:25	1:05	R12 W, WSW, WNW	1:20	1:15	1:20
R13 NW	1:05	1:05	1:00	1:00	1:00	R13 NW	1:05	1:05	1:20	1:00	1:00	1:15	1:00	R13 NW	1:10	1:10	1:10
2-Mile Ring and Downwind to EPZ Boundary																	
R14 NNE, NE	1:10	1:15	1:00	1:05	1:05	R14 NNE, NE	1:10	1:15	1:30	1:00	1:05	1:25	1:05	R14 NNE, NE	1:25	1:20	1:10
R15 ENE	1:10	1:10	1:00	1:00	1:00	R15 ENE	1:10	1:15	1:25	1:00	1:00	1:20	1:00	R15 ENE	1:20	1:20	1:10
R16 E, ESE	1:00	1:05	0:55	0:55	0:55	R16 E, ESE	1:00	1:05	1:15	0:55	0:55	1:15	0:55	R16 E, ESE	1:15	1:05	1:00
R17 SE	1:00	1:00	0:55	0:55	0:55	R17 SE	1:00	1:00	1:10	0:55	0:55	1:25	0:55	R17 SE	1:25	1:00	1:00

Table J-1B. Time to Clear the Indicated Area of _90_ Percent of The Affected Population

	Summer		Summer		Summer		Winter			Winter			Winter		Winter		
	Midweek		Weekend		Midweek Weekend		Midweek			Weekend			Midweek Weekend		Midweek		
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario:	(13)	(14)	(15)
	Midday		Midday		Evening		Midday			Midday			Evening		Midday		
Region Wind Toward:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Toward:	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Region Wind Toward:	New Plant Construction + Refueling	Proposed Causeway	Refueling Only
Entire 2-Mile Region, 5-Mile Region, and EPZ																	
R01 2-mile ring	1:50	1:50	1:45	1:45	1:45	R01 2-mile ring	1:50	1:50	2:05	1:45	1:45	2:40	1:45	R01 2-mile ring	2:25	1:45	1:50
R02 5-mile ring	1:35	1:45	1:35	1:40	1:35	R02 5-mile ring	1:35	1:45	2:10	1:35	1:40	2:00	1:35	R02 5-mile ring	1:50	1:40	1:40
R03 Entire EPZ	2:15	2:25	2:00	2:10	2:00	R03 Entire EPZ	2:15	2:25	2:55	2:00	2:10	2:40	2:00	R03 Entire EPZ	2:45	2:45	2:40
5-Mile Ring and Downwind to EPZ Boundary																	
R04 NNW	2:10	2:15	1:50	2:00	1:55	R04 NNW	2:10	2:15	2:50	1:50	1:55	2:30	1:55	R04 NNW	2:35	2:35	2:30
R05 N	2:10	2:15	1:50	2:00	1:55	R05 N	2:10	2:15	2:50	1:50	1:55	2:30	1:55	R05 N	2:35	2:35	2:30
R06 NNE, NE	2:00	2:05	1:40	1:50	1:45	R06 NNE, NE	2:00	2:05	2:35	1:40	1:45	2:15	1:45	R06 NNE, NE	2:15	2:15	2:00
R07 ENE	1:55	2:00	1:40	1:45	1:40	R07 ENE	1:55	2:00	2:30	1:35	1:45	2:15	1:40	R07 ENE	2:15	2:15	1:55
R08 E, ESE	1:40	1:50	1:35	1:40	1:40	R08 E, ESE	1:40	1:50	2:15	1:35	1:40	2:05	1:40	R08 E, ESE	1:55	1:45	1:45
R09 SE	1:40	1:45	1:35	1:40	1:35	R09 SE	1:40	1:45	2:10	1:35	1:40	2:05	1:35	R09 SE	1:50	1:40	1:40
R10 SSE	2:00	2:10	1:50	2:00	1:50	R10 SSE	2:00	2:10	2:45	1:50	2:00	2:30	1:50	R10 SSE	2:20	2:15	2:15
R11 S, SSW, SW	2:00	2:10	1:50	2:00	1:50	R11 S, SSW, SW	2:00	2:10	2:45	1:50	2:00	2:30	1:50	R11 S, SSW, SW	2:20	2:15	2:15
R12 W, WSW, WNW	2:10	2:20	2:00	2:10	2:00	R12 W, WSW, WNW	2:10	2:20	2:55	2:00	2:10	2:40	2:00	R12 W, WSW, WNW	2:40	2:40	2:40
R13 NW	2:00	2:05	1:50	1:55	1:50	R13 NW	2:00	2:05	2:40	1:45	1:55	2:25	1:50	R13 NW	2:30	2:30	2:30
2-Mile Ring and Downwind to EPZ Boundary																	
R14 NNE, NE	2:25	2:35	1:55	2:05	2:00	R14 NNE, NE	2:30	2:35	3:05	1:55	2:05	2:40	2:00	R14 NNE, NE	2:45	2:45	2:25
R15 ENE	2:15	2:25	1:50	2:00	1:55	R15 ENE	2:20	2:25	2:55	1:50	1:55	2:40	1:55	R15 ENE	2:40	2:40	2:15
R16 E, ESE	2:00	2:00	1:40	1:40	1:50	R16 E, ESE	2:00	2:00	2:40	1:40	1:45	2:30	1:50	R16 E, ESE	2:25	1:55	2:05
R17 SE	2:00	2:00	1:50	1:50	1:55	R17 SE	2:00	2:00	2:30	1:55	1:55	2:45	1:50	R17 SE	2:25	1:50	2:00

Table J-1C. Time to Clear the Indicated Area of *95* Percent of The Affected Population

Scenario:	(1) Summer Midweek Midday Good Weather	(2) Summer Midweek Midday Rain	(3) Summer Weekend Midday Good Weather	(4) Summer Weekend Midday Rain	(5) Summer Midweek Weekend Evening Good Weather
Region Wind Toward:					
Entire 2-Mile Region, 5-Mile Region, and EPZ					
R01 2-mile ring	2:05	2:05	2:05	2:05	2:05
R02 5-mile ring	1:50	2:00	1:40	1:50	1:50
R03 Entire EPZ	2:35	2:40	2:15	2:25	2:20
5-Mile Ring and Downwind to EPZ Boundary					
R04 NNW	2:30	2:35	2:05	2:15	2:15
R05 N	2:30	2:35	2:05	2:10	2:15
R06 NNE, NE	2:25	2:30	1:55	2:05	2:05
R07 ENE	2:20	2:25	1:50	2:00	2:00
R08 E, ESE	2:00	2:05	1:45	1:55	1:55
R09 SE	1:55	2:00	1:45	1:55	1:50
R10 SSE	2:25	2:30	2:05	2:15	2:10
R11 S, SSW, SW	2:20	2:30	2:05	2:15	2:10
R12 W, WSW, WNW	2:30	2:35	2:15	2:25	2:20
R13 NW	2:25	2:25	2:05	2:10	2:10
2-Mile Ring and Downwind to EPZ Boundary					
R14 NNE, NE	2:45	2:50	2:10	2:20	2:15
R15 ENE	2:30	2:40	2:10	2:15	2:15
R16 E, ESE	2:25	2:25	2:05	2:05	2:15
R17 SE	2:20	2:20	2:10	2:15	2:15

Scenario:	(6) Winter Midweek Midday Good Weather	(7) Winter Midweek Midday Rain	(8) Winter Midweek Midday Snow	(9) Winter Weekend Midday Good Weather	(10) Winter Weekend Midday Rain	(11) Winter Weekend Midday Snow	(12) Winter Midweek Weekend Evening Good Weather
Region Wind Toward:							
Entire 2-Mile Region, 5-Mile Region, and EPZ							
R01 2-mile ring	2:05	2:05	2:40	2:05	2:05	2:55	2:05
R02 5-mile ring	1:50	2:00	2:30	1:40	1:50	2:20	1:50
R03 Entire EPZ	2:35	2:45	3:25	2:15	2:25	3:00	2:20
5-Mile Ring and Downwind to EPZ Boundary							
R04 NNW	2:30	2:35	3:20	2:05	2:10	2:55	2:15
R05 N	2:30	2:35	3:15	2:05	2:10	2:55	2:15
R06 NNE, NE	2:25	2:30	3:05	1:50	2:00	2:40	2:05
R07 ENE	2:20	2:25	3:00	1:50	2:00	2:35	2:00
R08 E, ESE	2:00	2:05	2:45	1:45	1:55	2:25	1:55
R09 SE	1:55	2:00	2:35	1:45	1:55	2:25	1:50
R10 SSE	2:25	2:30	3:10	2:05	2:15	2:50	2:10
R11 S, SSW, SW	2:20	2:30	3:05	2:05	2:15	2:50	2:10
R12 W, WSW, WNW	2:30	2:40	3:20	2:15	2:25	3:00	2:20
R13 NW	2:25	2:25	3:10	2:00	2:10	2:50	2:10
2-Mile Ring and Downwind to EPZ Boundary							
R14 NNE, NE	2:45	2:50	3:30	2:10	2:15	3:05	2:20
R15 ENE	2:35	2:40	3:20	2:10	2:15	3:05	2:15
R16 E, ESE	2:25	2:25	3:10	2:05	2:05	3:00	2:15
R17 SE	2:20	2:20	3:00	2:15	2:15	3:00	2:15

Scenario:	(13) Winter Midweek Midday New Plant Construction + Refueling	(14) Winter Midweek Midday Proposed Causeway	(15) Winter Midweek Midday Refueling Only
Region Wind Toward:			
Entire 2-Mile Region, 5-Mile Region, and EPZ			
R01 2-mile ring	2:35	1:55	2:05
R02 5-mile ring	2:15	1:50	1:55
R03 Entire EPZ	3:05	3:05	3:05
5-Mile Ring and Downwind to EPZ Boundary			
R04 NNW	3:00	3:00	2:55
R05 N	3:00	3:00	2:55
R06 NNE, NE	2:45	2:45	2:25
R07 ENE	2:40	2:40	2:20
R08 E, ESE	2:20	2:05	2:05
R09 SE	2:15	1:55	2:00
R10 SSE	2:35	2:35	2:35
R11 S, SSW, SW	2:35	2:35	2:35
R12 W, WSW, WNW	3:05	3:05	3:05
R13 NW	2:55	2:55	2:55
2-Mile Ring and Downwind to EPZ Boundary			
R14 NNE, NE	3:05	3:05	2:40
R15 ENE	2:55	2:55	2:30
R16 E, ESE	2:35	2:15	2:30
R17 SE	2:35	2:05	2:25

Table J-1D. Time to Clear the Indicated Area of *100* Percent of The Affected Population

	Summer		Summer		Summer		Winter			Winter			Winter		Winter		
	Midweek		Weekend		Midweek Weekend		Midweek			Weekend			Midweek Weekend		Midweek		
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Scenario:	(13)	(14)	(15)
	Midday		Midday		Evening		Midday			Midday			Evening		Midday		
Region Wind Toward:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Toward:	Good Weather	Rain	Snow	Good Weather	Rain	Snow	Good Weather	Region Wind Toward:	New Plant Construction + Refueling	Proposed Causeway	Refueling Only
Entire 2-Mile Region, 5-Mile Region, and EPZ																	
R01 2-mile ring	4:00	4:05	3:10	3:10	3:10	R01 2-mile ring	4:00	4:05	5:10	3:10	3:10	4:10	3:10	R01 2-mile ring	4:00	4:00	4:00
R02 5-mile ring	4:10	4:10	4:10	4:10	4:10	R02 5-mile ring	4:10	4:10	5:10	4:10	4:10	5:10	4:10	R02 5-mile ring	4:10	4:10	4:10
R03 Entire EPZ	6:10	6:10	6:00	6:00	6:00	R03 Entire EPZ	6:10	6:15	6:15	6:00	6:00	6:00	6:00	R03 Entire EPZ	6:10	6:10	6:10
5-Mile Ring and Downwind to EPZ Boundary																	
R04 NNW	6:05	6:10	4:10	4:10	4:10	R04 NNW	6:05	6:10	6:10	4:10	4:20	5:10	4:10	R04 NNW	6:10	6:10	6:10
R05 N	6:05	6:05	4:10	4:10	4:10	R05 N	6:05	6:10	6:10	4:10	4:20	5:10	4:10	R05 N	6:10	6:10	6:10
R06 NNE, NE	6:00	6:00	4:10	4:10	4:10	R06 NNE, NE	6:10	6:10	6:10	4:10	4:10	5:10	4:10	R06 NNE, NE	6:10	6:10	6:00
R07 ENE	6:00	6:00	4:10	4:10	4:10	R07 ENE	6:00	6:10	6:10	4:10	4:10	5:10	4:10	R07 ENE	6:00	6:00	6:00
R08 E, ESE	4:10	4:10	4:10	4:10	4:10	R08 E, ESE	4:10	4:10	5:10	4:10	4:10	5:10	4:10	R08 E, ESE	4:10	4:10	4:10
R09 SE	4:10	4:10	4:10	4:10	4:10	R09 SE	4:10	4:10	5:10	4:10	4:10	5:10	4:10	R09 SE	4:10	4:10	4:10
R10 SSE	6:10	6:10	6:00	6:00	6:00	R10 SSE	6:10	6:10	6:10	6:00	6:00	6:00	6:00	R10 SSE	6:10	6:10	6:10
R11 S, SSW, SW	6:10	6:10	6:00	6:00	6:00	R11 S, SSW, SW	6:10	6:10	6:10	6:00	6:00	6:00	6:00	R11 S, SSW, SW	6:10	6:10	6:10
R12 W, WSW, WNW	6:10	6:10	6:00	6:00	6:00	R12 W, WSW, WNW	6:10	6:10	6:15	6:00	6:00	6:00	6:00	R12 W, WSW, WNW	6:10	6:10	6:10
R13 NW	6:00	6:05	4:10	4:10	4:10	R13 NW	6:00	6:05	6:10	4:10	4:15	5:10	4:10	R13 NW	6:10	6:10	6:10
2-Mile Ring and Downwind to EPZ Boundary																	
R14 NNE, NE	6:00	6:00	4:10	4:10	4:10	R14 NNE, NE	6:10	6:10	6:10	4:10	4:10	5:10	4:10	R14 NNE, NE	6:10	6:10	6:00
R15 ENE	6:00	6:00	4:10	4:10	4:10	R15 ENE	6:00	6:10	6:10	4:10	4:10	5:10	4:10	R15 ENE	6:00	6:00	6:00
R16 E, ESE	4:10	4:10	4:10	4:10	4:10	R16 E, ESE	4:10	4:10	5:10	4:10	4:10	5:00	4:10	R16 E, ESE	4:10	4:10	4:10
R17 SE	4:10	4:10	3:10	3:10	3:10	R17 SE	4:10	4:10	5:10	3:10	3:10	4:10	3:10	R17 SE	4:10	4:10	4:10

Table J-2. Description of Evacuation Regions*													
		ERPA											
		New Jersey								Delaware			
Region	Description	1	2	3	4	5	6	7	8	A	B	C	D
R01	2-Mile	x							x				x
R02	5-Mile	x							x	x			x
R03	Entire EPZ	x	x	x	x	x	x	x	x	x	x	x	x
5-Mile Ring and Downwind to EPZ Boundary													
		ERPA											
		New Jersey								Delaware			
Region	Wind Direction Towards:	1	2	3	4	5	6	7	8	A	B	C	D
R04	NNW	x		x		x			x	x		x	x
R05	N	x		x	x	x			x	x		x	x
R06	NNE, NE	x	x	x	x	x			x	x			x
R07	ENE	x	x	x	x		x		x	x			x
R08	E, ESE	x	x				x	x	x	x			x
R09	SE	x					x	x	x	x			x
R10	SSE	x						x	x	x	x		x
R11	S, SSW, SW	x							x	x	x		x
R12	WSW, W, WNW	x							x	x	x	x	x
R13	NW	x							x	x		x	x
2-Mile Ring and Downwind to EPZ Boundary													
		ERPA											
		New Jersey								Delaware			
Region	Wind Direction Towards:	1	2	3	4	5	6	7	8	A	B	C	D
R14	NNE, NE	x	x	x	x	x			x				x
R15	ENE	x	x	x	x		x		x				x
R16	E, ESE	x	x				x	x	x				x
R17	SE	x					x	x	x				x
N/A	NNW	Refer to Region R04											
	N	Refer to Region R05											
	SSE	Refer to Region R10											
	S, SSW, SW	Refer to Region R11											
	WSW, W, WNW	Refer to Region R12											
	NW	Refer to Region R13											
2-Mile Ring and Downwind to 5 Miles													
		ERPA											
		New Jersey								Delaware			
Region	Wind Direction Towards:	1	2	3	4	5	6	7	8	A	B	C	D
N/A	NNE, NE, ENE, E, ESE, SE	Refer to Region R01											
N/A	N, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW	Refer to Region R02											
x = ERPA EVACUATES		ERPA SHELTERS IN PLACE											
*Adapted from Region definitions in County/State Radiological Emergency Plans													

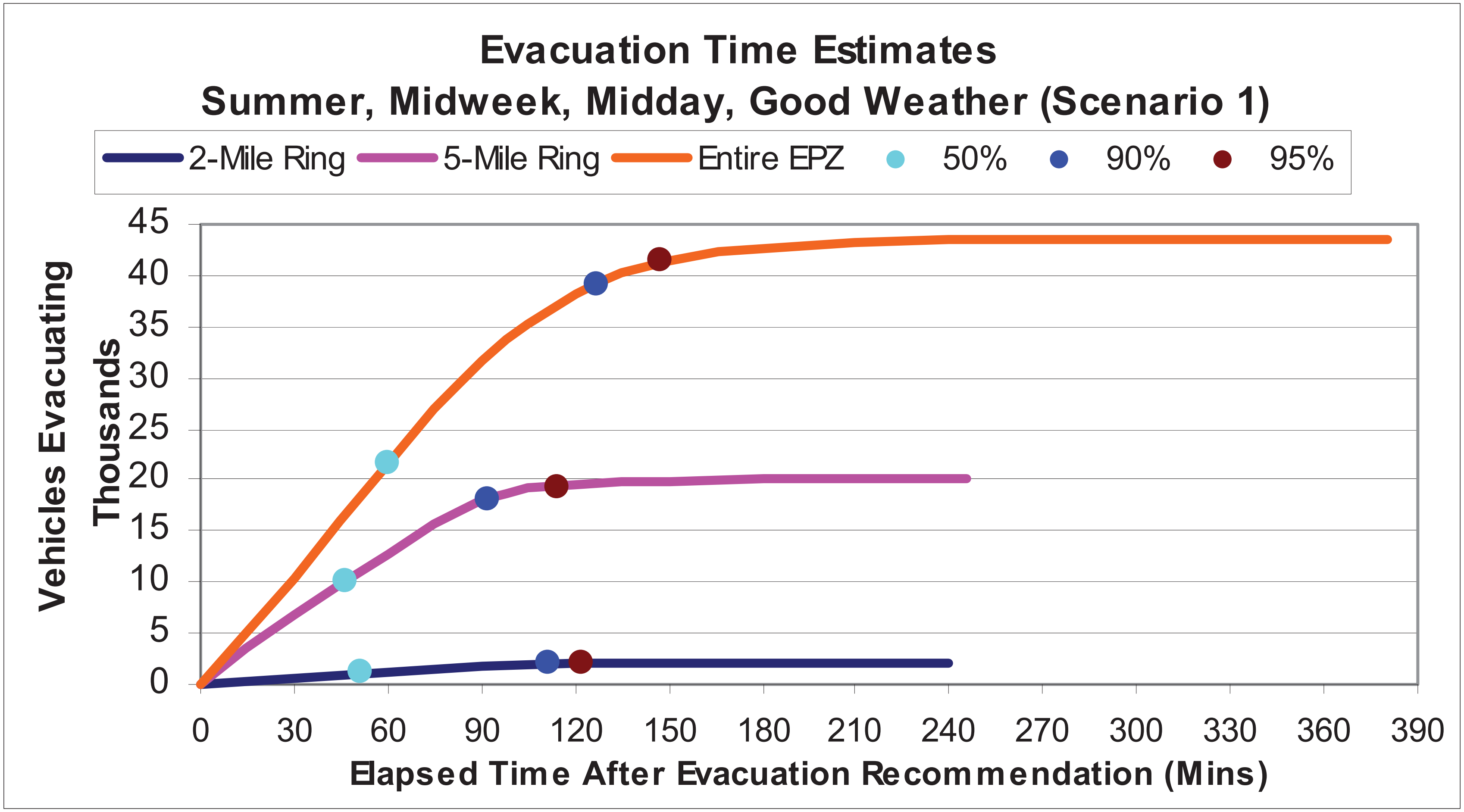


Figure J-1. Evacuation Time Estimates – Scenario 1 for Region R03 (Entire EPZ)

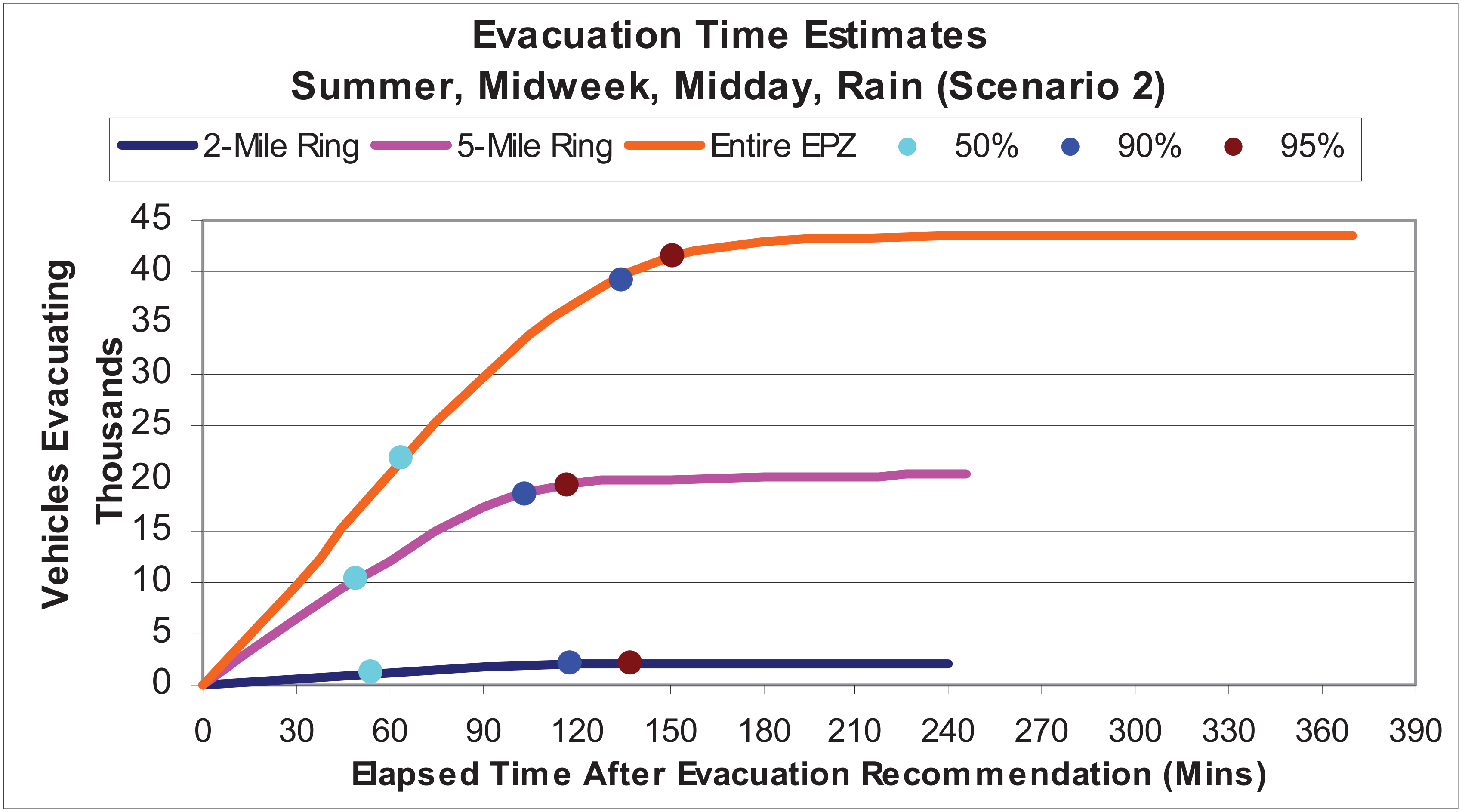


Figure J-2. Evacuation Time Estimates – Scenario 2 for Region R03 (Entire EPZ)

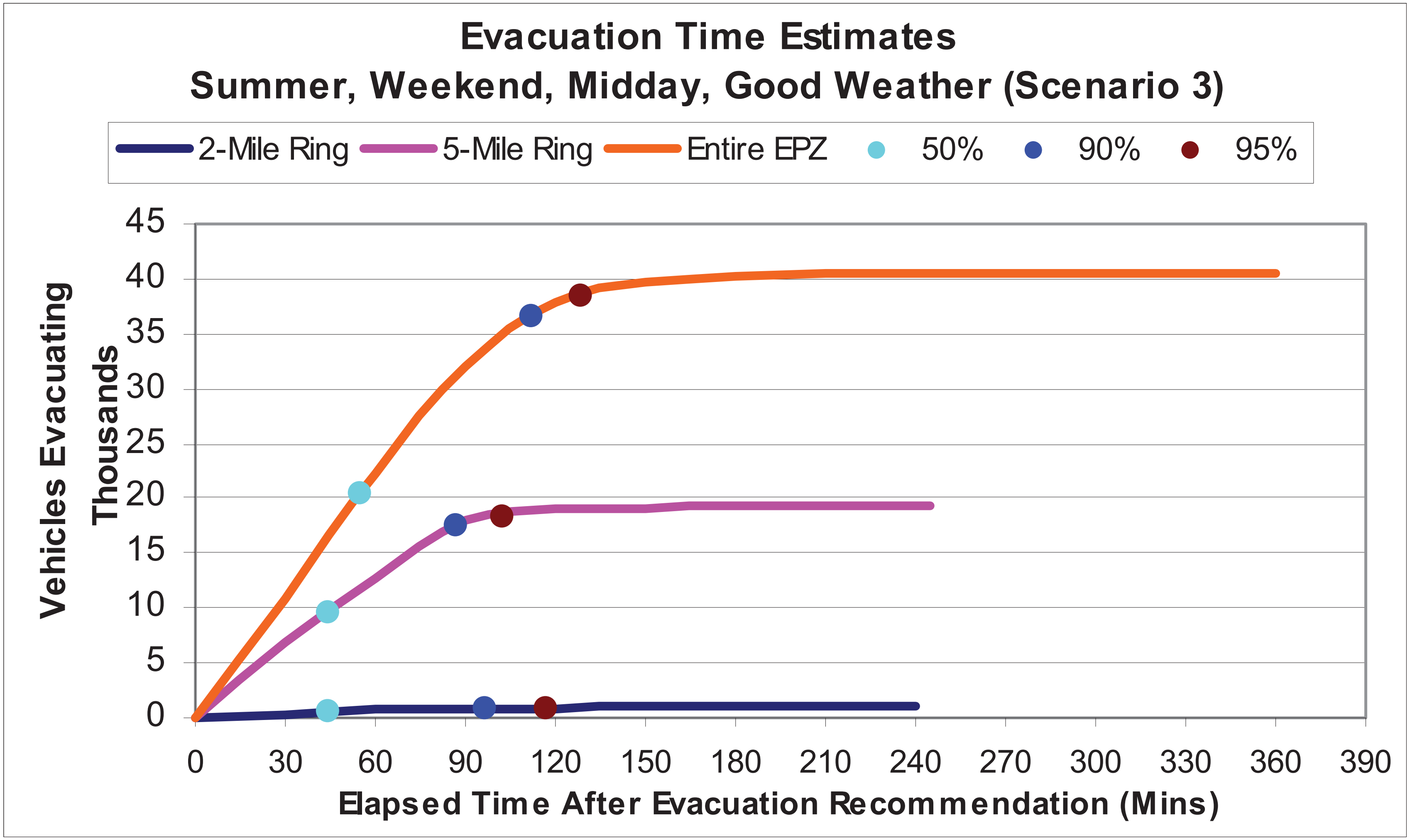


Figure J-3. Evacuation Time Estimates – Scenario 3 for Region R03 (Entire EPZ)

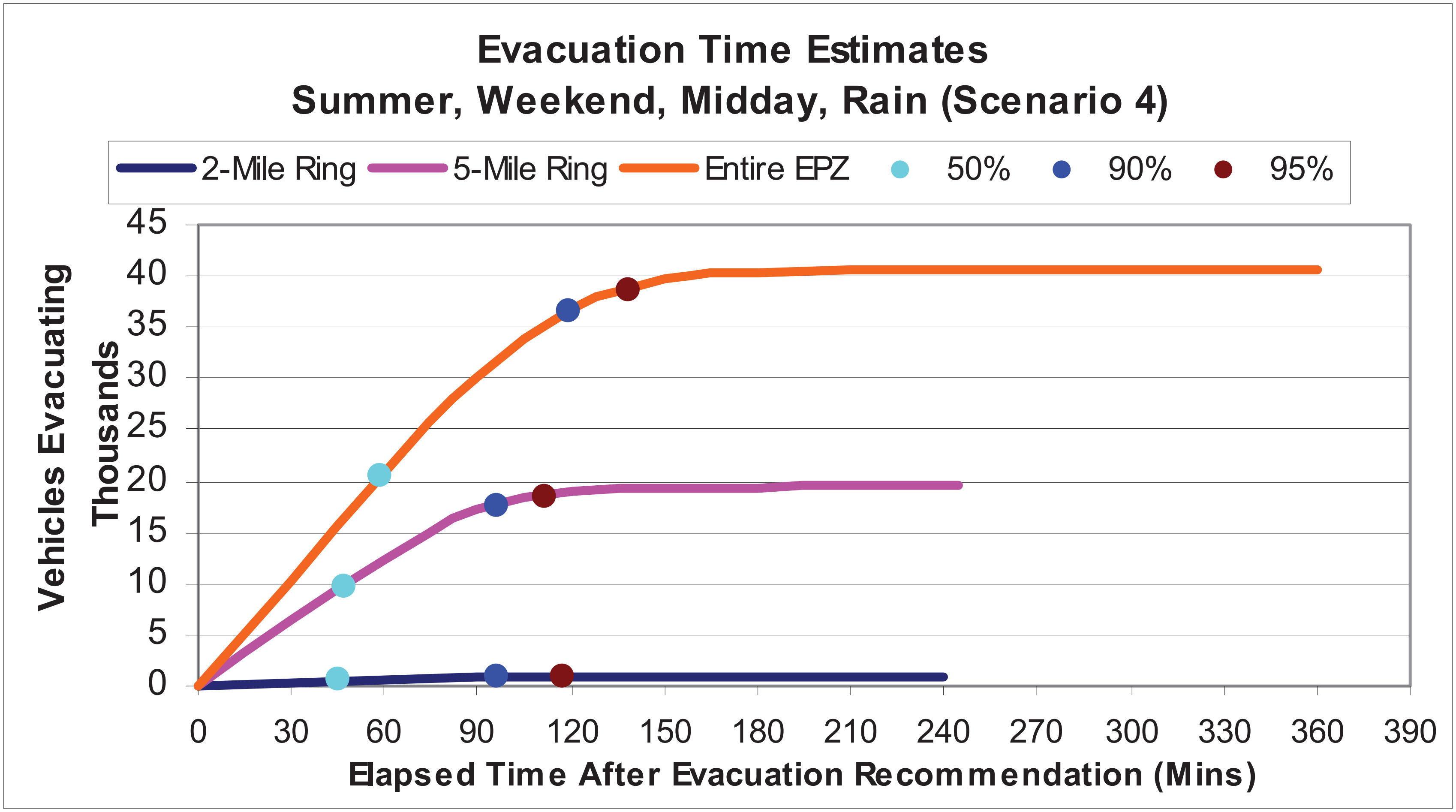


Figure J-4. Evacuation Time Estimates – Scenario 4 for Region R03 (Entire EPZ)

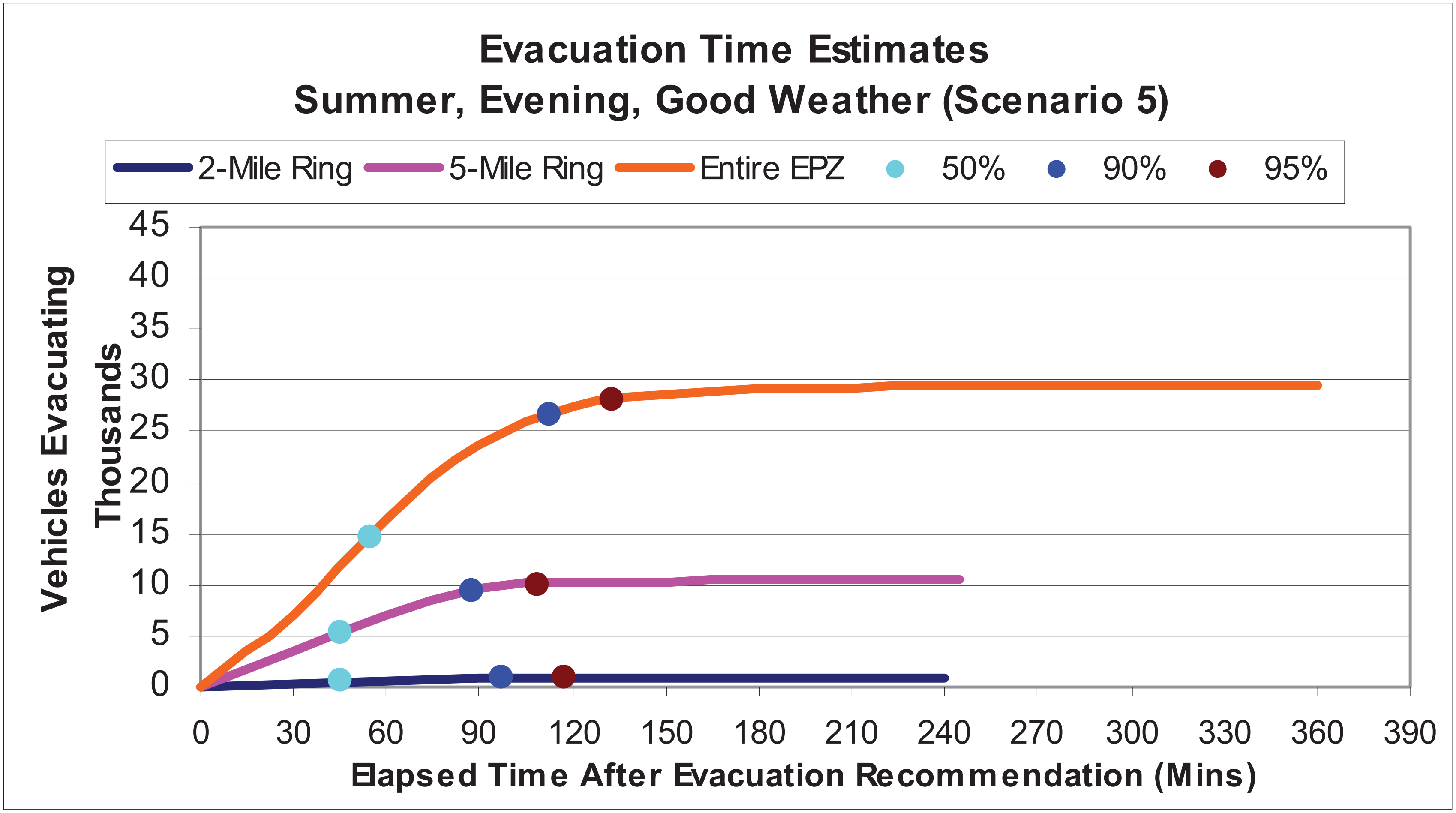


Figure J-5. Evacuation Time Estimates – Scenario 5 for Region R03 (Entire EPZ)

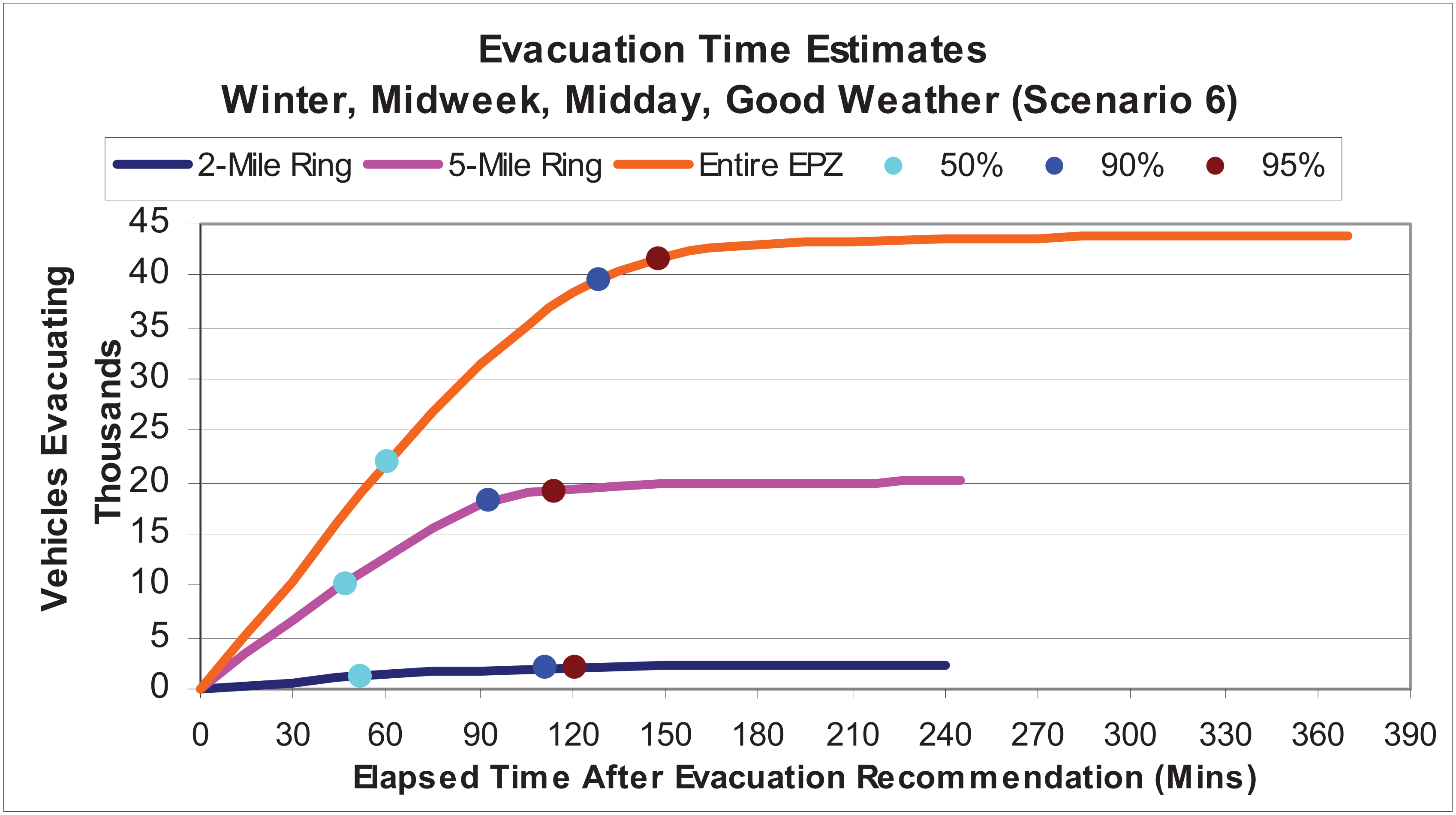


Figure J-6. Evacuation Time Estimates – Scenario 6 for Region R03 (Entire EPZ)

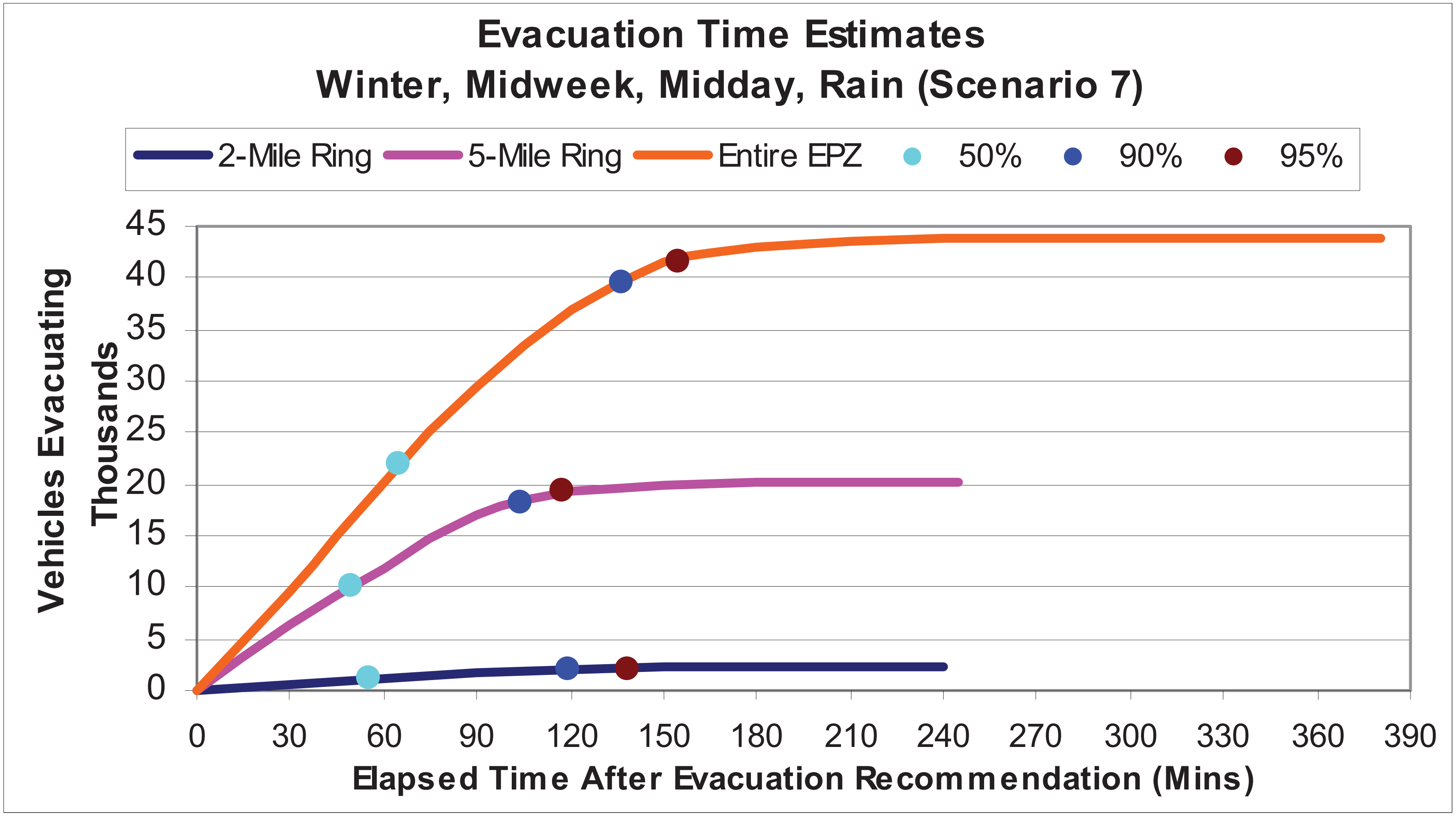


Figure J-7. Evacuation Time Estimates – Scenario 7 for Region R03 (Entire EPZ)

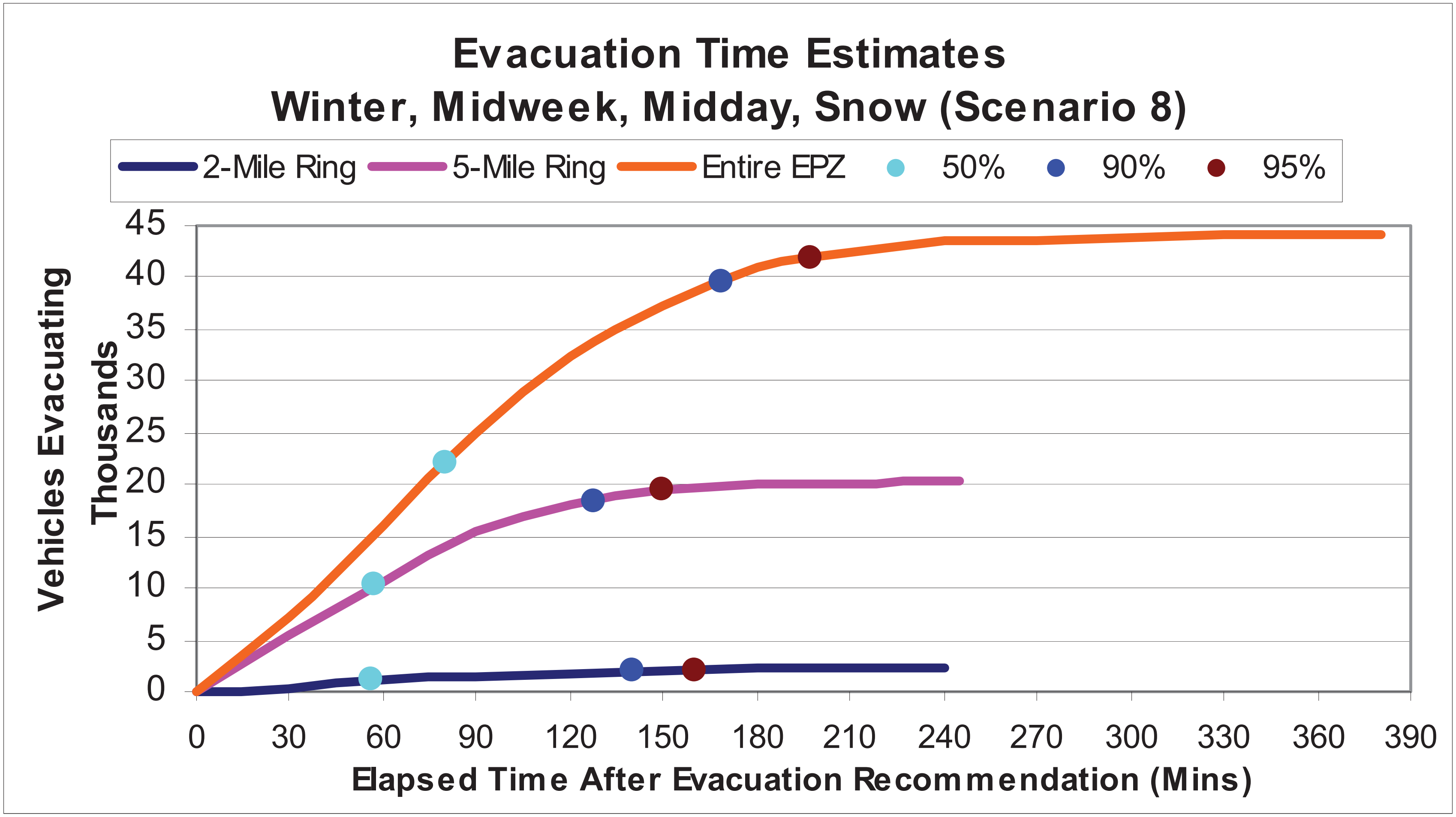


Figure J-8. Evacuation Time Estimates – Scenario 8 for Region R03 (Entire EPZ)

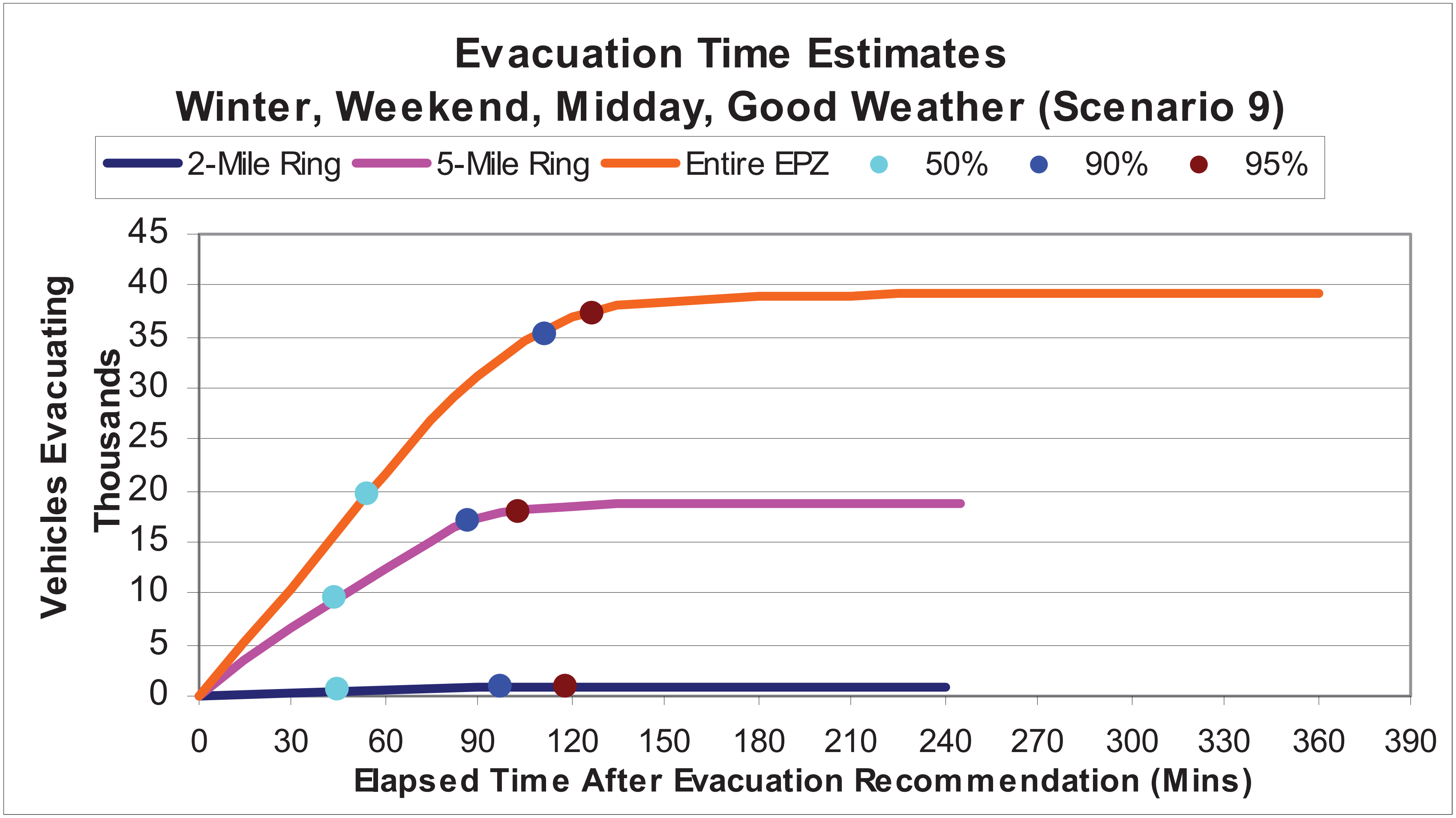


Figure J-9. Evacuation Time Estimates – Scenario 9 for Region R03 (Entire EPZ)

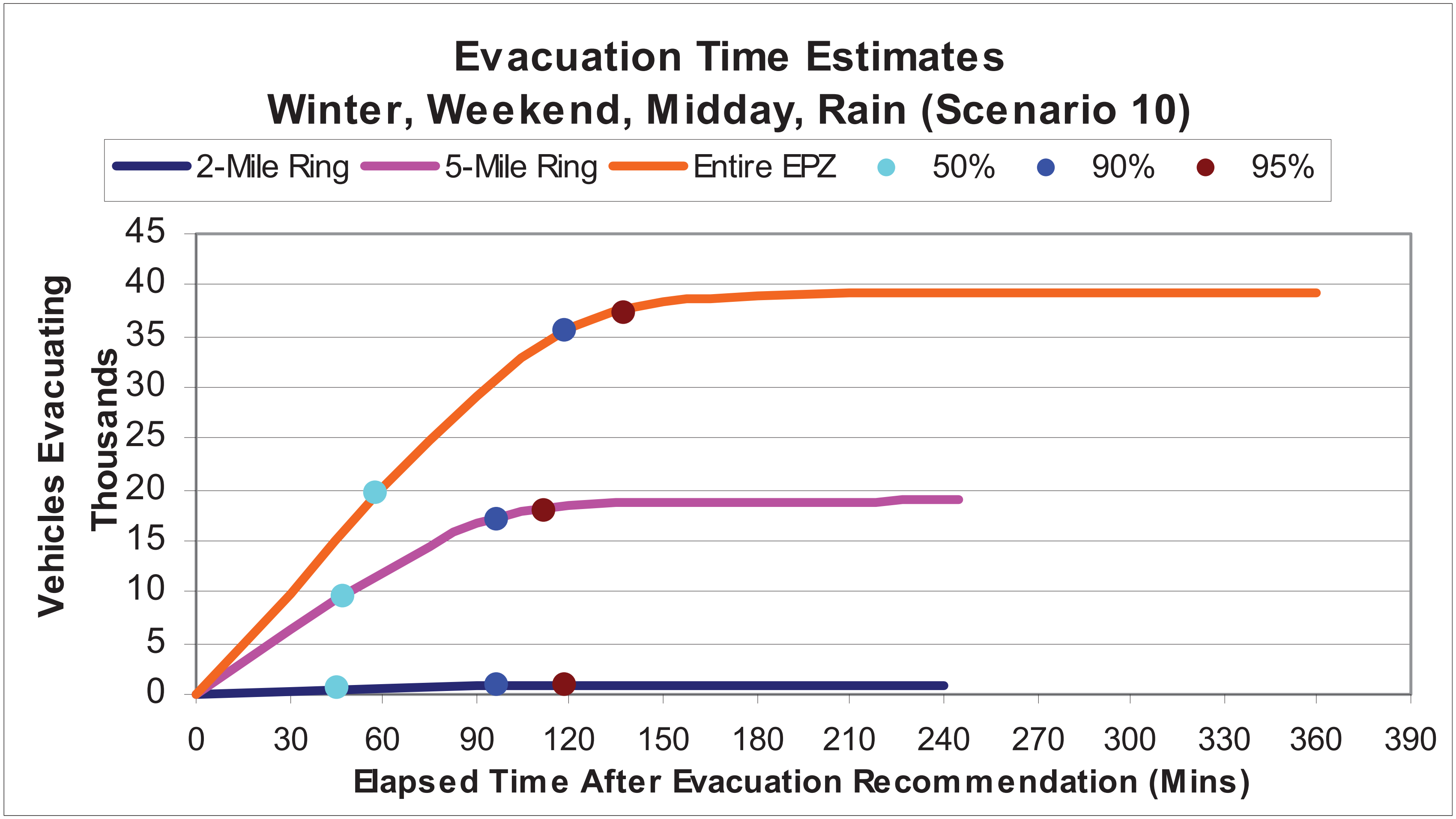


Figure J-10. Evacuation Time Estimates – Scenario 10 for Region R03 (Entire EPZ)

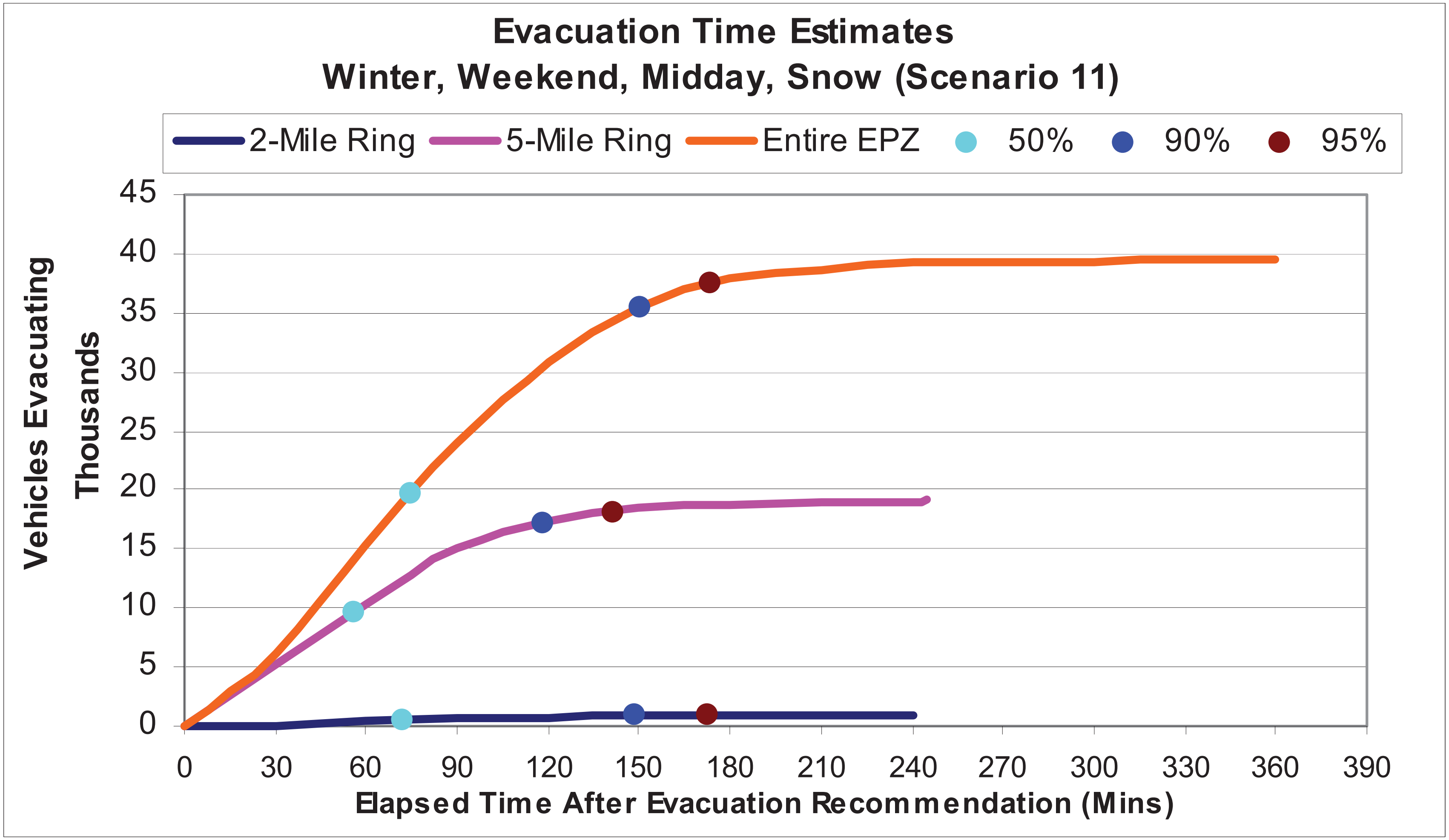


Figure J-11. Evacuation Time Estimates – Scenario 11 for Region R03 (Entire EPZ)

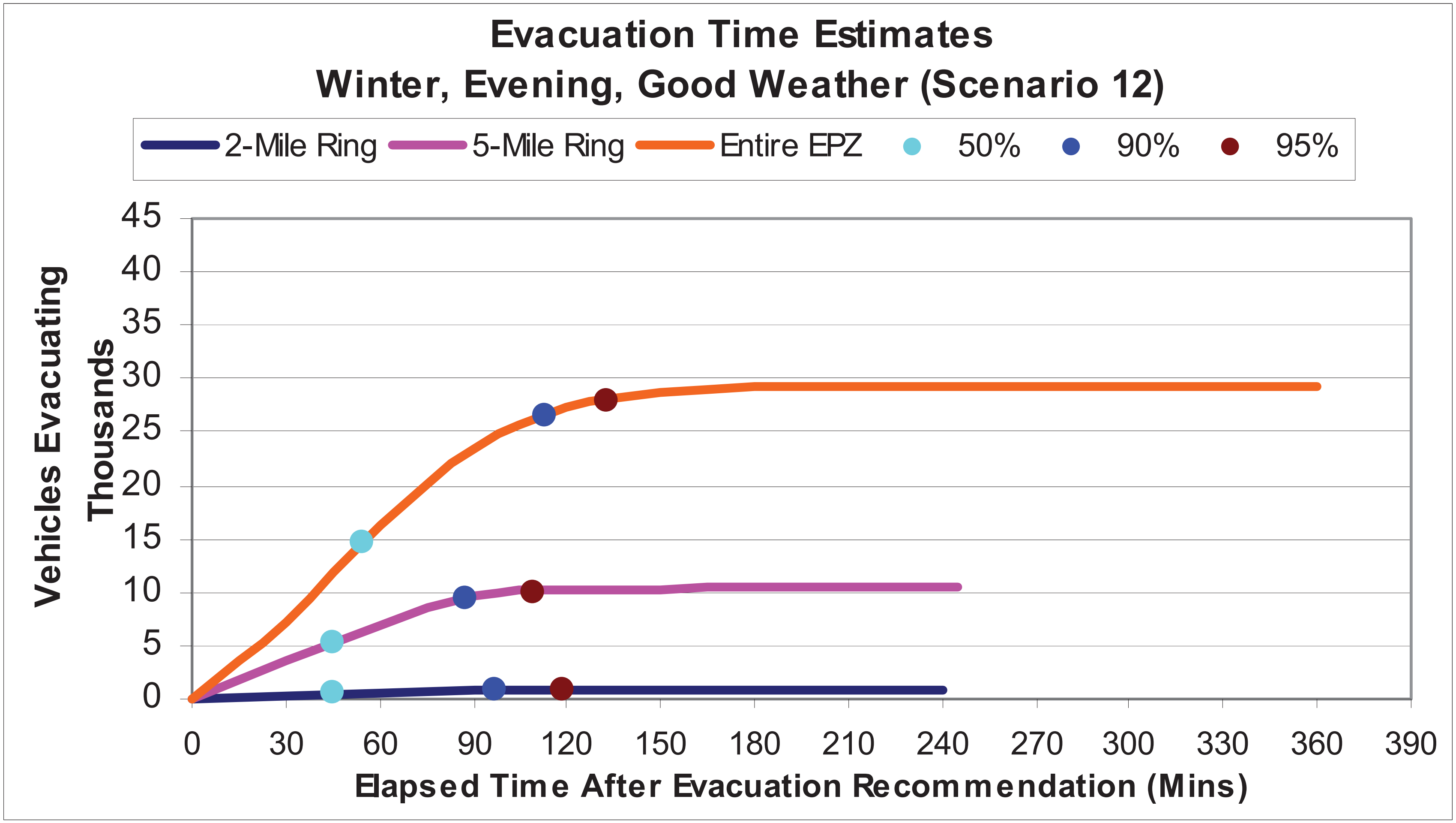


Figure J-12. Evacuation Time Estimates – Scenario 12 for Region R03 (Entire EPZ)

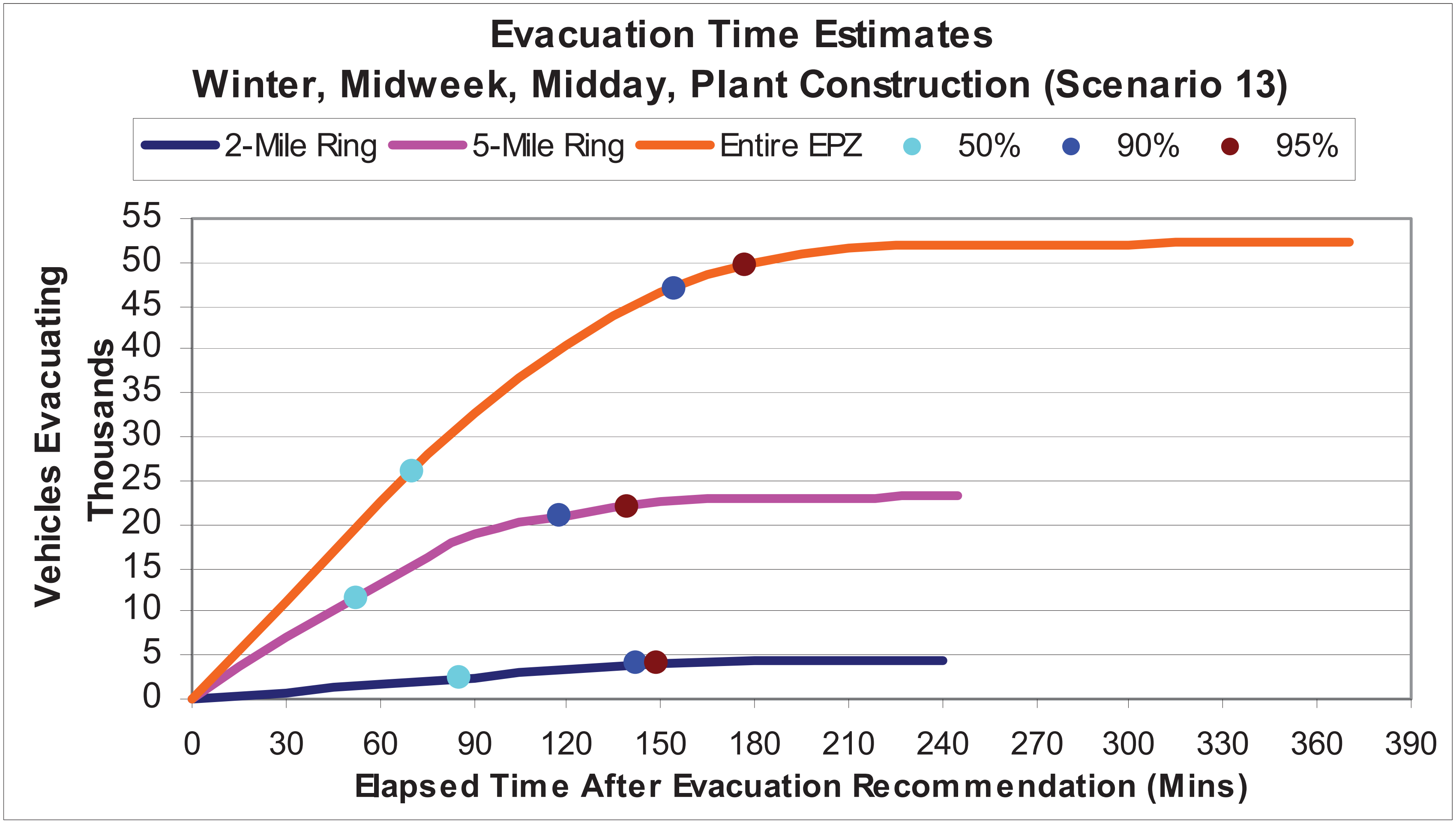


Figure J-13. Evacuation Time Estimates – Scenario 13 for Region R03 (Entire EPZ)

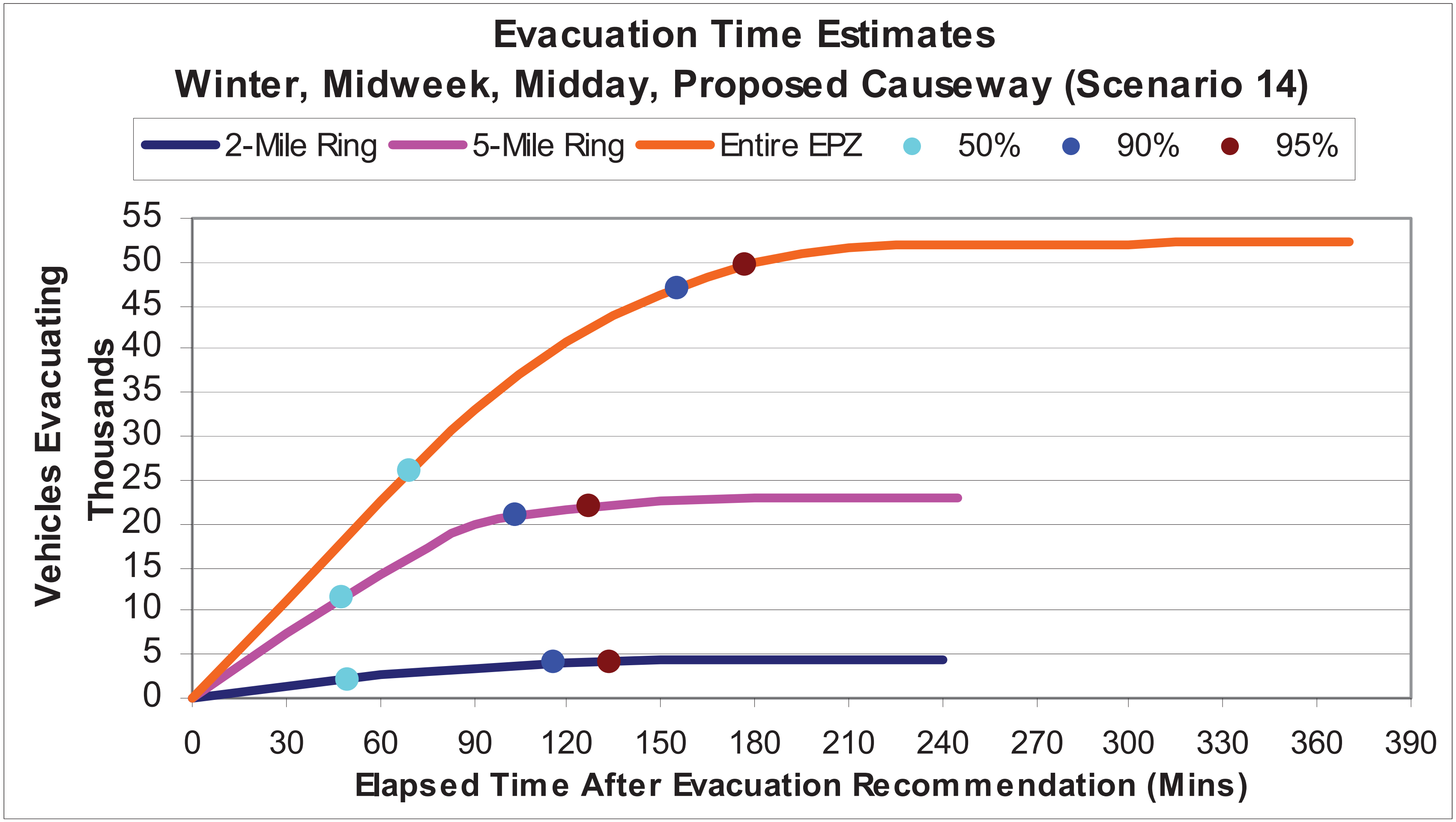


Figure J-14. Evacuation Time Estimates – Scenario 14 for Region R03 (Entire EPZ)

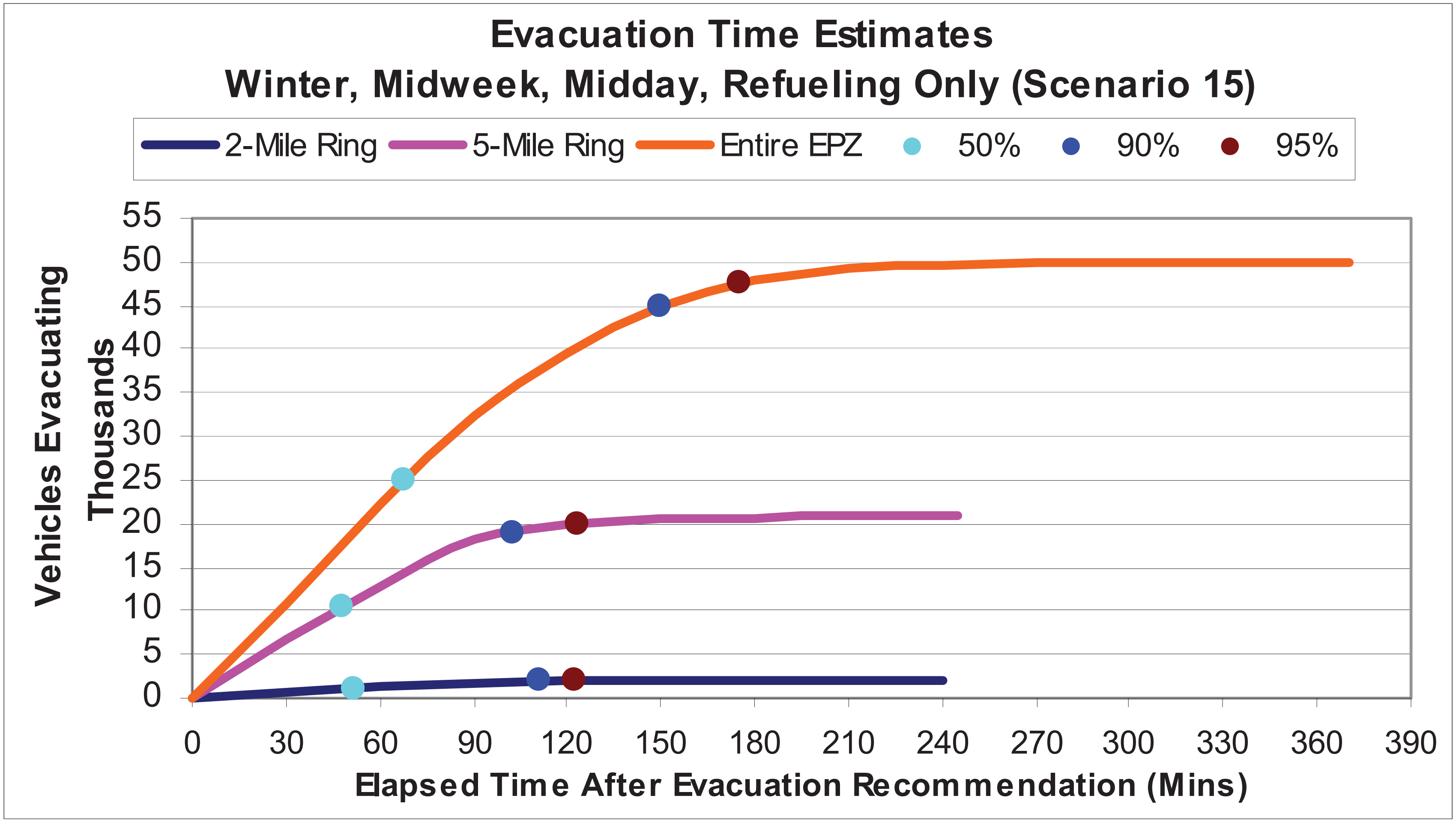


Figure J-15. Evacuation Time Estimates – Scenario 15 for Region R03 (Entire EPZ)

APPENDIX K

Evacuation Roadway Network

APPENDIX K: EVACUATION ROADWAY NETWORK

As discussed in Section 1.3, a computerized link-node analysis network was constructed to model the roadway network within the study area. Figure K-1 provides an overview of the link-node analysis network. The figure has been divided up into 24 more detailed figures (Figures K-2 through K-25) which show each of the links and nodes in the network.

The analysis network was calibrated using the observations made during the field survey conducted in April 2009. Table K-1 lists the characteristics of each roadway section modeled in the ETE analysis. Each link is identified by its upstream and downstream node numbers. These node numbers can be cross-referenced to Figures K-1 through K-25 to identify the geographic location of each link.

The term, "Full Lanes" in Table K-1 identifies the number of lanes that extend throughout the length of the link. Many links have additional lanes on the immediate approach to an intersection (turn pockets); these have been recorded and entered into the I-DYNEV System input stream.

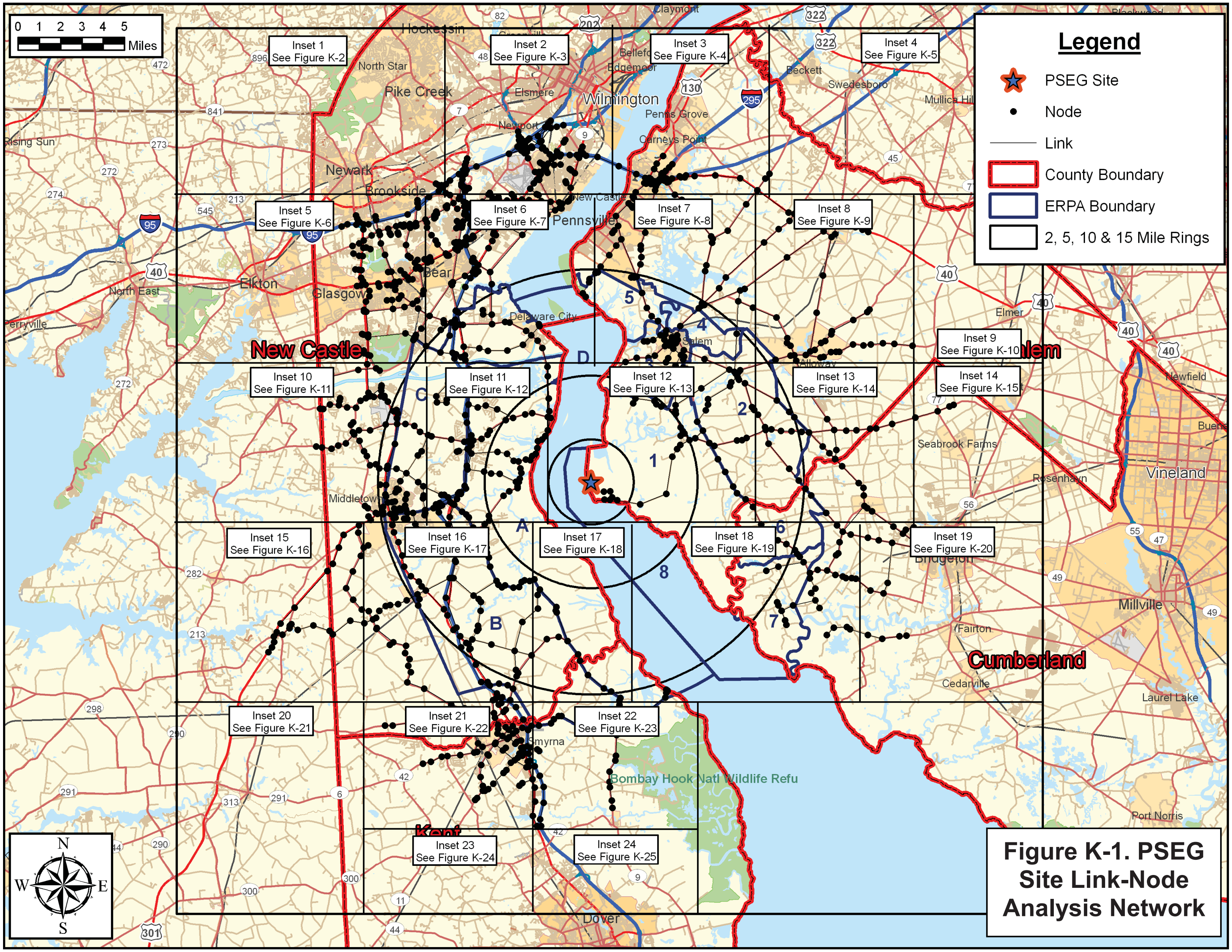


Figure K-1. PSEG Site Link-Node Analysis Network

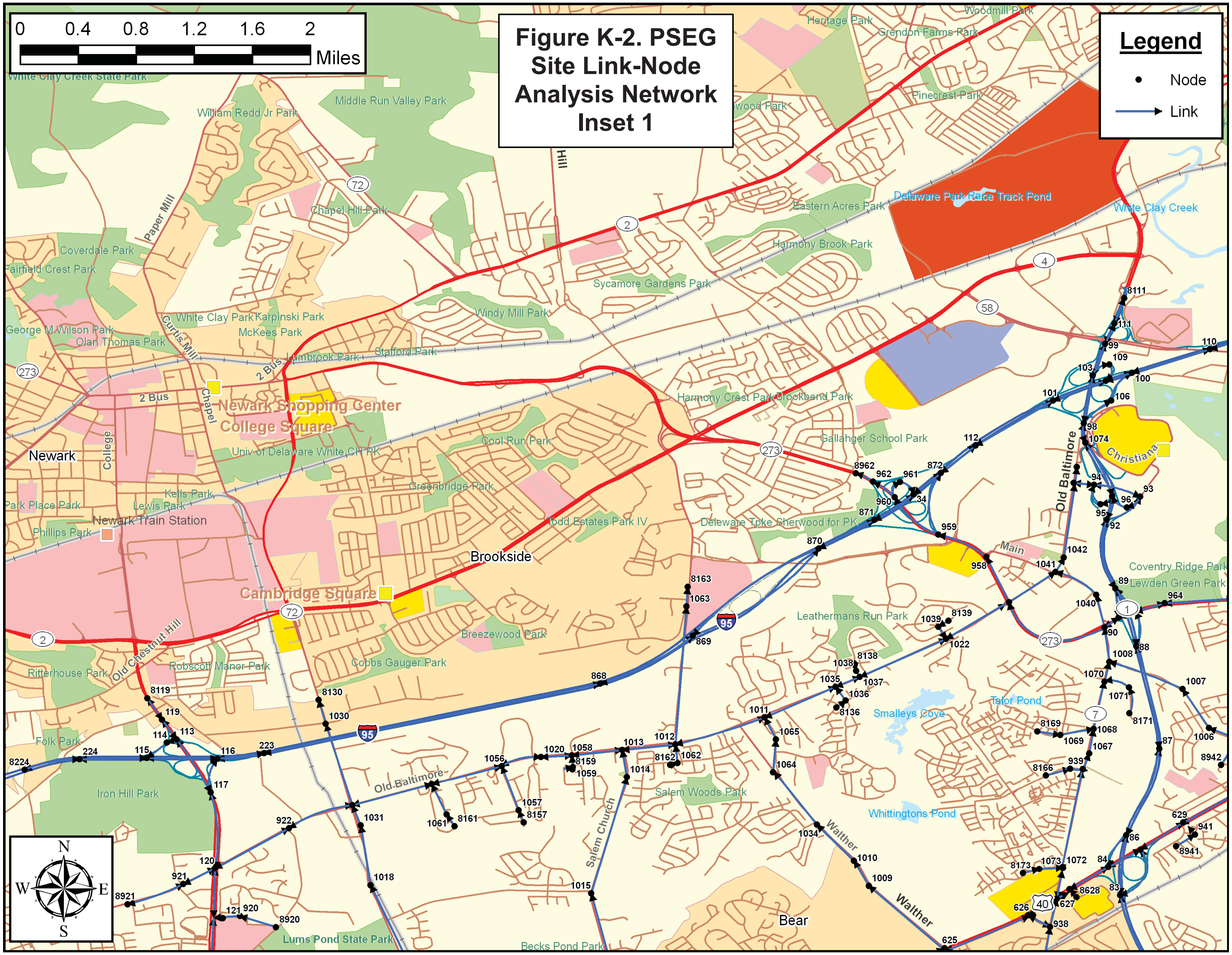


Figure K-2. PSEG Site Link-Node Analysis Network Inset 1
Legend
Node
Link
0 0.4 0.8 1.2 1.6 2 Miles
Newark
Brookside
Bear
Newark Shopping Center
College Square
Cambridge Square
Newark Train Station
Iron Hill Park
White Clay Creek State Park
Middle Run Valley Park
Delaware Park Race Track Pond
Christiana
Old Baltimore
Walther
Salem Church
Lums Pond State Park
N
S
E
W

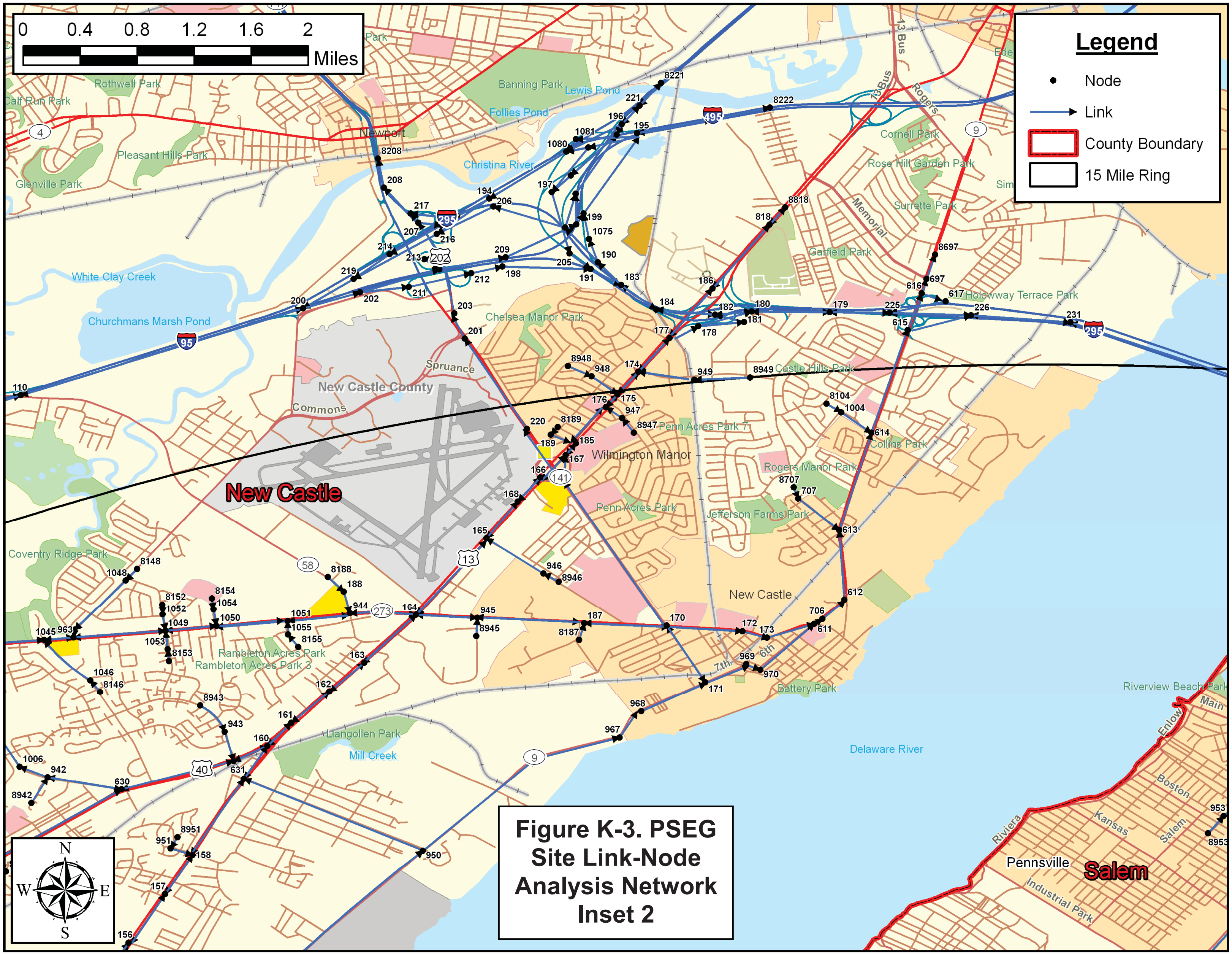


Figure K-3. PSEG Site Link-Node Analysis Network Inset 2

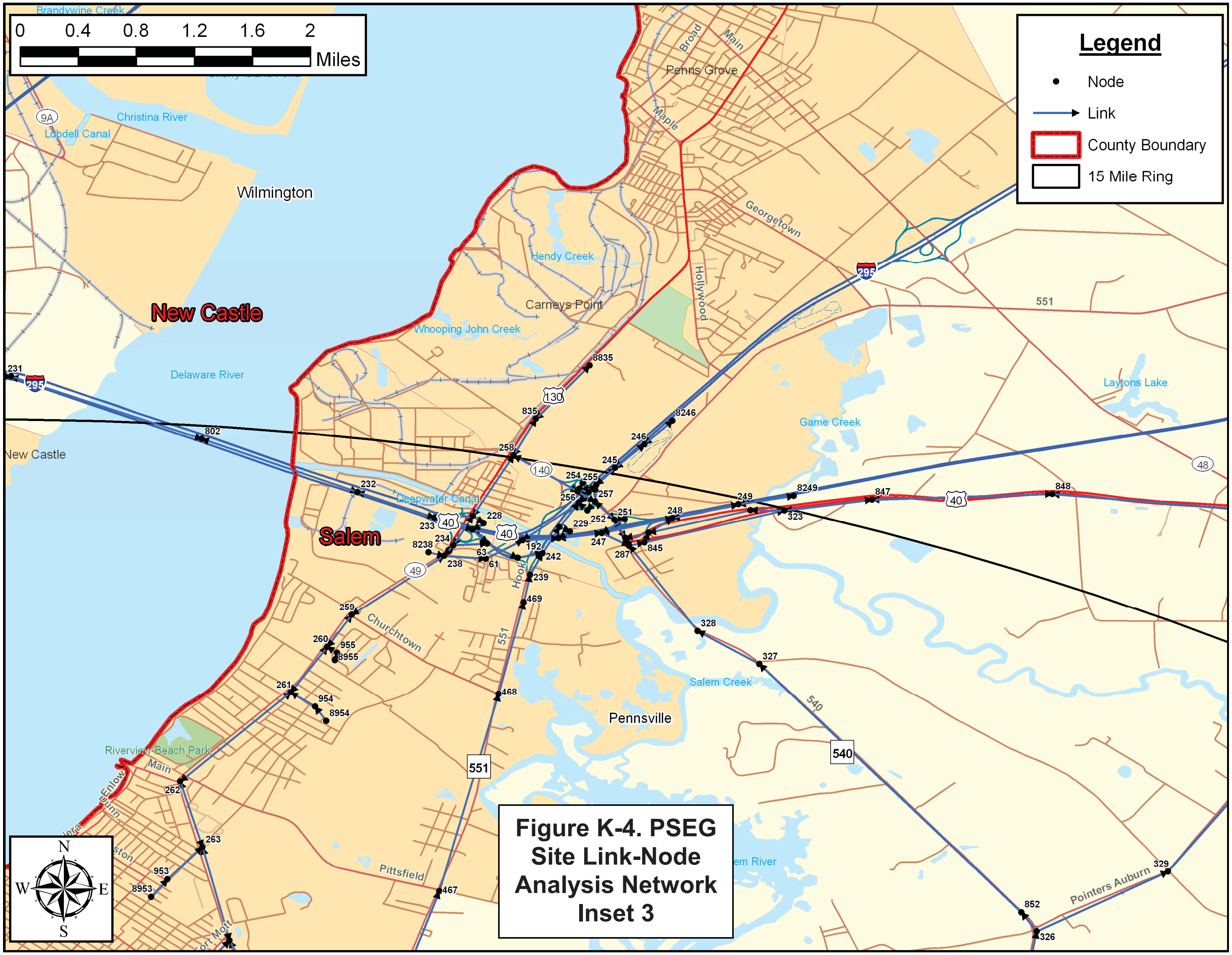


Figure K-4. PSEG Site Link-Node Analysis Network Inset 3

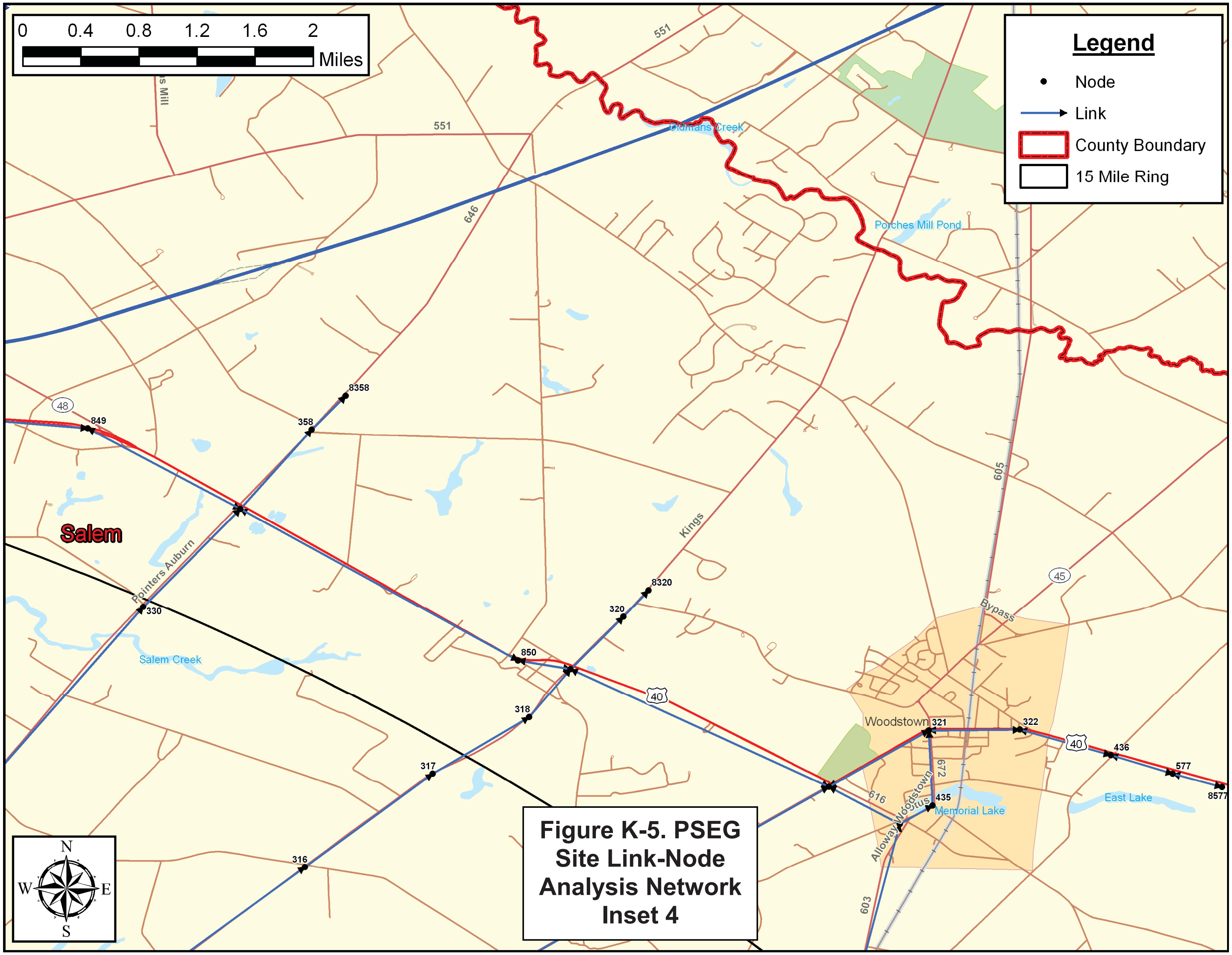


Figure K-5. PSEG Site Link-Node Analysis Network Inset 4

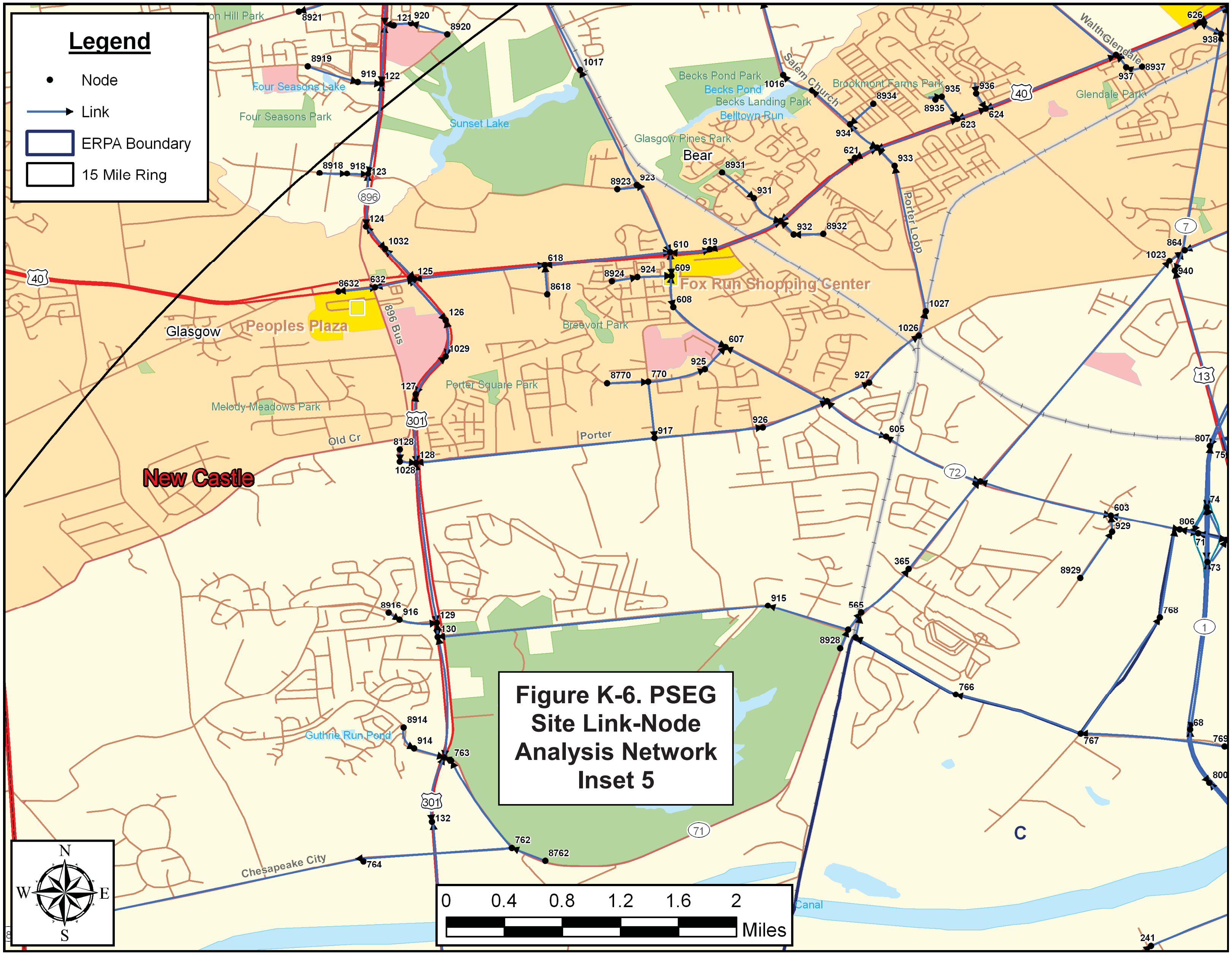


Figure K-6. PSEG Site Link-Node Analysis Network Inset 5

Figure K-7. PSEG Site Link-Node Analysis Network Inset 6

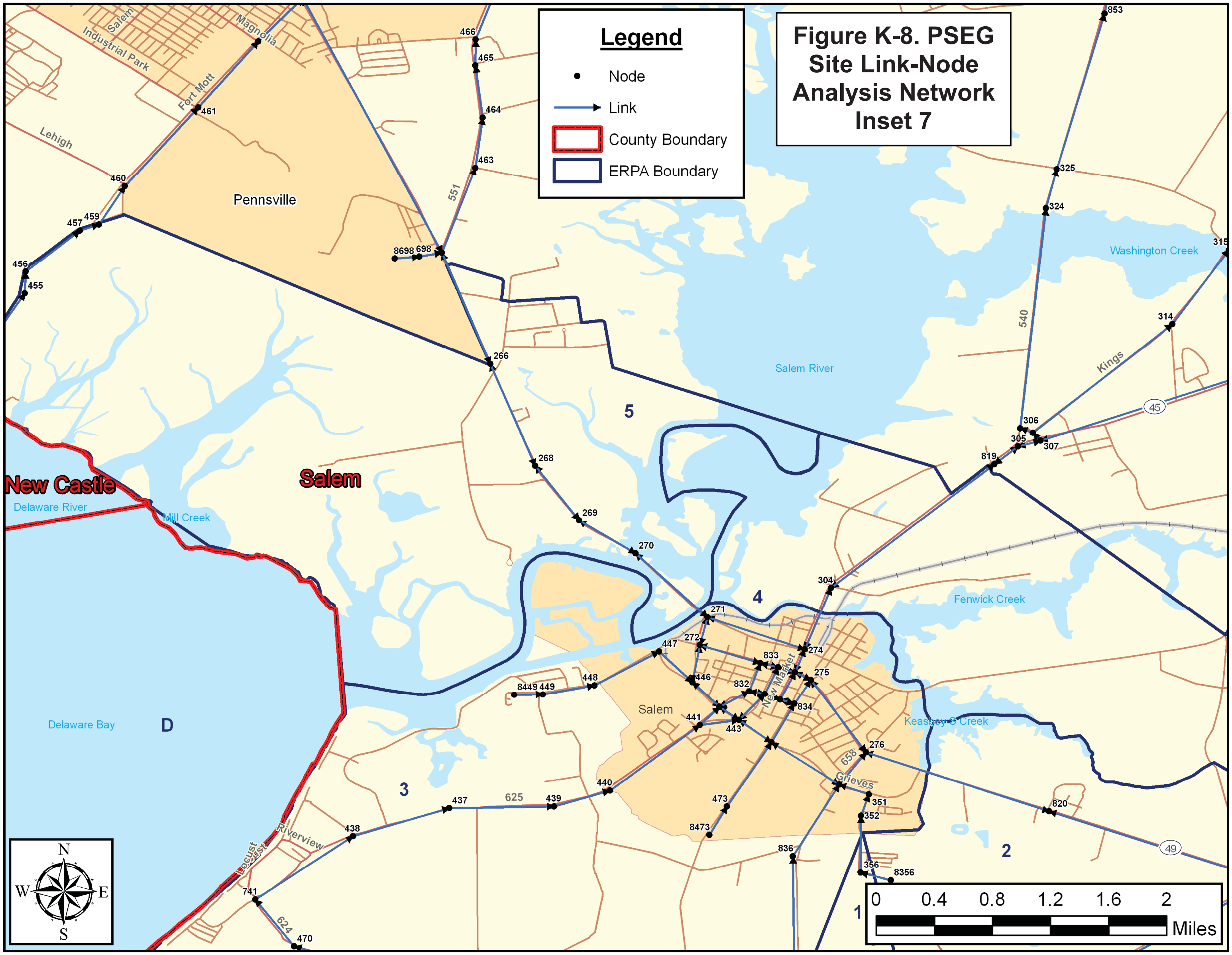


Figure K-8. PSEG Site Link-Node Analysis Network Inset 7
Legend
Node
Link
County Boundary
ERPA Boundary
Pennsville
Salem
New Castle
Delaware River
Mill Creek
Delaware Bay
Salem River
Washington Creek
Fenwick Creek
Keasbey Creek
Kings
Grieves
Riverview
New Market
Magnolia
Fort Mott
Lehigh
Salem Industrial Park
0 0.4 0.8 1.2 1.6 2
Miles

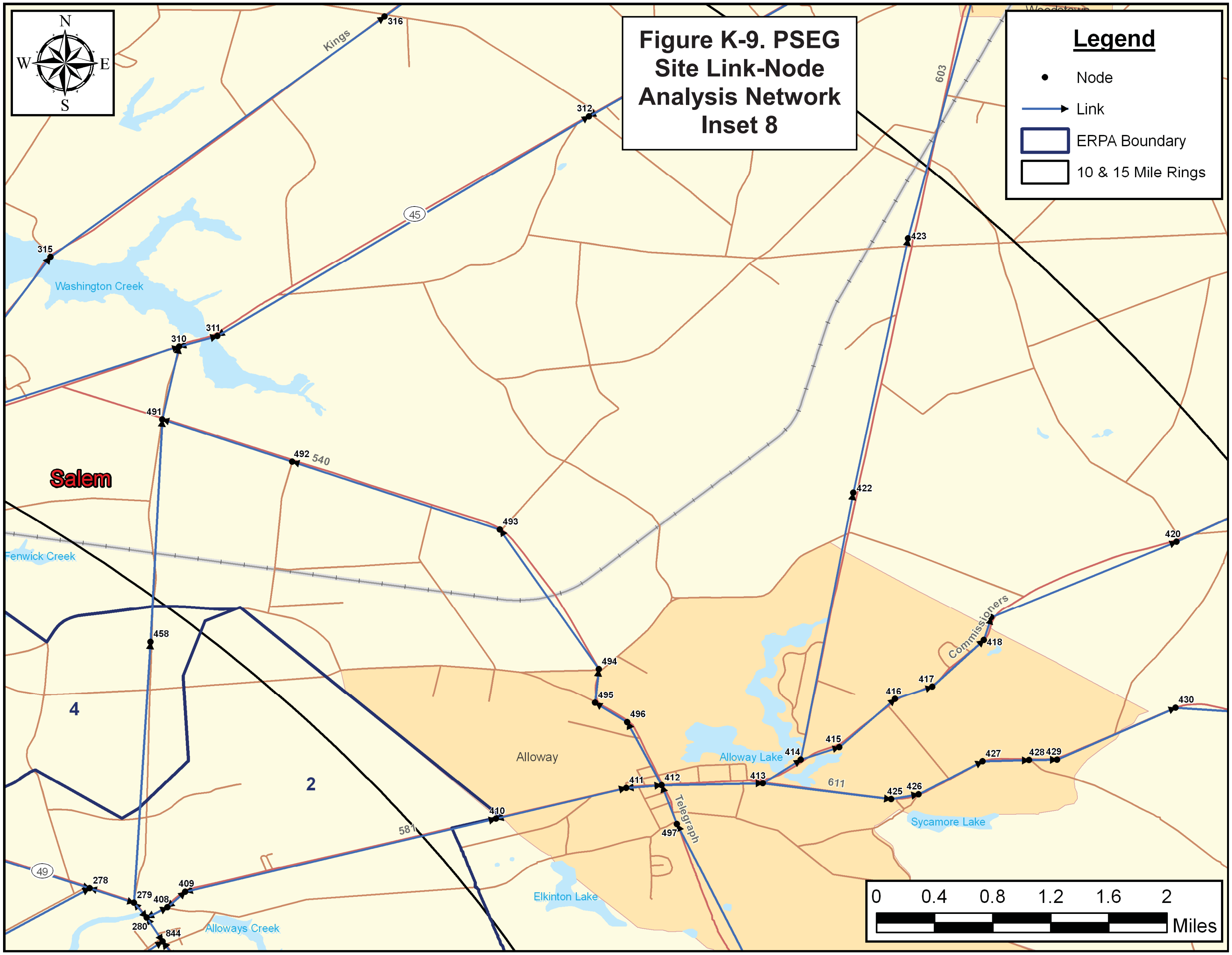


Figure K-9. PSEG Site Link-Node Analysis Network Inset 8
Legend
Node
Link
ERPA Boundary
10 & 15 Mile Rings
N
S
E
W
Salem
Alloway
Washington Creek
Fenwick Creek
Alloway Lake
Sycamore Lake
Elkinton Lake
Alloways Creek
Kings
Commissioners
Telegraph
45
540
603
611
581
49
4
2
316
312
315
311
310
491
492
493
423
422
420
458
494
495
496
411
412
413
414
415
416
417
418
410
497
425
426
427
428
429
430
278
279
408
409
280
844
0
0.4
0.8
1.2
1.6
2
Miles

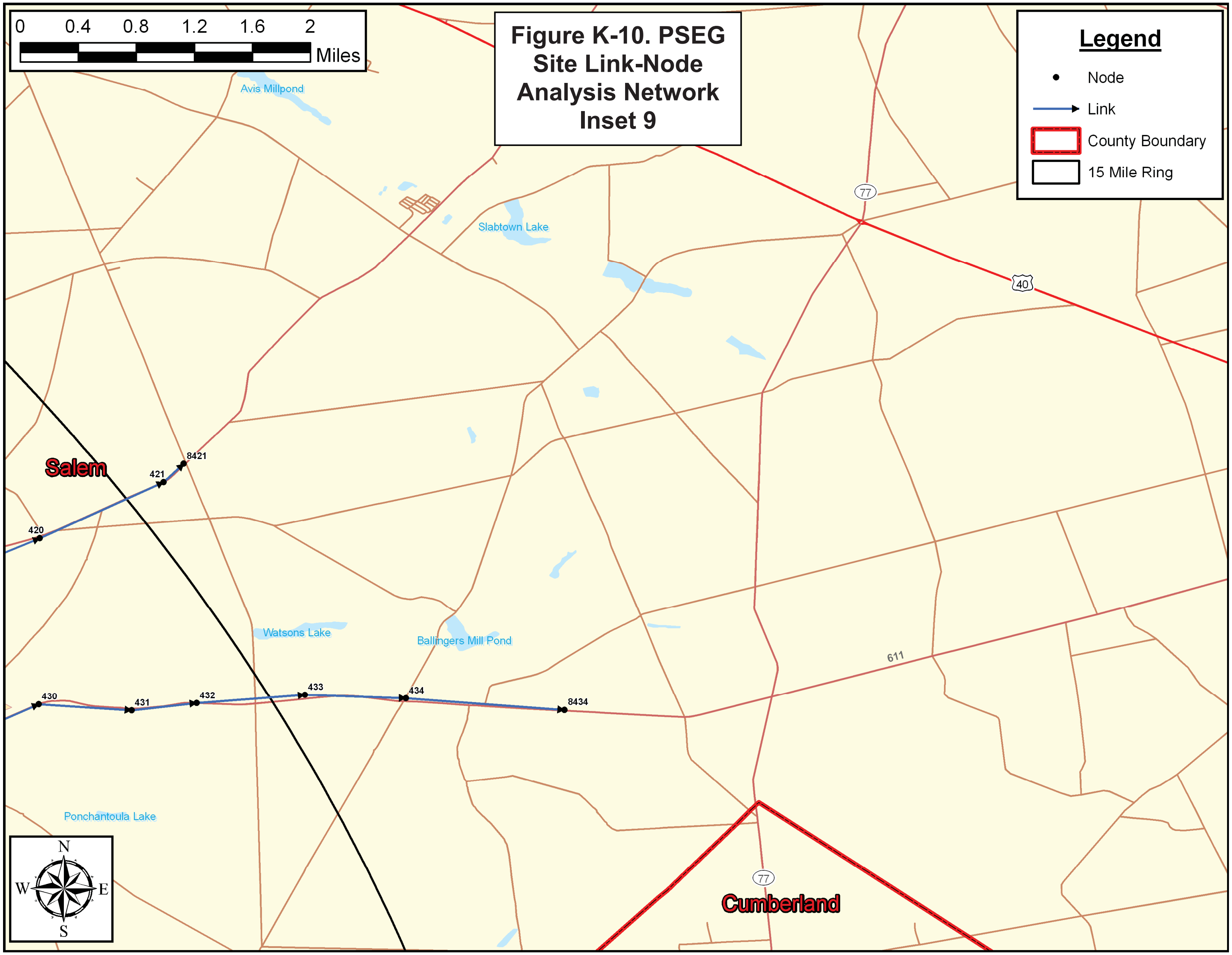


Figure K-10. PSEG Site Link-Node Analysis Network Inset 9
0
0.4
0.8
1.2
1.6
2
Miles
Legend
Node
Link
County Boundary
15 Mile Ring
Avis Millpond
Slabtown Lake
Watsons Lake
Ballingers Mill Pond
Ponchantoula Lake
Salem
Cumberland
8421
421
420
430
431
432
433
434
8434
77
40
611
N
E
S
W

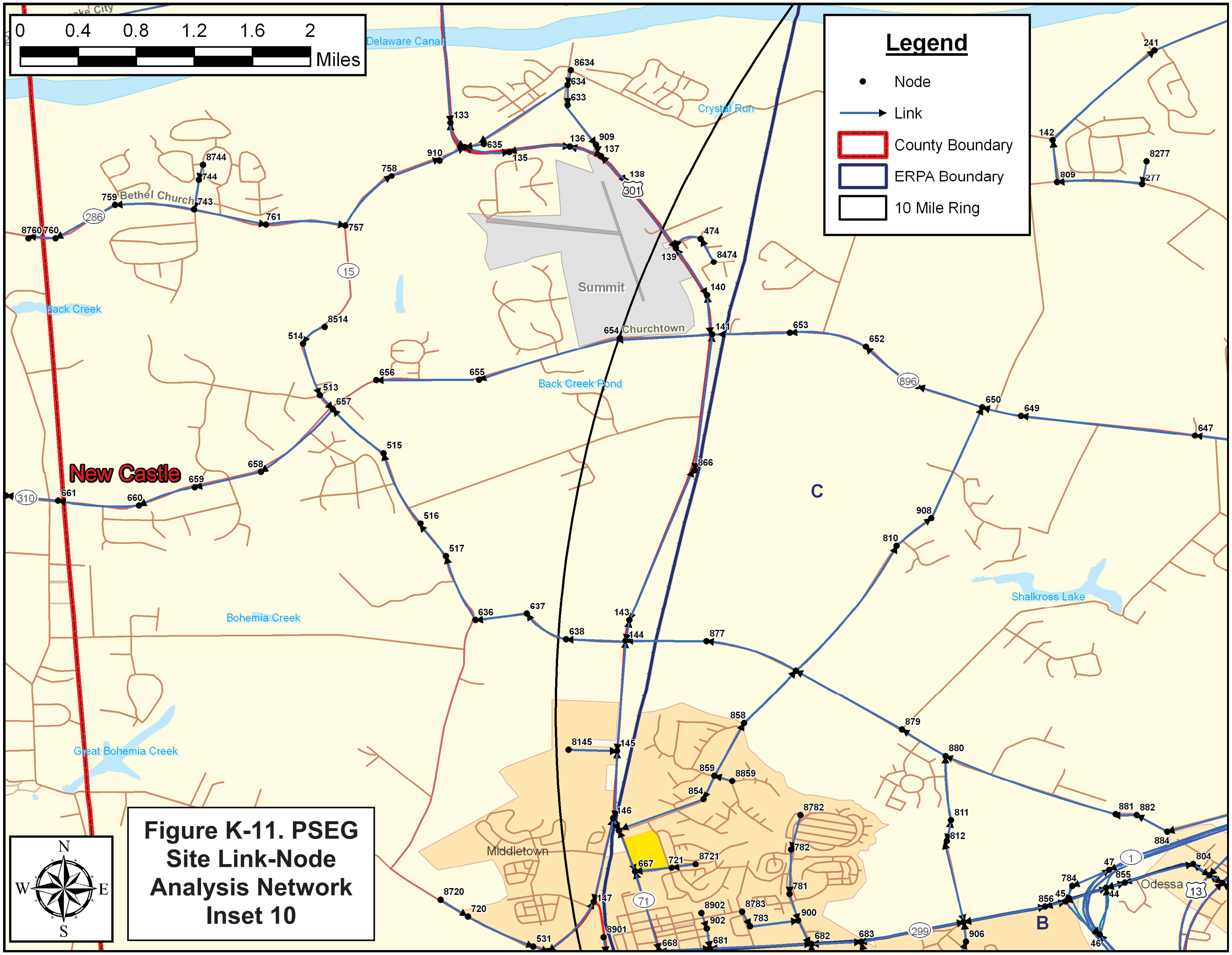


Figure K-11. PSEG Site Link-Node Analysis Network Inset 10

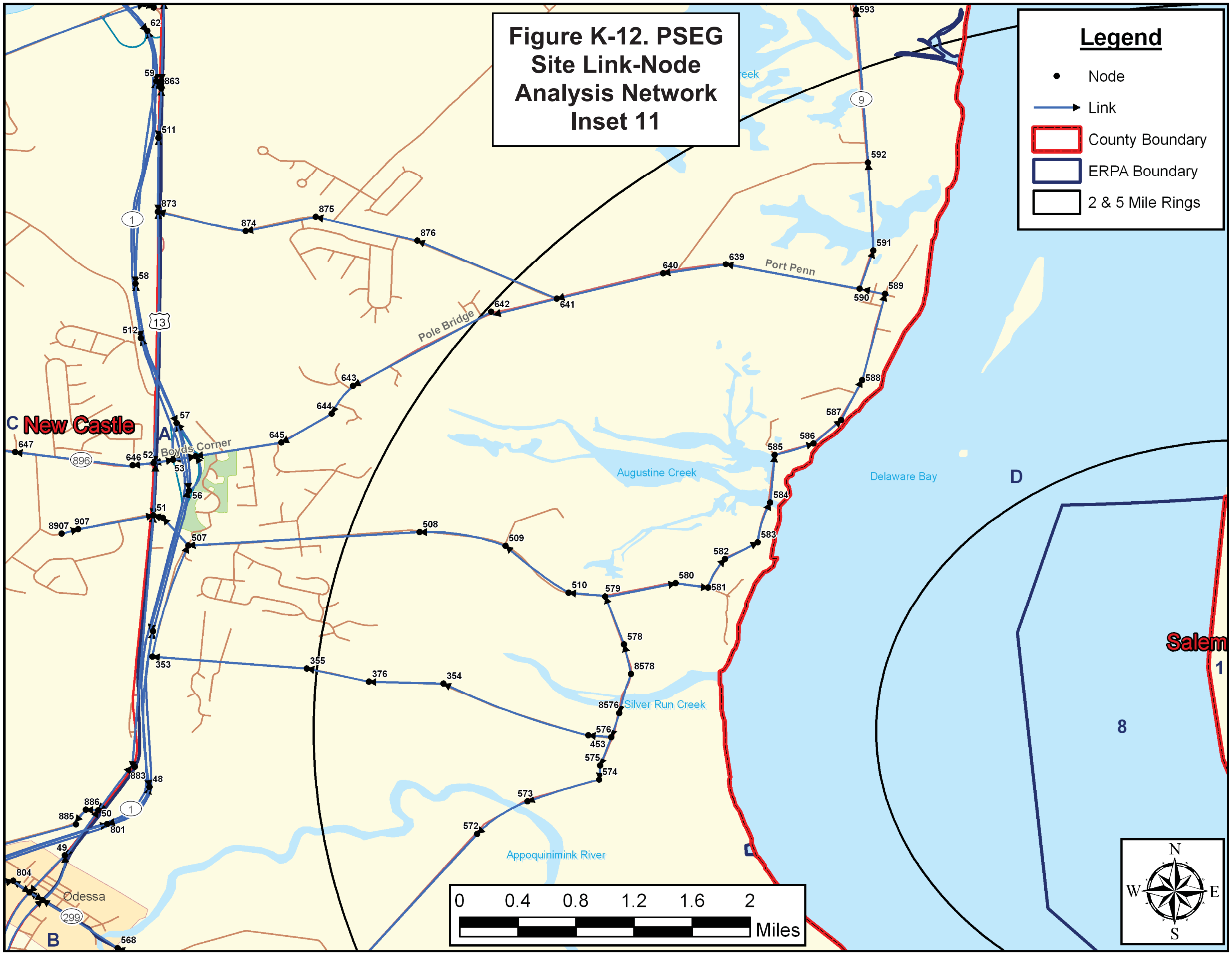


Figure K-12. PSEG Site Link-Node Analysis Network Inset 11

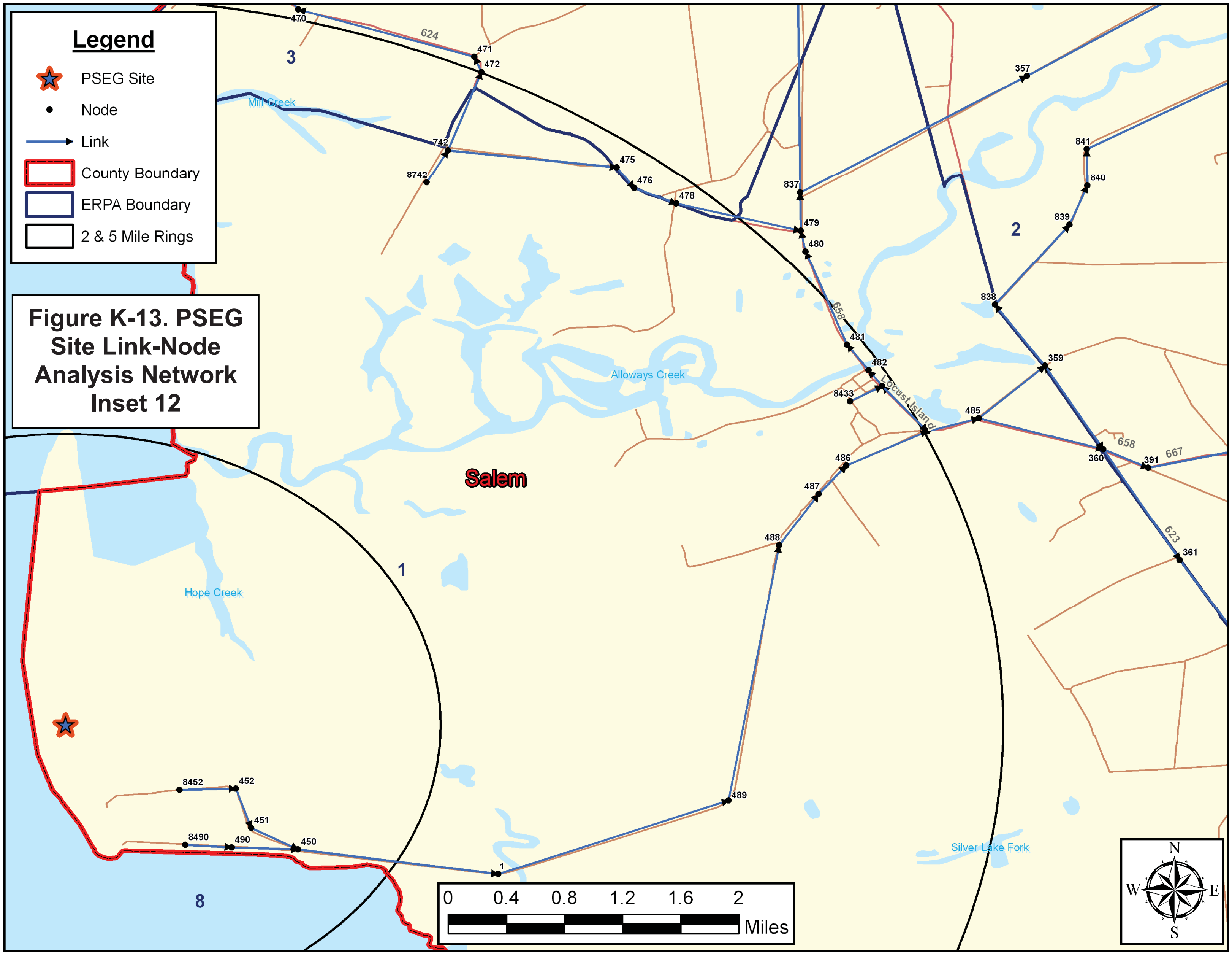


Figure K-13. PSEG Site Link-Node Analysis Network Inset 12

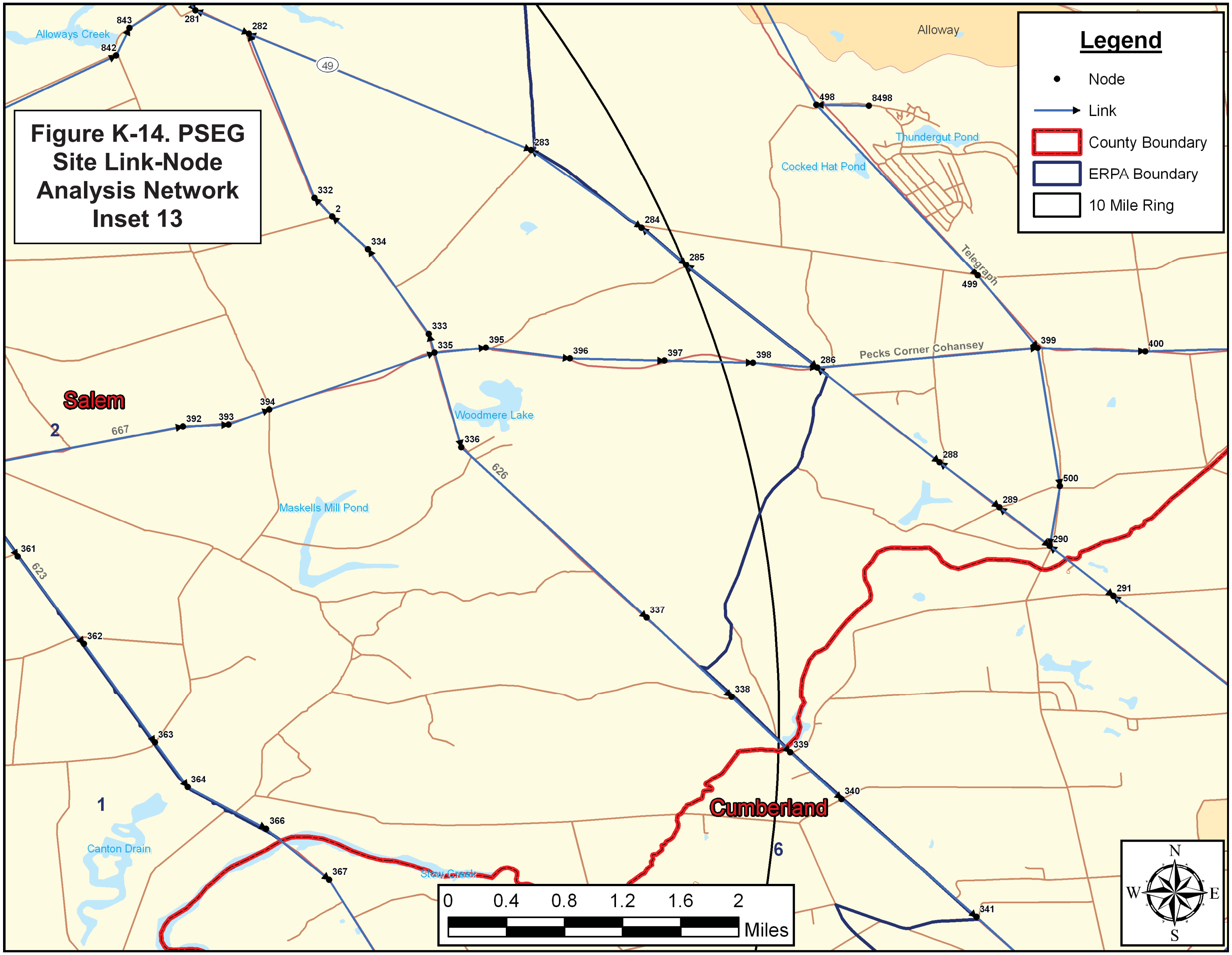


Figure K-14. PSEG Site Link-Node Analysis Network Inset 13
Legend
Node
Link
County Boundary
ERPA Boundary
10 Mile Ring
Salem
Cumberland
Alloways Creek
Alloway
Thundergut Pond
Cocked Hat Pond
Woodmere Lake
Maskells Mill Pond
Canton Drain
Stow Creek
Pecks Corner Cohansey
Telegraph
0 0.4 0.8 1.2 1.6 2
Miles
N
S
E
W

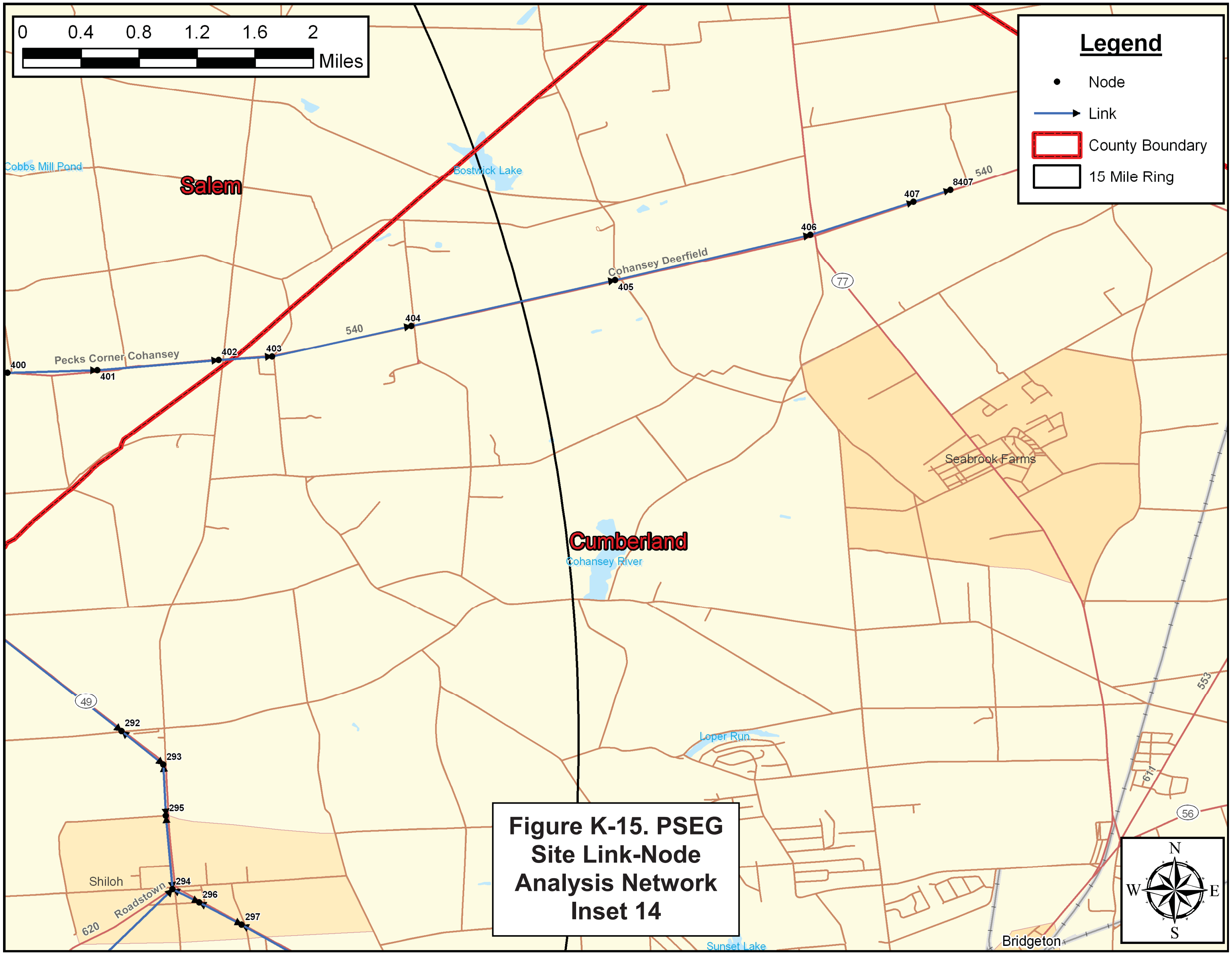


Figure K-15. PSEG Site Link-Node Analysis Network Inset 14

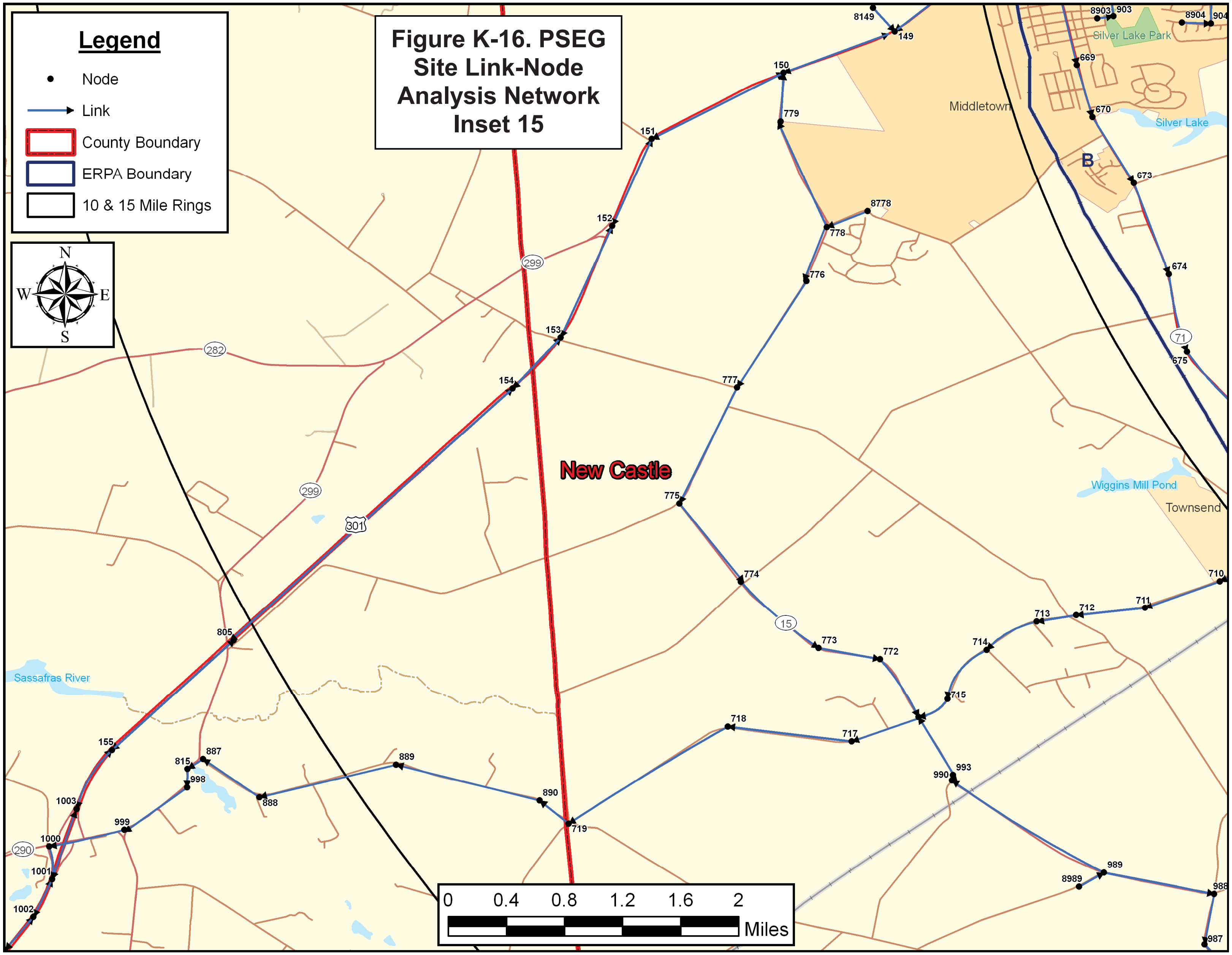


Figure K-16. PSEG Site Link-Node Analysis Network Inset 15
Legend
Node
Link
County Boundary
ERPA Boundary
10 & 15 Mile Rings
N
W
E
S
New Castle
Middletown
Silver Lake Park
Silver Lake
Wiggins Mill Pond
Townsend
Sassafras River
B
0
0.4
0.8
1.2
1.6
2
Miles

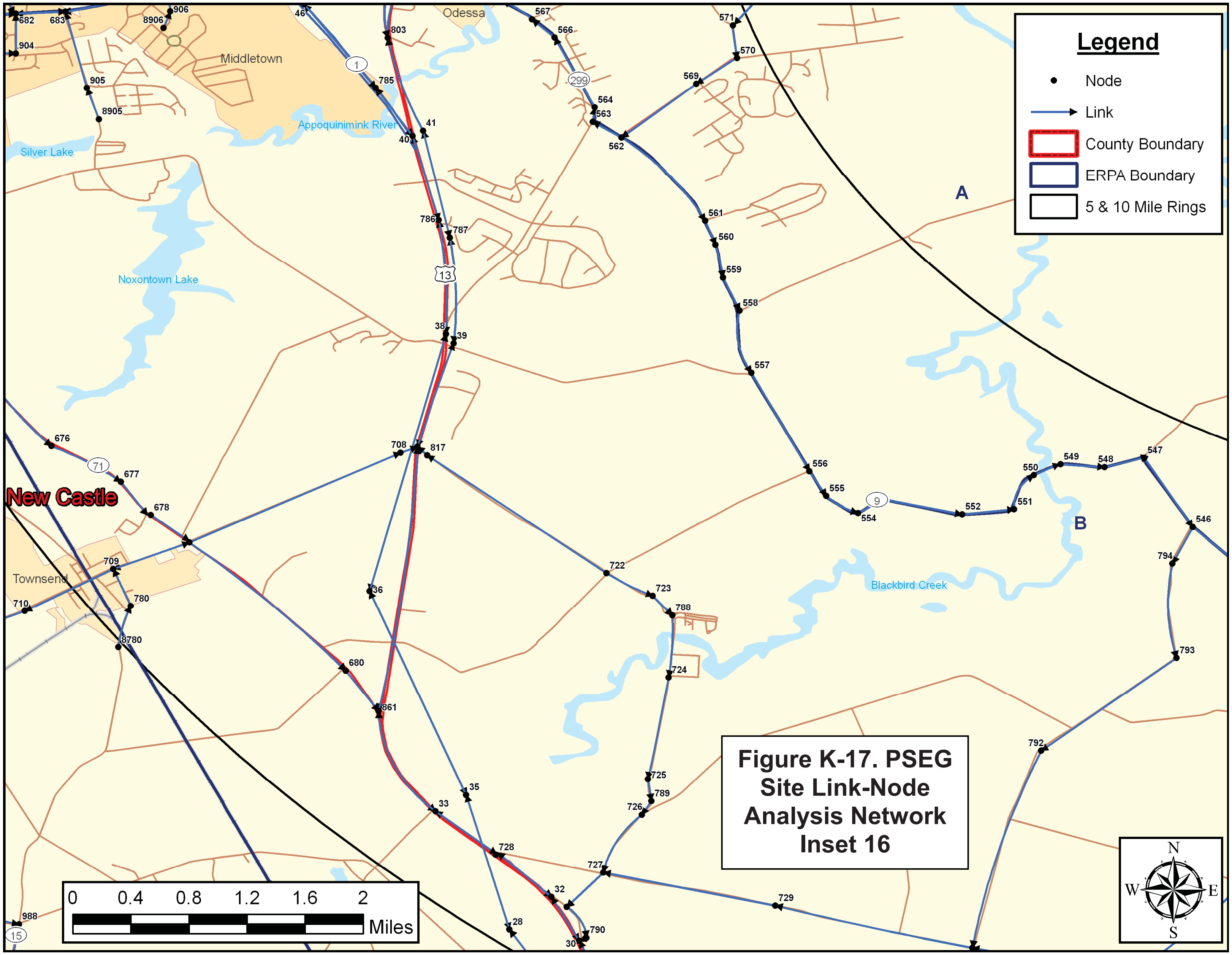


Figure K-17. PSEG Site Link-Node Analysis Network Inset 16

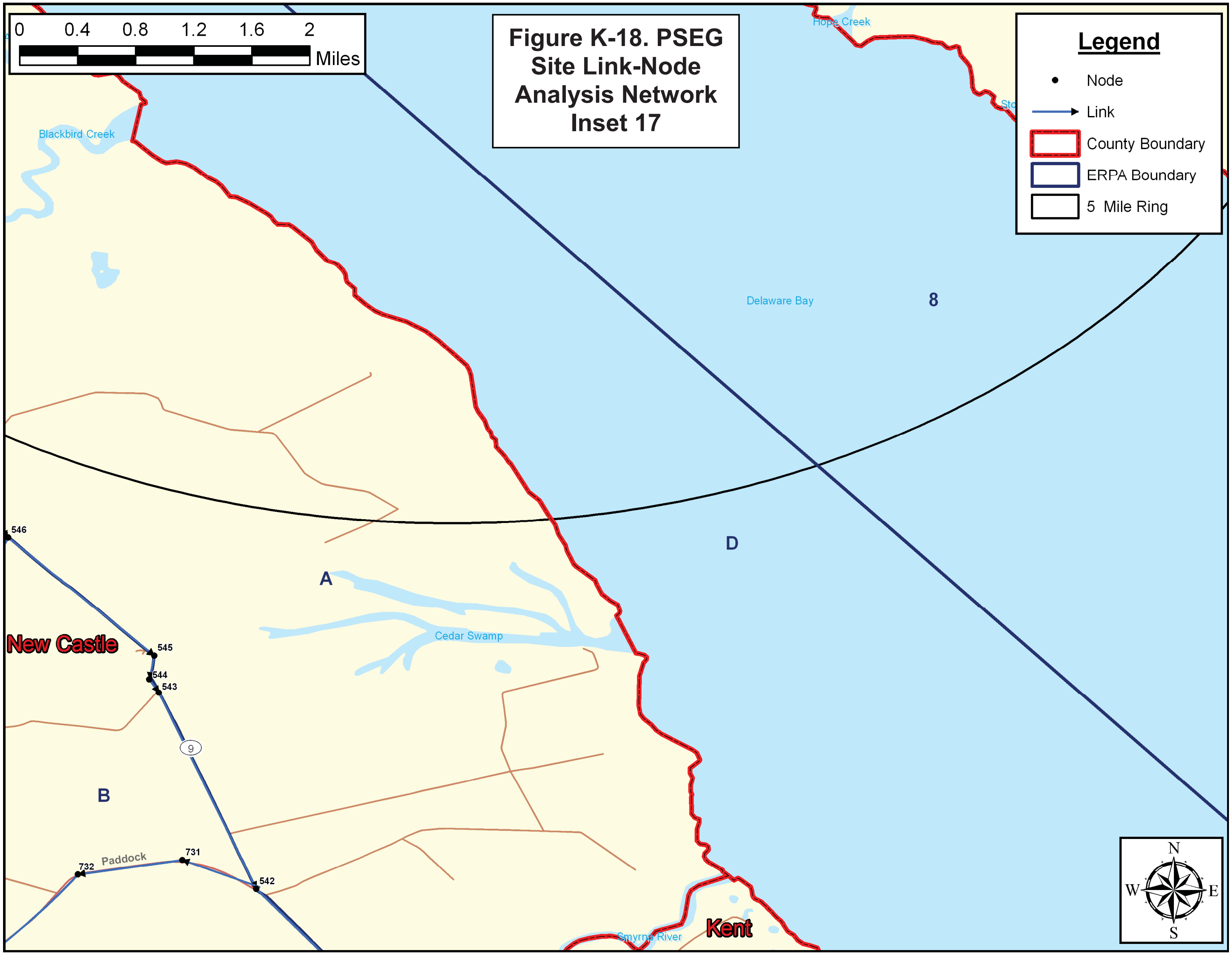


Figure K-18. PSEG Site Link-Node Analysis Network Inset 17
0 0.4 0.8 1.2 1.6 2 Miles
Legend
Node
Link
County Boundary
ERPA Boundary
5 Mile Ring
Hope Creek
Blackbird Creek
Delaware Bay
8
D
A
B
Cedar Swamp
New Castle
Kent
Smyrna River
Paddock
546
545
544
543
542
731
732
9
N
S
E
W

Figure K-19. PSEG Site Link-Node Analysis Network Inset 18

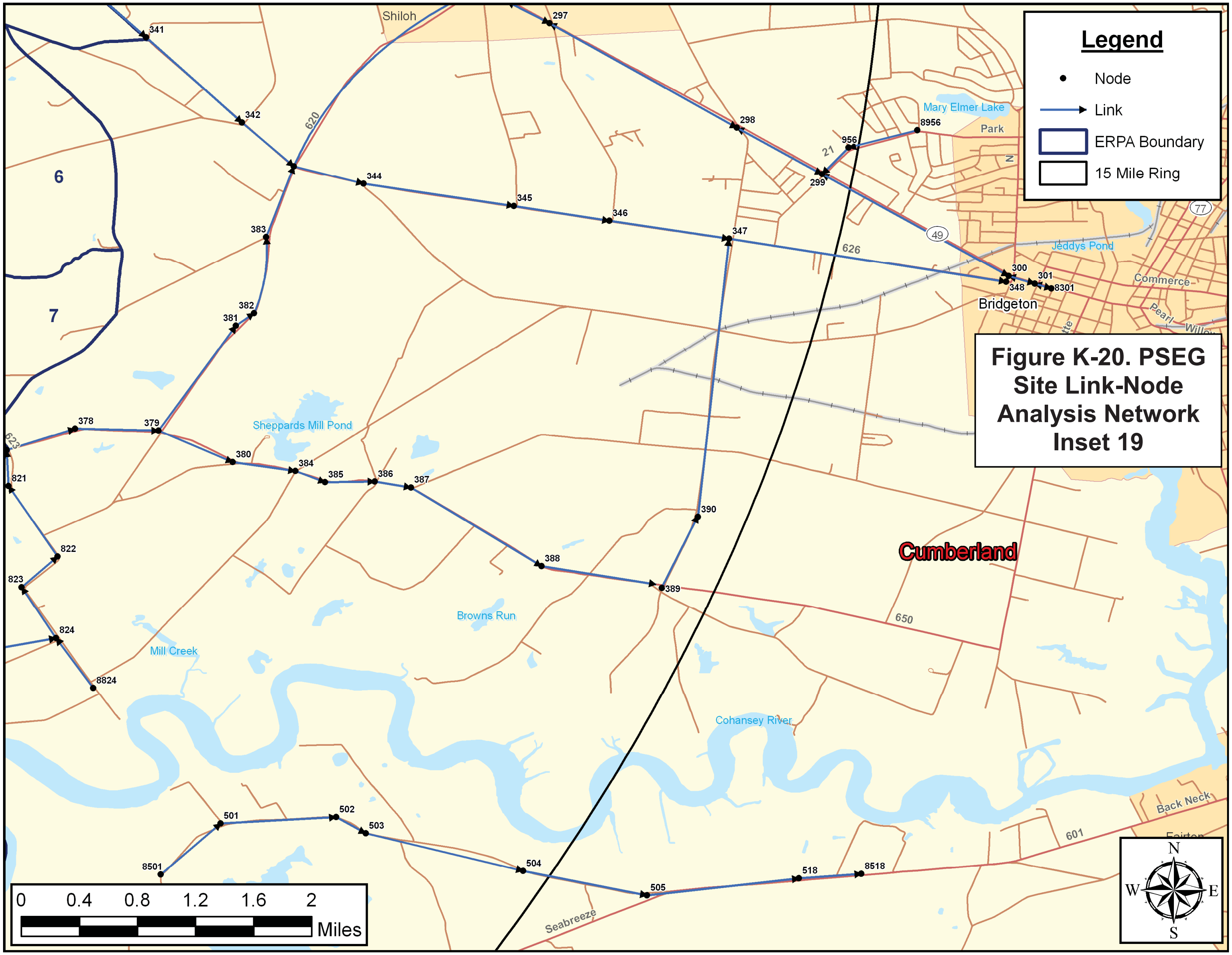


Figure K-20. PSEG Site Link-Node Analysis Network Inset 19

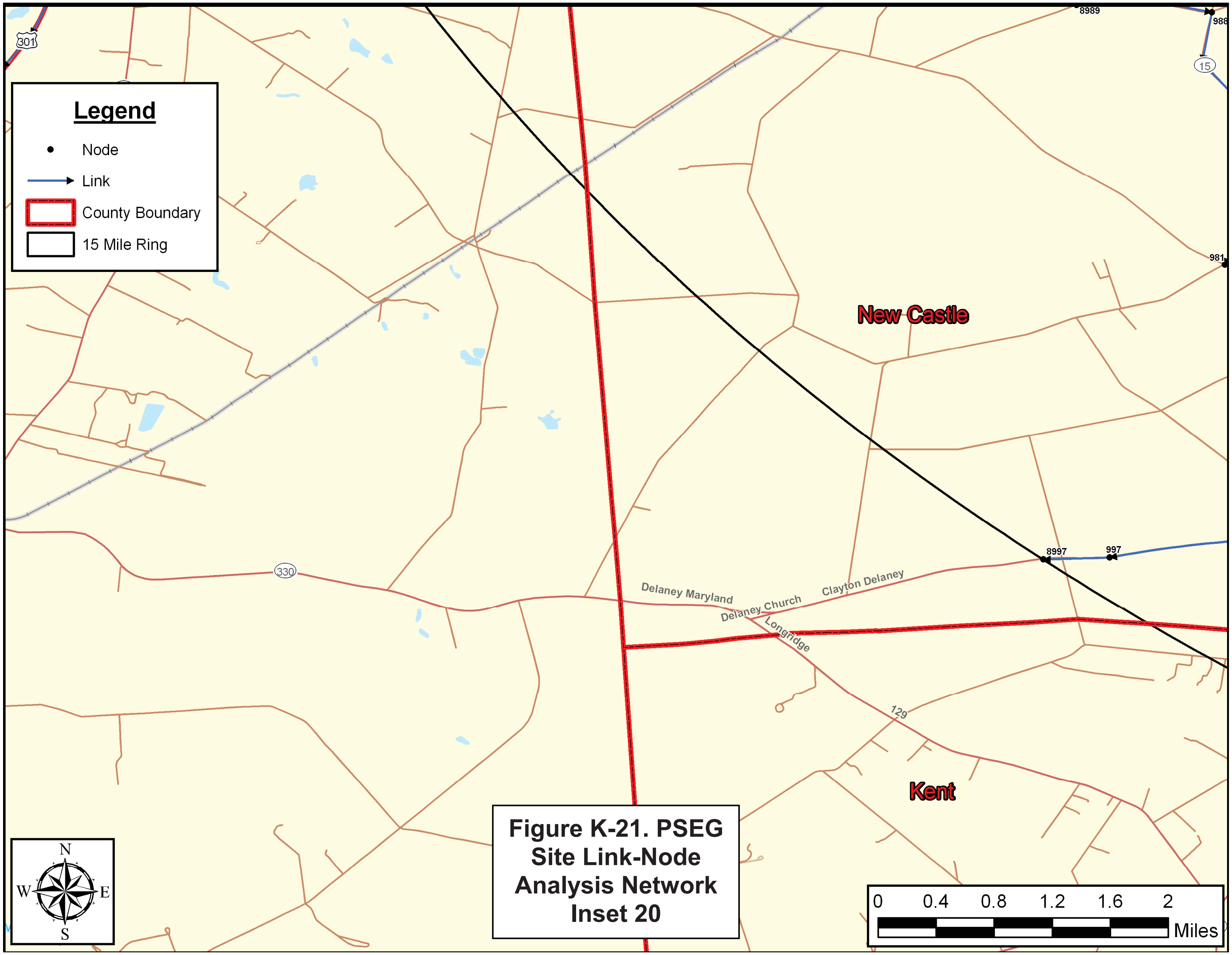


Figure K-21. PSEG Site Link-Node Analysis Network Inset 20

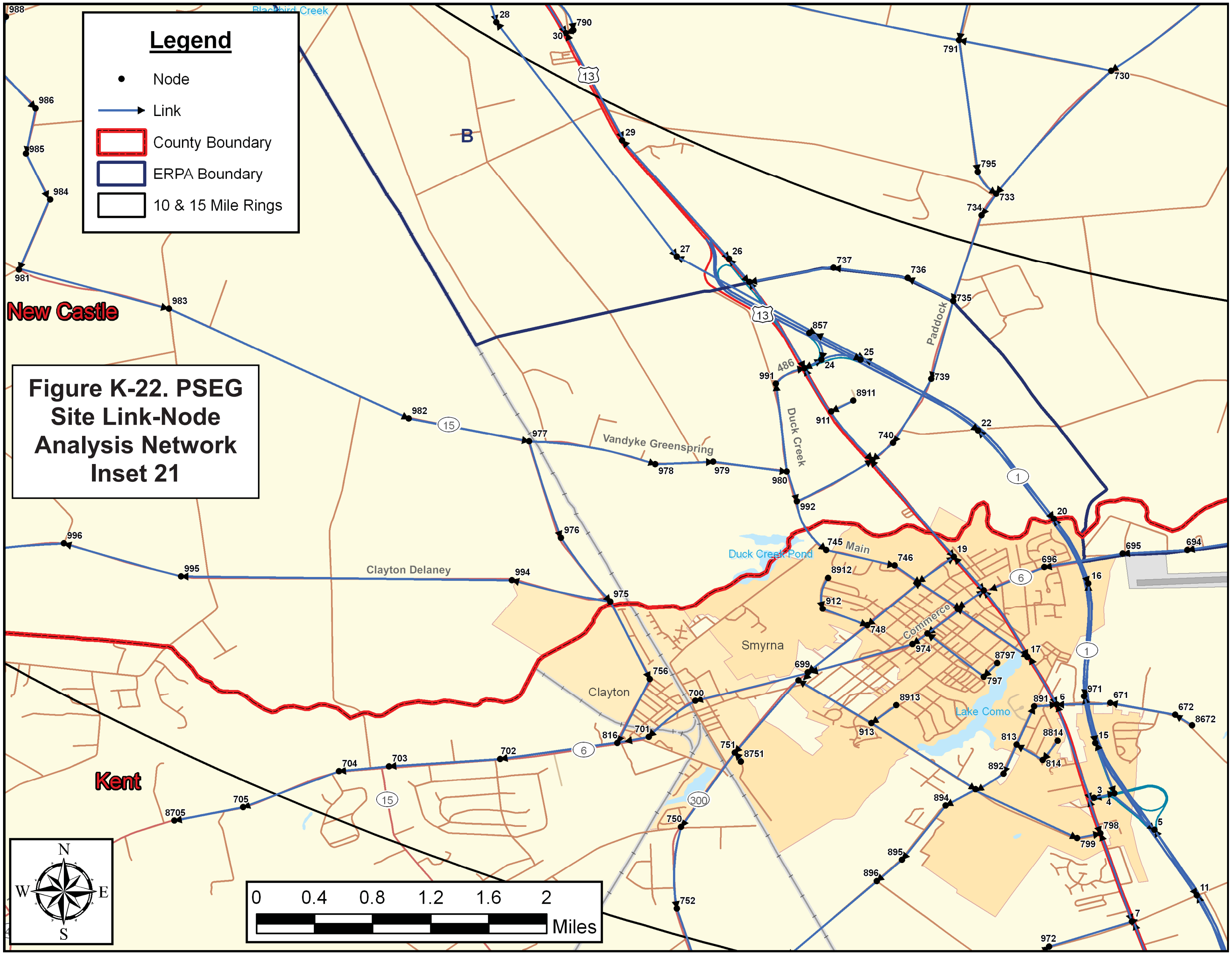


Figure K-22. PSEG Site Link-Node Analysis Network Inset 21

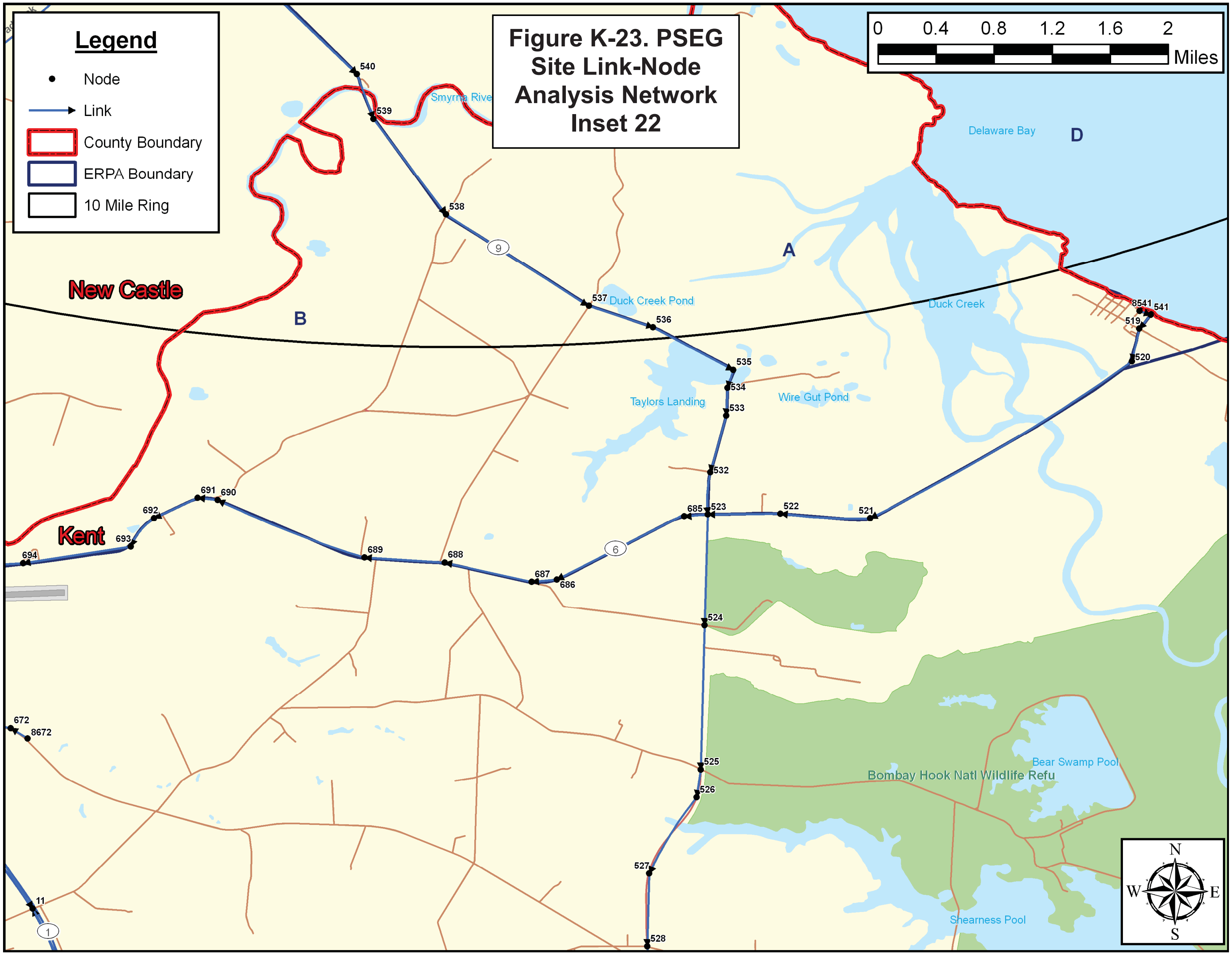


Figure K-23. PSEG Site Link-Node Analysis Network Inset 22
Legend
Node
Link
County Boundary
ERPA Boundary
10 Mile Ring
0 0.4 0.8 1.2 1.6 2 Miles
New Castle
Kent
A
B
D
Delaware Bay
Duck Creek Pond
Duck Creek
Taylors Landing
Wire Gut Pond
Bombay Hook Natl Wildlife Refu
Bear Swamp Pool
Shearness Pool
540
539
538
537
536
535
534
533
532
523
522
521
520
519
8541
541
685
524
525
526
527
528
686
687
688
689
690
691
692
693
694
672
8672
11
9
6
1
N
S
E
W

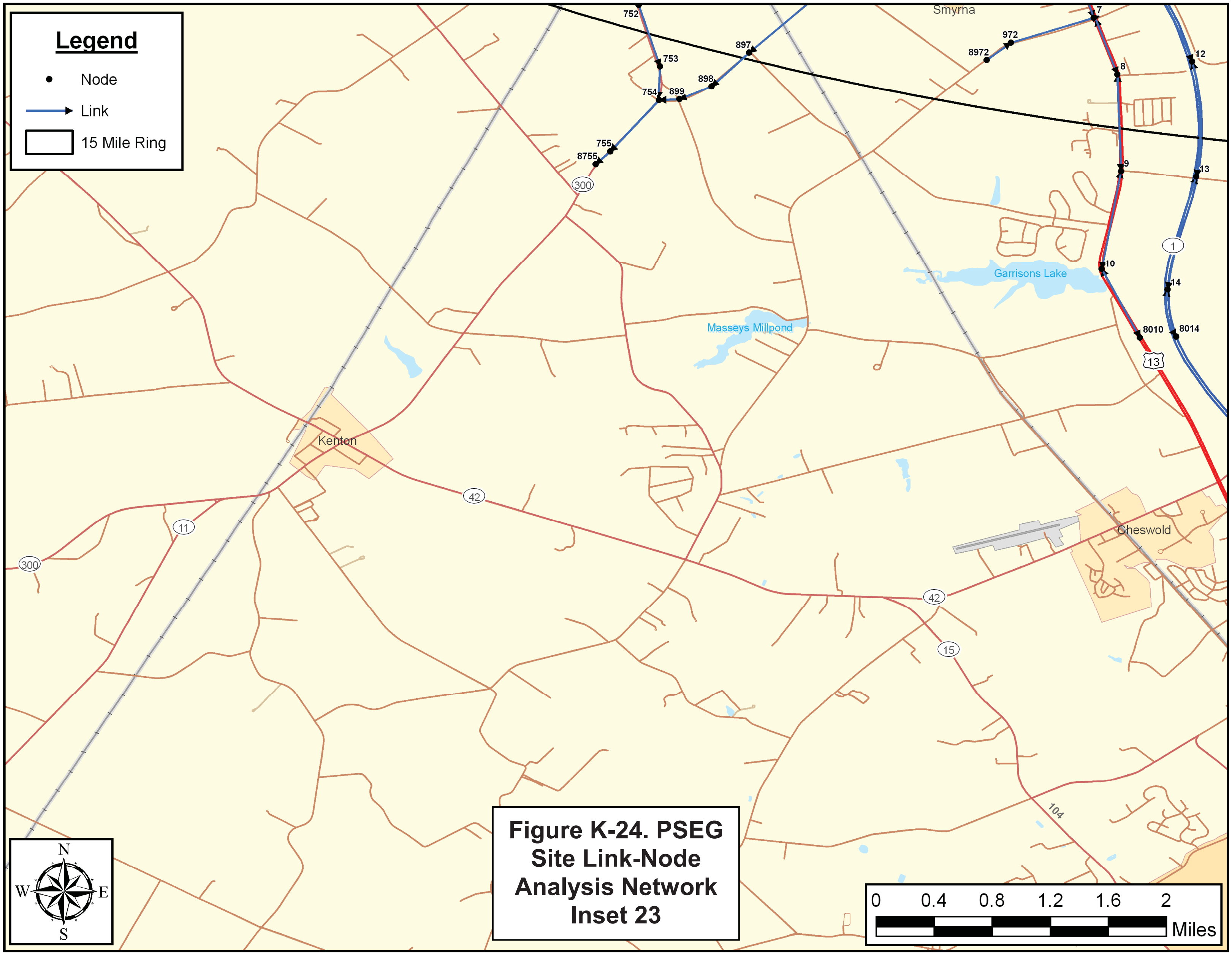


Figure K-24. PSEG Site Link-Node Analysis Network Inset 23

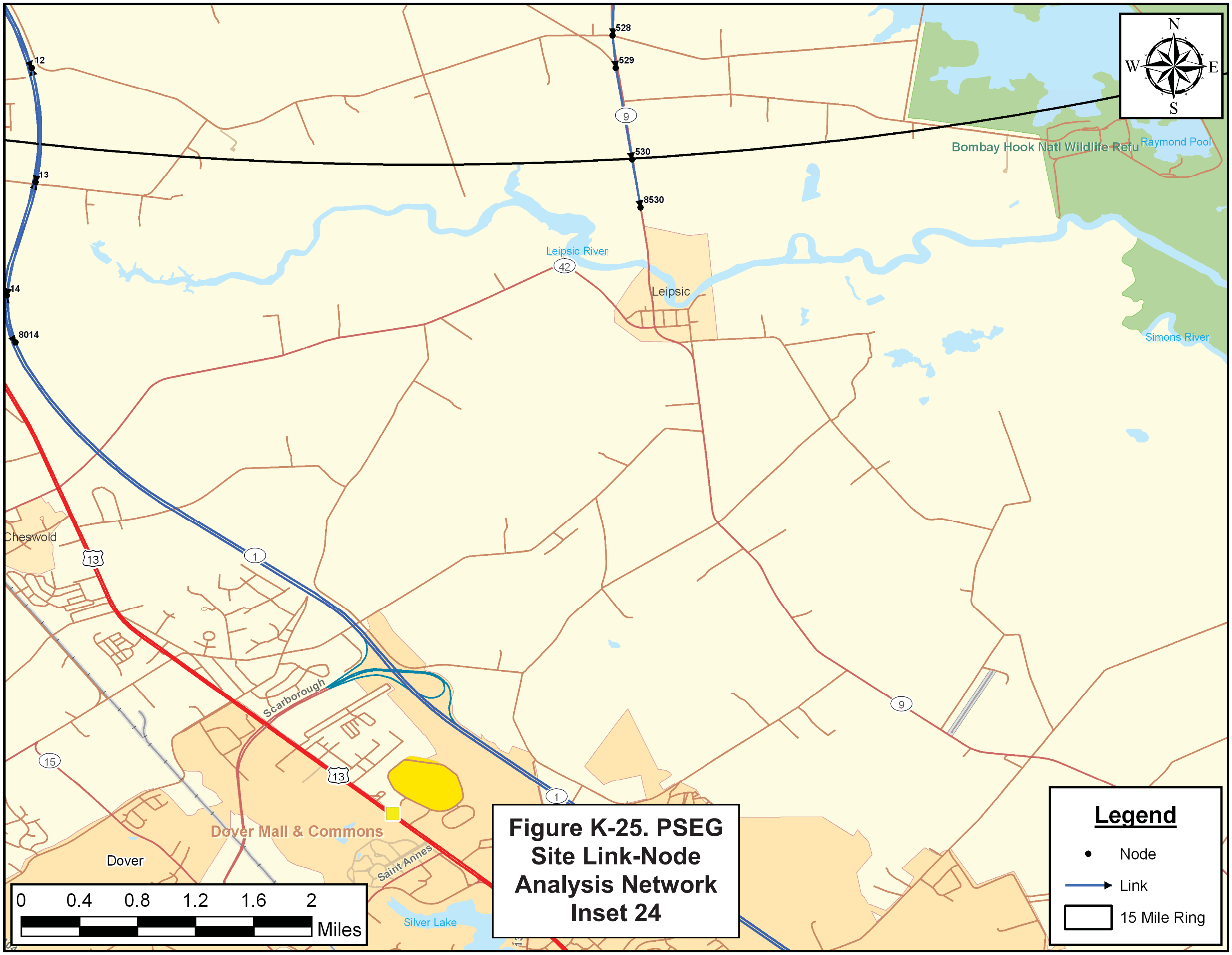


Figure K-25. PSEG Site Link-Node Analysis Network Inset 24

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
1	489	7022.4	1	1700	55
2	332	844.8	1	1700	50
3	4	580.8	1	1700	40
3	6	3590.4	2	1900	50
3	798	1267.2	2	1900	50
4	3	580.8	2	1700	40
4	5	1795.2	1	1700	50
5	11	2692.8	2	2250	60
5	15	3537.6	2	2250	70
6	3	3590.4	2	1900	50
6	17	1900.8	2	1700	35
7	8	2112	2	1900	50
7	798	3273.6	2	1900	50
8	7	2112	2	1900	50
8	9	3484.8	2	1900	50
9	8	3484.8	2	1900	50
9	10	3590.4	2	1900	50
10	9	3590.4	2	1900	50
11	5	2692.8	2	2250	70
11	12	2904	2	2250	70
12	11	2904	2	2250	70
12	13	3960	2	2250	70
13	12	3960	2	2250	70
13	14	4171.2	2	2250	70
14	13	4171.2	2	2250	70
15	4	1900.8	1	1700	40
15	5	3537.6	2	2250	70
15	971	1848	2	2250	75
16	20	2904	2	2250	75
16	971	3960	2	2250	75
17	6	1900.8	2	1900	50
17	18	2692.8	2	1700	35
18	17	2692.8	2	1700	35
18	19	1478.4	2	1700	35
18	973	950.4	1	1500	35
19	18	1478.4	2	1700	35
19	21	4224	2	1900	40
19	747	1372.8	1	1500	35
20	16	2904	2	2250	75

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	**Downstream Node Number**	**Length (Feet)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
20	22	3590.4	2	2250	75
21	19	4224	2	1700	35
21	911	2112	2	1900	50
22	20	3590.4	2	2250	75
22	25	4171.2	2	2250	70
23	24	686.4	1	1700	40
23	738	3537.6	2	1900	60
23	911	1742.4	2	1900	50
24	23	686.4	1	1700	40
24	25	1003.2	1	1700	40
25	22	4171.2	2	2250	75
25	857	1636.8	2	2250	75
26	29	5227.2	2	1900	50
26	738	1056	2	1900	60
27	28	9926.4	2	2250	75
27	857	4804.8	2	2250	75
28	27	9926.4	2	2250	75
28	35	5016	2	2250	75
29	26	5227.2	2	1900	60
29	30	4171.2	2	1900	60
30	29	4171.2	2	1900	50
30	32	1742.4	2	1900	60
31	790	1267.2	1	1500	30
32	30	1742.4	2	1900	60
32	728	2217.6	2	1900	60
33	728	2323.2	2	1900	60
33	861	4065.6	2	1900	60
34	871	1267.2	4	2250	70
34	872	1108.8	4	2250	70
35	28	5016	2	2250	75
35	36	7920	2	2250	75
36	35	7920	2	2250	75
36	38	9556.8	2	2250	75
37	39	4065.6	2	1900	65
37	861	9345.6	2	1900	60
38	36	9556.8	2	2250	75
38	786	4171.2	2	2250	75
39	37	4065.6	2	1900	60
39	787	3854.4	2	1900	65
40	785	2006.4	2	2250	75

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
40	786	3115.2	2	2250	75
41	787	3960	2	1900	65
41	803	3590.4	2	1900	50
42	43	422.4	2	1700	35
42	803	3432	2	1700	35
42	804	739.2	1	1500	30
43	42	422.4	2	1700	35
43	49	1636.8	2	1700	35
44	45	1267.2	2	1700	50
44	47	792	1	1700	50
44	855	422.4	2	1700	50
45	44	1267.2	2	1700	50
45	46	1478.4	1	1700	50
45	856	580.8	2	1700	50
46	44	1689.6	1	1500	30
46	47	2428.8	2	2250	75
46	785	3854.4	2	2250	75
47	46	2428.8	2	2250	75
47	784	897.6	1	1500	30
47	801	5808	2	2250	75
48	55	5649.6	2	2250	75
48	801	1900.8	2	2250	60
49	42	1584	2	1700	35
49	50	1900.8	2	1900	65
50	49	1900.8	2	1900	65
50	883	1848	2	1900	65
50	886	369.6	1	1500	30
51	52	1848	3	1900	65
51	883	9187.2	2	1900	65
52	51	1848	2	1900	65
52	53	528	2	1700	40
52	646	792	2	1700	40
52	873	9187.2	2	1900	65
53	52	528	2	1700	40
53	54	897.6	2	1700	40
54	53	897.6	2	1700	40
54	57	1372.8	1	1700	50
55	48	5649.6	2	2250	75
55	56	5280	2	2250	75
56	54	1320	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
56	55	5280	2	2250	75
56	57	2534.4	2	2250	75
57	53	1478.4	1	1700	40
57	56	2534.4	2	2250	75
57	512	3326.4	2	2250	75
58	59	7339.2	3	2250	75
58	512	1953.6	3	2250	75
59	58	7339.2	3	2250	65
59	62	1953.6	3	2250	75
60	255	369.6	2	2250	60
60	256	475.2	3	2250	60
61	192	1267.2	1	1700	50
62	59	1953.6	3	2250	75
62	800	5808	3	2250	70
63	240	1003.2	2	1700	45
64	65	739.2	2	1900	50
64	862	2904	2	1900	50
65	64	739.2	2	1900	50
65	66	475.2	2	1900	50
66	65	475.2	2	1900	65
66	67	2481.6	1	1700	50
67	66	2481.6	1	1700	50
67	69	1161.6	1	1700	50
68	73	6336	3	2250	70
68	800	1531.2	3	2250	70
69	67	1161.6	1	1700	50
69	771	2112	2	1900	65
70	72	844.8	2	1700	40
70	75	3168	2	1700	60
70	771	5596.8	2	1900	65
71	72	844.8	2	1700	40
71	806	528	2	1700	40
72	70	844.8	2	1700	40
72	71	844.8	2	1700	40
72	74	1214.4	1	1700	50
73	68	6336	3	2250	70
73	72	844.8	1	1700	40
73	74	1900.8	3	2250	70
74	71	1003.2	1	1700	40
74	73	1900.8	3	2250	70

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	**Downstream Node Number**	**Length (Feet)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
74	807	2217.6	3	2250	70
75	70	3168	2	1900	65
75	940	6864	1	1700	50
76	78	2904	2	1700	40
76	808	2534.4	3	2250	70
76	952	1795.2	2	1900	50
77	81	1214.4	2	1900	55
77	82	1108.8	2	1700	40
77	156	4857.6	2	1900	55
78	79	2904	2	1900	50
78	80	1161.6	1	1200	25
79	78	2904	1	1700	40
79	83	4435.2	2	2250	60
79	1025	2640	2	1700	50
80	952	739.2	1	1200	30
81	77	1214.4	2	1900	50
81	865	369.6	1	1500	30
81	952	792	2	1900	50
82	77	1108.8	2	1700	40
82	79	844.8	1	1500	50
83	79	4435.2	2	2250	60
83	85	1848	1	1700	40
83	86	1953.6	2	2250	60
84	85	1267.2	3	1900	50
84	628	1267.2	3	1900	50
85	83	1900.8	1	1200	50
85	84	1267.2	2	1900	50
85	629	1425.6	2	1900	50
86	83	1953.6	2	2250	60
86	84	1372.8	1	1700	40
86	87	3432	2	2250	60
87	86	3432	2	2250	60
87	88	4171.2	2	2250	60
88	87	4171.2	2	2250	60
88	89	1214.4	2	2250	60
88	91	844.8	1	1700	40
89	88	1214.4	2	2250	60
89	92	2956.8	3	2250	60
89	1044	686.4	1	1700	40
90	957	1953.6	2	1900	50

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	**Downstream Node Number**	**Length (Feet)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
90	1040	1214.4	1	1700	40
90	1044	475.2	2	1900	50
91	89	686.4	1	1700	50
91	964	686.4	2	1900	50
91	1044	686.4	2	1900	50
92	89	2956.8	3	2250	60
92	93	1320	1	1700	40
92	97	1003.2	2	2250	60
93	94	1372.8	1	1700	40
93	96	686.4	1	1200	25
94	93	1372.8	1	1700	40
94	1043	528	1	1700	40
95	94	792	1	1700	40
96	97	633.6	1	1200	50
97	92	1003.2	2	2250	60
97	95	475.2	1	1200	20
97	1074	2112	2	2250	60
98	103	1742.4	2	2250	60
98	106	1056	1	1700	40
98	1074	686.4	3	2250	60
99	103	1214.4	2	2250	60
99	111	792	2	1500	50
100	105	528	4	2250	70
100	110	2640	4	2250	70
101	105	1584	4	2250	70
101	112	2692.8	4	2250	70
103	98	1742.4	2	2250	60
103	99	1214.4	2	2250	60
103	109	739.2	1	1200	20
105	100	528	4	2250	70
105	101	1584	4	2250	70
106	100	897.6	1	1700	50
109	105	844.8	1	1700	50
110	100	2640	4	2250	70
110	200	8659.2	4	2250	60
111	99	792	2	2250	60
112	101	2692.8	4	2250	70
112	872	1372.8	4	2250	70
113	114	316.8	1	1700	40
113	117	2059.2	2	1900	50

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
113	119	1003.2	2	1500	50
114	115	633.6	1	1700	50
115	116	1795.2	4	2250	70
115	224	2270.4	4	2250	70
116	115	1795.2	4	2250	70
116	223	1161.6	4	2250	70
117	113	2112	2	1900	50
117	116	1320	1	1700	50
117	120	2745.6	2	1900	50
119	113	1003.2	2	1500	50
120	117	2745.6	2	1900	50
120	121	1795.2	2	1900	50
120	921	1267.2	1	1700	40
120	922	2376	1	1700	40
121	120	1795.2	2	1900	50
121	122	2112	2	1900	60
122	121	2112	2	1900	50
122	123	3484.8	2	1900	60
123	122	3484.8	2	1900	60
123	124	1900.8	2	1900	60
124	123	1900.8	2	1900	60
124	1032	950.4	2	1900	60
125	126	1848	3	1900	60
125	618	3220.8	2	1900	50
125	632	1056	2	1500	50
125	1032	1108.8	3	1900	60
126	125	1848	3	1900	50
126	1029	1320	2	1900	60
127	128	2481.6	2	1900	55
127	1029	1584	2	1900	60
128	127	2481.6	2	1900	60
128	129	5755.2	2	1900	55
129	128	5755.2	2	1900	55
129	130	580.8	2	1900	55
130	129	580.8	2	1900	55
130	131	4382.4	2	1900	55
131	130	4382.4	2	1900	55
131	132	2376	2	1900	55
132	131	2376	2	1900	55
132	133	7075.2	2	1900	55

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
133	132	7075.2	2	1900	55
133	134	950.4	2	1900	50
134	133	950.4	2	1900	50
134	135	1161.6	2	1900	50
135	134	1161.6	2	1900	50
135	136	1689.6	2	1900	50
136	135	1689.6	2	1900	50
136	137	950.4	2	1900	50
137	136	950.4	2	1900	50
137	138	1320	2	1900	50
138	137	1320	2	1900	50
138	139	2798.4	2	1900	60
139	138	2798.4	2	1900	60
139	140	1953.6	2	1900	60
140	139	1953.6	2	1900	60
140	141	1425.6	2	1900	60
141	140	1425.6	2	1900	60
141	654	2904	1	1700	45
141	866	4963.2	1	1700	60
142	241	4329.6	1	1700	40
143	144	792	1	1700	40
143	866	5755.2	1	1700	60
144	143	792	1	1700	40
144	145	4012.8	1	1700	40
144	638	1900.8	1	1700	40
145	144	4012.8	1	1700	40
145	146	2428.8	1	1700	35
146	145	2428.8	1	1700	40
146	147	3062.4	2	1700	40
146	867	475.2	1	1700	30
147	146	3062.4	2	1700	35
147	148	2270.4	2	1700	40
148	147	2270.4	2	1700	40
148	149	2270.4	2	1700	40
149	148	2270.4	2	1700	40
149	150	3273.6	2	1700	40
150	149	3273.6	2	1700	40
150	151	4435.2	1	1700	50
151	150	4435.2	1	1700	50
151	152	3326.4	1	1700	50

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
152	151	3326.4	1	1700	50
152	153	4329.6	1	1700	60
153	152	4329.6	1	1700	60
153	154	2323.2	1	1700	60
154	153	2323.2	1	1700	60
154	805	12144	2	1900	65
155	805	5280	2	1900	65
155	1003	2323.2	2	1900	65
156	77	4857.6	2	1900	50
156	157	2059.2	2	1900	55
157	156	2059.2	2	1900	55
157	158	1636.8	2	1900	55
158	157	1636.8	2	1900	55
158	159	3168	2	1900	55
159	158	3168	2	1900	55
159	160	1372.8	2	1900	50
160	159	1372.8	2	1900	55
160	161	1108.8	4	1500	50
160	631	1108.8	2	1900	50
161	160	1108.8	4	1900	50
161	162	1531.2	4	1500	50
162	161	1531.2	4	1500	50
162	163	1478.4	4	1500	50
163	162	1478.4	4	1500	50
163	164	2376	4	1900	50
164	163	2376	4	1900	50
164	165	3432	4	1900	50
164	944	1900.8	2	1900	50
164	945	1742.4	2	1700	40
165	164	3432	4	1900	50
165	168	1636.8	4	1900	50
166	167	1161.6	3	1900	50
166	168	1108.8	3	1900	50
167	166	1161.6	3	1900	50
167	185	528	3	1900	50
168	165	1636.8	4	1900	50
168	166	1108.8	3	1900	50
169	167	1003.2	1	1700	40
169	220	2270.4	2	1200	40
170	169	6177.6	2	1200	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
170	171	2376	1	1700	30
170	172	2112	1	1500	35
170	187	2428.8	1	1700	40
171	170	2376	1	1500	35
171	969	1372.8	1	1500	30
172	173	792	1	1200	30
173	611	1425.6	1	1700	40
174	175	1003.2	3	1900	50
174	177	1531.2	4	1900	50
175	174	1003.2	3	1900	50
175	176	580.8	3	1900	50
176	175	580.8	3	1900	50
176	185	1584	4	1900	50
177	174	1531.2	3	1900	50
177	178	844.8	2	1700	40
177	186	2164.8	2	1900	50
178	180	1636.8	1	1700	50
178	181	1320	1	1200	25
179	180	2217.6	4	2250	60
179	225	1689.6	4	2250	60
180	179	2217.6	4	2250	60
180	182	1056	2	2250	60
181	182	897.6	1	1500	50
182	180	1056	2	2250	60
182	184	1742.4	4	2250	60
183	184	1372.8	3	2250	60
183	190	1056	4	2250	60
184	182	1742.4	2	2250	60
184	183	1372.8	4	2250	60
185	167	528	3	1900	50
185	176	1584	3	1900	50
186	177	2164.8	3	1900	50
186	818	2851.2	3	1200	50
187	170	2428.8	1	1500	35
187	945	2956.8	1	1700	40
188	944	792	2	1700	40
189	185	633.6	1	1700	30
190	1075	897.6	2	1900	50
190	1076	1584	3	2250	60
191	183	1056	4	2250	60

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
192	230	1003.2	3	2250	60
192	237	369.6	4	2250	60
193	199	475.2	3	2250	60
193	1077	1161.6	2	1900	50
194	216	2006.4	3	2250	60
194	218	1267.2	2	1900	50
195	222	2217.6	3	2250	65
195	1078	1478.4	3	2250	60
195	1081	1795.2	1	1700	40
196	221	844.8	3	2250	60
196	1079	422.4	1	1700	50
196	1080	1900.8	2	2250	60
197	205	2481.6	2	2250	60
198	191	2587.2	2	2250	60
199	195	3484.8	3	2250	60
200	110	8659.2	4	2250	70
200	202	1742.4	4	2250	60
201	203	950.4	2	1900	50
202	210	2428.8	3	2250	70
202	211	1425.6	2	2250	60
203	204	2164.8	2	1900	50
204	207	1425.6	2	1900	50
204	213	528	1	1200	20
205	191	844.8	1	1700	60
206	216	1900.8	2	1900	50
207	215	1003.2	1	1200	20
207	217	422.4	2	1900	50
209	193	2481.6	4	2250	60
210	209	1953.6	4	2250	60
211	212	1848	2	2250	60
212	198	897.6	2	2250	60
213	210	686.4	1	1200	50
214	219	1372.8	1	1700	50
215	214	1848	2	1900	50
216	219	2904	5	2250	60
217	208	1161.6	2	2250	60
218	215	422.4	1	1700	50
218	217	1214.4	1	1700	50
219	200	1795.2	5	2250	60
220	201	3801.6	2	1200	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
221	196	844.8	3	2250	60
222	195	2217.6	3	2250	60
223	116	1161.6	4	2250	70
223	868	9979.2	4	2250	70
224	115	2270.4	4	2250	70
225	179	1689.6	4	2250	60
225	226	2323.2	4	2250	60
226	225	2323.2	4	2250	60
226	231	2851.2	4	2250	70
227	247	897.6	1	1700	50
228	236	422.4	1	1500	40
229	230	422.4	1	1500	40
230	192	1003.2	3	2250	60
230	247	1214.4	3	2250	60
231	226	2851.2	4	2250	60
231	802	5808	4	2250	70
232	233	2376	4	2250	70
232	802	4752	4	2250	70
233	232	2376	4	2250	70
233	236	1161.6	4	2250	60
234	63	950.4	1	1700	40
234	235	1214.4	1	1700	35
234	238	475.2	1	1700	35
235	228	422.4	1	1200	25
235	233	1108.8	1	1700	50
235	234	1214.4	1	1700	35
235	258	2481.6	1	1700	40
236	63	633.6	2	1700	40
236	233	1161.6	4	2250	60
236	237	1108.8	3	2250	60
237	192	369.6	2	2250	60
237	236	1108.8	4	2250	60
238	61	1161.6	1	1700	40
238	234	475.2	1	1700	35
238	259	3379.2	1	1700	35
239	242	844.8	1	1700	40
240	242	792	2	1700	45
241	244	5121.6	1	1700	40
242	243	1056	3	2250	60
243	229	528	1	1200	20

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	**Downstream Node Number**	**Length (Feet)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
243	256	1056	3	2250	60
244	267	475.2	1	1500	30
245	246	1214.4	2	2250	60
245	255	792	2	2250	60
246	245	1214.4	2	2250	60
247	230	1214.4	2	2250	60
247	248	2059.2	2	2250	60
247	287	897.6	1	1700	40
248	247	2059.2	2	2250	60
248	249	1900.8	2	2250	65
249	248	1900.8	2	2250	60
250	251	739.2	1	1700	40
250	287	316.8	1	1700	40
251	227	369.6	1	1200	25
251	250	739.2	1	1700	40
251	257	844.8	1	1700	30
252	256	422.4	1	1500	40
253	254	422.4	1	1200	25
253	257	633.6	1	1700	30
253	258	2217.6	1	1700	40
254	60	528	1	1500	40
255	60	369.6	2	2250	60
255	245	792	2	2250	60
256	60	475.2	3	2250	60
256	192	2112	2	1700	50
257	251	844.8	1	1700	40
257	252	475.2	1	1200	25
257	253	633.6	1	1700	40
257	255	633.6	1	1700	40
258	235	2481.6	1	1700	35
258	253	2217.6	1	1700	40
258	835	1478.4	1	1700	45
259	238	3379.2	1	1700	35
259	260	1372.8	1	1700	35
260	259	1372.8	1	1700	35
260	261	1953.6	1	1700	35
261	260	1953.6	1	1700	35
261	262	4488	1	1700	40
262	261	4488	1	1700	35
262	263	2481.6	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
263	262	2481.6	1	1700	40
263	264	3432	1	1700	40
264	263	3432	1	1700	40
264	265	10032	1	1700	45
265	264	10032	1	1700	40
265	266	4276.8	1	1700	45
265	463	3220.8	1	1700	55
266	265	4276.8	1	1700	45
266	268	3907.2	1	1700	55
267	302	792	1	1200	20
268	266	3907.2	1	1700	55
268	269	2323.2	1	1700	55
269	268	2323.2	1	1700	55
269	270	2006.4	1	1700	55
270	269	2006.4	1	1700	55
270	271	3062.4	1	1700	40
271	270	3062.4	1	1700	55
271	272	1056	1	1500	35
271	274	3009.6	1	1700	30
272	271	1056	1	1700	35
272	446	1372.8	1	1700	35
272	833	1848	1	1500	25
273	274	897.6	1	1500	30
273	275	528	1	1500	30
273	445	528	1	1500	25
274	271	3009.6	1	1700	30
274	273	897.6	1	1500	25
274	304	2376	1	1700	40
275	273	528	1	1500	25
275	276	3062.4	1	1500	25
276	275	3062.4	1	1500	30
276	820	5596.8	1	1700	45
277	809	2376	1	1700	40
278	279	1372.8	1	1700	40
278	820	6652.8	1	1700	55
279	278	1372.8	1	1700	55
279	280	633.6	1	1700	35
279	458	9451.2	1	1700	50
280	279	633.6	1	1700	40
280	408	686.4	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	**Downstream Node Number**	**Length (Feet)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
280	844	950.4	1	1700	35
281	282	1742.4	1	1700	55
281	844	686.4	1	1700	35
282	281	1742.4	1	1700	35
282	283	8976	1	1700	55
283	282	8976	1	1700	55
283	284	4171.2	1	1700	55
284	283	4171.2	1	1700	55
284	285	1848	1	1700	55
285	284	1848	1	1700	55
285	286	5227.2	1	1700	55
286	285	5227.2	1	1700	55
286	288	4857.6	1	1700	55
286	399	6230.4	1	1700	50
287	250	316.8	1	1700	40
287	845	422.4	2	1700	40
288	286	4857.6	1	1700	55
288	289	2323.2	1	1700	55
289	288	2323.2	1	1700	55
289	290	2006.4	1	1700	55
290	289	2006.4	1	1700	55
290	291	2534.4	1	1700	55
291	290	2534.4	1	1700	55
291	292	5808	1	1700	55
292	291	5808	1	1700	55
292	293	1689.6	1	1700	55
293	292	1689.6	1	1700	55
293	295	1848	1	1700	45
294	295	2692.8	1	1700	40
294	296	897.6	1	1700	40
295	293	1848	1	1700	40
295	294	2692.8	1	1700	35
296	294	897.6	1	1700	35
296	297	1425.6	1	1700	40
297	296	1425.6	1	1700	40
297	298	6494.4	1	1700	55
298	297	6494.4	1	1700	40
298	299	2904	1	1700	45
299	298	2904	1	1700	55
299	300	6441.6	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
300	299	6441.6	1	1700	45
300	301	792	2	1500	30
301	300	792	2	1500	30
302	303	264	1	1200	20
303	309	739.2	1	1200	20
304	274	2376	1	1700	30
304	819	6441.6	1	1700	50
305	307	686.4	1	1700	40
305	819	950.4	2	1700	50
306	324	8025.6	1	1700	55
307	305	686.4	1	1700	50
307	308	369.6	2	1700	40
307	310	9662.4	1	1700	50
308	306	369.6	2	1700	40
308	314	5544	1	1700	50
309	64	264	1	1200	20
310	307	9662.4	1	1700	40
310	311	1161.6	1	1700	50
311	310	1161.6	1	1700	50
311	312	13147.2	1	1700	50
312	311	13147.2	1	1700	50
312	313	11088	1	1700	40
313	312	11088	1	1700	50
313	319	8448	1	1700	40
313	321	3484.8	1	1700	30
314	315	3115.2	1	1700	50
315	316	12777.6	1	1700	50
316	317	4910.4	1	1700	50
317	318	3432	1	1700	50
318	319	2112	1	1700	40
319	313	8448	1	1700	40
319	320	2428.8	1	1700	40
319	850	1531.2	1	1700	40
321	313	3484.8	1	1700	40
321	322	2534.4	1	1700	35
322	321	2534.4	1	1700	30
322	436	2692.8	1	1700	40
323	846	950.4	2	1900	60
323	847	2481.6	2	1900	60
324	325	1478.4	1	1700	55

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
325	853	5808	1	1700	55
326	329	4276.8	1	1700	40
326	852	792	1	1700	55
327	328	2112	1	1700	50
328	287	3643.2	1	1700	50
329	330	7920	1	1700	55
330	331	4488	1	1700	55
331	358	3537.6	1	1700	55
331	849	5174.4	1	1700	55
331	850	9556.8	1	1700	55
332	282	6230.4	1	1700	50
333	334	3537.6	1	1700	55
334	2	1531.2	1	1700	55
335	333	686.4	1	1700	55
335	336	3537.6	1	1700	40
335	395	1478.4	1	1700	50
336	337	8078.4	1	1700	55
337	338	3748.8	1	1700	55
338	339	2587.2	1	1700	55
339	340	2217.6	1	1700	55
340	341	5702.4	1	1700	60
341	342	4118.4	1	1700	60
342	343	2164.8	1	1700	50
343	294	8553.6	1	1700	35
343	344	2059.2	1	1700	50
344	345	4329.6	1	1700	50
345	346	2745.6	1	1700	50
346	347	3432	1	1700	50
347	348	7972.8	1	1700	40
348	300	211.2	1	1700	40
349	597	3062.4	1	1500	25
350	276	1372.8	1	1700	35
350	831	2481.6	1	1700	35
351	350	897.6	1	1700	35
352	351	792	1	1700	40
353	507	4118.4	1	1700	40
354	376	2112	1	1700	40
355	353	4171.2	1	1500	30
356	352	2059.2	1	1700	40
357	278	8395.2	1	1700	45

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
359	360	3432	1	1700	40
359	838	2640	1	1500	35
360	359	3432	1	1700	40
360	361	4540.8	1	1700	50
360	391	1425.6	1	1700	50
361	362	3696	1	1700	50
362	363	4118.4	1	1700	40
363	364	1848	1	1700	45
364	366	2692.8	1	1700	50
365	604	3748.8	1	1700	50
366	367	2587.2	1	1700	50
367	368	4804.8	1	1700	55
368	369	3168	1	1700	50
369	370	2851.2	1	1700	50
370	371	2323.2	1	1700	50
371	372	2587.2	1	1700	40
372	373	1108.8	1	1700	35
373	374	1108.8	1	1500	35
374	375	1636.8	1	1700	50
375	377	3115.2	1	1700	40
376	355	1795.2	1	1700	40
377	378	2059.2	1	1700	45
378	379	2376	1	1700	45
379	380	2428.8	1	1700	40
379	381	4382.4	1	1700	50
380	384	1848	1	1700	40
381	382	686.4	1	1700	50
382	383	2798.4	1	1700	50
383	343	2692.8	1	1700	50
384	385	950.4	1	1700	40
385	386	1425.6	1	1700	40
386	387	1056	1	1700	40
387	388	4646.4	1	1700	40
388	389	3273.6	1	1700	40
389	390	2745.6	1	1700	40
390	347	10032	1	1700	50
391	392	5702.4	1	1700	50
392	393	1267.2	1	1700	50
393	394	1267.2	1	1700	50
394	335	5068.8	1	1700	50

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	**Downstream Node Number**	**Length (Feet)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
395	396	2376	1	1700	50
396	397	2745.6	1	1700	50
397	398	2587.2	1	1700	50
398	286	1848	1	1700	40
399	400	3009.6	1	1700	50
399	500	5068.8	1	1700	50
400	401	2534.4	1	1700	50
401	402	3432	1	1700	50
402	403	1478.4	1	1700	50
403	404	4065.6	1	1700	50
404	405	5966.4	1	1700	50
405	406	5755.2	1	1700	50
406	407	3115.2	1	1700	50
408	280	686.4	1	1700	40
408	409	739.2	1	1700	40
409	408	739.2	1	1700	40
409	410	9134.4	1	1700	55
410	409	9134.4	1	1700	55
410	411	3854.4	1	1700	35
411	410	3854.4	1	1700	40
411	412	1003.2	1	1700	35
412	411	1003.2	1	1700	35
412	413	2851.2	1	1700	40
412	496	2481.6	1	1700	40
413	414	1425.6	1	1700	40
413	425	3643.2	1	1700	40
414	415	1161.6	1	1700	40
414	422	9820.8	1	1700	40
415	416	2323.2	1	1700	40
416	417	1161.6	1	1700	55
417	418	2217.6	1	1700	55
418	419	844.8	1	1700	55
419	420	5913.6	1	1700	55
420	421	4012.8	1	1700	55
422	423	9345.6	1	1700	50
423	424	9820.8	1	1700	40
424	313	2428.8	1	1700	40
424	435	1161.6	1	1700	30
425	426	792	1	1700	40
426	427	2164.8	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
427	428	1320	1	1700	40
428	429	792	1	1700	40
429	430	3801.6	1	1700	40
430	431	2640	1	1700	50
431	432	1848	1	1700	50
432	433	3062.4	1	1700	50
433	434	2851.2	1	1700	50
435	321	2745.6	1	1700	30
436	322	2692.8	1	1700	40
436	577	1848	1	1700	50
437	439	2956.8	1	1700	50
438	437	2904	1	1700	40
439	440	1689.6	1	1700	35
440	441	3484.8	1	1700	35
441	442	844.8	1	1700	35
441	443	1108.8	1	1700	35
442	443	739.2	1	1700	35
442	446	1161.6	1	1700	35
442	832	1003.2	1	1500	25
443	442	739.2	1	1700	35
443	444	1214.4	1	1500	25
443	831	1214.4	1	1700	35
444	443	1214.4	1	1700	25
444	445	1056	1	1500	25
444	830	475.2	1	1500	25
444	832	475.2	1	1500	25
445	273	528	1	1500	25
445	833	528	1	1500	25
446	272	1372.8	1	1500	35
446	442	1161.6	1	1700	35
447	446	1478.4	1	1700	35
448	447	2164.8	1	1700	30
449	448	1478.4	1	1700	40
450	1	5702.4	1	1700	55
451	450	1531.2	1	1700	30
452	451	1478.4	1	1700	30
453	354	4488	1	1700	40
454	455	3220.8	1	1700	25
455	456	792	1	1700	25
456	457	2112	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
457	459	580.8	1	1700	40
458	491	8078.4	1	1700	50
459	460	1584	1	1700	40
460	461	3537.6	1	1700	55
461	462	2904	1	1700	35
462	264	2006.4	1	1700	35
463	464	1848	1	1700	55
464	465	1900.8	1	1700	55
465	466	950.4	1	1700	55
466	467	3432	1	1700	50
467	468	7392	1	1700	50
468	469	3432	1	1700	40
469	239	1003.2	1	1700	40
470	741	2006.4	1	1500	30
471	470	5227.2	1	1700	40
472	471	580.8	1	1700	40
473	831	2640	1	1700	35
474	139	792	1	1700	30
475	476	897.6	1	1700	50
476	478	1320	1	1700	55
477	565	792	1	1700	40
478	479	3643.2	1	1700	40
479	837	1372.8	1	1700	55
480	479	792	1	1700	55
481	480	3590.4	1	1700	55
482	481	1108.8	1	1700	55
483	482	686.4	1	1700	40
483	484	2059.2	1	1700	40
484	483	2059.2	1	1700	40
484	485	1531.2	1	1700	50
485	359	2640	1	1700	40
485	360	3696	1	1700	50
486	484	2587.2	1	1700	50
487	486	1320	2	1700	55
488	487	2164.8	1	1700	55
489	488	9345.6	1	1700	55
490	450	1848	1	1700	30
491	310	2692.8	1	1700	50
492	491	3960	1	1700	50
493	492	6336	1	1700	55

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
494	493	5755.2	1	1700	55
495	494	1214.4	1	1700	55
496	495	1161.6	1	1700	40
497	412	1478.4	1	1700	40
498	497	8976	1	1700	55
498	499	7656	1	1700	50
499	399	3115.2	1	1700	50
500	290	2217.6	1	1700	40
501	502	3273.6	1	1700	40
502	503	1003.2	1	1700	40
503	504	4699.2	1	1700	40
504	505	3590.4	1	1700	40
505	518	4329.6	1	1700	40
506	51	264	3	1700	40
507	506	1214.4	1	1700	40
508	507	6494.4	1	1700	40
509	508	2481.6	1	1700	40
510	509	2376	1	1700	40
511	863	1689.6	3	1900	50
511	873	2640	2	1900	65
512	57	3326.4	2	2250	75
512	58	1953.6	3	2250	65
513	657	633.6	1	1700	45
514	513	1900.8	1	1700	40
515	657	2112	1	1700	45
516	515	2798.4	1	1700	40
517	516	1372.8	1	1700	40
519	520	1214.4	1	1500	25
520	521	9345.6	1	1700	50
521	522	2323.2	1	1700	40
522	523	2270.4	1	1700	40
523	524	3960	1	1700	50
523	685	739.2	1	1700	55
524	525	5174.4	1	1700	50
525	526	1108.8	1	1700	50
526	527	3168	1	1700	50
527	528	2534.4	1	1700	50
528	529	1320	1	1700	50
529	530	3379.2	1	1700	50
531	148	475.2	3	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
532	523	1320	1	1700	40
533	532	2270.4	1	1700	45
534	533	1108.8	1	1700	45
535	534	633.6	1	1500	30
536	535	2798.4	1	1700	50
537	536	1953.6	1	1700	50
538	537	5174.4	1	1700	50
539	538	4012.8	1	1700	40
540	539	1689.6	1	1700	50
541	519	580.8	1	1500	25
542	540	4171.2	1	1700	50
542	731	2428.8	1	1700	40
543	542	7603.2	1	1700	50
544	543	528	1	1500	30
545	544	897.6	1	1500	30
546	545	5913.6	1	1700	50
546	794	1425.6	1	1700	40
547	546	2851.2	1	1700	50
548	547	1267.2	1	1700	40
549	548	1267.2	1	1700	40
550	549	844.8	1	1700	40
551	550	1372.8	1	1700	40
552	551	1478.4	1	1700	40
553	552	2164.8	1	1700	40
554	553	897.6	1	1500	30
555	554	1108.8	1	1500	30
556	555	1003.2	1	1700	45
556	722	6758.4	1	1700	45
557	556	3907.2	1	1700	45
558	557	2270.4	1	1700	45
559	558	1267.2	1	1700	45
560	559	1267.2	1	1700	40
561	560	897.6	1	1700	45
562	561	3854.4	1	1700	45
562	563	1003.2	1	1700	40
563	564	528	1	1700	40
564	566	2798.4	1	1700	40
565	365	2059.2	1	1700	40
566	567	897.6	1	1700	45
567	568	1214.4	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
568	43	2640	1	1700	35
569	562	2851.2	1	1700	45
570	569	1478.4	1	1700	45
571	570	1214.4	1	1700	40
572	571	6124.8	1	1700	40
573	572	1848	1	1700	40
574	573	2164.8	1	1700	40
575	574	528	1	1500	25
576	453	739.2	1	1700	40
576	575	1056	1	1700	45
577	436	1848	1	1700	50
578	579	1848	1	1700	40
579	510	1161.6	1	1700	40
579	580	1900.8	1	1700	40
580	581	1108.8	1	1700	40
581	582	1108.8	1	1700	40
582	583	1108.8	1	1700	40
583	584	1478.4	1	1700	40
584	585	1742.4	1	1700	30
585	586	1056	1	1700	20
586	587	1161.6	1	1700	40
587	588	1584	1	1700	35
588	589	3168	1	1700	25
589	590	792	1	1700	25
590	591	1425.6	1	1700	35
590	639	3960	1	1700	40
591	592	3220.8	1	1700	40
592	593	5544	1	1700	55
593	594	2376	1	1700	55
594	595	4804.8	1	1700	55
595	596	2217.6	1	1700	40
596	597	2006.4	1	1500	25
597	598	1689.6	1	1500	25
597	662	3115.2	1	1700	30
598	599	4593.6	1	1700	40
599	600	1108.8	1	1700	40
600	601	3326.4	1	1700	60
601	602	7286.4	1	1700	60
601	930	2428.8	1	1700	40
602	70	686.4	2	1700	50

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	**Downstream Node Number**	**Length (Feet)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
603	604	3696	1	1700	50
603	806	2006.4	1	1700	50
604	603	3696	1	1700	50
604	605	3326.4	1	1700	55
604	1023	9662.4	1	1700	50
605	604	3326.4	1	1700	50
605	606	1795.2	1	1700	50
606	605	1795.2	1	1700	55
606	607	3537.6	1	1700	55
606	927	1320	1	1700	45
607	606	3537.6	1	1700	50
607	608	2112	1	1700	40
608	607	2112	1	1700	55
608	609	1056	1	1700	40
609	608	1056	1	1700	40
609	610	897.6	1	1700	40
610	609	897.6	1	1700	40
610	618	4065.6	2	1900	50
610	619	1108.8	2	1900	50
610	923	2692.8	1	1700	50
611	706	316.8	1	1700	40
612	613	2587.2	2	1700	45
613	614	3748.8	2	1700	45
614	615	3960	2	1200	40
615	226	1848	1	1700	50
615	616	1425.6	2	1700	40
616	617	633.6	1	1200	20
616	697	580.8	2	1200	30
617	225	1689.6	1	1700	50
618	125	3220.8	2	1900	50
618	610	4065.6	2	1900	50
619	610	1108.8	2	1900	50
619	620	2270.4	2	1900	50
620	619	2270.4	2	1900	50
620	621	3115.2	2	1900	50
621	620	3115.2	2	1900	50
621	622	739.2	2	1900	50
622	621	739.2	2	1900	50
622	623	2534.4	2	1900	50
622	934	1372.8	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	**Downstream Node Number**	**Length (Feet)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
623	622	2534.4	2	1900	50
623	624	897.6	2	1900	50
624	623	897.6	2	1900	50
624	625	4118.4	2	1900	55
625	624	4118.4	2	1900	50
625	626	2640	3	1900	50
625	1009	3115.2	1	1700	40
626	625	2640	2	1900	55
626	627	1003.2	3	1900	50
626	938	686.4	1	1700	40
627	626	1003.2	3	1900	50
627	628	422.4	3	1900	50
627	1072	1003.2	2	1700	40
628	84	1267.2	2	1900	50
628	627	422.4	3	1900	50
629	85	1425.6	2	1900	50
629	630	4540.8	2	1900	50
630	629	4540.8	2	1900	50
630	631	3379.2	2	1900	50
630	942	2164.8	1	1700	40
631	160	1108.8	2	1900	50
631	630	3379.2	2	1900	50
632	125	1056	2	1900	50
633	909	1584	1	1700	40
634	633	739.2	1	1700	40
634	635	3273.6	1	1700	40
635	134	369.6	1	1700	40
636	517	2481.6	1	1700	40
637	636	1478.4	1	1500	35
638	637	1320	1	1500	35
639	640	1795.2	1	1700	55
640	641	3115.2	1	1700	55
641	642	1900.8	1	1700	55
641	876	4435.2	1	1700	55
642	643	4699.2	1	1700	40
643	644	1161.6	1	1700	40
644	645	1742.4	1	1700	40
645	54	2059.2	2	1700	40
646	647	3326.4	1	1700	60
647	649	4963.2	1	1700	50

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
648	771	3907.2	1	1700	40
649	650	950.4	1	1700	40
650	651	2112	1	1700	60
651	652	2059.2	1	1700	35
652	653	2323.2	1	1700	40
653	141	2006.4	1	1700	40
654	655	4118.4	1	1700	45
655	656	2745.6	1	1700	45
656	657	1584	1	1700	45
657	658	3115.2	1	1700	50
658	659	1953.6	1	1700	50
659	660	1848	1	1700	50
660	661	2323.2	1	1700	50
662	663	4118.4	1	1700	40
663	664	4857.6	1	1700	40
664	648	2164.8	1	1700	40
665	930	2059.2	1	1700	30
666	965	2956.8	1	1700	50
667	668	2904	1	1500	25
667	867	1531.2	1	1700	30
668	667	2904	1	1700	35
668	669	2745.6	1	1700	25
668	681	1175	1	1500	25
668	901	1848	1	1500	25
669	670	1953.6	1	1700	40
670	673	2640	1	1700	40
671	6	1478.4	1	1700	40
672	671	1900.8	1	1700	40
673	674	3484.8	1	1700	60
674	675	2798.4	1	1700	60
675	676	2904	1	1700	60
676	677	2376	1	1700	60
677	678	1425.6	1	1700	60
678	679	1425.6	1	1700	40
679	680	6494.4	1	1700	50
679	708	6652.8	1	1700	45
679	709	2270.4	1	1700	25
680	861	1742.4	1	1700	40
681	668	1161.6	1	1500	25
681	682	3046	1	1500	25

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
682	681	3062.4	1	1500	25
682	683	1425.6	1	1700	40
683	682	1425.6	1	1700	40
683	684	3062.4	1	1700	40
684	683	3062.4	1	1700	40
684	812	2956.8	1	1700	40
684	856	2112	1	1700	50
685	686	4276.8	1	1700	55
686	687	686.4	1	1700	55
687	688	2534.4	1	1700	55
688	689	2270.4	1	1700	55
689	690	4593.6	1	1700	55
690	691	633.6	1	1700	55
691	692	1425.6	1	1700	55
692	693	1214.4	1	1700	55
693	694	3115.2	1	1700	40
694	695	1848	1	1700	40
695	696	2270.4	1	1700	40
696	18	1742.4	1	1500	35
698	265	633.6	1	1700	30
699	700	3432	1	1500	30
699	749	316.8	1	1500	35
700	701	1848	1	1500	30
701	816	686.4	1	1700	30
702	703	3168	1	1700	45
703	704	1425.6	1	1700	45
704	705	3009.6	1	1700	45
706	612	950.4	2	1700	45
707	613	1689.6	1	1700	30
708	37	633.6	1	1700	30
709	679	2270.4	1	1700	25
709	710	3115.2	1	1700	25
710	711	2323.2	1	1700	40
711	712	1953.6	1	1700	40
712	713	1161.6	1	1700	40
713	714	1953.6	1	1700	40
714	715	1953.6	1	1700	40
715	716	897.6	1	1700	45
716	717	2323.2	1	1700	55
717	718	3537.6	1	1700	55

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
718	719	5438.4	1	1700	55
719	890	1161.6	1	1700	40
720	531	2323.2	1	1700	40
721	667	1056	1	1700	30
722	723	1531.2	1	1700	45
722	817	6600	1	1700	50
723	788	897.6	1	1500	30
724	725	3748.8	1	1700	45
725	789	792	1	1500	30
726	727	2481.6	1	1700	45
727	31	1478.4	1	1500	30
728	32	2217.6	2	1900	60
728	33	2323.2	2	1900	60
729	727	4910.4	1	1700	45
730	733	5544	1	1700	40
730	791	4382.4	1	1700	40
731	732	3009.6	1	1700	40
732	730	5596.8	1	1700	40
733	734	897.6	1	1700	40
734	735	3220.8	1	1700	40
735	736	1636.8	1	1700	40
735	739	2904	1	1700	40
736	737	2112	1	1700	30
737	738	2376	1	1700	30
738	23	3537.6	2	1900	50
738	26	1056	2	1900	60
739	740	2640	1	1700	40
740	21	739.2	1	1700	40
741	438	3643.2	1	1700	35
742	472	3009.6	1	1700	40
742	475	4804.8	1	1700	40
743	759	2217.6	1	1700	40
743	761	2112	1	1700	40
744	743	1056	1	1700	30
745	746	1953.6	1	1500	35
746	747	1003.2	1	1500	35
747	19	1372.8	1	1500	30
747	748	2217.6	1	1500	35
747	973	1478.4	1	1500	35
748	699	2376	1	1500	35

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	**Downstream Node Number**	**Length (Feet)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
748	747	2217.6	1	1500	35
749	751	3168	1	1700	45
750	752	2956.8	1	1700	60
751	750	3115.2	1	1700	60
752	753	2323.2	1	1700	60
753	754	1214.4	1	1700	60
754	755	2323.2	1	1700	60
756	816	2481.6	1	1700	30
757	758	2059.2	1	1700	40
758	910	1478.4	1	1700	40
759	760	2112	1	1700	40
761	757	2323.2	1	1500	30
762	763	3537.6	1	1700	40
762	764	4435.2	1	1700	40
763	131	475.2	2	1700	40
764	765	9873.6	1	1700	40
766	477	3379.2	1	1200	20
767	766	3854.4	1	1700	40
767	768	4752	1	1700	40
768	806	3220.8	1	1700	40
769	767	3960	1	1700	40
770	917	2217.6	1	1700	30
770	925	1636.8	1	1700	30
771	69	2112	2	1900	65
771	70	5596.8	2	1900	65
772	716	2270.4	1	1700	45
773	772	1795.2	1	1700	45
774	773	3273.6	1	1700	45
775	774	3379.2	1	1700	45
776	777	4329.6	1	1700	45
777	775	4488	1	1700	40
778	776	2112	1	1700	45
778	779	4012.8	1	1700	45
779	150	1742.4	1	1700	40
780	709	1320	1	1700	25
781	900	1003.2	1	1500	25
782	781	1584	1	1500	25
783	900	1425.6	1	1500	25
784	45	792	1	1500	30
785	40	2006.4	2	2250	75

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	**Downstream Node Number**	**Length (Feet)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
785	46	3854.4	2	2250	75
786	38	4171.2	2	2250	75
786	40	3168	2	2250	75
787	39	3854.4	2	1900	65
787	41	3960	2	1900	65
788	724	2112	1	1700	45
789	726	475.2	1	1500	30
790	30	264	1	1500	30
791	729	5966.4	1	1700	40
791	795	4752	1	1700	40
792	791	7444.8	1	1700	40
793	792	5068.8	1	1700	40
794	793	3432	1	1700	40
795	733	950.4	1	1700	30
796	973	1425.6	1	1200	35
796	974	580.8	1	1500	35
797	796	2217.6	1	1500	35
798	3	1267.2	2	1900	50
798	7	3273.6	2	1900	50
799	798	686.4	1	1700	40
800	62	5808	3	2250	70
800	68	1531.2	3	2250	70
801	47	5808	2	2250	75
801	48	1900.8	2	2250	60
802	231	5808	4	2250	70
802	232	4752	4	2250	70
803	41	3590.4	2	1900	65
803	43	3326.4	2	1700	35
804	42	739.2	1	1700	35
804	855	2164.8	1	1700	50
805	154	12144	2	1900	65
805	155	5280	2	1900	65
806	71	528	2	1700	40
806	603	2006.4	1	1700	50
807	74	2217.6	3	2250	70
807	808	6336	3	2250	70
808	76	2534.4	3	1900	60
808	807	6336	3	2250	70
809	142	1531.2	1	1700	40
810	908	1372.8	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
811	812	739.2	1	1700	40
811	880	2270.4	1	1700	40
812	684	2956.8	1	1700	40
812	811	739.2	1	1700	40
813	891	1478.4	1	1700	30
813	892	1108.8	1	1700	40
814	813	950.4	1	1700	30
815	998	686.4	1	1500	30
816	702	3590.4	1	1700	40
817	37	264	1	1700	30
818	186	2851.2	3	1200	50
819	304	6441.6	1	1700	50
819	305	950.4	1	1700	50
820	276	5596.8	1	1700	35
820	278	6652.8	1	1700	55
821	377	1320	1	1700	40
822	821	2904	1	1700	40
823	822	1478.4	1	1500	30
824	823	2112	1	1500	30
825	375	6388.8	1	1700	40
826	828	3273.6	1	1700	35
827	826	2481.6	1	1700	35
828	824	5755.2	1	1700	30
829	826	1584	1	1700	35
830	273	1056	1	1500	25
830	444	475.2	1	1500	25
830	834	422.4	1	1500	25
831	350	2481.6	1	1700	35
831	443	1214.4	1	1700	35
831	834	1531.2	1	1500	25
832	442	1003.2	1	1700	35
832	444	475.2	1	1500	25
832	833	1056	1	1500	25
833	272	1848	1	1500	35
833	445	528	1	1500	25
834	275	1003.2	1	1500	30
834	830	422.4	1	1500	25
835	258	1478.4	1	1700	45
836	350	2904	1	1700	35
837	357	7656	1	1700	50

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
837	836	9873.6	1	1700	55
838	839	3590.4	1	1700	55
839	840	1478.4	1	1700	55
840	841	1320	1	1700	55
841	842	6283.2	1	1700	50
842	843	1108.8	1	1700	40
843	844	1953.6	1	1700	35
844	280	950.4	1	1700	35
844	281	686.4	1	1700	35
845	323	4118.4	2	1900	60
845	851	369.6	1	1700	40
846	851	2956.8	2	1900	55
847	323	2481.6	2	1900	60
847	848	5068.8	2	1900	60
848	847	5068.8	2	1900	60
848	849	6230.4	2	1900	60
849	331	5174.4	1	1700	55
849	848	6230.4	2	1900	60
850	319	1531.2	1	1700	40
850	331	9556.8	1	1700	55
851	248	844.8	1	1700	50
851	250	686.4	2	1700	40
852	327	11616	1	1700	50
853	326	897.6	1	1700	55
854	867	2587.2	1	1700	30
855	44	422.4	2	1700	50
855	804	2164.8	1	1500	30
856	45	580.8	2	1700	50
856	684	2112	1	1700	40
857	24	1003.2	1	1700	40
857	25	1636.8	2	2250	70
857	27	4804.8	2	2250	75
858	878	2481.6	1	1700	40
859	854	897.6	1	1700	30
859	858	2059.2	1	1700	30
861	33	4065.6	2	1700	40
861	37	9345.6	2	1900	60
862	59	264	1	1700	40
862	863	316.8	2	1900	50
863	59	422.4	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
863	64	3220.8	2	1900	50
863	511	1689.6	2	1900	65
864	938	8025.6	1	1700	50
864	940	739.2	1	1700	60
864	1024	3379.2	1	1700	50
865	81	369.6	1	1500	30
865	1024	2904	1	1700	50
866	141	4963.2	1	1700	60
866	143	5755.2	1	1700	60
867	146	475.2	1	1700	30
867	667	1531.2	1	1700	35
868	223	9979.2	4	2250	70
868	869	3168	4	2250	70
869	868	3168	4	2250	70
869	870	3854.4	4	2250	70
870	869	3748.8	4	2250	70
870	871	2851.2	4	2250	70
871	34	1267.2	4	2250	70
871	870	2851.2	4	2250	70
872	34	1108.8	4	2250	70
872	112	1372.8	5	2250	70
873	52	9187.2	2	1900	65
873	511	2640	2	1900	65
874	873	2428.8	1	1700	40
875	874	2059.2	1	1700	55
876	875	3009.6	1	1700	55
877	144	2323.2	1	1700	50
878	810	5227.2	1	1700	40
878	877	2745.6	1	1700	50
879	878	3643.2	1	1700	50
880	811	2270.4	1	1700	40
880	879	1636.8	1	1700	40
881	880	5016	1	1700	40
882	881	686.4	1	1700	45
883	50	1848	2	1900	65
883	51	9187.2	2	1900	65
884	882	1108.8	1	1700	40
885	884	2640	1	1700	40
886	885	528	1	1500	30
887	815	580.8	1	1500	30

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
888	887	2112	1	1500	30
889	888	4012.8	1	1700	40
890	889	4276.8	1	1700	40
891	6	633.6	1	1700	30
892	893	1003.2	1	1700	40
893	799	3379.2	1	1700	40
893	894	1161.6	1	1700	40
894	895	2112	1	1700	40
895	896	1056	1	1700	40
896	897	3696	1	1700	50
897	898	1795.2	1	1700	50
898	899	897.6	1	1700	50
899	754	580.8	1	1700	40
900	682	897.6	1	1500	25
901	148	1372.8	1	1500	25
902	681	739.2	1	1500	25
903	681	1003.2	1	1500	25
904	682	1425.6	1	1500	25
905	683	2798.4	1	1700	40
906	684	686.4	1	1700	30
907	51	2164.8	1	1700	40
908	650	4276.8	1	1700	40
909	137	369.6	1	1700	40
910	134	1003.2	2	1700	40
911	21	2112	2	1900	50
911	23	1742.4	2	1900	50
912	748	1372.8	1	1500	35
913	749	2587.2	1	1500	35
913	893	3801.6	1	1700	40
914	131	1003.2	2	1700	30
915	130	9240	1	1700	50
916	129	1056	1	1700	30
917	128	6705.6	1	1700	45
917	926	2798.4	1	1700	45
918	123	580.8	2	1700	30
919	122	897.6	2	1700	30
920	121	739.2	1	1700	30
921	120	1267.2	1	1700	40
922	120	2376	1	1700	40
922	1019	2059.2	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
923	610	2692.8	1	1700	40
923	1017	4488	1	1700	50
924	609	950.4	1	1700	30
925	607	1003.2	1	1700	30
926	606	2217.6	1	1700	45
927	1026	2217.6	1	1700	45
928	565	739.2	1	1700	40
928	915	2428.8	1	1700	50
929	603	686.4	1	1700	30
930	601	2428.8	1	1700	40
930	666	7603.2	1	1700	45
931	620	1108.8	1	1700	30
932	620	633.6	1	1700	30
933	622	686.4	1	1700	40
934	622	1372.8	1	1700	40
934	1033	1636.8	1	1700	40
935	623	897.6	1	1700	30
936	624	580.8	1	1700	30
937	625	580.8	1	1700	30
938	626	686.4	1	1700	40
938	627	1056	2	1700	40
939	1067	633.6	2	1700	40
939	1072	3696	2	1700	40
940	75	6811.2	1	1700	60
940	864	633.6	1	1700	50
941	629	369.6	1	1700	30
942	630	2164.8	1	1700	40
942	1006	897.6	1	1700	40
943	631	1108.8	1	1500	40
944	164	1900.8	2	1900	40
944	1051	1742.4	2	1900	50
945	164	1742.4	2	1900	40
945	187	2956.8	1	1700	40
946	165	2059.2	1	1700	40
947	176	633.6	1	1700	30
948	175	1003.2	1	1700	30
949	174	1531.2	1	1700	30
950	159	5755.2	1	1700	40
950	966	4699.2	1	1700	50
951	158	686.4	1	1700	30

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
952	76	1795.2	2	1900	60
952	81	792	2	1900	55
953	263	1531.2	1	1700	30
954	261	844.8	1	1700	30
955	260	369.6	1	1700	30
956	299	1214.4	1	1700	40
957	1021	1689.6	2	1900	50
958	959	1161.6	2	1200	40
959	872	2323.2	1	1700	40
959	960	1953.6	2	1900	50
960	961	844.8	1	1200	20
960	962	897.6	2	1500	40
961	34	844.8	1	1500	50
963	1045	844.8	2	1900	50
963	1049	2640	2	1900	50
964	91	686.4	2	1900	50
964	1045	1953.6	2	1900	50
965	77	3379.2	1	1700	40
965	950	12302.4	1	1700	50
966	967	2534.4	1	1700	40
967	968	1161.6	1	1700	30
968	171	2164.8	1	1700	30
969	970	369.6	1	1500	30
970	611	2270.4	1	1200	30
971	15	1795.2	2	2250	75
971	16	3960	2	2250	75
972	7	2692.8	1	1700	40
973	17	2640	1	1200	30
973	18	950.4	1	1500	35
973	796	1425.6	1	1200	35
974	699	3062.4	1	1500	35
975	756	3009.6	1	1700	30
975	994	2851.2	1	1700	45
976	975	2745.6	1	1700	45
977	976	3643.2	1	1700	45
977	978	3696	1	1700	45
978	979	1636.8	1	1700	45
979	980	2112	1	1700	45
980	991	3220.8	1	1700	40
980	992	1214.4	1	1700	45

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
981	983	4488	1	1700	45
982	977	3379.2	1	1700	45
983	982	7867.2	1	1700	45
984	981	2692.8	1	1700	45
985	984	1742.4	1	1700	45
986	985	1636.8	1	1700	45
987	986	1848	1	1700	45
988	987	1795.2	1	1700	45
989	988	3273.6	1	1700	45
989	990	5332.8	1	1700	45
990	993	264	1	1700	40
991	23	897.6	1	1700	40
992	21	2587.2	1	1700	40
992	745	1953.6	1	1700	40
993	716	2323.2	1	1700	45
994	995	9345.6	1	1700	45
995	996	3590.4	1	1700	45
996	997	4752	1	1700	45
998	999	2481.6	1	1700	40
999	1000	2164.8	1	1700	40
1000	1001	1320	1	1700	50
1001	1002	1425.6	2	1900	65
1001	1003	2587.2	2	1900	65
1002	1001	1425.6	2	1900	65
1003	155	2270.4	2	1900	65
1003	1001	2587.2	2	1900	65
1004	614	1161.6	1	1700	30
1005	82	844.8	1	1700	40
1006	1007	1584	1	1700	40
1007	1008	2323.2	1	1700	40
1008	90	1267.2	1	1700	40
1009	1010	1003.2	1	1700	40
1010	1034	1689.6	1	1700	40
1011	1012	2587.2	1	1700	40
1011	1035	2481.6	1	1700	40
1012	1011	2587.2	1	1700	40
1012	1013	1531.2	1	1700	40
1012	1063	5016	1	1700	40
1013	1012	1531.2	1	1700	40
1013	1058	1425.6	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
1014	1013	1003.2	1	1700	40
1015	1014	4329.6	1	1700	40
1016	1015	2745.6	1	1700	40
1017	1018	3009.6	1	1700	50
1018	1031	2164.8	1	1700	50
1019	922	2059.2	1	1700	40
1019	1030	3062.4	2	1500	40
1019	1060	2376	1	1700	40
1020	1056	1161.6	1	1700	40
1020	1058	897.6	1	1700	40
1021	958	2164.8	2	1900	50
1021	1022	2112	1	1700	40
1021	1041	1689.6	1	1700	40
1022	1021	2112	1	1700	40
1022	1037	2851.2	1	1700	40
1023	864	475.2	1	1700	50
1024	864	3379.2	1	1700	50
1024	865	2904	1	1700	50
1025	76	1742.4	1	1700	50
1026	1027	897.6	1	1700	45
1027	933	5385.6	1	1700	45
1028	128	528	1	1500	30
1029	126	1320	2	1900	60
1029	127	1584	2	1900	60
1031	1019	739.2	2	1700	50
1032	124	950.4	2	1900	60
1032	125	1108.8	4	1900	50
1033	1016	844.8	1	1700	40
1034	1064	2270.4	1	1700	40
1035	1011	2481.6	1	1700	40
1035	1037	686.4	1	1700	40
1036	1035	528	1	1700	30
1037	1022	2851.2	1	1700	40
1037	1035	686.4	1	1700	40
1038	1037	316.8	1	1700	30
1039	1022	475.2	1	1700	30
1040	1041	1372.8	1	1700	40
1041	1042	580.8	1	1700	40
1042	1043	2692.8	1	1700	40
1043	94	528	1	1700	40

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
1044	90	475.2	2	1700	40
1044	91	686.4	2	1900	50
1045	963	844.8	2	1900	50
1045	964	1953.6	2	1900	50
1046	1045	2006.4	1	1700	30
1047	963	264	1	1700	30
1048	1047	2323.2	1	1700	30
1049	963	2640	2	1900	50
1049	1050	1478.4	2	1900	50
1050	1049	1478.4	2	1900	50
1050	1051	2059.2	2	1900	50
1051	944	1742.4	2	1900	50
1051	1050	2059.2	2	1900	50
1052	1049	580.8	1	1700	30
1053	1049	686.4	1	1700	30
1054	1050	633.6	1	1700	30
1055	1051	475.2	1	1700	30
1056	1020	1161.6	1	1700	40
1056	1060	2059.2	1	1700	40
1057	1056	1689.6	1	1700	30
1058	1013	1425.6	1	1700	40
1058	1020	897.6	1	1700	40
1059	1058	422.4	1	1700	30
1060	1019	2376	1	1700	40
1060	1056	2059.2	1	1700	40
1061	1060	1161.6	1	1700	30
1062	1012	686.4	1	1700	30
1064	1065	1214.4	1	1700	40
1065	1011	897.6	1	1700	40
1066	939	633.6	1	1700	30
1067	1068	844.8	1	1700	40
1068	1070	1742.4	1	1700	40
1069	1068	1161.6	1	1700	30
1070	1008	739.2	1	1700	40
1071	1070	633.6	1	1700	30
1072	627	1003.2	2	1700	40
1072	939	3696	2	1700	40
1073	1072	686.4	1	1700	30
1074	97	2059.2	3	2250	60
1074	98	686.4	2	2250	60

Table K-1. Evacuation Roadway Network Characteristics (Cont.)					
Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
1075	199	950.4	1	1700	50
1076	206	2270.4	2	1900	50
1076	1077	1320	1	1700	50
1077	1079	2481.6	3	2250	60
1078	197	1953.6	1	1700	50
1078	1080	633.6	2	2250	60
1079	196	422.4	3	2250	60
1079	1082	2006.4	2	1900	50
1080	194	2798.4	5	2250	60

APPENDIX L

ERPA Boundaries

APPENDIX L: ERPA Boundaries

ERPA 1

County: Salem

Defined as the area within the following boundary: The western portion of Lower Alloways Creek (LAC) Township. It consists of the area from the edge of the Delaware River along Mill Creek to Money Island Road. It then goes north on Money Island Road to Fort Elfsborg-Hancocks Bridge Road and east on Fort Elfsborg-Hancocks Bridge Road to the LAC/Elsinboro boundary line. It continues northeast to the boundary for Salem City and proceeds south down the LAC/Quinton boundary and along Salem New Bridge/Harmersville Canton Road/Main Street Canton to the county line. It then continues south on the county line to Delaware Bay.

ERPA 2

County: Salem

Defined as the area within the following boundary: The eastern portion of Lower Alloways Creek Township and the western portion of Quinton Township. It starts at the intersection of Quaker Neck Road and the Salem City line and goes east along Quaker Neck Road to the Mannington Township line. It continues southeast along the Quinton/Alloway Township boundary to Alloway Road (Route 581), then turns west to Burden Hill Road and south to Route 49. It then goes southeast along Route 49 to Gravely Hill Road. It then continues southwest on Gravely Hill Road to Quinton Jericho Road, then southeast to the county line. It continues west along the county line to Main Street Canton. It then goes northwest along Main Street Canton/Harmersville Canton Road/Salem New Bridge Roads and continues northwest along the Lower Alloways Creek/Quinton Township boundary to the Salem City line and then proceeds northeast along Salem City/Quinton line to Quaker Neck Road.

ERPA 3

County: Salem

Defined as the area within the following boundary: The township of Elsinboro and Salem City. It starts at the Delaware River and goes east along the Salem River to the southern edge of Mannington Marsh. It then goes east along the boundary line between Salem City and Mannington and continues south/southeast along the Salem/Quinton and Lower Alloways Creek/Elsinboro township lines to Fort Elfsborg Hancocks Bridge Road. It then goes west to Money Island Road, then south to Mill Creek and west to the Delaware River.

ERPA 4 County: Salem

Defined as the area within the following boundary: The southern portion of Mannington Township. It starts at the intersection of Quaker Neck Road and the Salem City line and goes east along Quaker Neck Road to the Mannington Township line. It then goes northwest to Fenwick Creek and then north to Penna Reading Railroad line and northwest to East Robert Street. It continues west past Newell Street to the Salem River. It then goes south along the river to the former H.J. Heinz Company (now Anchor Hocking Glass), then goes east along the Salem/Mannington boundary to intersection of Salem City line and Quaker Neck Road.

ERPA 5 County: Salem

Defined as the area within the following boundary: The southern portion of Pennsville Township. It starts at Salem Cove and goes east along the Salem River to a point near the former H.J. Heinz Company (now Anchor Hocking Glass). It then goes north on a direct line to Old Toll Bridge Road then north and west into Lenape Drive to Route 49. It continues south on Route 49 to Lighthouse Road and then goes northwest on Lighthouse Road to Fort Mott Road, then south to the entrance to Finn's Point National Cemetery.

ERPA 6 County: Cumberland

Defined as the area within the following boundary: The western portion of Stow Creek. It starts at the intersection of Quinton Jericho Road and Stow Creek and continues southwest along Stow Creek across Main Street Canton and turns south along Stow Creek to Raccoon Ditch. It then goes east along Raccoon Ditch to the southern shore of Davis Mill Pond. It continues east to Macanippuck Road and turns north to Buckhorn Road, then turns east to Quinton Jericho Road. It continues northwest on Quinton Jericho Road to Stow Creek.

ERPA 7 County: Cumberland

Defined as the area within the following boundary: The western portion of Greenwich Township. It starts at Oyster Cove and goes north along Stow Creek (county line) to Raccoon Ditch. It then goes east on Raccoon Ditch to the southern shore of Davis Mill Pond and continues to the intersection of Chestnut Road. It then turns south on Chestnut Road to Mill Road (aka Bacon's Neck-Othello Road) and goes southwest along Mill Road to the intersection of Gum Tree Corner Road. It then goes south on Gum Tree Corner Road to Bacon's Neck Road, then turns southwest to Tindall Island Road. It continues south on Tindall Island Road to the Cohansey River, then goes southwest along the Cohansey River to the Delaware Bay.

ERPA 8 County: N/A
Defined as the area within the following boundary: A portion of Delaware Bay south of Artificial Island. It starts at the Delaware/New Jersey line on Artificial Island and goes west one mile then south to southeast along the Delaware Bay boundary line between New Jersey and Delaware to Cohansey Point. It then goes east three miles to Cohansey Point.

ERPA A County: New Castle & Kent
Defined as the area within the following boundary: Port Penn, Odessa, East of Townsend, North Smyrna and South St. George's Areas. The area bounded to the west by Routes 13, 299 and 9; to the east by the Delaware River; to the north by the Chesapeake and Delaware Canal; to the south by Route 6.

ERPA B County: New Castle & Kent
Defined as the area within the following boundary: Middletown, East of Townsend, and North Smyrna Areas. The area bounded to the west by the Norfolk Southern Railroad; to the east by Route 9; to the north by Route 299; to the south by Route 6 and Smyrna Landing Road.

ERPA C County: New Castle
Defined as the area within the following boundary: Delaware City, North Middletown, St. George's and Reybold Areas. The area bounded to the north of Route 299 by Kirkwood St. George's Road; to the east of the Norfolk Southern Railroad to Route 13; to the south of the Red Lion Creek and east of Route 9; to the south of the Norfolk Southern Railroad and east of Route 13 to the Chesapeake and Delaware Canal; to the south of Route 72 and east of McCoy Road to Route 13.

ERPA D County: N/A
Defined as the area within the following boundary: The Delaware River and Bay. The area just north of Pea Patch Island, near Delaware City, south to Woodland Beach.

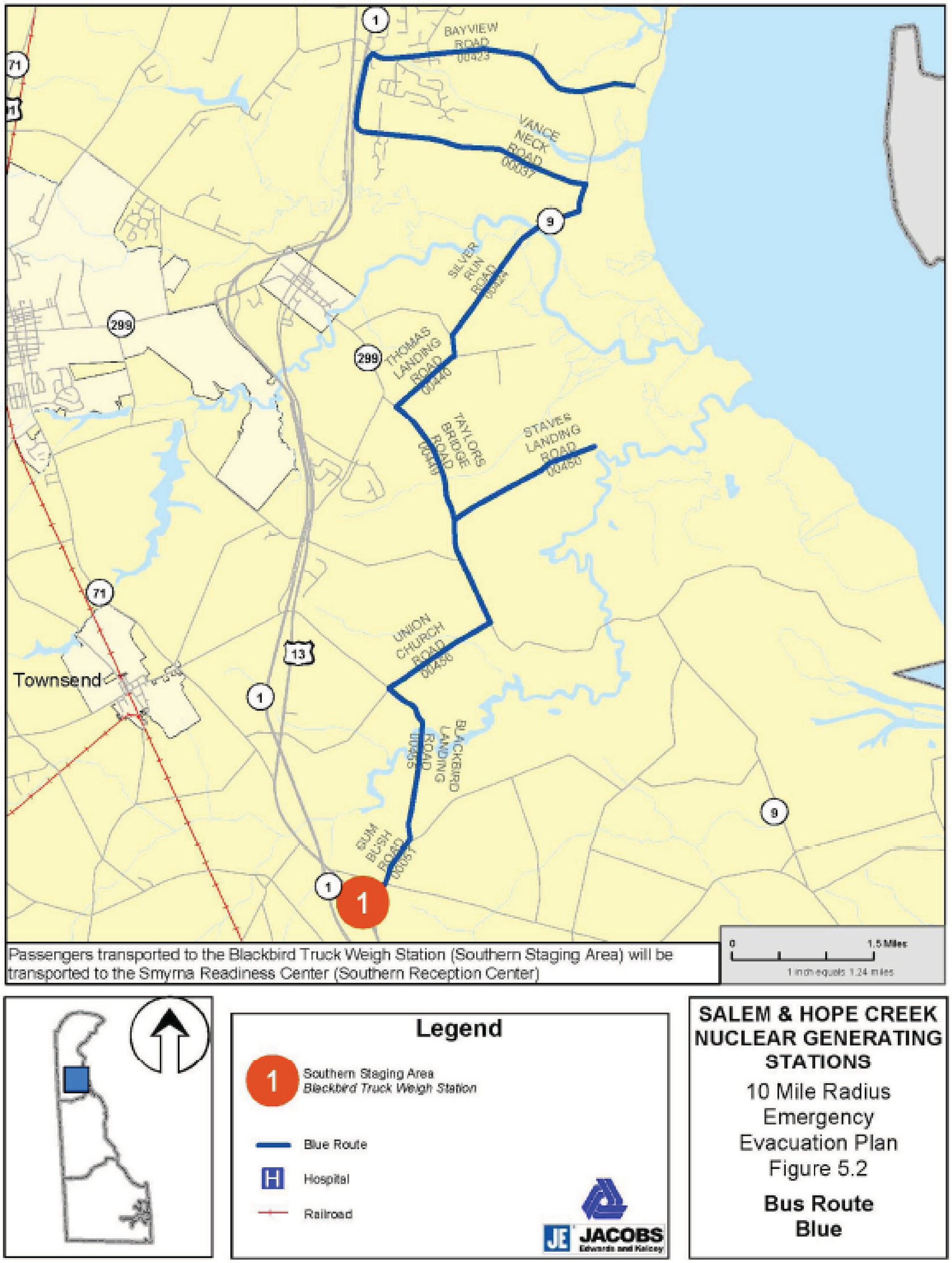
APPENDIX M

Transit-Dependent Bus Routes

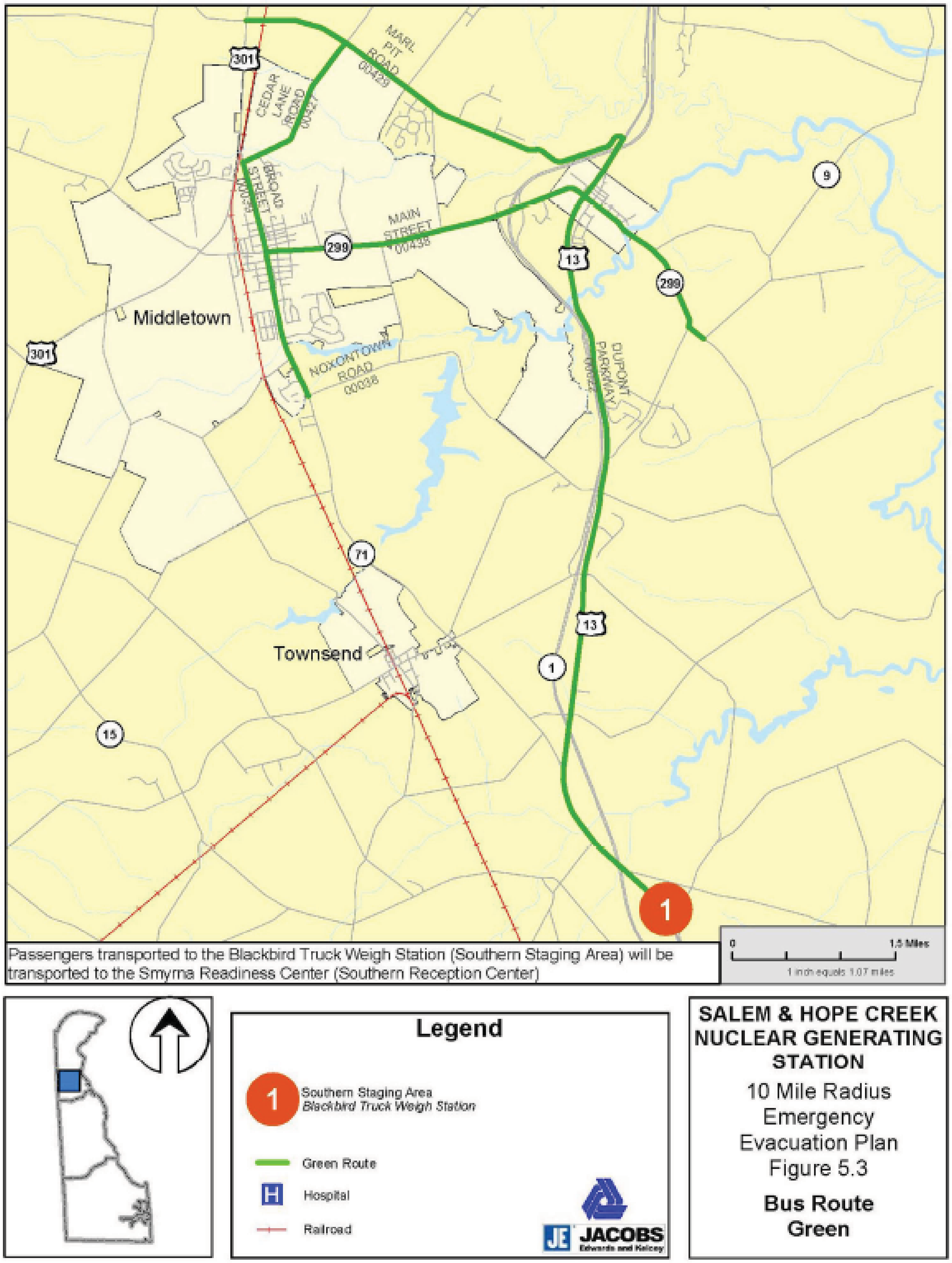
APPENDIX M: TRANSIT-DEPENDENT BUS ROUTES

This appendix presents the bus routes modeled in the ETE analysis described in Section 8 for evacuation of the transit-dependent population and of schools. These figures were extracted from the Delaware and New Jersey State Plans. Pages M-2 through M-7 identify the transit-dependent bus pickup routes for the Delaware portion of the EPZ, while pages M-8 through M-16 identify the routes for the New Jersey portion of the EPZ. Pages M-17 through M-36 identify the evacuation bus routes for each of the schools within the Delaware portion of the EPZ. Specific evacuation bus routes were not provided in the New Jersey State Plan; these schools were routed using the most likely route from the school to the host facility.

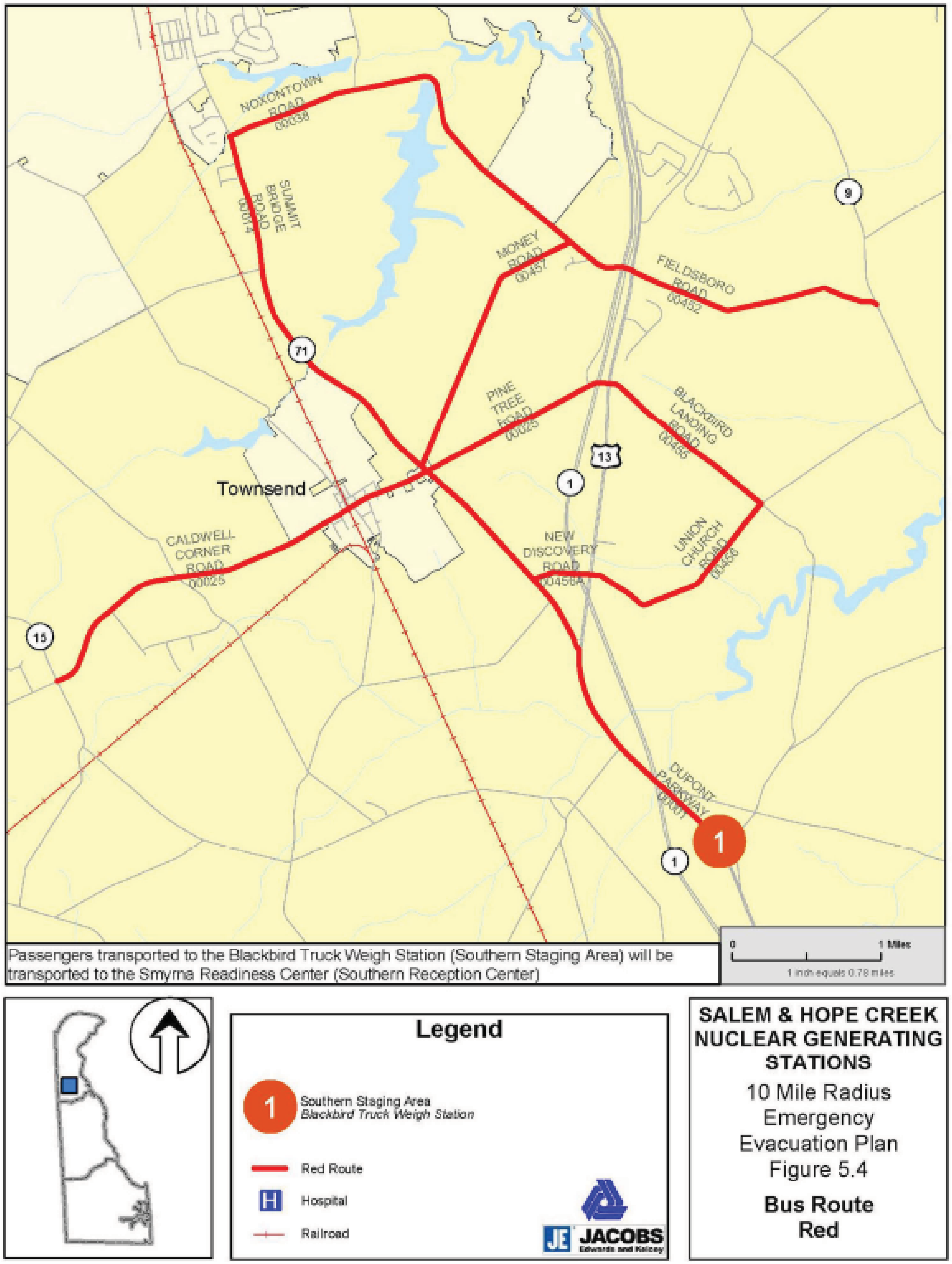
ATTACHMENT 1200-A2: EVACUATION BUS ROUTE MAPS (Continued)



ATTACHMENT 1200-A2: EVACUATION BUS ROUTE MAPS (Continued)



ATTACHMENT 1200-A2: EVACUATION BUS ROUTE MAPS (Continued)



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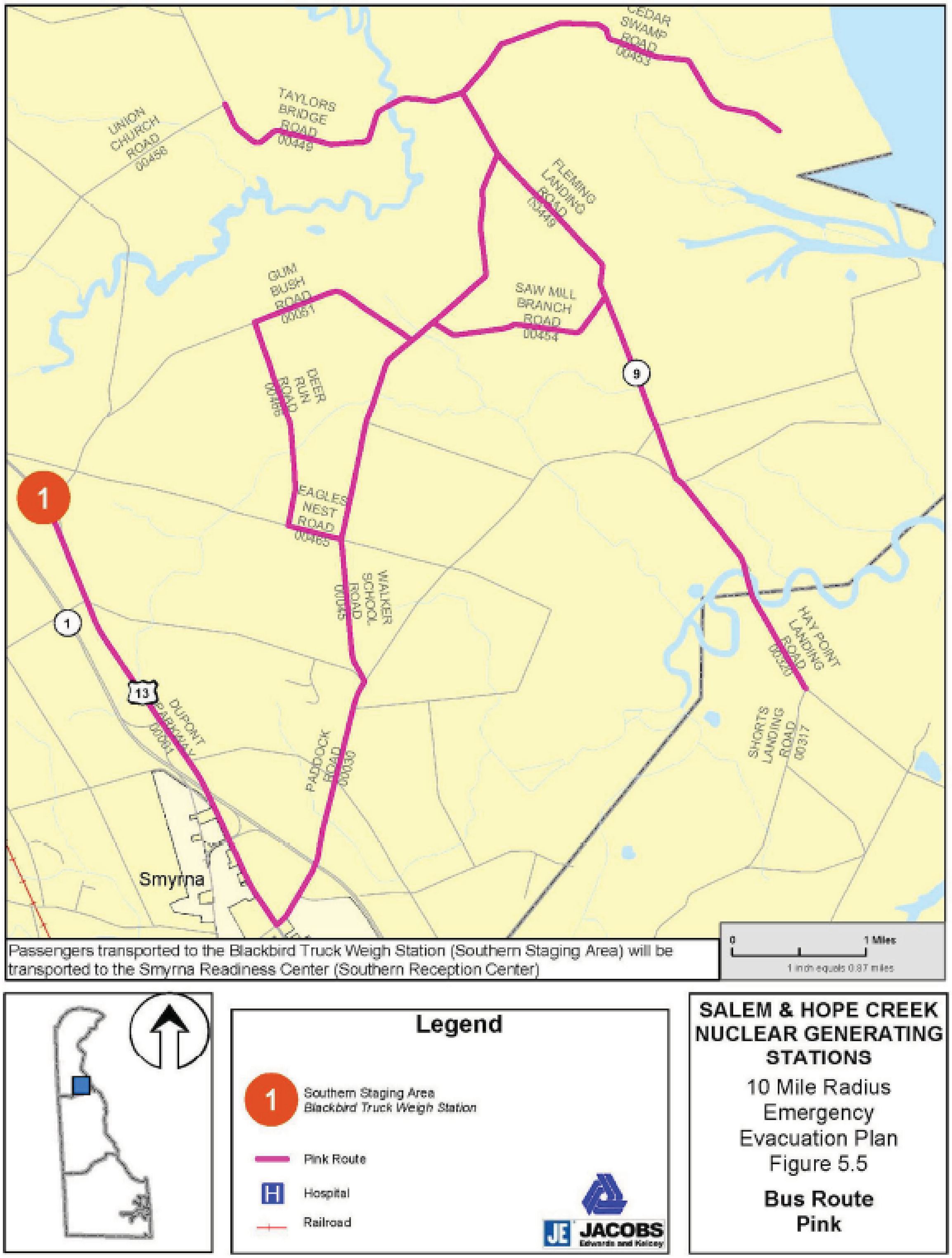
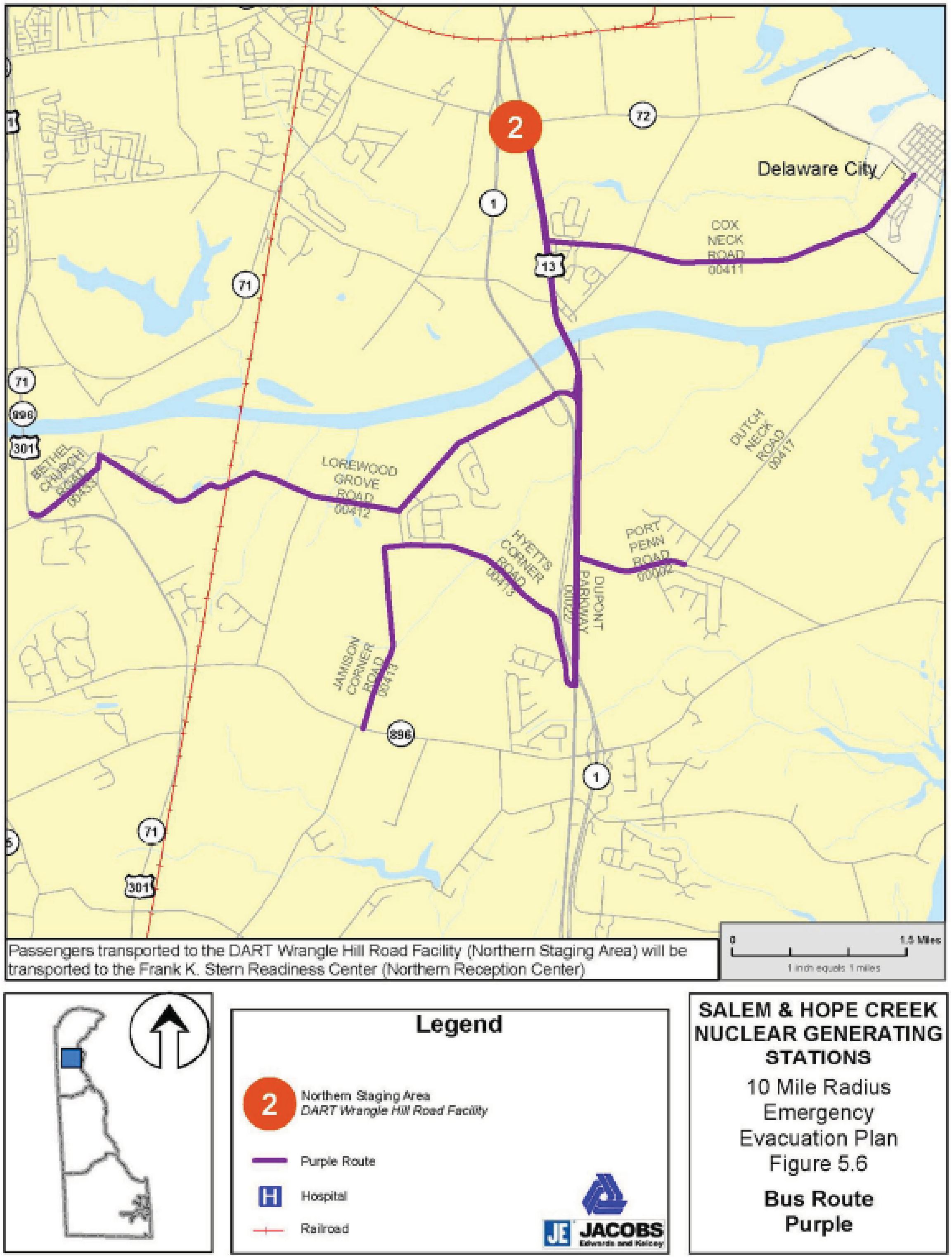
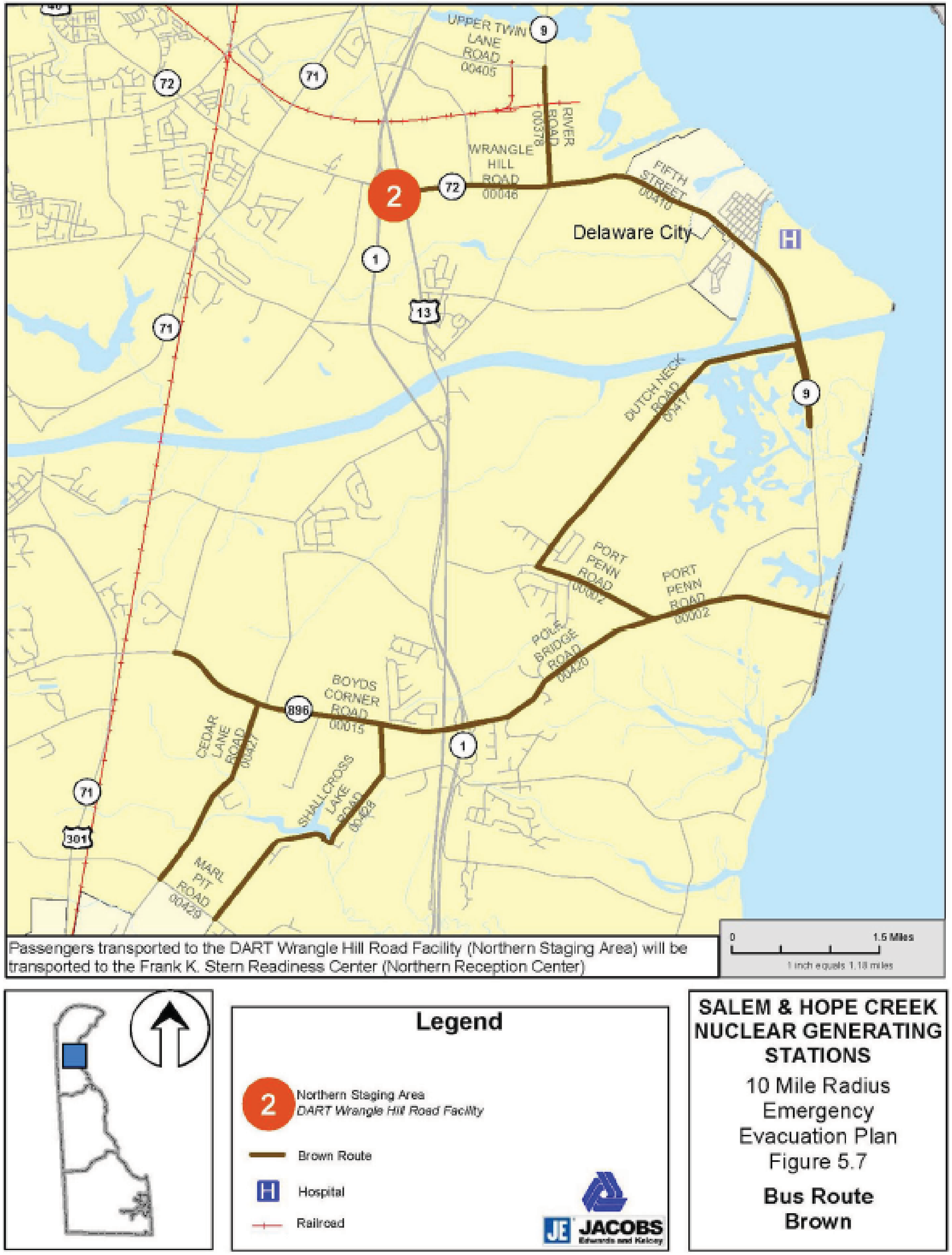
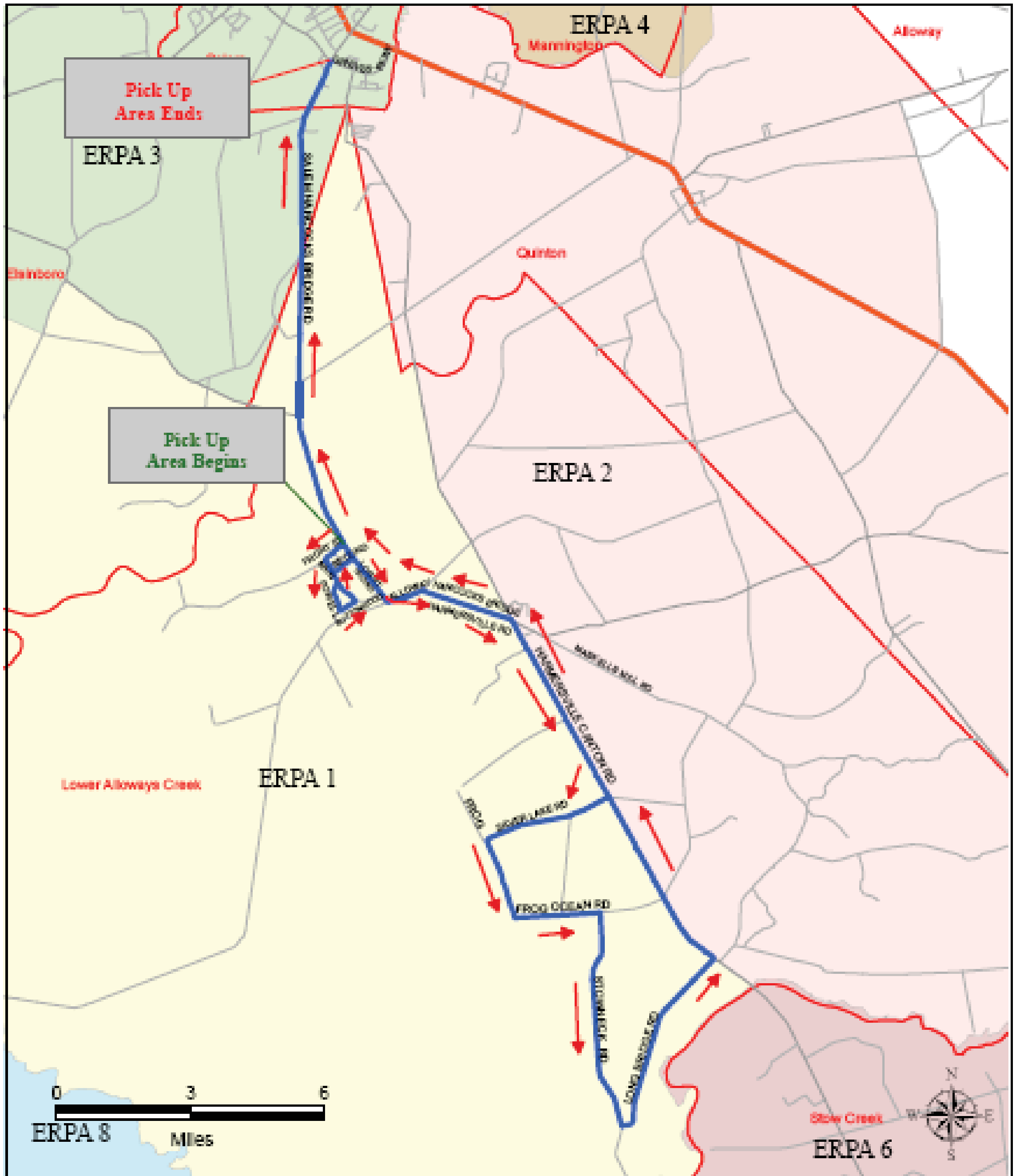


ATTACHMENT 1200-A2: EVACUATION BUS ROUTE MAPS (Continued)

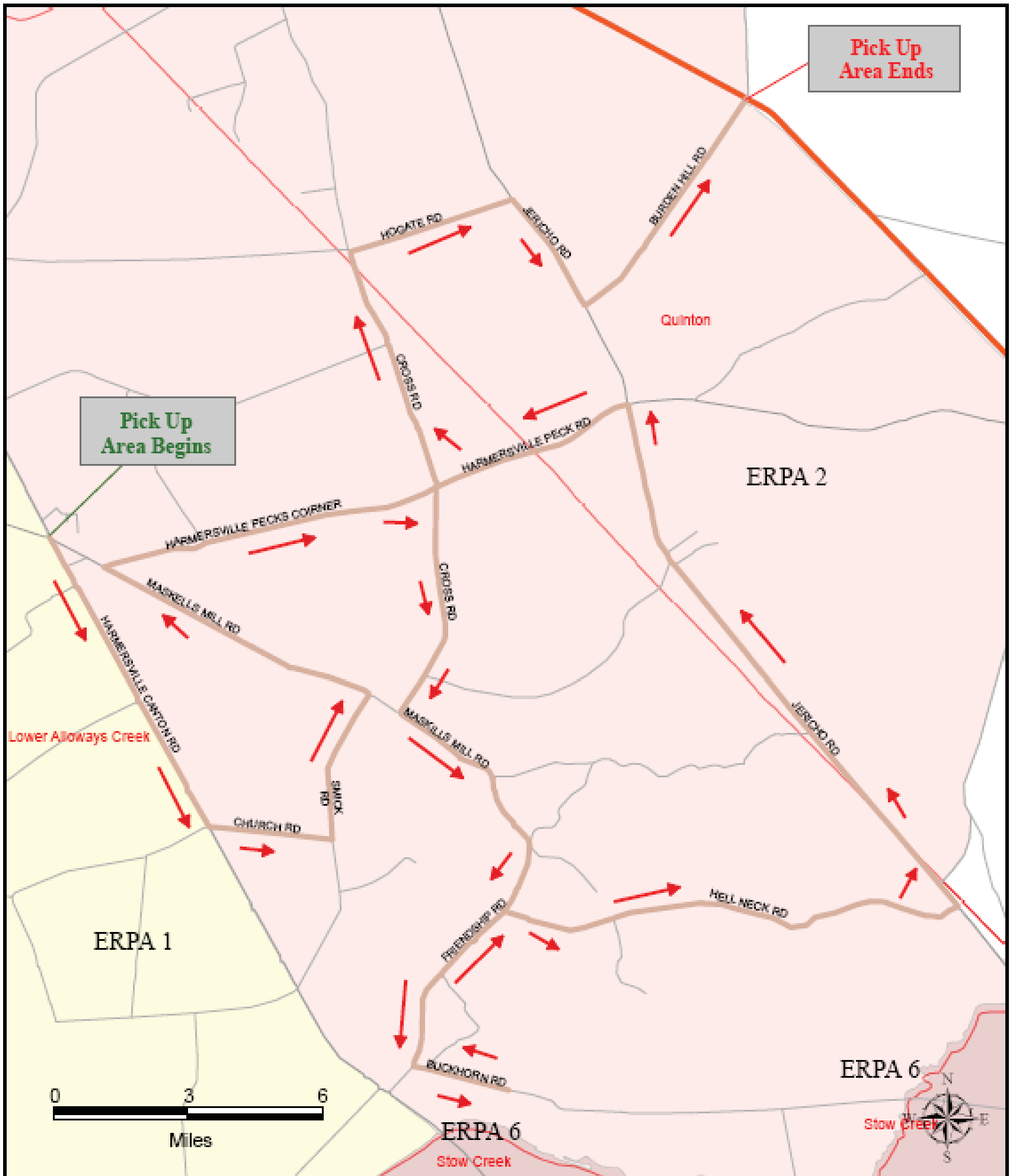


ATTACHMENT 1200-A2: EVACUATION BUS ROUTE MAPS (Continued)

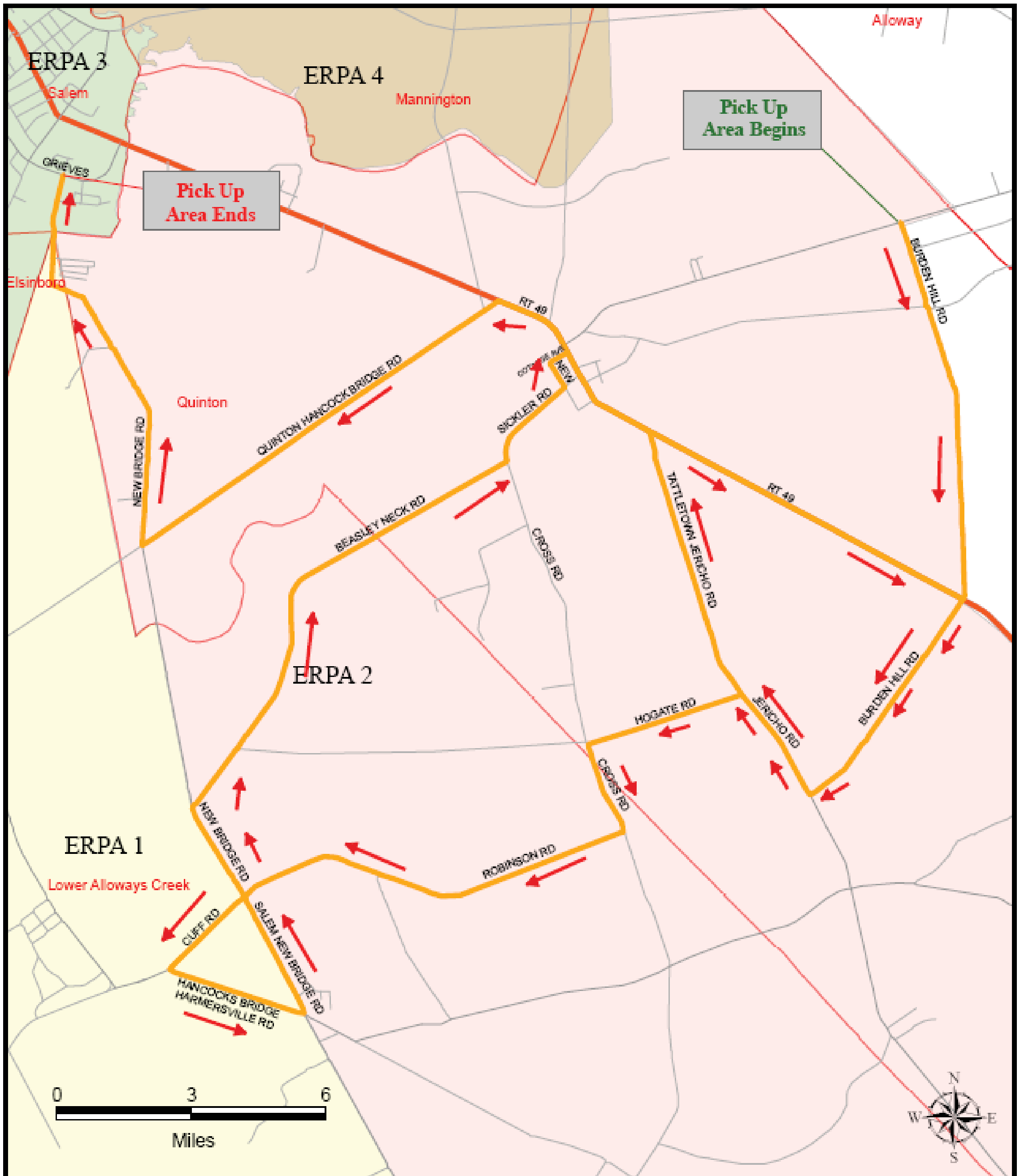




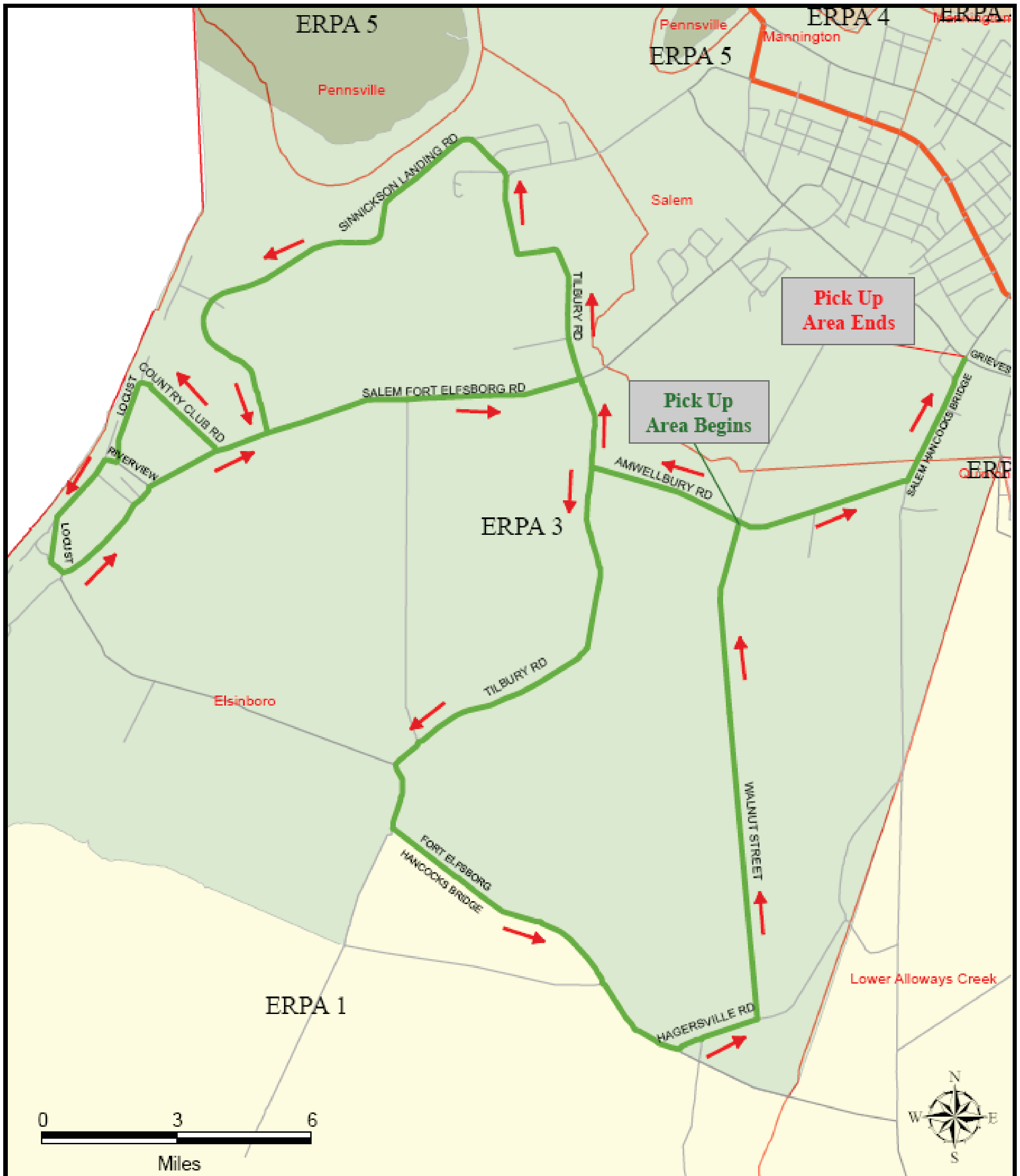
General Evacuation Bus Route #1
HANCOCKS BRIDGE
ERPA 1



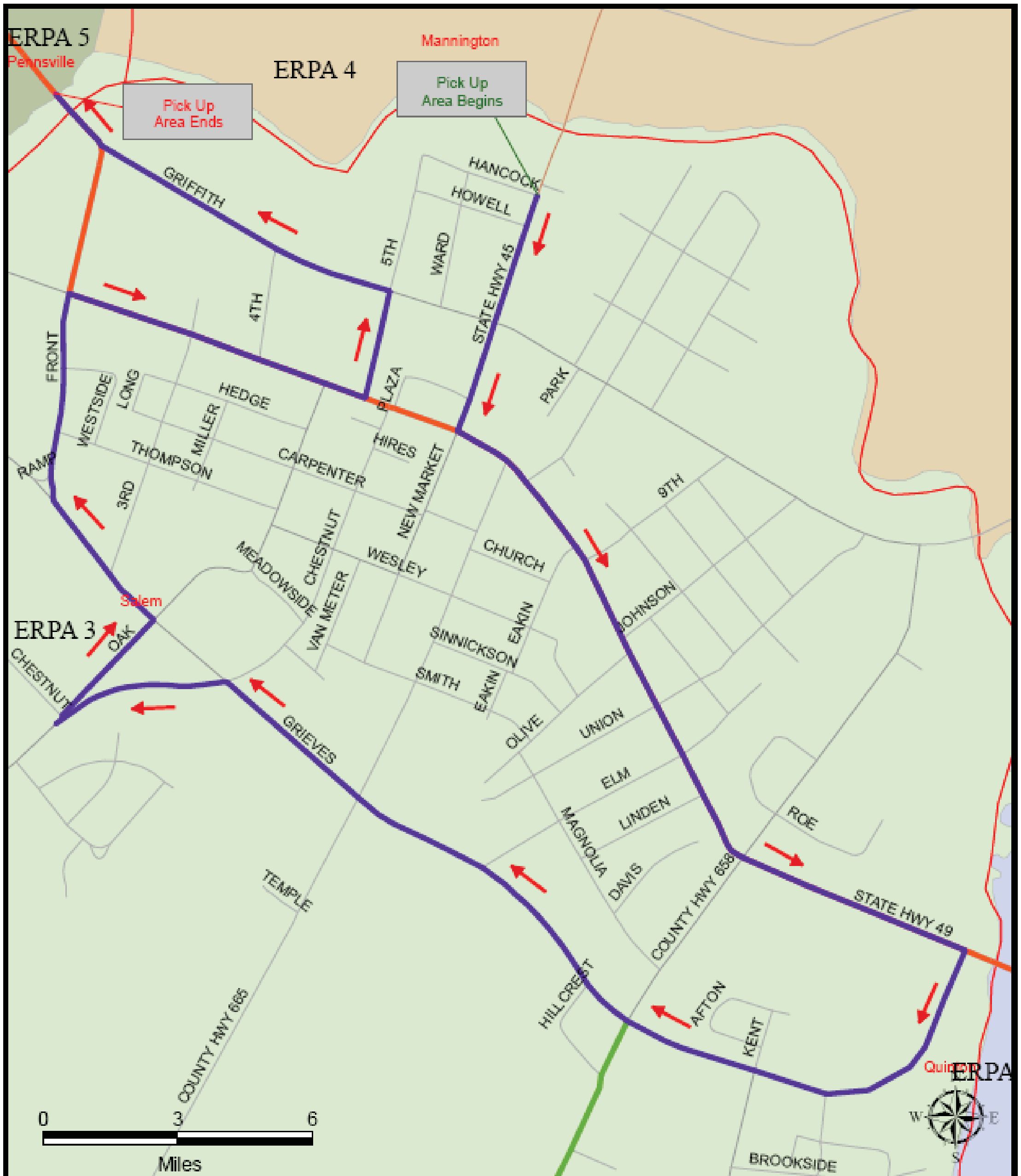
General Evacuation Bus Route #2A
QUINTON - LAC
ERPA 2



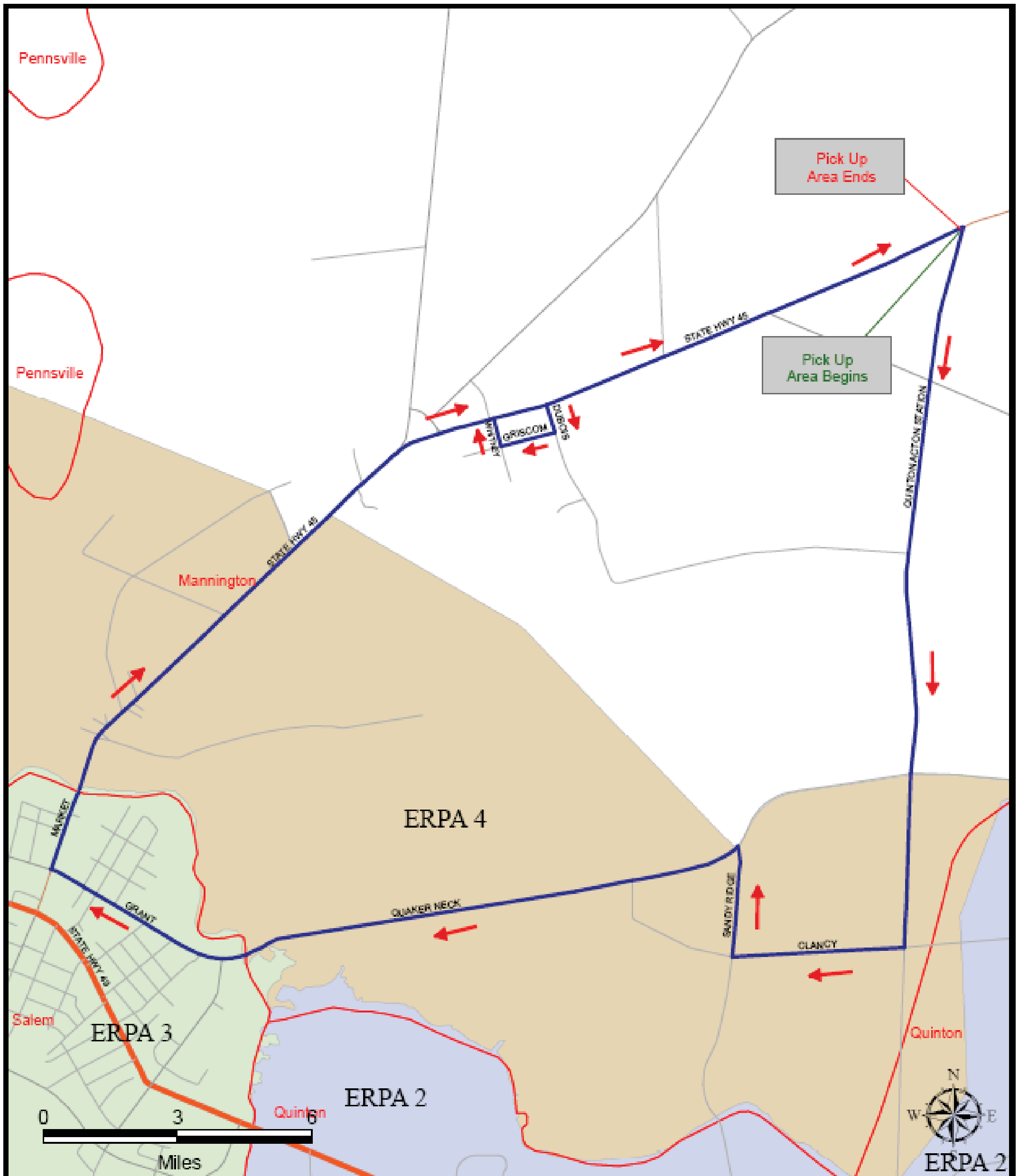
General Evacuation Bus Route #2B
QUINTON - LAC
ERPA 2



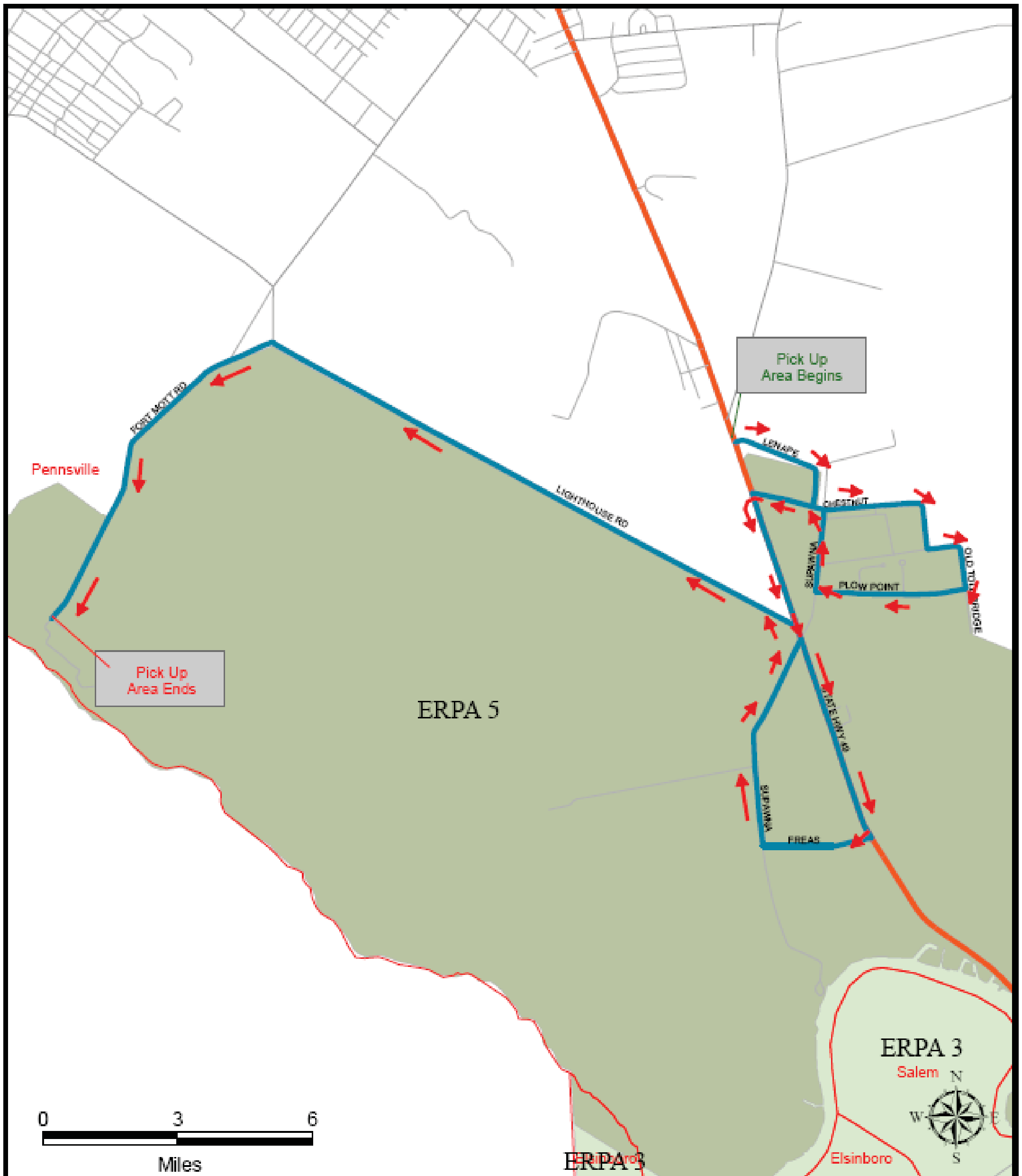
General Evacuation Bus Route #3A
ELSINBORO
ERPA 3



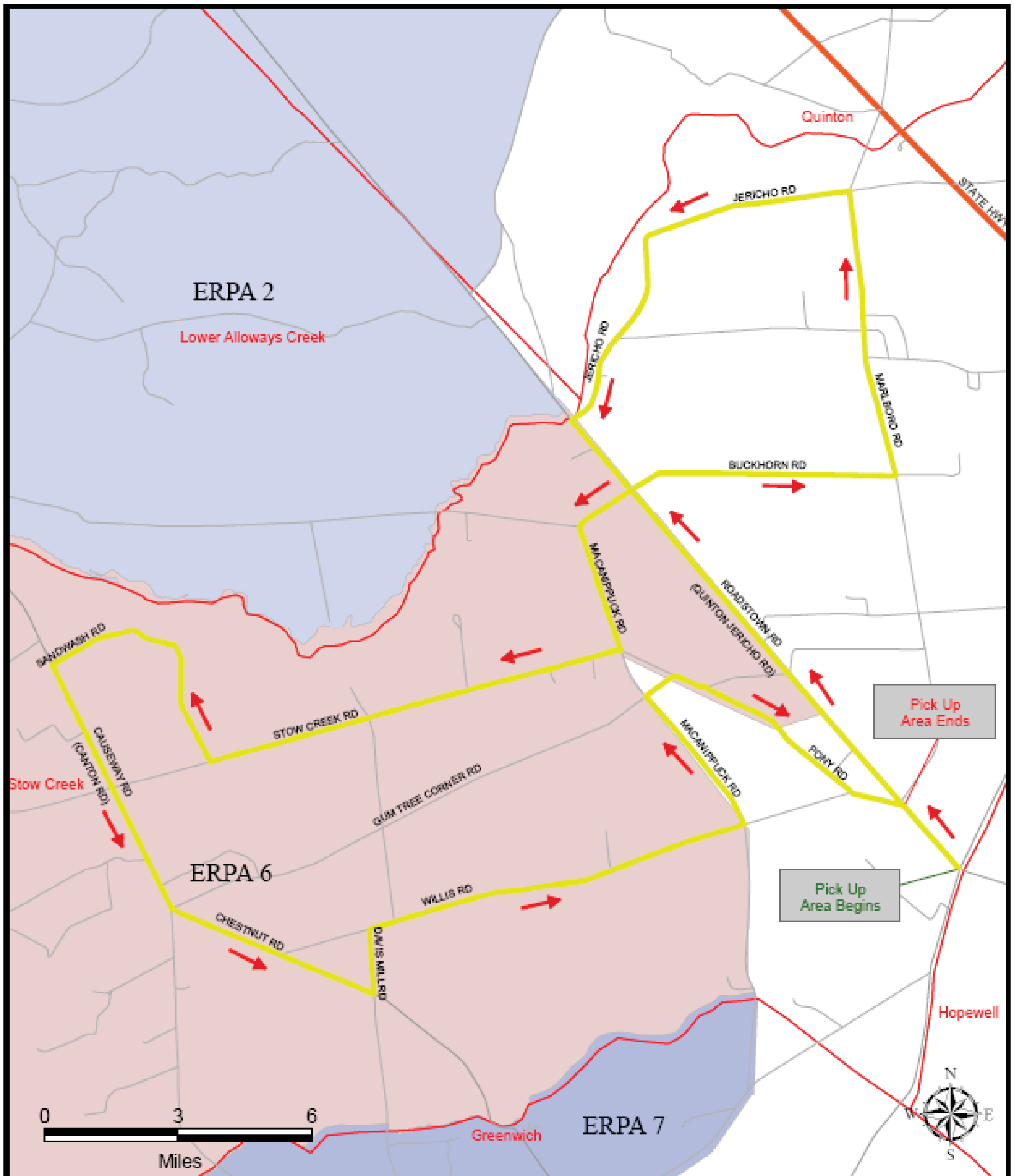
General Evacuation Bus Route #3B
SALEM CITY
ERPA 3



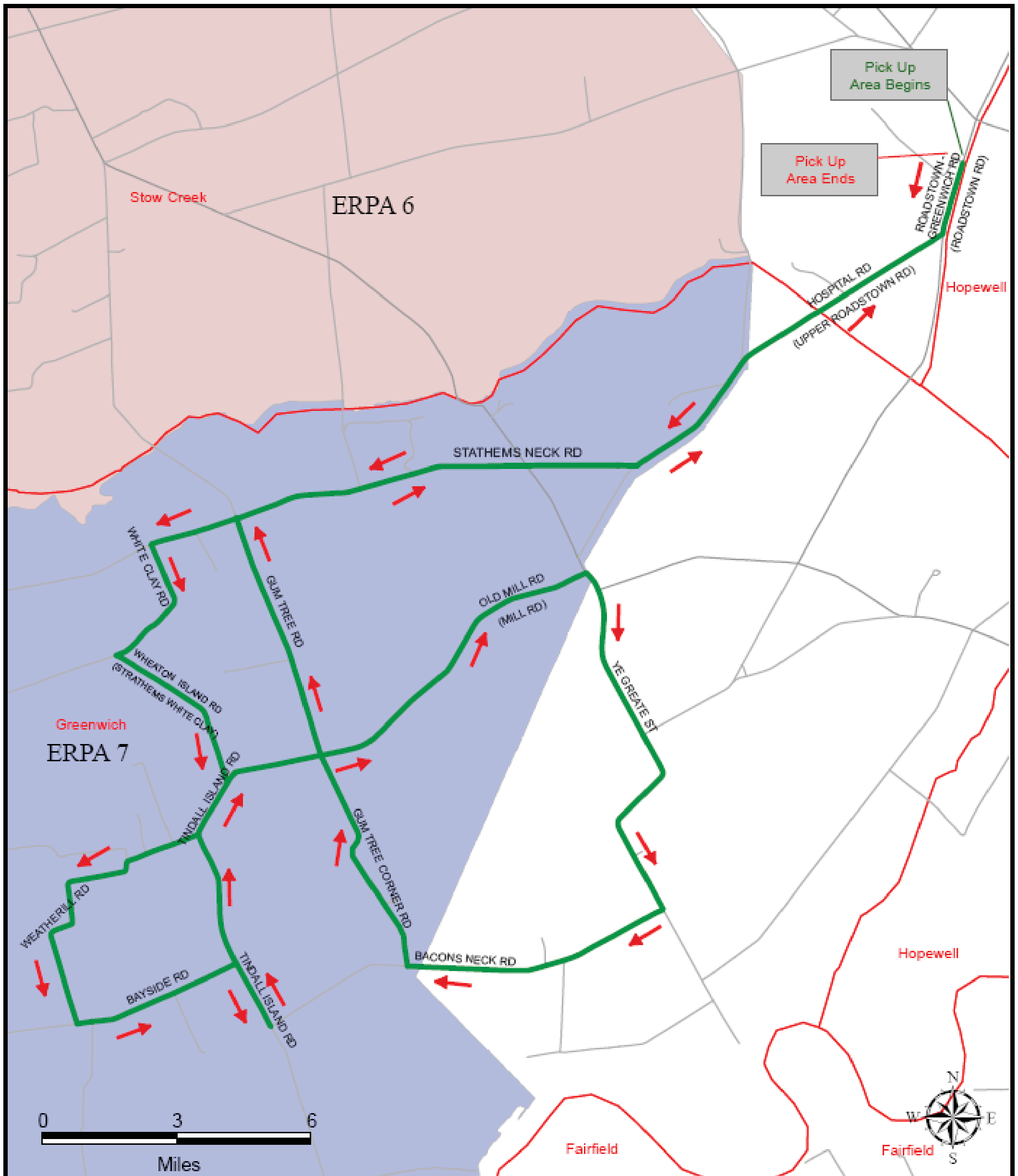
General Evacuation Bus Route #4
MANNINGTON
ERPA 4



General Evacuation Bus Route #5
PENNSVILLE
ERPA 5



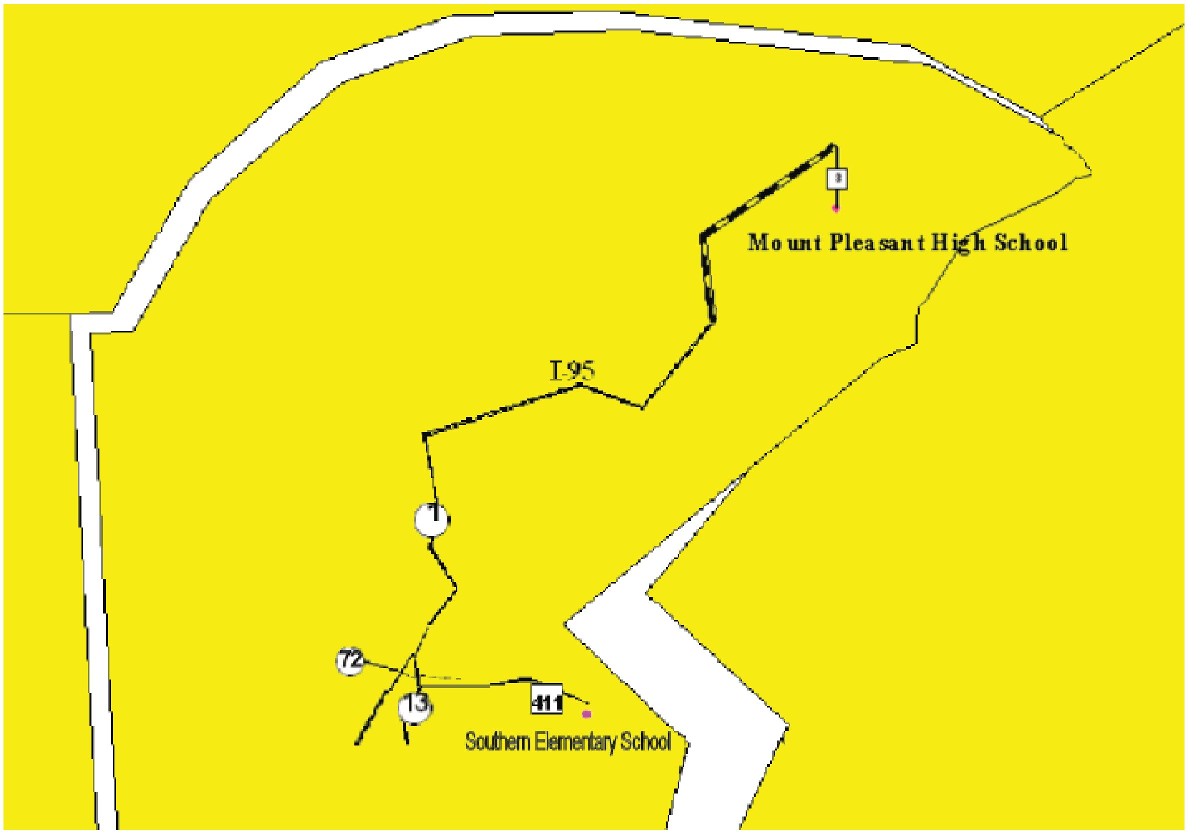
General Evacuation Bus Route #6
STOW CREEK
ERPA 6



General Evacuation Bus Route #7
GREENWICH
ERPA 7

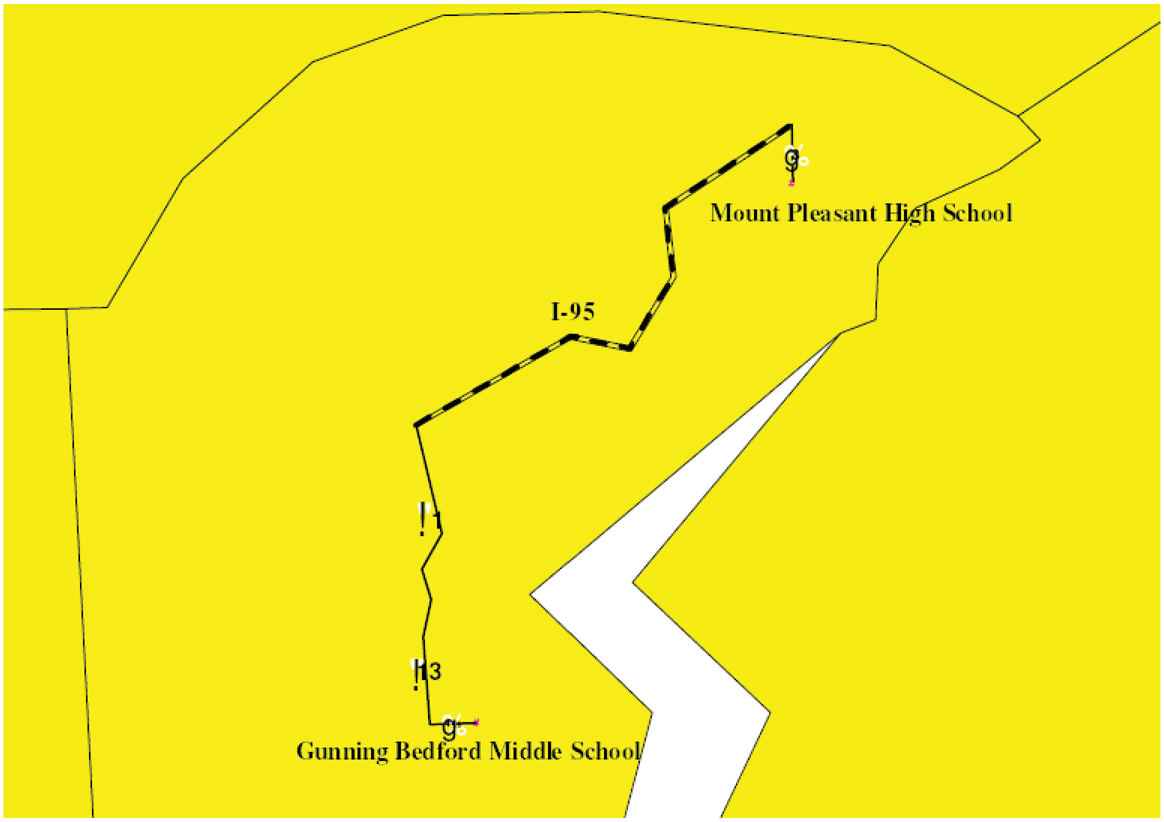
ATTACHMENT 1100-A6

SOUTHERN ELEMENTARY SCHOOL TO MT. PLEASANT HIGH SCHOOL



ATTACHMENT 1100-A7

GUNNING BEDFORD MIDDLE SCHOOL TO
MOUNT PLEASANT HIGH SCHOOL



ATTACHMENT 1100-A8

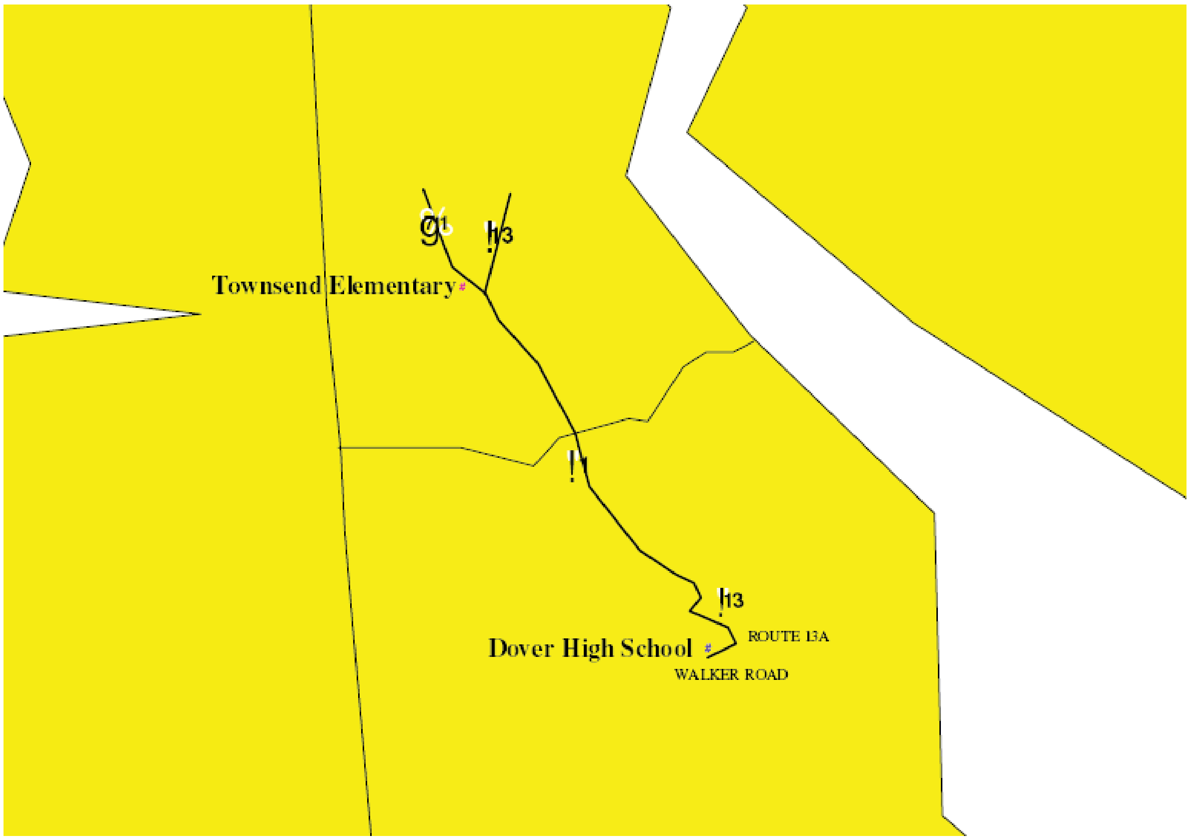
CEDAR LANE ELEMENTARY SCHOOL TO DOVER HIGH SCHOOL

ATTACHMENT 1100-A9

SILVER LAKE ELEMENTARY TO
DOVER HIGH SCHOOL

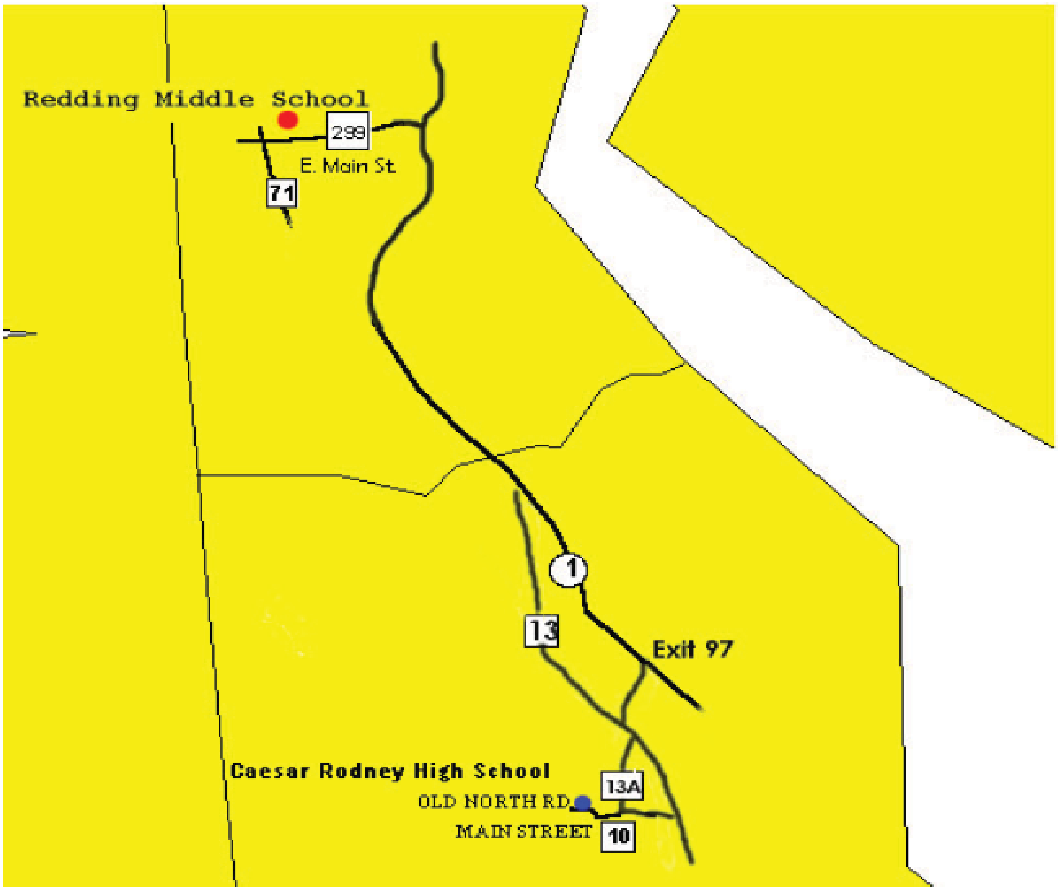
ATTACHMENT 1100-A10

TOWNSEND ELEMENTARY TO DOVER HIGH SCHOOL



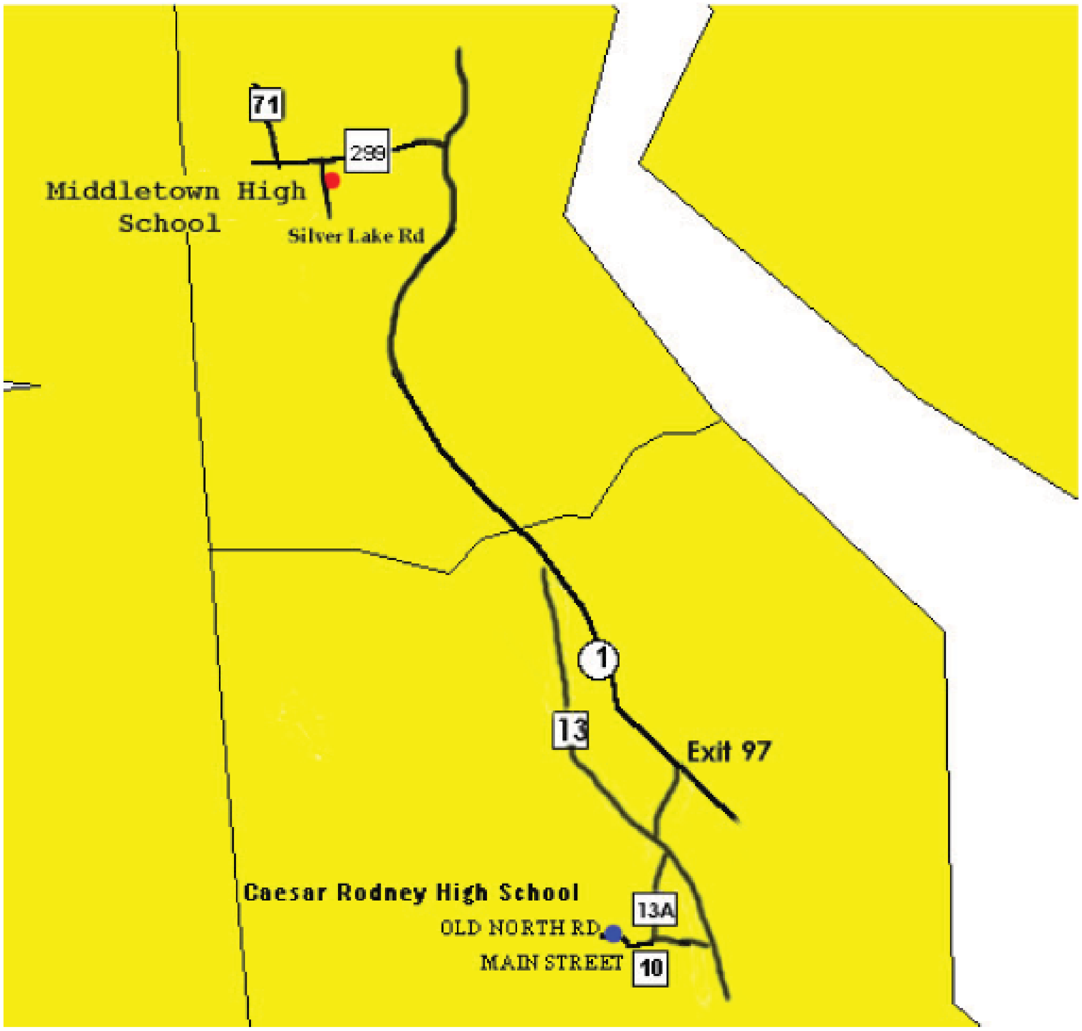
ATTACHMENT 1100-A11

REDDING MIDDLE SCHOOL TO CAESAR RODNEY HIGH SCHOOL



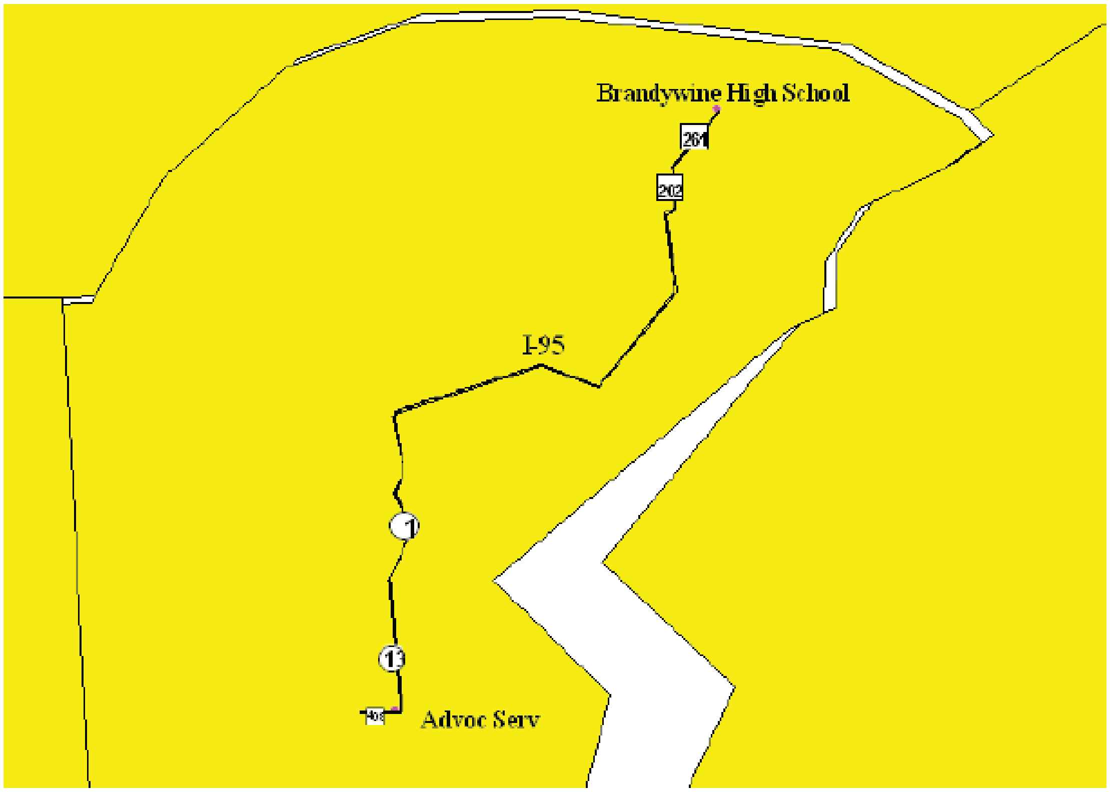
ATTACHMENT 1100-A12

MIDDLETOWN HIGH SCHOOL TO CAESAR RODNEY HIGH SCHOOL



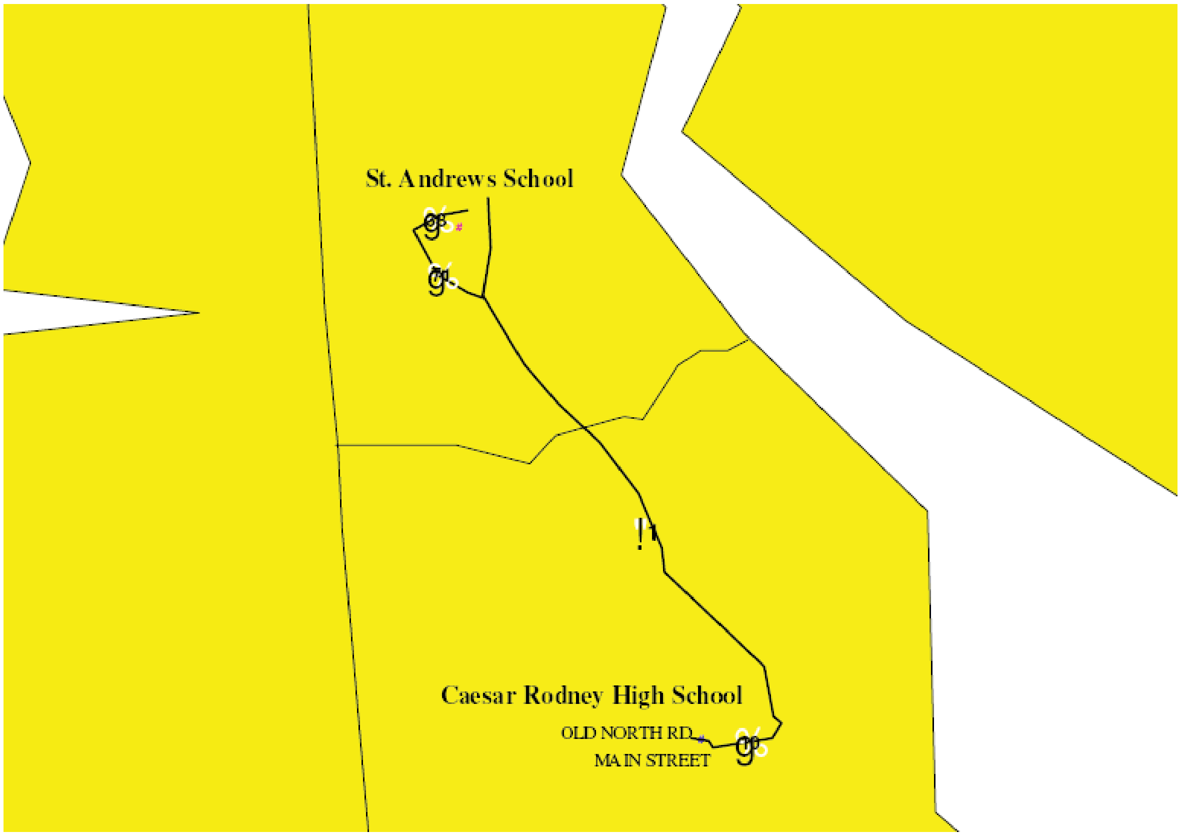
ATTACHMENT 1100-A13

ADVOC SERV SCHOOL TO BRANDYWINE HIGH SCHOOL



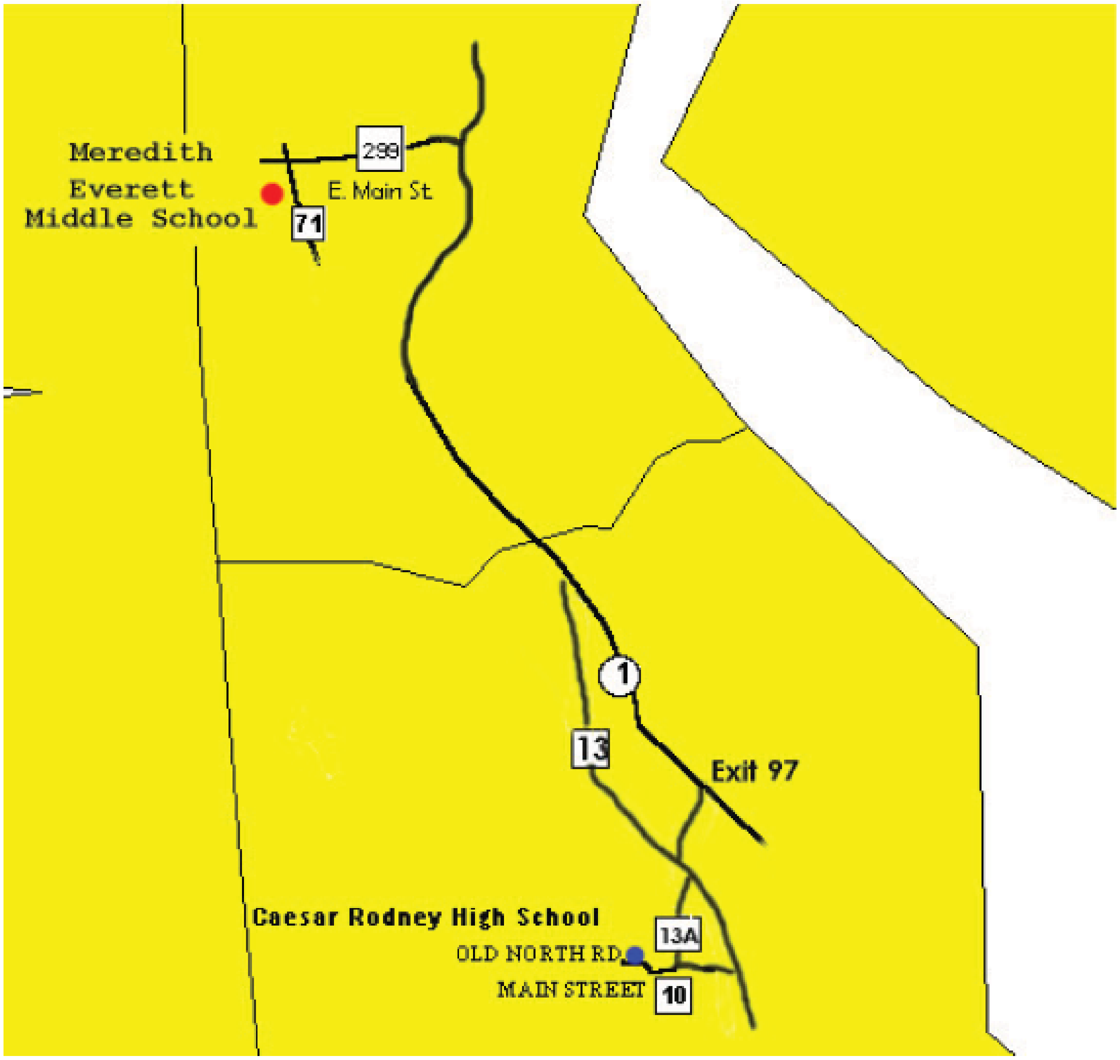
ATTACHMENT 1100-A14

ST. ANDREWS SCHOOL TO
CAESAR RODNEY HIGH SCHOOL



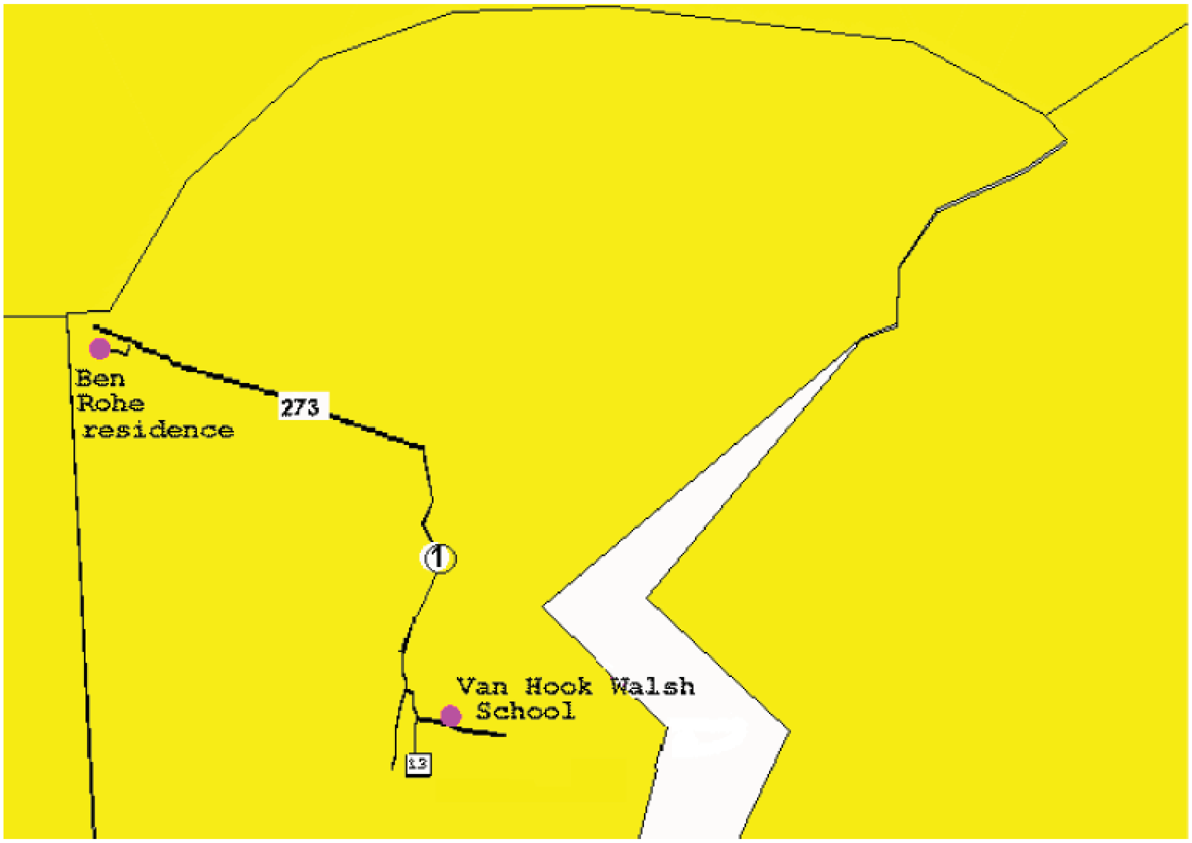
ATTACHMENT 1100-A15

EVERETT MEREDITH MIDDLE SCHOOL TO CAESAR RODNEY HIGH SCHOOL



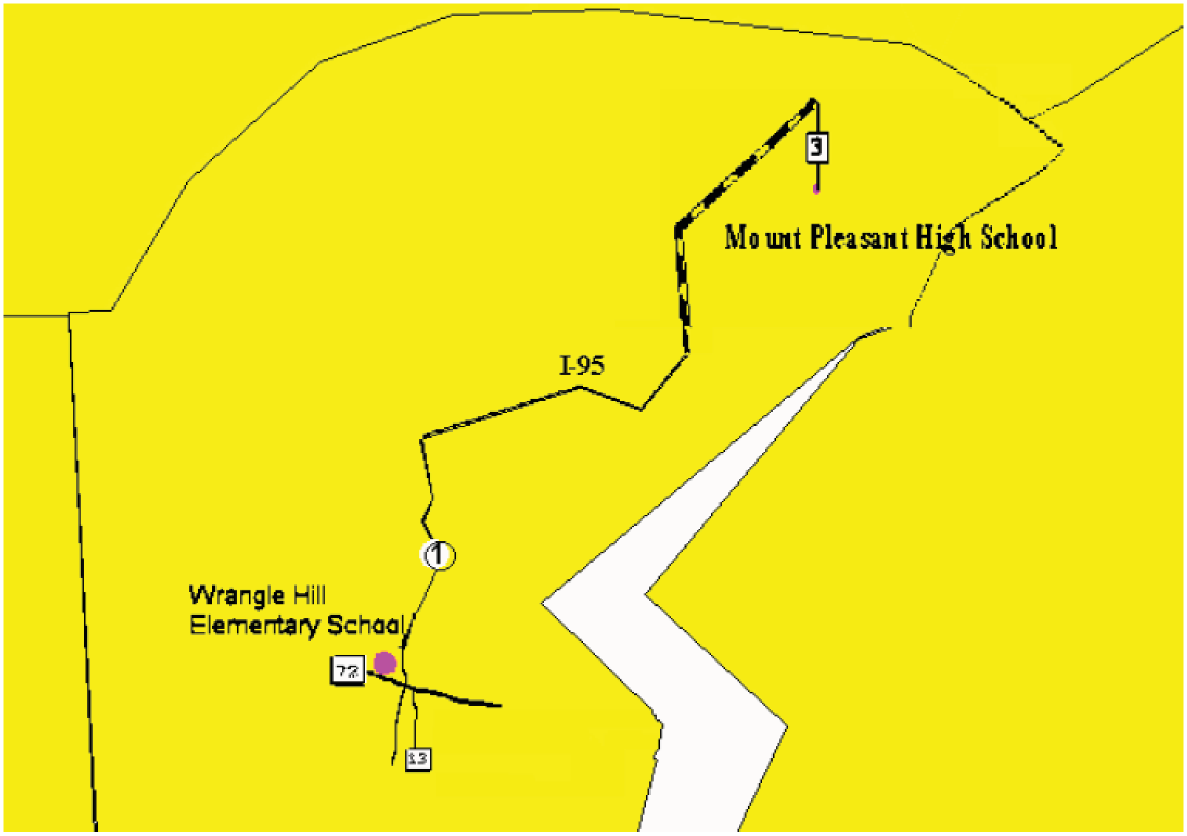
ATTACHMENT 1100-A16

VAN HOOK WALSH SCHOOL TO
BEN ROHE RESIDENCE
1134 POWDERHORN DRIVE
NEWARK, DE 19713



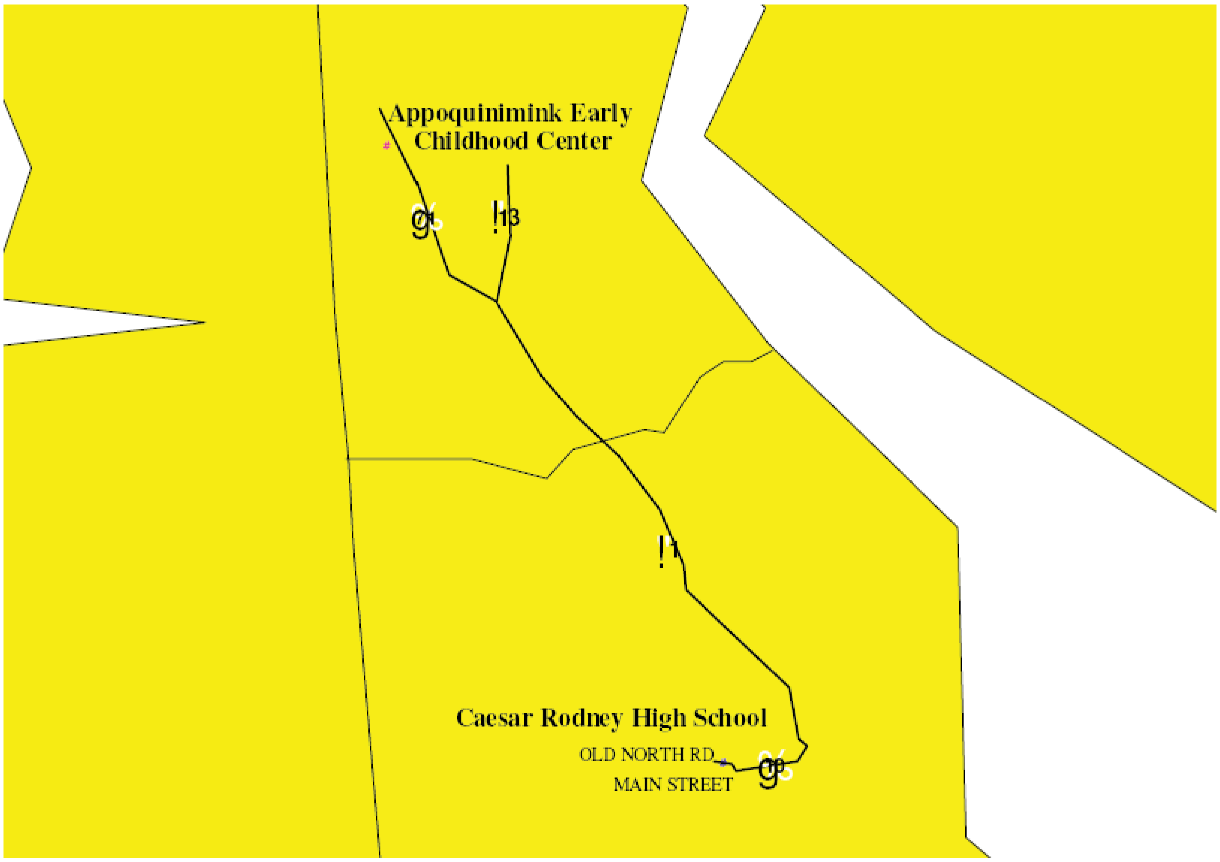
ATTACHMENT 1100-A21

WRANGLE HILL ELEMENTARY SCHOOL TO
MT. PLEASANT HIGH SCHOOL



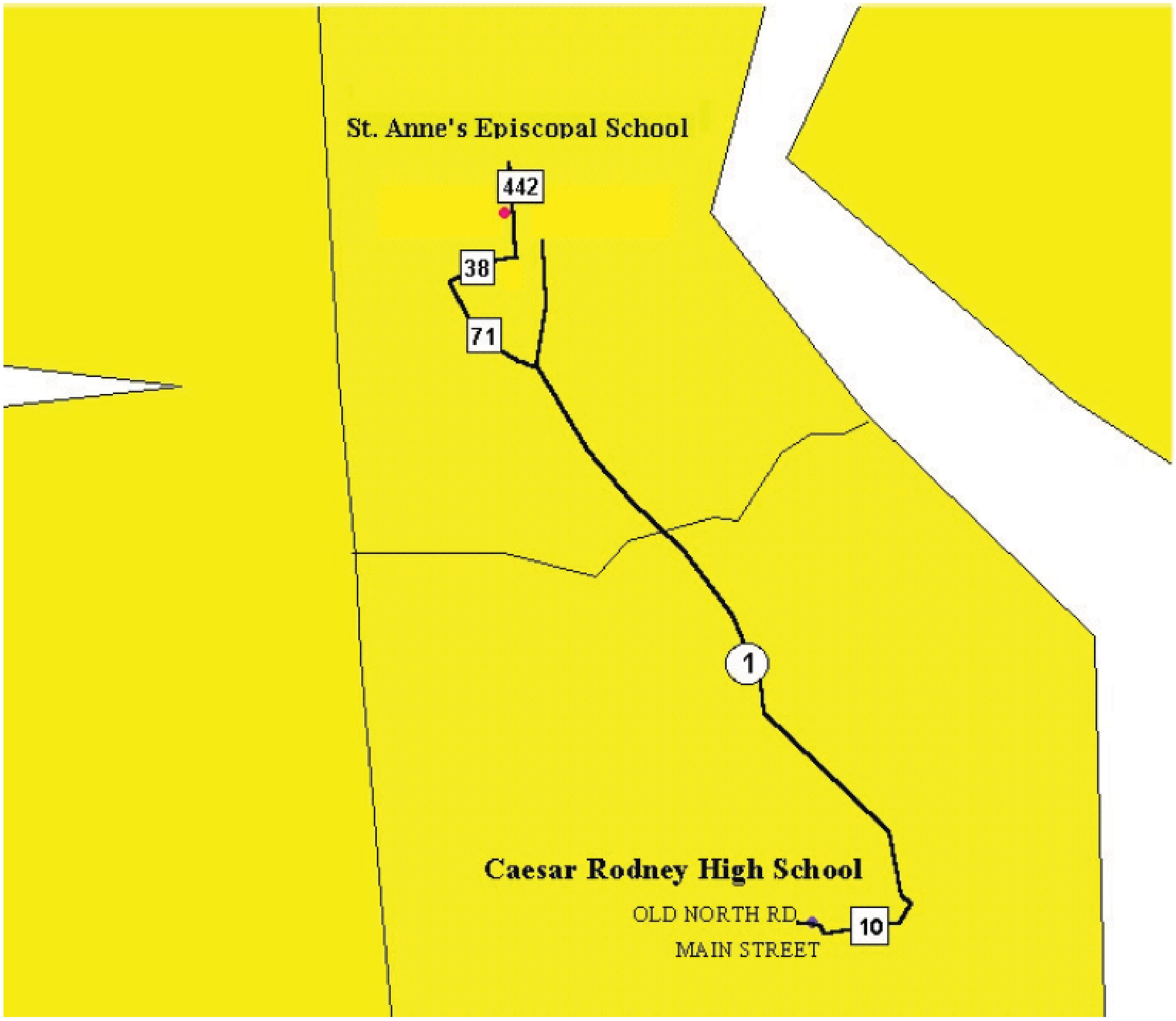
ATTACHMENT 1100-A22

APPOQUINIMINK EARLY CHILDHOOD CENTER TO CAESAR RODNEY HIGH SCHOOL



ATTACHMENT 1100 A-24

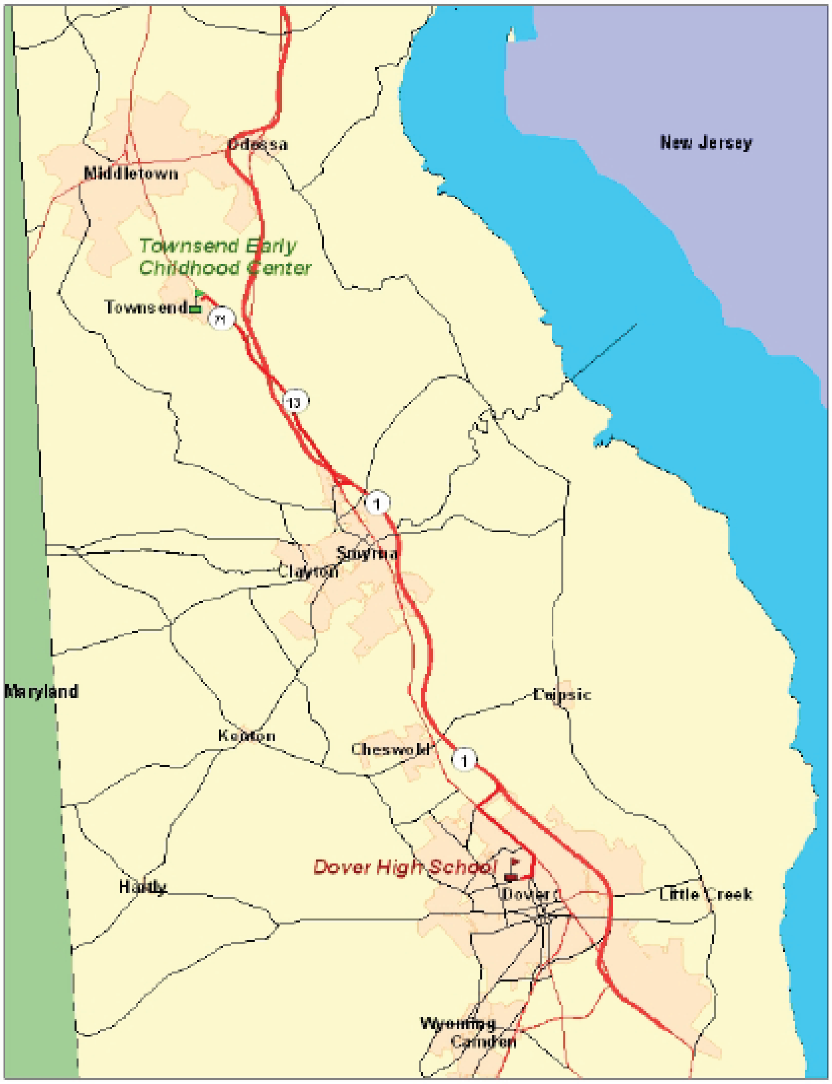
ST. ANNE'S EPISCOPAL SCHOOL TO
CAESAR RODNEY HIGH SCHOOL



ATTACHMENT 1100-A26

BRICK MILL ELEMENTARY SCHOOL TO DOVER HIGH SCHOOL

ATTACHMENT 1100 A-25
TOWNSEND EARLY CHILDHOOD CENTER TO
DOVER HIGH SCHOOL



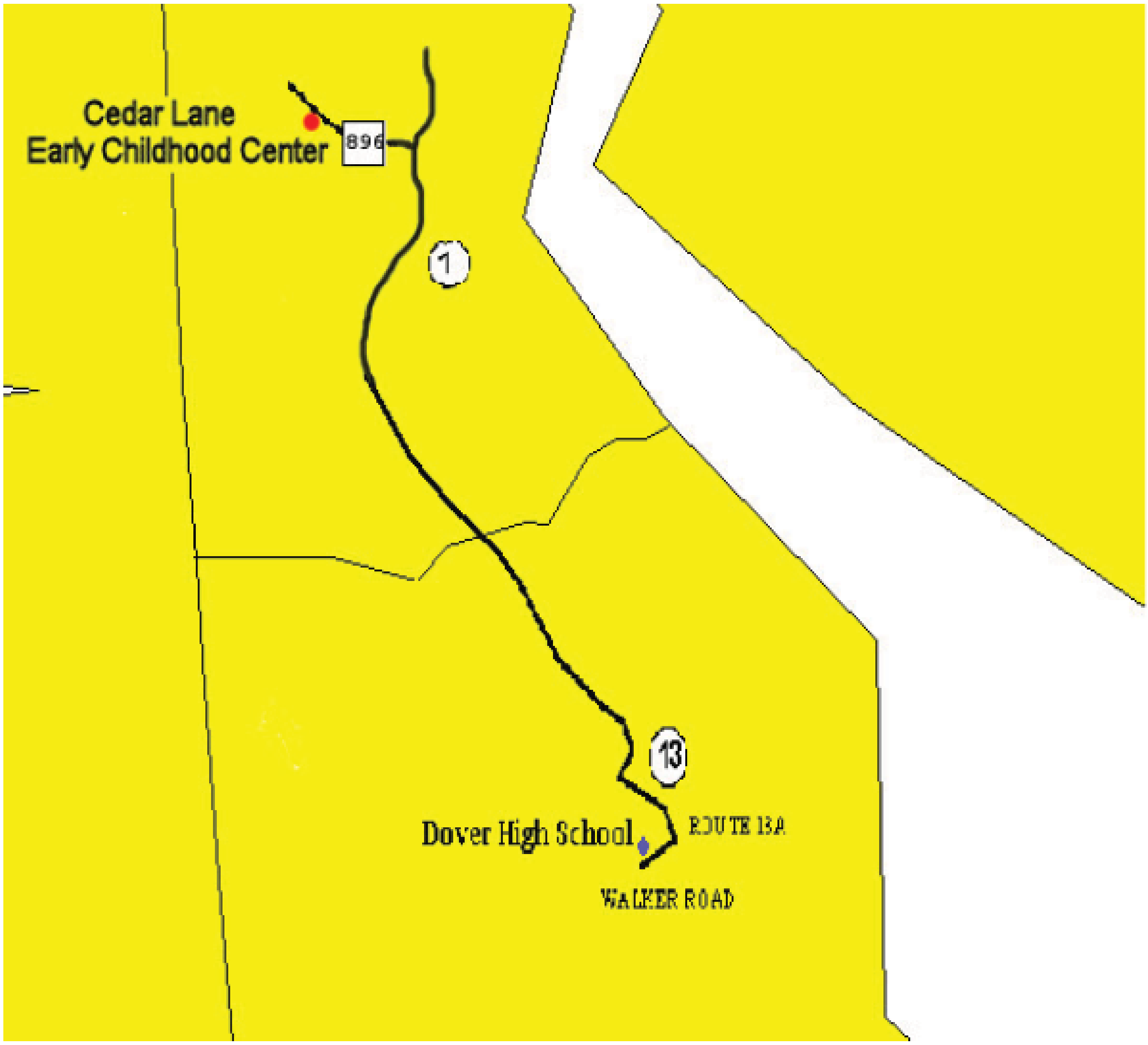
TRAVEL SOUTH ON ROUTE 71 TO ROUTE 13. TRAVEL SOUTH ON ROUTE 13 TO ROUTE 1 JUST NORTH OF SMYRNA. TRAVEL SOUTH ON ROUTE 1 TO ROUTE 13 (NORTH DOVER EXIT). TRAVEL SOUTH ON ROUTE 13 TO ROUTE 13A (STATE STREET). TAKE ROUTE 13A SOUTH TO WALKER ROAD TO DOVER HIGH SCHOOL.

ATTACHMENT 1100-A27

JAMES H. GROVES ADULT HIGH SCHOOL TO DOVER HIGH SCHOOL

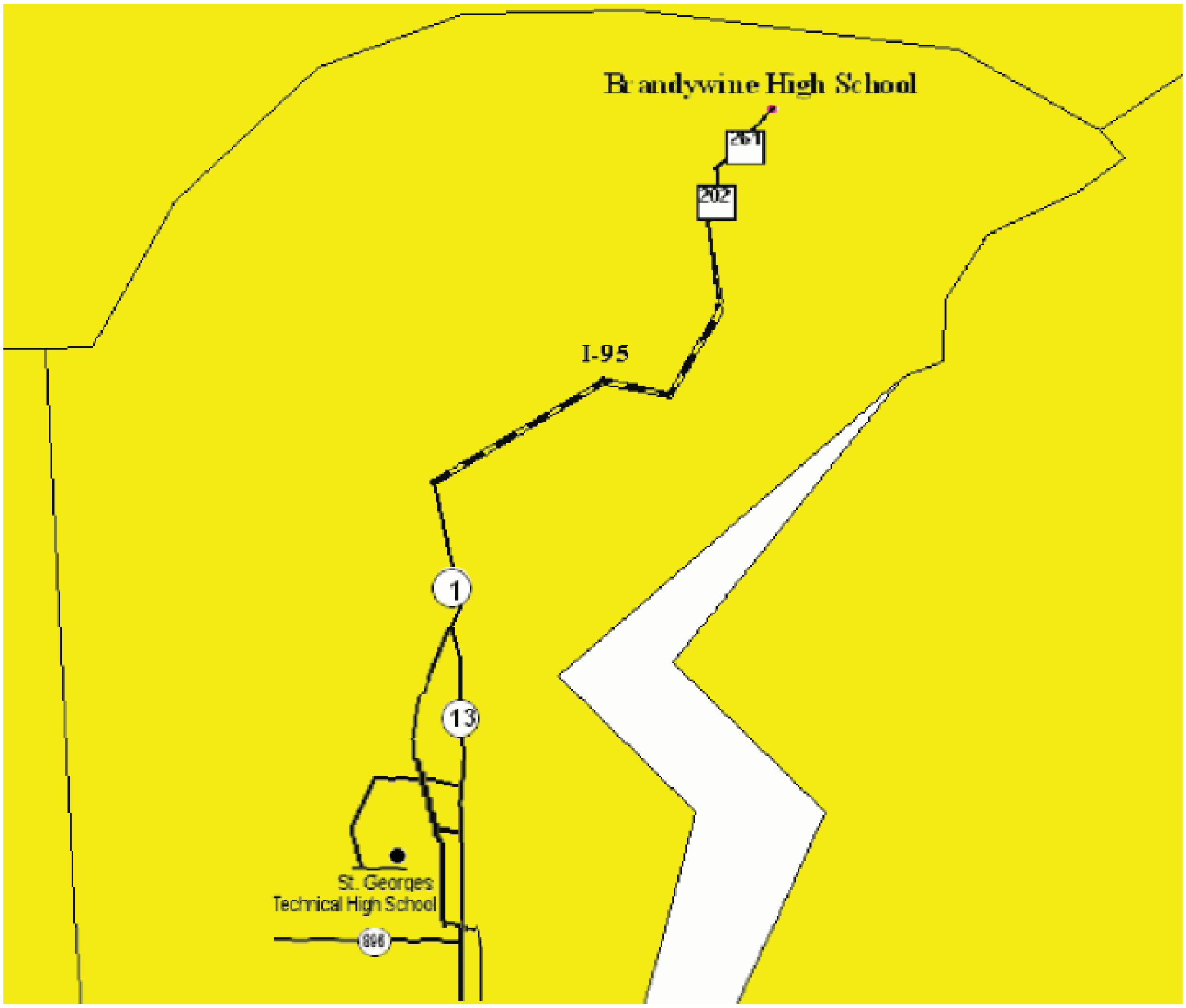
ATTACHMENT 1100-A32

CEDAR LANE EARLY CHILDHOOD CENTER TO DOVER HIGH SCHOOL



ATTACHMENT 1100-A34

ST. GEORGES TECHNICAL HIGH SCHOOL TO BRANDYWINE HIGH SCHOOL



ATTACHMENT 1100-A35

ALFRED WATERS MIDDLE SCHOOL TO DOVER HIGH SCHOOL

APPENDIX N

The Proposed Causeway Sensitivity Study

APPENDIX N: THE PROPOSED CAUSEWAY SENSITIVITY STUDY

1. INTRODUCTION

PSEG Power requested Sargent & Lundy LLC to prepare a feasibility study for constructing an alternate construction access road to the PSEG Site. The alternate route would be an elevated causeway linking local roads in Elsinboro Township with the existing site access road located within the Owners Controlled Area (OCA) of the PSEG Nuclear property. The alternate access road would be approximately 4.75 miles in length. A conceptual three lane roadway layout was developed for the feasibility study. A three lane roadway was selected in that three lanes would provide flexibility for changing the traffic pattern to and from the site during peak traffic hours; allow for wide loads when transporting equipment to and from the site; and allow for roadway maintenance or lane closure without significant disruption of traffic flow to and from the site. A copy of the conceptual roadway layout has been provided as Figure N-1.

This appendix studies the effect on evacuation time estimates (ETE) of using the proposed causeway as an additional access road to the site during peak construction of the proposed new plant at the PSEG Site.

2. METHODOLOGY

Figure 1-2 displays the link-node analysis network that was used to model the roadway system surrounding the PSEG Site and to compute ETE. Figures K-1 through K-25 provide additional detail of the link-node analysis network. The link-node analysis network was modified to include the proposed causeway. As shown in Figure N-2, nodes 1201, 1202 and 1203 and the links connecting these nodes in a northbound direction were added to the analysis network to represent the proposed causeway.

It is likely that traffic traveling northbound on the proposed causeway would use Amwellbury Rd to bypass Route 624 which has reduced speed limits through Fort Elfsborg and Oakwood Beach. Nodes 1204, 1205, 1206, 1207 and 1208 and the links connecting these nodes northbound along Amwellbury Rd were added to the analysis network to represent this bypass movement; Figure N-3 shows these links and nodes.

The proposed causeway and Amwellbury Rd were modeled as a single lane road outbound with a free speed of 50 mph and a capacity of 1,700 vehicles per hour per lane. Table K-1 provides the characteristics of all links in the analysis network. Table N-1 summarizes the characteristics of the links added to model the proposed causeway and Amwellbury Rd.

The vehicles used by existing employees at the operational Salem and Hope Creek units and those vehicles associated with refueling of one of the operational units were loaded eastbound on the existing access road. Those vehicles at the site associated with the construction of, and operations at, the new plant were loaded northbound on the proposed causeway.

3. RESULTS

As noted on page I-3, a sensitivity study was conducted to determine the effect on ETE of adding an additional travel lane to the existing site access road. The cases considered were Scenario 13, Regions R01, R02 and R03; winter, midweek, midday, good weather evacuations for the two-mile region, five-mile region and entire EPZ during peak construction of the new plant coincident with refueling of one of the operational units. This addendum considers a third configuration – the addition of the proposed causeway as an additional access road to the PSEG Site. Table N-2 compares the ETE for the three possible roadway configurations for Regions R01, R02 and R03 at the 90th, 95th and 100th percentiles.

As shown in Table N-2, there are significant ETE benefits for Regions R01 and R02 when using the proposed causeway, while the ETE for Region R03 are unaffected. As discussed in Section 7.2, the bottleneck for traffic evacuating in the New Jersey portion of the EPZ is Salem City. Many of the construction workers for the base case are evacuating northbound on Salem-Hancocks Bridge Rd toward Salem City and eastbound along Beasley Neck Rd and Harmersville Pecks Corner Rd to avoid the congestion in Salem City and travel out of the EPZ. Congestion propagates downstream along the access road from the signalized intersection with Salem-Hancocks Bridge Rd within the 2-mile and 5-mile regions. Adding the proposed causeway provides an additional northbound evacuation route and allows traffic to clear the 2-mile region forty minutes earlier at both the 90th and 95th percentiles relative to the existing access road for an evacuation of Region R01. The ETE is reduced by 10 minutes and 25 minutes for the 90th and 95th percentiles, respectively, for an evacuation of Region R02. Region R03, however, includes Salem City. The last of the congestion to clear during an evacuation is in Salem. The use of the proposed causeway as an additional evacuation route allows vehicles to leave the 2 and 5-mile regions more effectively; however, the bottleneck in Salem is not alleviated and the ETE for the entire EPZ is unaffected.

Figures N-4, N-5 and N-6 plot evacuating vehicles versus elapsed time after the advisory to evacuate for Regions R01, R02 and R03, respectively. As shown in Figures N-4 and N-5, the curve representing the proposed causeway alternative has a steeper slope due to the additional capacity of the extra evacuation route northbound. This additional capacity leads to faster ETE at the 90th and 95th percentiles. The 100th percentile is not affected as it is dictated by the trip generation time, as discussed in Sections 7.2 and 7.3. Figure N-6 indicates that the ETE are nearly identical (curves are coincident) for all alternatives, which is to be expected as the ETE are dictated by the clearance of congestion within Salem City. This congestion is not alleviated by an additional lane on the existing access road or by the use of the proposed causeway.

Figures N-7 through N-9 present the congestion patterns for an evacuation of Region R01 with the existing access road configuration, while Figures N-10 through N-12 present the congestion patterns for an evacuation of Region R01 with the proposed causeway. As shown in Figures N-7 and N-8, there is congestion on the access road within the 2-mile and 5-mile radii for two hours after the advisory to evacuate (ATE). Figure N-10 shows that there is congestion within the 2-mile and 5-mile radii at one hour after the advisory to evacuate (ATE); however, congestion within both radii is clear by 2 hours after the ATE (Figure N-11). Figures N-9 and N-12 indicate that congestion within the EPZ is clear by 3 hours after the ATE for both the existing access road configuration and the proposed causeway.

4. CONCLUSIONS

The proposed causeway would significantly reduce ETE at the 90th and 95th percentiles for an evacuation of the 2-mile region (Region R01) and of the 5-mile region (Region R02). The ETE for an evacuation of the entire EPZ (Region R03) is unaffected by the addition of the proposed causeway, unless coupled with roadway improvements within Salem City.

Figure N-1. The Proposed Causeway – Conceptual Drawing

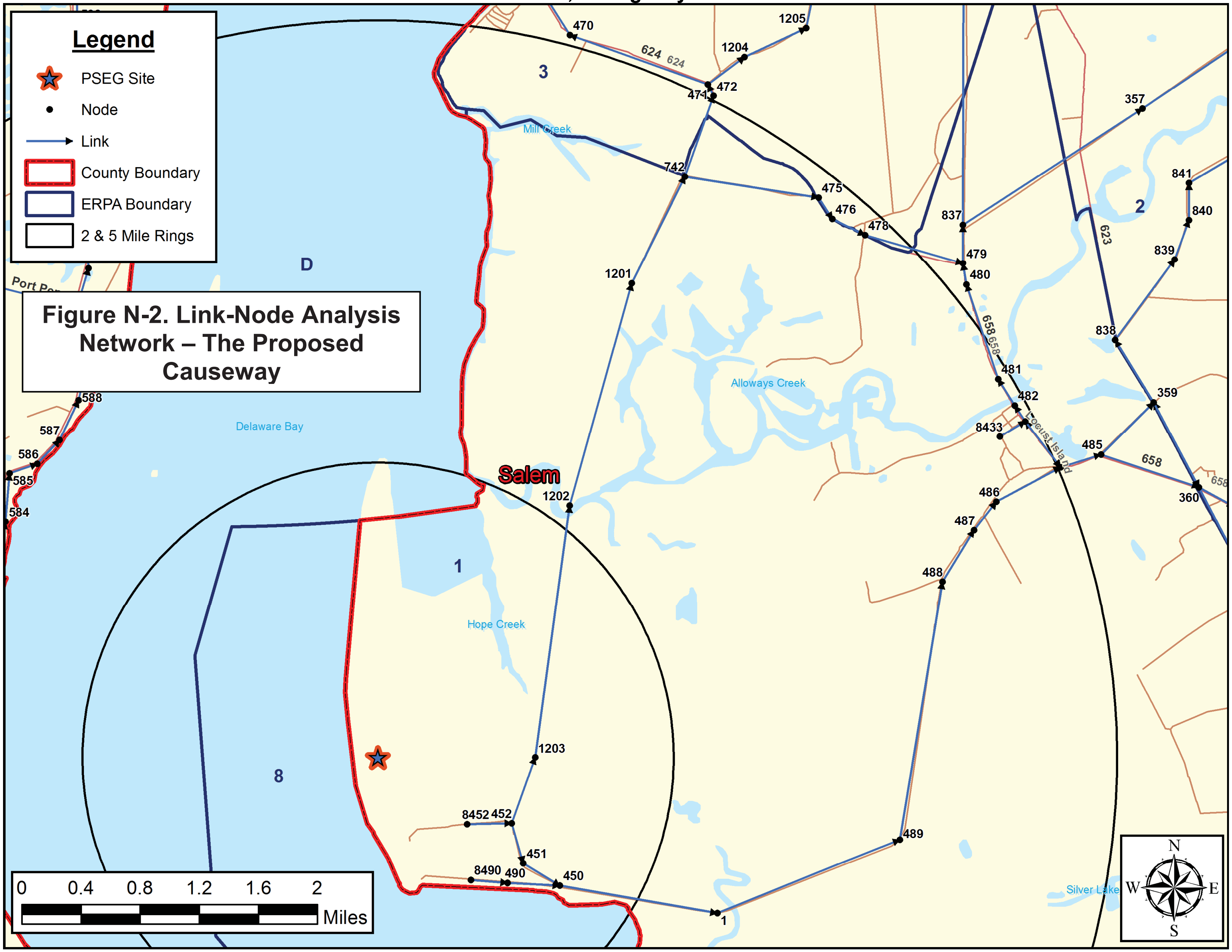


Figure N-2. Link-Node Analysis Network – The Proposed Causeway

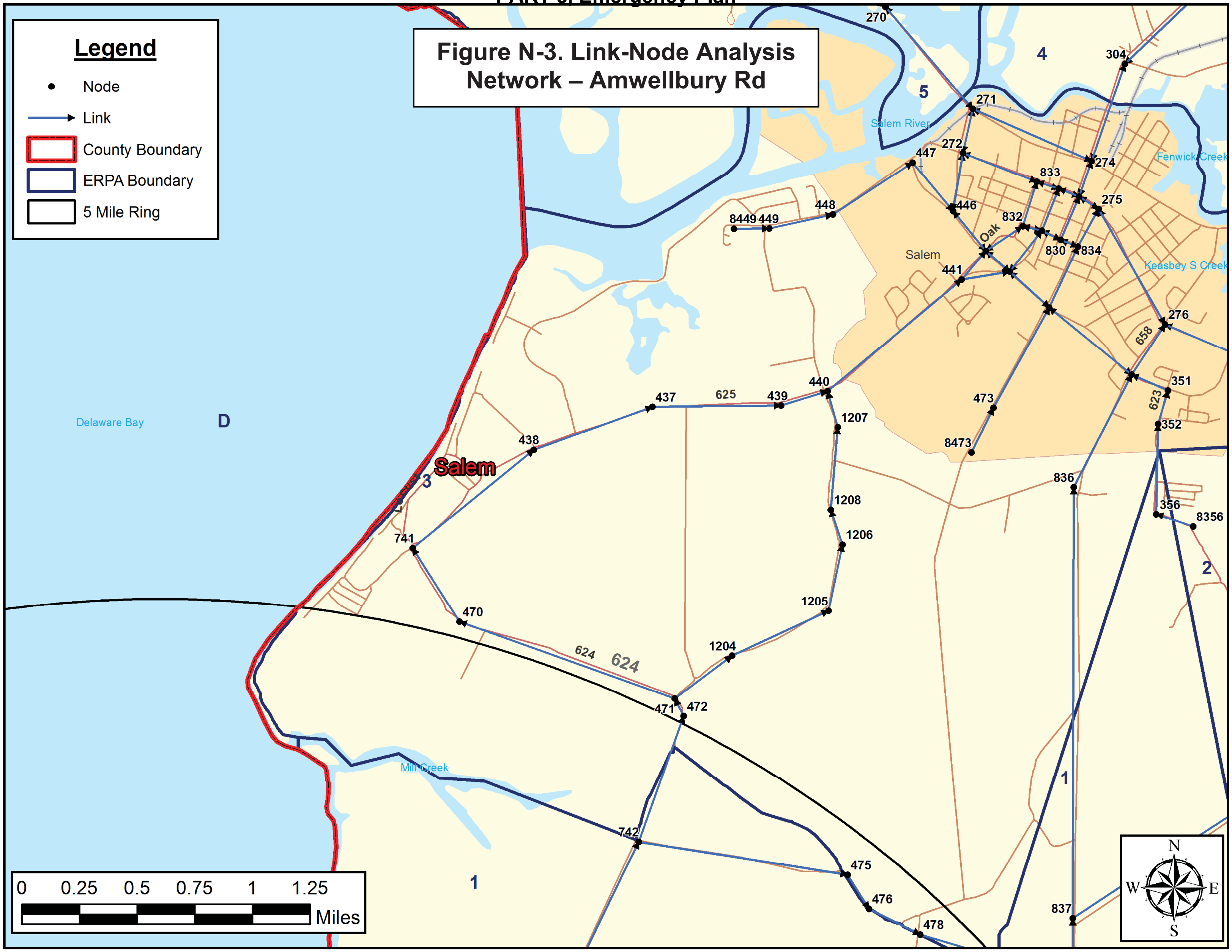


Figure N-3. Link-Node Analysis Network – Amwellbury Rd

Table N-1. Evacuation Roadway Network Characteristics

Upstream Node Number	Downstream Node Number	Length (Feet)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
452	1203	2513.3	1	1700	50
471	1204	1637.9	1	1700	50
1201	742	4270.3	1	1700	50
1202	1201	8269.1	1	1700	50
1203	1202	9100.3	1	1700	50
1204	1205	2440.1	1	1700	50
1205	1206	1556.6	1	1700	50
1206	1208	845.6	1	1700	50
1207	440	857.6	1	1700	50
1208	1207	1900.8	1	1700	50

Table N-2. Evacuation Time Estimates for Construction Scenario			
Case	Evacuation Time Estimate for ***Region R01***		
	90th Percentile	95th Percentile	100th Percentile
Existing Access Road Configuration (Base)	2:25	2:35	4:00
2 Lane Access Road Outbound	2:25	2:35	4:00
The Proposed Causeway	1:45	1:55	4:00
Case	Evacuation Time Estimate for ***Region R02***		
	90th Percentile	95th Percentile	100th Percentile
Existing Access Road Configuration (Base)	1:50	2:15	4:10
2 Lane Access Road Outbound	1:50	2:15	4:10
The Proposed Causeway	1:40	1:50	4:10
Case	Evacuation Time Estimate for ***Region R03***		
	90th Percentile	95th Percentile	100th Percentile
Existing Access Road Configuration (Base)	2:45	3:05	6:10
2 Lane Access Road Outbound	2:45	3:05	6:10
The Proposed Causeway	2:45	3:05	6:10

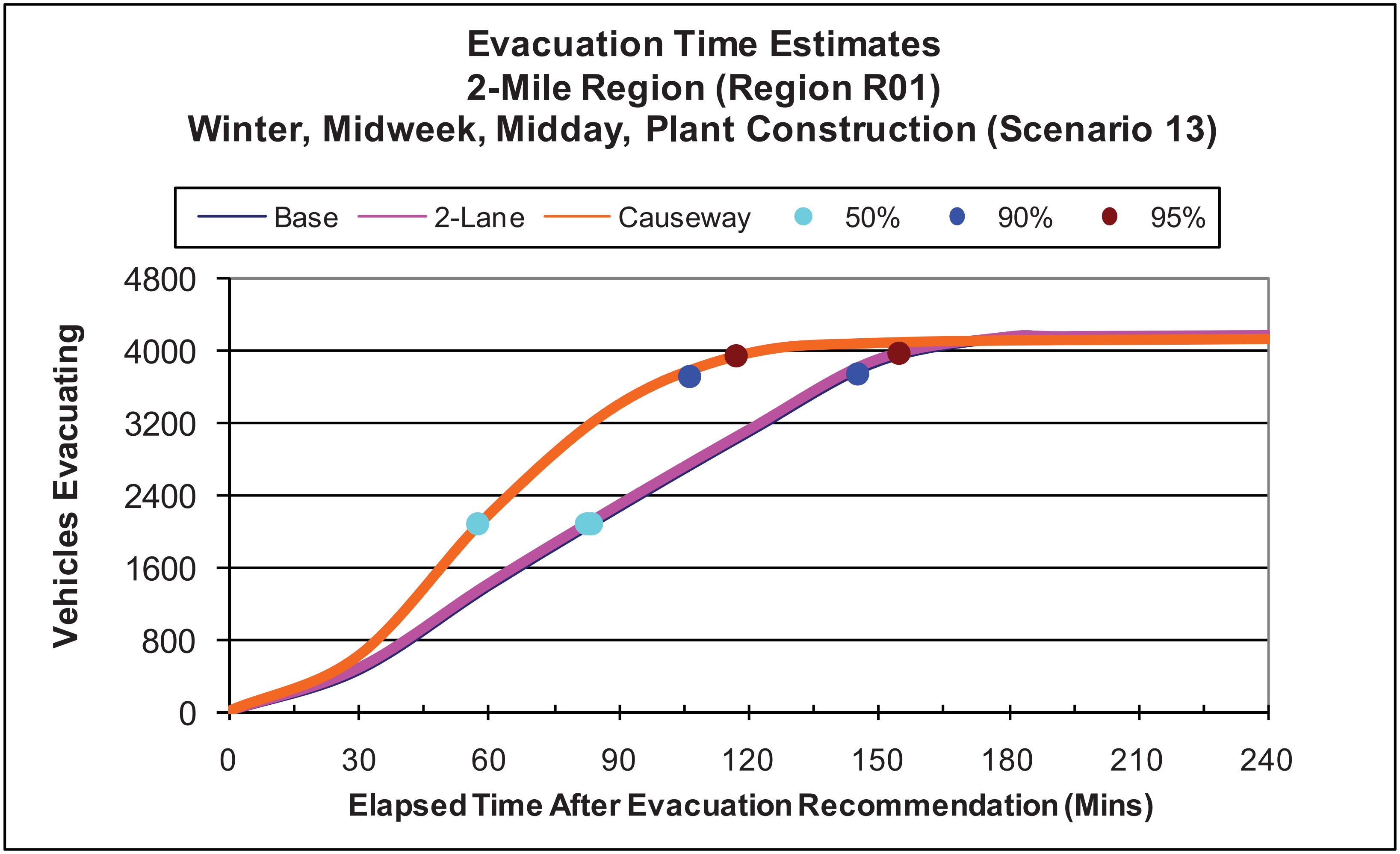


Figure N-4. Evacuation Time Estimate Plot for an Evacuation of the 2-Mile Region (Region R01)

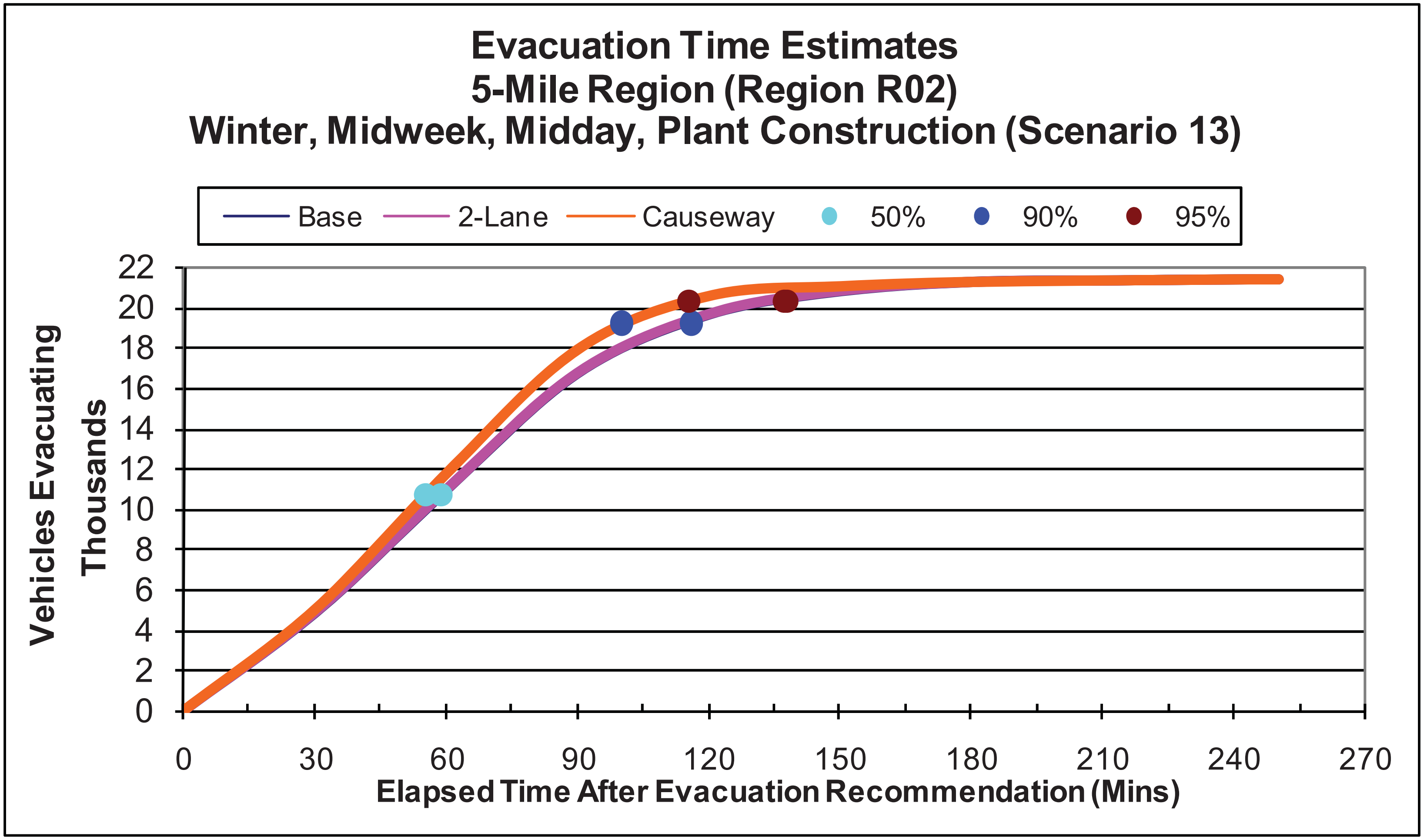


Figure N-5. Evacuation Time Estimate Plot for an Evacuation of the 5-Mile Region (Region R02)

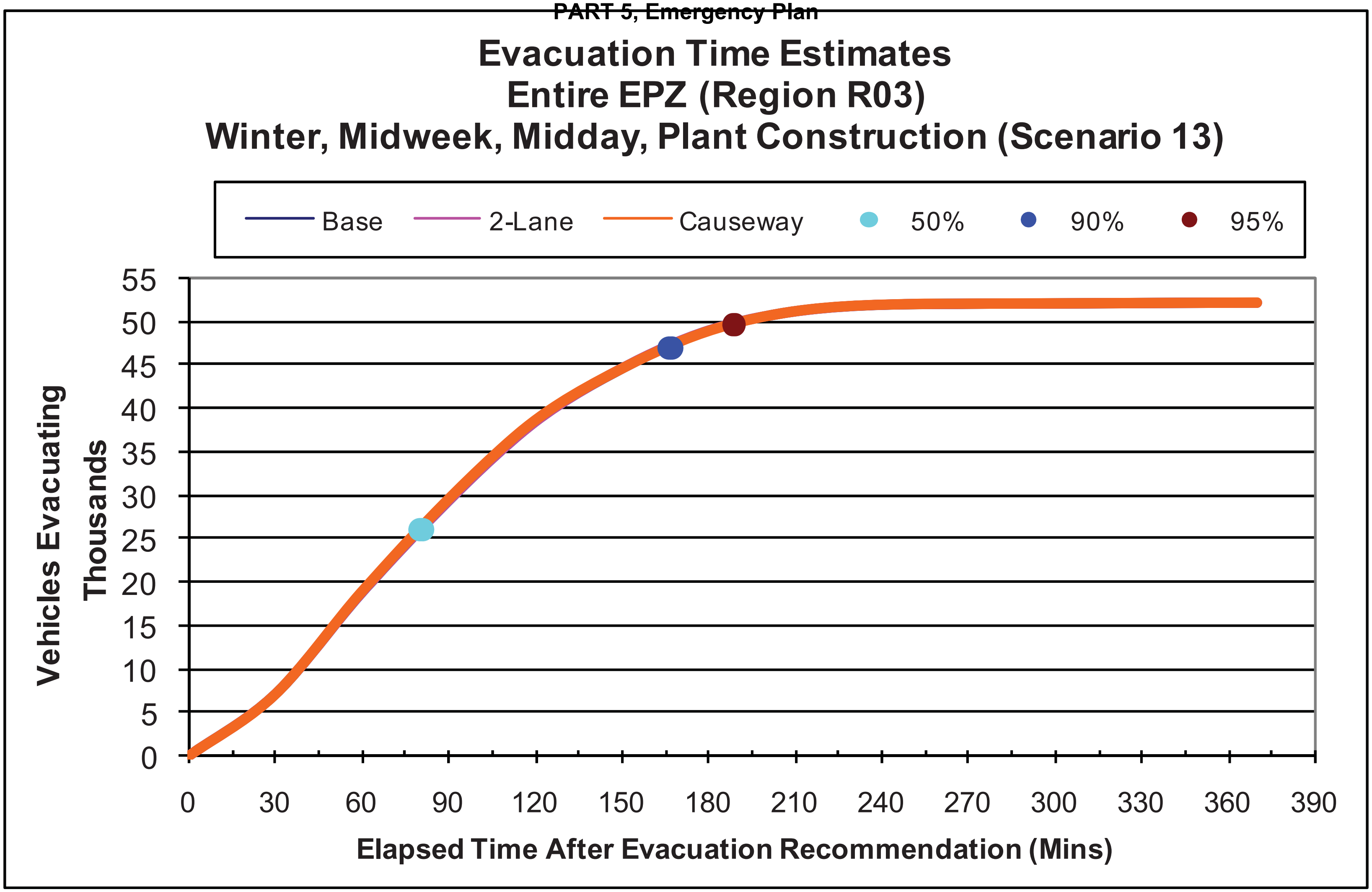


Figure N-6. Evacuation Time Estimate Plot for an Evacuation of the Entire EPZ (Region R03)

Figure N-7. Congestion Patterns for Base Case at *1 Hour* after the Advisory to Evacuate (Existing Access Road – Region R01)

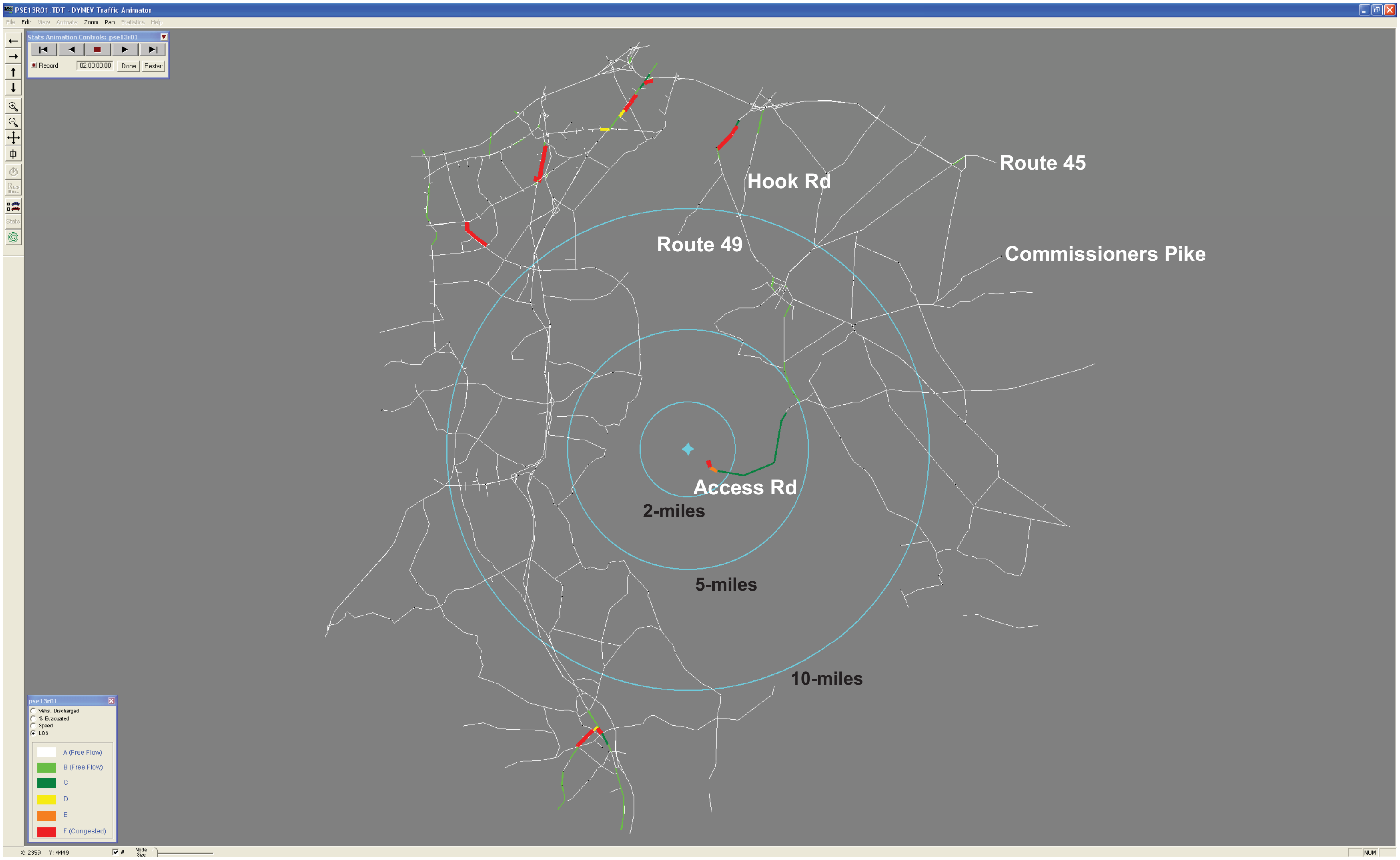


Figure N-8. Congestion Patterns for Base Case at _2 Hours_ after the Advisory to Evacuate (Existing Access Road – Region R01)

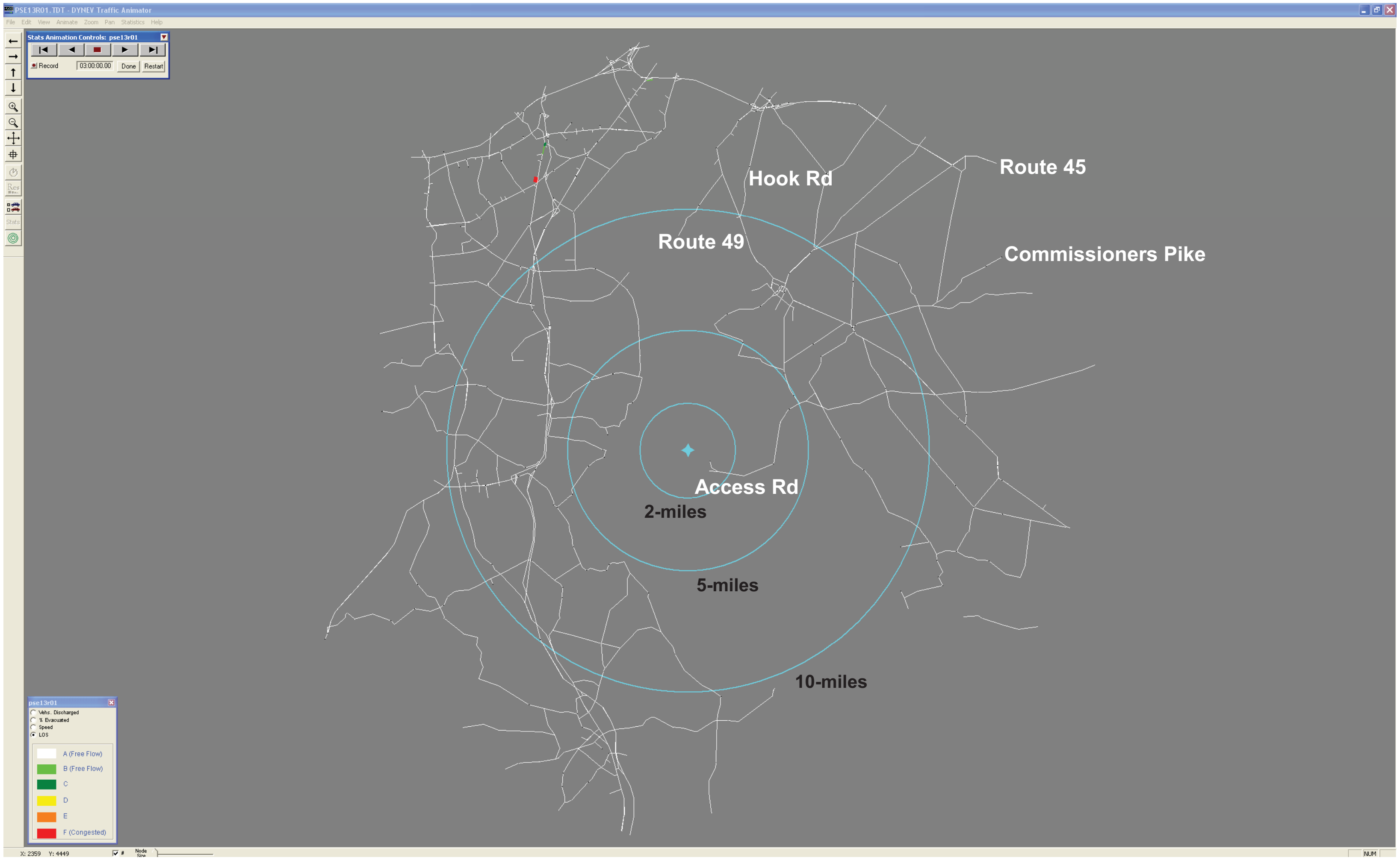


Figure N-9. Congestion Patterns for Base Case at *3 Hours* after the Advisory to Evacuate (Existing Access Road – Region R01)

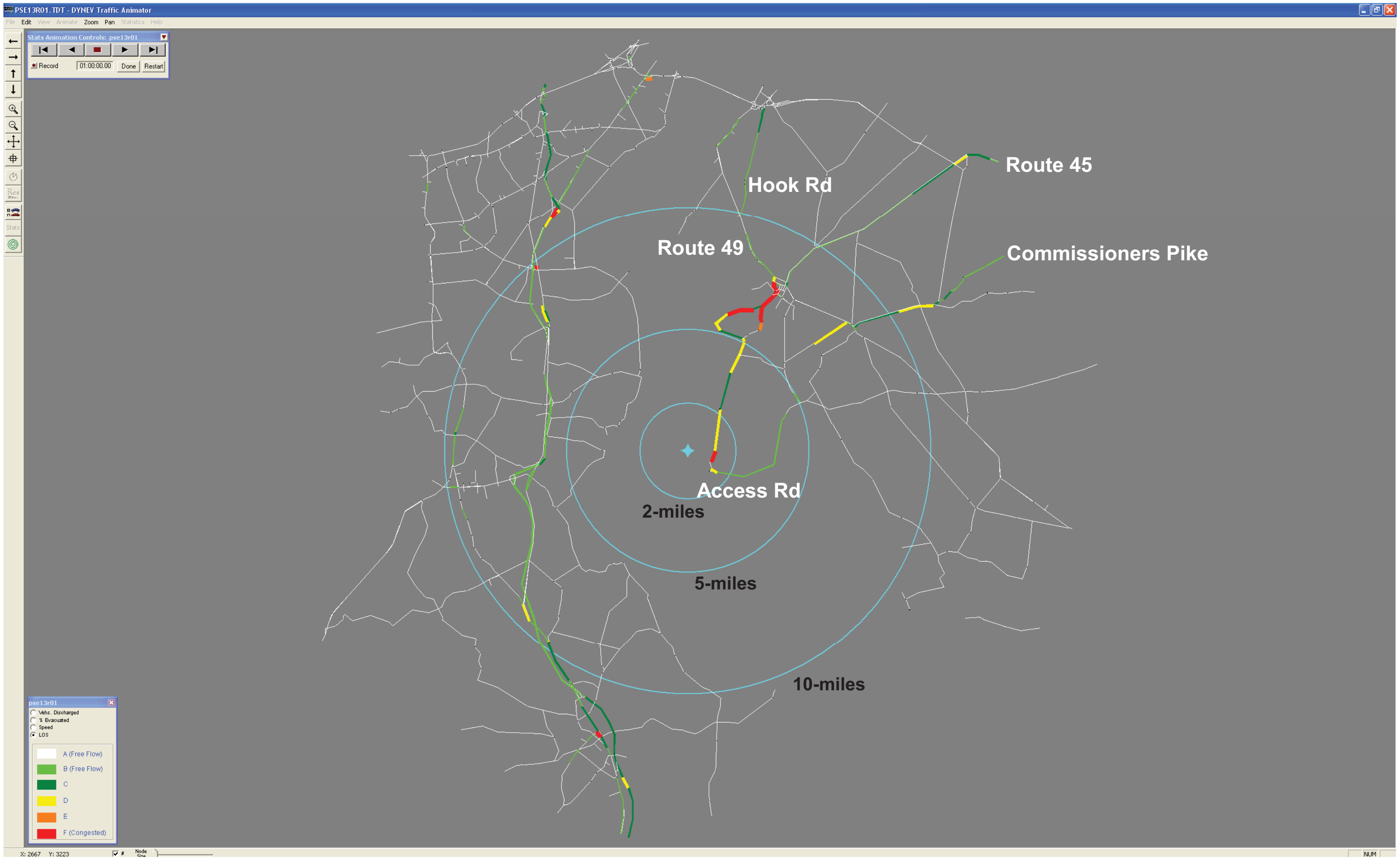


Figure N-10. Congestion Patterns for Causeway Alternative at *1 Hour* after the Advisory to Evacuate (Existing Access Road – Region R01)

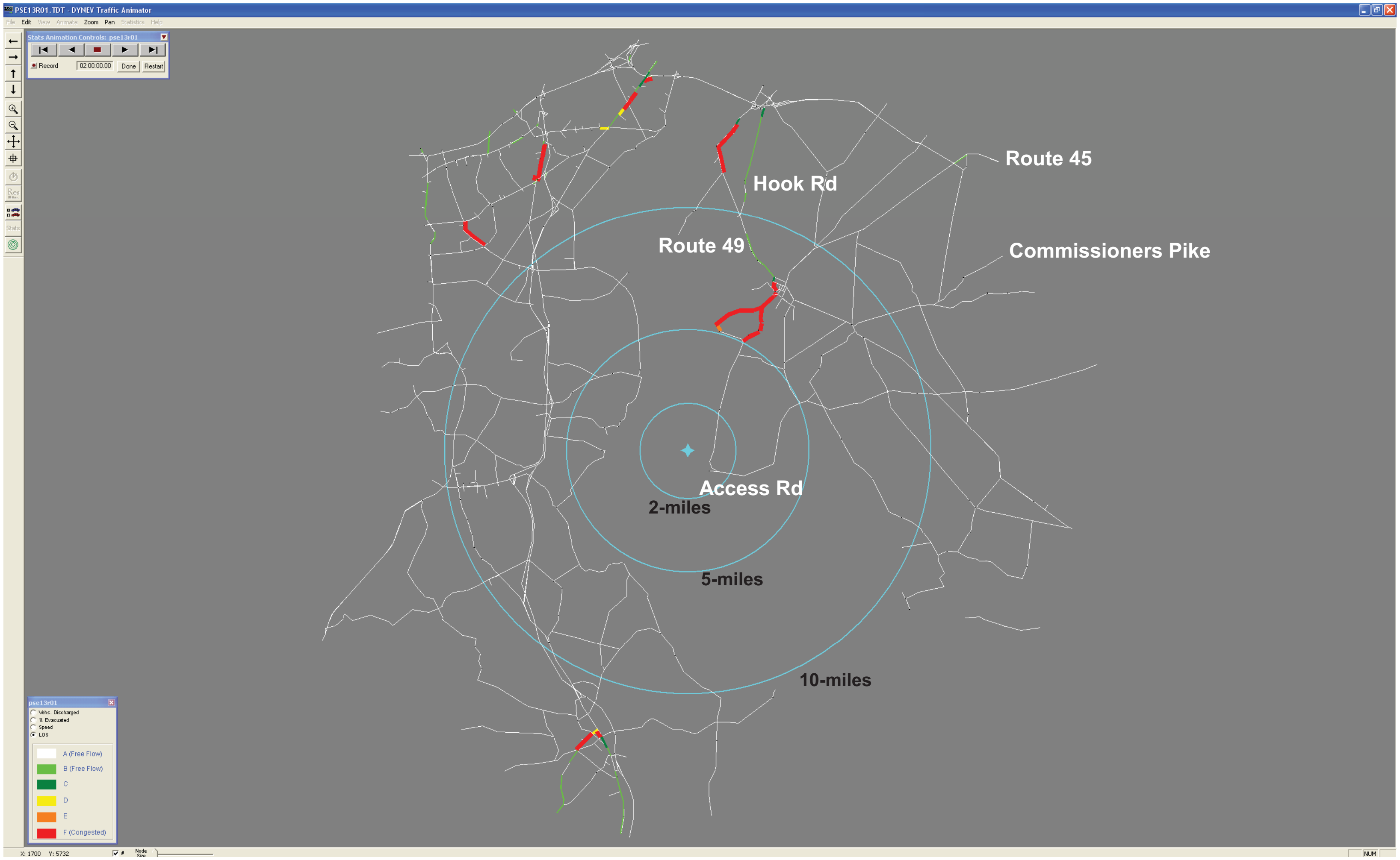


Figure N-11. Congestion Patterns for Causeway Alternative at *2 Hours* after the Advisory to Evacuate (Existing Access Road – Region R01)

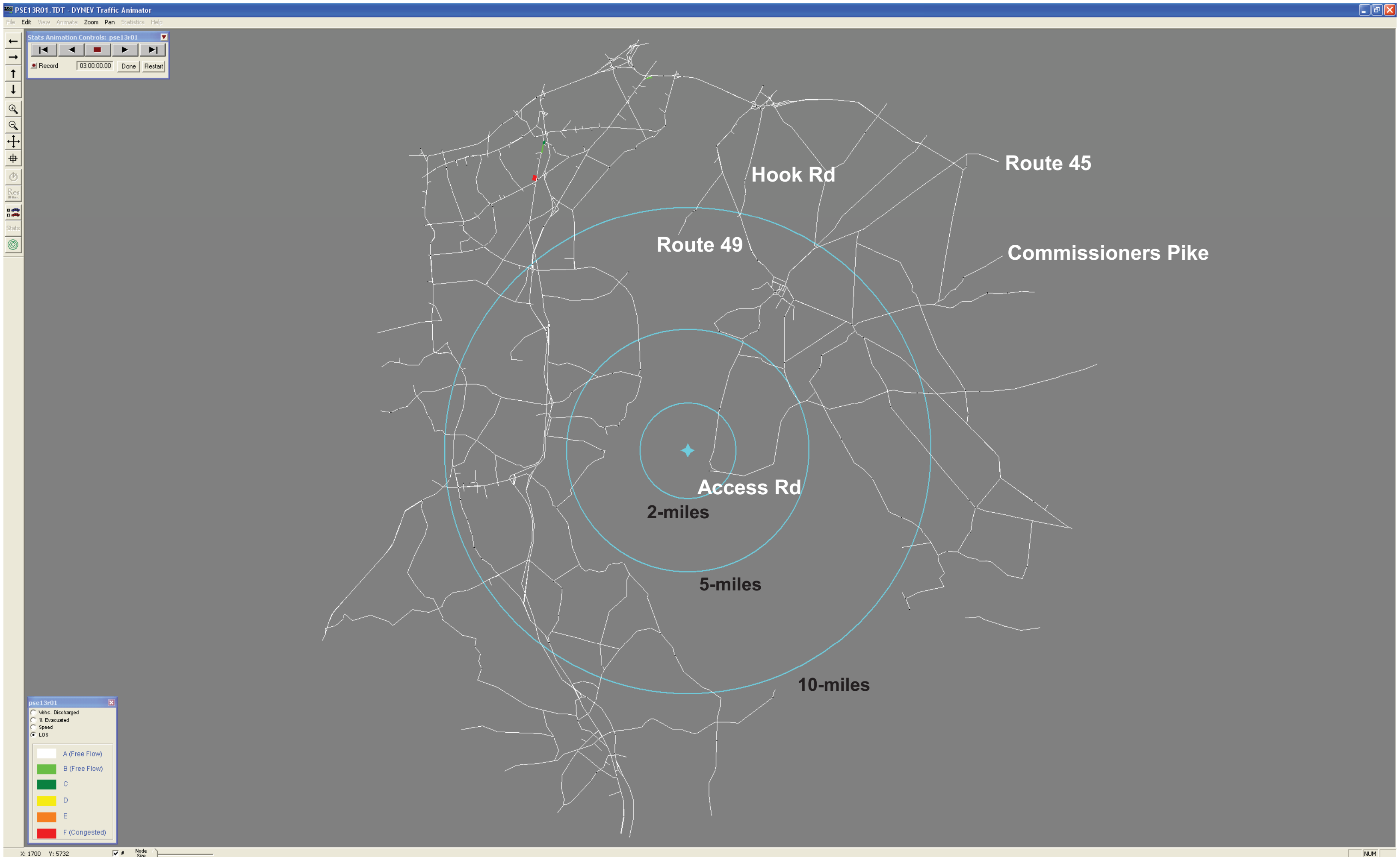


Figure N-12. Congestion Patterns for Causeway Alternative at *3 Hours* after the Advisory to Evacuate (Existing Access Road – Region R01)