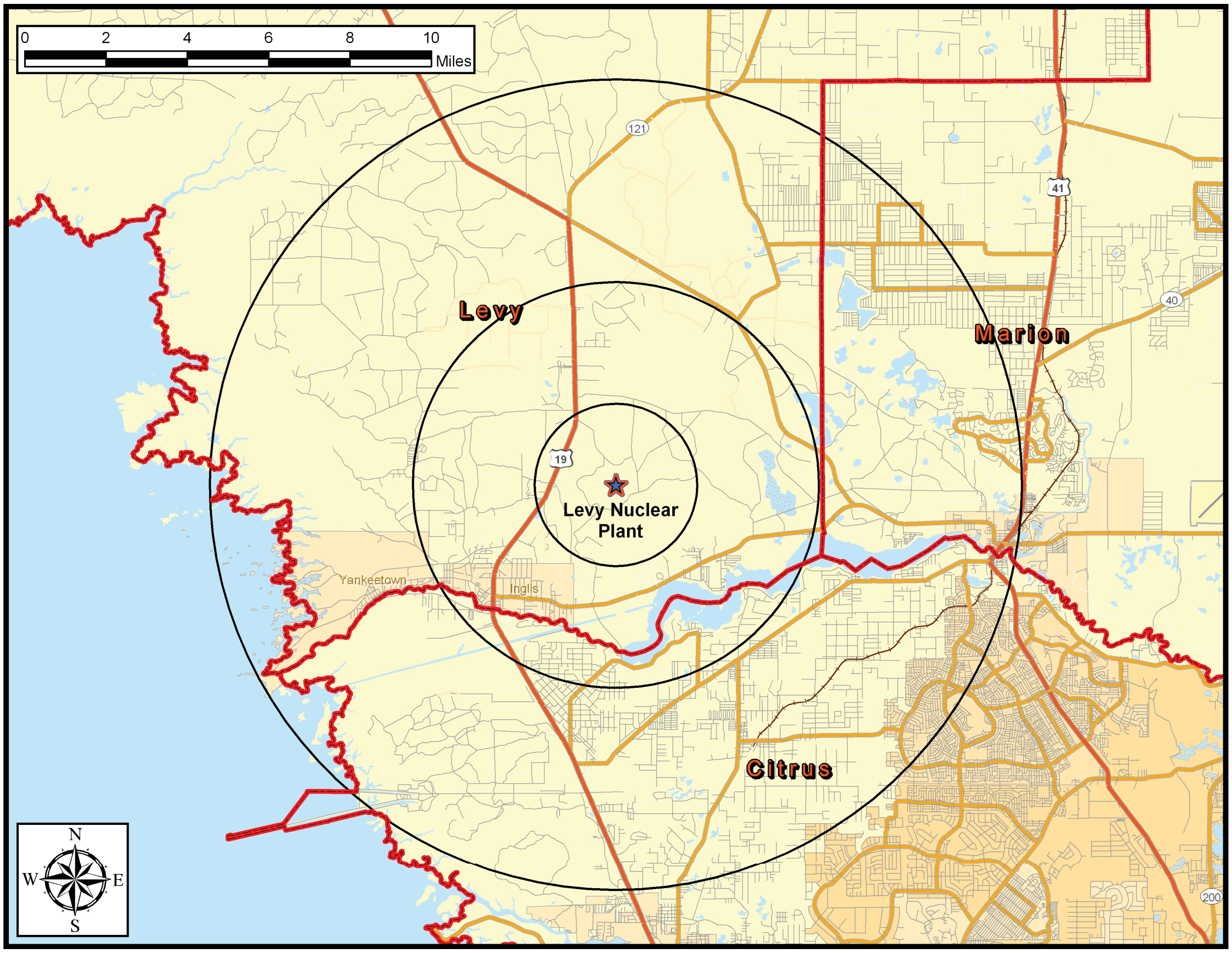
KLD ASSOCIATES, INC.

Levy Nuclear Plant
Development of Evacuation Time Estimates



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February, 2011 **Final Report** **KLD TR – 414, Rev. 5**

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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 Levy Nuclear Plant (LNP) located in Levy County, Florida. ETE are part of the required planning basis and provide LNP and State and local governments with site-specific information needed for Protective Action decision-making.

In the performance of this effort, all available prior documentation published by Federal Government agencies and relevant to ETE was reviewed. 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 February, 2007 and extended over a period of 7 months. The major activities performed are briefly described in chronological sequence:

- Attended "kick-off" meetings with Progress Energy personnel and emergency management personnel representing state and local governments.
- Reviewed prior ETE reports prepared for the Crystal River Nuclear Plant, which is located within 10 miles of the proposed LNP location.
- Accessed U.S. Census Bureau data files for the year 2000. Studied Geographical Information Systems (GIS) maps of the area in the vicinity of LNP, 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" area extending 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 8 Protective Action Zones (PAZ). These PAZ are then grouped within circular areas or "keyhole" configurations (circles plus radial sectors) that define a total of 13 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). One special scenario involving the completion of construction on Unit 2 when Unit 1 becomes operational in June 2016 at the LNP site was considered.
- The Planning Basis for the calculation of ETE is:
  - A rapidly escalating accident at LNP 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 specified host schools 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 school children 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 143 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 13 Evacuation Regions to completely evacuate from that Region, under the circumstances defined for one of the 11 Evacuation Scenarios (13 x 11 =143). Separate

ETE are calculated for transit-dependent evacuees, including school children 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 a distance of 15 miles from LNP, 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 LNP), then simulate the traffic flow movements over space and time. This simulation process estimates the rate that traffic flow exits the impacted region.
- 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.

Traffic Management

This study includes the development of a comprehensive traffic management plan designed to expedite the evacuation of people from within an impacted region. This

plan, which was reviewed with State and local law enforcement personnel, is also designed to control access into the EPZ after returning commuters have rejoined their families.

The plan is documented in the form of detailed schematics specifying: (1) the directions of evacuation travel to be facilitated, and other traffic movements to be discouraged; (2) the traffic control personnel and equipment needed (cones, barricades) and their deployment; (3) the locations of these "Traffic Control Points" (TCP); (4) the priority assigned to each traffic control point indicating its relative importance and how soon it should be manned relative to others; and (5) the number of traffic control personnel required.

<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 3-1 displays a map of the LNP site showing the layout of the 8 PAZ that comprise, in aggregate, the Emergency Planning Zone (EPZ).
- Table 3-1 presents the estimates of permanent resident population in each PAZ based on the 2000 Census data. Extrapolation to the year 2007 reflects population growth rates in each county obtained from the County Planning Departments.
- Table 6-1 defines each of the 13 Evacuation Regions in terms of their respective groups of PAZ.
- Table 6-2 lists the 11 Evacuation Scenarios.
- Tables 7-1C and 7-1D are compilations of ETE. These data are the times needed to *clear the indicated regions* of 95 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 8-5A presents ETE for children at schools and in daycare centers in good weather.
- Table 8-7A presents ETE for the transit-dependent population in good weather.

<u>Conclusion</u>

This report presents the methodological details supporting the results obtained and recommendations for consideration by local emergency responders.

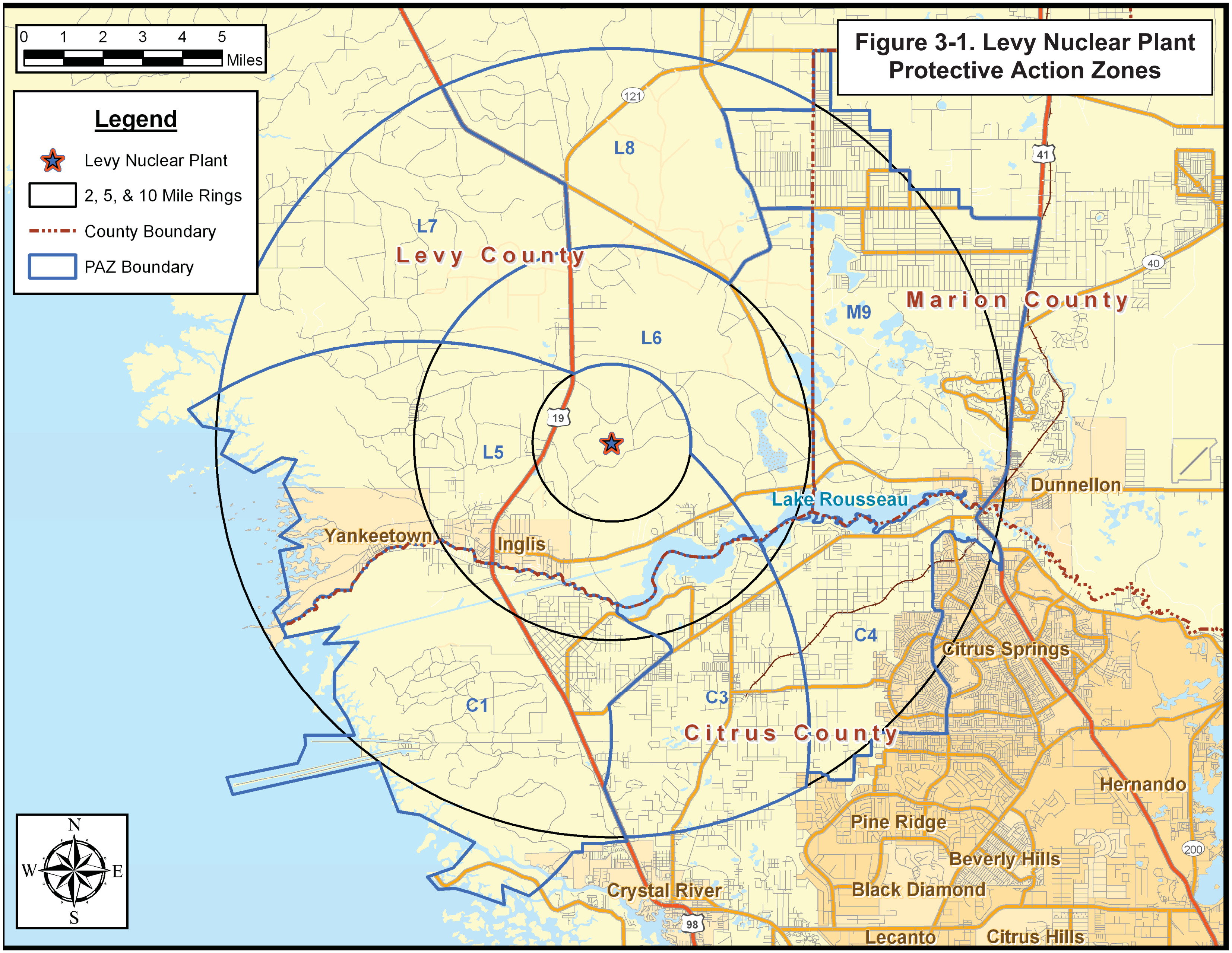
Figure 3-1. Levy Nuclear Plant
Protective Action Zones
0 1 2 3 4 5 Miles
Legend
Levy Nuclear Plant
2, 5, & 10 Mile Rings
County Boundary
PAZ Boundary
L5
L6
L7
L8
M9
C1
C3
C4
Levy County
Marion County
Citrus County
Lake Rousseau
Yankeetown
Inglis
Dunnellon
Citrus Springs
Hernando
Pine Ridge
Beverly Hills
Black Diamond
Crystal River
Lecanto
Citrus Hills
19
41
40
121
98
200
N
S
E
W

Table 3-1. EPZ Permanent Resident Population		
PAZ	**2000 Population**	**2007 Population**
C1	1,434	1,776
C3	4,422	5,476
C4	2,795	3,461
L5	3,004	3,601
L6	545	653
L7	14	17
L8	245	294
M9	5,866	7,480
TOTAL	**18,325**	**22,758**
	Population Growth:	**24%**

Table 6-1. Description of Evacuation Regions

Region	Description	PAZ							
		C1	C3	C4	L5	L6	L7	L8	M9
R01	2 mile ring				■				
R02	5-mile ring				■	■			
R03	Full EPZ	■	■	■	■	■	■	■	■
Evacuate 2 mile ring and 5 miles downwind									
Region	**Wind Direction Towards:**	**C1**	**C3**	**C4**	**L5**	**L6**	**L7**	**L8**	**M9**
Refer to R02	WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE				■	■			
Refer to R01	SSE, S, SSW, SW, WSW, W				■				
Evacuate 5 mile ring and downwind to EPZ boundary									
Region	**Wind Direction Towards:**	**C1**	**C3**	**C4**	**L5**	**L6**	**L7**	**L8**	**M9**
R04	N				■	■	■	■	■
R05	NNE, NE				■	■		■	■
R06	ENE, E			■	■	■			■
R07	ESE, SE		■	■	■	■			■
R08	SSE	■	■	■	■	■			
R09	S, SSW	■	■		■	■			
R10	SW, WSW	■			■	■			
R11	W	■			■	■	■		
R12	WNW				■	■	■		
R13	NW, NNW				■	■	■	■	

Table 6-2. Evacuation Scenario Definitions					
Scenarios	**Season**	**Day of Week**	**Time of Day**	**Weather**	**Special**
1	Summer	Midweek	Midday	Good	None
2	Summer	Midweek	Midday	Rain	None
3	Summer	Weekend	Midday	Good	None
4	Summer	Weekend	Midday	Rain	None
5	Summer	Midweek, Weekend	Evening	Good	None
6	Winter	Midweek	Midday	Good	None
7	Winter	Midweek	Midday	Rain	None
8	Winter	Weekend	Midday	Good	None
9	Winter	Weekend	Midday	Rain	None
10	Winter	Midweek, Weekend	Evening	Good	None
11	Winter	Weekend	Midday	Good	New Plant Construction

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

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

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		Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)
	Midday		Midday		Evening		Midday		Midday		Evening		Midday
Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ													
R01 2-mile ring	5:00	5:00	5:00	5:00	5:00	R01 2-mile ring	5:00	5:00	5:00	5:00	5:00	R01 2-mile ring	5:00
R02 5-mile ring	5:00	5:00	5:00	5:00	5:00	R02 5-mile ring	5:00	5:00	5:00	5:00	5:00	R02 5-mile ring	5:00
R03 Entire EPZ	5:10	5:10	5:10	5:10	5:10	R03 Entire EPZ	5:10	5:10	5:10	5:10	5:10	R03 Entire EPZ	5:10
2-Mile Ring and Downwind to 5 Miles													
Same As R01 SSE, S, SSW, SW, WSW, W	5:00	5:00	5:00	5:00	5:00	Same As R01 SSE, S, SSW, SW, WSW, W	5:00	5:00	5:00	5:00	5:00	Same As R01 SSE, S, SSW, SW, WSW, W	5:00
Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	5:00	5:00	5:00	5:00	5:00	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	5:00	5:00	5:00	5:00	5:00	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	5:00
5-Mile Ring and Downwind to EPZ Boundary													
R04 N	5:10	5:10	5:05	5:10	5:10	R04 N	5:10	5:10	5:05	5:10	5:10	R04 N	5:10
R05 NNE, NE	5:10	5:10	5:05	5:10	5:10	R05 NNE, NE	5:10	5:10	5:05	5:10	5:10	R05 NNE, NE	5:10
R06 ENE, E	5:10	5:10	5:05	5:10	5:05	R06 ENE, E	5:10	5:10	5:05	5:10	5:05	R06 ENE, E	5:10
R07 ESE, SE	5:10	5:10	5:05	5:10	5:05	R07 ESE, SE	5:10	5:10	5:10	5:10	5:10	R07 ESE, SE	5:10
R08 SSE	5:10	5:10	5:10	5:10	5:10	R08 SSE	5:10	5:10	5:10	5:10	5:10	R08 SSE	5:10
R09 S, SSW	5:10	5:10	5:10	5:10	5:10	R09 S, SSW	5:10	5:10	5:10	5:10	5:10	R09 S, SSW	5:10
R10 SW, WSW	5:10	5:10	5:10	5:10	5:10	R10 SW, WSW	5:10	5:10	5:10	5:10	5:10	R10 SW, WSW	5:10
R11 W	5:10	5:10	5:10	5:10	5:10	R11 W	5:10	5:10	5:10	5:10	5:10	R11 W	5:10
R12 WNW	5:00	5:00	5:00	5:00	5:00	R12 WNW	5:00	5:00	5:00	5:00	5:00	R12 WNW	5:00
R13 NW,NNW	5:00	5:05	5:00	5:00	5:05	R13 NW,NNW	5:05	5:05	5:00	5:05	5:05	R13 NW,NNW	5:05

Table 8-5A. School and Daycare 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)
Levy County Schools										
Yankeetown School	90	5	9.7	16.26	16.26	36	**2:15**	20.7	25	**2:40**
Citrus County Schools										
Bright Beginnings Pre-School	90	5	2.9	13.58	13.58	13	**1:50**	20.2	25	**2:15**
Citrus Springs Elementary School	90	5	2.0	49.77	49.77	3	**1:40**	2.9	4	**1:45**
North Oak Christian Day Care	90	5	1.3	49.77	49.77	2	**1:40**	19.6	24	**2:05**
Presswood Home Child Care	90	5	5.6	49.77	49.77	7	**1:45**	19.6	24	**2:10**
Marion County Schools										
Building Blocks Learning Center	90	5	6.9	50.31	50.31	9	**1:45**	27.7	34	**2:20**
Dunnellon Christian Academy	90	5	7.6	48.69	48.69	10	**1:45**	27.7	34	**2:20**
Dunnellon Middle School	90	5	7.8	48.69	48.69	10	**1:45**	27.7	34	**2:20**
Ready-Set-Go Learning Center	90	5	7.1	49.93	49.93	9	**1:45**	27.7	34	**2:20**
Romeo Elementary School	90	5	0.3	60.00	55.00	1	**1:40**	27.7	34	**2:10**
						Maximum for EPZ:	**2:15**		**Maximum:**	**2:40**
						Average for EPZ:	**1:45**		**Average:**	**2:15**

Table 8-7A. Transit Dependent Evacuation Time Estimates - Good Weather

Route Number	Bus Number	Single Wave: Mobilization (min.)	Route Length (mi.)	Average Speed (mph)	Adjusted Speed (mph)	Route Travel Time	Pickup Time	ETE	Second Wave: Mobilization (min.)	Unload	Driver Rest	Return time to EPZ	Average Speed (mph)	Adjusted Speed (mph)	Route Travel Time	Pickup Time	ETE
1	1,2	120	13.1	23.12	23.12	34	15	2:50	125	5	10	20	47.56	47.56	17	15	3:15
	3,4	120	15.6	25.48	25.48	37	15	2:55					32.25	32.25	29	15	3:25
2	1	120	10	49.77	49.77	12	15	2:30	125	5	10	20	49.77	49.77	12	15	3:10
	2	150	10	49.77	49.77	12	15	3:00									
	3	180	10	49.77	49.77	12	15	3:30									
3	1	120	14.2	44.77	44.77	19	15	2:35	125	5	10	20	44.77	44.77	19	15	3:15
	2	150	14.2	44.77	44.77	19	15	3:05									
	3	180	14.2	44.77	44.77	19	15	3:35									
4	1	120	18.2	44.57	44.57	25	15	2:40	125	5	10	20	54.08	54.08	20	15	3:15
	2	150	18.2	54.08	54.08	20	15	3:05									
5	1	120	18.2	51.47	51.47	21	15	2:40	125	5	10	20	51.47	51.47	21	15	3:20
	2	150	18.2	51.47	51.47	21	15	3:10									
6	1	120	11.3	56.83	55.00	12	15	2:30	125	5	10	20	56.83	55.00	12	15	3:10
7	1	120	19.2	53.31	53.31	22	15	2:40	125	5	10	20	53.31	53.31	22	15	3:20
							Maximum for EPZ:	**3:35**								**Maximum for EPZ:**	**3:25**
							Average for EPZ:	**2:55**								**Average for EPZ:**	**3:15**

1. INTRODUCTION

This report describes the analyses undertaken and the results obtained in preparing the Evacuation Time Estimates (ETE) for the proposed Levy Nuclear Plant (LNP), located in Levy County, Florida. ETE are part of the required planning basis and provide State and local governments with site-specific information needed for Protective Action decision-making.

In the performance of this effort, all available documentation published by Federal Government agencies and relevant to ETE was reviewed. 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 Levy County, Citrus County, and Marion County emergency management agencies and local and state law enforcement and planning agencies, who provided valued guidance and contributed information contained in this report.

1.1 Overview of the ETE Determination Process

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

1. Information Gathering:
   - Defined the scope of work in discussion with representatives of Progress Energy.
   - Attended meetings with emergency planners from the three EPZ Counties to identify issues to be addressed.
   - Conducted a detailed field survey of the 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, 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), and at Access Control Points (ACP) located outside the EPZ. Local and state police personnel have reviewed all traffic control plans.
5. Defined Evacuation Areas or Regions. The EPZ is partitioned into Protective Action Zones (PAZ) which serve as a basis for the ETE analysis presented herein. Evacuation "Regions" are comprised of contiguous PAZ for which ETE are calculated. The configuration of these Regions reflects the fact that the wind can take any direction and that the radial extent of the impacted area depends on accident-related circumstances. Each Region, other than those that approximate circular areas, approximates a "key-hole" configuration within the EPZ as required 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, from data provided by local and state agencies 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 Evacuation Scenario. Considered the effects on demand of "voluntary evacuation" and of the "shadow effect".
- Represented the traffic management strategy.
- Specified the candidate destinations of evacuation travel consistent with outbound movement relative to the location of the LNP.
- Prepared the input stream for the IDYNEV System.
- Executed the IDYNEV models to provide the estimates of evacuation routing and ETE.

8. Generated a complete set of ETE for all specified Evacuation Regions and Scenarios.
9. Documented ETE in formats responsive to the cited NUREG reports.
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 4, 7 and 8 are iterated as described in Appendix D.

1.2 The Levy Nuclear Plant Location

The Levy Nuclear Plant is located approximately 85 miles north of Tampa, Florida, 80 miles northwest of Orlando, Florida and 9 miles northeast of the existing Crystal River Nuclear Plant. The Emergency Planning Zone (EPZ) consists of parts of three counties: Levy County, Citrus County, and Marion County. Figure 1-1 displays the area surrounding LNP. This map identifies the communities in the area and the major roads. The inset to the map identifies the location of the plant relative to Tampa and Orlando.

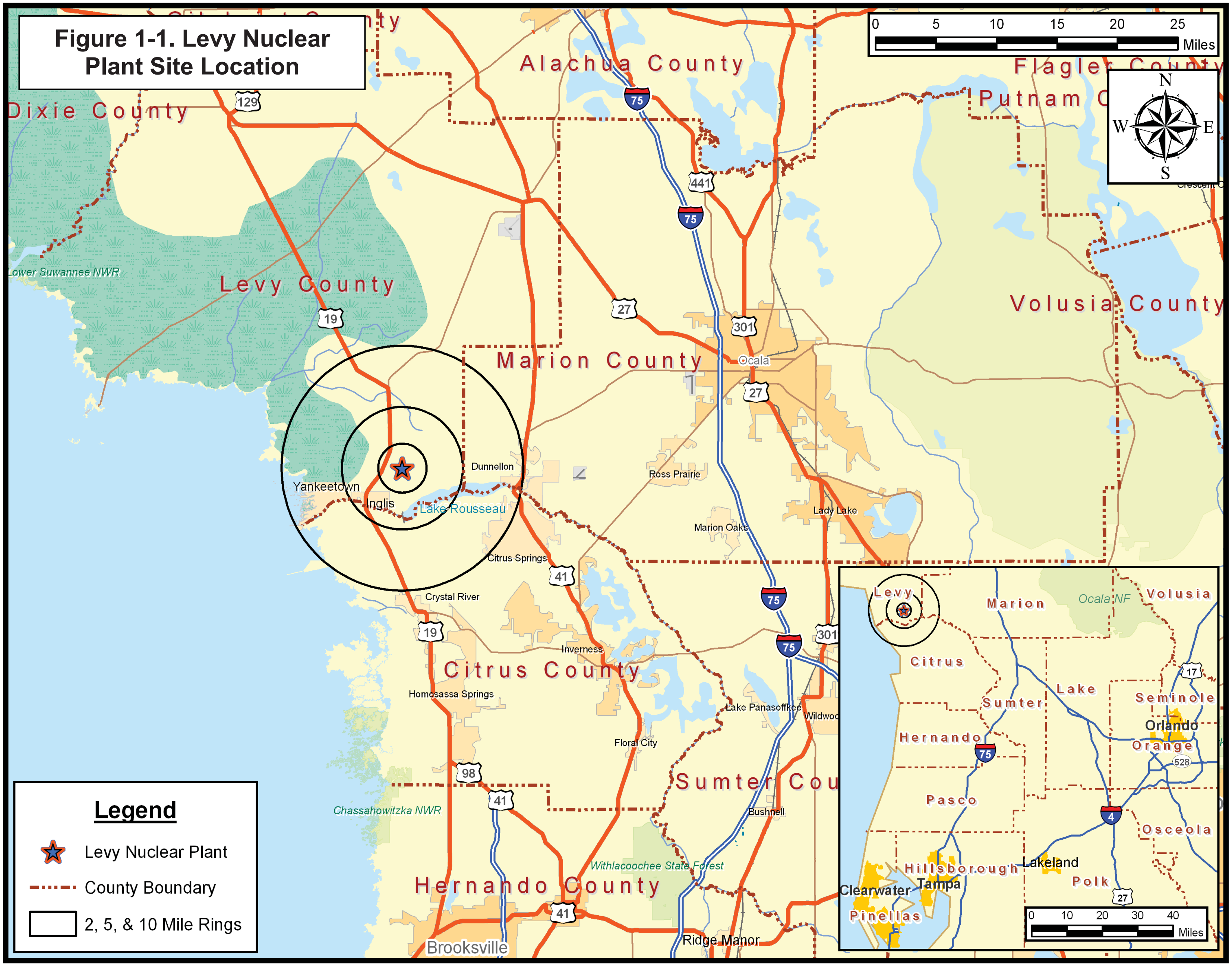


Figure 1-1. Levy Nuclear Plant Site Location
Legend
Levy Nuclear Plant
County Boundary
2, 5, & 10 Mile Rings
0 5 10 15 20 25 Miles
N
S
E
W
Dixie County
Levy County
Alachua County
Marion County
Putnam C
Flagler County
Volusia County
Citrus County
Sumter Cou
Hernando County
Lower Suwannee NWR
Chassahowitzka NWR
Withlacoochee State Forest
Yankeetown
Inglis
Lake Rousseau
Dunnellon
Citrus Springs
Crystal River
Homosassa Springs
Inverness
Floral City
Brooksville
Ridge Manor
Bushnell
Lake Panasoffkee
Marion Oaks
Ross Prairie
Ocala
Lady Lake
Levy
Marion
Citrus
Sumter
Lake
Volusia
Seminole
Orlando
Orange
Hernando
Pasco
Hillsborough
Tampa
Clearwater
Pinellas
Lakeland
Polk
Osceola
Ocala NF
0 10 20 30 40 Miles

1.3 Preliminary Activities

KLD performed preliminary review activities as described below.

Literature Review

KLD Associates reviewed documentation by the federal government on the development of emergency plans and the ETE. We also obtained supporting documents from a variety of sources, which contained information needed to form the database used for conducting evacuation analyses.

Field Surveys of the Highway Network

KLD personnel drove the entire highway system within the EPZ and for some distance outside. A personal computer equipped with Geographical Information Systems (GIS) software was used during the road survey to acquire and record data. 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	• Street parking
• 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 Highway Capacity Manual (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 I-DYNEV System.

As documented on page 20-3 of the HCM 2000, 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 I-DYNEV which calculates the ETE. The locations of these sections may be identified by reference to the maps in Appendix K, which show the link-node analysis network with the nodes annotated. Further discussion of roadway capacity is provided in Section 4 of this report.

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 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.

Highway capacity was estimated for each highway segment based on the field surveys and on the principles specified in the 2000 HCM. The link-node representation of the physical highway network was developed using Geographic Information System (GIS) mapping software and the observations obtained from the field survey. This network representation of “links” and “nodes” is shown in Figure 1-2.

Given the scale of Figure 1-2, it is not feasible to identify the links and nodes to enable the reader to relate to the information presented in Appendix K. 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.

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).

IDYNEV 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

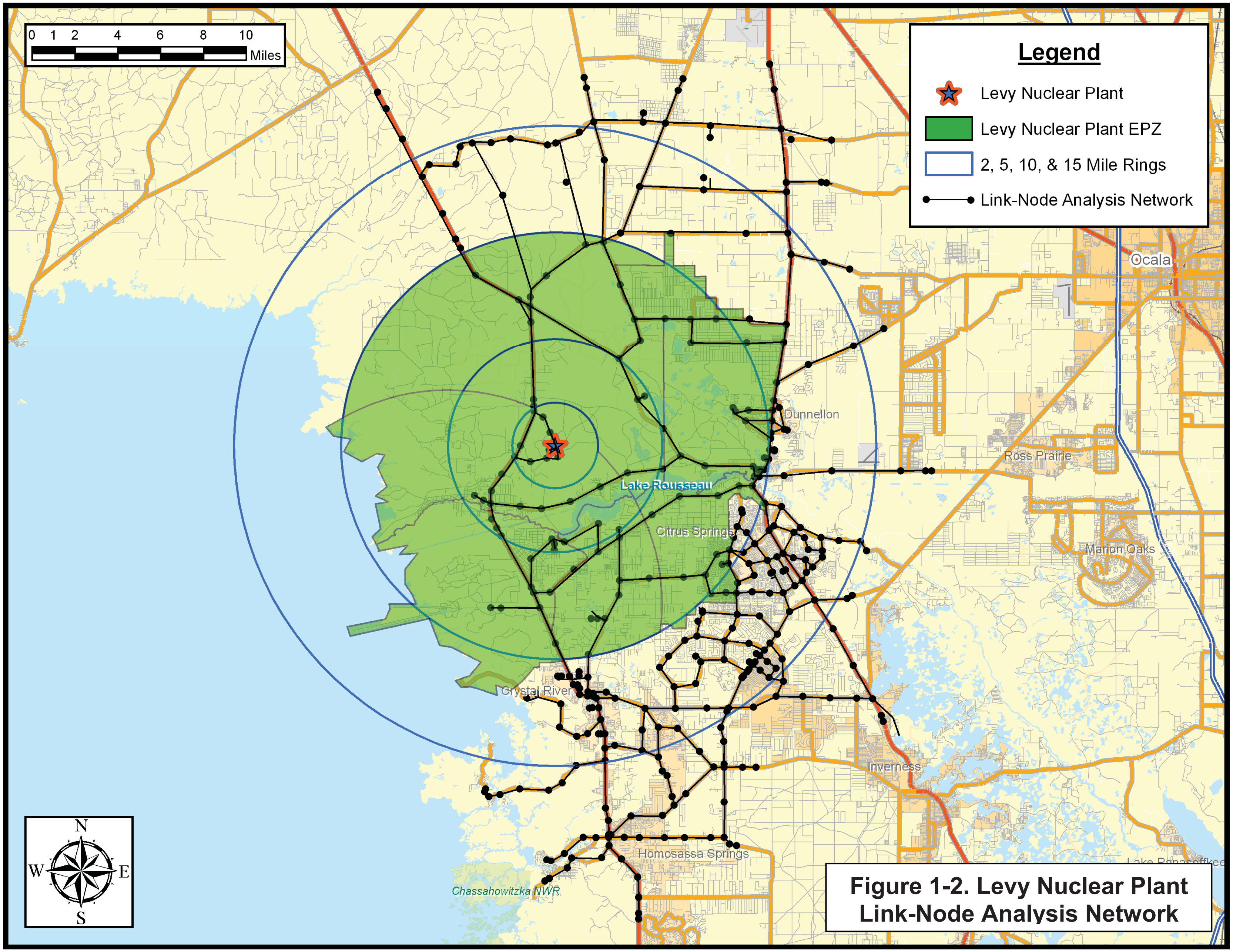


Figure 1-2. Levy Nuclear Plant Link-Node Analysis Network

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 LNP 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 LNP.

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. The outputs of this model are the volume of traffic, expressed as vehicles/hour, that exit the Evacuation Region along the various highways (links) that cross the Region boundaries. These outputs are exported into a spreadsheet which contains the ETE. Section 7 presents a further description of this process along with the ETE Tables.

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 ETE Study Overview

Table 1-1 presents an overview of this ETE study. The major factors that make this study and the ETE values obtained reliable can be summarized as follows:

- 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 highly detailed.
- Regions developed with guidance from NUREG/CR-6863.
- Traffic management plan included.

Table 1-1. Summary of ETE Study	
Topic	**Description**
Resident Population Basis	ArcGIS Software using 2000 US Census blocks; block centroid method used; population extrapolated to 2007. Permanent resident population inside the EPZ = 22,758
Resident Population Vehicle Occupancy	2.25 persons/household, 1.39 evacuating vehicles/household yielding: 1.62 persons/vehicle
Employee Population	Employees treated as separate population group. Employee estimates based on information provided by county emergency management offices about major employers in EPZ. 1.03 employees/vehicle based on phone survey results.
Voluntary evacuation from within EPZ in areas outside region to be evacuated	50 percent of population within the specified evacuation radius, but not within the area to be evacuated; 35 percent, in annular ring between the evacuation radius and the EPZ boundary (See Figure 2.1).
Shadow Evacuation	30% of people outside of the EPZ within the Shadow Region (See Figure 7-2).
Network Size	517 Links; 364 Nodes.
Roadway Geometric Data	Field surveys conducted in February, 2007. 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.
Transit Dependent Population	Defined as households with 0 vehicles + households with 1 vehicle with commuters who do not return home + households with 2 vehicles with commuters who do not return home. Telephone survey results used to estimate transit dependent population (See Table 8-1).

Table 1-1. Summary of ETE Study (cont.)	
Ridesharing	50 percent of transit dependent persons will ride out with a neighbor of friend.
Trip Generation for Evacuation	Based on residential telephone survey of specific pre-trip mobilization activities: Residents with commuters returning leave between 30 minutes and 5 hours. Residents without commuters returning leave between 15 minutes and 5 hours. Employees and transients leave between 15 minutes and 2 hours. All times measured from the Advisory to Evacuate.
Traffic and Access Control	Traffic and Access Control used in all scenarios to facilitate the flow of traffic outbound relative to LNP.
Weather	Normal or Rain. The capacity and free flow speed of all links in the network are reduced by 10% in the event of rain.
Modeling	IDYNEV System: TRAD and PC-DYNEV.
Special Events	One considered – new plant construction.
Evacuation Cases	13 Regions (central sector wind direction and each adjacent sector technique used as specified in NUREG/CR-6863) and 11 Scenarios producing 143 unique cases
Evacuation Time Estimates Reporting	ETE reported for 50th, 90th, 95th, and 100th percentile population. Results presented by Region and Scenario.
Evacuation Time Estimates for the entire EPZ, 100th percentile.	Winter Weekday Midday Good weather = 5:10 Winter Weekend Midday Good weather = 5:10

2. STUDY ESTIMATES AND ASSUMPTIONS

This section presents the estimates and assumptions utilized in the development of the Evacuation Time Estimates (ETE).

2.1 Data Estimates

1. Population estimates are based upon Census 2000 data, projected to year 2007. County-specific projections are based upon growth rates obtained from the county planning departments. Estimates of employees who commute into the EPZ to work are based upon employment data obtained from county emergency management offices.
2. Population estimates at special facilities are based on available data from county emergency management offices.
3. Roadway capacity estimates are based on field surveys and the application of Highway Capacity Manual 2000.
4. Population mobilization times are based on a statistical analysis of data acquired from the telephone survey.
5. The relationship between resident population and evacuating vehicles is developed from the telephone survey. The average values of 2.25 persons per household and 1.39 evacuating vehicles per household are used.
6. The relationship between persons and vehicles for special facilities is as follows:
   a. Parks/Recreational: 1 vehicle per family
   b. Employees: 1.03 employees per vehicle (telephone survey results)
7. ETE are presented for the evacuation of the 100th percentile of population for each Region and for each Scenario, and for the 2-mile, 5-mile and 10-mile distances. ETE are presented in tabular format and graphically showing the values of ETE associated with the 50th, 90th and 95th percentiles of population. An Evacuation Region is defined as a group of Protective Action Zones (PAZ) 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 persons within a specific Region of the EPZ, and the time that Region is clear of the indicated percentile of people.
2. The ETE are computed and presented in a format compliant with the guidance in the cited NUREG documentation. The ETE for each evacuation area ("Region" comprised of included PAZ) is presented in both statistical and graphical formats.

3. Evacuation movements (paths of travel) are generally outbound relative to the power plant to the extent permitted by the highway network, as computed by the computer models. All available 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 PAZ 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 evacuate within the same time-frame. In the annular area between the circle defined by the central "key-hole" 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 annular area centered at the plant (the "Shadow Region"), it will be 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" (Appendix I).
6. A total of 11 "Scenarios" representing different seasons, time of day, day of week and weather are considered. One special event scenario is studied; the construction period of a new nuclear plant. These Scenarios are tabulated below:

Scenarios	Season	Day of Week	Time of Day	Weather	Special
1	Summer	Midweek	Midday	Good	None
2	Summer	Midweek	Midday	Rain	None
3	Summer	Weekend	Midday	Good	None
4	Summer	Weekend	Midday	Rain	None
5	Summer	Midweek, Weekend	Evening	Good	None
6	Winter	Midweek	Midday	Good	None
7	Winter	Midweek	Midday	Rain	None
8	Winter	Weekend	Midday	Good	None
9	Winter	Weekend	Midday	Rain	None
10	Winter	Midweek, Weekend	Evening	Good	None
11	Winter	Weekend	Midday	Good	New Plant Construction

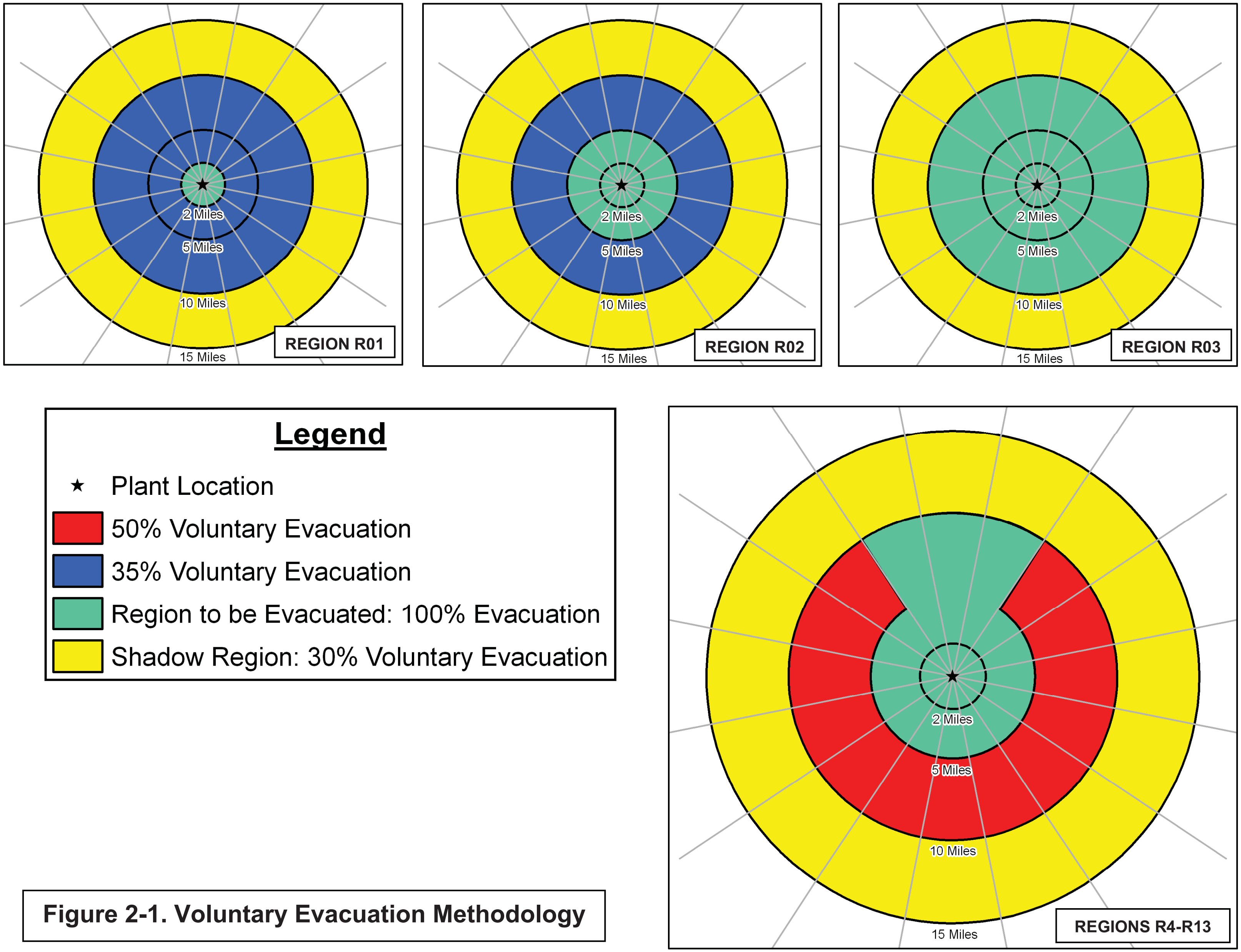


Figure 2-1. Voluntary Evacuation Methodology

7. The models of the IDYNEV System represent the state of the art, and have been recognized as such by the Atomic Safety and Licensing Board (ASLB) in past hearings. (Sources: Atomic Safety & Licensing Board Hearings on Seabrook and Shoreham; Urbanik[1]).

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 10 minutes of the Advisory to Evacuate.
   c. ETE are measured relative to the Advisory to Evacuate.
2. It is assumed that everyone within the group of PAZ forming a Region that is issued an Advisory to Evacuate will, in fact, respond in general accord with the planned routes.
3. It is further assumed that all households in the EPZ with at least one commuter (45% of households according to Figure F-6) will await the return of the commuter before beginning their evacuation trip .
4. A portion of the population outside the evacuated Region will elect to evacuate even though not advised to do so ("voluntary evacuation"). See Figure 2-1.
5. 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.
6. Access Control Points (ACP) will be staffed within approximately 90 minutes of the siren notifications, to divert traffic attempting to enter the EPZ. Earlier activation of ACP locations could delay returning commuters. It is assumed that no vehicles will enter the EPZ after this 90 minute mobilization time period.
7. 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 personnel 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.

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

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.

8. 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 assigned Reception Centers.

   b. Schoolchildren, if school is in session, are given priority in assigning transit vehicles.

   c. Bus mobilization time is considered in ETE calculations.

   d. Analysis of the number of required “waves” of transit vehicles used for evacuation is presented.

9. It is reasonable to assume that some of transit-dependent 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[2], which cites previous evacuation experience. The remaining transit-dependent portion of the general population will be evacuated to reception centers by bus.

10. An adverse weather scenario is also considered. Rain may occur for either winter or summer scenarios. In the case of rain, it is assumed that the rain begins prior to, or at about the same time as the evacuation advisory is issued. No weather-related reduction in the number of transients who may be present in the EPZ is assumed. Adverse weather scenarios affect roadway capacity, free flow highway speeds and the time required to mobilize the general population. The factors assumed for the ETE study are:

[2] 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).

Scenario	Highway Capacity*	Free Flow Speed*	Mobilization Time for the General Population
Rain	90%	90%	No Effect
*Adverse weather capacity and speed values are given as a percentage of good weather conditions. Roads are assumed to be passable.			

11. School buses used to transport students are assumed to have the capacity to transport 70 children per bus for elementary schools, and 50 children per bus for middle and high schools. Transit buses used to transport the transit-dependent general population are assumed to transport an average of 30 people per bus.
12. It is assumed that summer-school enrollment is 10% of the enrollment for the regular school year.
13. It is assumed that sufficient bus drivers are available for all buses servicing the EPZ.
14. Based on the presence of the siren system within the EPZ, it is assumed that 85 percent of the EPZ population will be aware of the accident within 30 minutes with the remainder notified within the following 20 minutes.

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 Levy Nuclear Plant 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 (e.g., boating, camping) and then leave the area.
- Commuter-Employees - people who reside outside 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 Protective Action Zone (PAZ) and by polar coordinate representation (population rose). The LNP EPZ has been subdivided into 8 PAZ as shown in Figure 3-1.

<u>Permanent Residents</u>

The primary source for estimating permanent population is the latest U.S. Census data. The average household size (2.25 persons/household) and the number of evacuating vehicles per household (1.39 vehicles/household) were adapted from the telephone survey results.

The rate of population change for each County in the EPZ was obtained by KLD from the county planning departments and applied to 2000 Census data to project population to 2007. The data in Table 3-1 show that the EPZ population has increased by 24 percent over the last 7 years.

Permanent resident population and vehicle estimates for 2007 are presented in Table 3-2. Figures 3-2 and 3-3 present the permanent resident population and permanent resident vehicle estimates by sector and distance from LNP. This "rose" was constructed using GIS software.

<u>Construction</u>

A "special event" scenario (Scenario 11) which represents a typical winter, weekend, midday with construction workers on-site at the time of the emergency, is considered. Based on discussions with Progress Energy, there will be two units constructed at the proposed Levy site. The construction plans are offset slightly in that Unit 1 will be operational in February 2018, while construction will persist on Unit 2 which will be operational in February 2019. There will be 565 workers on site at Unit 1 when operational and 150 construction workers will remain at Unit 2, for a total of 715 additional people in the EPZ for this special event. An average vehicle occupancy of 1.03 workers per vehicle (adapted from telephone survey results) is used to convert workers to vehicles – 695 total vehicles. The existing roadway system is used for the construction scenario; no roadway improvements are considered. All vehicles and population are extrapolated to 2019 for this scenario, as follows:

The EPZ permanent resident population and shadow population are extrapolated using a compound growth rate and yearly population growth rates, by county.

$$Pop_{2007} = Pop_{2000}(1 + yearly\ growth\ rate)^{7}$$
$$Pop_{2019} = Pop_{2000}(1 + yearly\ growth\ rate)^{19}$$

<u>Growth Rates</u>
Citrus = 3.10% per year
Levy = 2.62% per year
Marion = 3.55% per year

Using this methodology, the year 2019 EPZ permanent resident population and shadow population are estimated to be 33,062 and 73,277 respectively.

The estimates of employees are extrapolated to year 2019 using the compound growth formula and county-specific labor growth rates obtained from the US Department of Labor website, as shown below.

County-Specific Labor Growth Rates			
Average Annual Employment	COUNTY		
	Citrus	Levy	Marion
Year 2001	28,185	7,748	82,168
Year 2007	34,025	9,122	103,410
Annual Growth Rate	2.7%	2.4%	3.3%

As shown in Table 8-1, 2.6% of the EPZ population is transit-dependent, after ridesharing. Applying this same percentage to the year 2019 permanent resident population estimate results in 860 transit dependent persons (2.6% x 33,062). Based on the transit bus occupancy of 30 persons (see Section 8), 29 bus runs will be needed to service this component of the 2019 permanent resident population. As stated in the footnote to Table 6-3, 1 bus is considered as 2 passenger car equivalents (PCEs); thus, 58 vehicles will be included for the construction scenario to represent transit buses.

As noted in Table 6-2 of the ETE report, the construction scenario is a weekend scenario. Therefore, school will not be in session for this scenario (no school buses indicated for Scenario 11 in Table 6-4) and projection of school buses to year 2019 need not be considered.

Special event traffic (Unit 2 construction worker vehicles), by definition, is already in the year 2019 timeframe.

It is assumed that the total transient vehicles and the total external traffic for the year 2019 scenario will have the same proportion of the year 2019 permanent resident vehicle totals, as the 2007 transient vehicles to the 2007 permanent resident vehicles. As shown in Table 6-4 of the ETE report, there are 889 transient vehicles and 14,058 permanent resident vehicles for scenario 8 in 2007. Thus, the number of transient vehicles evacuating is 6.3% of the number of permanent resident vehicles evacuating. This percentage will be applied to the year 2019 permanent resident vehicle estimate in order to estimate the transient vehicles in year 2019. This same methodology will be used to extrapolate external traffic.

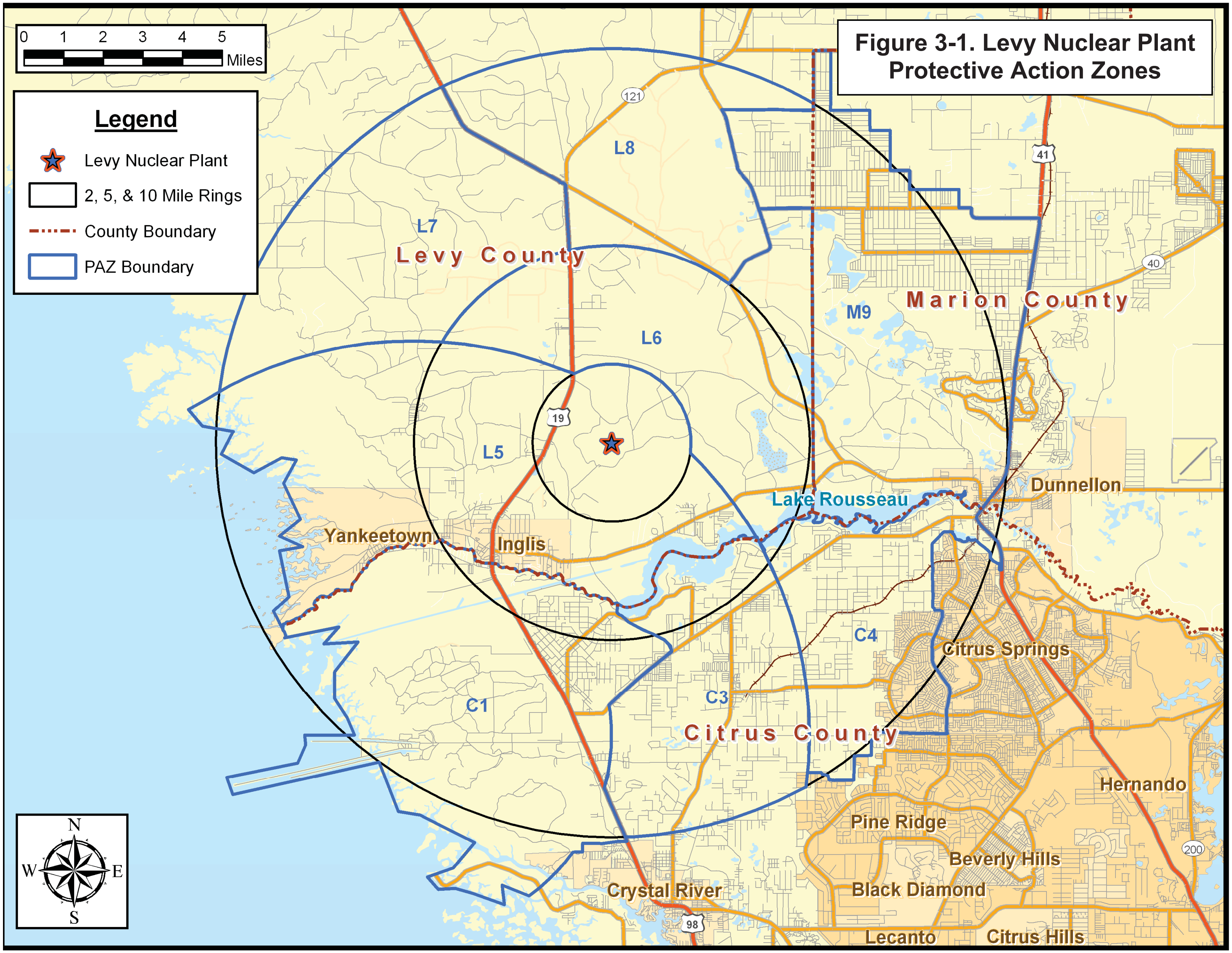
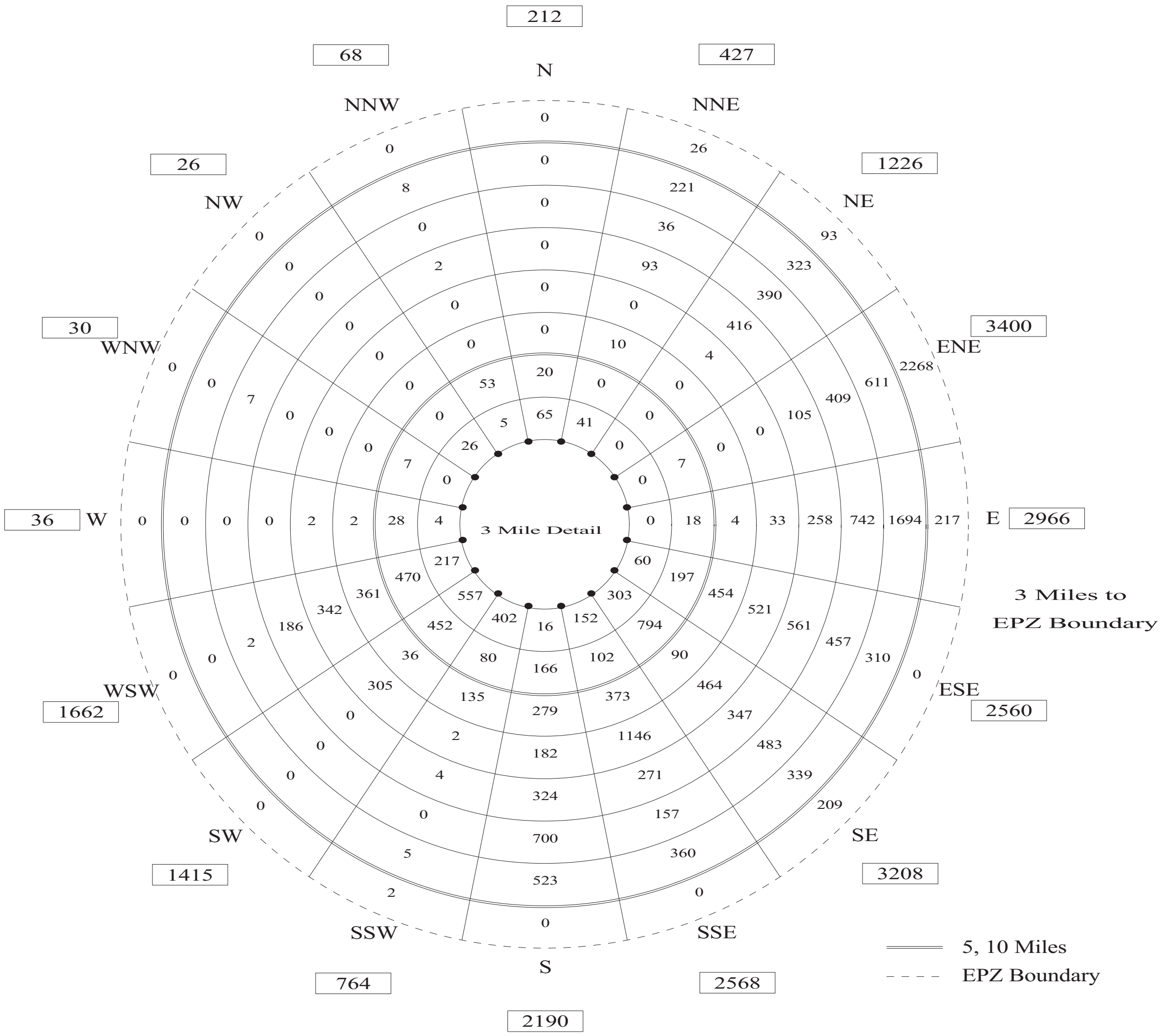


Figure 3-1. Levy Nuclear Plant
Protective Action Zones
0 1 2 3 4 5
Miles
Legend
Levy Nuclear Plant
2, 5, & 10 Mile Rings
County Boundary
PAZ Boundary
N
W
E
S
Levy County
Marion County
Citrus County
L5
L6
L7
L8
M9
C1
C3
C4
Lake Rousseau
Dunnellon
Yankeetown
Inglis
Citrus Springs
Hernando
Pine Ridge
Beverly Hills
Black Diamond
Crystal River
Lecanto
Citrus Hills
19
41
40
121
98
200

Table 3-1. EPZ Permanent Resident Population		
PAZ	**2000 Population**	**2007 Population**
C1	1,434	1,776
C3	4,422	5,476
C4	2,795	3,461
L5	3,004	3,601
L6	545	653
L7	14	17
L8	245	294
M9	5,866	7,480
TOTAL	**18,325**	**22,758**
	Population Growth:	**24%**

Table 3-2. Permanent Resident Population and Vehicles by PAZ		
PAZ	**2007 Population**	**2007 Vehicles**
C1	1,776	1,095
C3	5,476	3,384
C4	3,461	2,138
L5	3,601	2,224
L6	653	403
L7	17	12
L8	294	181
M9	7,480	4,621
TOTAL	**22,758**	**14,058**



Resident Population			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-1	0	0-1	0
1-2	159	0-2	159
2-3	453	0-3	612
3-4	1848	0-4	2460
4-5	2394	0-5	4854
5-6	1744	0-6	6598
6-7	3001	0-7	9599
7-8	2567	0-8	12166
8-9	3383	0-9	15549
9-10	4394	0-10	19943
10-EPZ	2815	0-EPZ	22758

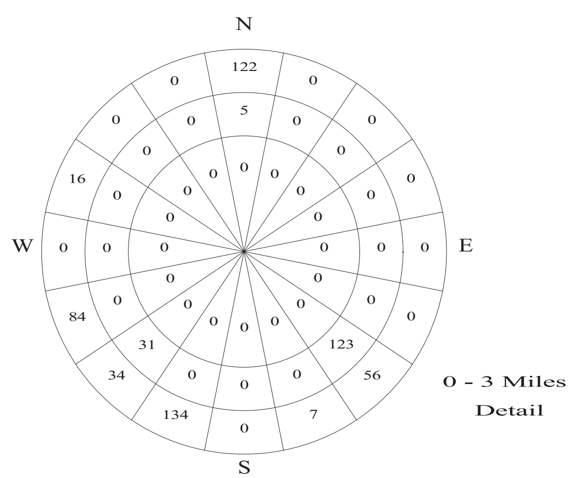
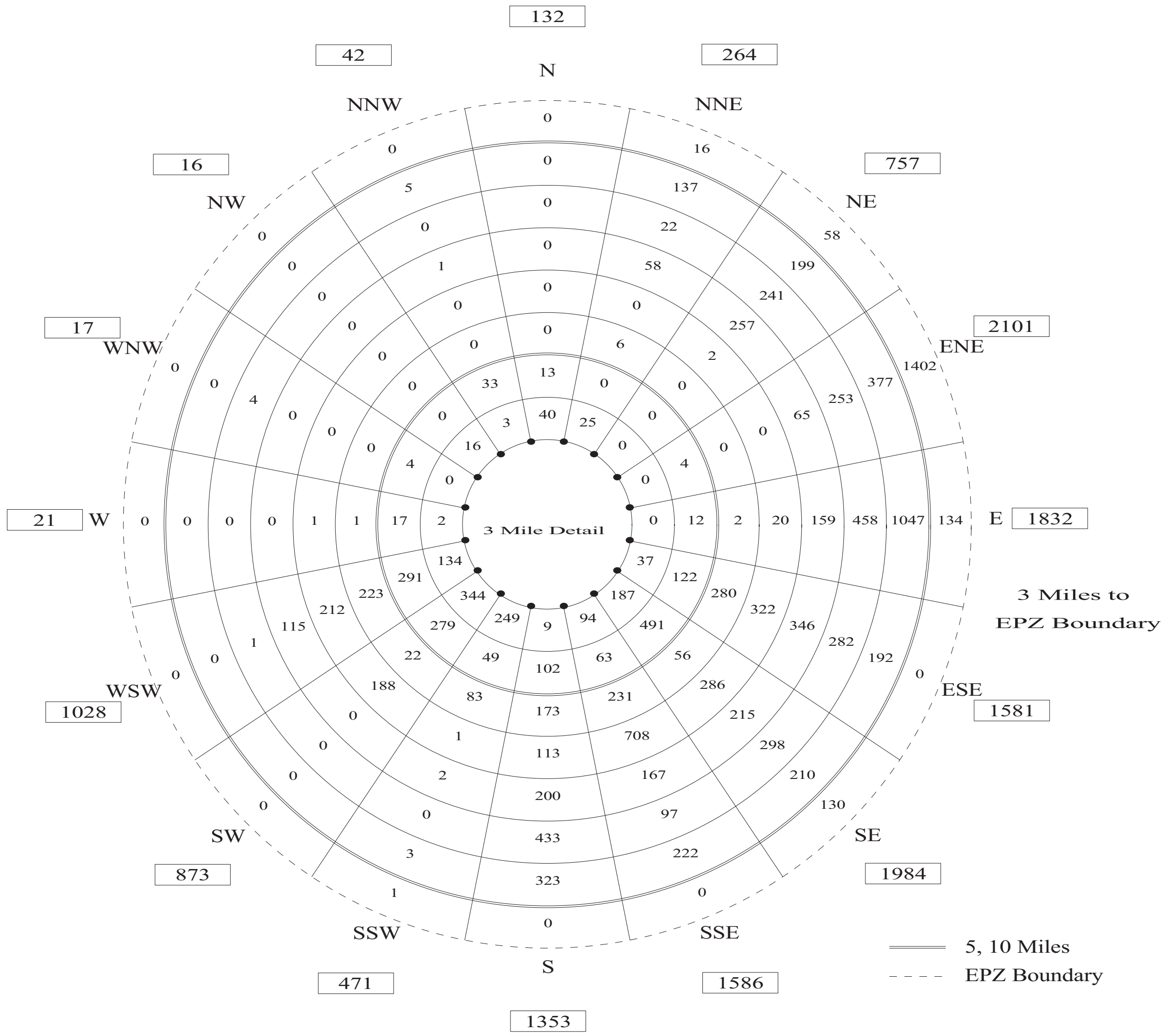


Figure 3-2. Permanent Residents by Sector



Resident Vehicles			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-1	0	0-1	0
1-2	98	0-2	98
2-3	280	0-3	378
3-4	1140	0-4	1518
4-5	1480	0-5	2998
5-6	1077	0-6	4075
6-7	1853	0-7	5928
7-8	1585	0-8	7513
8-9	2089	0-9	9602
9-10	2715	0-10	12317
10-EPZ	1741	0-EPZ	14058

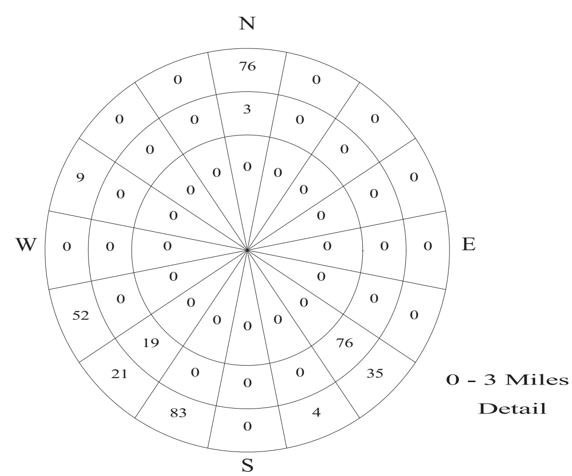


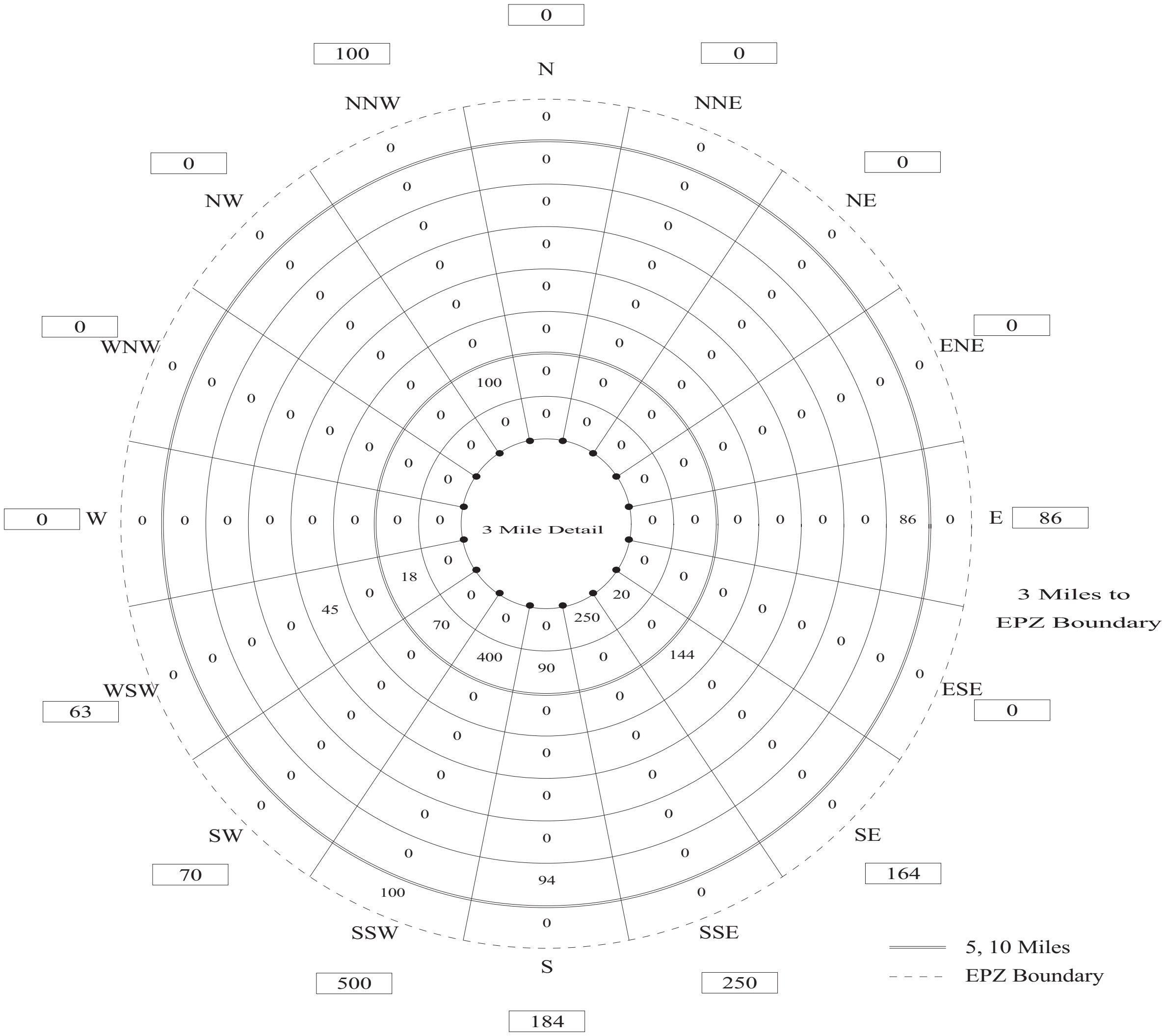
Figure 3-3. Permanent Resident Vehicles by Sector

Transient Population

Transient population groups are defined as those people who are not permanent residents and who enter the EPZ for a specific purpose (camping, boating). Transients may spend less than one day or stay overnight or longer at rented apartments, camping facilities, hotels and motels. There are several locations within the LNP EPZ that offer boating, fishing and camping facilities in and along Lake Rousseau and on the Gulf of Mexico.

A total of 1,417 people could be recreating in the EPZ during the peak season based on data obtained from the survey of the major recreational areas for LNP. This represents about 889 vehicles in the EPZ at an average occupancy rate of 1.63 persons/vehicle. The peak season is winter; 10-15% of transients are assumed to be present during off-peak times. See Appendix E for supporting data.

Figures 3-4 and 3-5 present transient population and transient vehicle data by sector.



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	270	0-4	270
4-5	678	0-5	948
5-6	144	0-6	1092
6-7	45	0-7	1137
7-8	0	0-8	1137
8-9	0	0-9	1137
9-10	180	0-10	1317
10-EPZ	100	0-EPZ	1417

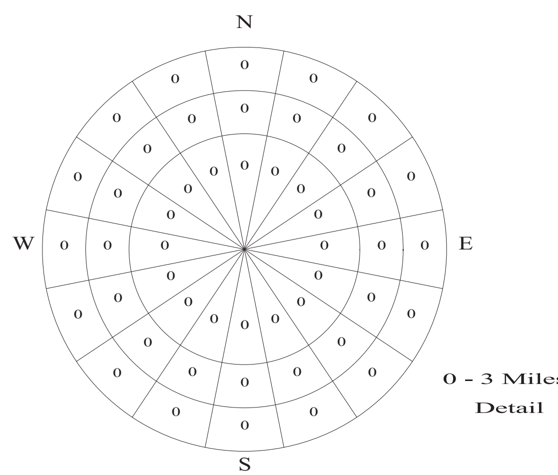
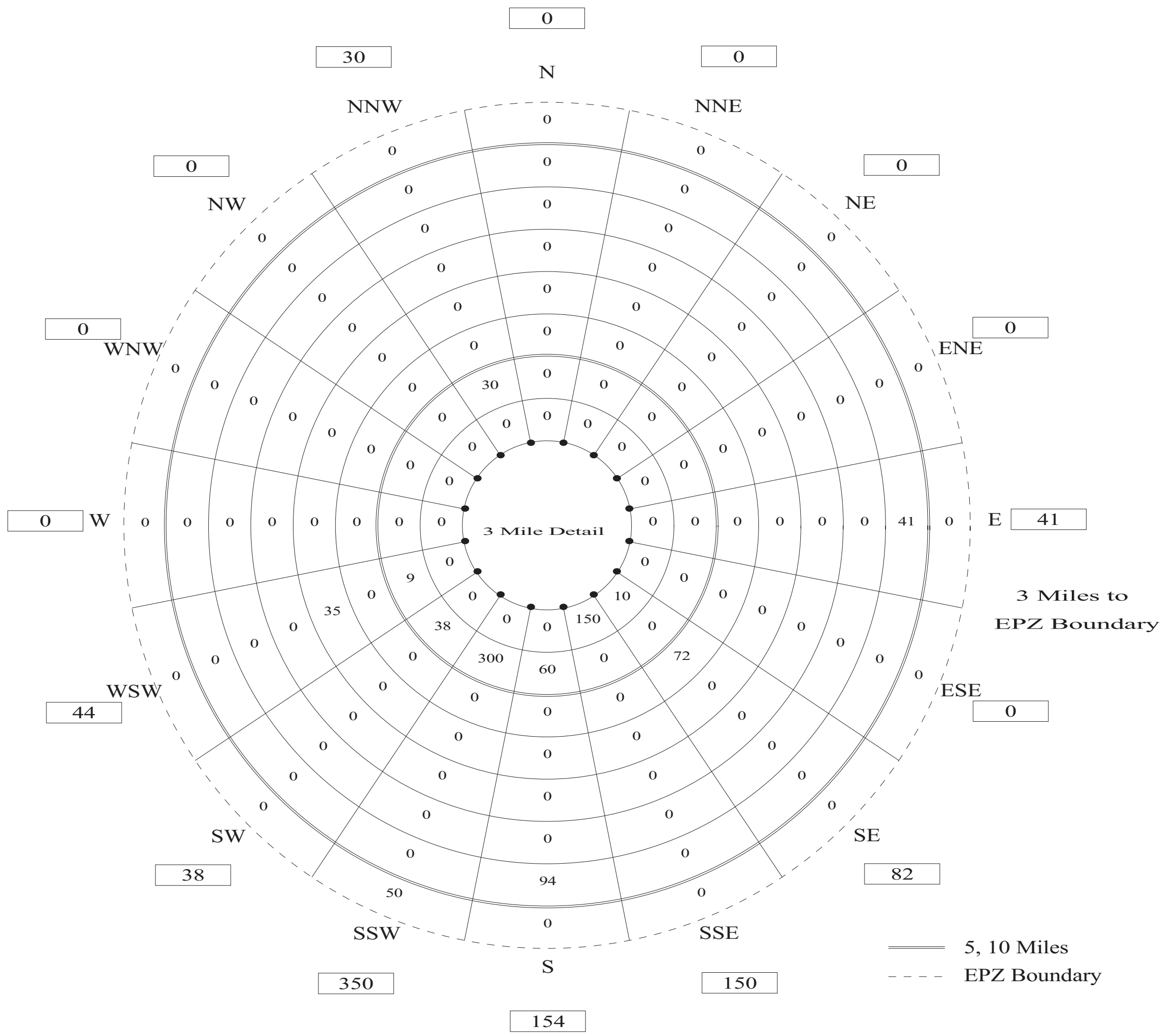


Figure 3-4. Transient Population by Sector



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	160	0-4	160
4-5	437	0-5	597
5-6	72	0-6	669
6-7	35	0-7	704
7-8	0	0-8	704
8-9	0	0-9	704
9-10	135	0-10	839
10-EPZ	50	0-EPZ	889

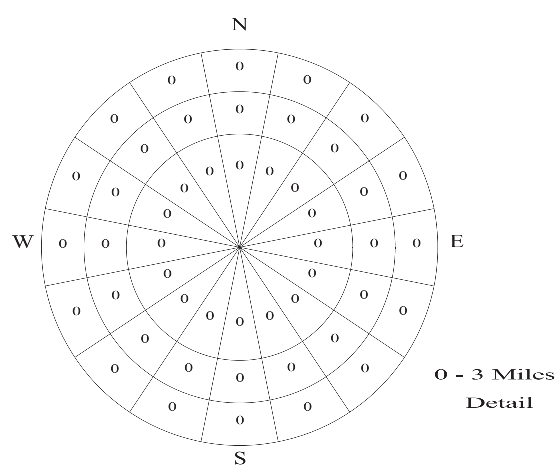


Figure 3-5. Transient Vehicles by Sector

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 on those commuting employees who will evacuate along with the permanent resident population.

Data for major employers (more than 50 total employees) in the EPZ was provided by the county emergency management offices. The locations of these facilities were mapped using GIS software. The GIS map was overlaid with the evacuation analysis network and employees were loaded onto appropriate links.

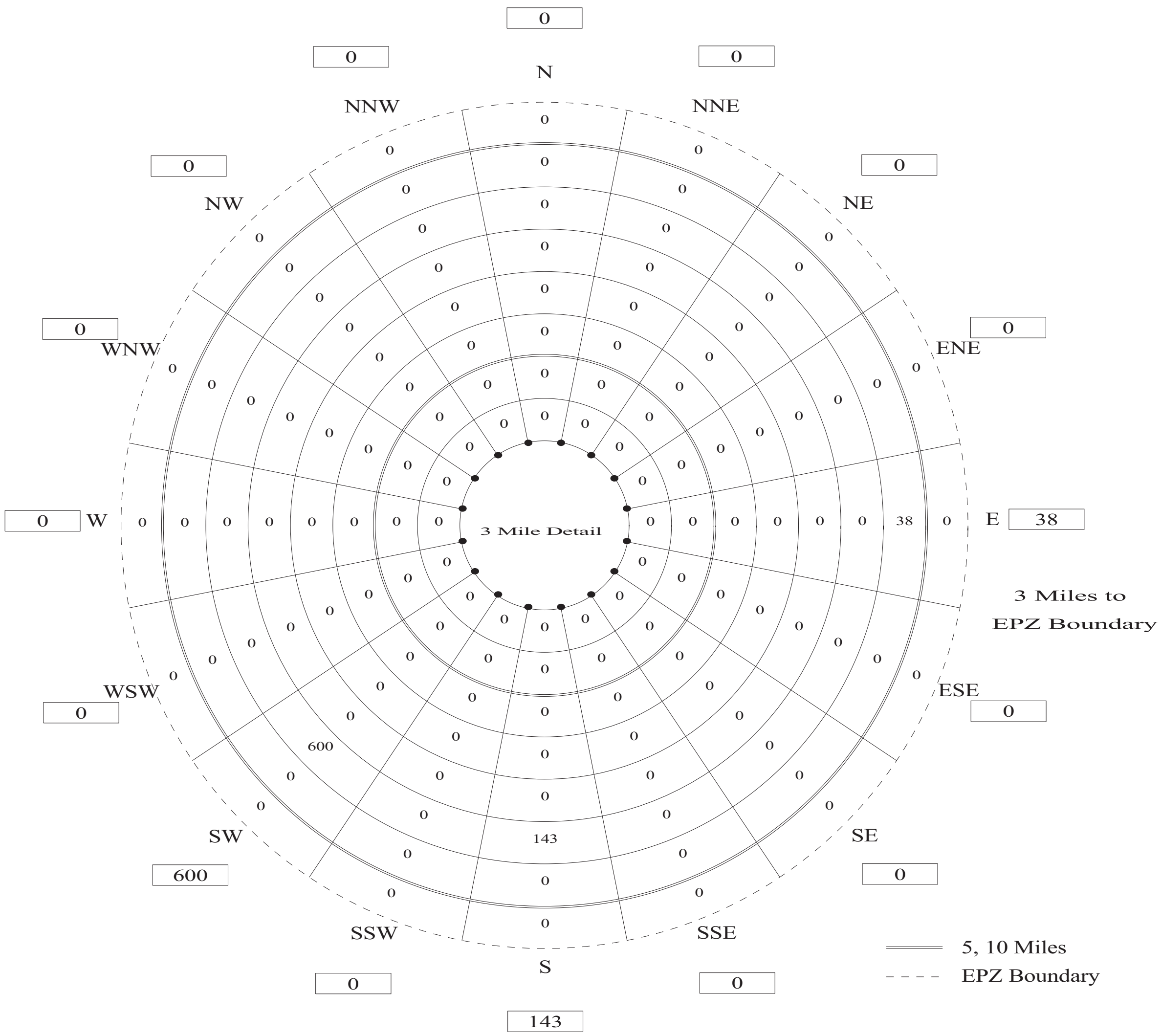
Three major employers were identified for the LNP EPZ:

1. The Crystal River Nuclear Plant
   - Total employment of 1,000 people.
   - Maximum shift employment of 800 people.
   - 75% of employees are non-EPZ residents; thus max shift is 600 non-EPZ employees.
   - Evening workforce is equal to 13% of daytime workforce.
   - Based on information provided by Progress Energy, in the event of an emergency evacuation, a skeleton crew of 40 employees would remain at the Crystal River Nuclear Power Plant (CRNPP). It is conservatively assumed in this study, however, that 100% of the CRNPP employees would evacuate.
2. Sweetbay Supermarket – Grocery Store
   - Total employment of 60 people.
   - Maximum shift employment of 25 people.
   - Assumed 50% of employees are non-EPZ residents.
3. Super Walmart – Grocery/Convenience Store
   - Assumed Total employment of 100 people.
   - Assumed Maximum shift employment of 50 people.
   - Assumed 50% of employees are non-EPZ residents.
4. Seven Rivers Regional Medical Center
   - Total and maximum shift employment of 190 people.
   - Assumed 75% of employees are non-EPZ residents.

There are likely several smaller employment centers within the EPZ, but employees at such facilities are most likely EPZ residents.

An occupancy of 1.03 persons per employee-vehicle obtained from the telephone survey, was used to determine the number of evacuating employee vehicles.

Figures 3-6 and 3-7 present non-EPZ Resident employee data by sector.



Employees			
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	0	0-4	0
4-5	0	0-5	0
5-6	0	0-6	0
6-7	0	0-7	0
7-8	0	0-8	0
8-9	743	0-9	743
9-10	38	0-10	781
10-EPZ	0	0-EPZ	781

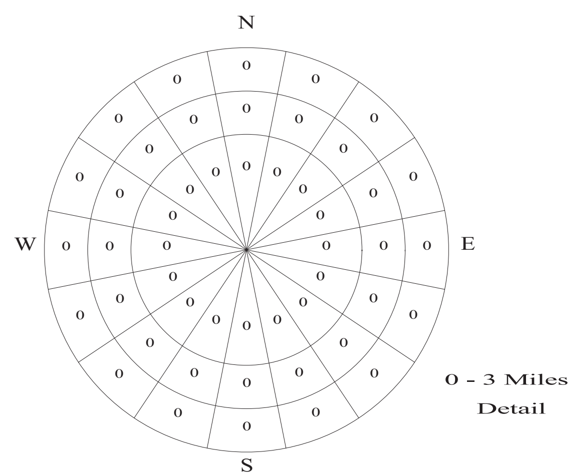
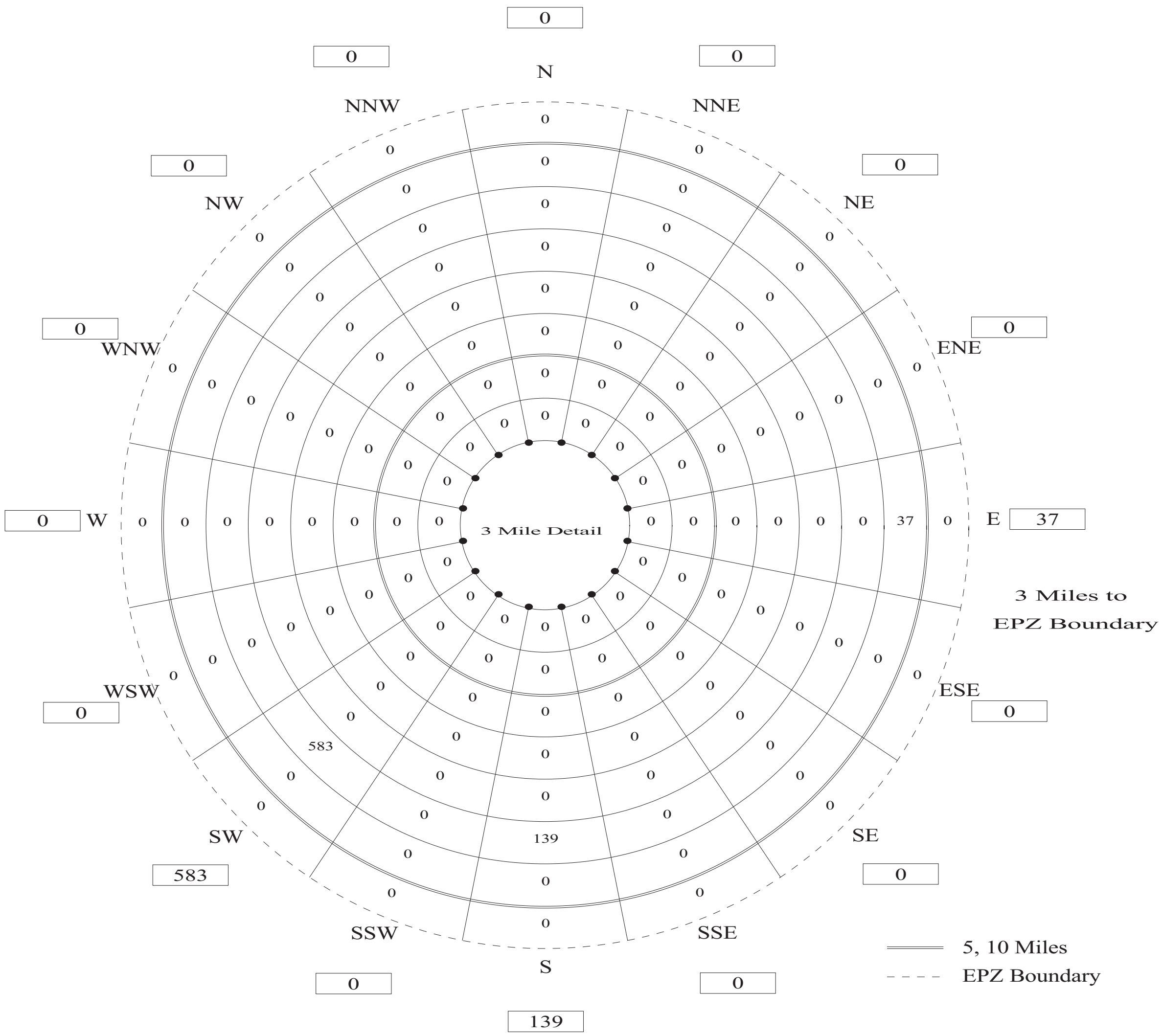


Figure 3-6. Employee Population by Sector



Employee 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	0	0-4	0
4-5	0	0-5	0
5-6	0	0-6	0
6-7	0	0-7	0
7-8	0	0-8	0
8-9	722	0-9	722
9-10	37	0-10	759
10-EPZ	0	0-EPZ	759

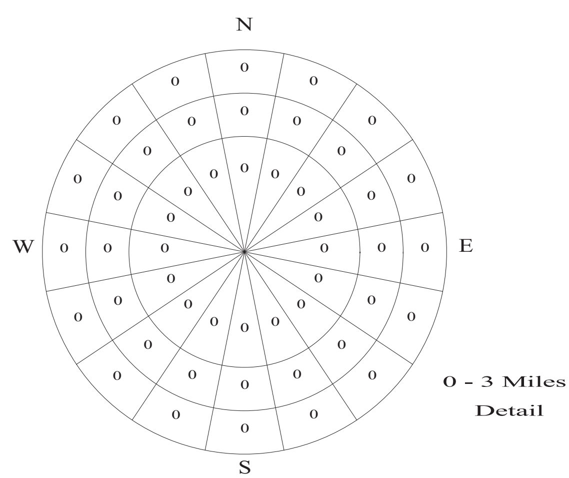


Figure 3-7. Employee Vehicles by Sector

Medical Facilities

There are three medical facilities in the LNP EPZ; a data request form was completed for each facility. Chapter 8 details the evacuation time estimate for the patients residing in these facilities. The number and type of evacuating vehicles that need to be provided depends on the state of health of the patients. 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 (patients).

Pass-Through Demand

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 through the EPZ (e.g. US Hwy 19, US Hwy 41). It is assumed that this traffic will continue to enter the EPZ during the first 90 minutes following the Advisory to Evacuate. We estimate 3,600 (2,400 vehicles per hour) vehicles enter the EPZ as external-external trips during this period.

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 (From the 2000 Highway Capacity Manual).

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 heavy 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.

Given the rural character of the EPZ within Levy and Marion Counties and the availability of well-maintained highways, congestion arising from evacuation is not likely to develop in those portions of the EPZ. The suburban character of the Citrus County portion of the EPZ will likely result in localized congestion. 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, 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.

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 (called Traffic Control Points, TCP – See Appendix G) 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	=	The mean duration of GREEN time servicing vehicles that are executing movement, m, for each signal cycle; seconds
L	=	The mean "lost time" for each signal phase servicing movement, m; seconds
C	=	The duration of each signal cycle; seconds
P_m	=	The 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, 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:

$$h_m \geq h_{sat}$$

[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.

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, …, 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.

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.

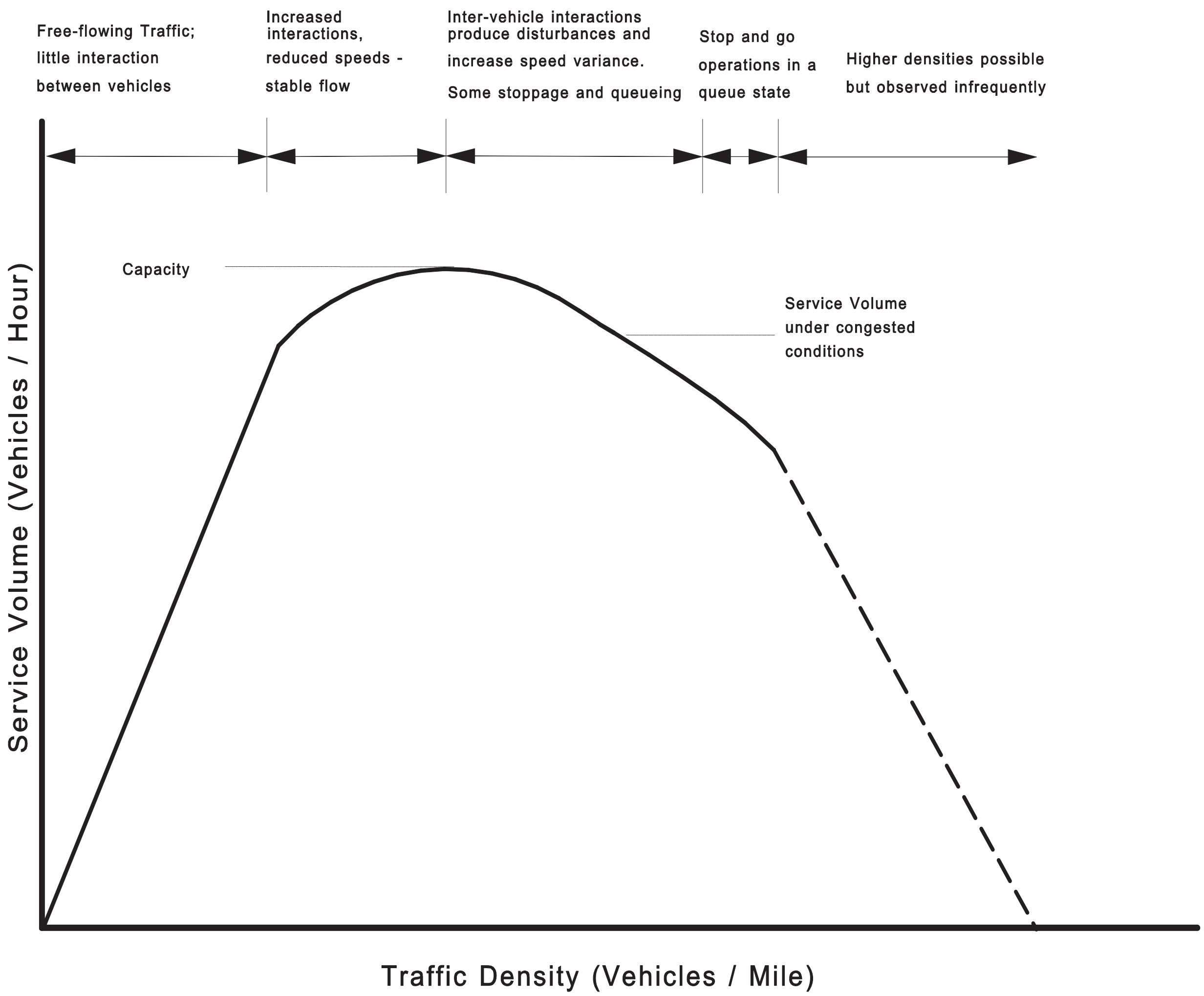


Figure 4-1. Fundamental Relationship Between Volume and Density

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 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 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.

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

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 capacities. Exhibit 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.

Application to the Levy Nuclear Plant EPZ

As part of the development of the Levy Nuclear Plant (LNP) 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 LNP EPZ consists primarily of two categories of roads and, of course, intersections:

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

Each of these classifications will be discussed.

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”.

Multi-Lane Highway

Ref: HCM Chapters 12 and 21

Exhibit 21-23 (in the HCM) presents a set of curves that indicates a per-lane capacity of approximately 2100 pc/h, for free-speeds of 55-60 mph. Based on observation, the multi-lane highways running north-south along the eastern and western parts of the EPZ (US Highway 19 and US Highway 41) 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. Chapter 12 presents the basic concepts underlying the procedures in Chapters 20 and 21.

Intersections

Ref: HCM Chapters 10, 16 and 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 the basic concepts underlying the procedures in Chapters 16 and 17.

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.

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 plant 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 accord 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 circumstances permit.

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

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

It is likely that a longer time will elapse between the various classes of an emergency at LNP and that the Advisory to Evacuate is announced somewhat later than the siren alert.

For example, suppose one hour elapses 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 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 permanent resident population within the EPZ approximates 22,758 persons who are deployed over an area of approximately 314 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 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.

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 also 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.

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 activities) 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	No-accident condition
2	Awareness of accident situation
3	Depart place of work or elsewhere, to return home
4	Arrive (or be at) home
5	Begin evacuation trip to leave the area

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

Event Sequence	Activity	Distribution
1 → 2	Receives notification	1
2 → 3	Prepare to leave work	2
2,3 → 4	Travel home*	3
2,4 → 5	Prepare to leave to Evacuate	4

*If already at home, this is a null (no-time-consumed) activity.

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. Note that event 5, "Leave to evacuate the area," is conditional either on event 2 or on event 4. For this study, we adopt the conservative posture that all activities will occur in sequence.

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.

<u>Estimated Time Distributions of Activities Preceding Event 5</u>

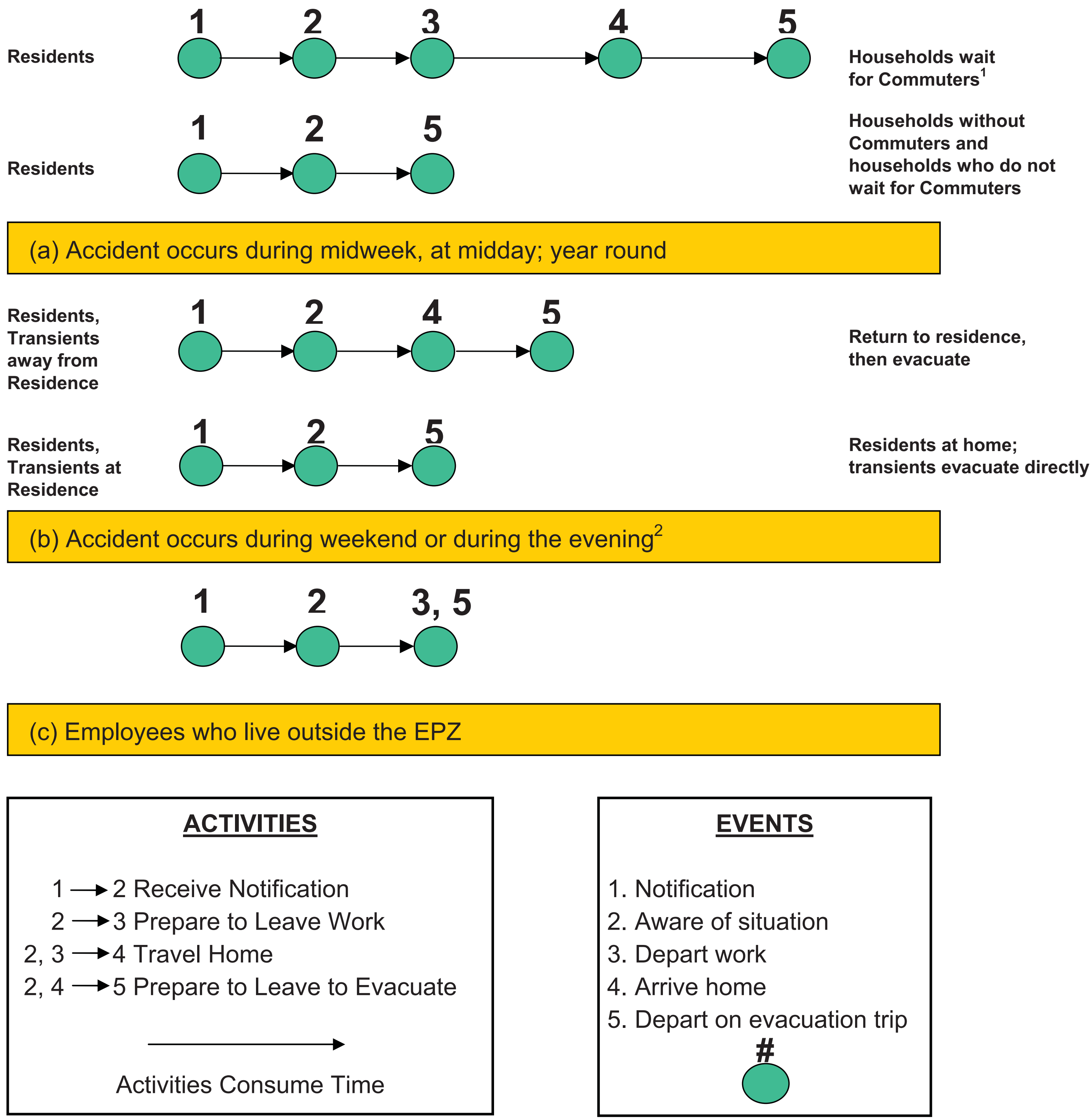
The time distribution of an event is obtained by "summing" the time distributions of all prior contributing activities (This "summing" process is quite different than an algebraic sum since we are operating on distributions – not scalar numbers).

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

Based on the presence of the siren system within the EPZ, it is assumed 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:

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

Elapsed Time (Minutes)	**Percent of Population Notified**
0	0
5	7
10	13
15	26
20	46
25	65
30	85
35	90
40	95
45	98
50	100



[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

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 or livestock 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.

Elapsed Time (Minutes)	**Cumulative Percent Employees Leaving Work**
0	0
5	33
10	46
15	57
20	65
25	73
30	81
35	84
40	86
45	89
50	90
55	92
60	94
65	95
70	96
75	97
80	98
85	98
90	98
95	98
100	100

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

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

The distribution of time to travel home from work/school is provided in the table below. This distribution is plotted in Figure 5-2.

Elapsed Time (Minutes)	Cumulative Percent Returning Home
0	0
5	18
10	37
15	50
20	61
25	70
30	77
35	82
40	85
45	90
50	92
55	92
60	94
65	95
70	96
75	96
80	96
85	97
90	97
95	97
100	97
105	97
110	98
115	99
120	100

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

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

The distribution of time to prepare the home before departing on the evacuation trip is provided in the table below. This distribution is plotted in Figure 5-2.

Elapsed Time (Minutes)	Cumulative Pct. Ready to Evacuate	Elapsed Time (Minutes)	Cumulative Pct. Ready to Evacuate
0	0	110	88
5	9	115	89
10	18	120	90
15	27	125	91
20	37	130	93
25	48	135	94
30	54	140	94
35	60	145	94
40	63	150	95
45	65	155	95
50	70	160	95
55	74	165	95
60	79	170	95
65	81	175	95
70	83	180	95
75	85	185	96
80	85	190	96
85	85	195	97
90	86	200	98
95	86	205	99
100	86	210	100
105	86		

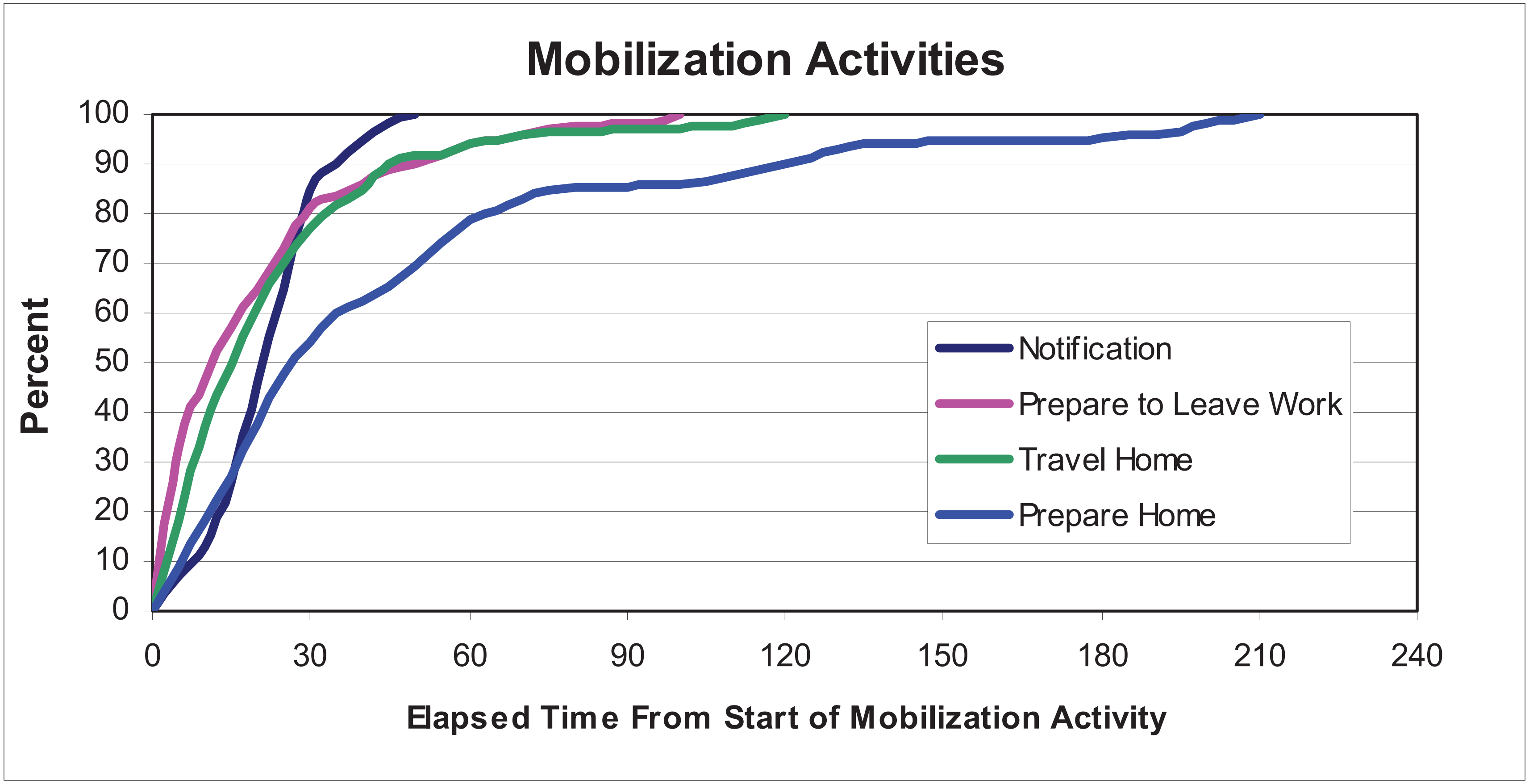


Figure 5-2. Evacuation Mobilization Activities

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.

Apply "Summing" Algorithm To:	**Distribution Obtained**	**Event Defined**
Distributions 1 and 2	To Obtain Distribution A	That defines Event 3
Distributions A and 3	To Obtain Distribution B	That defines Event 4
Distributions B and 4	To Obtain Distribution C	That defines Event 5
Distributions 1 and 4	To Obtain Distribution D	That defines Event 5

Distributions A through D are described below; distributions A, C, and D are shown in Figure 5-3:

Distribution	Description
A	Time distribution of commuters departing place of work (Event 3). Also applies to employees who work within the EPZ but live outside the EPZ, and to Transients within the EPZ.
B	Time distribution of commuters arriving home.
C	Time distribution of residents with commuters leaving home to begin the evacuation trip.
D	Time distribution of residents without commuters returning home to begin the evacuation trip.

As shown in Figure 5-2 and in the figures of Appendix F, the mobilization activity distributions have long tails. Combining multiple distributions with long tails results in a distribution with an even longer tail. Thus, the 100th percentile of the combined distribution is indistinct and difficult to quantify. Given these characteristics, a statistical analysis on the mobilization distributions was performed to quantify a "confidence band" about the distribution. This band serves as the basis for establishing the point in time where the long tail should be "truncated".

The ETE for the vast majority of evacuees should not be distorted for those few stragglers (typically less than 2 percent of households) who take considerably longer to prepare to evacuate. As such, the combined distributions are "truncated" to avoid biasing the ETE. In "truncating" these distributions, the mobilization of the stragglers is advanced. Therefore, the stragglers are not eliminated from the ETE. Appendix F presents the raw distributions for the various mobilization activities. Appendix M describes the statistical analysis used to "truncate" the resultant distributions.

Figure 5-3 presents the combined trip generation distributions designated A, C, and D. These distributions are presented on the same time scale. Comparison of the distributions in Appendix F with those in Figures 5-2 and 5-3 indicates that the combined distributions are somewhat shorter (5 hours) than the individual distributions (up to 6 hours). This is a result of the aforementioned "truncation" procedure.

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, and D, properly displaced with respect to one another, are tabulated in Table 5-1 (Distribution B, Arrive Home, omitted for clarity).

The final time period (10) 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.

95% confidence bounds were computed on the expected value of the 95th percentile time for the values in Table 5-1 and curves in Figure 5-3. The following summarizes the results:

- Employees, Transients = 90 ± 5 minutes
- Residents, No Commuters = 180 ± 12 minutes
- Residents with Commuters = 257 ± 7 minutes

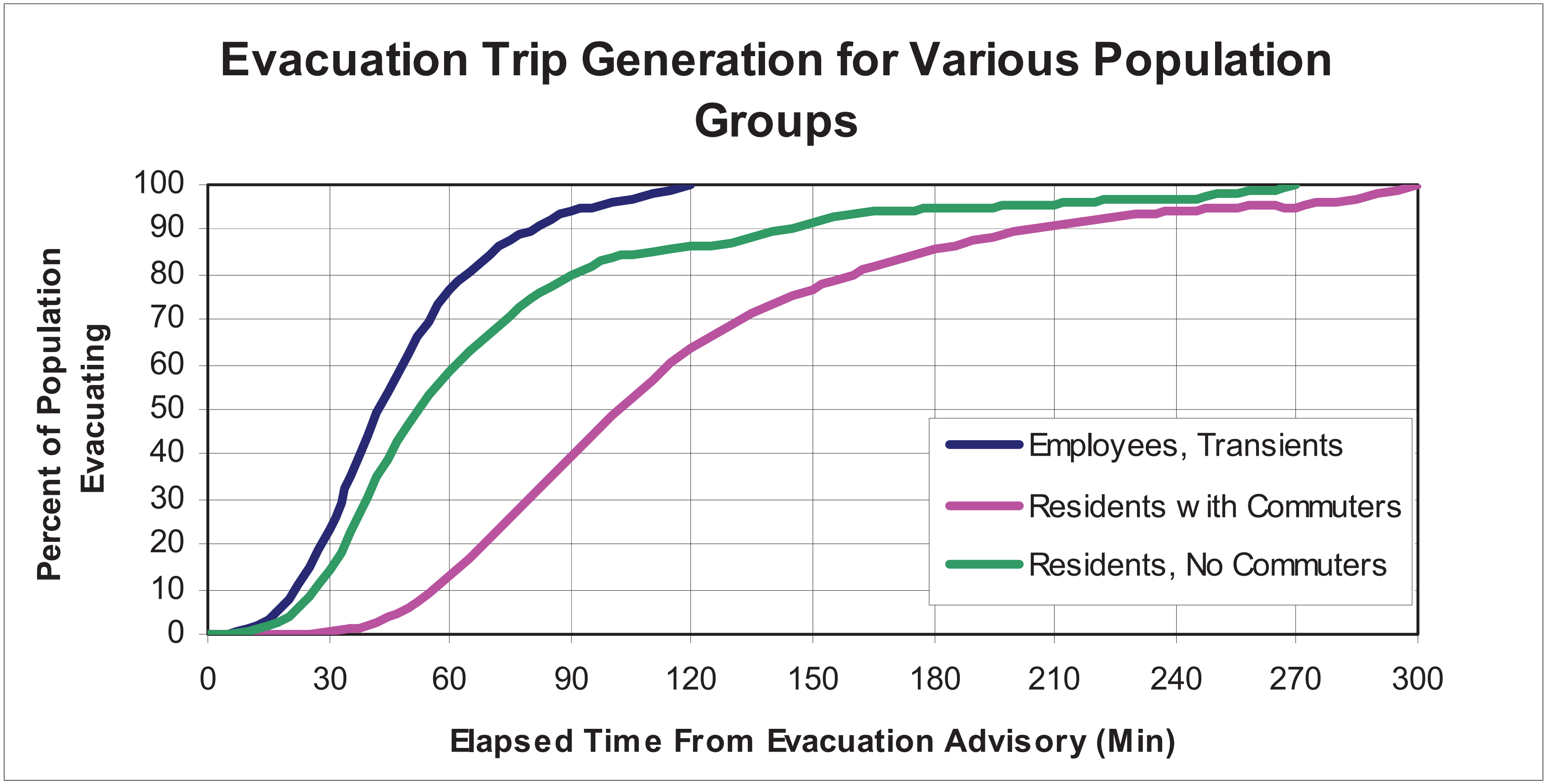


Figure 5-3. Comparison of Trip Generation Distributions

Table 5-1. Trip Generation Histograms for the EPZ Population

Time Period	Duration (Min)	Percent of Total Trips Generated Within Indicated Time Period			
		Residents With Commuters (Distribution C)	Residents Without Commuters (Distribution D)	Employees (Distribution A)	Transients (Distribution A)
1	15	0	3	5	5
2	15	1	12	20	20
3	30	11	45	53	53
4	30	28	20	17	17
5	30	25	7	5	5
6	30	14	4	0	0
7	30	7	4	0	0
8	60	7	3	0	0
9	60	7	2	0	0
10	600	0	0	0	0

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 Protective Action Zones (PAZ), 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 13 Regions were defined which encompass all the groupings of PAZ considered. These Regions are defined in Table 6-1. The PAZ configurations are identified in Figure 6-1. Each keyhole sector-based area consists of a circular area centered at the Levy Nuclear Plant (LNP), and three adjoining sectors, each with a central angle of 22.5 degrees. These sectors extend to a distance of 5 miles from LNP, or to the EPZ boundary. The azimuth of the center sector defines the orientation of these Regions.

A total of 11 Scenarios were evaluated for all Regions. Thus, there are a total of 11 x 13 = 143 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.

Table 6-1. Description of Evacuation Regions									
		PAZ							
Region	**Description**	**C1**	**C3**	**C4**	**L5**	**L6**	**L7**	**L8**	**M9**
R01	2 mile ring				X				
R02	5-mile ring				X	X			
R03	Full EPZ	X	X	X	X	X	X	X	X
Evacuate 2 mile ring and 5 miles downwind									
		PAZ							
Region	**Wind Direction Towards:**	**C1**	**C3**	**C4**	**L5**	**L6**	**L7**	**L8**	**M9**
Refer to R02	WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE				X	X			
Refer to R01	SSE, S, SSW, SW, WSW, W				X				
Evacuate 5 mile ring and downwind to EPZ boundary									
		PAZ							
Region	**Wind Direction Towards:**	**C1**	**C3**	**C4**	**L5**	**L6**	**L7**	**L8**	**M9**
R04	N				X	X	X	X	X
R05	NNE, NE				X	X		X	X
R06	ENE, E			X	X	X			X
R07	ESE, SE		X	X	X	X			X
R08	SSE	X	X	X	X	X			
R09	S, SSW	X	X		X	X			
R10	SW, WSW	X			X	X			
R11	W	X			X	X	X		
R12	WNW				X	X	X		
R13	NW, NNW				X	X	X	X	

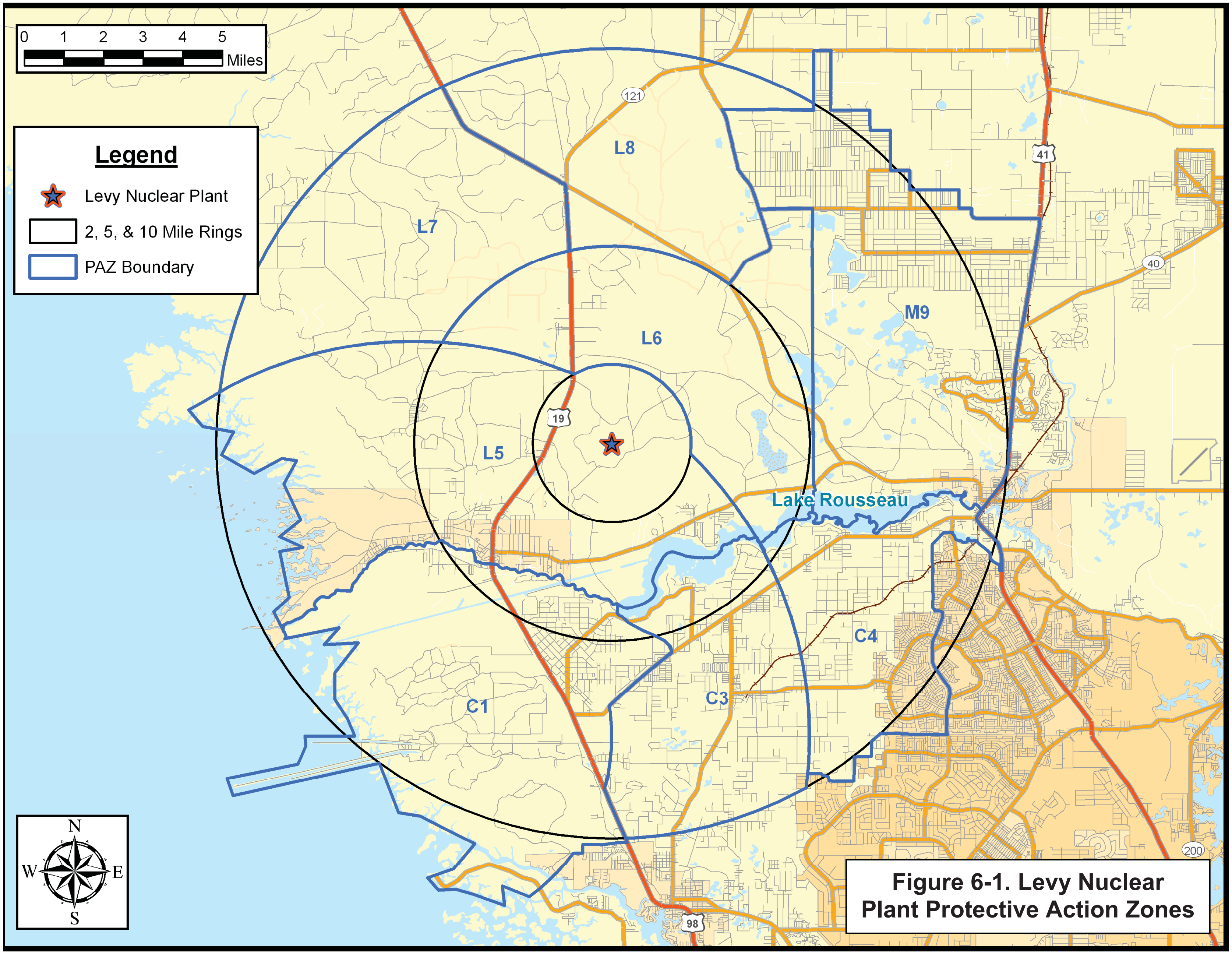


Figure 6-1. Levy Nuclear Plant Protective Action Zones

Table 6-2. Evacuation Scenario Definitions					
Scenarios	**Season**	**Day of Week**	**Time of Day**	**Weather**	**Special**
1	Summer	Midweek	Midday	Good	None
2	Summer	Midweek	Midday	Rain	None
3	Summer	Weekend	Midday	Good	None
4	Summer	Weekend	Midday	Rain	None
5	Summer	Midweek, Weekend	Evening	Good	None
6	Winter	Midweek	Midday	Good	None
7	Winter	Midweek	Midday	Rain	None
8	Winter	Weekend	Midday	Good	None
9	Winter	Weekend	Midday	Rain	None
10	Winter	Midweek, Weekend	Evening	Good	None
11	Winter	Weekend	Midday	Good	New Plant Construction

Note: Schools are assumed to be in session for the Winter season (midweek, midday).

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

Scenarios	Residents With Commuters in Household	Residents With No Commuters in Household	Employees	Transients	Shadow	Special Event	School Buses	Transit Buses	External Through Traffic
1	45%	55%	96%	10%	32%	0%	10%	100%	100%
2	45%	55%	96%	10%	32%	0%	10%	100%	100%
3	10%	90%	15%	15%	30%	0%	0%	100%	100%
4	10%	90%	15%	15%	30%	0%	0%	100%	100%
5	10%	90%	15%	5%	30%	0%	0%	100%	60%
6	45%	55%	100%	50%	32%	0%	100%	100%	100%
7	45%	55%	100%	50%	32%	0%	100%	100%	100%
8	10%	90%	15%	100%	30%	0%	0%	100%	100%
9	10%	90%	15%	100%	30%	0%	0%	100%	100%
10	10%	90%	15%	50%	30%	0%	0%	100%	60%
11	10%	90%	15%	100%	30%	100%	0%	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 in the Levy Nuclear Plant area during the completion of construction on Unit 2 in the Year 2019. Unit 1 will be operational in the Year 2018.

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), respectively. It is assumed that summer school is in session for Scenarios 1 and 2 and that 10% of the buses needed for the regular school session will be needed to evacuate summer school students.

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****

Scenarios	Residents with Commuters	Residents without Commuters	Employees	Transients	Shadow	Special Events	School Buses *	Transit Buses *	External Traffic	Total Scenario Vehicles
1	6,334	7,724	729	89	9,810	-	14	40	3,600	28,340
2	6,334	7,724	729	89	9,810	-	14	40	3,600	28,340
3	633	13,425	114	133	9,402	-	-	40	3,600	27,347
4	633	13,425	114	133	9,402	-	-	40	3,600	27,347
5	633	13,425	114	44	9,402	-	-	40	2,160	25,818
6	6,334	7,724	759	445	9,830	-	126	40	3,600	28,858
7	6,334	7,724	759	445	9,830	-	126	40	3,600	28,858
8	633	13,425	114	889	9,402	-	-	40	3,600	28,103
9	633	13,425	114	889	9,402	-	-	40	3,600	28,103
10	633	13,425	114	445	9,402	-	-	40	2,160	26,219
11**	918	19,516	157	1,294	13,274	695	-	58	5,233	41,145

NOTE:
* School Buses and Transit Buses are expressed in vehicle equivalents (1 bus = 2 vehicles). Therefore actual number of buses are 1/2 the value shown.
**All vehicles have been extrapolated to the Year 2019 when Unit 1 will be operational while Unit 2 construction is being completed (see the discussion of construction on page 3-2 for additional information).
*** The values presented are for an evacuation of the full EPZ (Region R03).

7. <u>GENERAL POPULATION EVACUATION TIME ESTIMATES (ETE)</u>

This section presents the current results of the computer analyses using the IDYNEV System described in Appendices B, C and D. These results cover 13 regions within the Levy Nuclear Plant EPZ and the 11 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.** The tabulated values of ETE are obtained from the PC-DYNEV simulation model outputs of vehicles exiting the specified evacuation areas. These data are generated at 10-minute intervals, then interpolated to the nearest 5 minutes.

7.1 <u>Voluntary Evacuation and Shadow Evacuation</u>

We define “voluntary evacuees” as people who are within the EPZ in Protective Action Zones (PAZ) located outside the Evacuation Region, 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 evacuation are assumed to take place over the same time frame as the evacuation from within the impacted Evacuation Region. The shadow vehicles are loaded on the link-node analysis network (Figure 1-2) using the same trip generation times as EPZ residents with Commuters (See Distribution C in Table 5-1).

The ETE for LNP addresses the issue of voluntary evacuees as discussed in Section 2.2 and displayed in Figure 7-1 (same as Figure 2-1). Figure 7-2 presents the area identified as the Shadow Evacuation Region. This region extends radially from the boundary of the EPZ to a distance of 15 miles from LNP. The estimated 2007 permanent-resident population within the Shadow Region is 50,324 people; this estimate was obtained using the same methodology described in Section 3 for permanent resident population residing within the EPZ.

Traffic generated within this Shadow Evacuation Region, traveling away from the plant, has the 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. **All ETE calculations include this shadow traffic movement.**

7.2 Patterns of Traffic Congestion During Evacuation

Figures 7-3 through 7-6 illustrate the patterns of traffic congestion that arise for the case when the entire EPZ (Region R03) is advised to evacuate during the winter, weekend, midday period under good weather conditions (Scenario 8).

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 at the indicated times are delineated in these Figures by a red line; all others are lightly indicated. Congestion develops in areas with high population density and at traffic bottlenecks. The approaches to US Hwy 41 in Dunnellon, to US Hwy 19/98 in Crystal River and to US Hwy 19/98 in Inglis/Yankeetown are congested at 1 hour after the Advisory to Evacuate (ATE) for Scenario 8, as indicated in Figure 7-3. Congestion is also exhibited northbound on US Hwy 41 and eastbound on State Highway 484 at this time. Congestion patterns are similar at 1 hour and 30 minutes after the ATE, as shown in Figure 7-4. Figure 7-5 indicates that congestion in the EPZ persists 2 hours after the ATE on the approaches to US Hwy 19/98 in Yankeetown and Inglis, on US Hwy 19/98 at the intersection with Dunnellon Rd (State Hwy 488) near Red Level, in the Rainbow Springs area southbound along US Hwy 41 and on the approaches to US Hwy 41 in Dunnellon. The final areas of congestion to clear are at 2 hours and 30 minutes after the ATE on the approach to US Hwy 19/98 from Inglis and on US Hwy 19/98 at the intersection with Dunnellon Rd near Red Level, as shown in Figure 7-6. 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 necessarily imply that traffic has completely cleared from these roadway sections.

Table 7-3 provides a description of each congestion point identified in Figures 7-3 through 7-6, 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 #2 experiences 6.6 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 (19,18) experience 6.6 minutes of delay, on average.

7.3 Evacuation Rates

Another format for displaying the dynamics of evacuation is depicted in Figure 7-7. This plot indicates the rate at which traffic flows out of the indicated areas for the case of an evacuation of the entire EPZ (Region R03) under the indicated conditions. Appendix J presents these plots for all Evacuation Scenarios for Region R03.

As indicated in Figure 7-7, 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. There is no significant congestion within the EPZ and the ETE is driven by the mobilization activities of the EPZ population.

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 the real world, this ideal is generally unattainable reflecting the variation in population density and in highway capacity within the EPZ.

7.4 Guidance on Using ETE Tables

Tables 7-1A through 7-1D present the ETE values for all 13 Evacuation Regions and all 11 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**:
   - The Season
     - Summer
     - Winter (also Autumn and Spring)
   - The Day of Week
     - Midweek (work-day)
     - Weekend, Holiday
   - The Time of Day
     - Midday (work and commuting hours)
     - Evening
   - Weather Condition
     - Good Weather
     - Rain
   - Special Event (if any)
     - New Plant Construction

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, Scenario (9) applies.
- The seasons are defined as follows:
  - Summer implies that public schools are in summer session (assumed 10% enrollment of regular school year).
  - 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 (and column in the Table) 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 Levy Nuclear Plant. 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 R13)
- Enter Table 7-2 and identify the applicable group of candidate Regions based on the wind direction and on the distance that the selected Region extends from LNP. 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 10 miles (to EPZ boundary).
- The desired ETE is that value needed to evacuate 95 percent of the population from within the impacted Region.

Table 7-1C is applicable because the 95th-percentile population is desired. Proceed as follows:

1. Identify the Scenario as summer, weekend, evening and raining. Entering Table 7-1C, 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 group entitled “Evacuate 5-Mile Ring and Downwind to EPZ Boundary”. Under “Wind Direction Towards:”, identify the NE (northeast) azimuth and read REGION R05 in the first column of that row.

3. Enter Table 7-1C to locate the data cell containing the value of ETE for Scenario 4 and Region R05. This data cell is in column (4) and in the row for Region R05; it contains the ETE value of **3:00**.

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		Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)
	Midday		Midday		Evening		Midday		Midday		Evening		Midday
Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ													
R01 2-mile ring	1:15	1:20	1:15	1:20	1:10	R01 2-mile ring	1:15	1:20	1:15	1:20	1:10	R01 2-mile ring	1:30
R02 5-mile ring	1:20	1:20	1:10	1:15	1:10	R02 5-mile ring	1:20	1:25	1:10	1:20	1:10	R02 5-mile ring	1:25
R03 Entire EPZ	1:25	1:30	1:20	1:25	1:15	R03 Entire EPZ	1:25	1:30	1:20	1:25	1:15	R03 Entire EPZ	1:40
2-Mile Ring and Downwind to 5 Miles													
Same As R01 SSE, S, SSW, SW, WSW, W	1:15	1:20	1:15	1:20	1:10	Same As R01 SSE, S, SSW, SW, WSW, W	1:15	1:20	1:15	1:20	1:10	Same As R01 SSE, S, SSW, SW, WSW, W	1:30
Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	1:20	1:20	1:10	1:15	1:10	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	1:20	1:25	1:10	1:20	1:10	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	1:25
5-Mile Ring and Downwind to EPZ Boundary													
R04 N	1:20	1:25	1:10	1:15	1:10	R04 N	1:20	1:25	1:15	1:15	1:10	R04 N	1:30
R05 NNE, NE	1:20	1:25	1:10	1:15	1:10	R05 NNE, NE	1:20	1:25	1:15	1:15	1:10	R05 NNE, NE	1:30
R06 ENE, E	1:20	1:25	1:15	1:15	1:10	R06 ENE, E	1:20	1:25	1:15	1:20	1:10	R06 ENE, E	1:30
R07 ESE, SE	1:25	1:25	1:15	1:20	1:15	R07 ESE, SE	1:25	1:25	1:15	1:20	1:15	R07 ESE, SE	1:35
R08 SSE	1:25	1:30	1:15	1:20	1:15	R08 SSE	1:25	1:30	1:20	1:20	1:15	R08 SSE	1:35
R09 S, SSW	1:25	1:30	1:15	1:20	1:10	R09 S, SSW	1:25	1:30	1:15	1:20	1:10	R09 S, SSW	1:35
R10 SW, WSW	1:25	1:30	1:15	1:20	1:15	R10 SW, WSW	1:25	1:30	1:15	1:25	1:15	R10 SW, WSW	1:30
R11 W	1:25	1:30	1:20	1:25	1:15	R11 W	1:25	1:30	1:20	1:25	1:15	R11 W	1:30
R12 WNW	1:20	1:25	1:15	1:20	1:10	R12 WNW	1:20	1:25	1:15	1:20	1:10	R12 WNW	1:25
R13 NW,NNW	1:20	1:25	1:15	1:20	1:10	R13 NW,NNW	1:20	1:25	1:15	1:20	1:10	R13 NW,NNW	1:25

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		Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)
	Midday		Midday		Evening		Midday		Midday		Evening		Midday
Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ													
R01 2-mile ring	2:15	2:25	2:10	2:20	2:00	R01 2-mile ring	2:15	2:25	2:10	2:20	2:00	R01 2-mile ring	3:00
R02 5-mile ring	2:25	2:30	2:10	2:20	2:05	R02 5-mile ring	2:20	2:30	2:10	2:20	2:05	R02 5-mile ring	3:00
R03 Entire EPZ	2:50	2:55	2:30	2:40	2:35	R03 Entire EPZ	2:50	2:55	2:35	2:45	2:35	R03 Entire EPZ	3:20
2-Mile Ring and Downwind to 5 Miles													
Same As R01 SSE, S, SSW, SW, WSW, W	2:15	2:25	2:10	2:20	2:00	Same As R01 SSE, S, SSW, SW, WSW, W	2:15	2:25	2:10	2:20	2:00	Same As R01 SSE, S, SSW, SW, WSW, W	3:00
Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	2:25	2:30	2:10	2:20	2:05	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	2:20	2:30	2:10	2:20	2:05	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	3:00
5-Mile Ring and Downwind to EPZ Boundary													
R04 N	2:40	2:40	2:20	2:30	2:25	R04 N	2:40	2:40	2:20	2:30	2:25	R04 N	3:00
R05 NNE, NE	2:40	2:40	2:20	2:30	2:25	R05 NNE, NE	2:40	2:40	2:20	2:30	2:25	R05 NNE, NE	3:00
R06 ENE, E	2:45	2:45	2:25	2:30	2:30	R06 ENE, E	2:45	2:45	2:25	2:30	2:30	R06 ENE, E	3:00
R07 ESE, SE	2:50	2:50	2:30	2:35	2:35	R07 ESE, SE	2:50	2:50	2:30	2:40	2:35	R07 ESE, SE	3:10
R08 SSE	2:45	2:50	2:30	2:40	2:30	R08 SSE	2:45	2:55	2:35	2:45	2:30	R08 SSE	3:20
R09 S, SSW	2:40	2:50	2:30	2:40	2:25	R09 S, SSW	2:45	2:55	2:35	2:50	2:25	R09 S, SSW	3:20
R10 SW, WSW	2:35	2:50	2:30	2:40	2:20	R10 SW, WSW	2:40	2:55	2:30	2:45	2:20	R10 SW, WSW	3:20
R11 W	2:35	2:50	2:30	2:40	2:20	R11 W	2:40	2:55	2:30	2:45	2:20	R11 W	3:20
R12 WNW	2:25	2:30	2:10	2:25	2:10	R12 WNW	2:25	2:30	2:15	2:25	2:10	R12 WNW	3:00
R13 NW,NNW	2:25	2:35	2:15	2:25	2:10	R13 NW,NNW	2:25	2:35	2:15	2:25	2:10	R13 NW,NNW	3:00

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

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

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		Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)
	Midday		Midday		Evening		Midday		Midday		Evening		Midday
Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ													
R01 2-mile ring	5:00	5:00	5:00	5:00	5:00	R01 2-mile ring	5:00	5:00	5:00	5:00	5:00	R01 2-mile ring	5:00
R02 5-mile ring	5:00	5:00	5:00	5:00	5:00	R02 5-mile ring	5:00	5:00	5:00	5:00	5:00	R02 5-mile ring	5:00
R03 Entire EPZ	5:10	5:10	5:10	5:10	5:10	R03 Entire EPZ	5:10	5:10	5:10	5:10	5:10	R03 Entire EPZ	5:10
2-Mile Ring and Downwind to 5 Miles													
Same As R01 SSE, S, SSW, SW, WSW, W	5:00	5:00	5:00	5:00	5:00	Same As R01 SSE, S, SSW, SW, WSW, W	5:00	5:00	5:00	5:00	5:00	Same As R01 SSE, S, SSW, SW, WSW, W	5:00
Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	5:00	5:00	5:00	5:00	5:00	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	5:00	5:00	5:00	5:00	5:00	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	5:00
5-Mile Ring and Downwind to EPZ Boundary													
R04 N	5:10	5:10	5:05	5:10	5:10	R04 N	5:10	5:10	5:05	5:10	5:10	R04 N	5:10
R05 NNE, NE	5:10	5:10	5:05	5:10	5:10	R05 NNE, NE	5:10	5:10	5:05	5:10	5:10	R05 NNE, NE	5:10
R06 ENE, E	5:10	5:10	5:05	5:10	5:05	R06 ENE, E	5:10	5:10	5:05	5:10	5:05	R06 ENE, E	5:10
R07 ESE, SE	5:10	5:10	5:05	5:10	5:05	R07 ESE, SE	5:10	5:10	5:10	5:10	5:10	R07 ESE, SE	5:10
R08 SSE	5:10	5:10	5:10	5:10	5:10	R08 SSE	5:10	5:10	5:10	5:10	5:10	R08 SSE	5:10
R09 S, SSW	5:10	5:10	5:10	5:10	5:10	R09 S, SSW	5:10	5:10	5:10	5:10	5:10	R09 S, SSW	5:10
R10 SW, WSW	5:10	5:10	5:10	5:10	5:10	R10 SW, WSW	5:10	5:10	5:10	5:10	5:10	R10 SW, WSW	5:10
R11 W	5:10	5:10	5:10	5:10	5:10	R11 W	5:10	5:10	5:10	5:10	5:10	R11 W	5:10
R12 WNW	5:00	5:00	5:00	5:00	5:00	R12 WNW	5:00	5:00	5:00	5:00	5:00	R12 WNW	5:00
R13 NW,NNW	5:00	5:05	5:00	5:00	5:05	R13 NW,NNW	5:05	5:05	5:00	5:05	5:05	R13 NW,NNW	5:05

Table 7-2. Description of Evacuation Regions									
Region	Description	PAZ							
		C1	C3	C4	L5	L6	L7	L8	M9
R01	2 mile ring				■				
R02	5-mile ring				■	■			
R03	Full EPZ	■	■	■	■	■	■	■	■
Evacuate 2 mile ring and 5 miles downwind									
Region	Wind Direction Towards:	PAZ							
		C1	C3	C4	L5	L6	L7	L8	M9
Refer to R02	WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE				■	■			
Refer to R01	SSE, S, SSW, SW, WSW, W				■				
Evacuate 5 mile ring and downwind to EPZ boundary									
Region	Wind Direction Towards:	PAZ							
		C1	C3	C4	L5	L6	L7	L8	M9
R04	N				■	■	■	■	■
R05	NNE, NE				■	■		■	■
R06	ENE, E			■	■	■			■
R07	ESE, SE		■	■	■	■			■
R08	SSE	■	■	■	■	■			
R09	S, SSW	■	■		■	■			
R10	SW, WSW	■			■	■			
R11	W	■			■	■	■		
R12	WNW				■	■	■		
R13	NW, NNW				■	■	■	■	

Table 7-3. Average Delay for Selected Roadways in the Levy Nuclear Plant EPZ

CP #	Link		Roadway	Average Delay per Vehicle (min/veh) at Indicated Time After the Advisory to Evacuate (hr:min)			
	From Node	To Node		1:00	1:30	2:00	2:30
1	148	144	West Dunnelon Rd Eastbound	0.2	4.7	6.7	0.0
2	19	18	US Highway 19 at Florida State Barge Canal Bridge	6.6	6.6	6.0	0.0
3	143	145	State Route 484 Eastbound	2.3	2.2	0.1	0.0
4	253	252	US Highway 41 Northbound	0.5	0.0	0.0	0.0
5	15	14	US Highway 19 Southbound at Crystal River Nuclear Plant	5.3	6.0	6.0	4.8
6	11	10	US Highway 19 Southbound at Citrus Ave	2.4	2.5	2.5	2.4
7	70	19	State Route 40 Eastbound (Yankeetown evacuees)	9.8	9.7	8.8	0.0
8	331	19	State Route 40 Westbound (Inglis evacuees)	9.4	9.8	9.5	5.1
9	40	10	Citrus Ave Westbound at US Highway 19	5.9	5.9	5.9	5.9

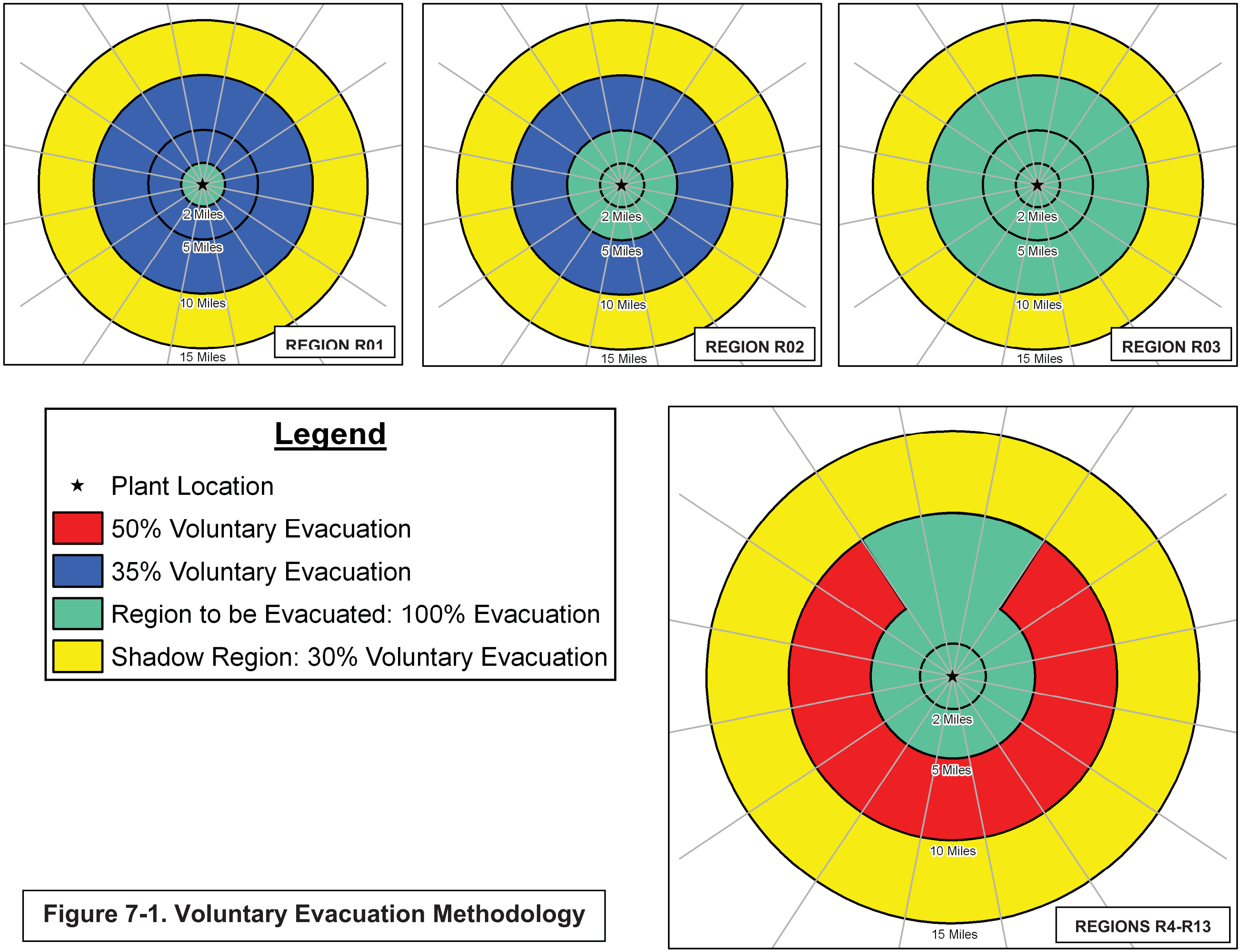


Figure 7-1. Voluntary Evacuation Methodology

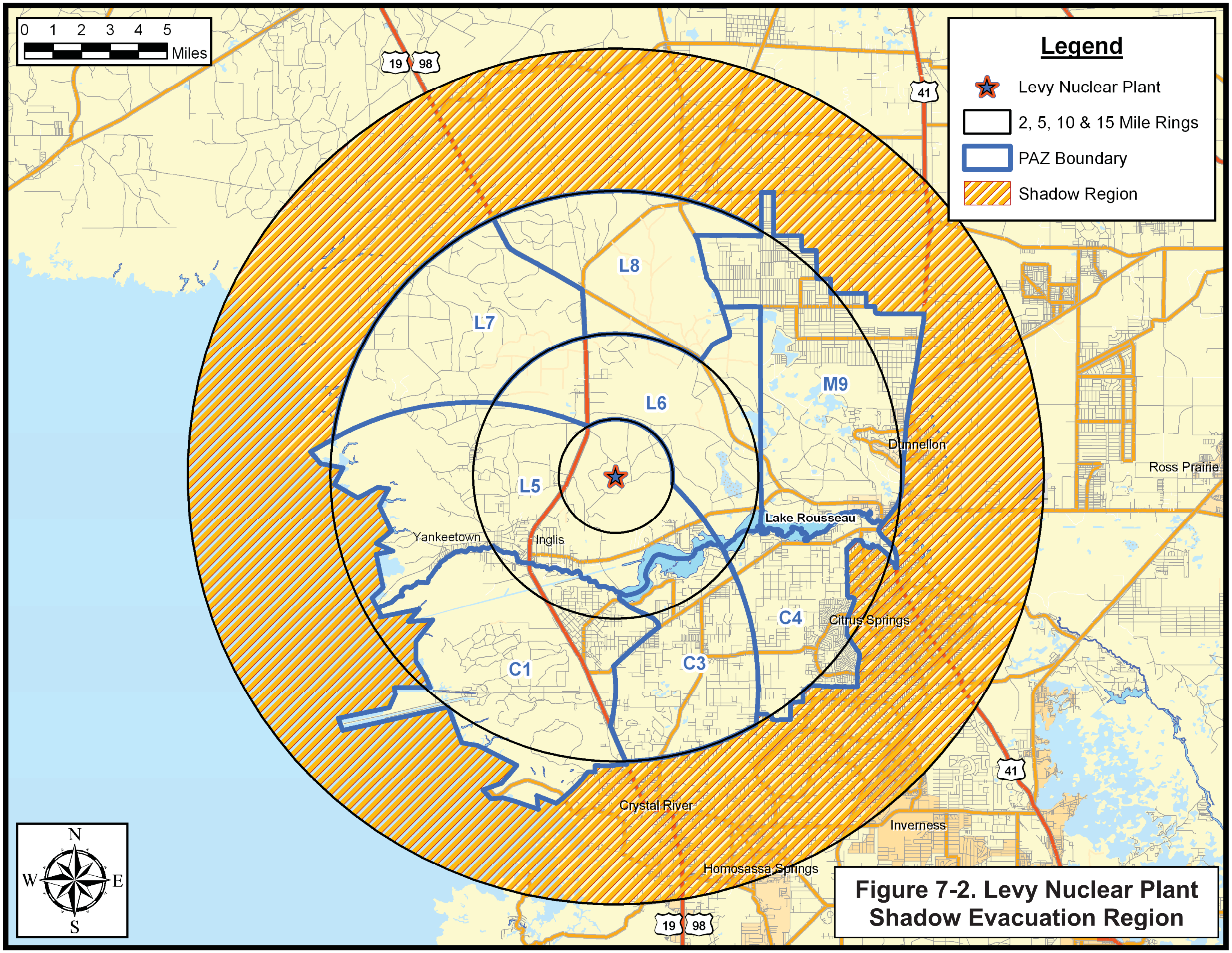


Figure 7-2. Levy Nuclear Plant Shadow Evacuation Region

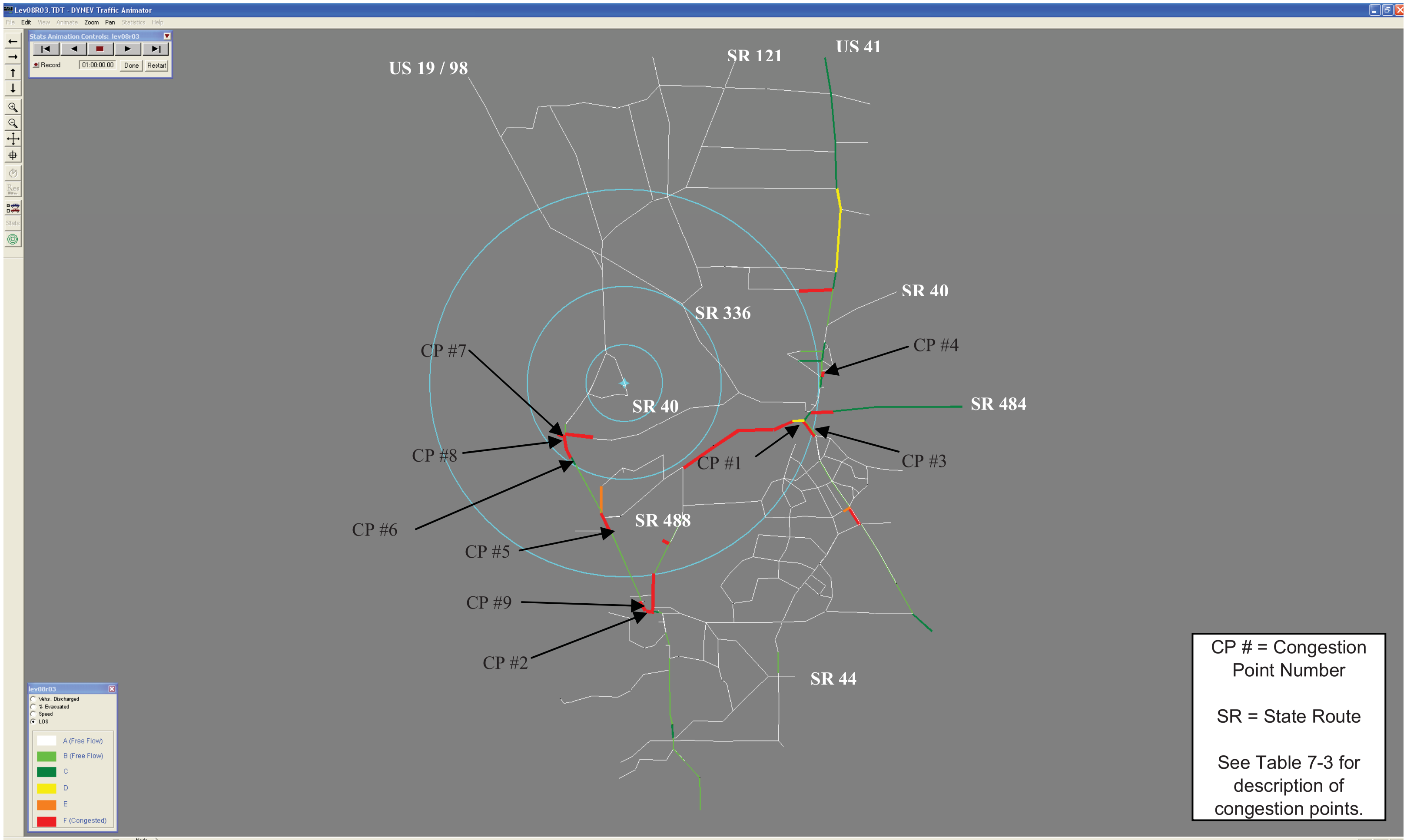


Figure 7-3. Congestion Patterns at 1 Hour After the Advisory to Evacuate (Scenario 8)

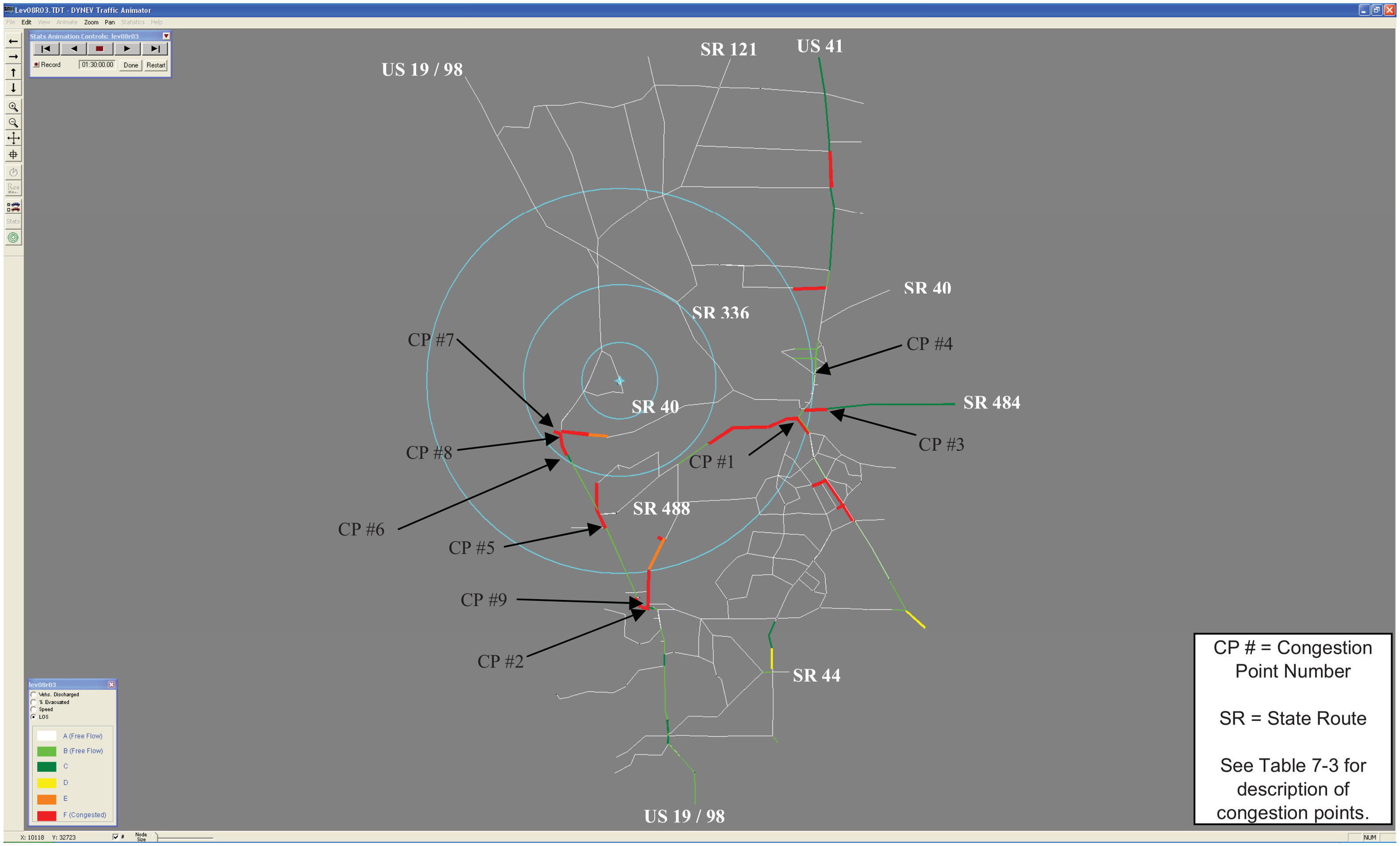


Figure 7-4. Congestion Patterns at 1 Hour, 30 Minutes After the Advisory to Evacuate (Scenario 8)

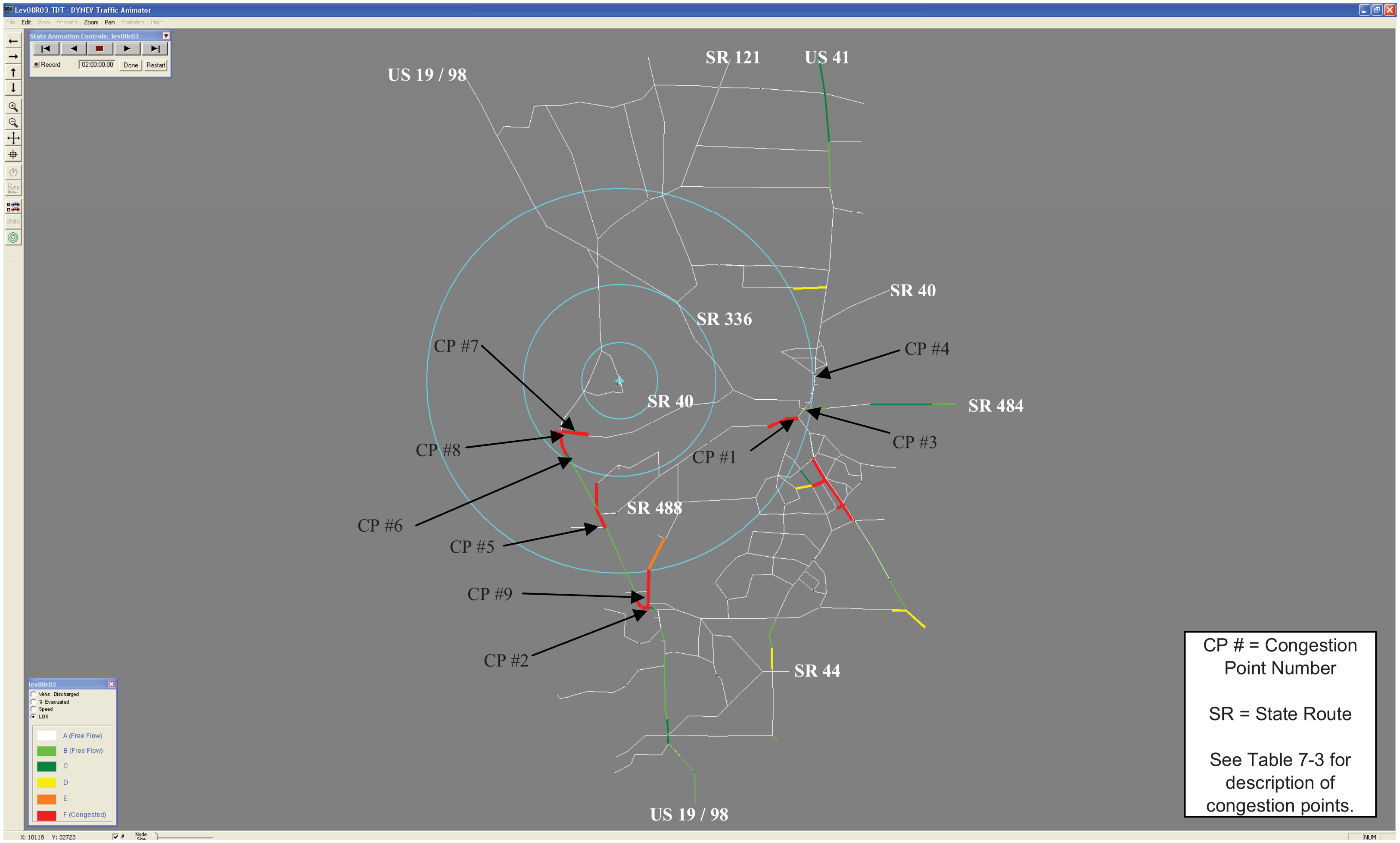


Figure 7-5. Congestion Patterns at 2 Hours After the Advisory to Evacuate (Scenario 8)

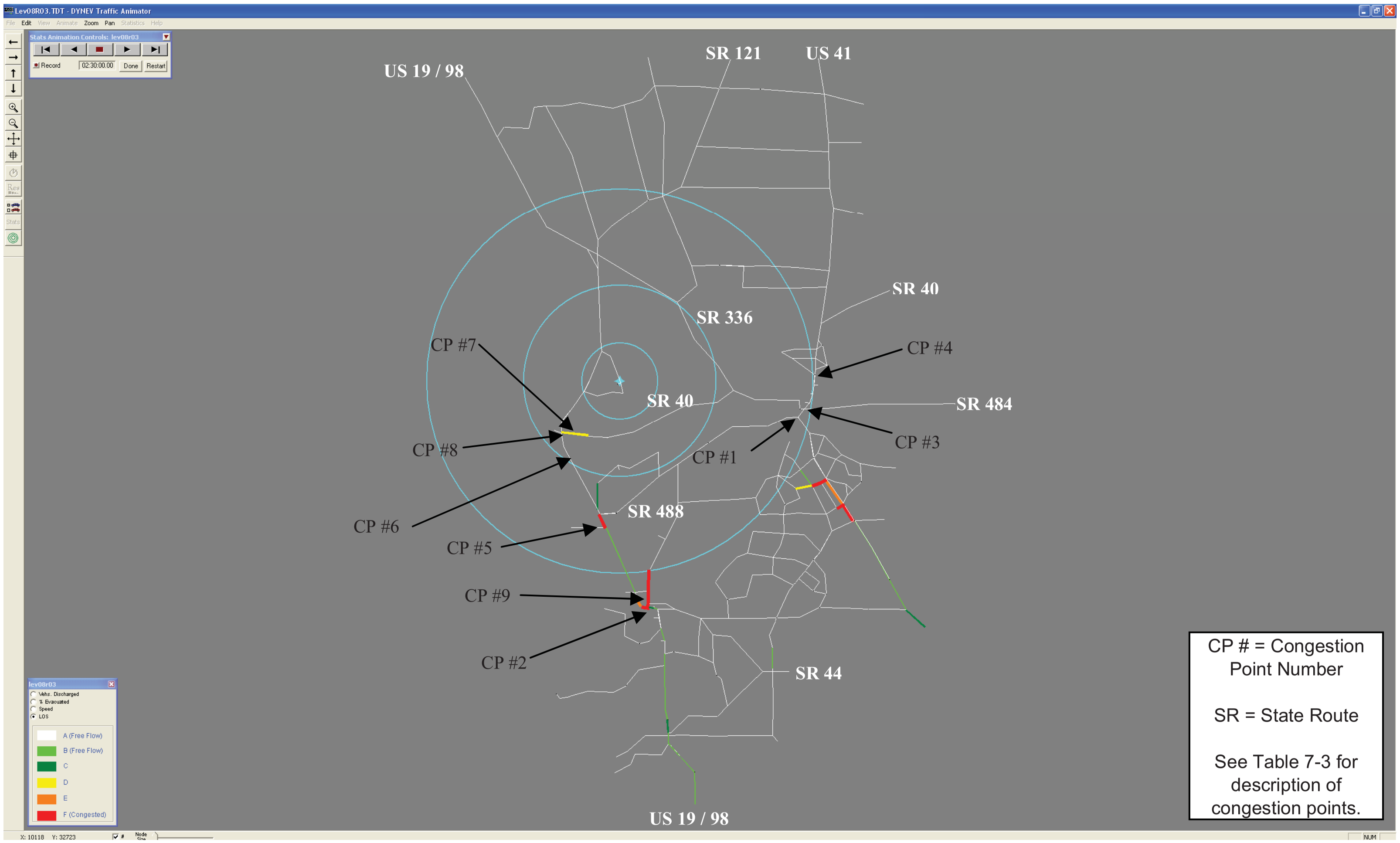


Figure 7-6. Congestion Patterns at 2 Hours, 30 Minutes After the Advisory to Evacuate (Scenario 8)

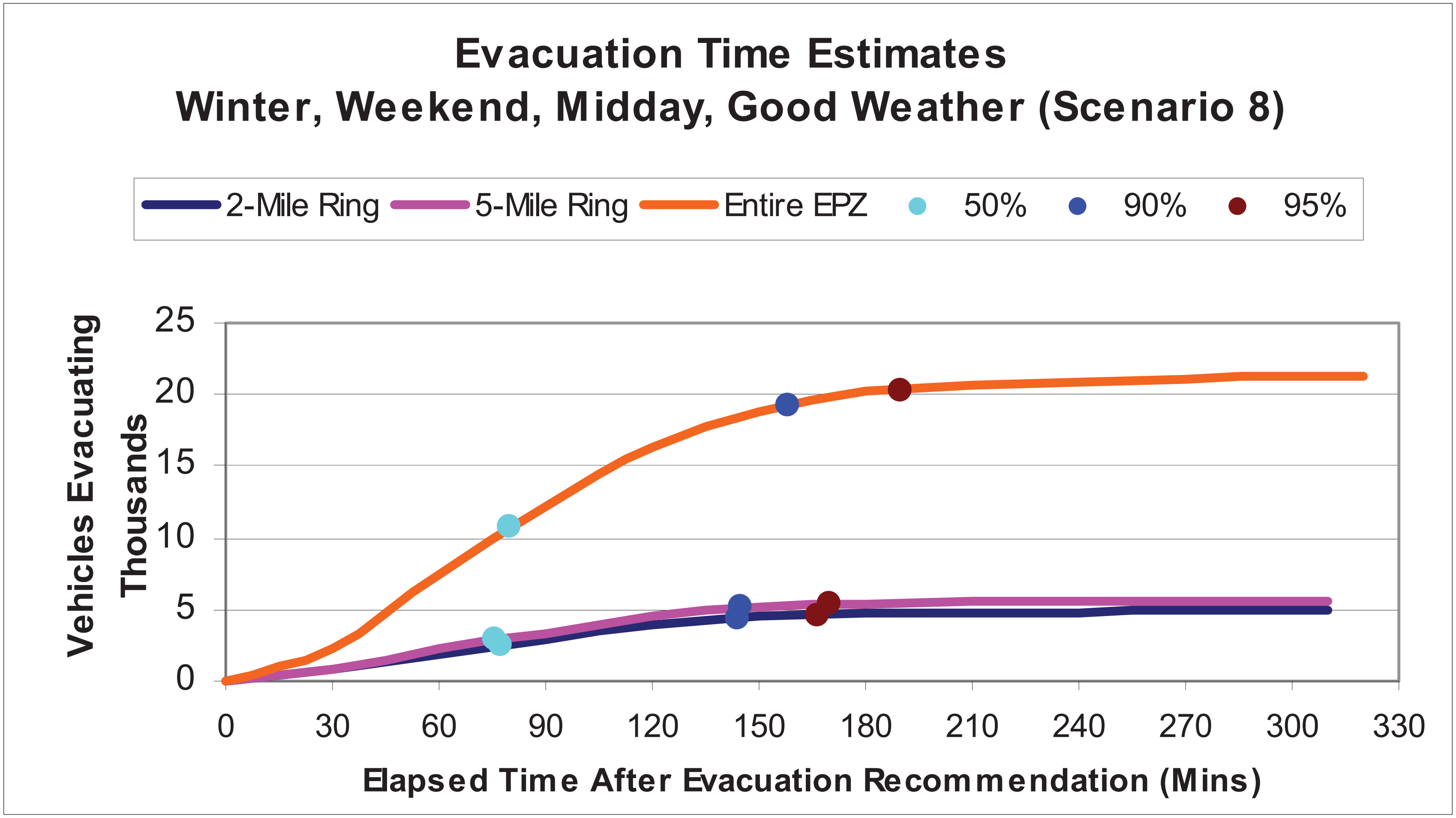


Figure 7-7. Evacuation Time Estimates for LNP Winter, Weekend, Midday, Good Weather Evacuation of Region R03 (Entire EPZ)

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, health-support facilities, institutions and child-care 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 larger 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 suburban 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 their respective assignments.

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 members is universally prevalent during emergencies and should be anticipated in the planning process. Many emergency plans, however, call for parents to pick up children at host schools or reception centers to speed the evacuation of the school children in the event that buses need to return to the EPZ and evacuate transit dependents. We provide estimates of buses under the assumption that no children will be picked up at school by their parents as an upper bound estimate of the transit vehicles needed.

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 ordered.

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 school children. For those evacuation scenarios where children are at school when an evacuation is ordered, separate transportation is provided for the school children. 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. **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 (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 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 582 people. Therefore, a total of 20 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 Levy EPZ:

$$P = 10{,}150 \times (0.045 \times 1.40 + 0.349 \times (1.70 - 1) \times 0.45 \times 0.41 + 0.421 \times (2.45 - 2) \times (0.45 \times 0.41)^2)$$
$$P = 10{,}150 * (0.1147) = 1164$$
$$B = (0.5 \times P) \div 30 = 20$$

These calculations are explained as follows:

- All members (1.4 avg.) of households (HH) with no vehicles (4.5%) will evacuate by public transit or ride-share. The term 10,150 (total households) x 0.045 x 1.40, accounts for these people.
- The members of HH with 1 vehicle away (34.9%), who are at home, equal (1.70-1). The number of HH where the commuter will not return home is equal to (10,150 x 0.349 x 0.45 x 0.41), given that 45% of the households in the EPZ have at least one commuter, 41% of which will not wait for the commuter to return before evacuating. 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 (42.1%), who are at home, equal (2.45 – 2). The number of HH where neither commuter will return home is equal to 10,150 x 0.421 x $(0.45 \times 0.41)^2$. The number of persons who will evacuate by public transit or ride-share is equal to the product of these two terms.
- 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.

8.2 School and Daycare Population – Transit Demand

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

- No children will be picked up by their parents prior to the arrival of the buses.
- Bus capacity, expressed in children per bus, is set to 70 for primary schools and 50 for middle and high schools.
- Those staff members who do not accompany the children will evacuate in their private vehicles.
- No allowance is made for absenteeism which is in the neighborhood of 3 percent, daily.

We recommend that the Counties introduce procedures whereby the schools and daycares 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 children to be evacuated. In this way, the number of buses dispatched to the schools and daycares will reflect the actual number needed. Some parents will likely pick up their children, although they are asked to pick children up at the relocation schools. Those buses originally allocated to evacuate school and daycare children 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 relocation schools for each school and daycare in the EPZ. Those children not picked up by their parents prior to the arrival of the buses, will be transported to these relocation schools 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 as of July, 2007. Approximately 127 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. 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 wheelchairs per trip; wheelchair buses can transport 15 patients, and the number of bus runs estimated assumes 30 ambulatory patients per trip.

8.4 Evacuation Time Estimates for Transit-Dependent People

The available resources expressed in terms of bus-seats, are sufficient in each county to service the evacuation demand in a “single-wave”, assuming drivers are available for all vehicles. In general, the buses will transport the evacuees to the appropriate reception centers and return to the EPZ for a second trip if needed.

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 its first evacuation trip, to complete a “second wave” of providing transport service to evacuees. For this reason, the ETE will be calculated for both a one wave transit evacuation and for two waves (Table 8-7). 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.

For each county, transit resources will be assigned to schools as a first priority. When these 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.

ETE 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.

<u>Activity: Mobilize Drivers (A→B→C)</u>

Mobilization is the elapsed time from the Advisory to Evacuate until the time the buses have arrived 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.

<u>Activity: Board Passengers (C→D)</u>

Studies have shown that passengers can board a bus at headways of 2-4 seconds (Ref. HCM 2000 Page 27-27). Therefore, the total dwell time to service passengers boarding a bus to capacity at a single stop (e.g., at a school) is about 5 minutes. A loading time of 10 minutes will be used for rain scenarios. For multiple stops along a pick-up route (such as the routes for the transit-dependent population) we must allow for the additional delay associated with stopping and starting at each pick-up point. There are no pre-determined pickup points established for the transit dependent population within the EPZ. It is assumed that transit-dependent persons will walk to the nearest route and flag down a passing bus as it traverses the route. These “flag” stops result in an estimate of boarding time of 15 minutes in good weather computed as follows:

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 = 45 seconds: a very generous value for about 2 passengers per stop

v = 35 mph = 52 ft/sec

a = 4 ft/sec/sec, a moderate average rate

Then, P ≈ 58 seconds per stop. Allowing 15 minutes pick-up time per bus run implies 15 stops per run. Thus the delay associated with stopping and the dwell time for buses has been considered as the "pickup time". It is assumed that pickup time is 5 minutes longer (20 minutes total) in rain.

Activity: Travel to EPZ Boundary (D→E)

School Evacuation

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 relocation school. 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 travel times to the EPZ boundary are computed from the route length and the speeds output by the model (at the mobilization plus loading time). The bus routes input are documented in Table 8-12.

Tables 8-5A (good weather) and 8-5B (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. + 5 + 10 = 1:45 for Dunnellon Middle School, with good weather). 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 indicated in Section 5, about 90 percent of the evacuees will complete their mobilization when the first buses will begin their routes, 120 minutes after the Advisory to Evacuate.

Those buses servicing the transit-dependent evacuees will first travel along their pick-up routes, then proceed out of the EPZ. Table 8-6 details the proposed bus routes to service the transit dependent people in the Levy EPZ, while Figure 8-2 maps the proposed bus pick-up routes. The travel distance along the respective pick-up routes within the EPZ is measured using GIS software. The average speed output by the PC-DYNEV model at the mobilization time is used to estimate the route travel time. Routes 2 through 5 which circulate through the major population centers within the EPZ have multiple buses spaced at 30 minute headways; each subsequent bus arrives at the route 30 minutes after the previous bus. The use of bus headways is designed to service those transit-dependent persons that may need more time to mobilize.

Table 8-7 presents the transit-dependent population evacuation time estimates for each route obtained using the above procedures. For example, the ETE for Route 6 is computed as 120 + 12 + 15 = 2:30 for good weather. Here, 12 minutes is the time to travel 11.3 miles at 55 mph (average speed output by PC-DYNEV). 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 reception centers are also measured using Geographical Information Systems (GIS) software along the most likely route from the EPZ to the relocation school. 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.

Activity: Passengers Leave Bus (F→G)

Passengers can deboard within 5 minutes. The bus 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 buses that evacuated the schools. Thus, the mobilization time for the second wave is the average time that buses arrive at the

reception center (See Table 8-5). The travel time back to the EPZ is estimated as 20 minutes for good weather and 25 minutes for rain. The bus then travels its route and picks up transit-dependent evacuees along the route. The average speed output by PC-DYNEV at the time the buses begin the second wave is used to compute the route travel time. Multiple buses will likely not be needed for the second wave evacuation. Thus, only a single bus will be sent for a second wave evacuation, as Table 8-7 indicates. The additional buses at the reception center may be needed for a second wave evacuation of special facilities as detailed in the following section.

The travel times for Bus Route Number 6 are computed as follows for good weather:

- Bus arrives at reception center at 2:15 in good weather (average of “ETE to RC (min)” column in Table 8-5A).
- Bus discharges passengers (5 minutes) and driver takes a 10-minute rest: 15 minutes.
- Bus returns to EPZ: 20 minutes (assumed).
- Bus completes pick-ups along route and departs EPZ: 15 minutes + (11.3 miles @ 55 mph) = 30 minutes (rounded up to nearest 5 minutes).
- Bus exits EPZ at time 2:15 + 0:15 + 0:20 + 0:30 = 3:25 after the Advisory to Evacuate.

The ETE estimates for the second wave are given in Table 8-7. The ETE for the transit-dependent population does not extend beyond the ETE for the general population.

<u>Evacuation of Ambulatory Persons from Special Facilities</u>

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

- Buses are assigned on the basis of 25-30 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 “first-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 approximately 2:15 on average, and about 20 minutes of additional inbound travel time to the special facility from the reception area would be required. It follows, therefore, that about one hour would have to be added to the calculated ETE for special facilities, in the event they are evacuated as a “second wave.”

Table 8-4 indicates that the medical facilities are 7.5 miles from the plant, on average. Thus, buses evacuating these facilities will have to travel approximately 2.5 miles. We will conservatively estimate the travel distance out of the EPZ as 5 miles. The average

travel speed at 90 minutes after the Advisory to Evacuate is 44.2 mph, thus the travel time out of the EPZ for buses evacuating special facilities is 7 minutes. The ETE for Crystal Gem Manor Assisted Living, with 43 patients, is provided as an example:

ETE: 90 + 43 x 1 + 7 = 140 min. or 2:20 rounded up. 3:20 for "second wave".

Table 8-4 indicates that 2 wheelchair bus runs and 2 wheelchair van runs are needed for the entire EPZ. Wheelchair buses and vans are often scarce; however, regular buses can be used to transport wheelchair bound patients. Patients would occupy the front portion of the bus and their wheelchairs would be folded and stacked in the back of the bus. Loading times are estimated at 5 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 Seven Rivers Regional Medical Center is:

ETE: 90 + 33 x 5 + 7 = 4:25 (rounded up to the nearest 5 minutes).

Thus, the ETE for special facilities do not exceed the general population ETE.

Emergency Medical Services (EMS) Vehicles

The previous discussion focused on transit operations for ambulatory persons residing at medical facilities within the Evacuation Region. It is also necessary to provide transit services to non-ambulatory persons who do not – or cannot – have access to private vehicles. Based on the data provided in Table 8-4, a total of 10 ambulance runs are needed to evacuate all of the bed ridden patients in the EPZ, assuming 2 people per ambulance. These ambulances will be provided by EMS providers within the EPZ. Additional ambulances will be provided by Crystal River and other neighboring cities if needed.

It is estimated that 30 minutes will be needed to mobilize ambulances and travel to the medical facilities. Loading times are conservatively estimated as 30 minutes per ambulance. As with the buses transporting ambulatory patients, ambulances will have to travel 5 miles, on average, to leave the EPZ. The average speed output by the model at 1 hour for Region 3, Scenario 6 is 41.12 mph as much of the EPZ has not yet mobilized; thus, travel time out of the EPZ is 7 minutes.

The ETE for ambulances is: 30 + 30 + 7 = 1:10 (rounded to the nearest 5 minutes)

Forestry Youth Camp Incarceration Center

According to page VI-46 of the Levy Nuclear Plant Site Plan (Appendix VI of Annex A to the State of Florida Radiological Emergency Management Plan), inmates at the Forestry Youth Camp Incarceration Center will be transported to a facility outside the EPZ in Tallahassee, FL by combined efforts of the Sheriff's Office and the affected police departments. Data provided by the facility indicates that they have sufficient transportation resources to evacuate all inmates in a single wave. As shown in Figure E-2, the Forestry Youth Camp is located on State Hwy 336 in Levy County. Given that the inmates will be evacuated to Tallahassee, buses will travel northbound on State Hwy 336 to US Hwy 19/98 and then north on 19/98 out of the EPZ. The route from the facility to the EPZ boundary is 8.7 miles long. It is conservatively assumed that 2 hours will be needed to mobilize all inmates and the transportation and security resources needed to move the inmates. Thirty minutes will be needed to load the inmates and secure the buses. As shown in Figure 7-6, congestion along State Hwy 336 and northbound along US Hwy 19/98 with the EPZ has dissipated by 2 hours and 30 minutes after the advisory to evacuate. Therefore, it can be safely assumed that buses evacuating the inmates will average 40 mph. Travel time would be 13 minutes (8.7 miles ÷ 40 miles/hr x 60 minutes/hr). Thus, the ETE for the Forestry Youth Camp Incarceration Center is:

ETE: 120 + 30 + 13 = 163 minutes = 2:45 (hr:min), rounded to the nearest 5 minutes.

8.5 Evacuation of Homebound Special Needs Population

The registered homebound special needs population within the Levy EPZ is summarized by county in Table 8-8. These data were provided by the county offices of emergency management.

As stated in Section 8.3 of the ETE report, buses can transport 30 ambulatory persons per trip, wheelchair buses can transport 15 persons per trip, wheelchair vans can transport 4 persons per trip and ambulances can transport 2 bed-ridden persons per trip. Based on these capacities, the transportation resources needed to evacuate the homebound special needs population residing within the Levy EPZ were estimated and are presented in Table 8-9. The transportation resources available by county are summarized in Table 8-10.

Comparison of Tables 8-9 and 8-10 indicates that the counties have sufficient resources to evacuate the homebound special needs population. Note that approximately 76% (73 of 96) special needs persons require transportation assistance – see Table 8-8. Other special needs persons living at home have their transport needs provided by other members of the household and would not require assistance from the county.

ETE for Homebound Special Needs Population

Buses

Assuming no more than one special needs person per household implies that 28 households (HH) need to be serviced. While only 3 buses are needed from a capacity perspective (Table 8-9), if 6 buses are deployed to service these special needs HH, then each would require about 5 stops. The following outlines the ETE calculations:

1. Assume 6 buses are deployed, each with about 5 stops, to service a total of 28 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 + 28 = 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. It is further assumed that travel speeds are 10% lower in rain – travel time to the EPZ boundary at free speed from last pickup requires 28 minutes (8 miles @ 18 mph) 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 2.25 persons) travel with the disabled person yields 5 x 2.25 = 12 persons per bus. From the perspective of bus capacity, fewer buses could be deployed. For example, 3 buses, each servicing 10 HH could accommodate 2.25 x 10 = 23 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 3 buses.

Ambulances

As shown in Table 8-4, it is estimated that 10 ambulance runs will be needed to evacuate the institutionalized bed-ridden population within the EPZ, all of which reside in Citrus County. Table 8-10 indicates that there are 11 ambulances available in Citrus County. Table 8-9 indicates that 5 ambulances are needed to evacuate the homebound bed-ridden population within the EPZ, all of which reside in Levy County. Table 8-10 indicates that there are 7 ambulances available in Levy County. There are no ambulances needed to service the Marion County portion of the EPZ; however, as noted in Table 8-10, there are 59 ambulances available in the county.

Based on the information provided in Tables 8-4, 8-9 and 8-10, there are sufficient ambulance resources in the EPZ to evacuate the institutionalized and homebound bed-ridden populations in a single wave.

As stated on page 8-9, 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 = <u>1:50</u>

Rain ETE: 35 + 30 + 11 + 30 + 11 = <u>2:00</u>

Wheel-Chair Vans

Table 8-8 indicates that there are 35 homebound wheelchair bound persons in the EPZ, while Table 8-9 indicates that 10 wheelchair vans are needed to evacuate this population. 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 those of school buses = 20 mph between households. It is further assumed that vans travel 5 miles to the EPZ boundary after the last pickup. Mobilization time is 10 minutes longer and travel speed is 10% less in rain.

a. Assumed mobilization time for wheelchair van resources to arrive at first household: 90 minutes

b. Loading time at first household: 15 minutes

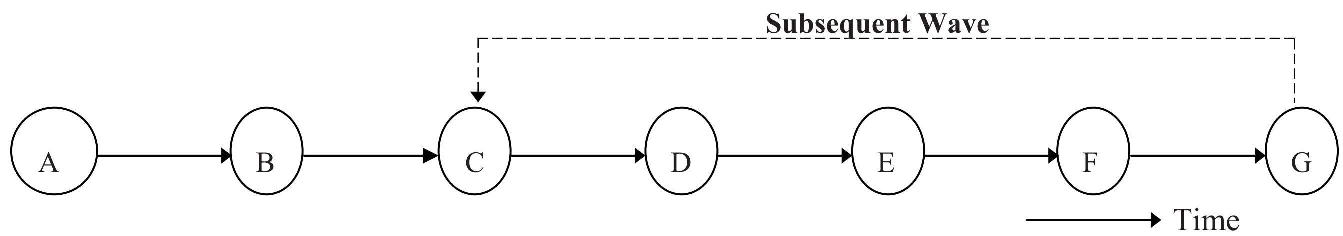
c. Travel to next household: 3 @ 15 minutes (5 miles @ 20 mph) = 45 minutes

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

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

ETE: 90 + 15 + 45 + 45 + 15 = 3:30

Rain ETE: 100 + 15 + 51 + 45 + 17 = 3:50



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	2007 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						
Levy Nuclear Plant	22,758	1.40	1.70	2.45	10,150	4.5%	34.9.%	42.1%	45%	41%	1164	50%	582	2.6%

Table 8-2. School and Daycare Population Demand Estimates							
Zone	**Distance (miles)**	**Dire-ction**	**School Name**	**Municipality**	**Enroll-ment**	**Staff**	**# of Buses Required**
Levy County							
L5	5.0	WSW	Yankeetown School	Yankeetown	329	51	5
Citrus County							
C3	9.9	S	Bright Beginnings Pre-School	Crystal River	63	10	1
C4	9.0	SE	Presswood Home Child Care	Dunnellon	8	1	1
C4	9.7	ESE	North Oak Christian Daycare	Citrus Springs	30	5	1
C4	9.9	SW	Citrus Springs Elementary	Citrus Springs	875	55	13
				Citrus County Total:	976	71	16
Marion County							
M9	9.4	E	Dunnellon Middle School	Dunnellon	1,100	110	22
M9	9.4	E	Dunnellon Christian Academy	Dunnellon	263	33	4
M9	9.6	E	Ready-Set-Go Learning Center	Dunnellon	46	5	1
M9	9.8	E	Building Blocks Learning Center	Dunnellon	163	21	3
M9	11.9	ENE	Romeo Elementary School	Dunnellon	810	105	12
				Marion County Total:	2,382	274	42
				EPZ Total:	**3,687**	**396**	**63**

Table 8-3. School and Daycare Relocation Schools		
Facility	**Zone**	**Relocation School**
Middle Schools		
Dunnellon Middle School	M9	Bronson High School
Elementary Schools		
Citrus Springs Elementary	C4	Citrus Springs Middle School
Dunnellon Christian Academy	M9	Bronson High School
Romeo Elementary	M9	Bronson High School
Yankeetown School	L5	First United Methodist Church
Day Care		
Building Blocks Learning Center	M9	Bronson High School
Ready-Set-Go Learning Center	M9	Bronson High School
North Oak Christian Day Care	C4	First United Methodist Church
Presswood Home Child Care	C4	First United Methodist Church
Bright Beginnings Pre-School	C3	First United Methodist Church

*Figure E-1 in Appendix E identifies the location of all EPZ schools and daycare centers, and the relocation schools they are evacuated to.

Table 8-4. Special Facility Transit Demand

PAZ	Distance (miles)	Direction	Facility Name	Municipality	Capacity	Current Census	Ambulatory Patients	Wheelchair Bound	Bed-ridden	Ambulance Runs	Wheelchair Bus Runs	Wheelchair Van Runs	Bus Runs
Citrus County													
C1	8.2	S	Seven Rivers Regional Medical Center	Crystal River	128	80	27	33	20	10	2	1	1
C1	8.0	S	Crystal Gem Manor Assisted	Crystal River	70	43	43	0	0	0	0	0	2
C3	6.8	SSE	Richard Hoffman Adult Family Care Home	Dunnellon	5	4	2	2	0	0	0	1	1
EPZ Total:					**203**	**127**	**72**	**35**	**20**	**10**	**2**	**2**	**4**

Table 8-5A. School and Daycare 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 Bndry (min)	ETE (hr:min)	Dist. EPZ Bndry to R.C. (mi.)	Travel Time EPZ Bndry to RC (min)	ETE to R.C. (hr:min)
Levy County Schools										
Yankeetown School	90	5	9.7	16.26	16.26	36	**2:15**	20.7	25	**2:40**
Citrus County Schools										
Bright Beginnings Pre-School	90	5	2.9	13.58	13.58	13	**1:50**	20.2	25	**2:15**
Citrus Springs Elementary School	90	5	2.0	49.77	49.77	3	**1:40**	2.9	4	**1:45**
North Oak Christian Day Care	90	5	1.3	49.77	49.77	2	**1:40**	19.6	24	**2:05**
Presswood Home Child Care	90	5	5.6	49.77	49.77	7	**1:45**	19.6	24	**2:10**
Marion County Schools										
Building Blocks Learning Center	90	5	6.9	50.31	50.31	9	**1:45**	27.7	34	**2:20**
Dunnellon Christian Academy	90	5	7.6	48.69	48.69	10	**1:45**	27.7	34	**2:20**
Dunnellon Middle School	90	5	7.8	48.69	48.69	10	**1:45**	27.7	34	**2:20**
Ready-Set-Go Learning Center	90	5	7.1	49.93	49.93	9	**1:45**	27.7	34	**2:20**
Romeo Elementary School	90	5	0.3	60.00	55.00	1	**1:40**	27.7	34	**2:10**
						Maximum for EPZ:	**2:15**		**Maximum:**	**2:40**
						Average for EPZ:	**1:45**		**Average:**	**2:15**

Table 8-5B. School and Daycare 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 Bndry (min)	ETE (hr:min)	Dist. EPZ Bndry to R.C. (mi.)	Travel Time EPZ Bdry to RC (min)	ETE to R.C. (hr:min)
Levy County Schools										
Yankeetown School	100	10	9.7	14.23	14.23	41	**2:35**	20.7	32	**3:05**
Citrus County Schools										
Bright Beginnings Pre-School	100	10	2.9	13.46	13.46	13	**2:05**	20.2	31	**2:35**
Citrus Springs Elementary School	100	10	2.0	45.00	45.00	3	**1:55**	2.9	5	**2:00**
North Oak Christian Day Care	100	10	1.3	45.00	45.00	2	**1:55**	19.6	30	**2:25**
Presswood Home Child Care	100	10	5.6	45.00	45.00	8	**2:00**	19.6	30	**2:30**
Marion County Schools										
Building Blocks Learning Center	100	10	6.9	45.34	45.34	10	**2:00**	27.7	42	**2:45**
Dunnellon Christian Academy	100	10	7.8	43.85	43.85	11	**2:05**	27.7	42	**2:45**
Dunnellon Middle School	100	10	7.6	43.85	43.85	11	**2:05**	27.7	42	**2:45**
Ready-Set-Go Learning Center	100	10	7.1	44.98	44.98	10	**2:00**	27.7	42	**2:45**
Romeo Elementary School	100	10	0.3	53.86	50.00	1	**1:55**	27.7	42	**2:35**
						Maximum for EPZ:	**2:35**		**Maximum:**	**3:05**
						Average for EPZ:	**2:00**		**Average:**	**2:35**

Table 8-6. Summary of Transit Dependent Bus Routes

Route Number	Number of Buses	Route Description	Length (mi.)
1	6	West on CR 488 (6 buses), buses split with 3 buses continuing west on CR 488 and then SB on US Hwy 19/98 out of the EPZ and 3 buses going south on CR 495 out of the EPZ.	13.1, 15.6
2	4	Buses will circulate in Citrus Springs picking up passengers along local roads, then proceed out of the EPZ.	10.0
3	4	Buses will circulate in Dunnellon picking up passengers along local roads, then proceed out of the EPZ northbound on US Hwy 41.	14.2
4	2	Buses will circulate in Yankeetown picking up passengers along local roads, then proceed out of the EPZ southbound on US Hwy 19/98.	18.2*
5	2	Buses will circulate in Inglis picking up passengers along local roads, then proceed out of the EPZ southbound on US Hwy 19/98.	18.2*
6	1	West on Rainbow Lakes Blvd, north on Soundview Dr, west on Sea Cliff Ave, north on NW Ridgewood Rd, and then east on 27th St out of the EPZ.	11.3
7	1	West on CR 40, northwest on CR 336, and then north on US Hwy 19/98 out of the EPZ.	19.2

*Circulating portion of route is assumed to be 10 miles long.

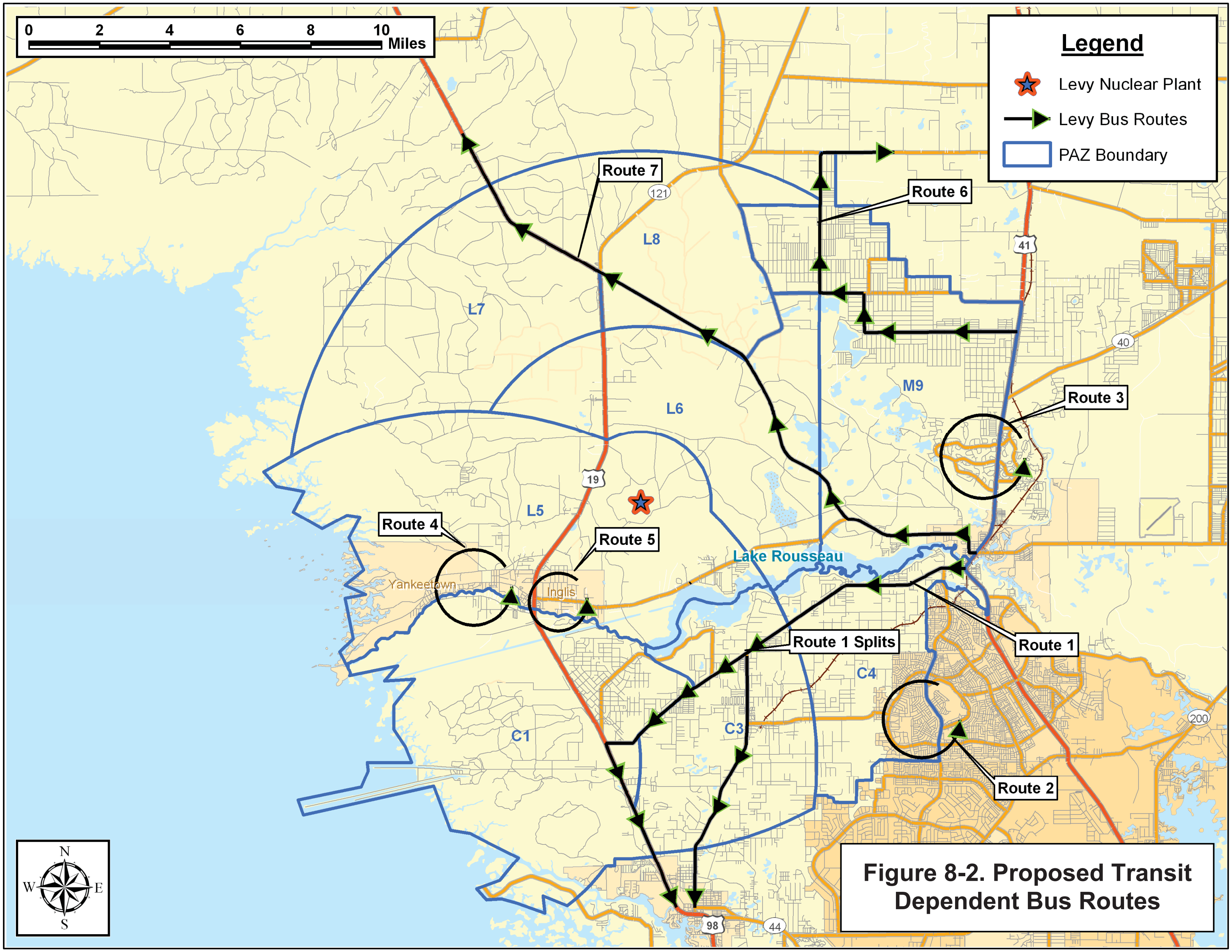


Figure 8-2. Proposed Transit Dependent Bus Routes

Table 8-7A. Transit Dependent Evacuation Time Estimates - Good Weather

Route Number	Bus Number	Single Wave: Mobilization (min.)	Route Length (mi.)	Average Speed (mph)	Adjusted Speed (mph)	Route Travel Time	Pickup Time	ETE	Second Wave: Mobilization (min.)	Unload	Driver Rest	Return time to EPZ	Average Speed (mph)	Adjusted Speed (mph)	Route Travel Time	Pickup Time	ETE
1	1,2	120	13.1	23.12	23.12	34	15	2:50	135	5	10	20	47.56	47.56	17	15	3:25
	3,4	120	15.6	25.48	25.48	37	15	2:55					32.25	32.25	29	15	3:35
2	1	120	10	49.77	49.77	12	15	2:30	135	5	10	20	49.77	49.77	12	15	3:20
	2	150	10	49.77	49.77	12	15	3:00									
	3	180	10	49.77	49.77	12	15	3:30									
3	1	120	14.2	44.77	44.77	19	15	2:35	135	5	10	20	44.77	44.77	19	15	3:25
	2	150	14.2	44.77	44.77	19	15	3:05									
	3	180	14.2	44.77	44.77	19	15	3:35									
4	1	120	18.2	44.57	44.57	25	15	2:40	135	5	10	20	54.08	54.08	20	15	3:25
	2	150	18.2	54.08	54.08	20	15	3:05									
5	1	120	18.2	51.47	51.47	21	15	2:40	135	5	10	20	51.47	51.47	21	15	3:30
	2	150	18.2	51.47	51.47	21	15	3:10									
6	1	120	11.3	56.83	55.00	12	15	2:30	135	5	10	20	56.83	55.00	12	15	3:20
7	1	120	19.2	53.31	53.31	22	15	2:40	135	5	10	20	53.31	53.31	22	15	3:30
							Maximum for EPZ:	**3:35**								**Maximum for EPZ:**	**3:35**
							Average for EPZ:	**2:55**								**Average for EPZ:**	**3:30**

Table 8-7B. Transit Dependent Evacuation Time Estimates - Rain

Route Number	Bus Number	Single Wave: Mobilization (min.)	Route Length (mi.)	Average Speed (mph)	Adjusted Speed (mph)	Route Travel Time	Pickup Time	ETE	Second Wave: Mobilization (min.)	Unload	Driver Rest	Return time to EPZ	Average Speed (mph)	Adjusted Speed (mph)	Route Travel Time	Pickup Time	ETE
1	1,2	120	13.1	22.23	22.23	35	20	2:55	155	5	10	25	42.94	42.94	18	20	3:55
	3,4	120	15.6	21.06	21.06	44	20	3:05					40.46	40.46	23	20	4:00
2	1	120	10	45.00	45.00	13	20	2:35	155	5	10	25	45.00	45.00	13	20	3:50
	2	150	10	45.00	45.00	13	20	3:05									
	3	180	10	45.00	45.00	13	20	3:35									
3	1	120	14.2	40.39	40.39	21	20	2:45	155	5	10	25	40.39	40.39	21	20	4:00
	2	150	14.2	40.39	40.39	21	20	3:15									
	3	180	14.2	40.39	40.39	21	20	3:45									
4	1	120	18.2	28.63	28.63	38	20	3:00	155	5	10	25	48.66	48.66	22	20	4:00
	2	150	18.2	48.66	48.66	22	20	3:15									
5	1	120	18.2	44.19	44.19	25	20	2:45	155	5	10	25	46.25	46.25	24	20	4:00
	2	150	18.2	46.25	46.25	24	20	3:15									
6	1	120	11.3	51.13	50.00	14	20	2:35	155	5	10	25	51.13	50.00	14	20	3:50
7	1	120	19.2	48.08	48.08	24	20	2:45	155	5	10	25	48.08	48.08	24	20	4:00
							Maximum for EPZ:	**3:45**								**Maximum for EPZ:**	**4:00**
							Average for EPZ:	**3:05**								**Average for EPZ:**	**4:00**

Table 8-8. Registered Special Needs Population within the Levy EPZ				
Within EPZ	Citrus	Levy	Marion	Total
Registered Special Needs Population	49	30	17	96
Bed-ridden	0	10	0	10
Wheelchair bound	21	10	4	35
Ambulatory	12	10	6	28
Total Population Requiring Transportation	33	30	10	73

Table 8-9. Transportation Needs for Evacuation of Special Needs Population within the Levy EPZ				
Within EPZ	Citrus	Levy	Marion	Total
Ambulances	0	5	0	5
Wheelchair Vans	6	3	1	10
Buses	1	1	1	3

Table 8-10. Transportation Resource Availability				
County-wide	Citrus	Levy	Marion	Total
Ambulances	11	7	59	77
Wheelchair Vans	8	17	41	66
Wheelchair Buses	68	0	35	103
Buses	158	9	339	506

Table 8-11. Available and Required Transit Resources by County				
Requirements	**Buses**	**Ambulances**	**Wheelchair Vans**	**Wheelchair Buses**
Citrus County				
Available Resources	**158**	**11**	**8**	**68**
School	13	0	0	0
Medical Facilities	4	10	2	2
Transit Routes	10	0	0	0
Homebound Special Needs	1	0	6	0
Total Resources Needed	28	10	8	2
Levy County				
Available Resources	**9**	**7**	**17**	**0**
Schools	5	0	0	0
Medical Facilities	0	0	0	0
Transit Routes	4	0	0	0
Homebound Special Needs	1	5	3	0
Total Resources Needed	**10**	**5**	**3**	**0**
Marion County				
Available Resources	**339**	**59**	**41**	**35**
Schools	38	0	0	0
Medical Facilities	0	0	0	0
Transit Routes	6	0	0	0
Homebound Special Needs	1	0	1	0
Total Resources Needed	45	0	1	0

Table 8-12: Bus Route Descriptions

Bus Route Number	Description	Nodes Traversed from Route Start to EPZ Boundary
1	Dunnellon Middle School and Dunnellon Christian Academy	121, 286, 143, 282, 281, 280, 253, 252, 251, 250, 249, 135, 131, 130
2	Citrus Springs Elementary	170, 169, 168, 161, 162
3	Romeo Elementary School	131, 130
4	Yankeetown School	70, 19, 18, 63, 17, 16, 15, 14, 58
5	Route 1 - first split	100, 101, 102, 62, 103, 41
6	Route 1 - second split	99, 60, 95, 15, 14, 58, 13
7	Route 2	170, 171, 156, 175, 155, 158
8	Route 3	258, 154, 253, 252, 251, 250, 249, 135
9	Route 4	70, 19, 20, 259, 21, 22, 23, 24, 25, 26, 2, 266
10	Route 5	331, 119, 329, 330, 118, 260, 117, 120, 121, 286, 143, 145
11	Route 6	133, 263, 112, 262, 111, 125, 124
12	Route 7	115, 114, 2, 27, 28, 29
13	Bright Beginnings	62, 103, 41
14	Presswood Home Child Care	241, 240, 170, 169, 168, 161, 162
15	North Oak Christian Daycare	172, 156, 175
16	Ready Set Go	285, 282, 281, 280, 253, 252, 251, 250, 249, 135, 131, 130
17	Building Blocks Learning Center	282, 281, 280, 253, 252, 251, 250, 249, 135, 131, 130

9. TRAFFIC MANAGEMENT STRATEGY

This section presents the current 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 plant, 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 extensively 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 developed in conjunction with county emergency management representatives and law enforcement personnel.

The control tactic at each TCP is presented in each schematic that appears in Appendix G.

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 nuclear 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.

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 6 and 7 in Section 2.3 discuss ACP and TCP staffing schedules and operations.

10. EVACUATION ROUTES

Evacuation routes are composed of two distinct components:

- Routing from a Protective Action Zone (PAZ) 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 the 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 Levy Nuclear Plant, 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 the reception centers should be responsive to several considerations:

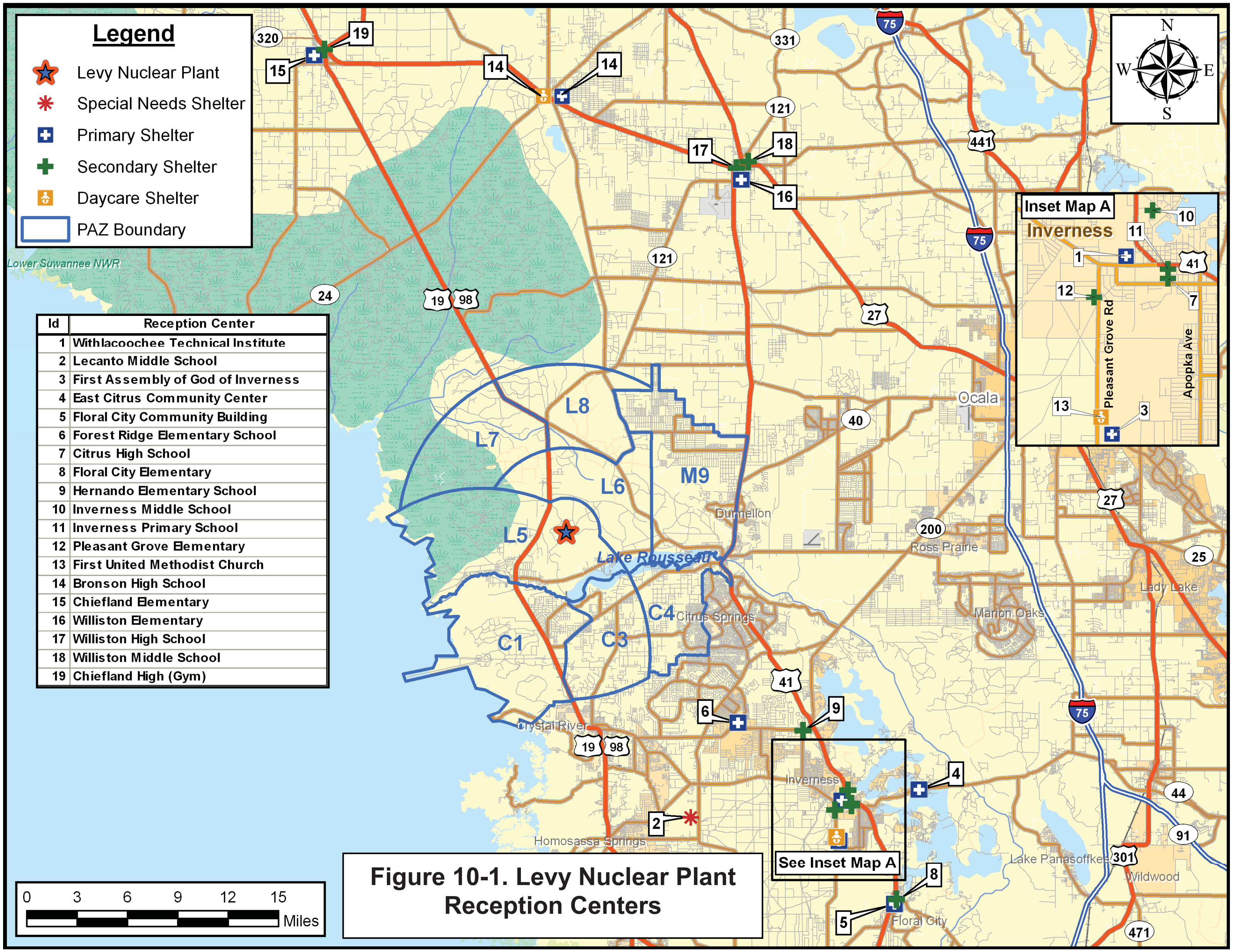
- Minimize the amount of travel outside the EPZ, from the points where these routes cross the EPZ boundary, to the reception centers.

- Relate the anticipated volume of traffic destined to the reception center, to the capacity of the reception center facility.

It is assumed that the reception centers/shelters for the Levy EPZ will be the same as those used for the existing Crystal River Nuclear Plant. Table 10-1 lists the details – name, facility type and location for all the designated reception centers/shelters. Figure 10-1 maps each of the reception centers/shelters identified in Table 10-1. The major evacuation routes for the three counties within the EPZ are presented in Figures 10-2 and 10-3.

Table 10-1 Reception Center Details – Name, Type and Location

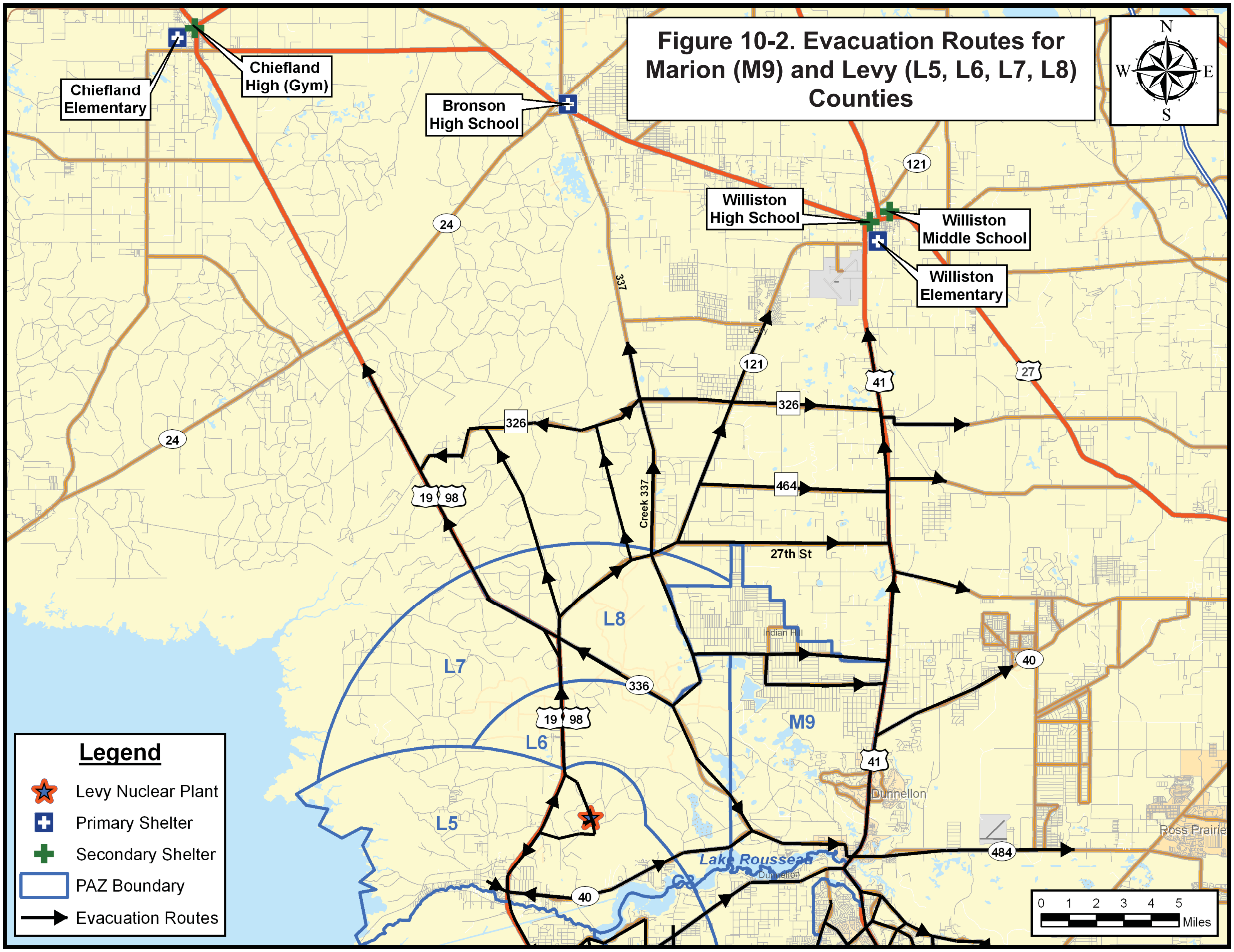
Reception Center	Facility Type	Street Address	City	State	ZIP	County
Withlacoochee Technical Institute	Reception Center	1201 W Main Street	Inverness	Florida	34450	Citrus
Lecanto Middle School	Special Needs Shelter	3800 W Educational Path	Lecanto	Florida	34461	Citrus
First Assembly of God of Inverness	Primary Shelter	4201 S Pleasant Grove Rd	Inverness	Florida	34452	Citrus
East Citrus Community Center	Primary Shelter	9907 E. Gulf-to-Lake Hwy.	Inverness	Florida	34450	Citrus
Floral City Community Building	Primary Shelter	8370 E Orange Ave	Floral City	Florida	34436	Citrus
Forest Ridge Elementary School	Primary Shelter	2927 N Forest Ridge Blvd	Hernando	Florida	34442	Citrus
Citrus High School	Secondary Shelter	600 W Highland Blvd	Inverness	Florida	34452	Citrus
Floral City Elementary	Secondary Shelter	8457 E. Marvin St.	Floral City	Florida	34436	Citrus
Hernando Elementary School	Secondary Shelter	2353 N Croft Ave	Hernando	Florida	34442	Citrus
Inverness Middle School	Secondary Shelter	1000 Middle School Dr	Inverness	Florida	34450	Citrus
Inverness Primary School	Secondary Shelter	206 S Line Avenue	Inverness	Florida	34452	Citrus
Pleasant Grove Elementary	Secondary Shelter	630 Pleasant Grove Rd.	Inverness	Florida	34452	Citrus
First United Methodist Church	Daycare Shelter	3896 S. Pleasant Grove Rd	Inverness	Florida	34452	Citrus
Bronson High School	Primary and Daycare Shelter	350 School St.	Bronson	Florida	32621	Levy
Chiefland Elementary	Primary Shelter	1205 NW 4th Ave.	Chiefland	Florida	32626	Levy
Chiefland High (Gym)	Secondary Shelter	816 N. Main St.	Chiefland	Florida	32626	Levy
Williston Middle School	Secondary Shelter	1345 NE 3rd Ave.	Williston	Florida	32696	Levy
Williston High School	Secondary Shelter	427 W. Noble Ave.	Williston	Florida	32696	Levy
Williston Elementary	Primary Shelter	801 S. Main St.	Williston	Florida	32696	Levy



Id	Reception Center
1	Withlacoochee Technical Institute
2	Lecanto Middle School
3	First Assembly of God of Inverness
4	East Citrus Community Center
5	Floral City Community Building
6	Forest Ridge Elementary School
7	Citrus High School
8	Floral City Elementary
9	Hernando Elementary School
10	Inverness Middle School
11	Inverness Primary School
12	Pleasant Grove Elementary
13	First United Methodist Church
14	Bronson High School
15	Chiefland Elementary
16	Williston Elementary
17	Williston High School
18	Williston Middle School
19	Chiefland High (Gym)

Figure 10-1. Levy Nuclear Plant Reception Centers

Figure 10-2. Evacuation Routes for Marion (M9) and Levy (L5, L6, L7, L8) Counties



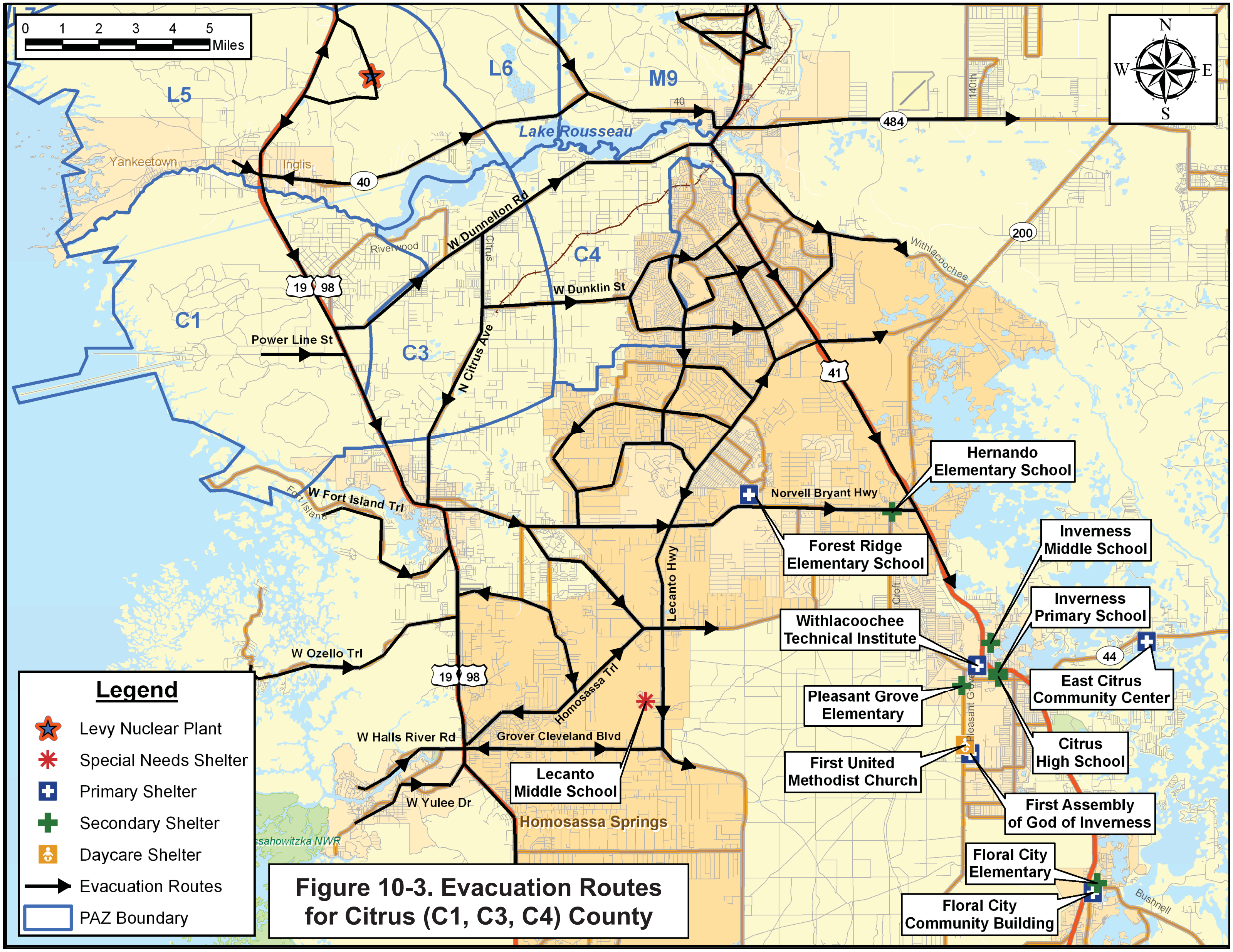


Figure 10-3. Evacuation Routes for Citrus (C1, C3, C4) County

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 exhausting 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. Tow trucks with a supply of gasoline may 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.

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. Although the counties in the EPZ may use their own procedures for confirmation, 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 3-1/2 hours after the Advisory to Evacuate, which is when 90 percent of evacuees have completed their mobilization activities. 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 7-1/2 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 Protective Action Zones), then the confirmation process will extend over a time frame of about 75 minutes. Thus, the confirmation should be completed 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.

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.) = 10,150
Est. proportion, F, of households that have not evacuated = 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:

$$n_F = \frac{nN}{n + N - 1} = 299$$

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 = 212.

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+20+0.8(36)+0.2(60)]/3600 = 7.6

13. RECOMMENDATIONS

The following recommendations 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 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.

   Efforts should be made to keep the traffic management plan up to date and to have all deputies working within the EPZ briefed on the plan.
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 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. Counties 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.
5. Counties should establish a system to confirm that the Advisory to Evacuate is being adhered to (see the approach suggested by KLD in Section 12). Given the propensity for diving and boating within the EPZ along Lake Rousseau and the Gulf of Mexico, one or more helicopters equipped with loudspeakers could fly over these areas to alert all transients of the need to immediately evacuate. Vehicles equipped with loudspeakers are also recommended. Police boats using colored smoke and flares could also be used to alert transients.
6. Examination of the ETE in Section 7 and Appendix J shows that the ETE for 100 percent of the population is generally 1½ to 2 hours longer than for 95 percent of the population. This non-linearity reflects the fact that relatively few stragglers require significantly more time to mobilize (i.e. prepare for the evacuation trip) than their neighbors. This leads to two recommendations:
   - 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 J-1C which lists the time needed to evacuate 95 percent of the population, when preparing recommended protective actions.**
7. In the rare event that a simultaneous evacuation of both the Crystal River Nuclear Plant and Levy Nuclear Plant EPZs is advised, there would be a

shortage of ambulances in Citrus County. As discussed in Appendix I, it is recommended that a mutual aid agreement be established between Citrus and Marion Counties for ambulance resource support in the event of a simultaneous evacuation.

8. As shown in Section 8, there would be a shortage of buses in Levy County in the event of an evacuation of the Levy EPZ. There is, however, a surplus of wheelchair buses in Levy County. It is recommended that plans are made to use these surplus wheelchair buses within the county or that a mutual aid agreement be established by Levy County with Citrus and/or Marion Counties for bus resource support in the event of an evacuation.

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 area, 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.

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[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

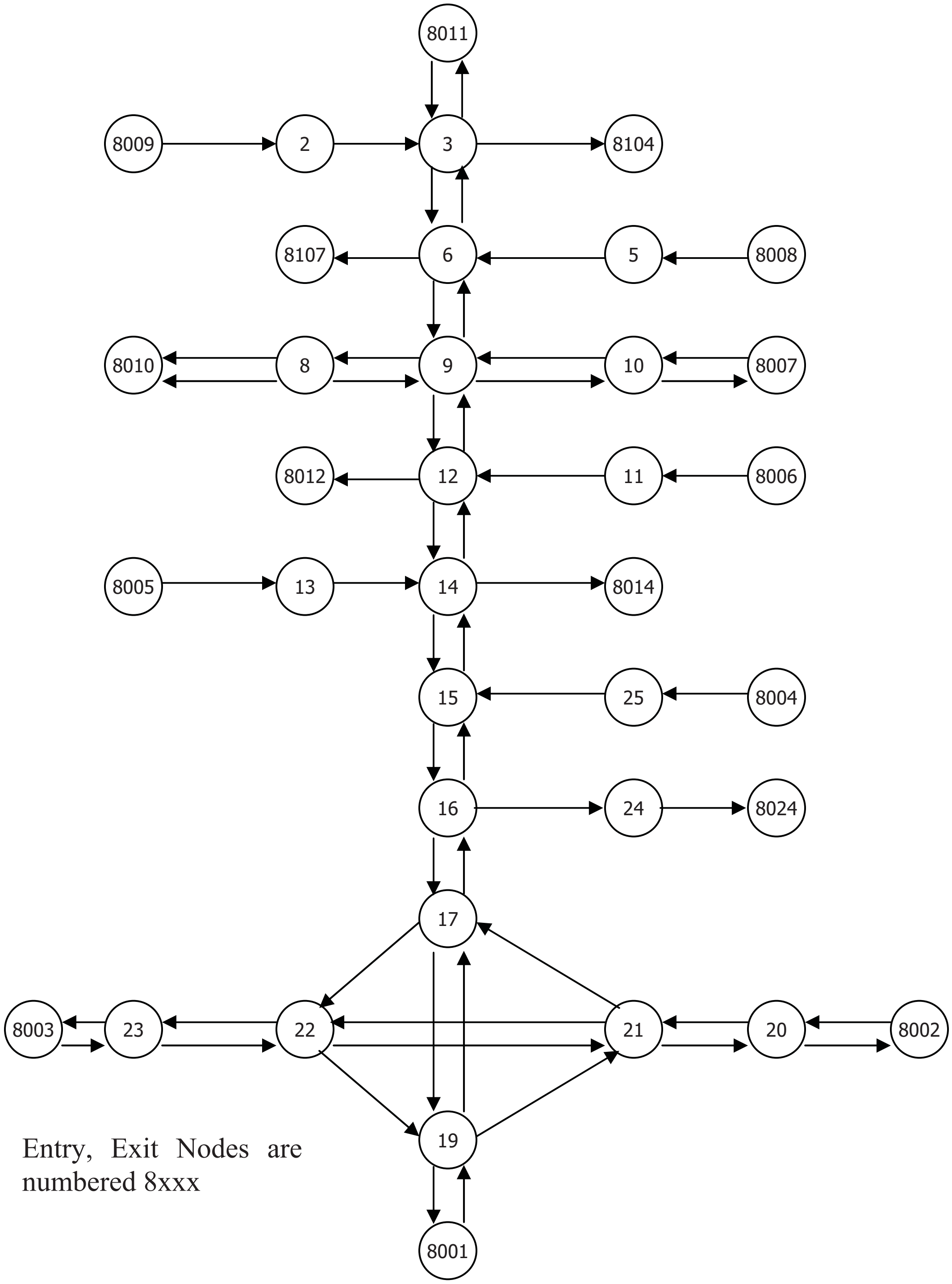
- On all entry links and sink/source nodes stratified by vehicle type: auto, car pool, bus, truck
- Link-specific turn movements

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.



Entry, Exit Nodes are numbered 8xxx

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 results of a telephone survey conducted within the EPZ. Transient population data and employee data were obtained through data collection forms submitted by County Emergency Management Offices.

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 and employment 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 destinations at the periphery of the EPZ.

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. A tablet computer equipped with Global Position System (GPS) technology is used during the road survey to accurately record the position of traffic control devices and record other roadway data.

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

Step 5.
With the network created, 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 were entered into the computer to create the input stream for the TRaffic Assignment and Distribution (TRAD) model. This model was 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.

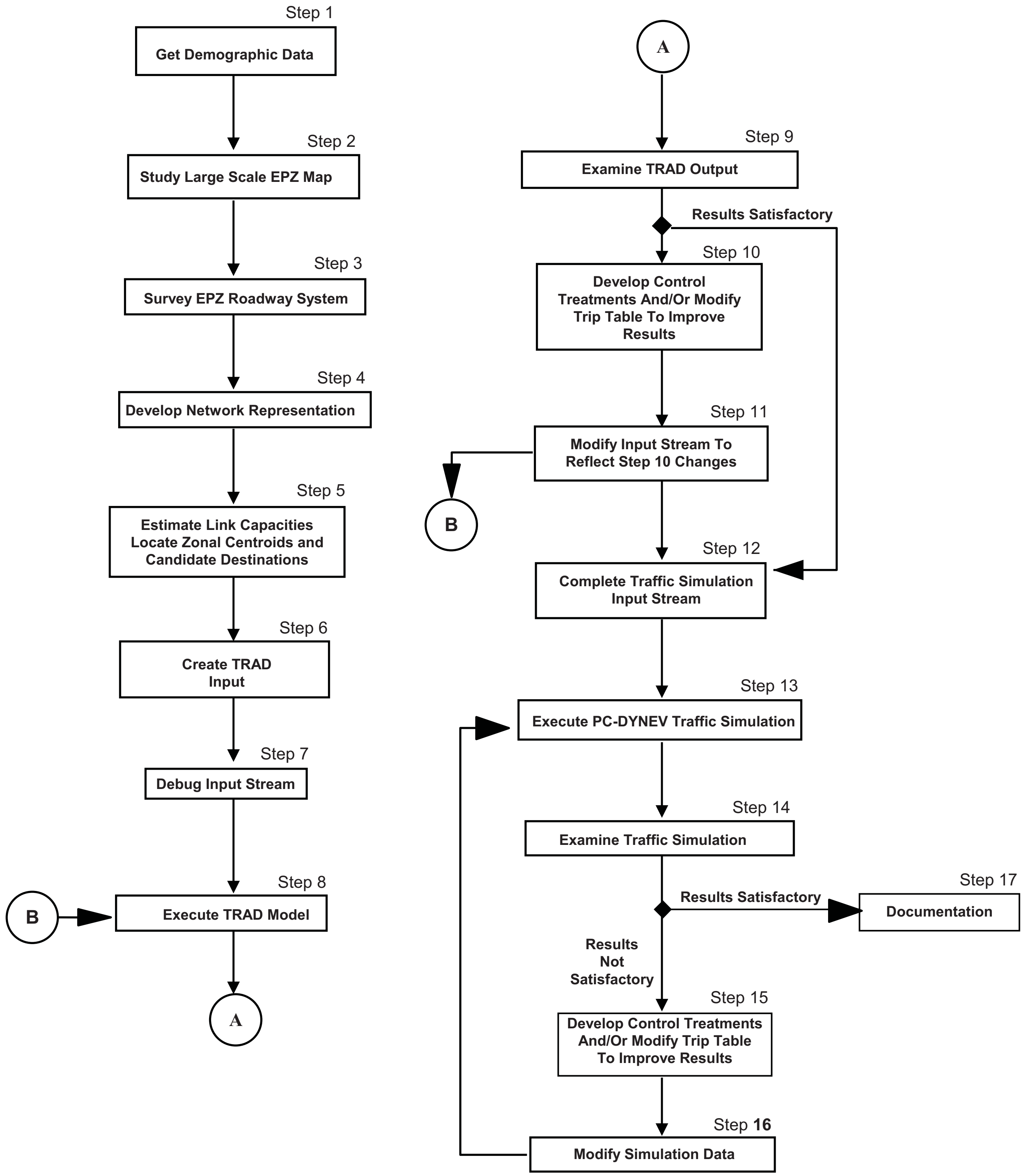


Figure D-1. Flow Diagram of Activities

APPENDIX E

Special Facility Data

APPENDIX E: SPECIAL FACILITY DATA

The following tables list population information, as of July, 2007 for special facilities that are located within the Levy Nuclear Plant EPZ. Special facilities are defined as schools, day care centers, hospitals and other medical care facilities, correctional facilities, and major employers. Transient population data is included in the tables for state parks, county parks, hotels and motels, and other recreational areas. Each table is grouped by county. The location of the facility is described by its straight-line distance (miles) and direction (magnetic bearing) from the nuclear Plant.

Table E-1. Levy EPZ: Schools (As of July 2007)

PAZ	Distance (miles)	Dire-ction	School Name	Street Address	Municipality	Phone	Enroll-ment	Staff
Levy County								
L5	5.0	WSW	Yankeetown School	4500 Hwy 40 West	Yankeetown	(352) 447-2372	329	51
Citrus County								
C4	9.9	SW	Citrus Springs Elementary	3570 W Century Blvd	Citrus Springs	(352) 344-4079	875	55
Marion County								
M9	9.4	E	Dunnellon Middle School	21005 Chestnut St	Dunnellon	(352) 465-6720	1,100	110
M9	9.4	E	Dunnellon Christian Academy	20831 Powell Rd	Dunnellon	(352) 489-7716	263	33
M9	11.9	ENE	Romeo Elementary School	19550 SW 36th St	Dunnellon	(352) 465-6700	810	105
						Total	**3,377**	**354**

Table E-2. Levy EPZ: Day Care Facilities (As of July 2007)

PAZ	Distance (miles)	Dir-ection	Name	Street Address	Municipality	Phone	Enroll-ment	Empl-oyees
Citrus County								
C4	9.0	SE	Presswood Home Child Care	5721 W Bangkok Ln	Dunnellon	(352) 465-2272	8	1
C4	9.7	ESE	North Oak Christian Daycare	9324 N Elkcam Blvd	Citrus Springs	(352) 489-3359	30	5
C3	9.9	S	Bright Beginnings Pre-School	4801 N Citrus Avenue	Crystal River	(352) 795-1240	63	10
Marion County								
M9	9.6	E	Ready-Set-Go Learning Center	20660 Powell Rd	Dunnellon	(352) 465-1565	46	5
M9	9.8	E	Building Blocks Learning Center	11364 Robinson Rd	Dunnellon	(352) 489-7972	163	21
						Total	**310**	**42**

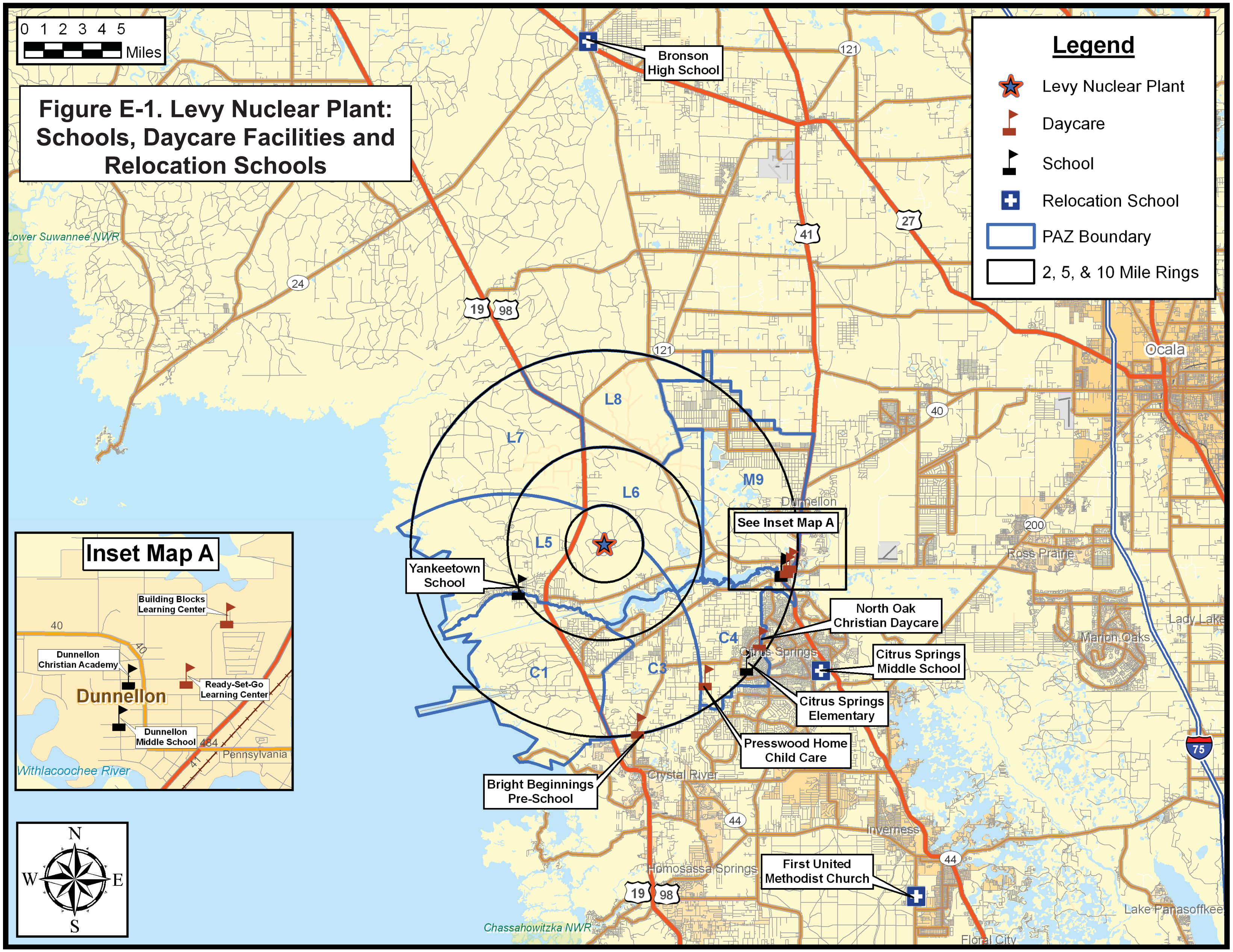


Figure E-1. Levy Nuclear Plant: Schools, Daycare Facilities and Relocation Schools
0 1 2 3 4 5
Miles
Legend
Levy Nuclear Plant
Daycare
School
Relocation School
PAZ Boundary
2, 5, & 10 Mile Rings
Bronson High School
Yankeetown School
See Inset Map A
North Oak Christian Daycare
Citrus Springs Middle School
Citrus Springs Elementary
Presswood Home Child Care
Bright Beginnings Pre-School
First United Methodist Church
L5
L6
L7
L8
M9
C1
C3
C4
Ocala
Dunnellon
Ross Prairie
Marion Oaks
Lady Lake
Citrus Springs
Crystal River
Homosassa Springs
Inverness
Floral City
Lake Panasoffkee
Lower Suwannee NWR
Chassahowitzka NWR
Inset Map A
Building Blocks Learning Center
Dunnellon Christian Academy
Ready-Set-Go Learning Center
Dunnellon Middle School
Dunnellon
Withlacoochee River
Pennsylvania
N
S
E
W

Table E-3. Levy EPZ: Medical Facilities and Assisted Living Facilities (As of July 2007)

PAZ	Distance (miles)	Dir-ection	Name	Street Address	Municipality	Phone	Cap-acity	Empl-oyees
CITRUS COUNTY								
C1	8.4	S	Seven Rivers Regional Medical Center	6201 N Suncoast Blvd	Crystal River	(352) 795-8311	128	190
C1	8.2	S	Crystal Gem Manor Assisted Living	10845 W Gem St	Crystal River	(352) 794-7601	70	9
C3	7.0	SSE	Richard Hoffman Adult Family Home	8620 N Himalayas Pt	Dunnellon	(352) 563-0259	5	3
						Total	**203**	**202**

Table E-4. Levy EPZ: Correctional Facilities (As of July 2007)

PAZ	Distance (miles)	Dir-ection	Name	Street Address	Municipality	Phone	Max. Capacity	Avg. Capacity
Levy County								
L6	4.7	NE	Forestry Youth Camp	14251 SE Glass Rd	Inglis	(352) 465-8533	40	35
						Total	**40**	**35**

Table E-5. Levy EPZ Major Employers (As of July 2007)

PAZ	Distance (miles)	Dir-ection	Facility Name	Street Address	Municipality	Phone	Total Employees	Maximum Shift	% Non-EPZ	Max Shift Non-EPZ Employees
Citrus County										
C1	8.9	SSW	Crystal River Nuclear Plant	15760 W Powerline St	Crystal River	(352) 563-2358	1,000	800	75%	600
C1	8.4	S	Seven Rivers Regional Medical Center	6201 N Suncoast Blvd	Crystal River	(352) 795-8311	190	190	75%	143
						Citrus County Total:	*1,190*	*990*	*75%*	*743*
Marion County										
M9	10	E	Sweetbay Supermarket	11352 N. Williams St. #305	Dunnellon	(352) 489-6607	60	25	50%	13
M9	10	E	Super Wal-mart	11012 N. Williams St	Dunnellon	(352) 489-4210	100	50	50%	25
						Marion County Total:	*160*	*75*	*50%*	*38*
						Total	**1,350**	**1,065**	**73%**	**781**

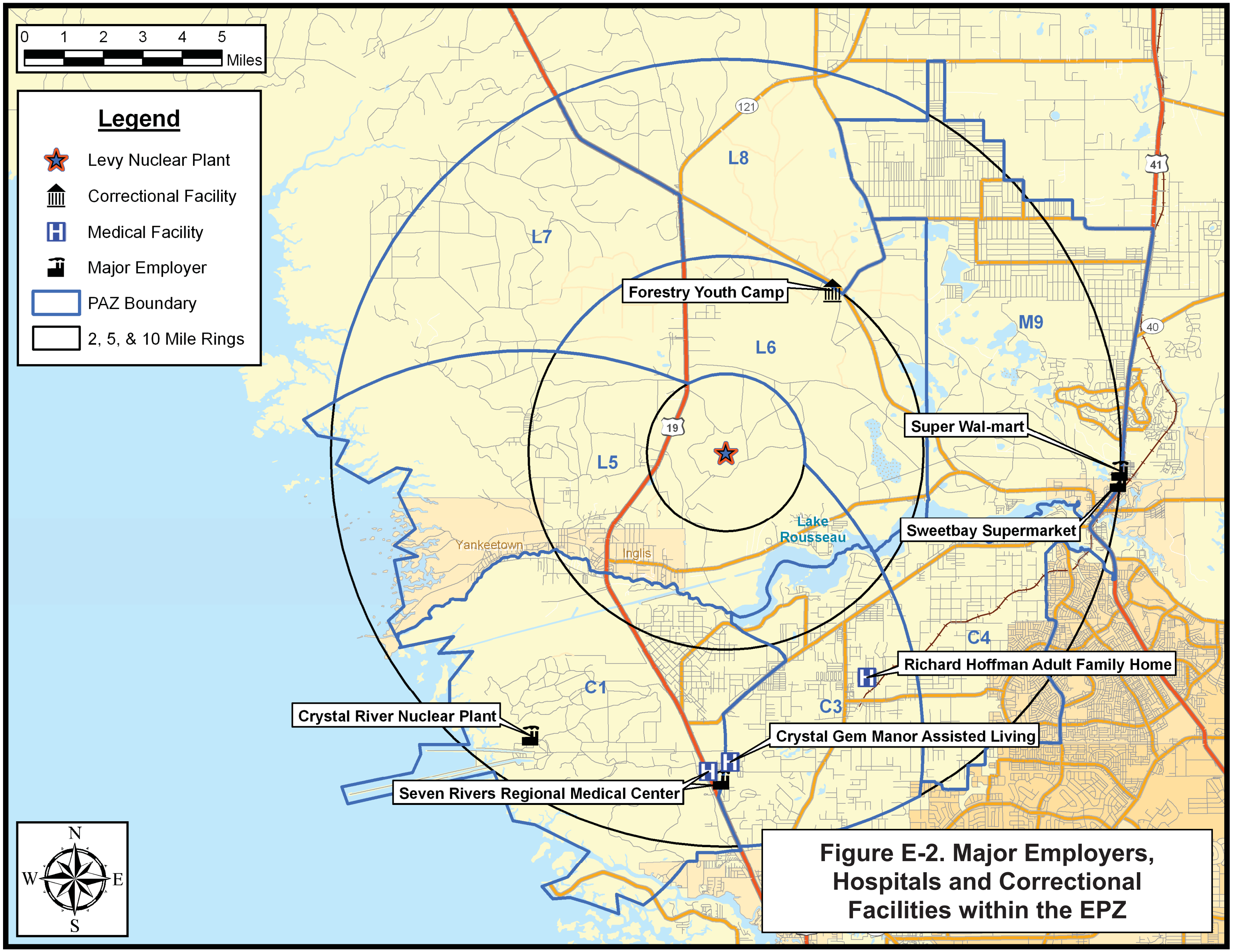


Figure E-2. Major Employers, Hospitals and Correctional Facilities within the EPZ

Table E-6. Levy EPZ: Recreational Areas (As of July 2007)

PAZ	Distance (miles)	Dir-ection	Facility Name	Street Address	Municipality	Phone	Total People	Total Vehicles
Levy County								
L5	3.4	SE	Big Bass Village	10530 SE 201 St	Inglis	(352) 447-3474	20	10
L6	4.6	NNW	Florida Sheriff's Youth Ranch - Caruth Ranch	14470 SE USHY 19	Inglis	(352) 447-2259	100	30
L5	6.6	WSW	Cattail Creek	41 Cattail Lane	Yankeetown	(352) 447-3050	20	20
L5	6.9	WSW	B's Marina & Campground	6621 Riverside Dr	Yankeetown	(352) 447-5888	25	15
Citrus County								
C1	12.0	SW	Fort Island Gulf Beach	16000 W Fort Island Trail	Crystal River	(352) 527-7678	100	50
C3	4.2	SSE	Lake Rousseau RV Park	10811 N Coveview Terrace	Crystal River	(352) 795-6336	250	150
C1	4.6	S	Inglis Dam Recreation Area*	Riverwood Drive	Crystal River	(352) 447-1720	90	60
C1	4.6	SW	Big Oaks River Resort	14035 West River Rd	Inglis	(352) 447-5333	40	23
C1	4.8	SSW	Withlacoochee Bay Trail / Felburn Trailhead	10201 N Suncoast Blvd	Crystal River	(352) 447-1720	200	100
C1	5.1	SSW	Nature Coast Landings	10173 N Suncoast Blvd	Crystal River	(352) 447-2299	200	200
C3	5.7	SSE	Quail Roost RV Campground	9835 N Citrus Ave	Crystal River	(352) 563-0404	144	72
						Total	**1,189**	**730**

*Detailed data was not available, the total people and vehicles are assumed.

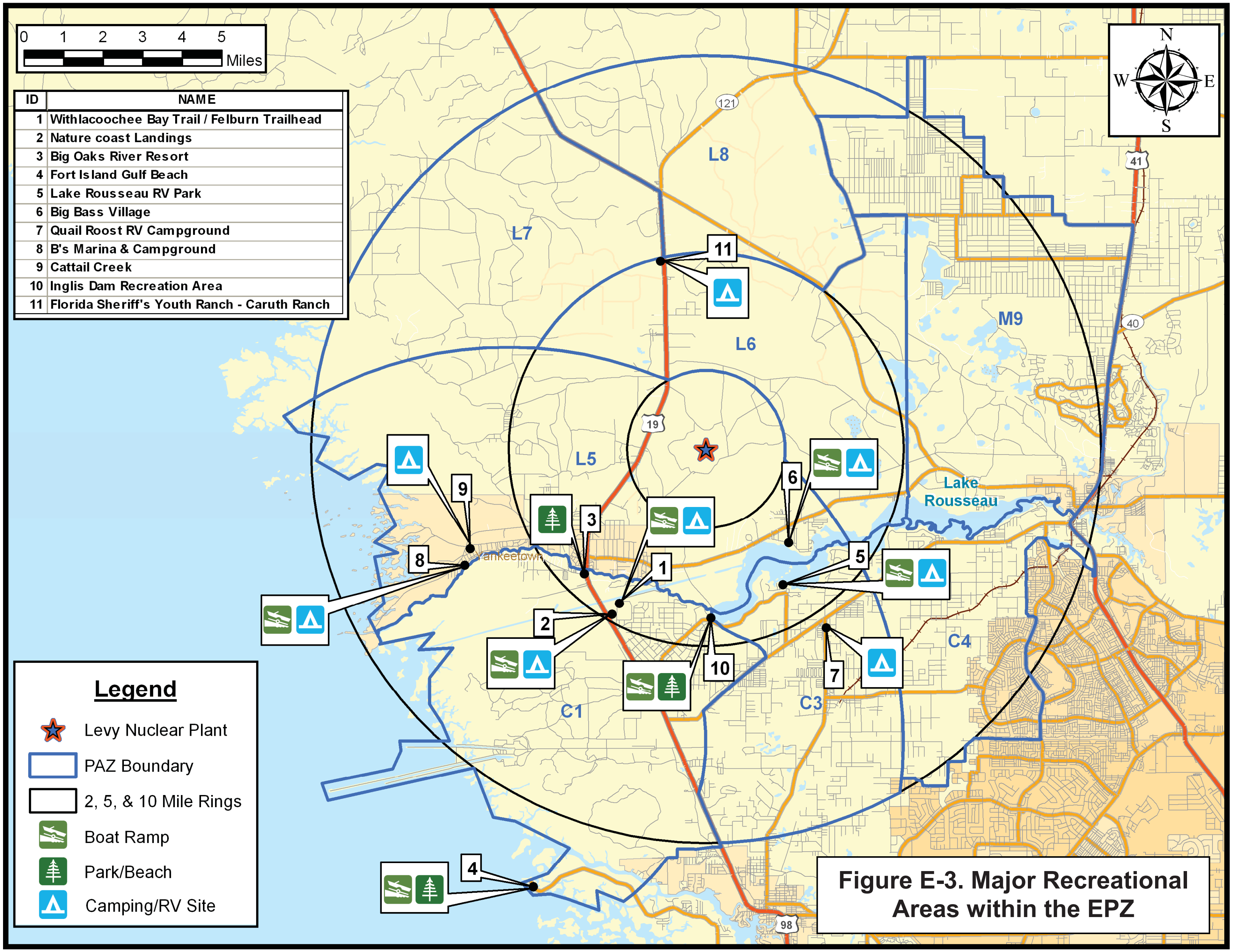


Figure E-3. Major Recreational Areas within the EPZ

Table E-7. Levy EPZ: Lodging (As of July 2007)

PAZ	Distance (miles)	Dir-ection	Facility Name	Street Address	Municipality	Phone	Per-sons	Veh-icles
Levy County								
L5	4.2	SW	Withlacoochee Motel	66 Hwy 19 South	Inglis	(352) 447-2211	30	15
L5	4.9	WSW	Pine Lodge Bed & Breakfast	649 Highway 40 West	Inglis	(352) 447-7463	18	9
Marion County								
M9	9.5	E	Two Rivers Inn	20814 W Pennsylvania Ave	Dunnellon	(352) 489-2309	18	9
M9	9.6	ESE	Angler's Family Resort	12189 S USHY 41	Dunnellon	(352) 489-2397	20	8
M9	9.7	E	Dinner Bell	12084 S Williams St	Dunnellon	(352) 489-2550	48	24
Citrus County								
C1	10.2	S	Comfort Inn	4486 N Suncoast Blvd	Crystal River	(352) 563-5426	94	94
						Total	**228**	**159**

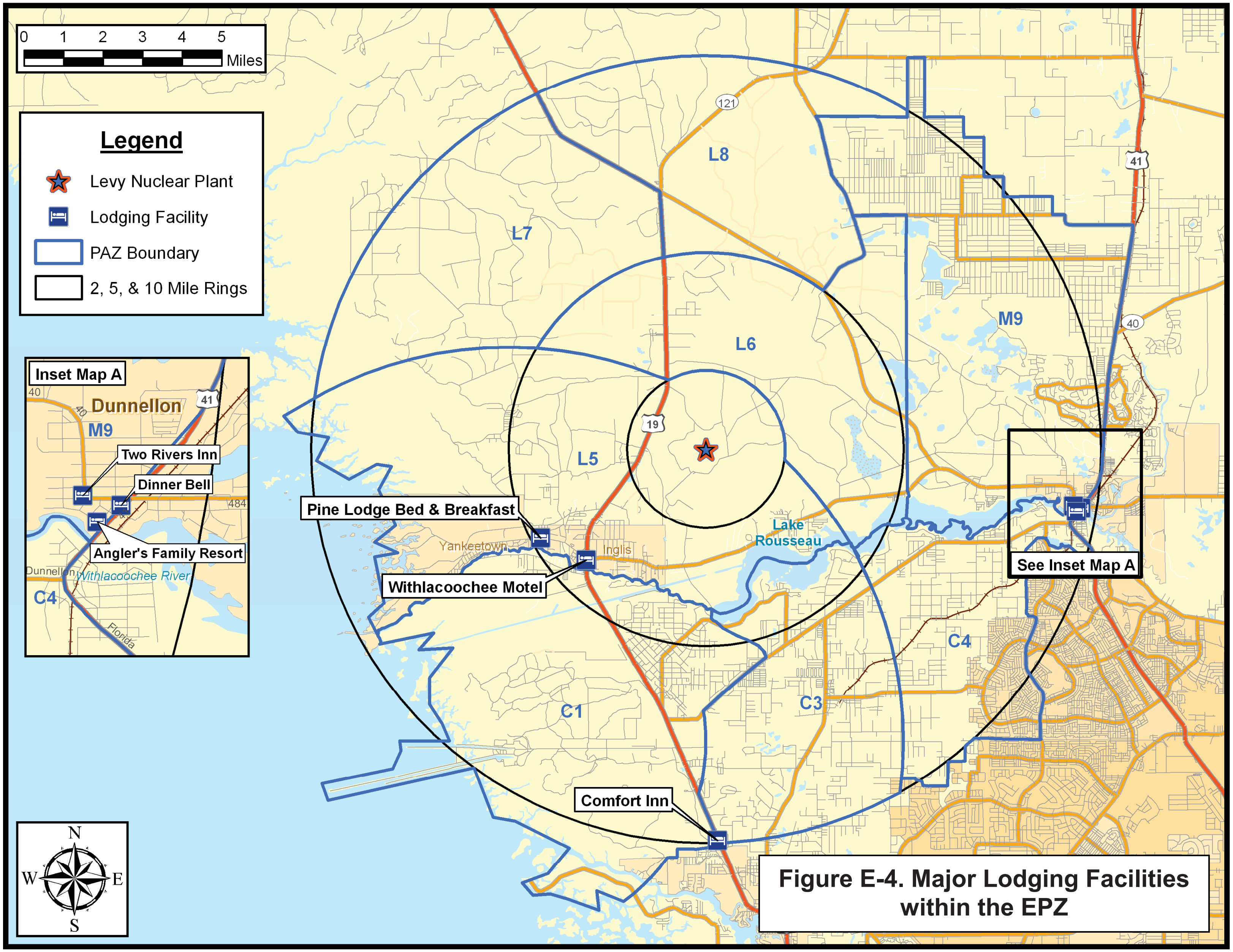


Figure E-4. Major Lodging Facilities within the EPZ

APPENDIX F

Telephone Survey

APPENDIX F: TELEPHONE SURVEY

1. INTRODUCTION

The development of evacuation time estimates for the Emergency Planning Zone (EPZ) of the Levy Nuclear Plant 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, the 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 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.

Following the completion of the instrument, a sampling plan was developed. The sample must be drawn from the EPZ population. Consequently, a list of zip codes within the combined Levy/Crystal River EPZ (Table F-1) and a list of zip codes for the Levy EPZ (Table F-2) were developed. Comparison of the final column in Table F-1 and the final column in Table F-2 shows that the distribution of phone calls is different amongst the zip codes; however, this is to be expected as the actual survey conducted using Table F-1 was a blend of the two EPZs, whereas Table F-2 focuses only on the Levy EPZ.

The population and number of households within each zip code area was estimated using geographical information systems (GIS) software. A sample size of approximately 553 completed survey forms yields results with an acceptable sampling error. The list of zip codes considered, the Year 2000 population of each zip code, the number of households within each zip code, and the proportional number of the desired completed survey interviews for each zip code is shown in Table F-1 and Table F-2.

Due to the close proximity of the Crystal River and Levy Nuclear Plants, a combined survey of the two EPZs was done in order to obtain demographic data useful for both plants.

<table>
<tr><th colspan="4">Table F-1. Combined Levy and Crystal River Nuclear Plants Telephone Survey Sampling Plan</th></tr>
<tr><th>Zip Code</th><th>Population in ZIP (2000)</th><th>Households in ZIP (2000)</th><th>Required Sample</th></tr>
<tr><td>34428</td><td>8,920</td><td>3,779</td><td>151</td></tr>
<tr><td>34429</td><td>8,605</td><td>3,233</td><td>129</td></tr>
<tr><td>34431</td><td>6,664</td><td>3,176</td><td>127</td></tr>
<tr><td>34433</td><td>4,246</td><td>1,691</td><td>67</td></tr>
<tr><td>34449</td><td>3,908</td><td rowspan="2">1,979</td><td rowspan="2">79</td></tr>
<tr><td>34498</td><td>574</td></tr>
<tr><td>Total:</td><td>32,917</td><td>13,858</td><td>553</td></tr>
<tr><td colspan="3">Average Household Size</td><td>2.38</td></tr>
<tr><td colspan="3">Total Sample Required</td><td>553</td></tr>
</table>

Table F-2. Levy Nuclear Plant EPZ Population by Zip Code

Zip Code	Population within EPZ (2000)	Households within EPZ (2000)	Required Sample
34428	3,793	1,526	106
34429	2	1	0
34431	6,186	2,820	197
34433	4,134	1,686	118
34434	168	71	5
34449	3,461	1,541	107
34465	7	4	0
34498	574	287	20
Total	**18,325**	**7,936**	**553**

Note that the Table F-1 combined zip codes 34449 and 34498 have 1,979 households within the combined study area, versus a total of 13,858 households for the whole study area. Thus, the sample size for these two zip codes is 1,979 ÷ 13,858 × 553 = 79. Table F-2 shows combined zip codes 34449 and 34498 have 1,828 households when using only the Levy EPZ versus a total of 7,936 households for the whole study area. Thus, the sample size for these two zip codes when considering only the Levy EPZ is 1,828 ÷ 7,936 × 553 = 127. Therefore, the required sample size increases even though the total households and population decrease. This anomaly is explained by the fact that the total households nearly doubles when using the combined study area versus only the Levy EPZ and the number of households in those zip codes makes up a larger percentage of the total households when just considering the Levy EPZ.

A combined telephone survey for the existing Crystal River Nuclear Plant and the proposed Levy Nuclear Plant is justified because of the close proximity of the facilities and the similar EPZ demographics. The combined survey sampling plan, as documented in Table F-1is valid and the results of the telephone survey are used in computing the ETE results.

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. 95% confidence bounds are provided for the average values shown in the figures below.

Household Demographic Results

Household Size

Figure F-1 presents the distribution of household size within the EPZ. The average household contains 2.25 ± 0.10 people. The estimated household size (2.38 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.

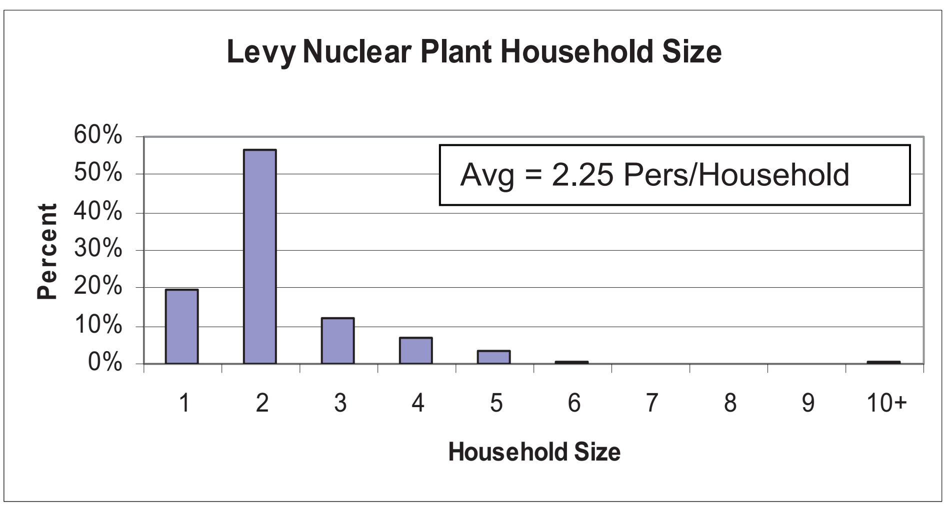


Figure F-1. Household Size in the EPZ

Automobile Ownership

The average number of automobiles per household in the EPZ is 1.82 ± 0.09. The distribution of automobile ownership is presented in Figure F-2. Figures F-3 and F-4 present the automobile availability by household size; approximately 4.5 percent of households do not have access to an automobile. The majority of households without access to a car are single person households; nearly all households of 2 or more people have access to at least one vehicle.

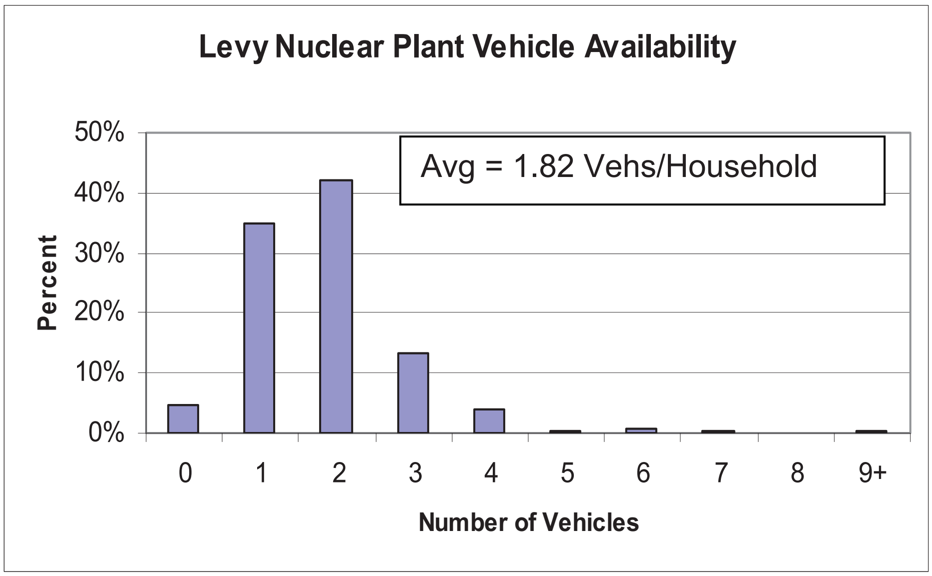


Figure F-2. Household Vehicle Availability

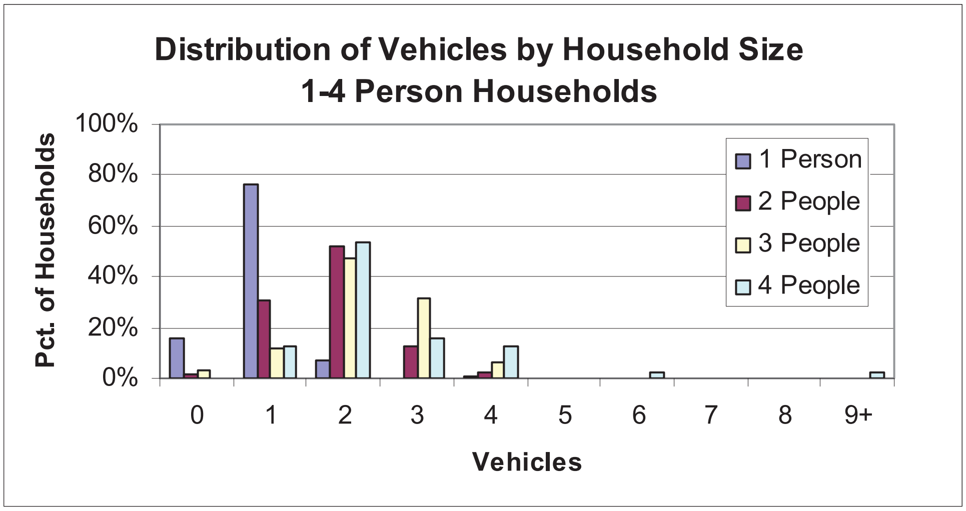


Figure F-3. Vehicle Availability – 1 to 4 Person Households

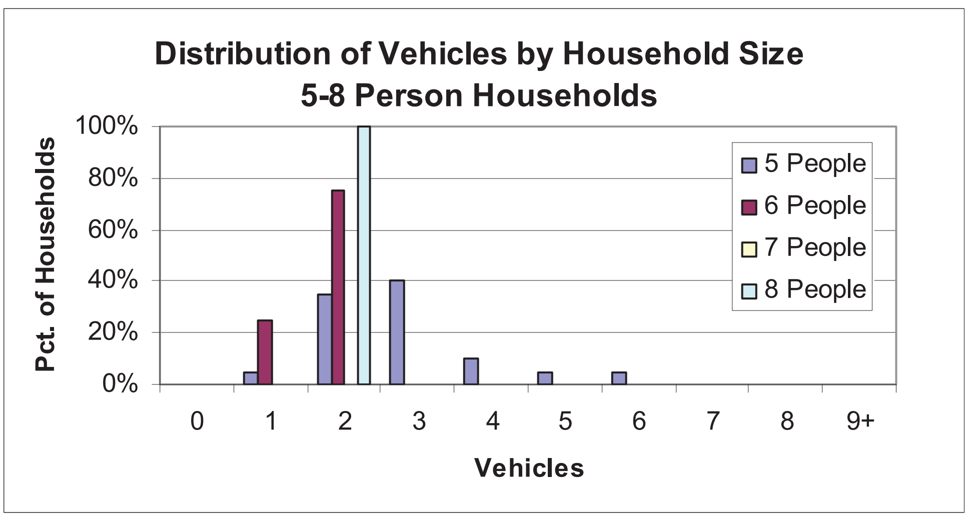


Figure F-4. Vehicle Availability – 5 to 8 Person Households

Schoolchildren

The average number of schoolchildren per household identified by the survey is 0.36 ± 0.15. Figure F-5 presents the distribution of schoolchildren.

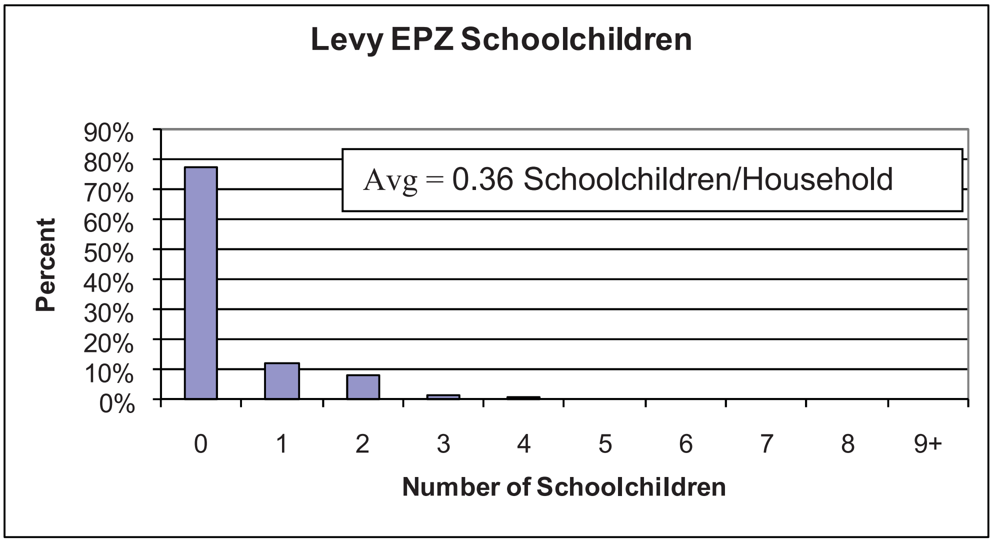


Figure F-5. Schoolchildren in Households

Commuters

Figure F-6 presents the distribution of the number of commuters in each household. The data shows an average of 0.70 ± 0.12 commuters in each household in the EPZ. The data indicate that 55.2% ± 4.16% of households have no commuters.

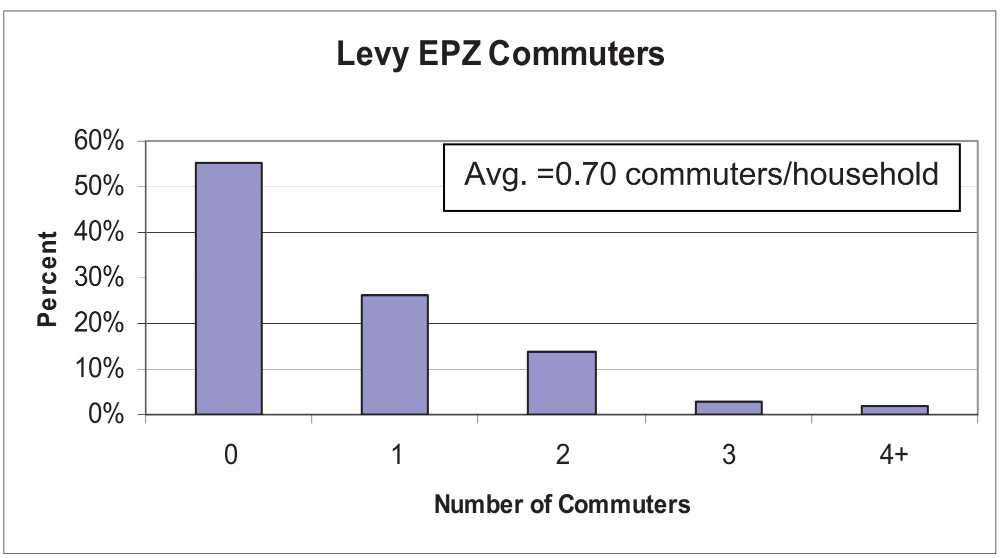


Figure F-6. Commuters in Households in the EPZ

Commuter Travel Modes

Figure F-7 presents the mode of travel that commuters use on a daily basis. The vast majority (94.5% ± 2.3%) of commuters use their private automobiles to travel to work or school.

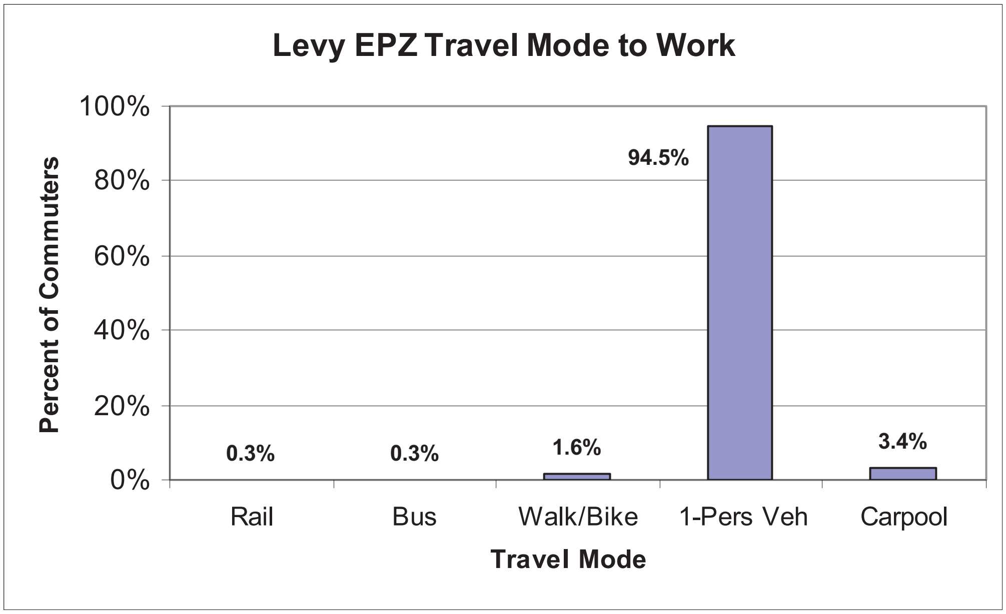


Figure F-7. Modes of Travel to Work by EPZ Residents

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, 1.39 ± 0.08 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, 69 percent said that there was another vehicle available to evacuate, while 31 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, 59 percent said they would await the return of other family members before evacuating and 41 percent indicated that they would not await the return of other family members.

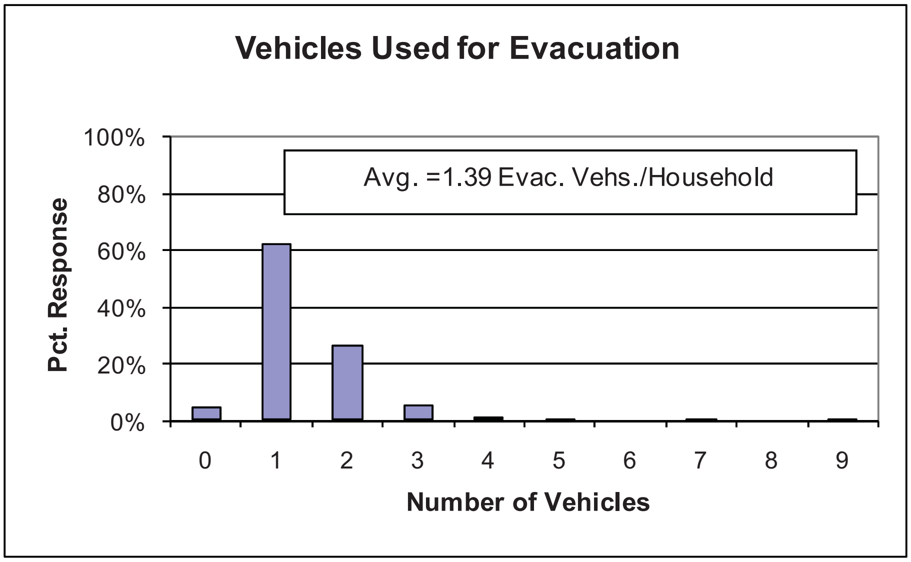


Figure F-8. Number of Vehicles Used for Evacuation

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-9 presents the cumulative distribution. In all cases, the activity is completed by about 120 minutes. Fifty four percent can leave within 15 minutes.

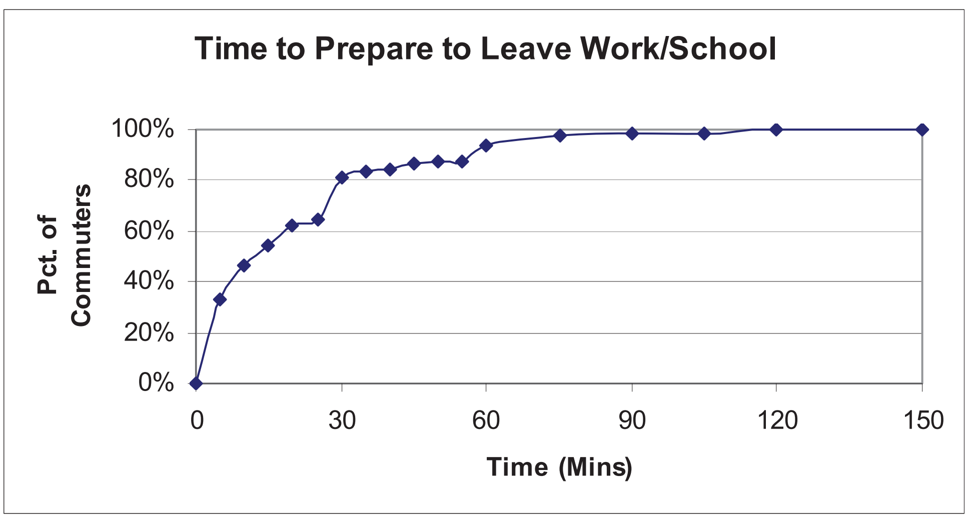


Figure F-9. Time Required to Prepare to Leave Work/School

How long would it take the commuter to travel home?

Figure F-10 presents the work to home travel time. Over 90 percent of commuters can arrive home within about 45 minutes of leaving work; nearly all within 90 minutes.

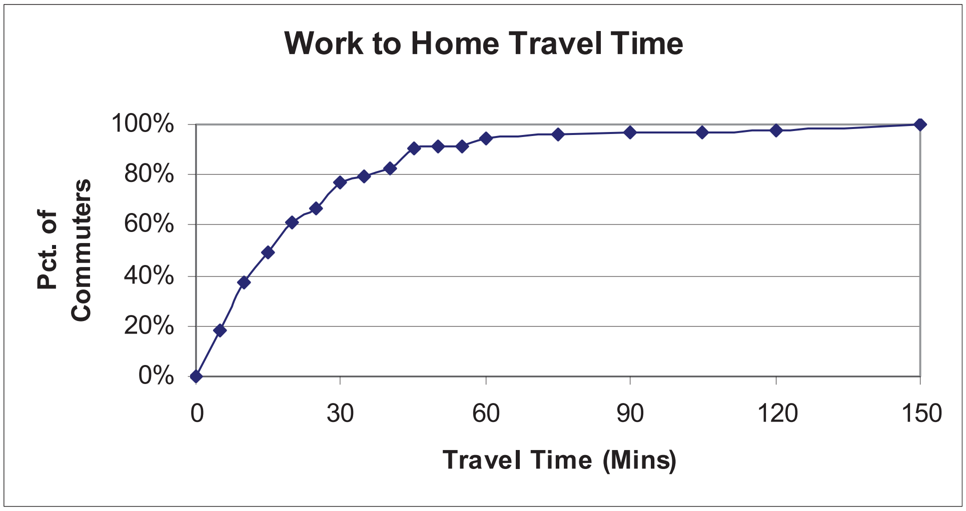


Figure F-10. Work to Home Travel Time

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

Figure F-11 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-11 has a long "tail." Approximately 90 percent of households can be ready to leave home within two hours; nearly all households can be ready to leave within four hours.

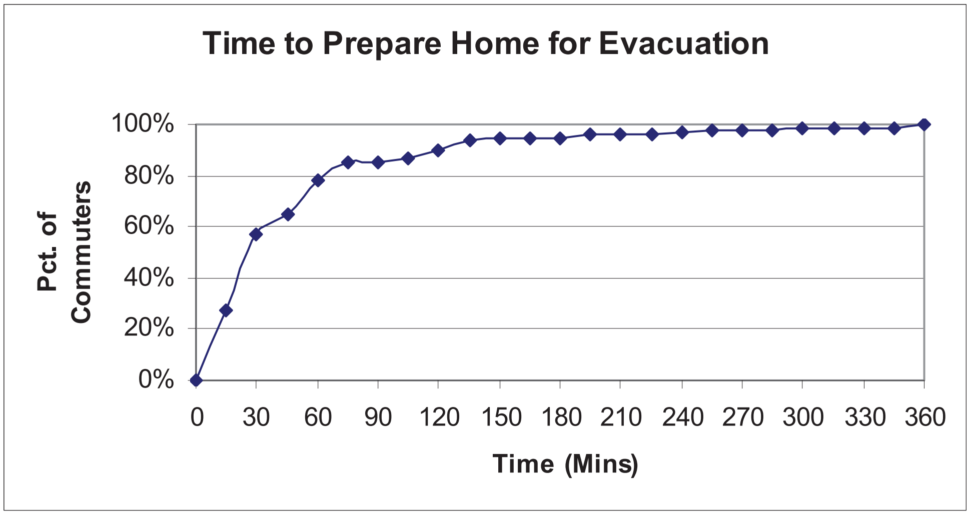


Figure F-11. Time to Prepare Home for Evacuation

3. CONCLUSIONS

The telephone survey provides valuable, relevant data 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 in connection with an update of the county's emergency response plans. 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 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. Would you take household pets with you if you were asked to evacuate the area?

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

Thank you very much. ____
(TELEPHONE NUMBER CALLED)

If requested:
For Additional information
Contact your County Emergency Management Office

ANNEX B

Code of Data Collection Standards With Notes Section
Market Research Association

P.O. Box 230 • Rocky Hill, CT 06067-0230 • 860-257-4008 • Fax: 860-257-3990

Code Approved May 1997

Notes Added September 1999

RESPONSIBILITIES TO RESPONDENTS

Data Collection Companies ...

1. will make factually correct statements to secure cooperation and will honor promises to respondents, whether verbal or written;
2. will not use information to identify respondents without the permission of the respondent, except to those who check the data or are involved in processing the data. If such permission is given, it must be recorded by the interviewer at the time the permission is secured;
3. will respect the respondent's right to withdraw or to refuse to cooperate at any stage of the study and not use any procedure or technique to coerce or imply that cooperation is obligatory;
4. will obtain and document respondent consent when it is known that the name and address or identity of the respondent may be passed to a third party for legal or other purposes, such as audio or video recordings;
5. will obtain permission and document consent of a parent, legal guardian or responsible guardian before interviewing children 12 years old or younger;
6. will give respondents the opportunity to refuse to participate in the research when there is a possibility they may be identifiable even without the use of their name or address (e.g., because of the size of the population being sampled).

Interviewers ...

1. will treat the respondent with respect and not influence him or her through direct or indirect attempts, including the framing of questions and/or a respondent's opinion or attitudes on any issue;
2. will obtain and document permission from a parent, legal guardian or responsible guardian before interviewing children 12 years old or younger. Prior to obtaining permission, the interviewer should divulge the subject matter, length of the interview and other special tasks that will be required.

RESPONSIBILITIES TO CLIENTS

Data Collection Companies ...

1. will ensure that each study is conducted according to the client's exact specifications;
2. will observe confidentiality with all research techniques or methodologies and with information considered confidential or proprietary. Information will not be revealed that could be used to identify clients or respondents without proper authorization;
3. will ensure that companies, their employees and subcontractors involved in data collection take all reasonable precautions so that more than one survey is not conducted in one interview without explicit permission from the Client
4. will report research results accurately and honestly;
5. will not misrepresent themselves as having qualifications, experience, skills or facilities that they do not possess;
6. will refrain from referring to membership in the Marketing Research Association as proof of competence, since the Association does not certify any person's or organization's competency or skill level.

RESPONSIBILITIES TO DATA COLLECTORS

Clients ...

1. will be responsible for providing products and services that are safe and fit or their intended use and disclose/label all product contents;
2. will provide verbal or written instructions;
3. will not ask our members who subcontract research to engage in any activity that is not acceptable as defined in this Code or that is prohibited under any applicable federal, state, local laws, regulations and/or ordinances.

RESPONSIBILITIES TO THE GENERAL PUBLIC AND BUSINESS

COMMUNITY

Data Collection Companies ...

1. will not intentionally abuse public confidence in marketing and opinion research;
2. will not represent a non-research activity to be marketing and opinion research, such as:
   - questions whose sole objective is to obtain personal information about respondents, whether for legal, political, private or other purposes,
   - the compilation of lists, registers or data banks of names and addresses for any non-research purposes (e.g., canvassing or fundraising),
   - industrial, commercial or any other form of espionage,
   - the acquisition of information for use by credit rating services or similar organizations,
   - sales or promotional approaches to the respondent,
   - the collection of debts;
3. will make interviewers aware of any special conditions that may be applicable to any minor (18 years old or younger).

These notes are intended to help users of the Code to interpret and apply it in practice. Any questions about how to apply the Code in a specific situation should be addressed to MRA Headquarters.

RESPONSIBILITIES TO RESPONDENTS

Data Collection Companies ...

1. will make factually correct statements to secure cooperation and honor promises to respondents, whether oral or written; *Interviewers will not knowingly provide respondents with information that misrepresents any portion of the interviewing process, such as; length of the interview, scope of task involved, compensation, or intended use of the information collected.*
2. will not use information to identify respondents without the permission of the respondent, except to those who check the data or are involved in processing the data. If such permission is given, it must be recorded by the interviewer at the time the permission is secured; *Respondent information will be linked to data collected only for research purposes such as validation, evaluating data in aggregate based on demographic information, modeling. Providing respondent information is not permissible for any purpose other than legitimate research purposes as mentioned above. If anyone requests respondent identifiable information it will only be provided upon receipt of written declaration of and agreement of some intended use. Such use shall be determined by the provider to qualify as legitimate research use. (i.e. validation, planned recalls, modeling, demographic analysis.) No other use of this information falls within the boundaries of the Code. This applies to all types of respondent sample sources including client supplied lists.*
3. will respect the respondent's right to withdraw or to refuse to cooperate at any stage of the study and not use any procedure or technique to coerce or imply that cooperation is obligatory. *Respondent cooperation is strictly on a voluntary basis. Respondents are entitled to withdraw from an interview at any stage or to refuse to cooperate in a research project. Interviewers should never lead respondents to believe they have no choice in their participation.*
4. will obtain and record respondent consent when it is known that the name and addresses or identity of the respondent may be passed to a third party for legal or other purposes, such as audio or video recordings; *By documenting the respondent's consent for a defined specific use of his/ her name and address we are confirming the respondent realizes we are asking something new of them, i.e., possible participation in another research project.*
5. will obtain permission and document consent of a parent, legal guardian or responsible guardian before interviewing children 12 years old or younger; *Interviewers must take special care when interviewing children or young people. The informed consent of the parent or responsible adult must first be obtained for interviews with children.*
6. will give respondents the opportunity to refuse to participate in the research when there is a possibility they may be identifiable even without the use of their name or address (e.g., because of the size of the population being sampled.) *Respondent cooperation is strictly on a voluntary basis. Respondents are entitled to withdraw from a research project. Company policies and/or interviewer instructions should state the interviewer must give respondents the opportunity to not participate for any reason.*

Interviewers ...

1. will treat the respondent with respect and not influence him or her through direct or indirect attempts, including the framing of questions, a respondent's opinion or attitudes on any issue. *Interviewers cannot ask questions in a way that leads or influences respondents' answers, nor can they provide their own opinions, thoughts or feelings that might bias a respondent and therefore impact the answers they give.*
2. will obtain and document permission of a parent, legal guardian or responsible guardian before interviewing children 12 years old or younger. Prior to obtaining permission, the interviewer should divulge the subject matter, length of interview and other special tasks that will be required. *Interviewers must take special care when interviewing children and young people. The informed consent of the parent or responsible adult must first be obtained for interviews with children. Parents or responsible adults must be told some specifics about the interview process and special tasks, such as audio or video recording, taste testing, respondent fees and special tasks, before permission is obtained.*

RESPONSIBILITIES TO CLIENTS

Data Collection Companies ...

1. will ensure that each study is conducted according to the client's specifications; *Procedures are implemented to conform or verify that client specifications are being followed.*
2. will observe confidentiality with all research techniques or methodologies and with information considered confidential or proprietary. Information will not be revealed that could be used to identify clients or respondents without proper authorization; *Respondent information will be linked to data collected only for research purposes and will not be used for any purpose other than legitimate research. Protect the confidentiality of anything learned about the respondent and/or his or her business.*
3. will ensure that companies, their employees and subcontractors involved in data collection take all reasonable precautions so that no more than one survey is conducted in one interview without explicit permission from the sponsorship company or companies; *Company policies or procedures indicate the practice of conducting more than one survey within an interview is not done without specific permission from the relevant clients.*
4. will report research results accurately and honestly; *Describe how the research was done in enough detail that a skilled researcher could repeat the study; provide data representative of a defined population or activity and enough data to yield projectable results; present the results understandably and fairly, including any results that may seem contradictory or unfavorable.*
5. will not misrepresent themselves as having qualifications, experience, skills or facilities that they do no possess; *If regularly subcontracting data collection, should not infer to clients and prospective clients that they possess this capability "in house"; claim only legitimate academic degrees, clients and other qualifications.*
6. will refrain from referring to membership in the Marketing Research Association as proof of competence, since the Association does not certify any person's or organization's competency or skill level. *MRA does not currently have a certification program for marketing research competency, therefore while members can state their membership in the Association, they cannot claim that this automatically conveys a message of their competency to carry out the marketing research process.*

RESPONSIBILITIES TO DATA COLLECTORS

Clients ...

1. will be responsible for providing products and services that are safe and fit for their intended use and disclose/label all product contents; *It is the client's responsibility to ensure that all test products are in compliance with all safety standards and that all product contents information is provided to the data collectors. Data Collectors should request in writing all pertinent information as well as emergency numbers for respondents and themselves.*
2. will provide oral or written instructions; *To ensure the success of the research, detailed instructions are to be provided prior to the start of any project. These instructions must be written and then confirmed orally for: understanding, ability of the agency to implement and agreement to comply.*
3. will not ask our members who subcontract research to engage in any activity that is not acceptable as defined in this Code or that is prohibited under any applicable federal, state and local laws, regulations and ordinances. *All MRA Members have agreed to comply with the Code as written and thus will not agree to, or ask anyone else to, knowingly violate any of the points of the Code.*

RESPONSIBILITIES TO THE GENERAL PUBLIC AND BUSINESS COMMUNITY

Data Collection Companies ...

1. will not intentionally abuse public confidence in marketing and opinion research; *Marketing research shall be conducted and reported for the sole purpose of providing factual information upon which decisions will be made. At no time is marketing research information to be used to intentionally mislead public opinion. Instances of abuse of public confidence undermine the credibility of our Industry.*
2. will not represent a non-research activity to be marketing and opinion research, such as:
    - questions whose sole objective is to obtain personal information about respondents, whether for legal, political, private or other purposes,
    - the compilation of lists, registers or data banks of names and addresses for any non-research purposes (e.g., canvassing or fundraising),
    - industrial, commercial or any other form of espionage,
    - the acquisition of information for use by credit rating services or similar organizations,
    - sales or promotional approaches to the respondent,

APPENDIX G

Traffic Management

APPENDIX G: TRAFFIC MANAGEMENT

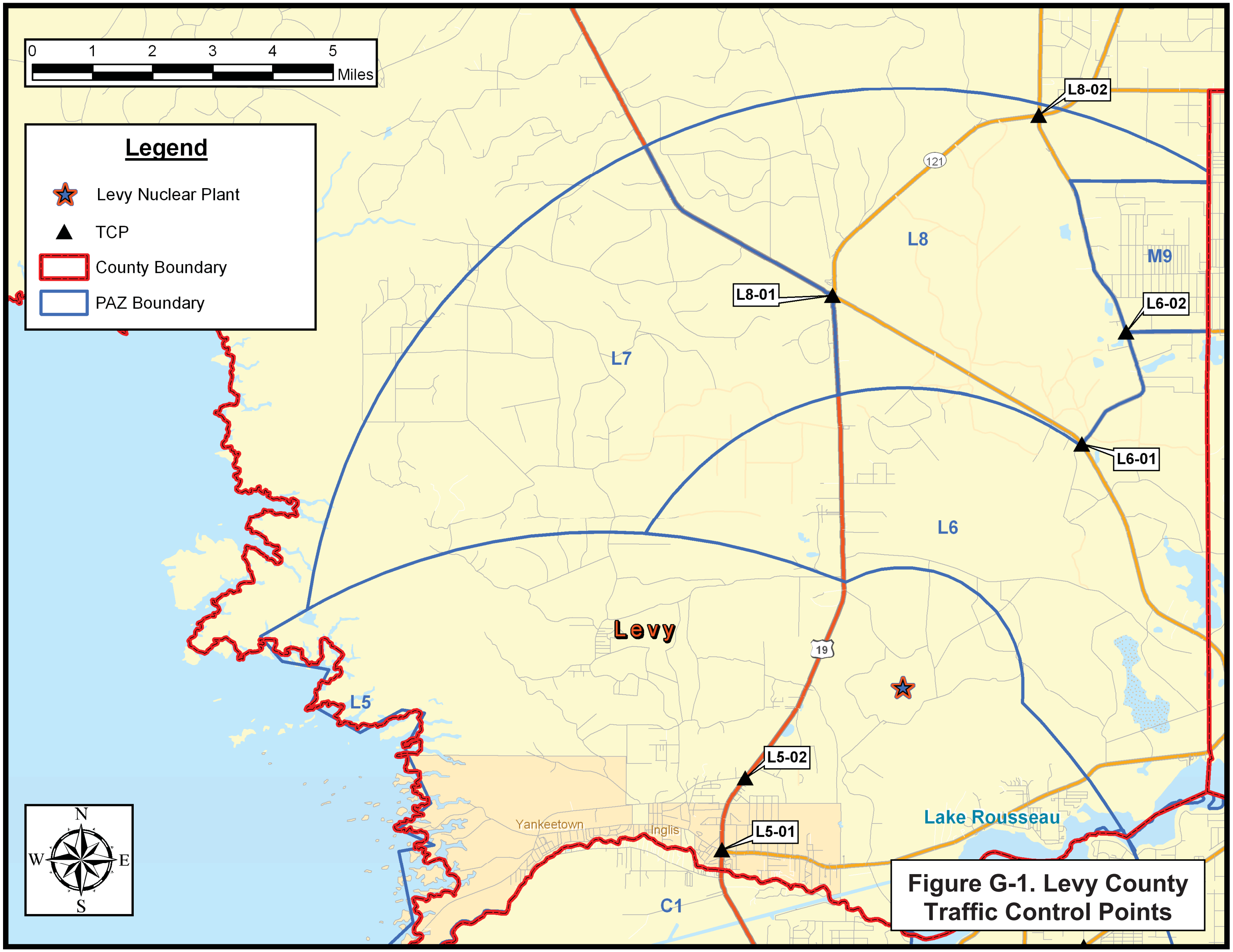
This appendix presents suggested traffic control measures to facilitate the evacuation of the Levy Nuclear Plant EPZ. Pages G-2 through G-35 detail Traffic Control Points (TCP), which are typically intersections within the EPZ; these points are established to facilitate the flow of evacuee traffic from within the EPZ. Table G-1 summarizes the TCP and the manpower and equipment needed to implement traffic control. Figures G-1 through G-3 provide detailed mapping of the location of each traffic control point by county.

Pages G-36 through G-50 detail the Access Control Points (ACP), which are typically on the periphery of the EPZ; these points are established to divert vehicles from entering the EPZ. Doing so provides all of the available roadway capacity within the EPZ to the evacuees. Table G-2 summarizes the ACP and the manpower and equipment needs to establish access control, while Figure G-4 provides a detailed map of the location of each ACP.

This traffic management plan was reviewed with the state and local police who voiced concern over manpower and equipment shortages. As such, prioritization of TCP and ACP was established to make the most efficient use of manpower and equipment in the event of an emergency. The use of ITS technologies, as outlined in Section 9, will also aid in overcoming manpower shortages.

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.

Table G-1. Traffic Control Points						
Priority	PAZ	ID#	Town	Intersection Location	# of Guides	# of Cones
CITRUS COUNTY						
1	C4	C4-01	Citrus Springs	USHY 41 & W Dunnellon Rd	2	6
1	N/A	Q2-08	Holder	USHY 41 & N Lecanto Hwy	1	12
2	C1	C1-01	Crystal River	USHY 19/USHY 98 & N Basswood Ave	1	12
2	C1	C1-02	Crystal River	USHY 98/USHY 19 & W Dunnellon Rd	1	12
2	C1	C1-03	Crystal River	USHY 19/USHY 98 & W Power Line Rd	2	9
2	C3	C3-01	Crystal River	Dunnellon Rd & N Citrus Ave	1	6
2	C3	C3-02	Crystal River	W Dunklin St & N Citrus Ave	1	3
2	C4	C4-03	Citrus Springs	N Citrus Springs Blvd & N Elkcam Blvd	1	6
2	C4	C4-07	Citrus Springs	W Citrus Springs Blvd & N Elkcam Blvd	1	6
3	C4	C4-02	Citrus Springs	N Florida Ave & W Withlacoochee Trail	1	6
3	C4	C4-04	Citrus Springs	N Elkcam Blvd & N Golfview Dr & N Gilovu Dr	1	6
3	C4	C4-05	Citrus Springs	N Elkcam Blvd & W Century Blvd	1	6
3	C4	C4-06	Citrus Springs	N Citrus Springs Blvd & W Dunklin St	1	6
Total Manpower & Equipment for Citrus County					15	96
LEVY COUNTY						
2	L5	L5-01	Inglis	USHY 19/USHY 98 & STHY 40	2	12
2	L5	L5-02	Inglis	USHY 19/USHY 98 & County Rd 40A	2	9
2	L8	L8-01	Inglis	USHY 19/USHY 98 & STHY 336 & STHY 121	2	12
3	L6	L6-01	Tidewater	CR 336 & CR 337	1	9
3	L6	L6-02	Inglis	STHY 337 & 120th St	1	3
3	L8	L8-02	Inglis	STHY 121 & STHY 337	1	6
Total Manpower & Equipment for Levy County					9	51
MARION COUNTY						
1	M9	M9-02	Dunnellon	USHY 41 & STHY 40 Westbound	2	18
1	M9	M9-09	Dunnellon	USHY 41 & STHY 40 Eastbound	2	12
1	M9	M9-11	Dunnellon	USHY 41 & Rainbow Lakes Blvd	2	6
2	M9	M9-03	Dunnellon	USHY 41 & Powell Rd	2	12
2	M9	M9-04	Dunnellon	USHY 41 & Brooks St	2	12
2	M9	M9-05	Dunnellon	USHY 41 & Wal-Mart Entrance	1	6
2	M9	M9-07	Dunnellon	USHY 41 & SW 99th Pl	1	9
3	M9	M9-01	Dunnellon	STHY 40 & CR 336	2	9
3	M9	M9-06	Dunnellon	USHY 41 & 102nd St	1	12
3	M9	M9-08	Dunnellon	USHY 41 & SW 88th Place Rd	1	12
3	M9	M9-10	Dunnellon	USHY 41 & SW 36th St	1	6
Total Manpower & Equipment for Marion County					17	114
Total Manpower & Equipment for EPZ					41	261


0 1 2 3 4 5
Miles
Legend
Levy Nuclear Plant
TCP
County Boundary
PAZ Boundary
L8-02
L8-01
L6-02
L6-01
L5-02
L5-01
121
19
L8
L7
L6
L5
M9
C1
Levy
Yankeetown
Inglis
Lake Rousseau
N
W
E
S
Figure G-1. Levy County
Traffic Control Points

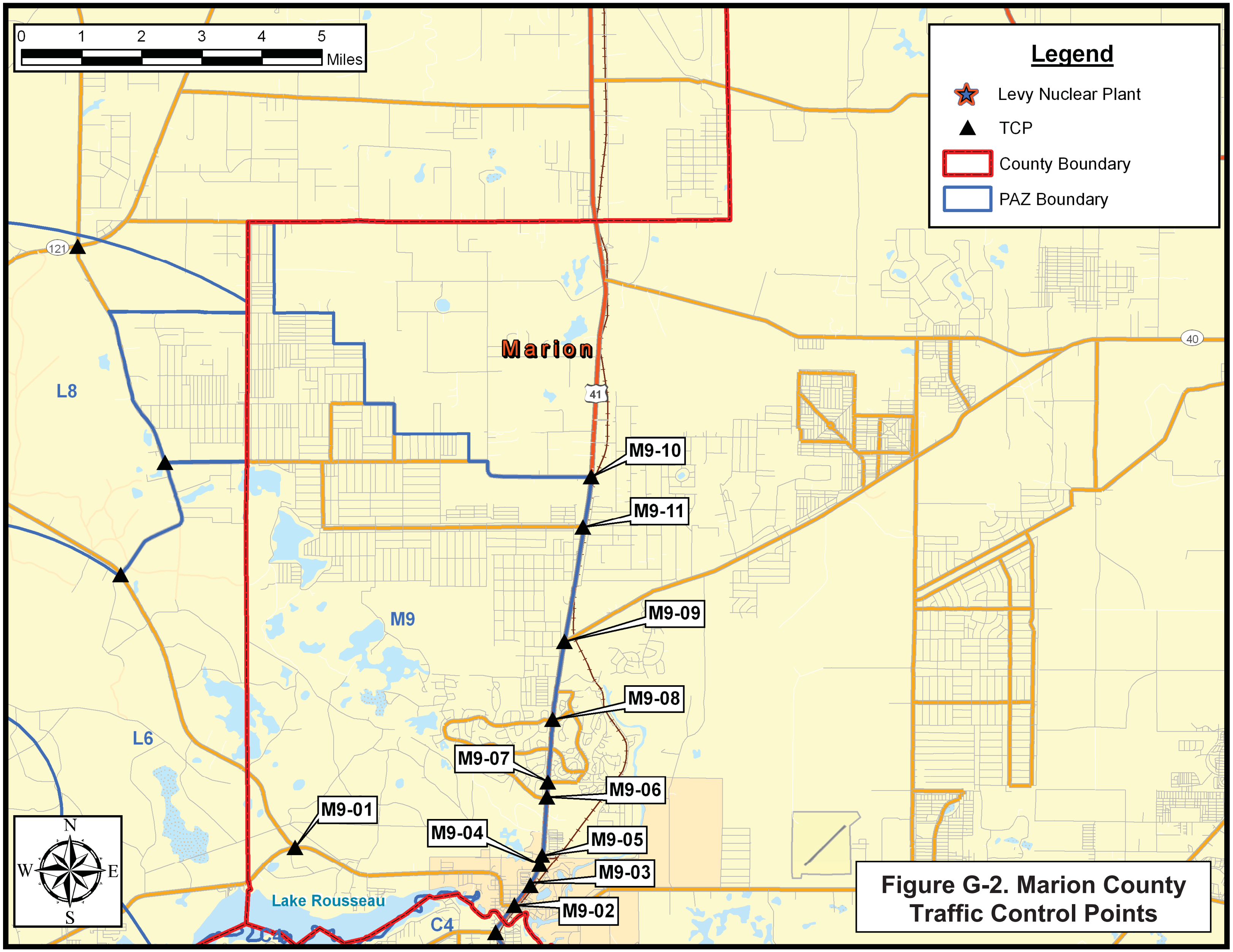


Figure G-2. Marion County Traffic Control Points

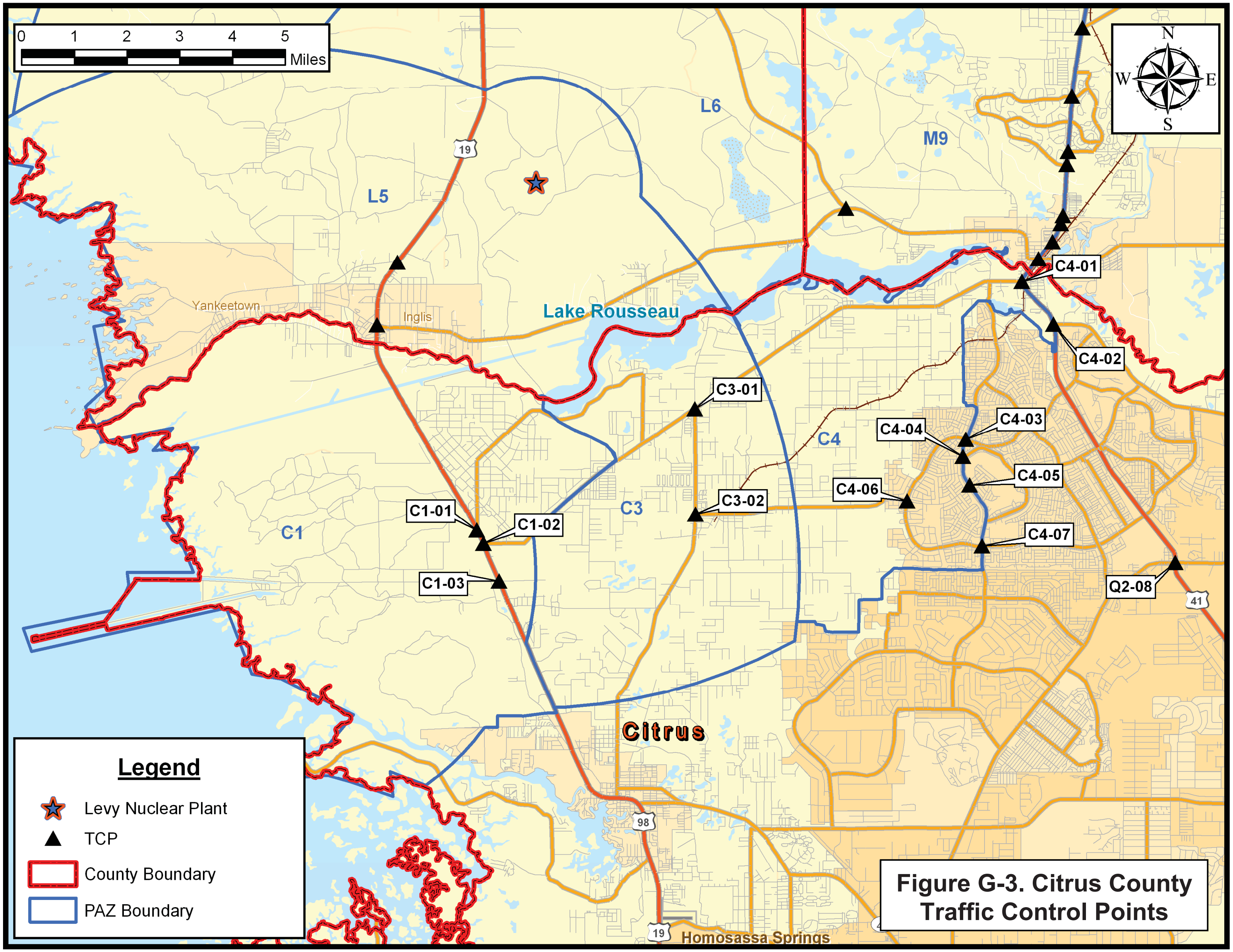


Figure G-3. Citrus County Traffic Control Points

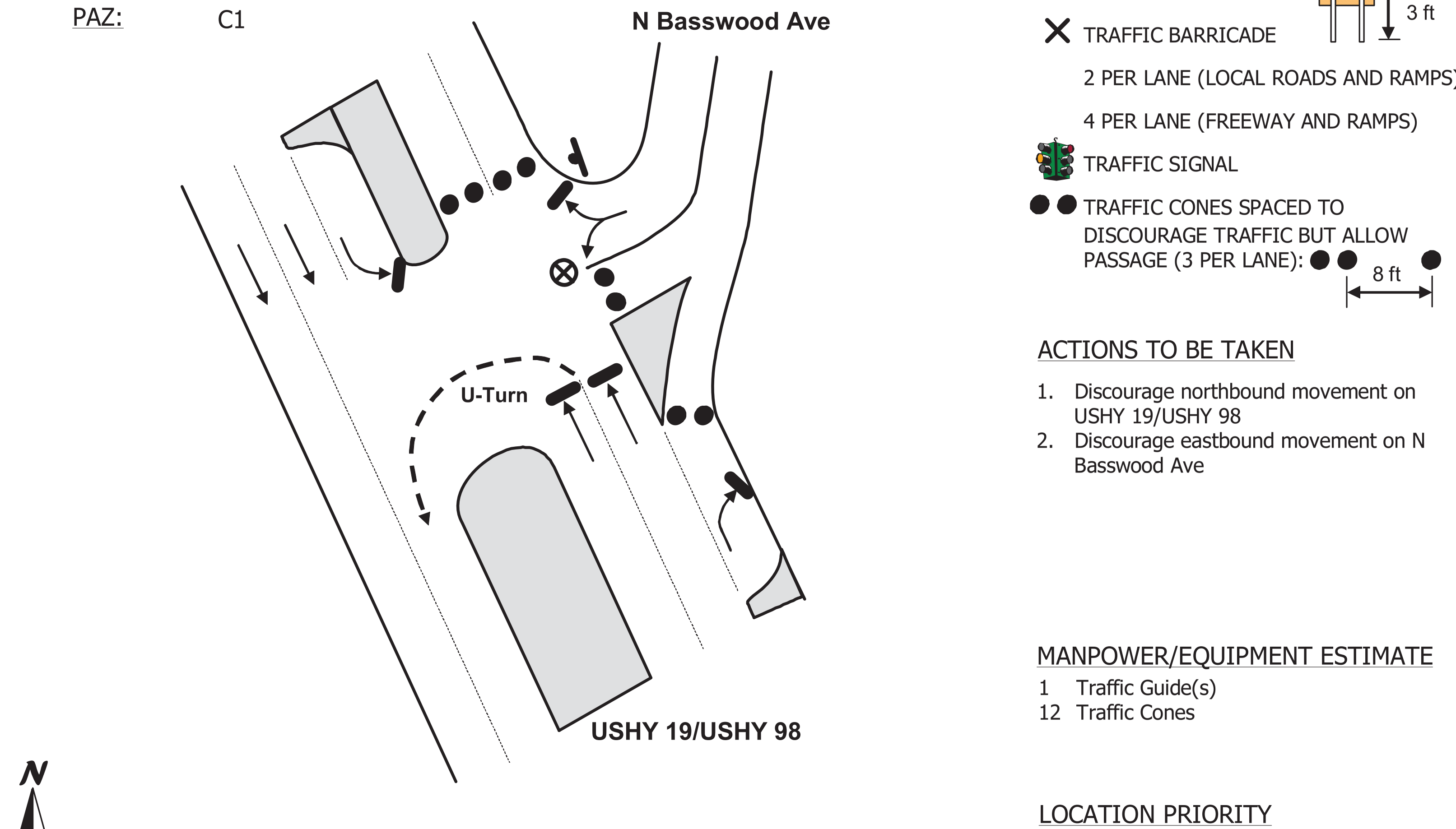
TCP

TOWN: CRYSTAL RIVER

LOCATION: USHY 19/USHY 98 & N Basswood Ave

TCP ID: C1-01

PAZ: C1



****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 northbound movement on USHY 19/USHY 98
2. Discourage eastbound movement on N Basswood Ave

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
12 Traffic Cones

LOCATION PRIORITY

2

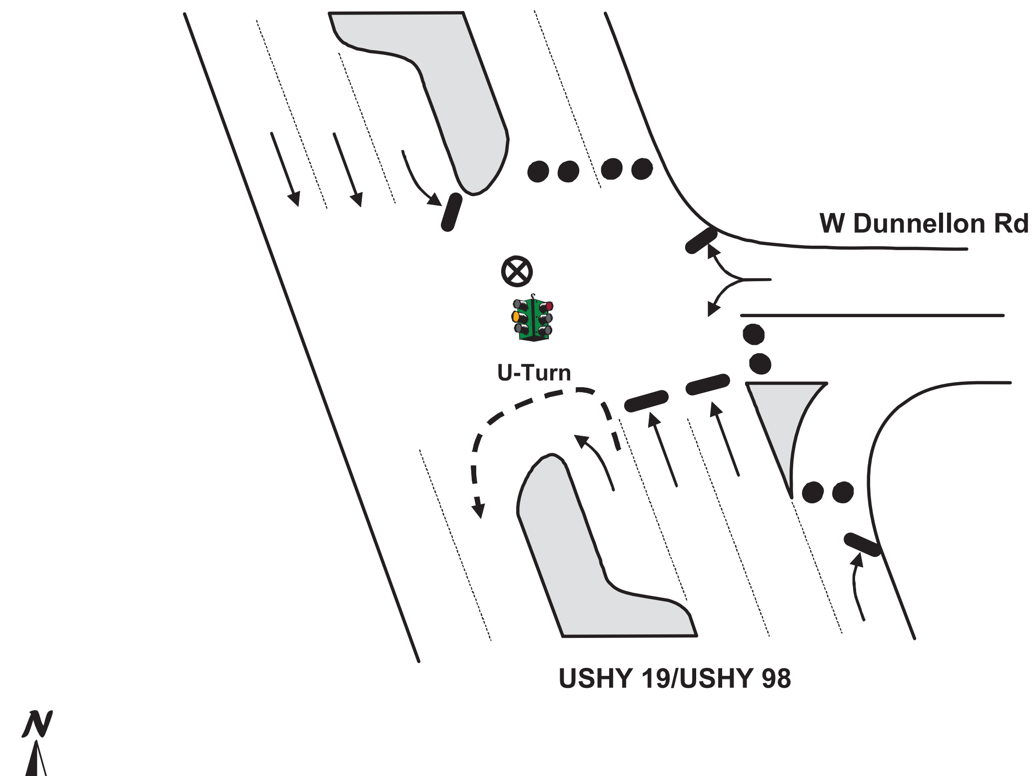
TCP

TOWN: CRYSTAL RIVER

LOCATION: USHY 98/USHY 19 & W DUNNELLON RD

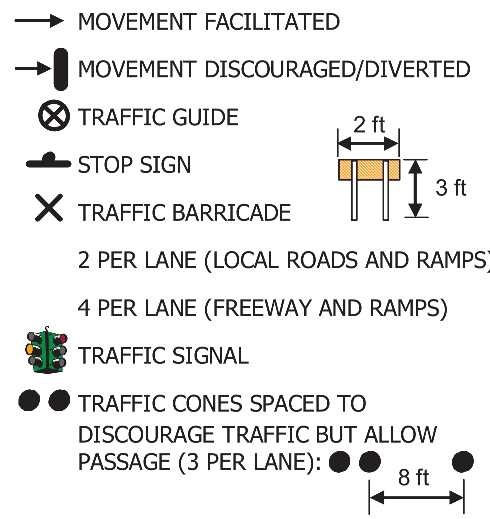
TCP ID: C1-02

PAZ: C1



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

KEY



ACTIONS TO BE TAKEN

1. Discourage northbound movement on USHY 19/USHY 98
2. Discourage eastbound movement on W Dunnellon Rd

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
12 Traffic Cones

LOCATION PRIORITY

2

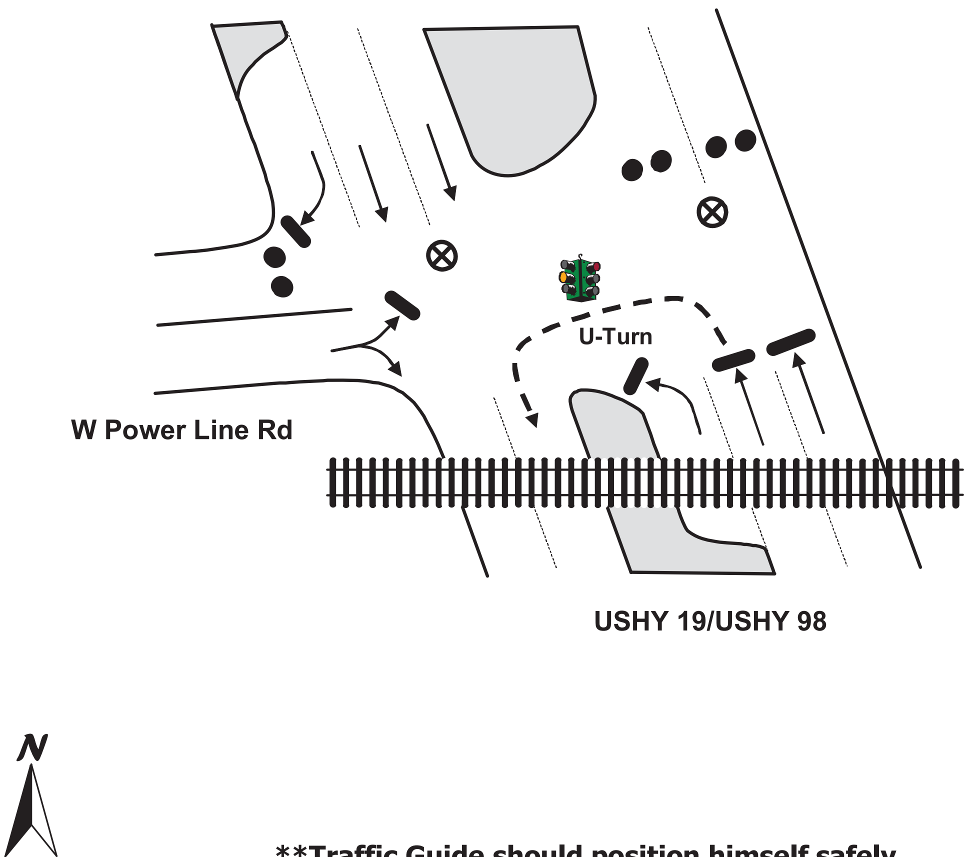
TCP

TOWN: CRYSTAL RIVER

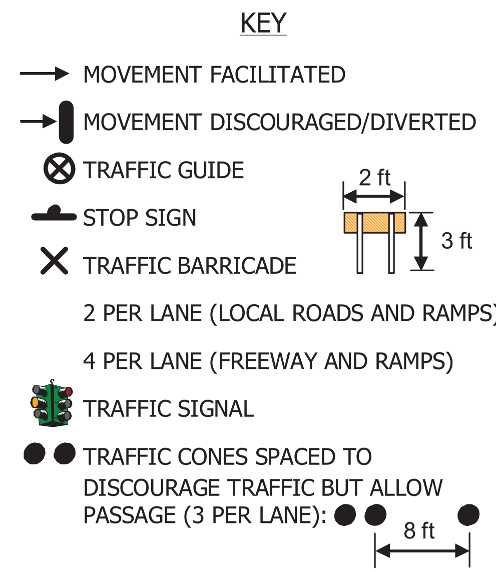
LOCATION: USHY 19/USHY 98 & W Power Line Rd

TCP ID: C1-03

PAZ: C1



**Traffic Guide should position himself safely



ACTIONS TO BE TAKEN

1. Discourage northbound movement on USHY 19/USHY 98
2. Discourage westbound movement on W Power Line Rd

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
9 Traffic Cones

LOCATION PRIORITY

2

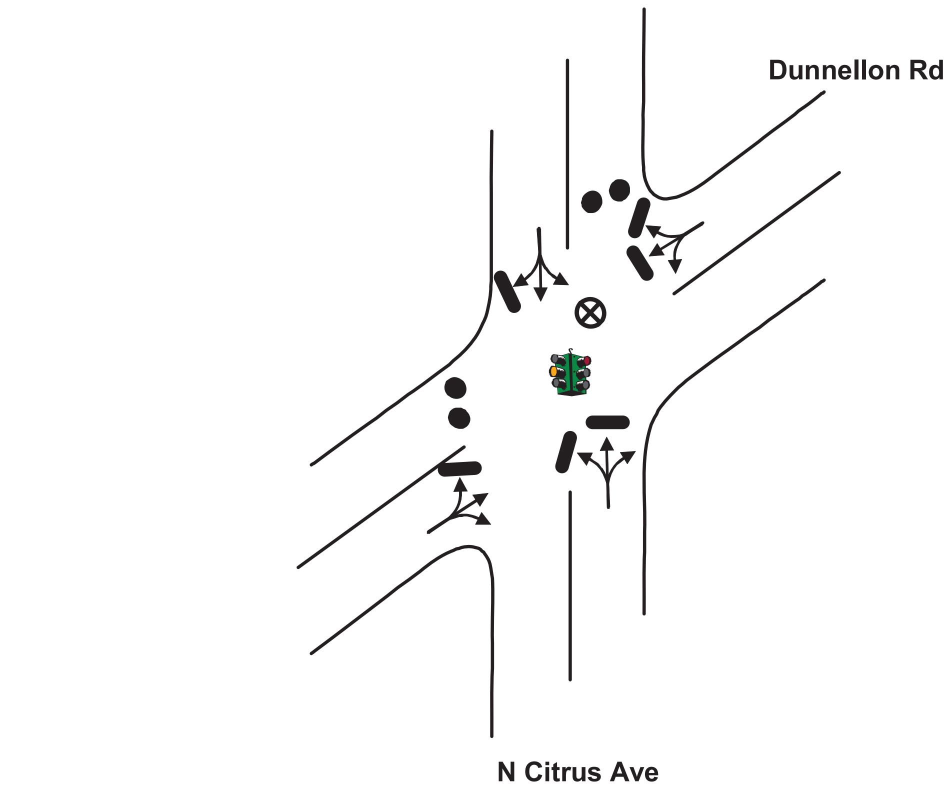
TCP

TOWN: CRYSTAL RIVER

LOCATION: Dunnellon Rd & N Citrus Ave

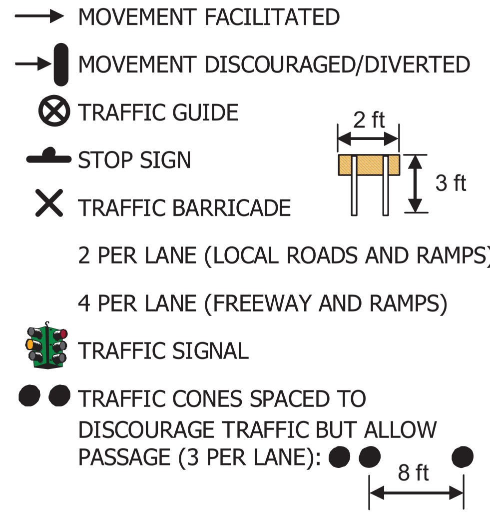
TCP ID: C3-01

PAZ: C3



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

KEY



ACTIONS TO BE TAKEN

1. Discourage westbound movement on Dunnellon Rd
2. Discourage northbound movement on N Citrus Ave

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

2

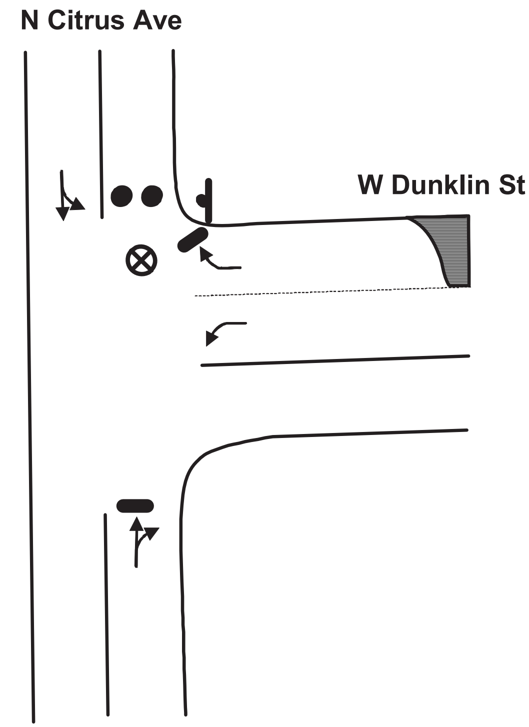
TCP

TOWN: CRYSTAL RIVER

LOCATION: W Dunklin St & N Citrus Ave

TCP ID: C3-02

PAZ: C3



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 northbound movement on N Citrus Ave

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
3 Traffic Cones

LOCATION PRIORITY

2

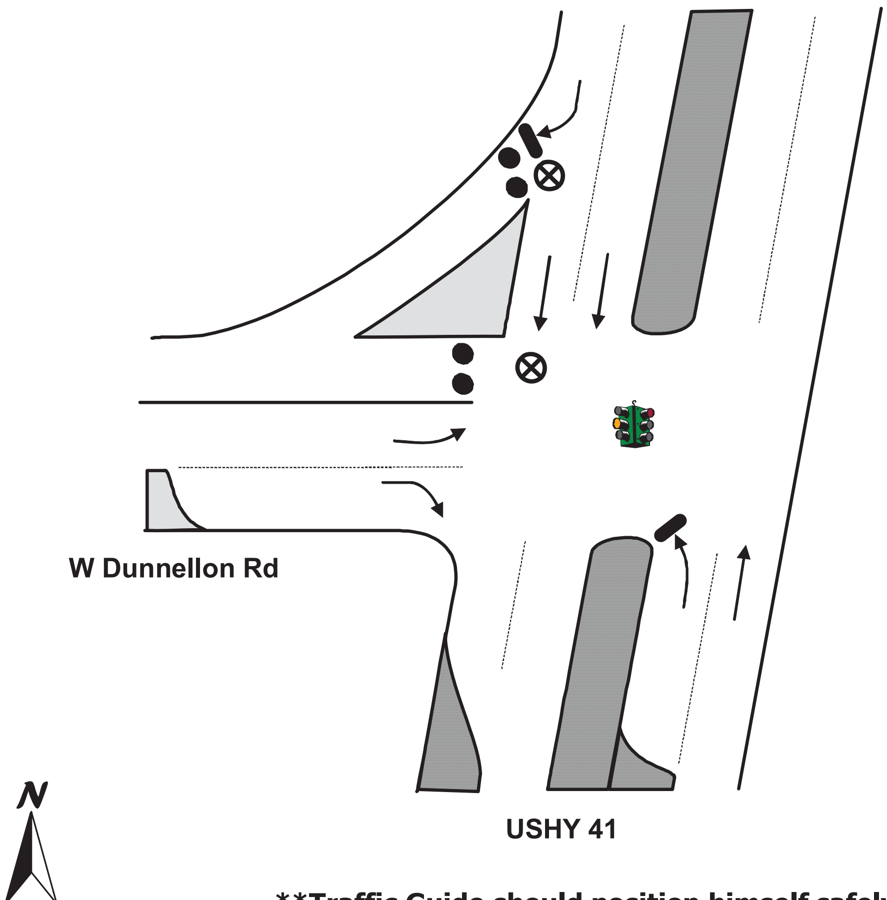
TCP

TOWN: CITRUS SPRINGS

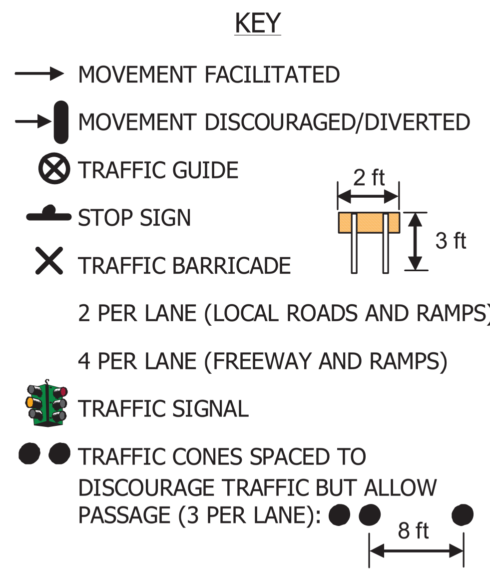
LOCATION: USHY 41 & W Dunnellon Rd

TCP ID: C4-01

PAZ: C4



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



ACTIONS TO BE TAKEN

1. Discourage westbound movement on W Dunnellon Rd

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

1

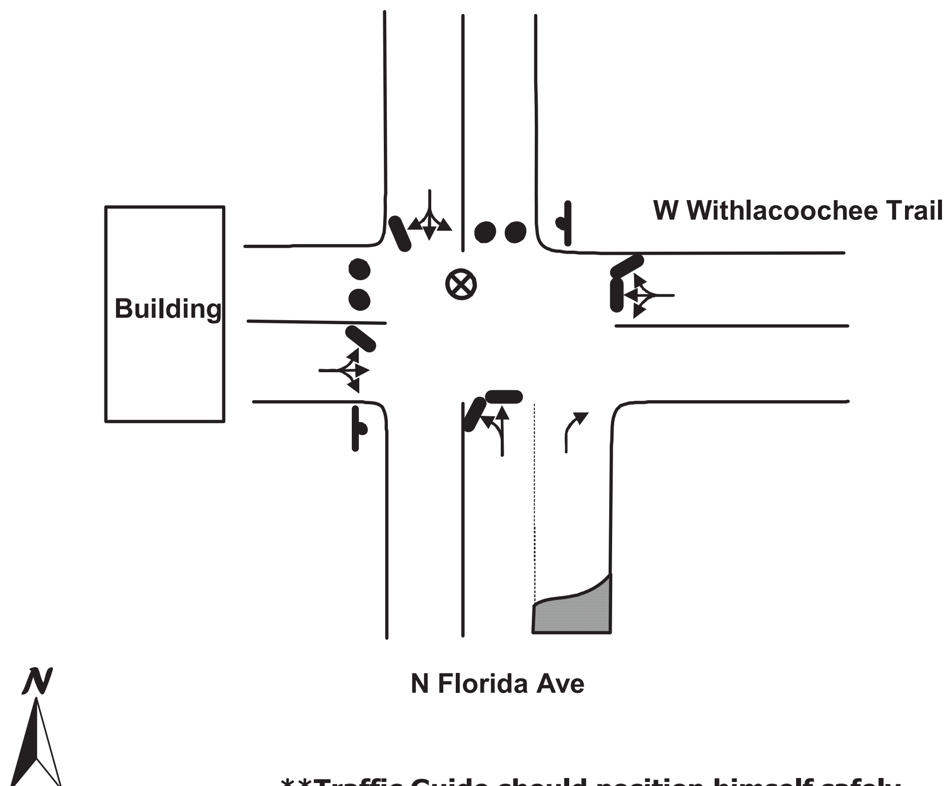
TCP

TOWN: CITRUS SPRINGS

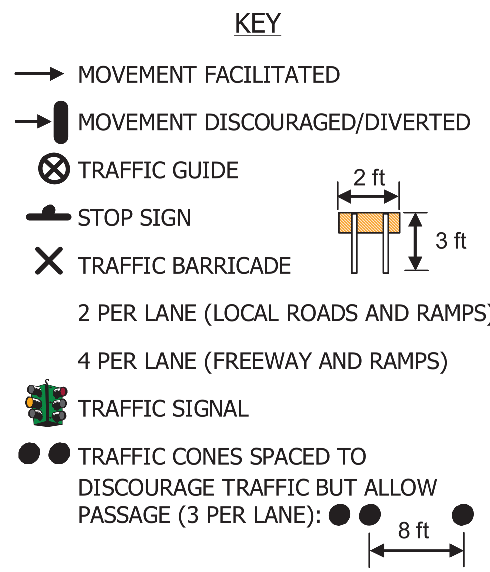
LOCATION: N Florida Ave & W Withlacoochee Trail

TCP ID: C4-02

PAZ: C4



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



ACTIONS TO BE TAKEN

1. Discourage northbound movement on N Florida Ave

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

3

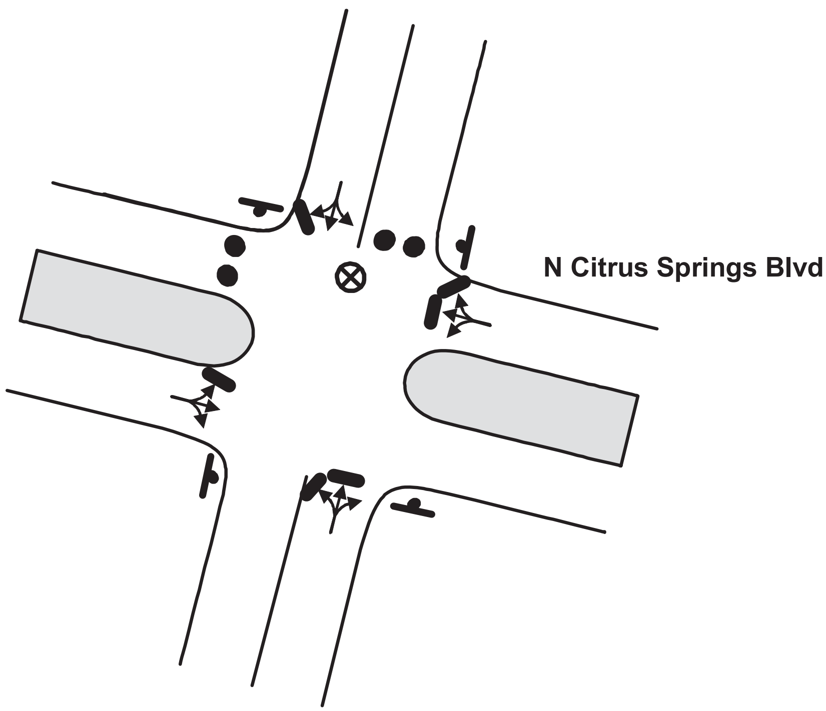
TCP

TOWN: CITRUS SPRINGS

LOCATION: N Citrus Springs Blvd & N Elkcam Blvd

TCP ID: C4-03

PAZ: C4



****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 northbound movement on N Elkcam Blvd
2. Discourage westbound movement on N Citrus Springs Blvd

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

2

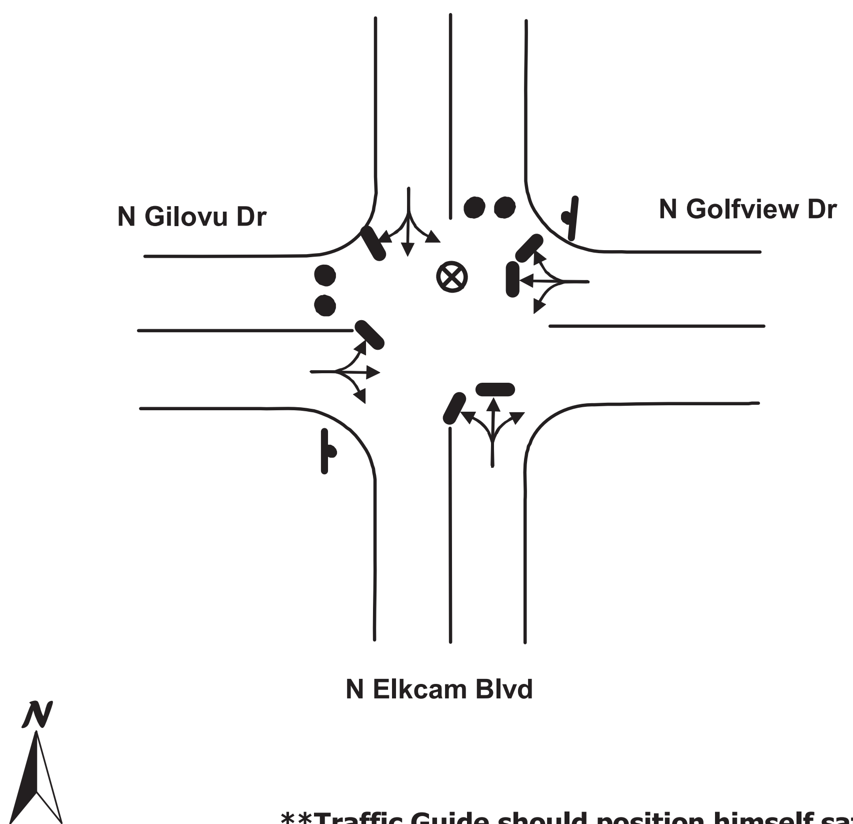
TCP

TOWN: CITRUS SPRINGS

LOCATION: N Elkcam Blvd & N Golfview Dr & N Gilovu Dr

TCP ID: C4-04

PAZ: C4



****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 northbound movement on N Elkcam Blvd
2. Discourage westbound movement on N Gilovu Dr

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

3

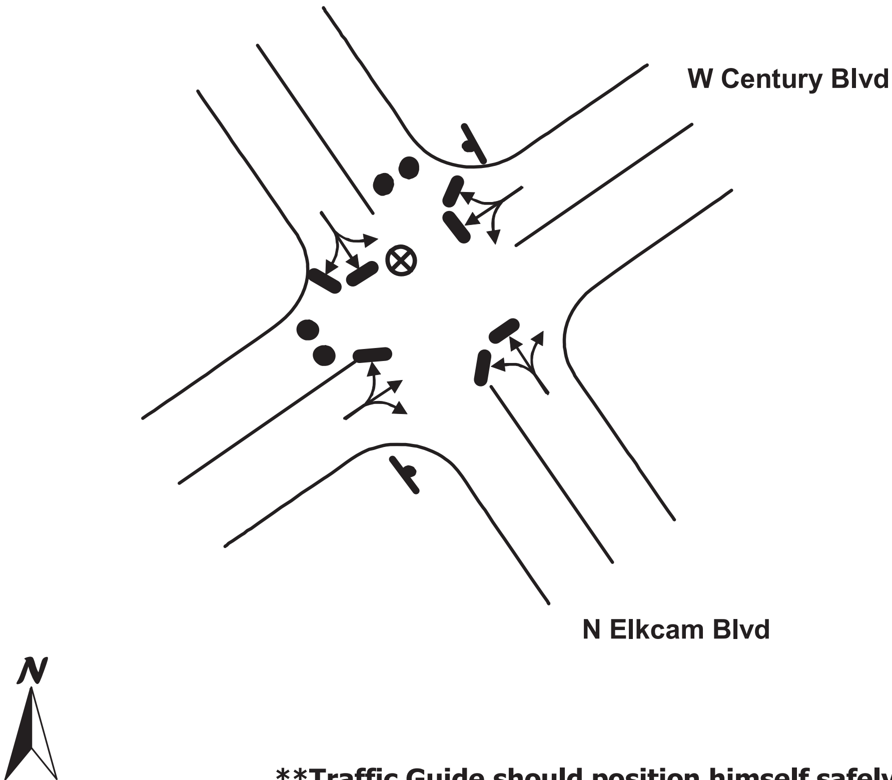
TCP

TOWN: CITRUS SRPINGS

LOCATION: N Elkcam Blvd & W Century Blvd

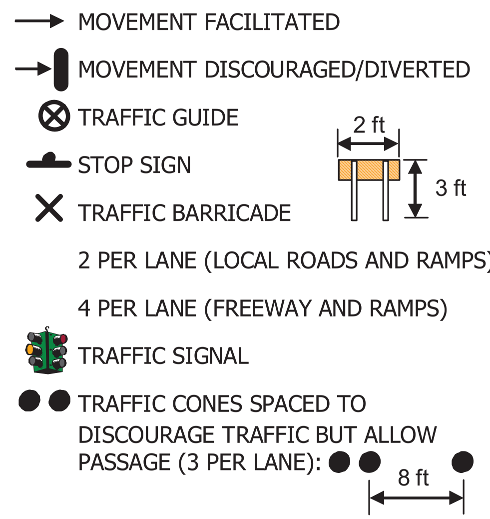
TCP ID: C4-05

PAZ: C4



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

KEY



ACTIONS TO BE TAKEN

1. Discourage northbound movement on N Elkcam Blvd
2. Discourage westbound movement on W Century Blvd

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

3

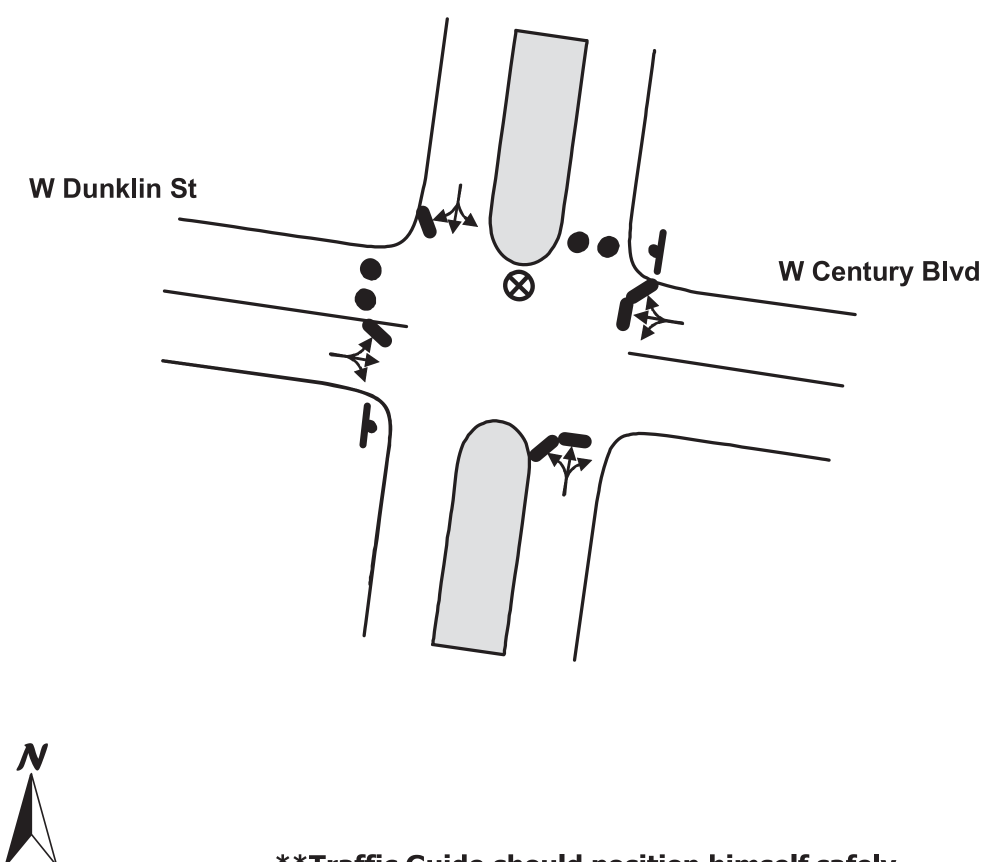
TCP

TOWN: CITRUS SPRINGS

LOCATION: N Citrus Springs Blvd & W Century Blvd & W Dunklin St

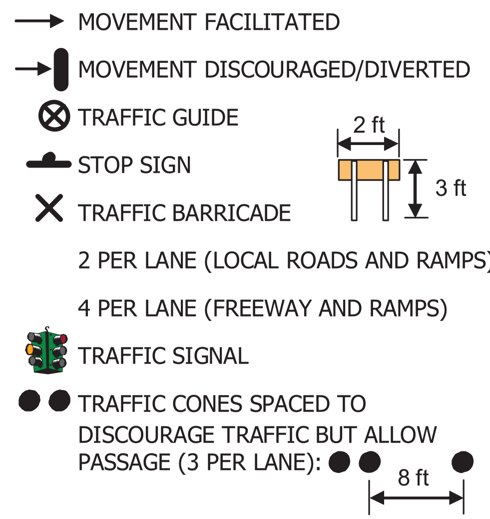
TCP ID: C4-06

PAZ: C4



Traffic Guide should position himself safely

KEY



ACTIONS TO BE TAKEN

1. Discourage northbound movement on N Citrus Springs Blvd
2. Discourage westbound movement on W Dunklin St

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

3

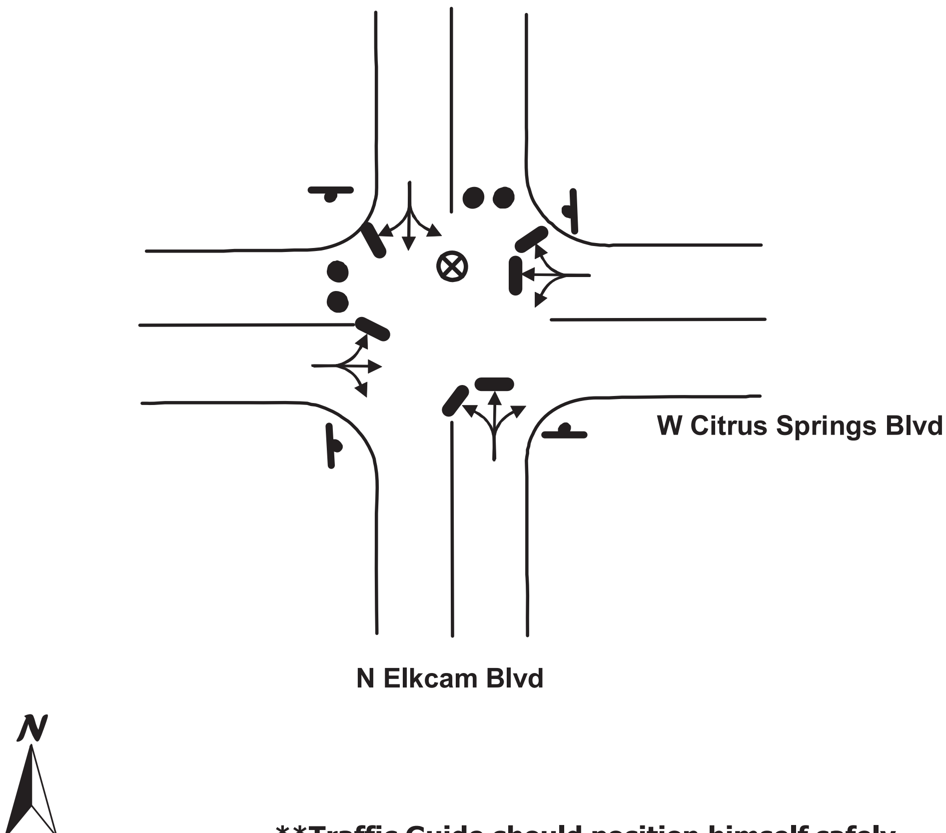
TCP

TOWN: CITRUS SPRINGS

LOCATION: W Citrus Springs Blvd & N Elkcam Blvd

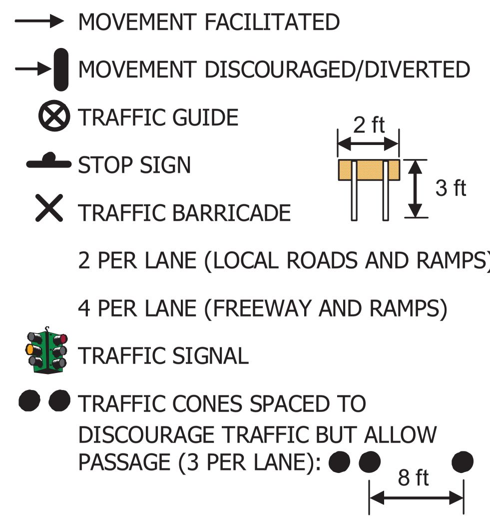
TCP ID: C4-07

PAZ: C4



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

KEY



ACTIONS TO BE TAKEN

1. Discourage northbound movement on N Elkcam Blvd
2. Discourage westbound movement on W Citrus Springs Blvd

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

2

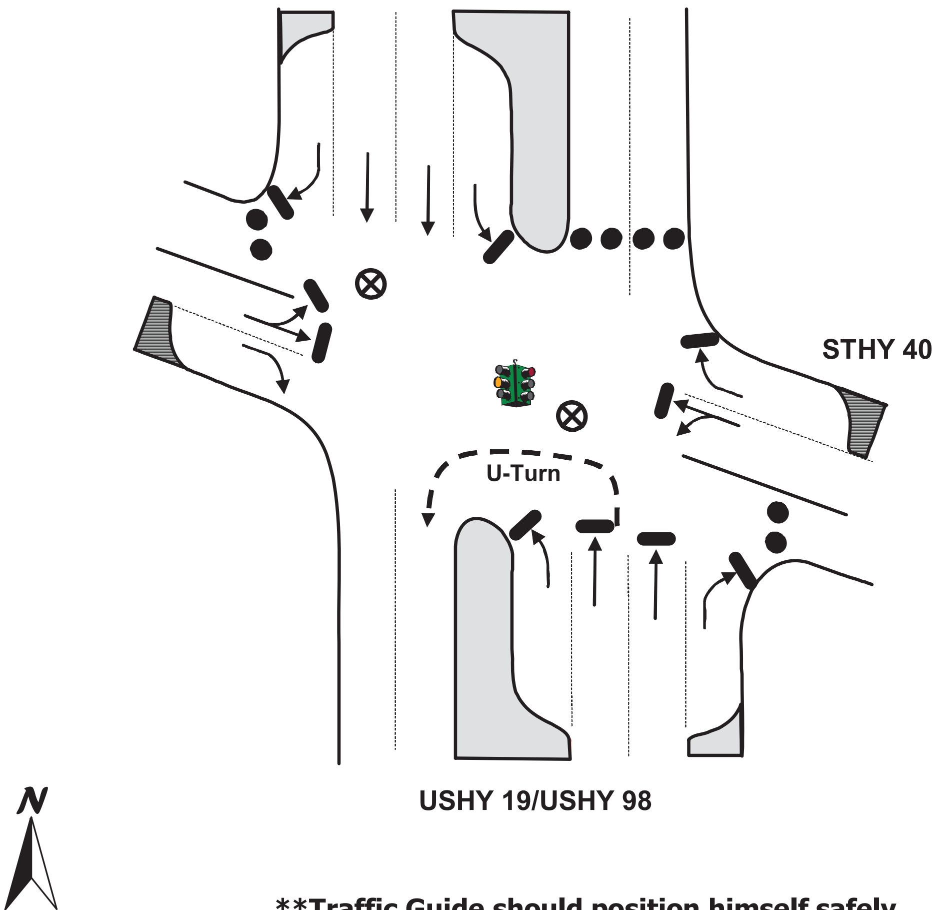
TCP

TOWN: INGLIS

LOCATION: USHY 19/USHY 98 & STHY 40

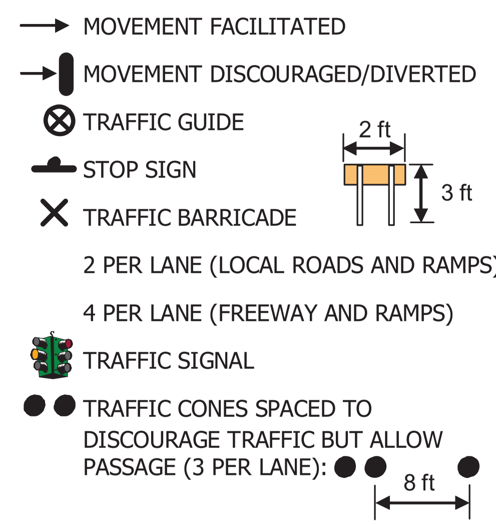
TCP ID: L5-01

PAZ: L5



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

KEY



ACTIONS TO BE TAKEN

1. Discourage northbound movement on USHY 19/USHY 98
2. Discourage eastbound and westbound movements on STHY 40

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
12 Traffic Cones

LOCATION PRIORITY

2

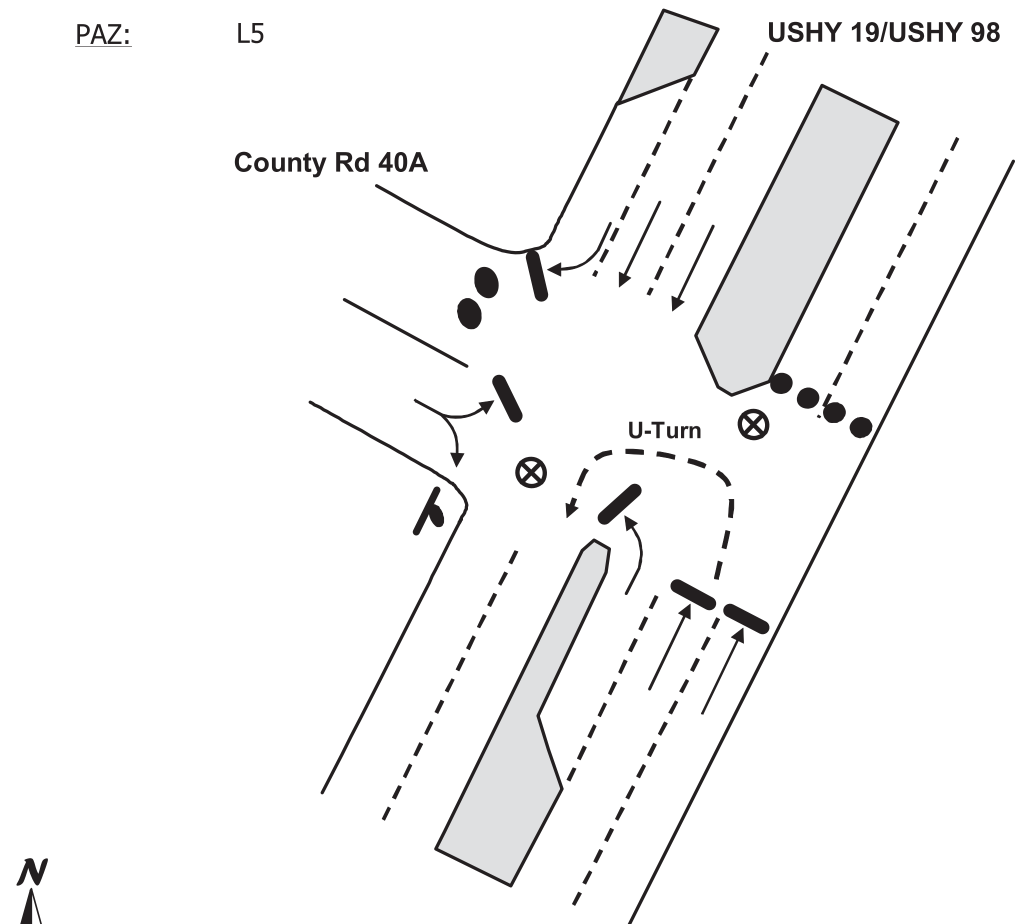
TCP

TOWN: INGLIS

LOCATION: USHY 19/USHY 98 & County Rd 40A

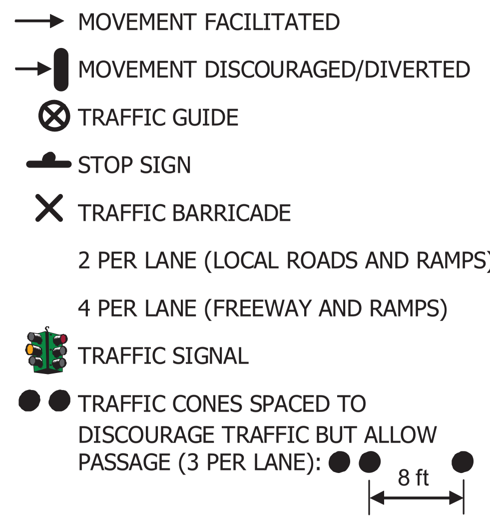
TCP ID: L5-02

PAZ: L5



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

KEY



ACTIONS TO BE TAKEN

1. Discourage northbound movement on USHY 19/USHY 98
2. Discourage westbound movement on County Rd 40A

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
9 Traffic Cones

LOCATION PRIORITY

2

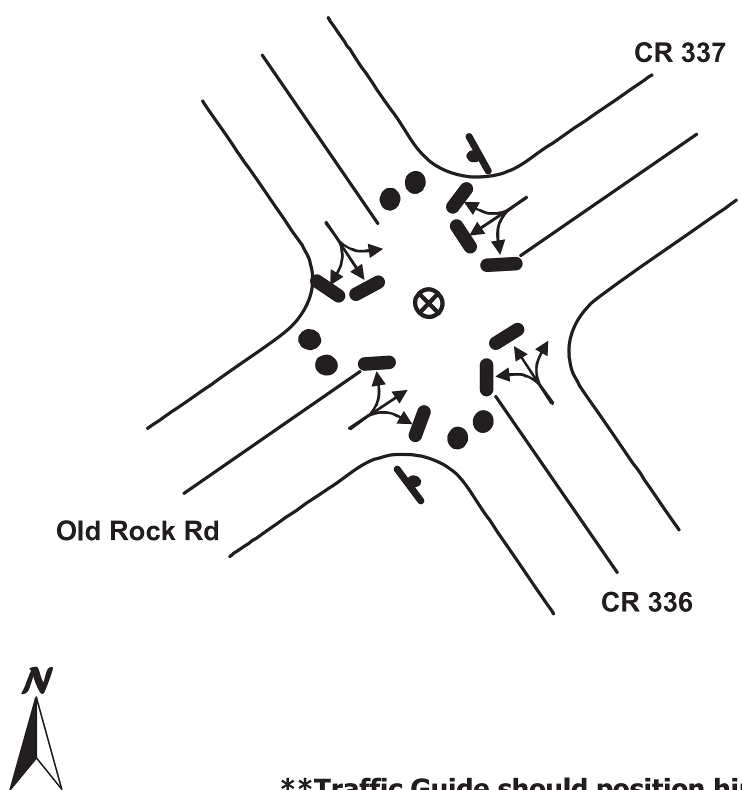
TCP

TOWN: TIDEWATER

LOCATION: CR 336 & CR 337

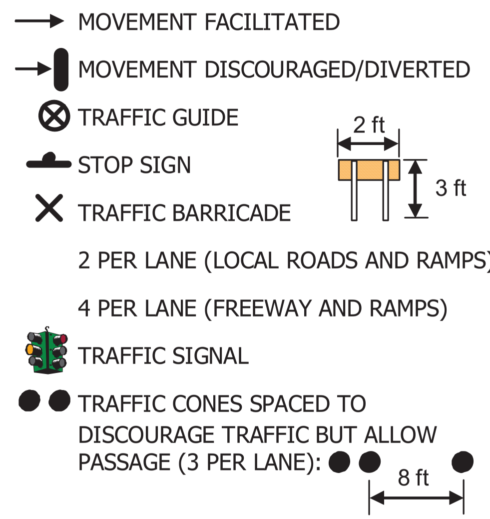
TCP ID: L6-01

PAZ: L6



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

KEY



ACTIONS TO BE TAKEN

1. Discourage northbound and southbound movements on CR 336
2. Discourage southbound movement on Old Rock Rd

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
9 Traffic Cones

LOCATION PRIORITY

3

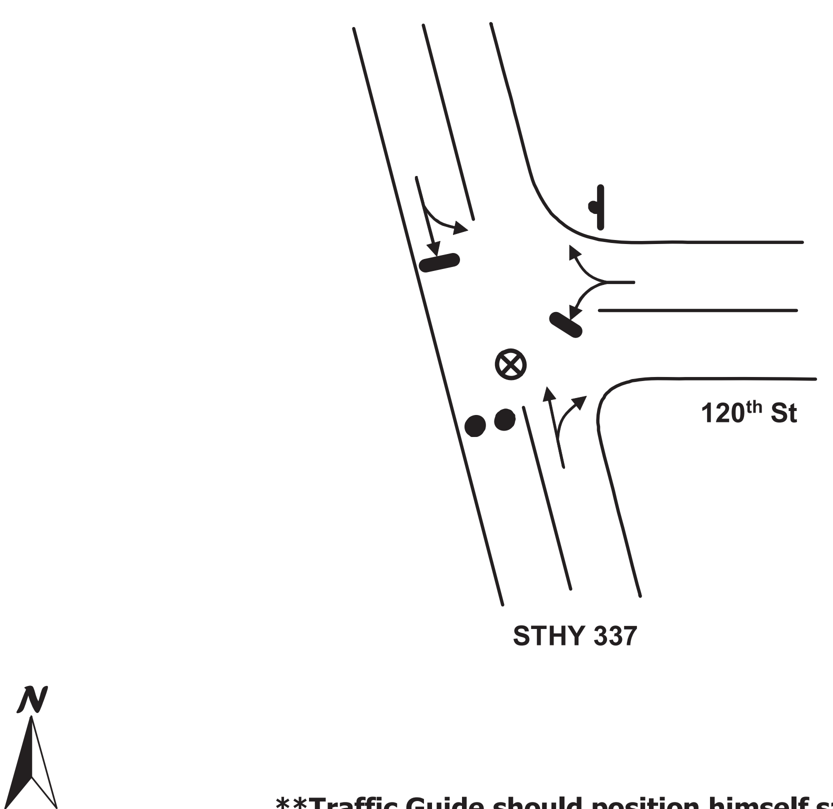
TCP

TOWN: INGLIS

LOCATION: STHY 337 & 120TH St

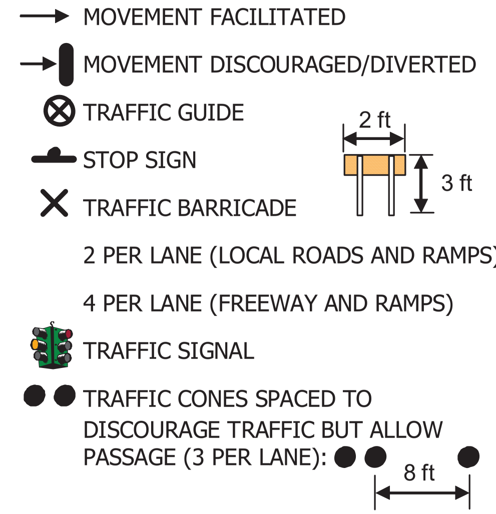
TCP ID: L6-02

PAZ: L6



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

KEY



ACTIONS TO BE TAKEN

1. Discourage southbound movement on STHY 337

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
3 Traffic Cones

LOCATION PRIORITY

3

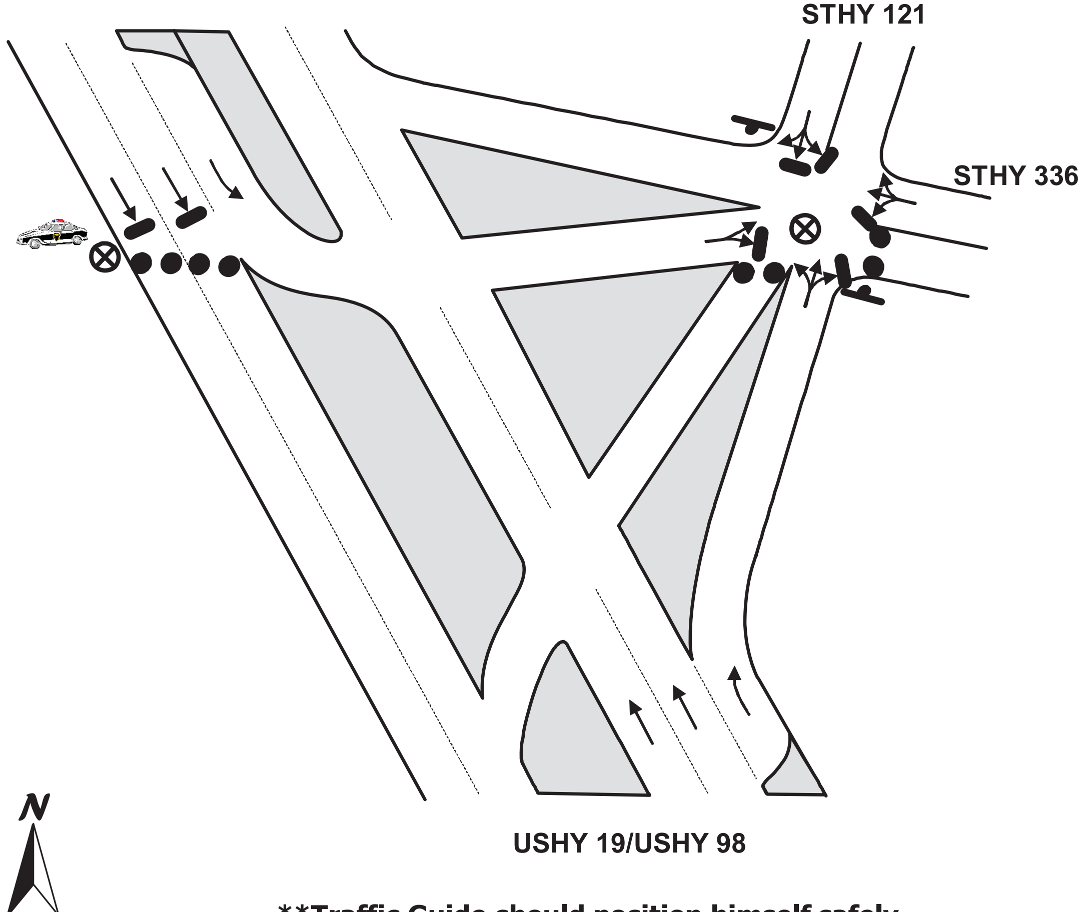
TCP

TOWN: INGLIS

LOCATION: USHY 19/USHY 98 & STHY 336 & STHY 121

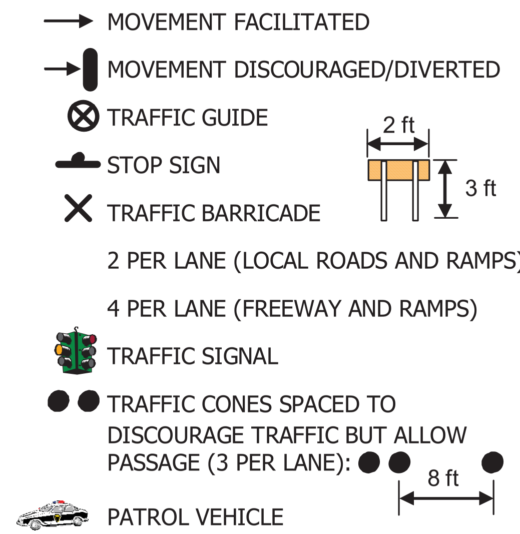
TCP ID: L8-01

PAZ: L8



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

KEY



ACTIONS TO BE TAKEN

1. Discourage southbound movement on USHY 19/USHY 98
2. Discourage eastbound movement on STHY 336
3. Park patrol vehicle on shoulder with lights flashing

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
12 Traffic Cones
1 Patrol Vehicle

LOCATION PRIORITY

2

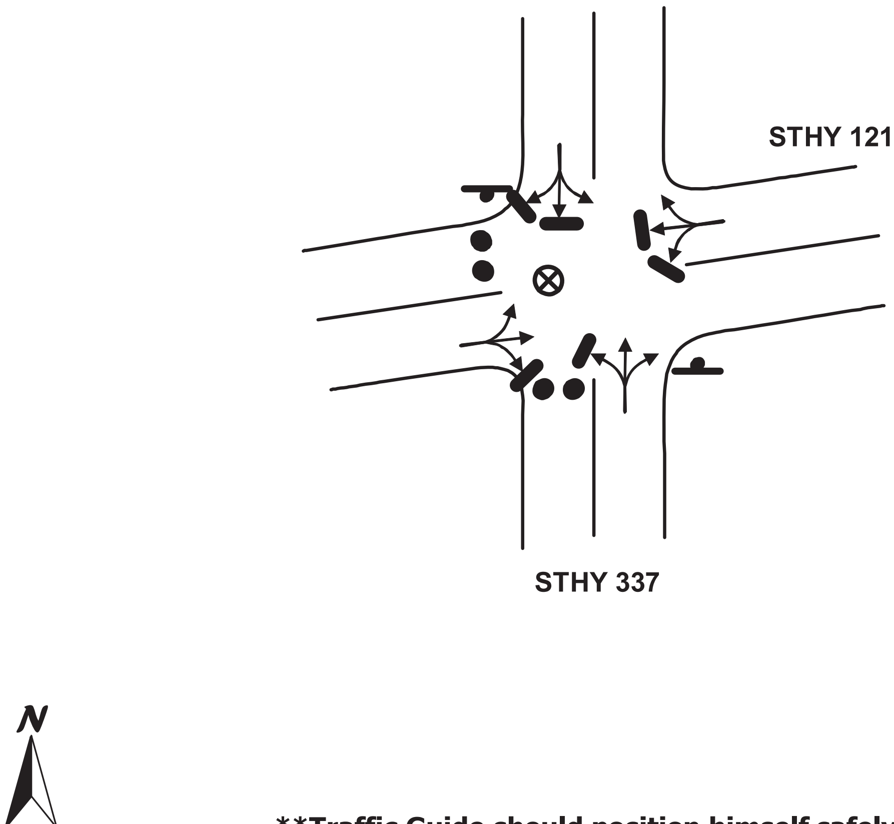
TCP

TOWN: INGLIS

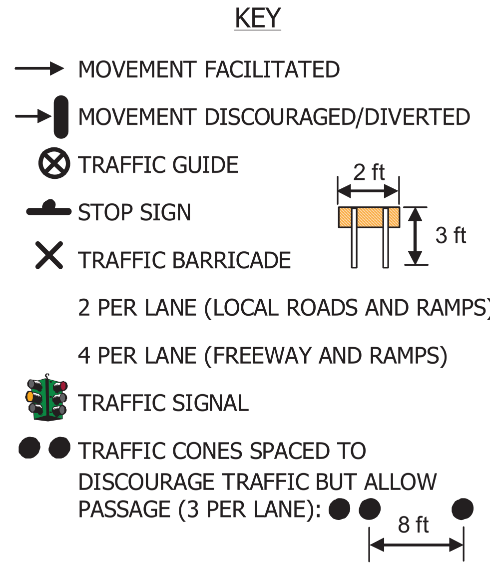
LOCATION: STHY 121 & STHY 337

TCP ID: L8-02

PAZ: L8



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



ACTIONS TO BE TAKEN

1. Discourage westbound movement on STHY 121
2. Discourage southbound movement on STHY 337

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

3

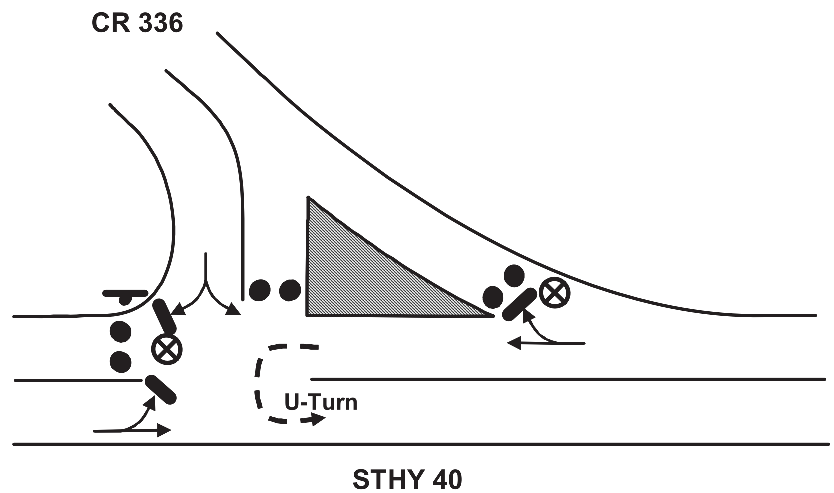
TCP

TOWN: DUNNELLON

LOCATION: STHY 40 & CR 336

TCP ID: M9-01

PAZ: M9



****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 westbound movement on CR 336
2. Discourage westbound movement on STHY 40

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
9 Traffic Cones

LOCATION PRIORITY

3

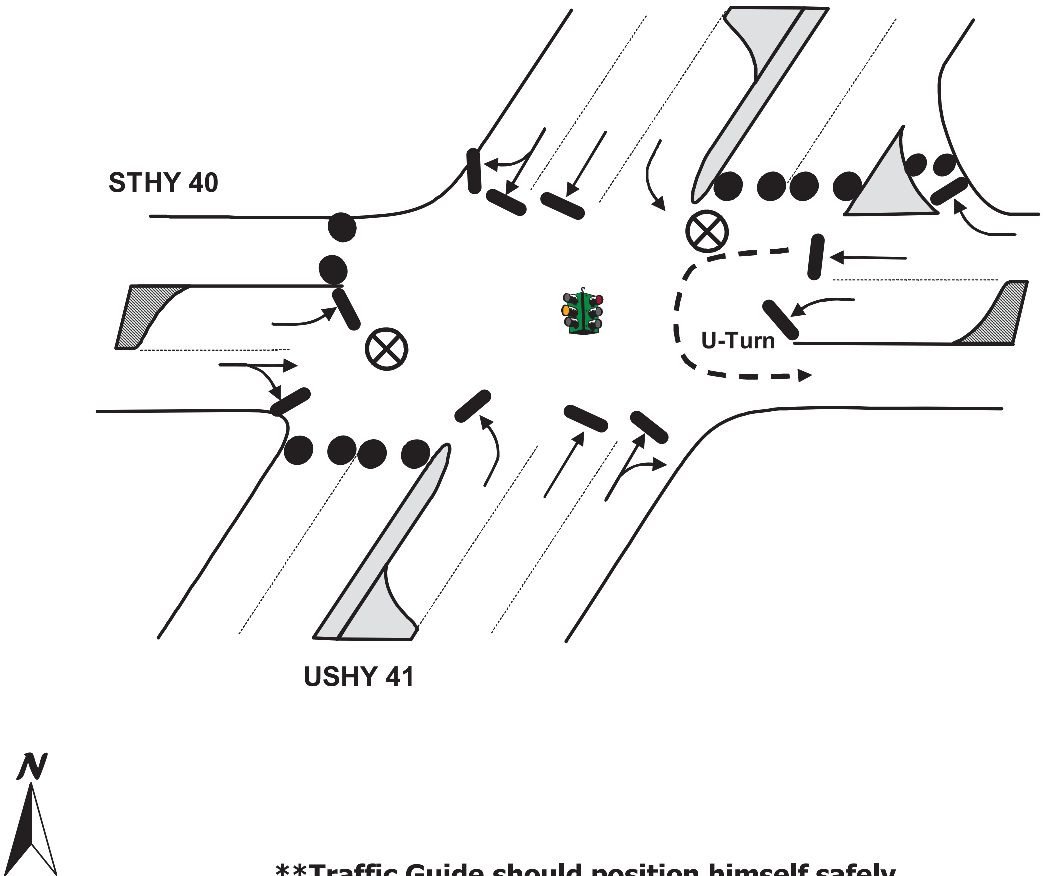
TCP

TOWN: DUNNELLON

LOCATION: USHY 41 & STHY 40 WESTBOUND

TCP ID: M9-02

PAZ: M9



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 movement onto USHY 41
2. Facilitate eastbound movement on STHY 40
3. Discourage westbound movement on STHY 40

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
18 Traffic Cones

LOCATION PRIORITY

1

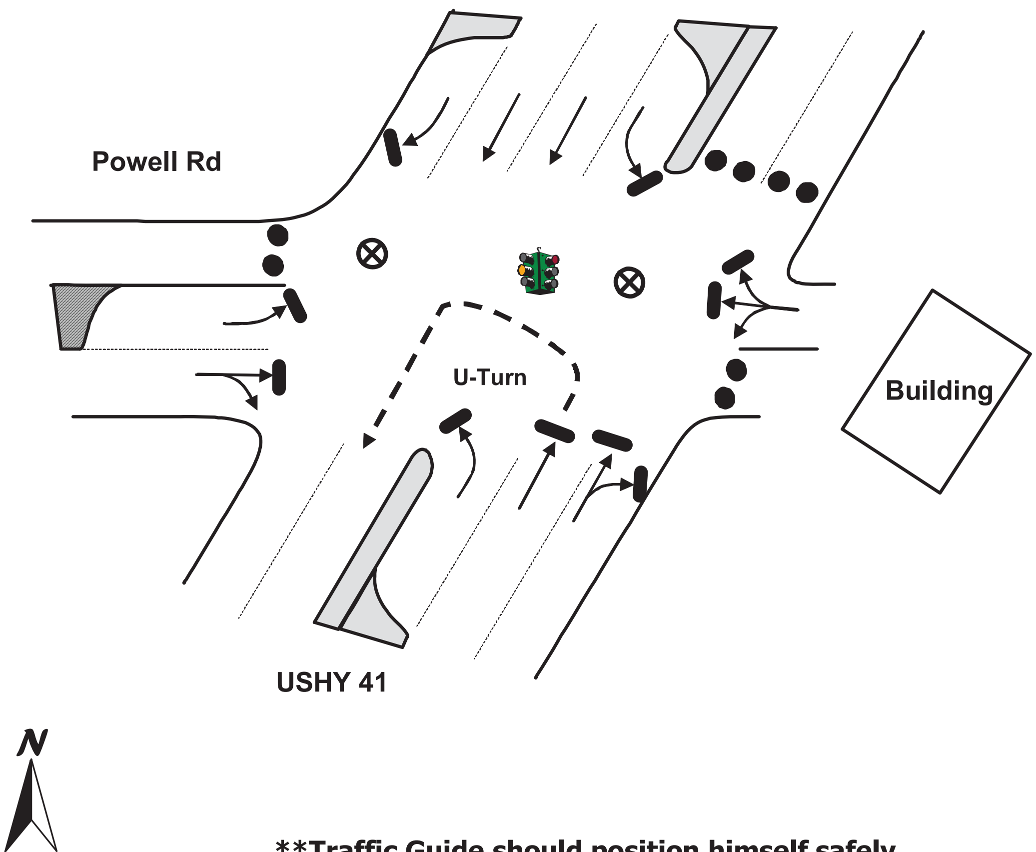
TCP

TOWN: DUNNELLON

LOCATION: USHY 41 & Powell Rd

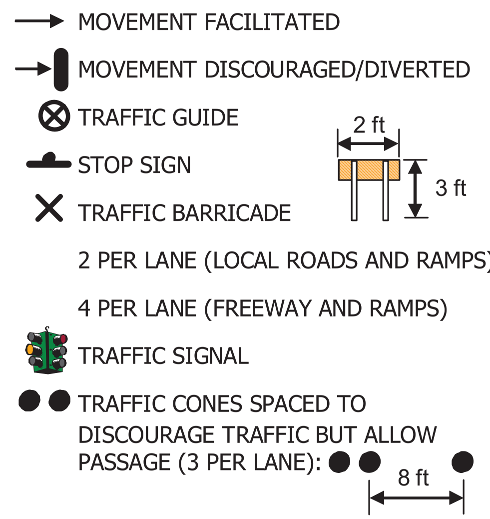
TCP ID: M9-03

PAZ: M9



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

KEY



ACTIONS TO BE TAKEN

1. Discourage northbound movement on USHY 41
2. Discourage westbound movement on Powell Rd

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
12 Traffic Cones

LOCATION PRIORITY

2

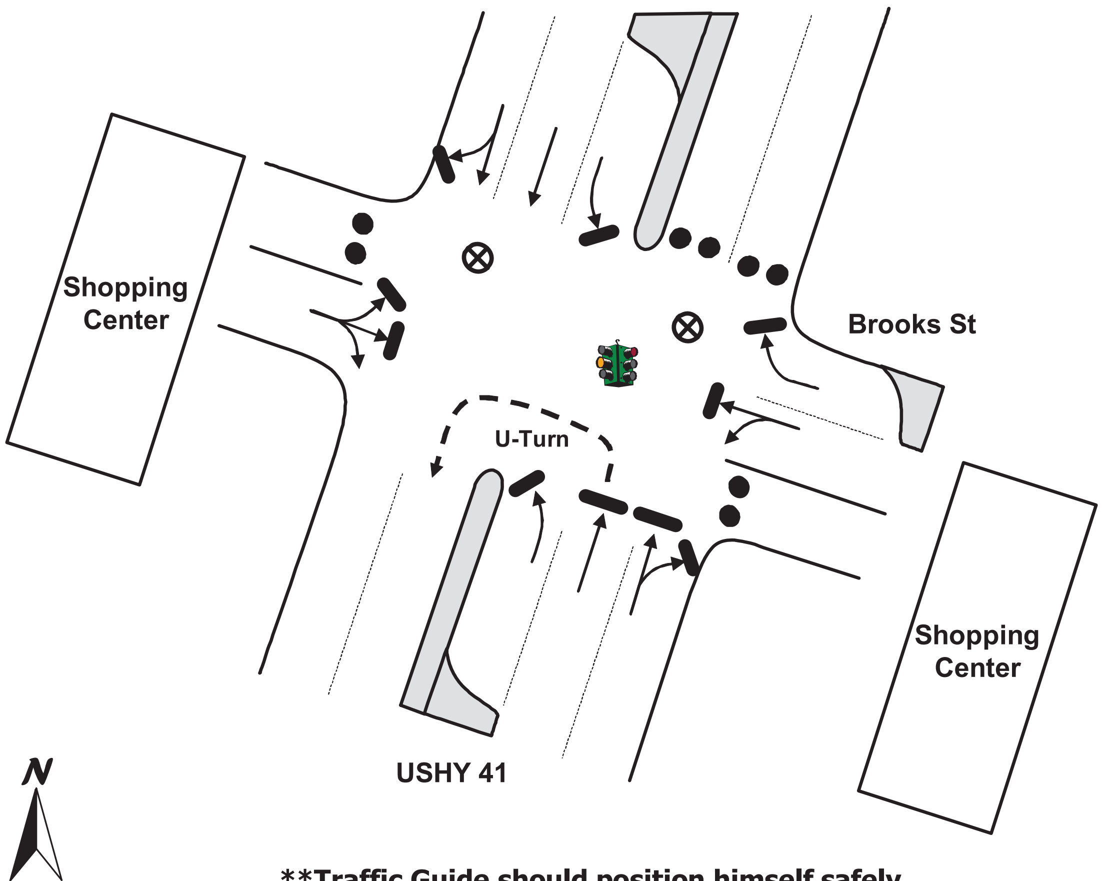
TCP

TOWN: DUNNELLON

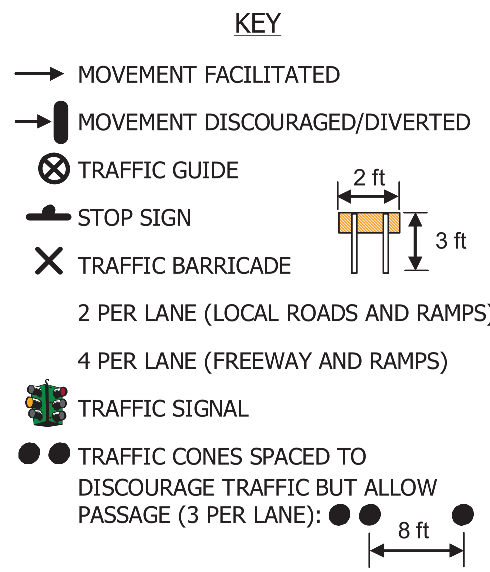
LOCATION: USHY 41 & Brooks St

TCP ID: M9-04

PAZ: M9



**Traffic Guide should position himself safely



ACTIONS TO BE TAKEN

1. Discourage northbound movement on USHY 41
2. Discourage movement into shopping centers

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
12 Traffic Cones

LOCATION PRIORITY

2

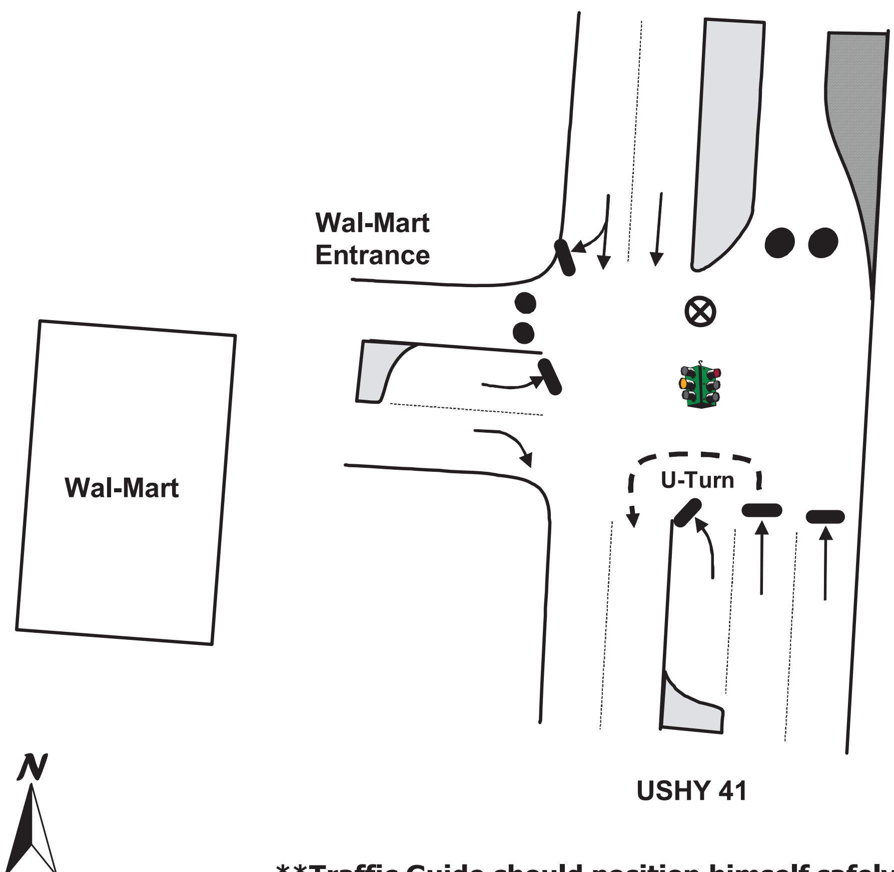
TCP

TOWN: DUNNELLON

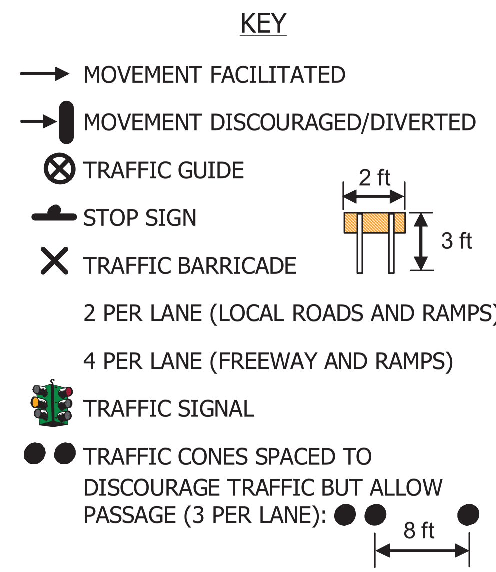
LOCATION: USHY 41 & Wal-Mart Entrance

TCP ID: M9-05

PAZ: M9



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



ACTIONS TO BE TAKEN

1. Discourage northbound movement on USHY 41
2. Discourage movement into Wal-Mart

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

2

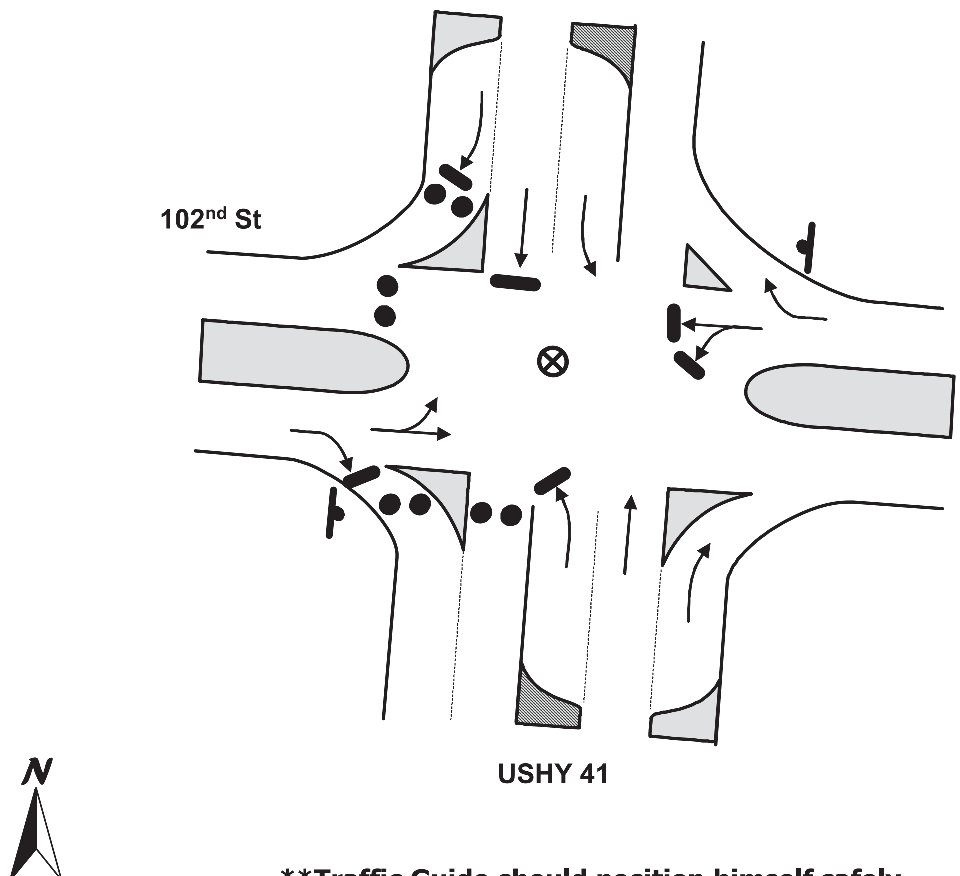
TCP

TOWN: DUNNELLON

LOCATION: USHY 41 & 102nd St

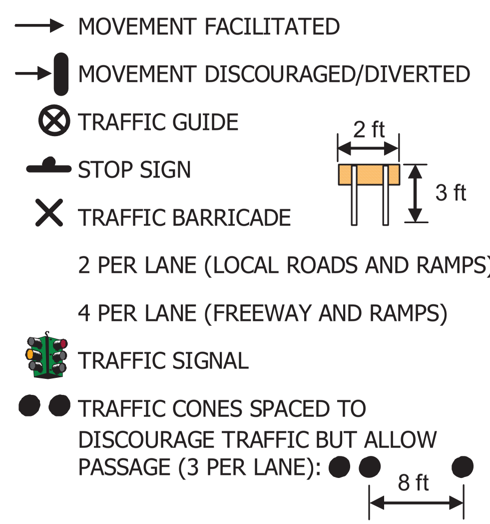
TCP ID: M9-06

PAZ: M9



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

KEY



ACTIONS TO BE TAKEN

1. Discourage southbound movement on USHY 41
2. Discourage westbound movement on 102nd St

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
12 Traffic Cones

LOCATION PRIORITY

3

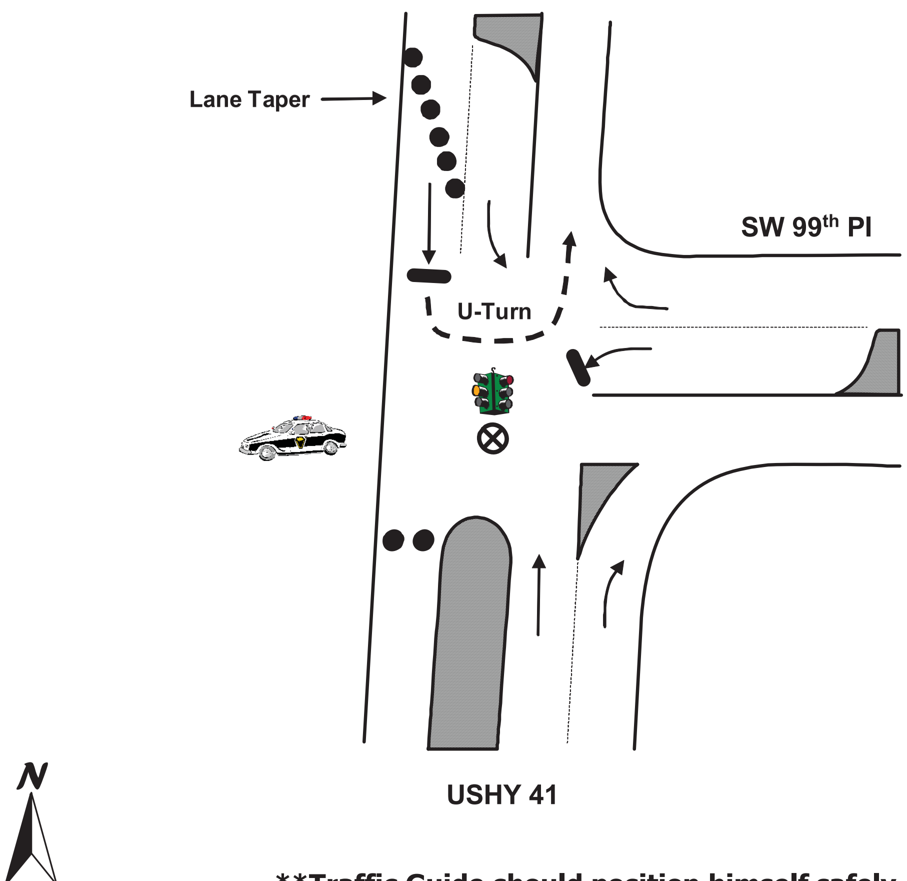
TCP

TOWN: DUNNELLON

LOCATION: USHY 41 & SW 99th Pl

TCP ID: M9-07

PAZ: M9



**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
- POLICE CAR

ACTIONS TO BE TAKEN

1. Discourage southbound movement on USHY 41

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
9 Traffic Cones

LOCATION PRIORITY

2

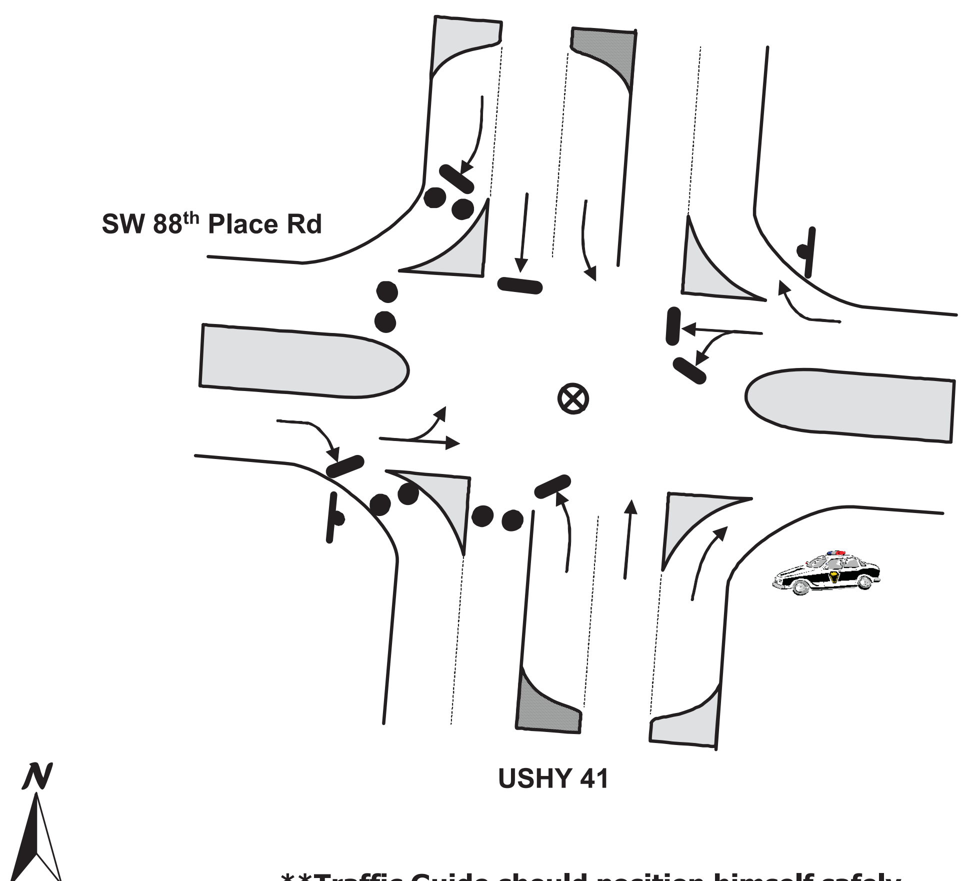
TCP

TOWN: DUNNELLON

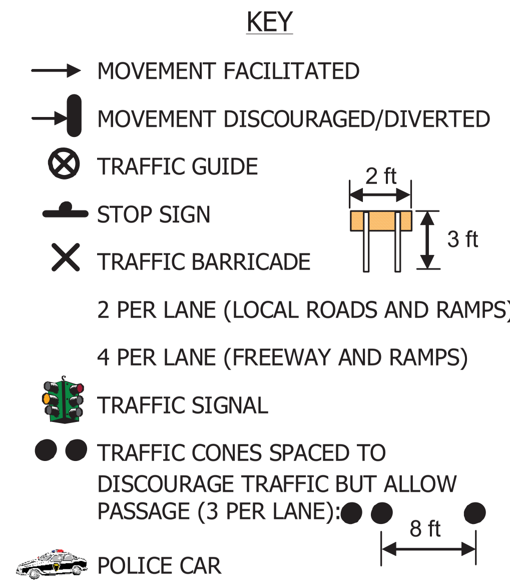
LOCATION: USHY 41 & SW 88th Place Rd

TCP ID: M9-08

PAZ: M9



Traffic Guide should position himself safely



ACTIONS TO BE TAKEN

1. Discourage southbound movement on USHY 41
2. Discourage westbound movement onto SW 88th Place Rd

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
12 Traffic Cones

LOCATION PRIORITY

3

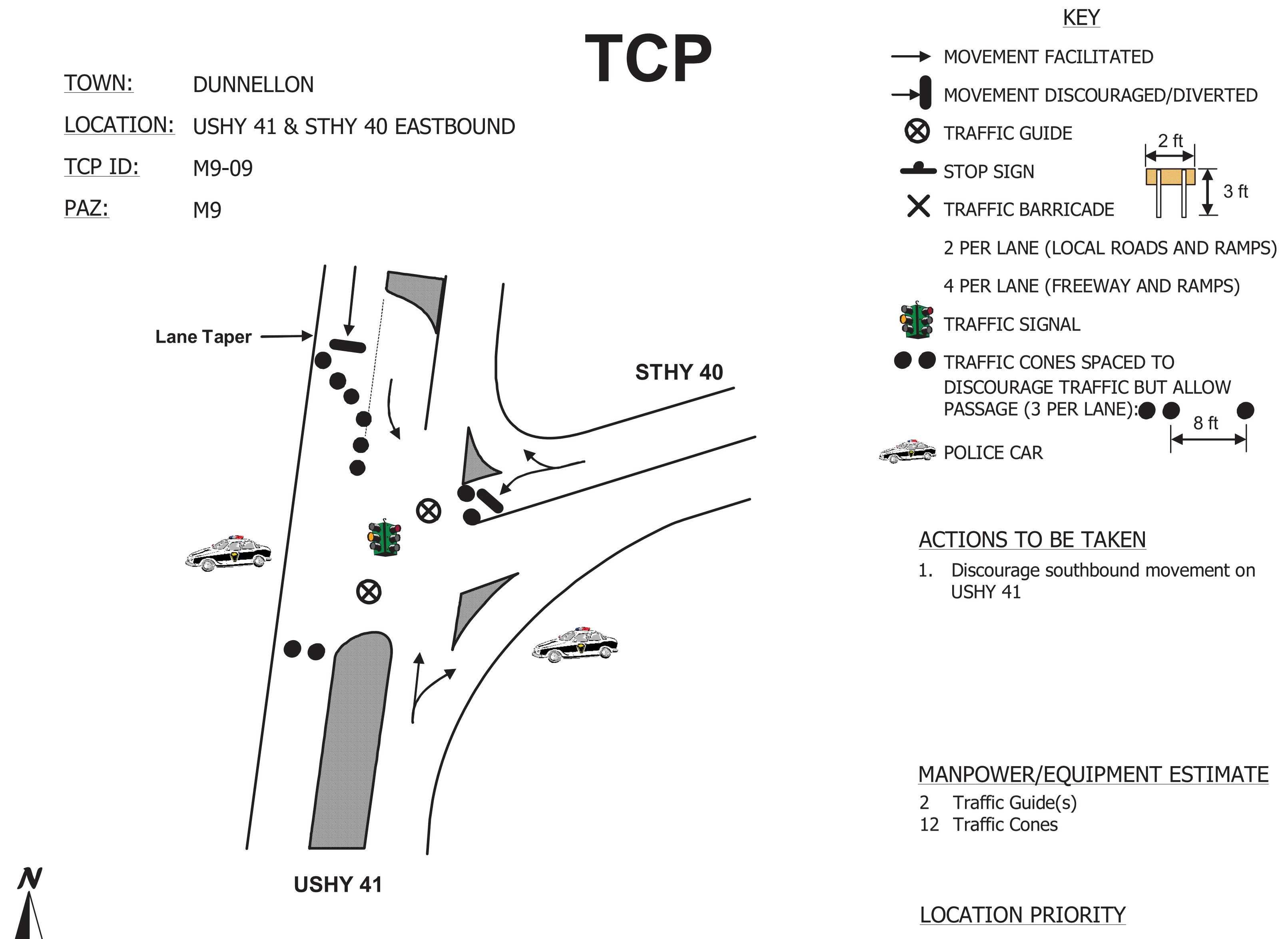
TCP

TOWN: DUNNELLON

LOCATION: USHY 41 & STHY 40 EASTBOUND

TCP ID: M9-09

PAZ: M9



**Traffic Guide should position himself safely

ACTIONS TO BE TAKEN

1. Discourage southbound movement on USHY 41

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
12 Traffic Cones

LOCATION PRIORITY

1

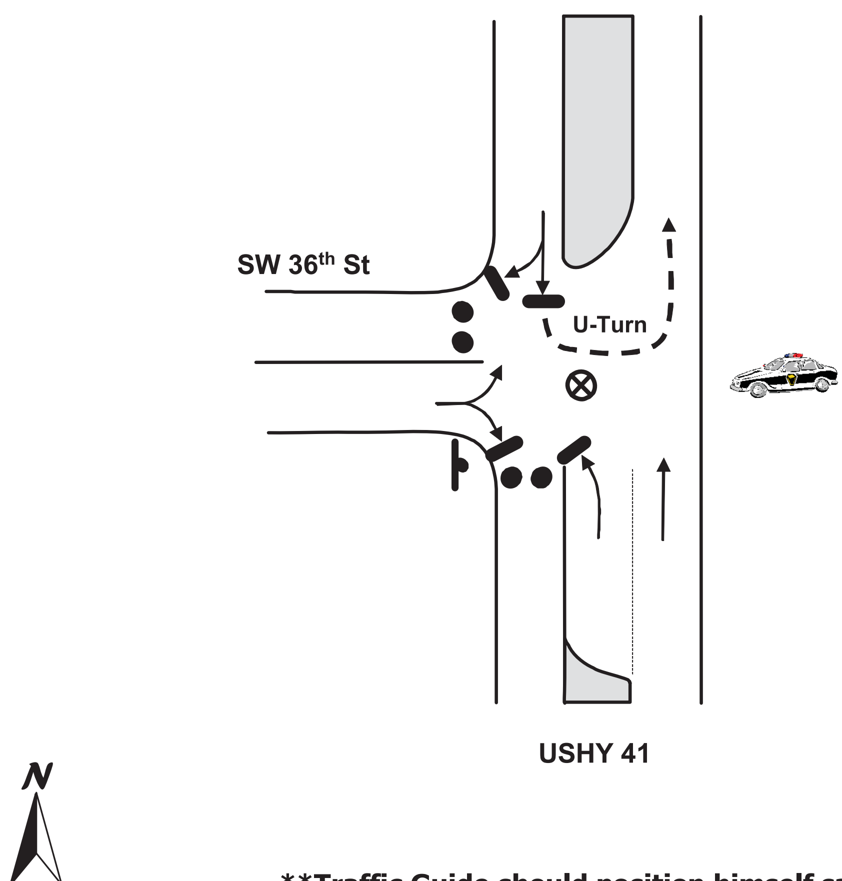
TCP

TOWN: DUNNELLON

LOCATION: USHY 41 & SW 36th St

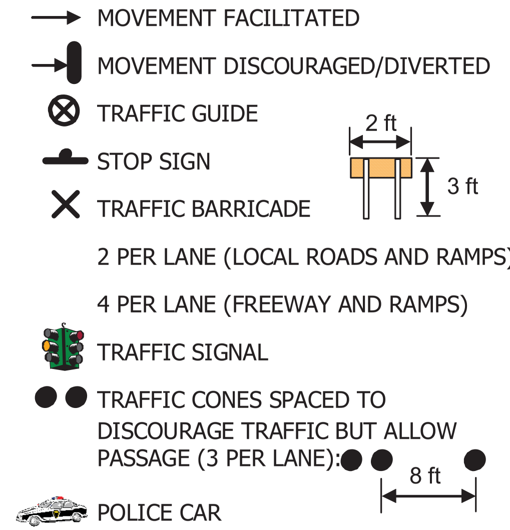
TCP ID: M9-10

PAZ: M9



**Traffic Guide should position himself safely

KEY



ACTIONS TO BE TAKEN

1. Discourage southbound movement on USHY 41
2. Discourage westbound movement on SW 36th St

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

3

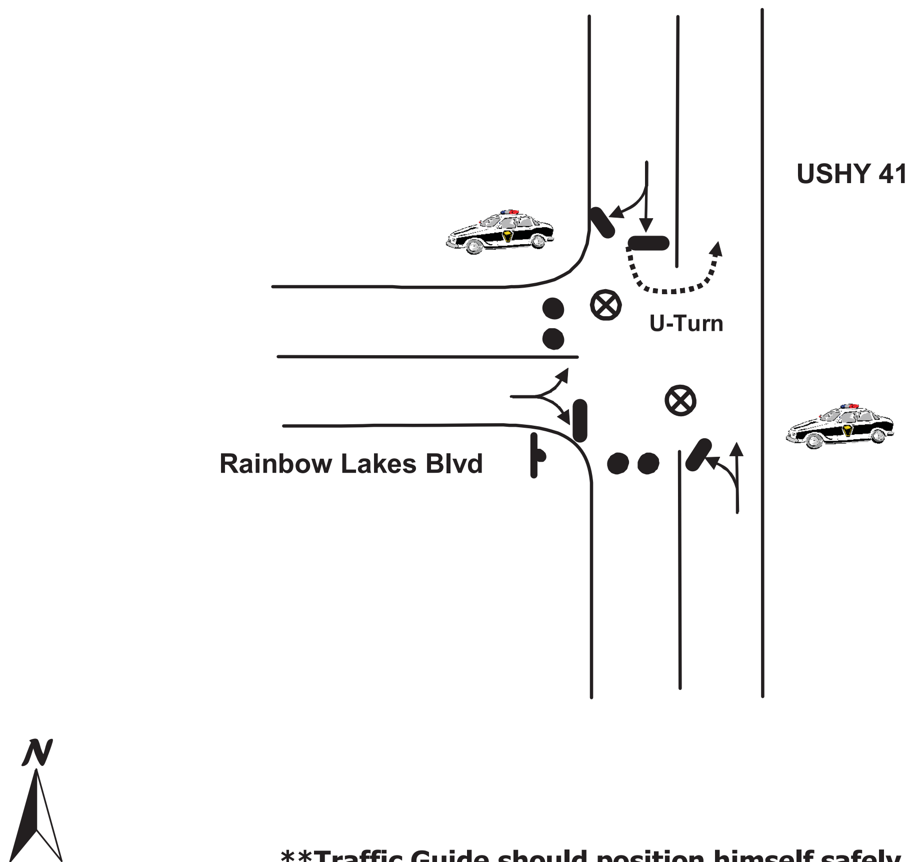
TCP

TOWN: DUNNELLON

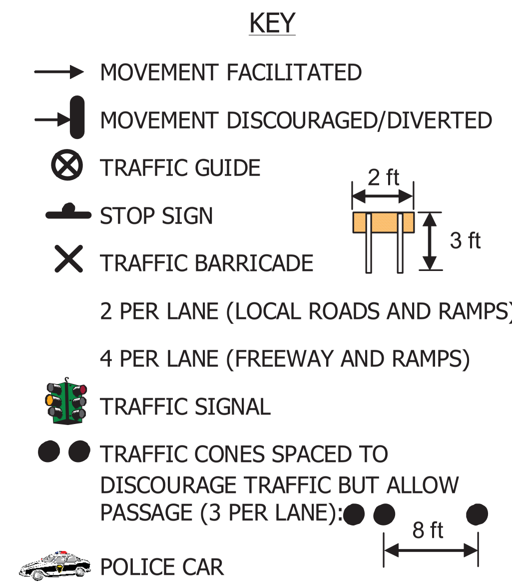
LOCATION: USHY 41 & Rainbow Lakes Blvd

TCP ID: M9-11

PAZ: M9



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



ACTIONS TO BE TAKEN

1. Discourage southbound movement on USHY 41
2. Discourage westbound movement on Rainbow Lakes Blvd
3. U-Turn southbound traffic on US 41 and re-route them northbound

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
6 Traffic Cones

LOCATION PRIORITY

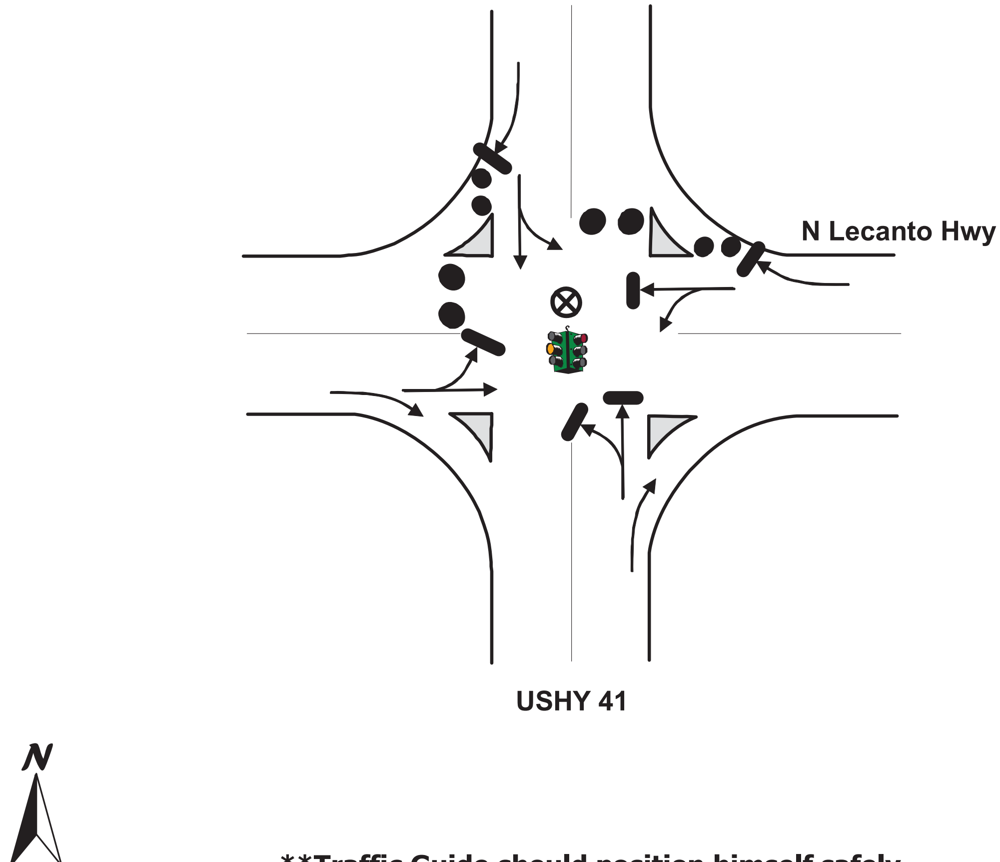
1

TCP

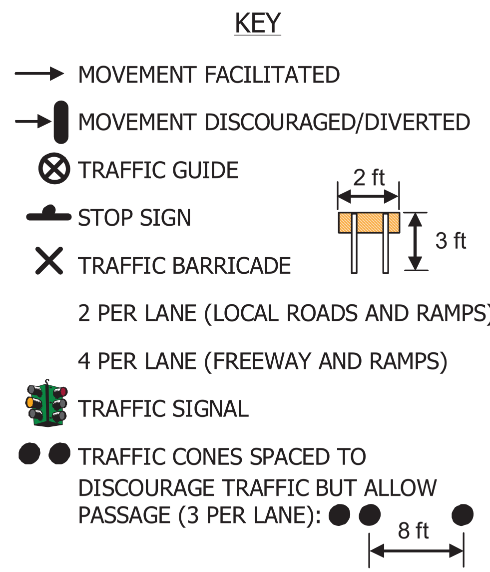
TOWN: HOLDER

LOCATION: USHY 41 & N Lecanto Hwy

TCP ID: Q2-08



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



ACTIONS TO BE TAKEN

1. Discourage northbound movement on USHY 41
2. Discourage westbound movement on N Lecanto Hwy

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
12 Traffic Cones

LOCATION PRIORITY

1

Table G-2. Access Control Points					
Priority	ID#	Town	Intersection Location	# of Guides	# of Barricades
CITRUS COUNTY					
1	Q2-02	Citrus Springs	USHY 41 & N Citrus Springs Blvd	1	8
1	Q2-07	Crystal River	STHY 44 & USHY 19/USHY 98	2	6
1	Q2-08	Holder	USHY 41 & N Lecanto Hwy	1	8
2	Q2-03	Citrus Springs	N Deltona Blvd & Citrus Springs Blvd	1	4
2	Q2-04	Citrus Springs	N Deltona Blvd & W Country Club Blvd	1	4
2	Q2-05	Citrus Springs	N Deltona Blvd & W Citrus Springs Blvd	1	4
3	Q2-06	Citrus Springs	N Elkcam Blvd & W Hampshire Blvd	1	2
Total Manpower & Equipment for Citrus County				**8**	**36**
LEVY COUNTY					
1	Q4-01	Otter Creek	USHY 19/USHY 98 & STHY 326	2	6
2	Q1-02	Morriston	STHY 121 & SE 80th St	1	2
3	Q1-01	Morriston	CR 326 & CR 337	1	2
Total Manpower & Equipment for Levy County				**4**	**10**
MARION COUNTY					
1	Q1-04	Dunnellon	STHY 40 & SW 140th Ave	2	2
2	Q1-03	Dunnellon	USHY 41 & W CR-328	1	2
2	Q2-01	Dunnellon	Ned Folks/SW CR-484 & SW 140th Ave	1	2
Total Manpower & Equipment for Marion County				**4**	**6**
Total Manpower & Equipment for EPZ				**16**	**52**

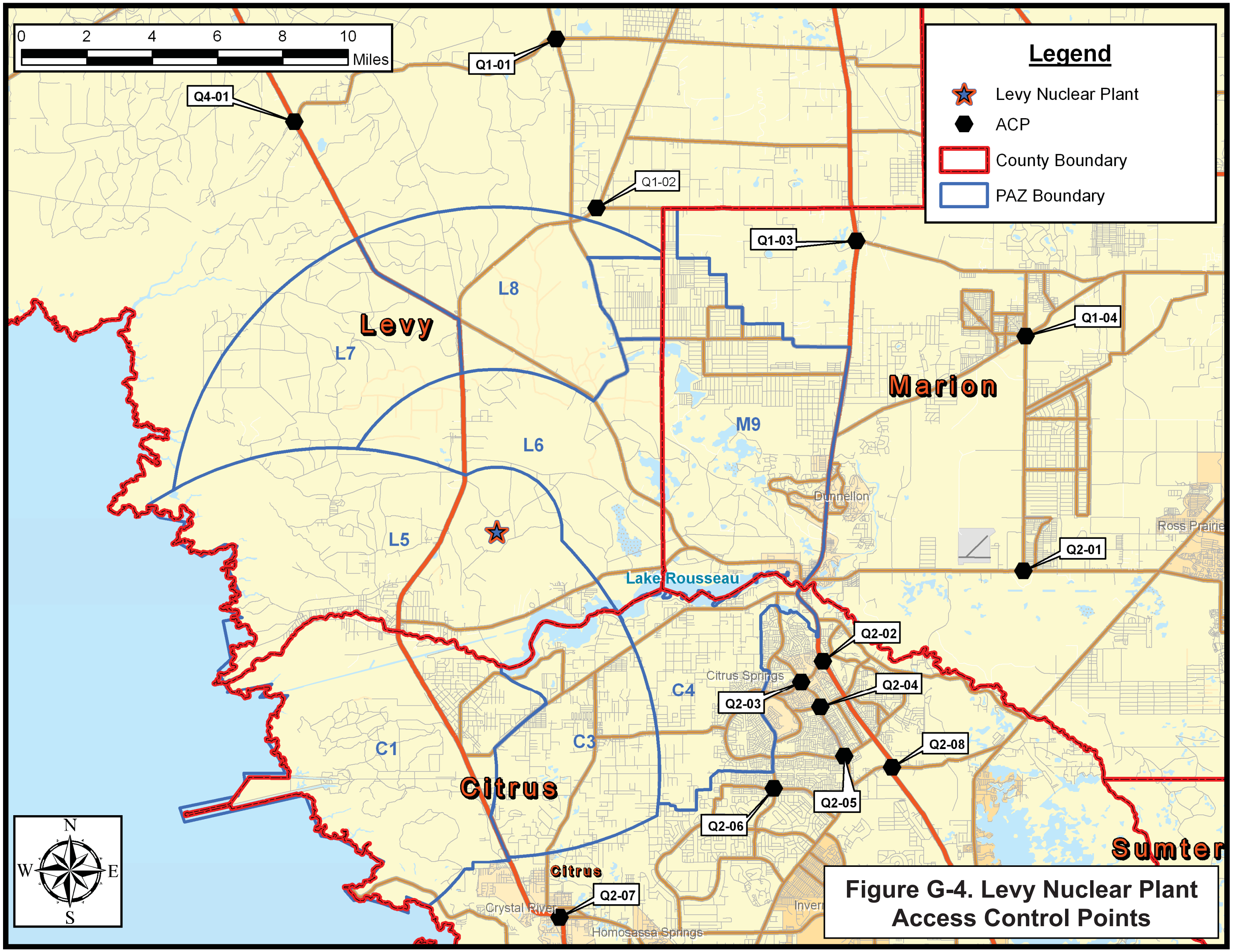


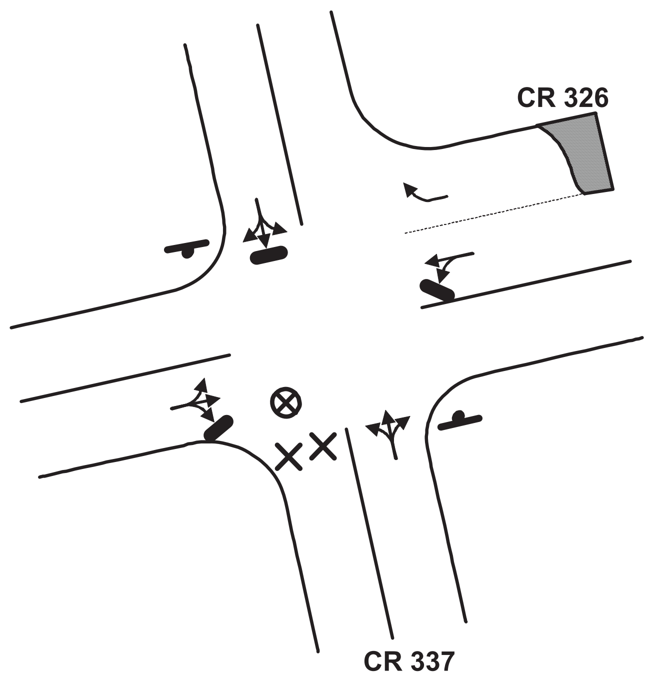
Figure G-4. Levy Nuclear Plant Access Control Points

ACP

TOWN: MORRISTON

LOCATION: CR 326 & CR 337

ACP ID: Q1-01



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 direct southbound movement on CR 337

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
2 Traffic Barricades

LOCATION PRIORITY

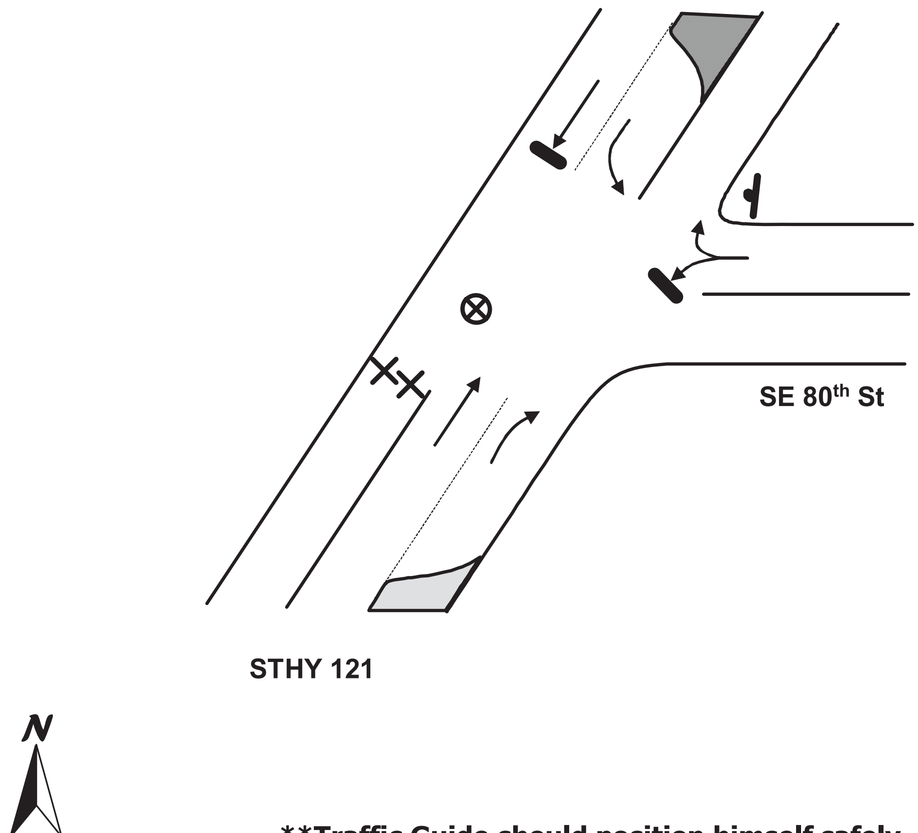
3

ACP

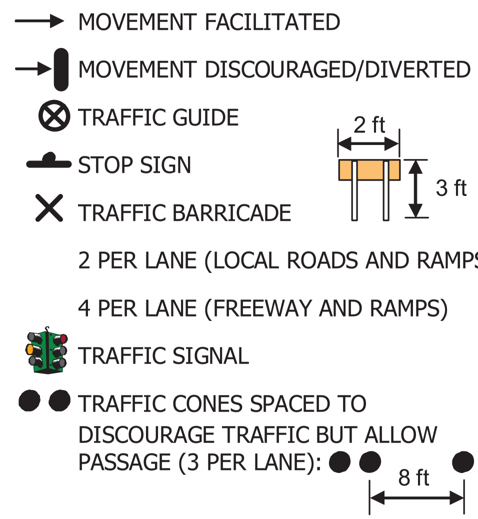
TOWN: MORRISTON

LOCATION: STHY 121 & SE 80th St

ACP ID: Q1-02



**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 movement on STHY 121

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
2 Traffic Barricades

LOCATION PRIORITY

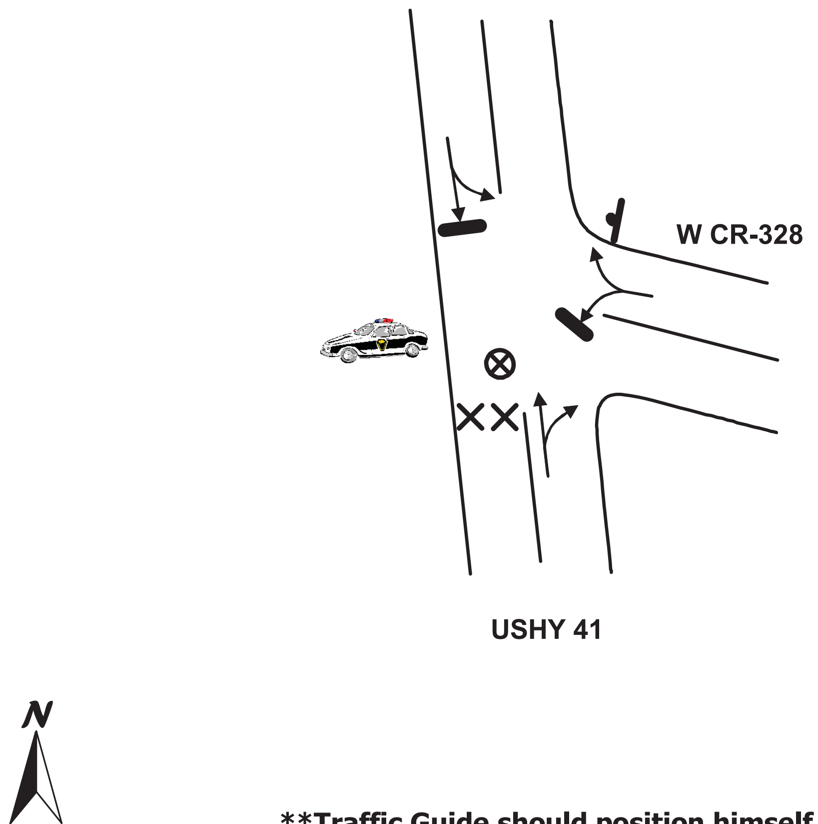
2

ACP

TOWN: DUNNELLON

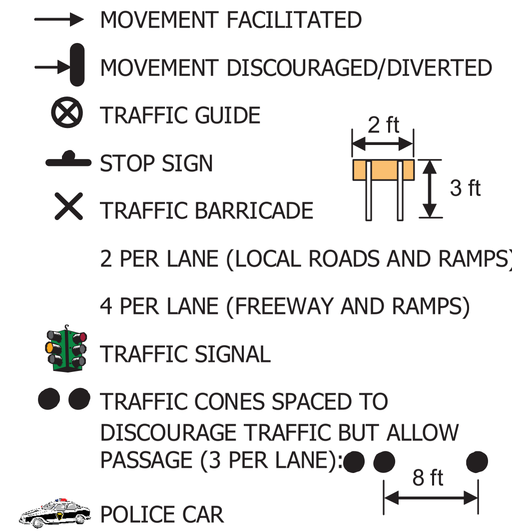
LOCATION: USHY 41 & W CR-328

ACP ID: Q1-03



Traffic Guide should position himself safely

KEY



ACTIONS TO BE TAKEN

1. Interdict and divert southbound movement on USHY 41

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
2 Traffic Barricades

LOCATION PRIORITY

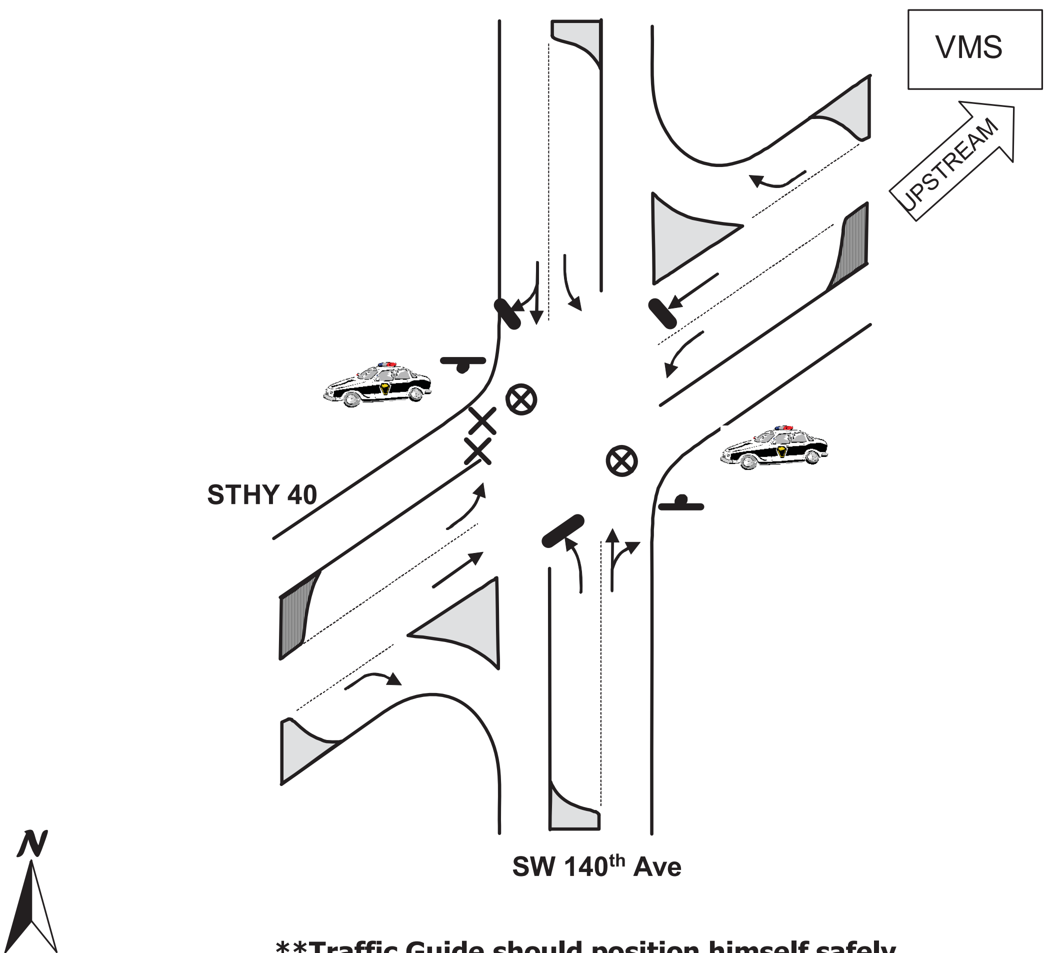
2

ACP

<u>TOWN:</u> DUNNELLON

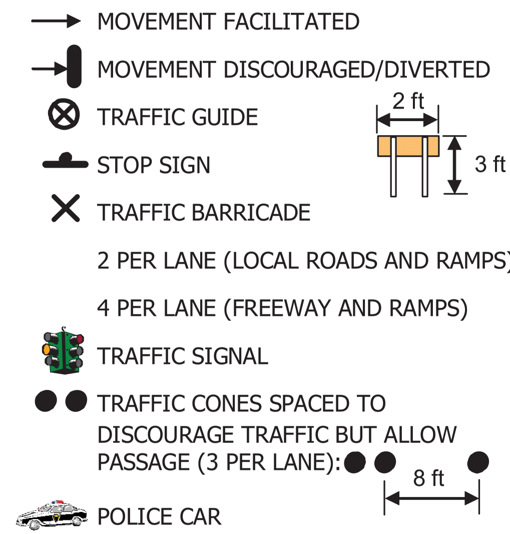
<u>LOCATION:</u> STHY 40 & SW 140th Ave

<u>ACP ID:</u> Q1-04



**Traffic Guide should position himself safely

KEY



ACTIONS TO BE TAKEN

1. Interdict and divert westbound movement on STHY 40
2. Due to high speeds, curves of road will need signage warning of approach. Position Variable Message Sign (VMS) upstream warning motorists to slow down.

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
2 Traffic Barricades

LOCATION PRIORITY

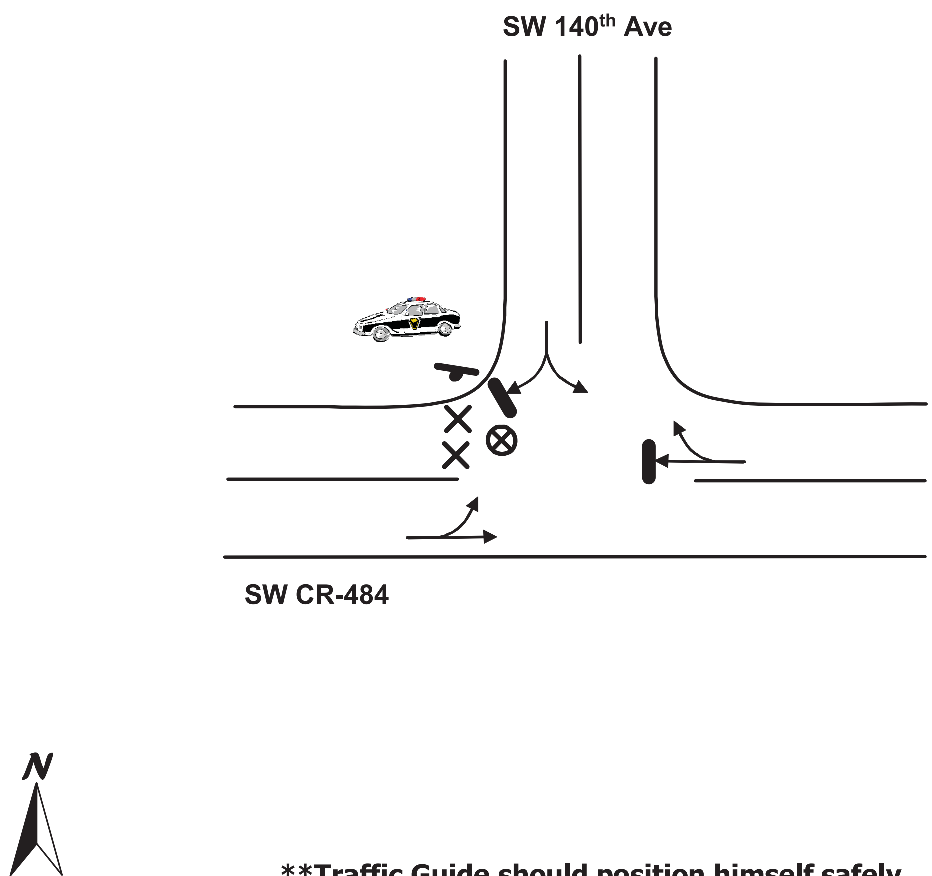
1

ACP

TOWN: DUNNELLON

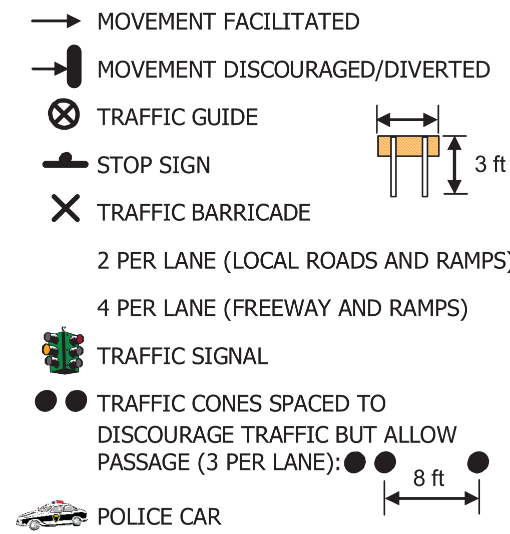
LOCATION: Ned Folks Hwy/SW CR-484 & SW 140th Ave

ACP ID: Q2-01



Traffic Guide should position himself safely

KEY



ACTIONS TO BE TAKEN

1. Interdict and divert westbound movement on SW CR-484

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
2 Traffic Barricades

LOCATION PRIORITY

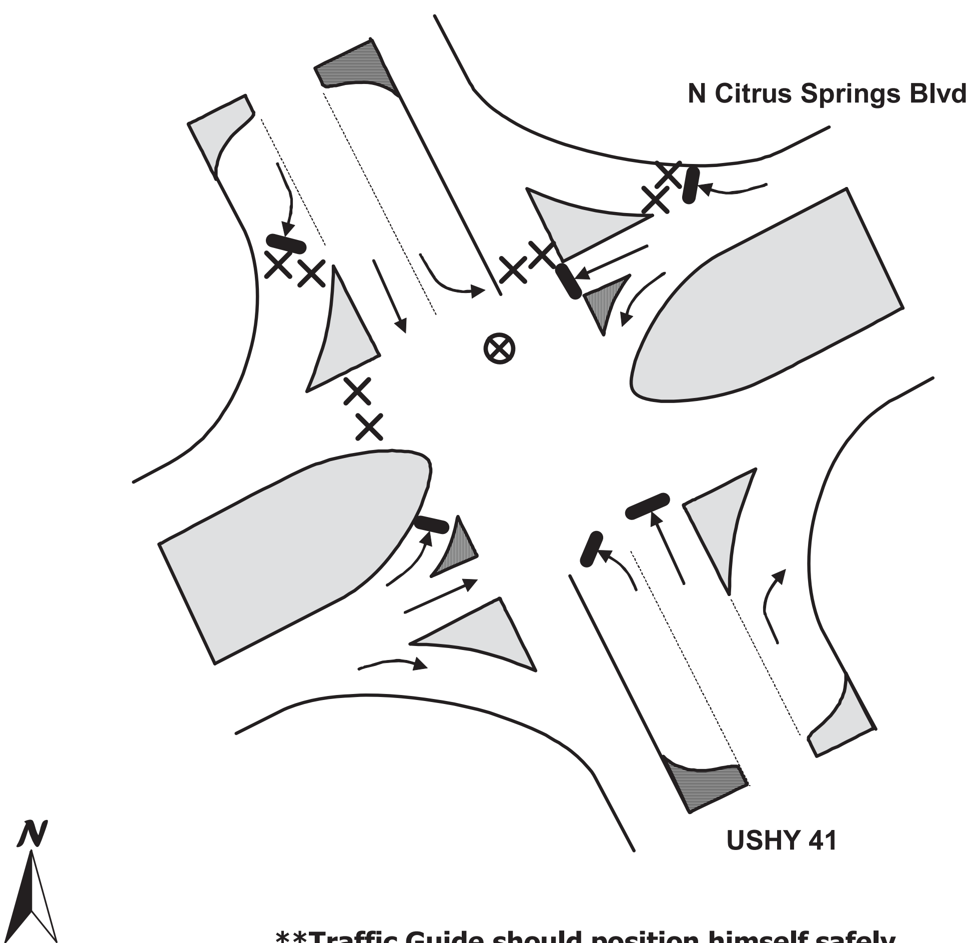
2

ACP

TOWN: CITRUS SPRINGS

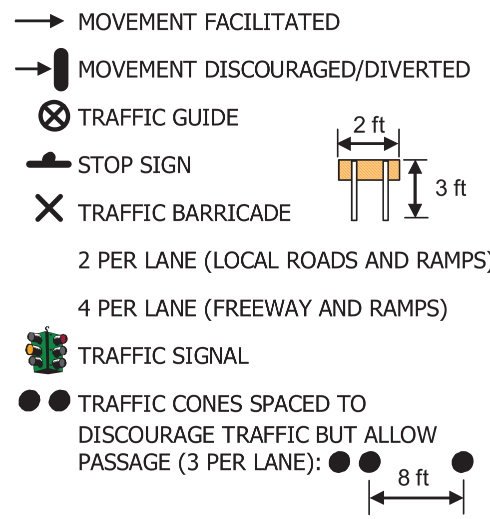
LOCATION: USHY 41 & N Citrus Springs Blvd

ACP ID: Q2-02



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

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)

ACTIONS TO BE TAKEN

1. Interdict and divert northbound movement on USHY 41
2. Interdict and divert westbound movement on N Citrus Springs Blvd

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
8 Traffic Barricades

LOCATION PRIORITY

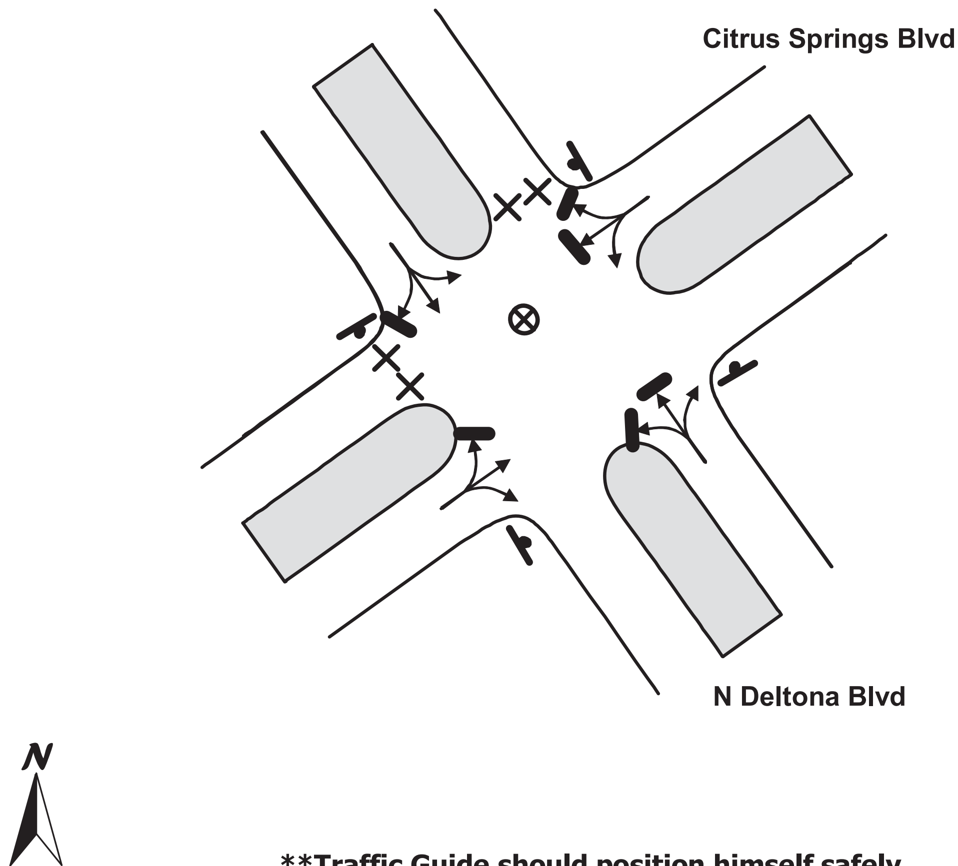
1

ACP

TOWN: CITRUS SPRINGS

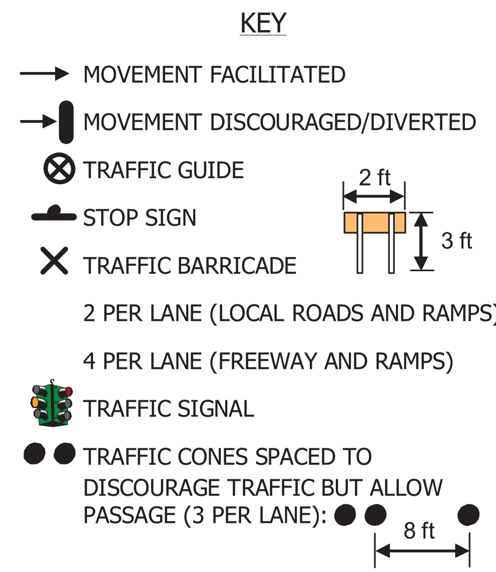
LOCATION: N Deltona Blvd & Citrus Springs Blvd

ACP ID: Q2-03



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

KEY



ACTIONS TO BE TAKEN

1. Interdict and divert northbound movement on N Deltona Blvd
2. Interdict and divert westbound movement on Citrus Springs Blvd

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
4 Traffic Barricades

LOCATION PRIORITY

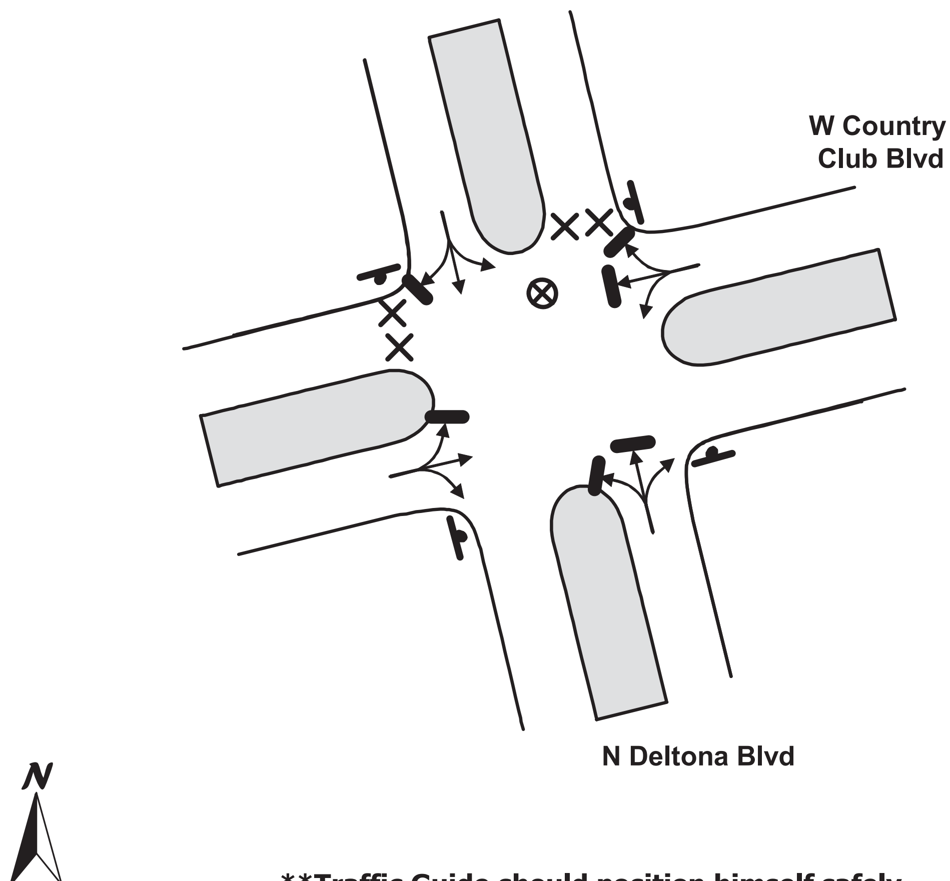
2

ACP

TOWN: CITRUS SPRINGS

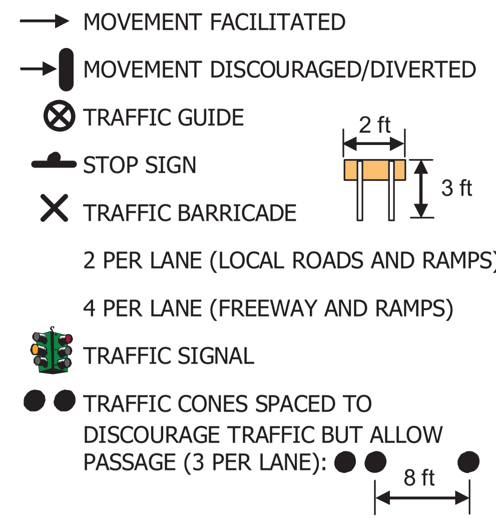
LOCATION: N Deltona Blvd & W Country Club Blvd

ACP ID: Q2-04



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

KEY



ACTIONS TO BE TAKEN

1. Interdict and divert northbound movement on N Deltona Blvd
2. Interdict and divert westbound movement on W Country Club Blvd

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
4 Traffic Barricades

LOCATION PRIORITY

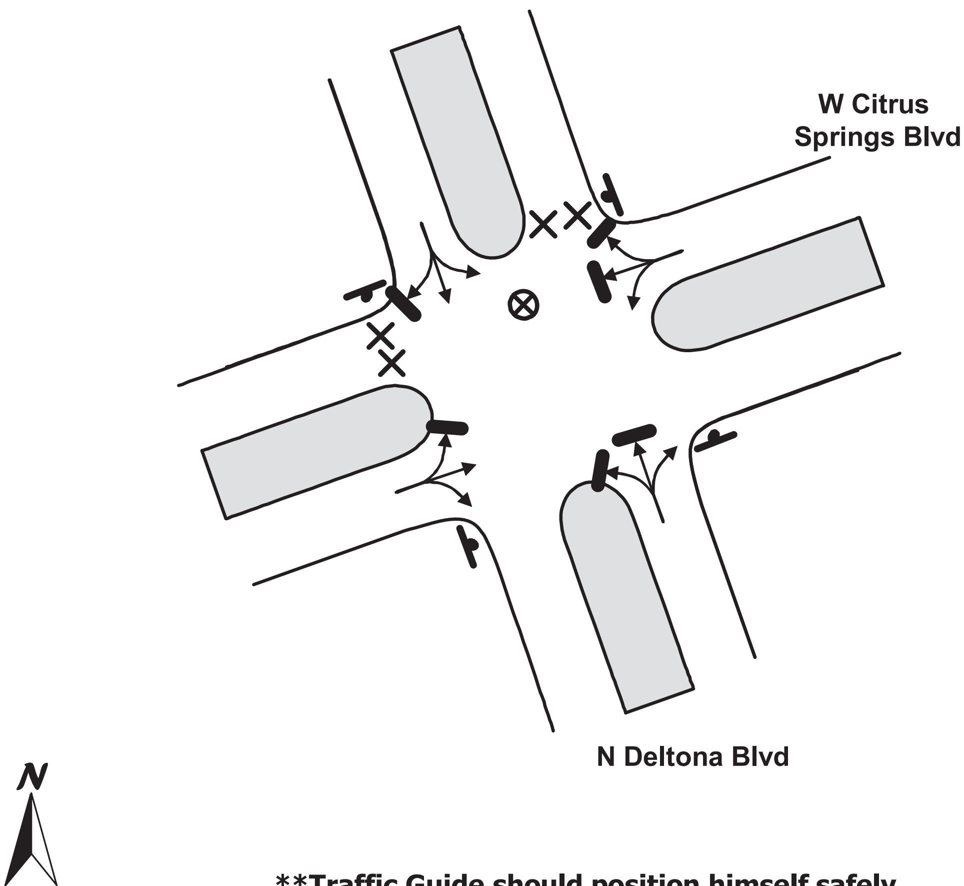
2

ACP

TOWN: CITRUS SPRINGS

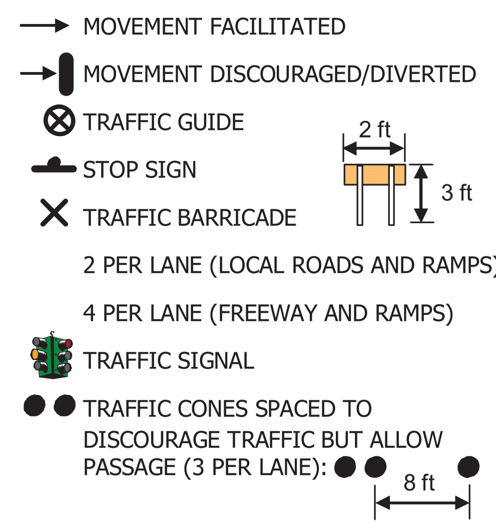
LOCATION: N Deltona Blvd & W Citrus Springs Blvd

ACP ID: Q2-05



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

KEY



ACTIONS TO BE TAKEN

1. Interdict and divert northbound movement on N Deltona Blvd
2. Interdict and divert westbound movement on W Citrus Springs Blvd

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
4 Traffic Barricades

LOCATION PRIORITY

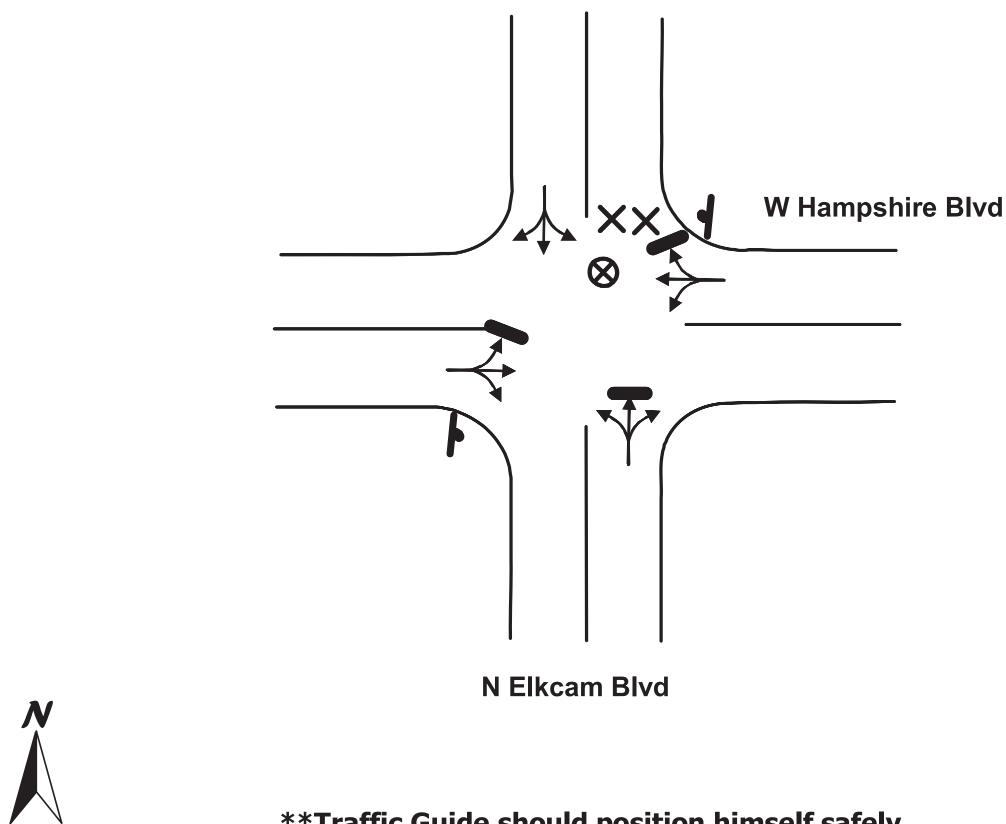
2

ACP

TOWN: CITRUS SPRINGS

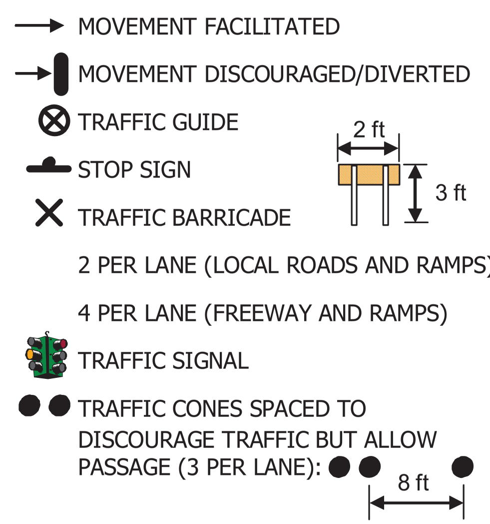
LOCATION: N Elkcam Blvd & W Hampshire Blvd

ACP ID: Q2-06



**Traffic Guide should position himself safely

KEY



ACTIONS TO BE TAKEN

1. Interdict and divert northbound movement on N Elkcam Blvd

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
2 Traffic Barricades

LOCATION PRIORITY

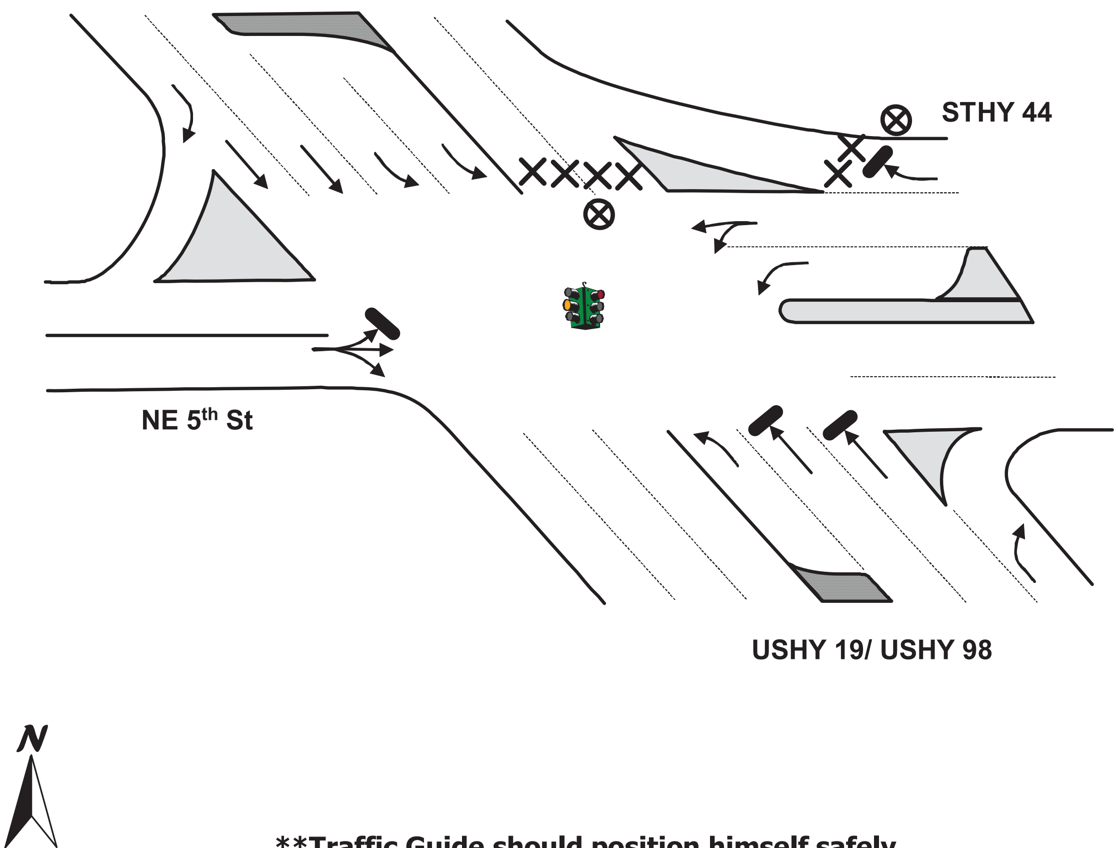
3

ACP

TOWN: CRYSTAL RIVER

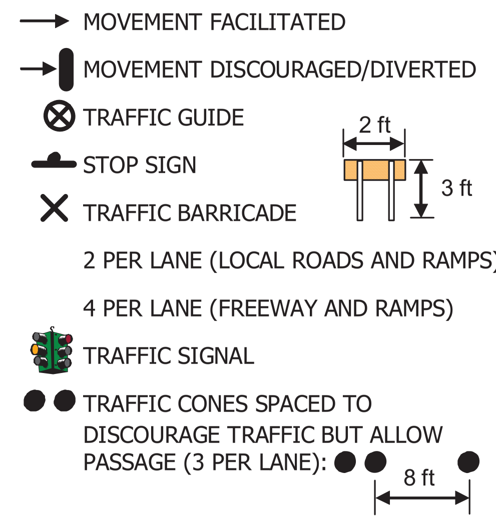
LOCATION: STHY 44 & USHY 19 / USHY 98

ACP ID: Q2-07



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

KEY



ACTIONS TO BE TAKEN

1. Interdict and divert northbound movement on USHY 19/USHY 98

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
6 Traffic Barricades

LOCATION PRIORITY

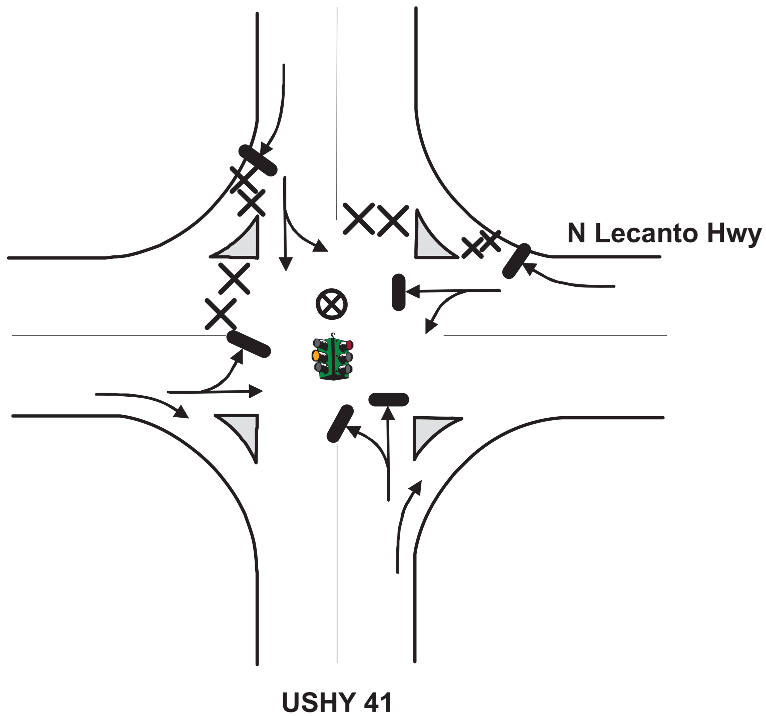
1

ACP

TOWN: HOLDER

LOCATION: USHY 41 & N Lecanto Hwy

ACP ID: Q2-08



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 movement on USHY 41
2. Interdict and divert westbound movement on N Lecanto Hwy

MANPOWER/EQUIPMENT ESTIMATE

1 Traffic Guide(s)
8 Traffic Barricades

LOCATION PRIORITY

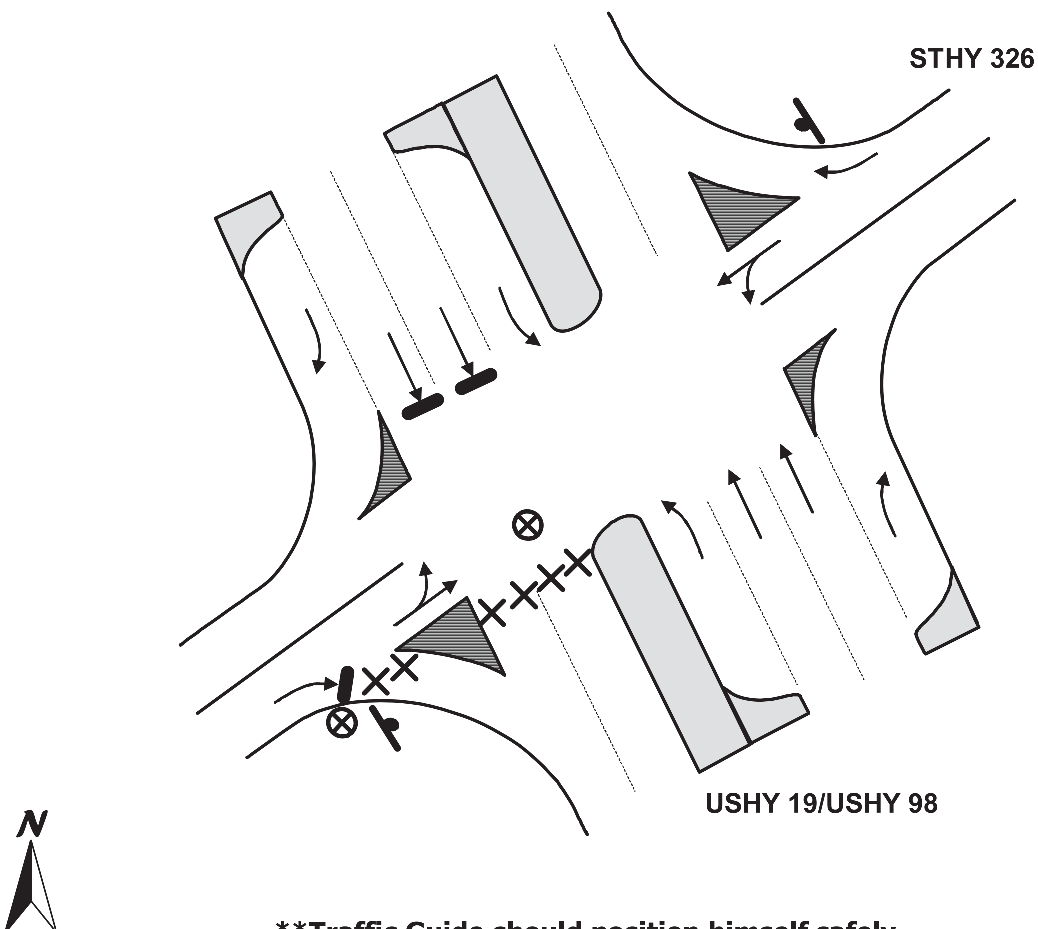
1

ACP

TOWN: OTTER CREEK

LOCATION: USHY 19 / USHY 98 & STHY 326

ACP ID: Q4-01



**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 movement on USHY 19/USHY 98

MANPOWER/EQUIPMENT ESTIMATE

2 Traffic Guide(s)
6 Traffic Barricades

LOCATION PRIORITY

1

APPENDIX H

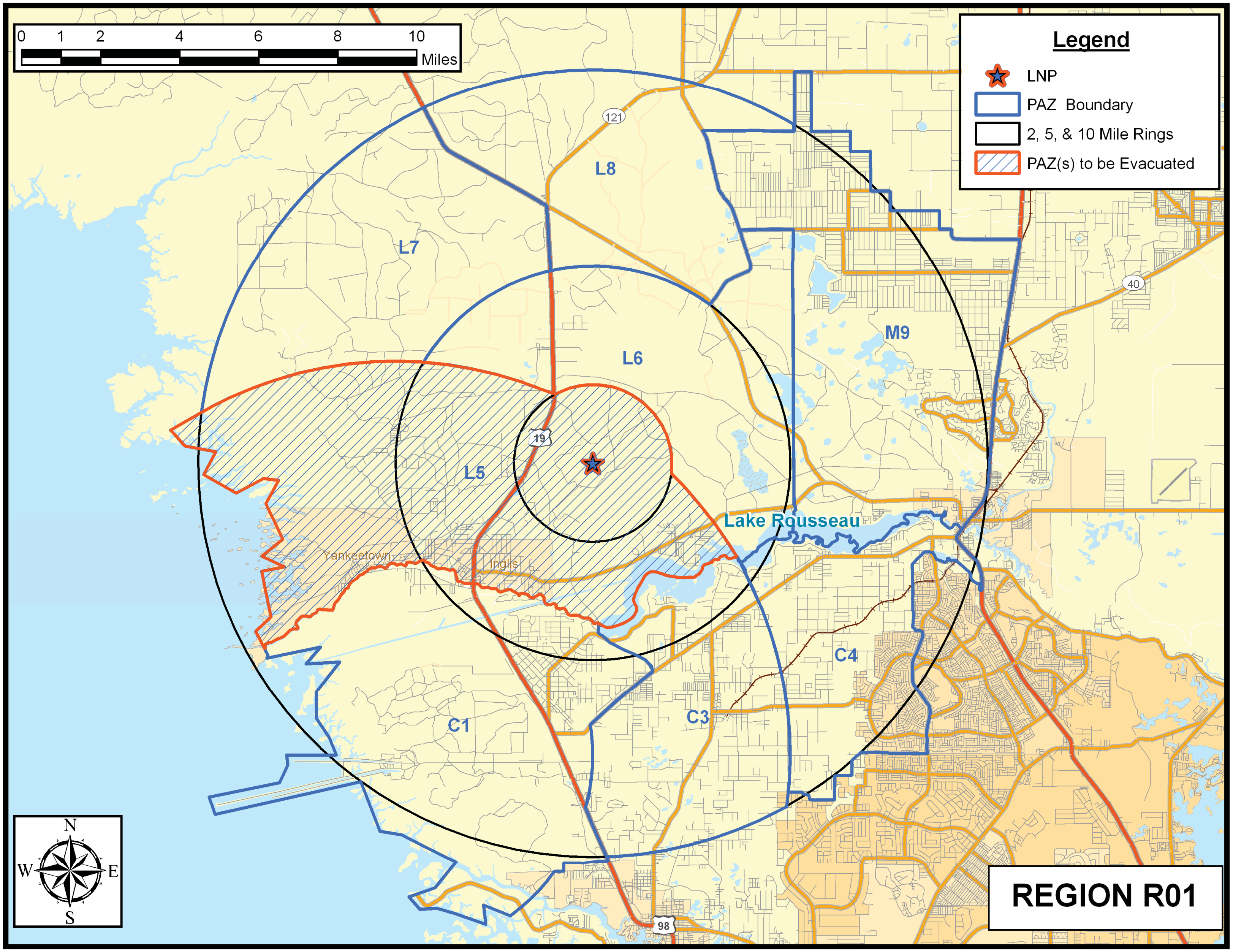
Evacuation Regions

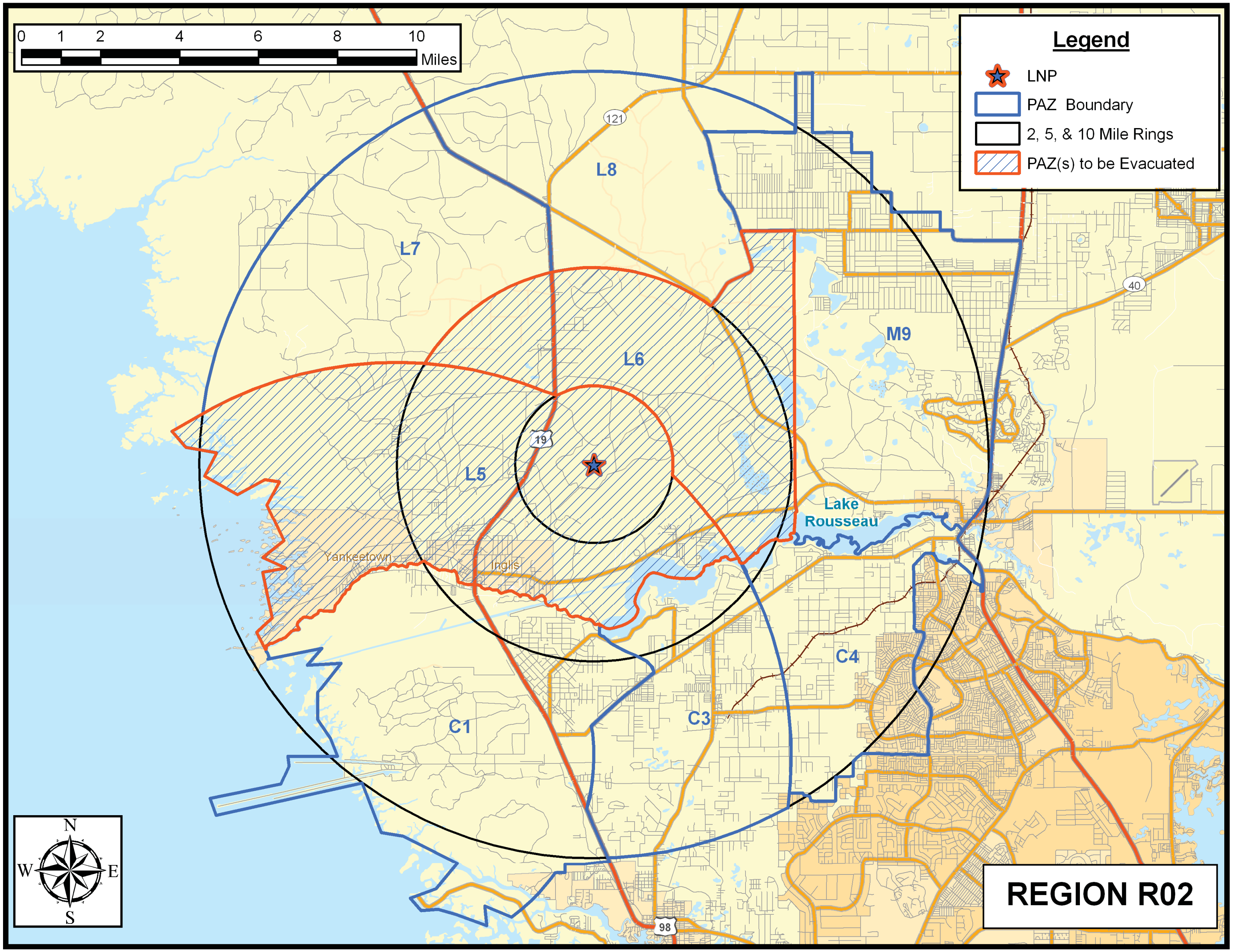
APPENDIX H: EVACUATION REGIONS

This appendix presents the assumed voluntary evacuation percentages for each Evacuation Region (Table H-1) and maps of all Evacuation Regions. The values shown in Table H-1 were determined using the methodology discussed in assumption 5 of Section 2.2 and shown graphically in Figures 2-1 and 7-1.

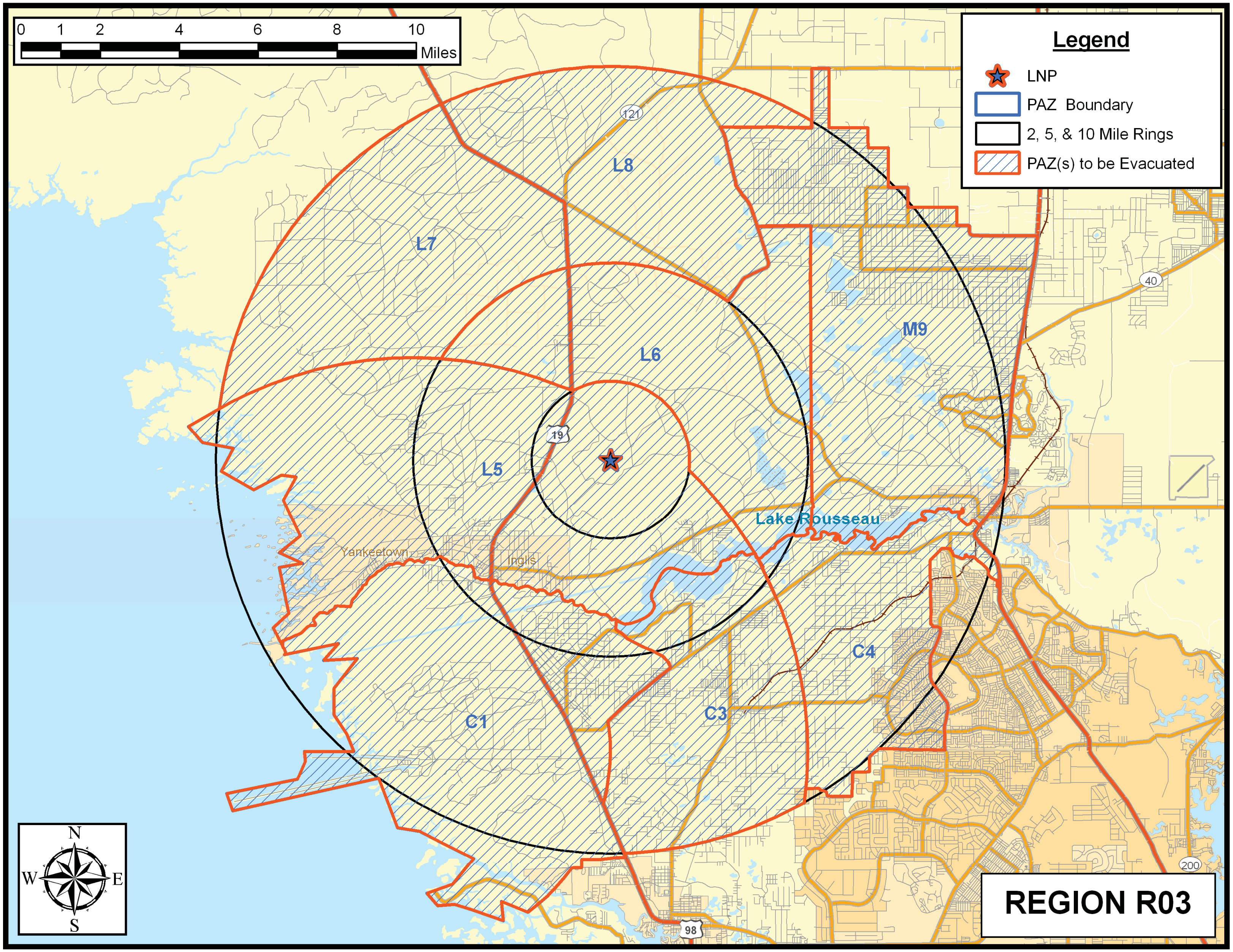
Table H-1. Percent of PAZ Population Evacuating for Each Region

	Region												
	2-Mile Ring, 5-Mile Ring, Entire EPZ			5-Mile Radius and Downwind to EPZ Boundary									
PAZ	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
C1	35%	35%	100%	50%	50%	50%	50%	100%	100%	100%	100%	50%	50%
C3	35%	35%	100%	50%	50%	50%	100%	100%	100%	50%	50%	50%	50%
C4	35%	35%	100%	50%	50%	100%	100%	100%	50%	50%	50%	50%	50%
L5	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
L6	35%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
L7	35%	35%	100%	100%	50%	50%	50%	50%	50%	50%	100%	100%	100%
L8	35%	35%	100%	100%	100%	50%	50%	50%	50%	50%	50%	50%	100%
M9	35%	35%	100%	100%	100%	100%	100%	50%	50%	50%	50%	50%	50%

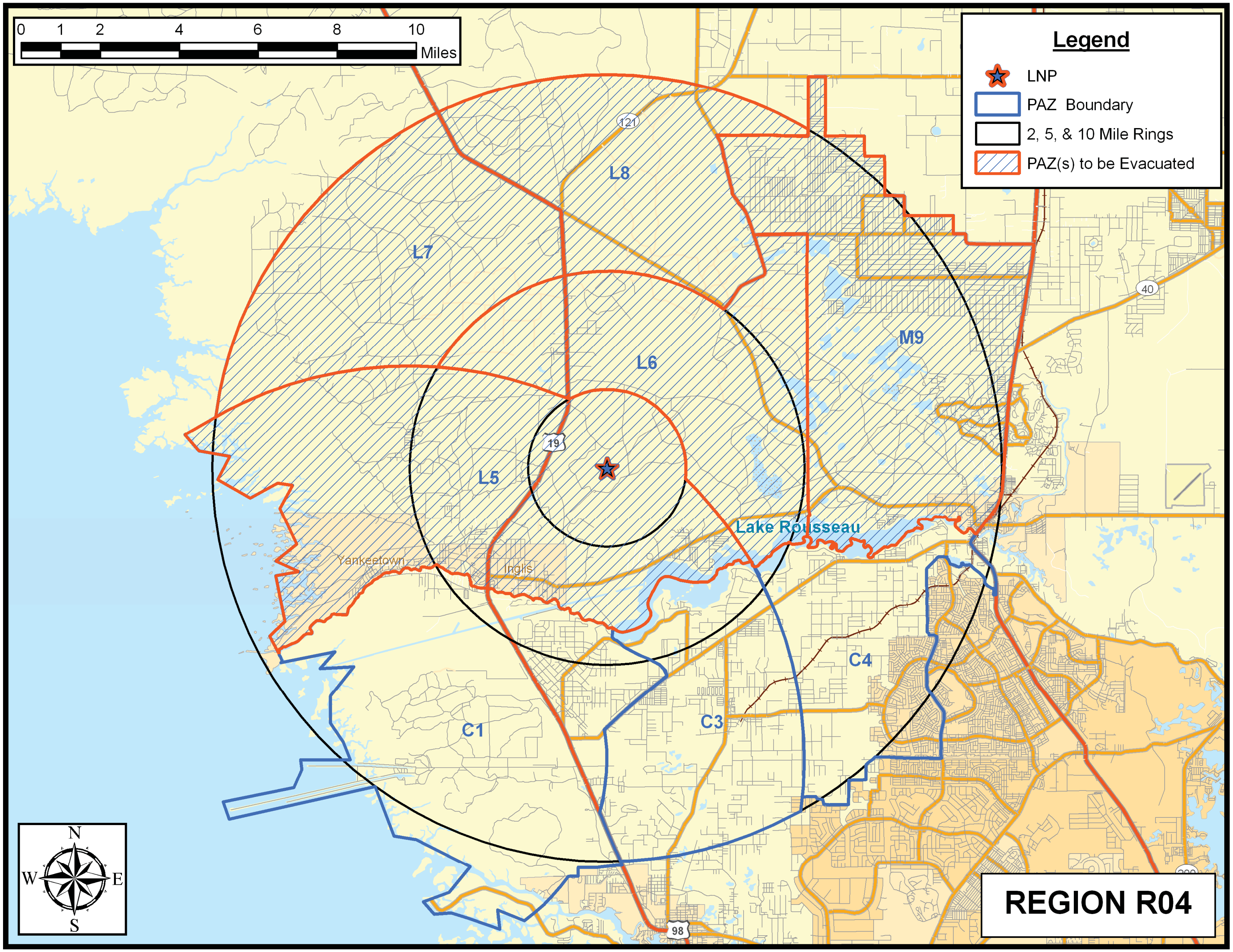

0 1 2 4 6 8 10
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
L5
L6
L7
L8
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
19
40
98
121
N
S
E
W
REGION R01

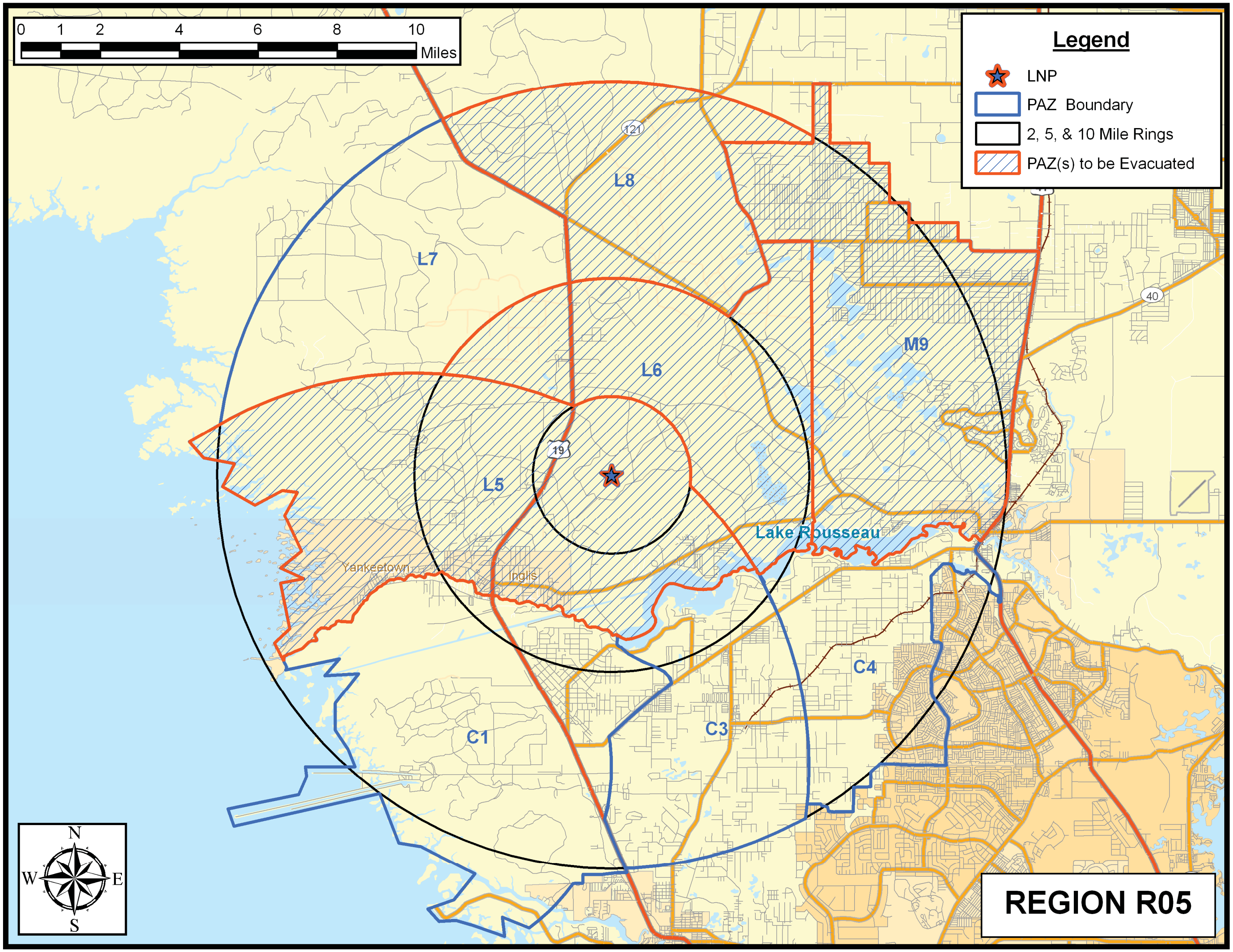


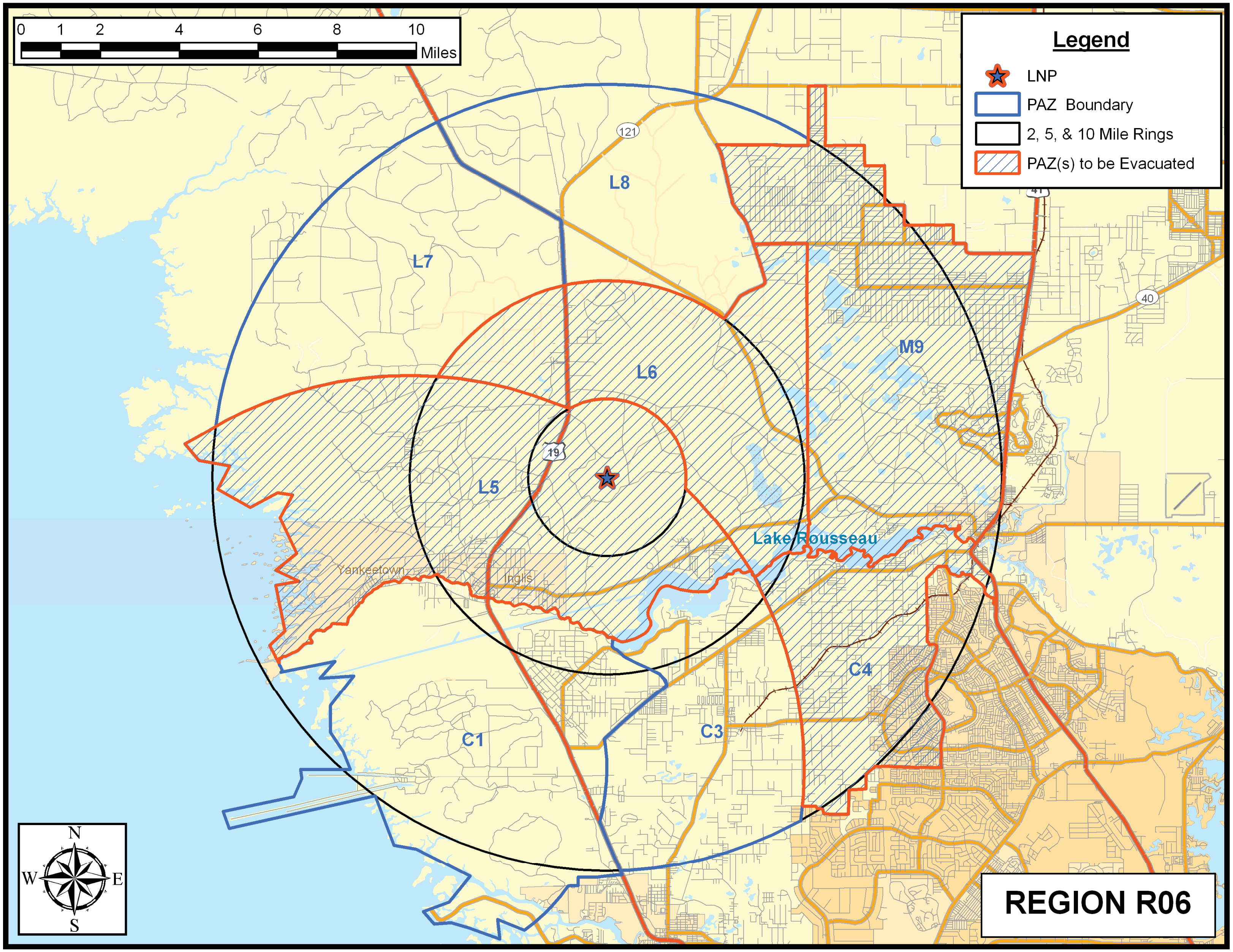
0
1
2
4
6
8
10
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
121
L8
L7
40
M9
L6
19
L5
Lake
Rousseau
Yankeetown
Inglis
C4
C1
C3
N
W
E
S
REGION R02
98



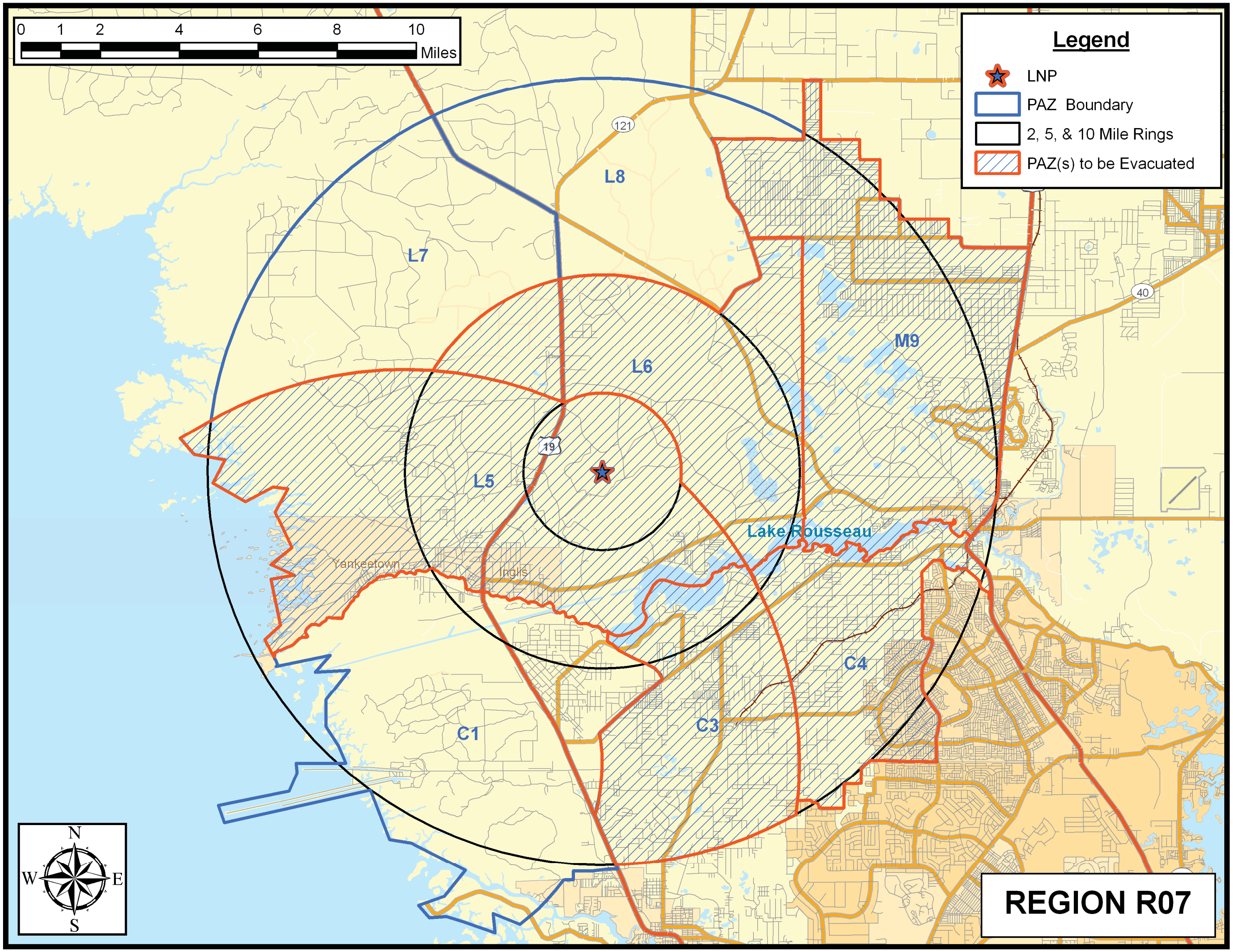
0
1
2
4
6
8
10
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
L8
L7
L6
L5
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
121
19
40
98
200
N
W
E
S
REGION R03

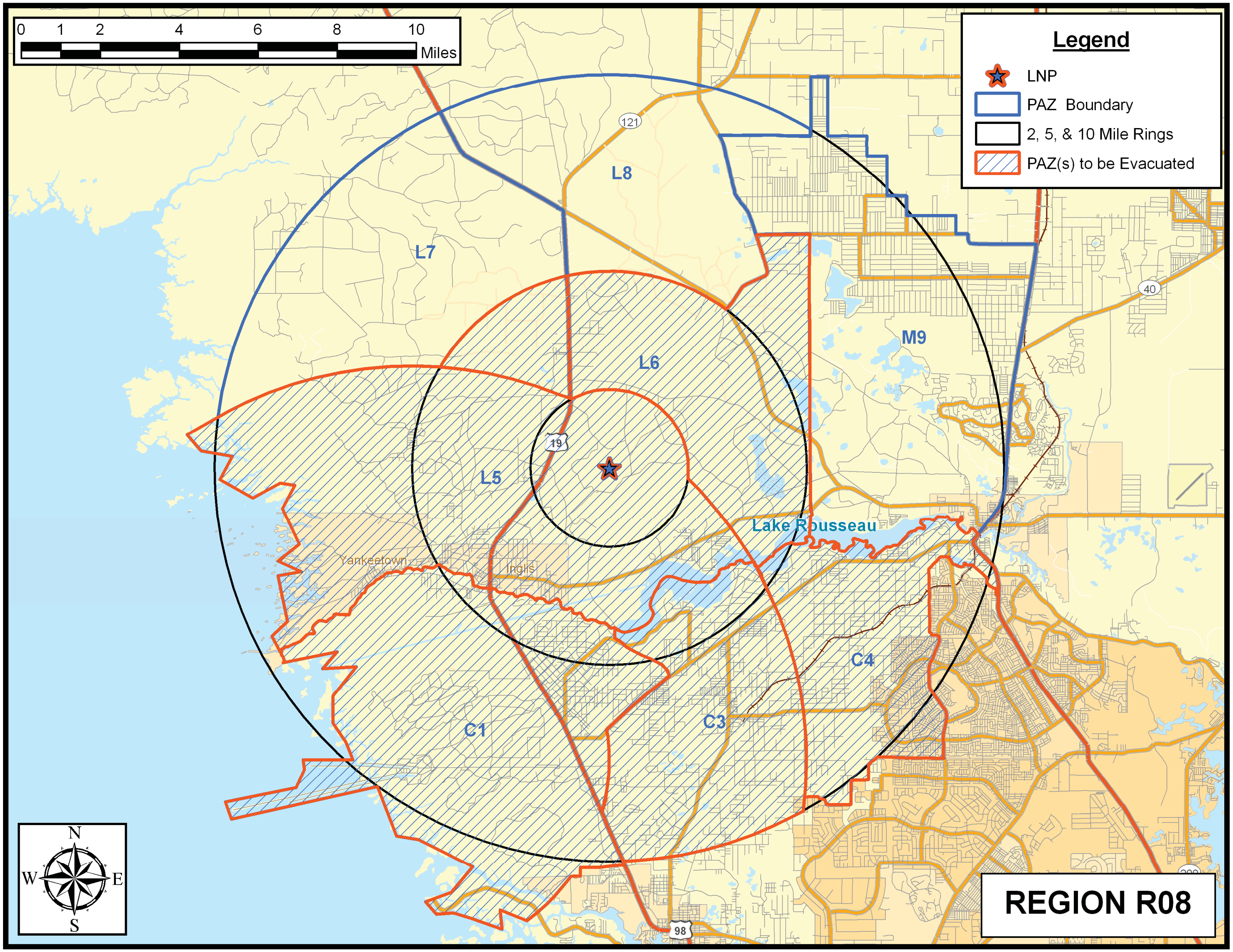

0 1 2 4 6 8 10
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
REGION R04
L5
L6
L7
L8
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
19
40
98
121
N
S
E
W

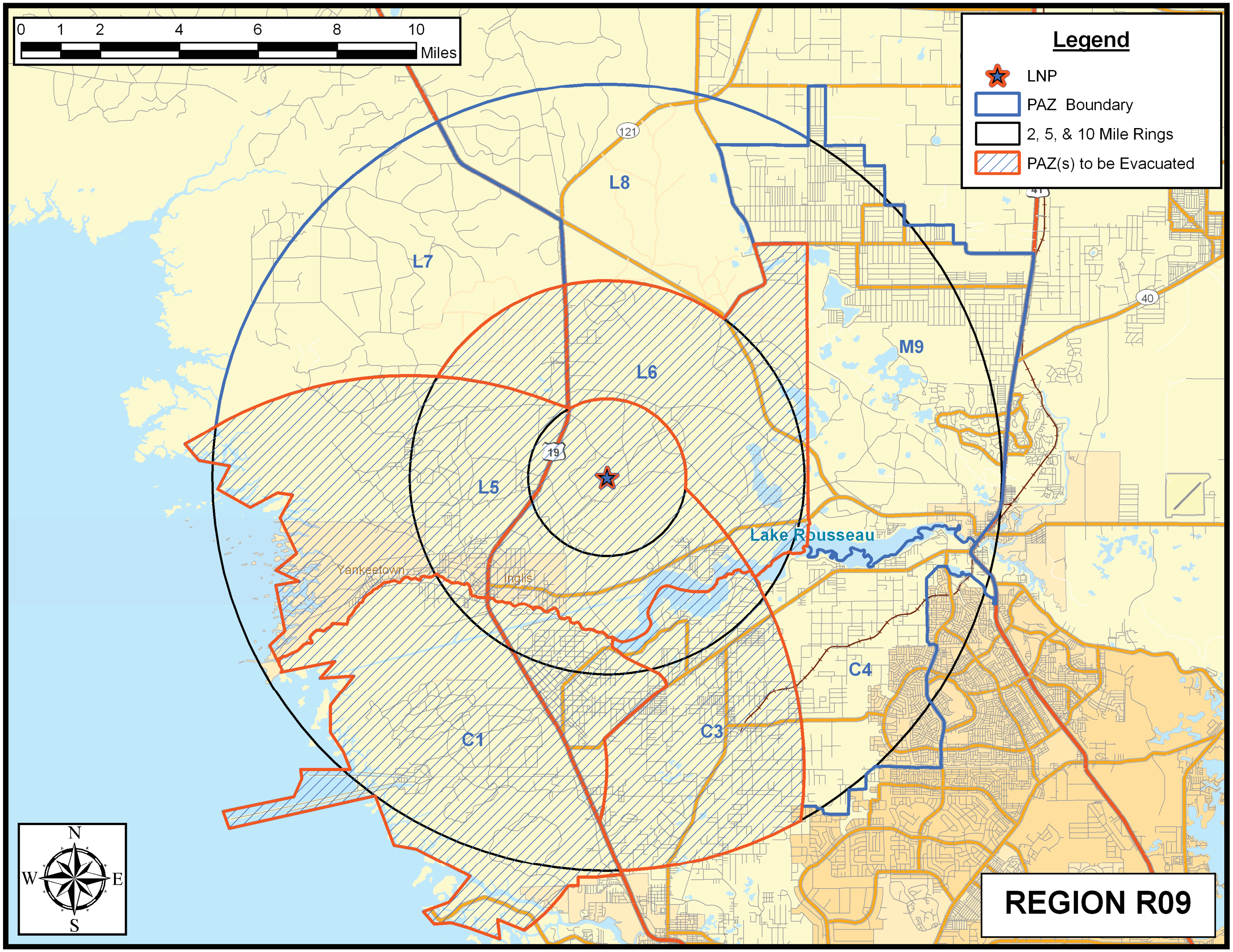

0
1
2
4
6
8
10
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
L8
L7
L6
L5
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
121
19
40
N
W
E
S
REGION R05

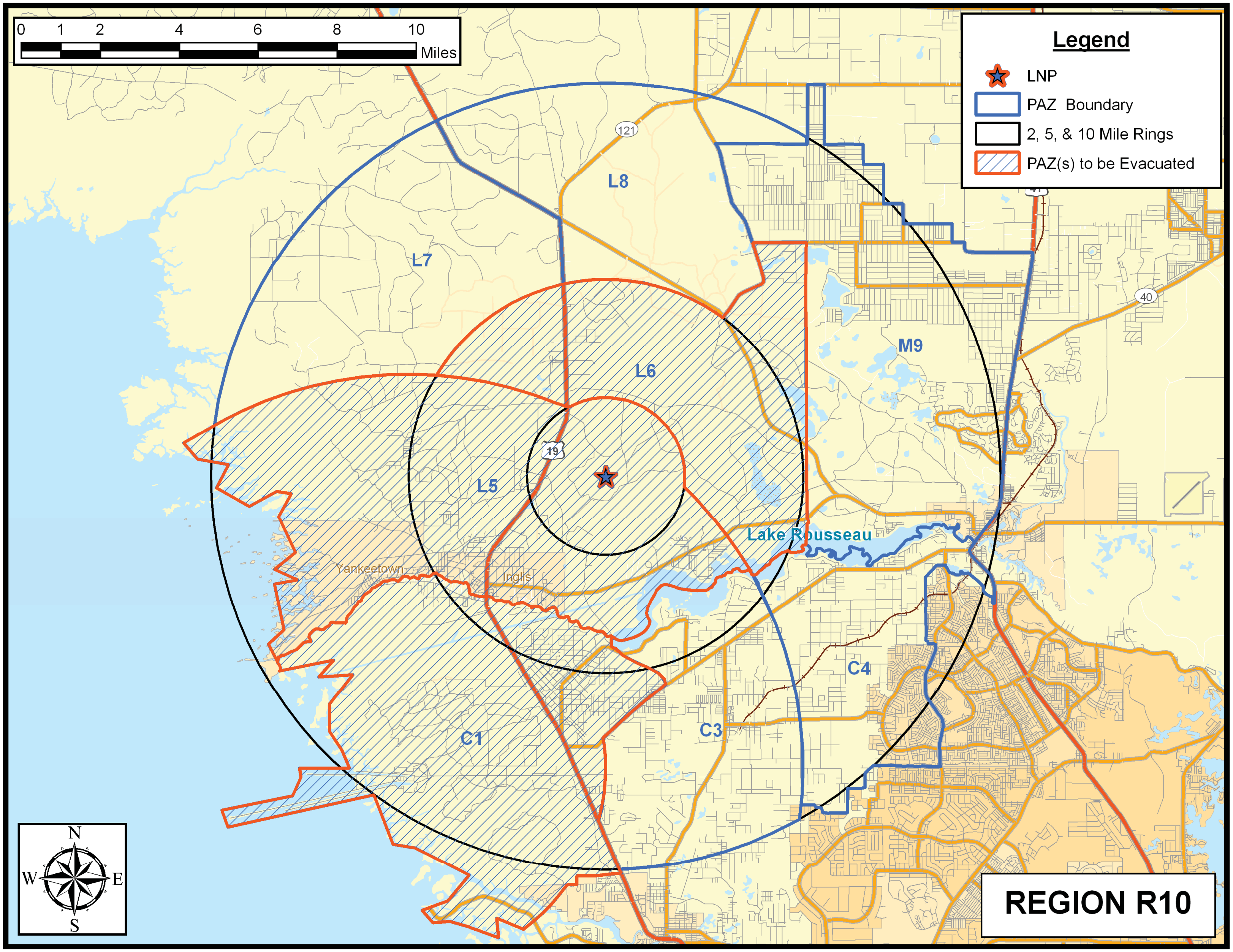


0 1 2 4 6 8 10
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
REGION R06
L5
L6
L7
L8
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
19
121
40
41
N
S
E
W


0
1
2
4
6
8
10
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
121
40
19
L8
L7
L6
L5
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
N
W
E
S
REGION R07


0 1 2 4 6 8 10
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
L7
L8
L6
L5
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
121
19
40
98
N
W
E
S
REGION R08


0 1 2 4 6 8 10
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
L8
L7
L6
L5
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
121
40
19
N
W
E
S
REGION R09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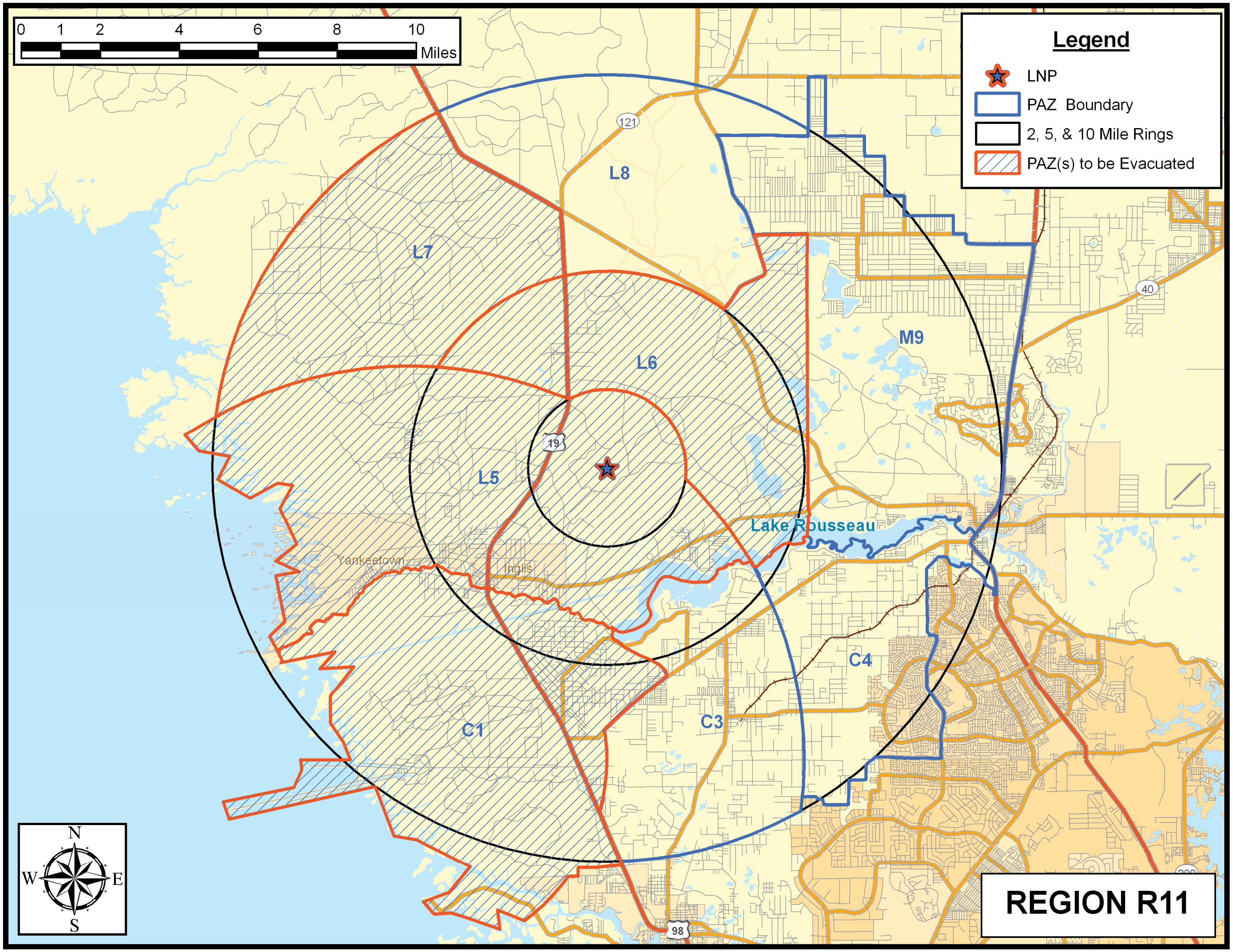
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
L8
L7
L6
L5
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
121
19
40
N
W
E
S
REGION R10


0
1
2
4
6
8
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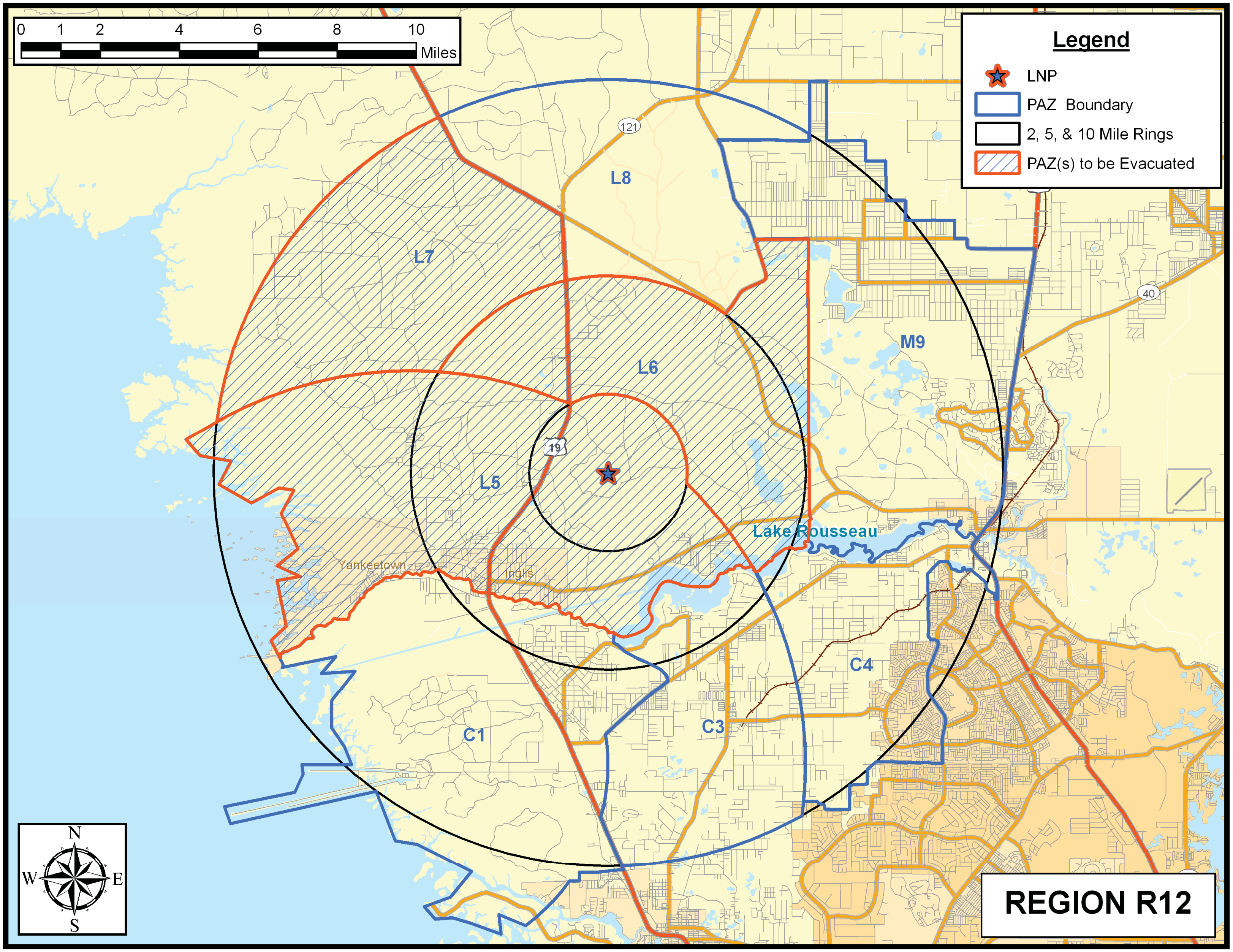
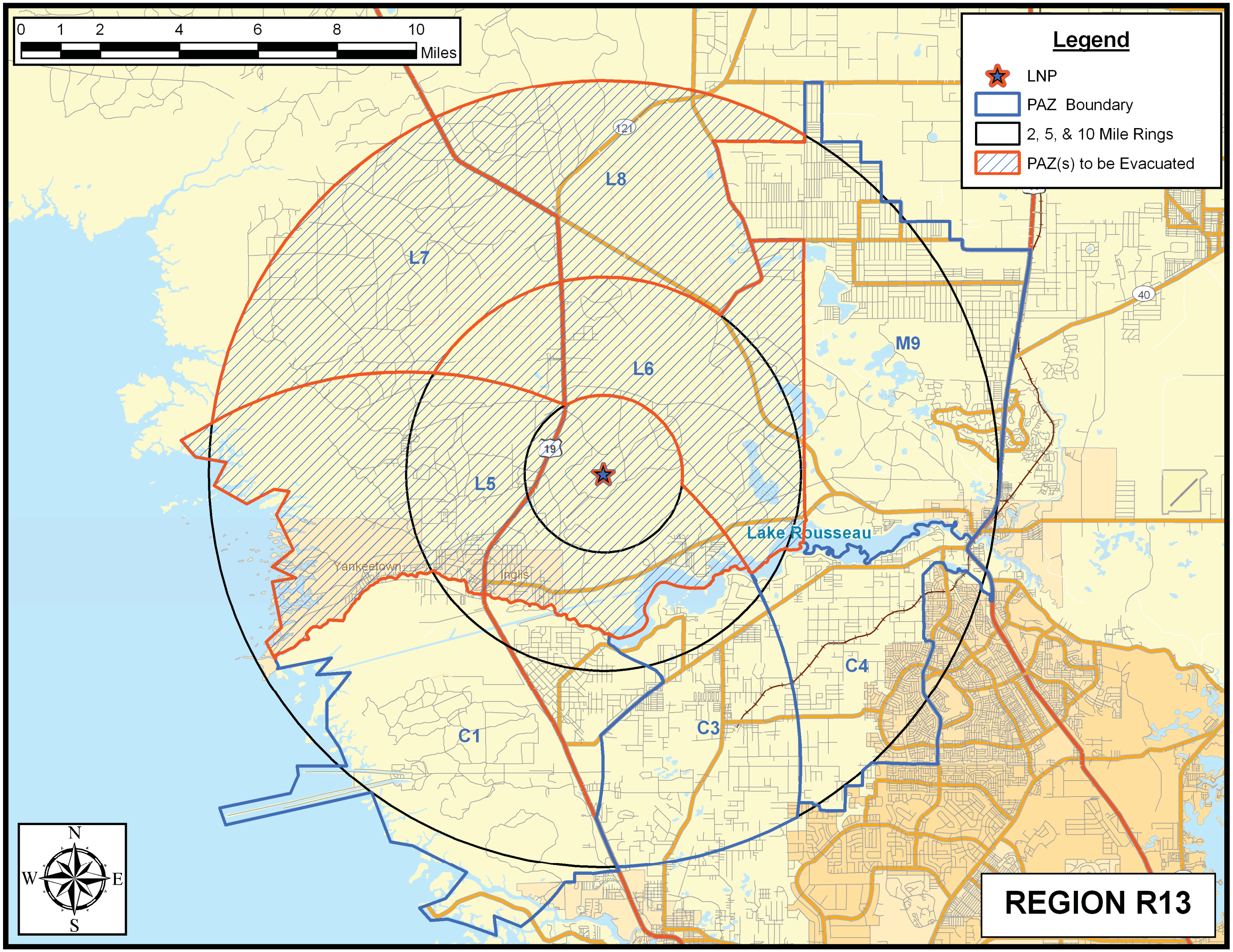
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
L7
L8
L6
L5
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
121
19
40
98
N
S
E
W
REGION R11


0 1 2 4 6 8 10
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
L8
L7
L6
L5
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
121
40
19
N
W
E
S
REGION R12



0 1 2 4 6 8 10
Miles
Legend
LNP
PAZ Boundary
2, 5, & 10 Mile Rings
PAZ(s) to be Evacuated
121
40
19
L8
L7
L6
L5
M9
C1
C3
C4
Lake Rousseau
Yankeetown
Inglis
N
W
E
S
REGION R13

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 8, Region 3; a winter, weekend, midday, good weather evacuation for 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 Region		
	2-Mile Region (R01)	5-Mile Region (R02)	Entire EPZ (R03)
4 Hours	4:00	4:00	4:10
5 Hours (Base)	5:00	5:00	5:10
6 Hours	6:00	6:00	6:10

As the mobilization time is reduced, the change in traffic loading does not cause congestion. Hence the ETE reflects the duration of trip generation. The results confirm the importance of accurately estimating the trip generation times. The evacuation time estimates closely mirror the values for the time the last evacuation trip is generated. The reason for this is the lack of prolonged traffic congestion during an evacuation. The results indicate that programs to educate the public and encourage them toward faster responses for a radiological emergency can considerably enhance county emergency planning programs.

A sensitivity study was also conducted to determine the effects on ETE of changes in the percentage of people who decide to relocate from the Shadow Region. The movement of people in the Shadow Region has the potential to impede vehicles evacuating from an Evacuation Region within the EPZ.

Table I-2 presents the evacuation time estimates for each of these cases. The ETE for all regions remain unchanged as the percentage of people who decide to relocate from areas within the Shadow Region increases from 15% to 60%. There are a total of 50,324 people (31,089 vehicles) within the Shadow Region.

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

Shadow Data			Evacuation Region		
Percent Shadow Evacuation	**Number of Shadow Residents**	**Number of Shadow Resident Vehicles**	**2-Mile Region (R01)**	**5-Mile Region (R02)**	**Entire EPZ (R03)**
15	7,549	4,663	5:00	5:00	5:10
30 (Base)	15,098	9,327	5:00	5:00	5:10
60	30,196	18,653	5:00	5:00	5:10

A sensitivity study was conducted to measure the effects of a simultaneous evacuation of the EPZs for both the Levy Nuclear Plant and the Crystal River Nuclear Plant during Scenario 6 conditions. The combined EPZ differs from the LNP EPZ with the addition of PAZ C2 within the Crystal River EPZ, as shown in Figure I-1. All people living between the two plants (mostly Yankeetown and Inglis residents) were routed east along State Route 40 into Dunnellon and then out of the EPZ, rather than using US Route 19/98 – a high speed, high capacity roadway. This change in routing and the addition of the population in PAZ C2 increases congestion (especially in Dunnellon) and increases the ETE at the 50th, 90th and 95th percentiles by 0, 25 and 5 minutes, respectively. The results of this study are provided in Table I-3.

Table I-3. Combined Crystal River/Levy ETE – Scenario 6 Conditions

Percentile	50%	90%	95%	100%
Levy (Region R03)	1:25	2:50	3:40	5:10
Crystal River (Region R02)	1:25	3:00	3:40	5:00
Combined	1:25	3:15	3:45	5:10

The increased congestion in the combined EPZ results in lower average speeds. Those people in Yankeetown and Inglis who were evacuating on US Route 19/98 are now traveling east on State Route 40 and experience significant delay and reductions in speed in Dunnellon. The average speed of 44.2 mph reported on page 8-8 decreased to 30.0 mph. Therefore, a simultaneous evacuation of both EPZs (although a highly unlikely event) would increase ETE and decrease average travel speeds.

The eastbound routing of evacuees from Yankeetown and Inglis along State Highway 40 increases the ETE for these residents. For an evacuation of the Levy plant alone, they would evacuate southbound on US Highway 19/98, a higher capacity, higher speed road than State Highway 40. Also, the ETE for Dunnellon residents is increased by a simultaneous evacuation in that the available roadway capacity in the area would also be used by Yankeetown and Inglis evacuees. The ETE for Citrus Springs may be increased slightly by a simultaneous evacuation in that those evacuating through Dunnellon may proceed southbound along US Highway 41 and travel through Citrus Springs. The ETE for the City of Crystal River is not impacted by the simultaneous evacuation. The city is on the southern portion of the Crystal River Nuclear Plant EPZ and is outside of the Levy Nuclear Plant EPZ. The routing for Crystal River is the same for a simultaneous evacuation of both plants as it would be for an evacuation of only the Crystal River Nuclear Plant. Also, no traffic is re-routed from other populated areas through Crystal River in the event of a simultaneous evacuation.

There is considerable overlap of the EPZs for the Crystal River Nuclear Plant (CRNP) and the Levy Nuclear Plant (LNP). The only Protective Action Zone (PAZ) within the CRNP EPZ that is not within the LNP EPZ is PAZ C2 in Citrus County. Therefore, only the resources for Citrus County would be affected by a simultaneous evacuation of both EPZs. The following data are provided for PAZ C2 in Revision 1 of the CRNP ETE

prepared by KLD Associates in January 2008:

- Table 8-2 – 60 school buses needed for the schools in PAZ C2.
- Table 8-4 – 3 buses, 24 ambulances, 12 wheelchair buses and 2 wheelchair vans needed for the medical facilities in PAZ C2.
- Table 8-6 and Figure 8-2 – transit- dependent bus routes 6, 7 and 8 service PAZ C2. There are a total of 8 buses on these routes.
- Assume homebound special needs is the same for PAZ C2 as it is for the Citrus County portion of the Levy EPZ; therefore 1 bus and 6 wheelchair vans (see Table 8-9) are needed.

Table I-4 summarizes the Citrus County data from Table 8-11 and the data presented above for the evacuation of the CRNP EPZ. Comparing the available resources with the resources needed indicates that there is a shortage of ambulances and wheelchair vans. The shortage of wheelchair vans can be addressed using the surplus of wheelchair buses in the county. The shortage of ambulances can be resolved by establishing a mutual aid agreement with Marion County, who has excess ambulance resources, as noted in Table 8-11.

Table I-4. Available and Required Transit Resources for Citrus County (Levy and Crystal River Nuclear Plants Combined)

Requirements	Buses	Ambulances	Wheelchair Vans	Wheelchair Buses
Citrus County				
Available Resources	158	11	8	68
School	73	0	0	0
Medical Facilities	7	34	4	14
Transit Routes	16	0	0	0
Homebound Special Needs	2	0	12	0
Total Resources Needed	98	34	16	14

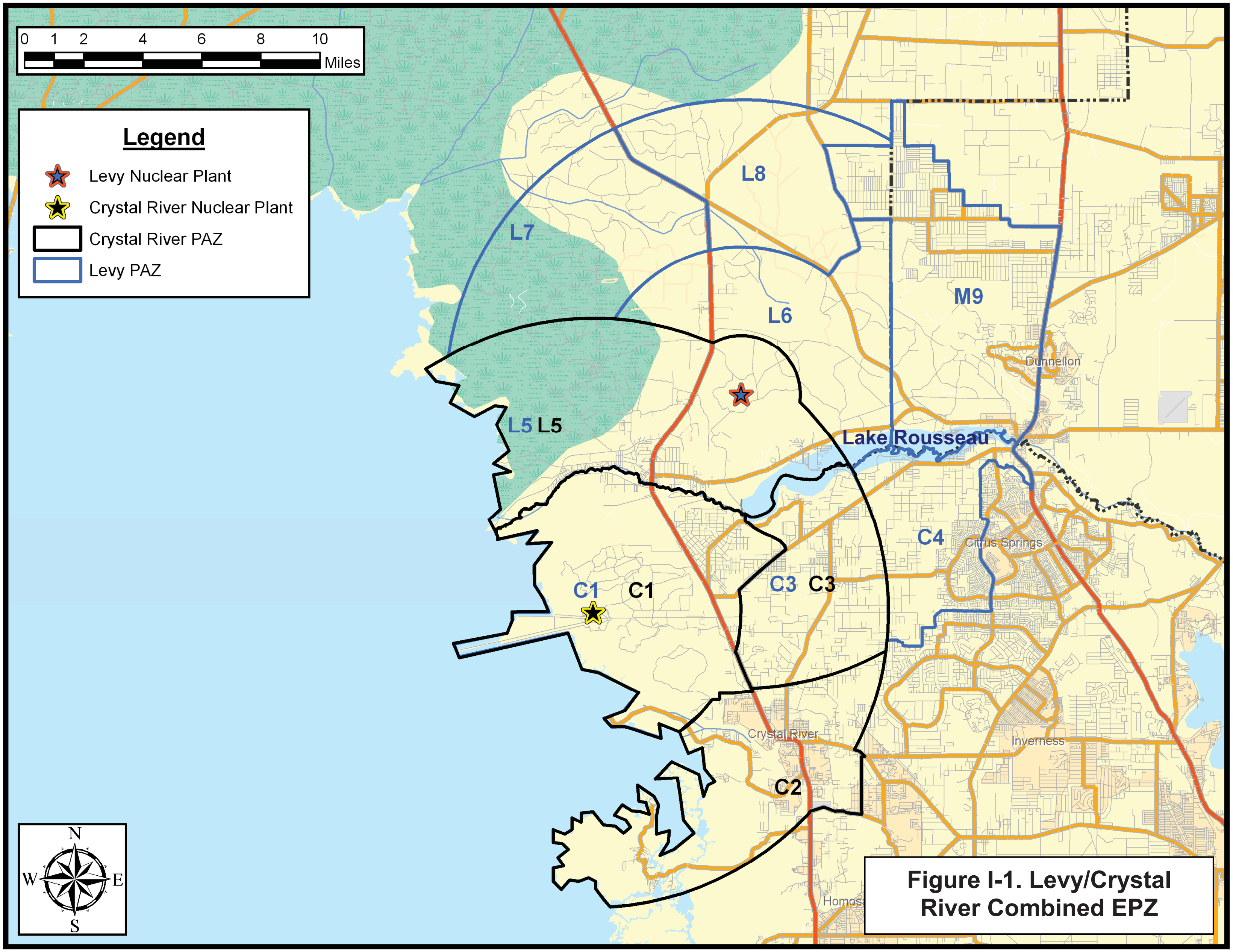


Figure I-1. Levy/Crystal River Combined EPZ

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 13 Regions and all 11 Scenarios (Tables J-1A through J-1D).

Plots of Evacuating Vehicles vs. Elapsed Time leaving the 2-mile and 5-mile circular areas around the Levy Nuclear Plant and the entire EPZ for Region R03, for all 11 scenarios are presented. 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 13 Evacuation Regions and all 11 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**:
   - The Season
     - Summer
     - Winter (also Autumn and Spring)
   - The Day of Week
     - Midweek (work-day)
     - Weekend, Holiday

- The Time of Day
  - Midday (work and commuting hours)
  - Evening
- Weather Condition
  - Good Weather
  - Rain
- Special Event (if any)
  - New Plant Construction

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, Scenario (9) applies.
- The seasons are defined as follows:
  - Summer implies that public schools are in summer session (assumed 10% enrollment of regular school year).
  - 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 (and column in the Table) 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 Levy Nuclear Plant. 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 R13)
- Enter Table J-2 and identify the applicable group of candidate Regions based on the wind direction and on the distance that the selected Region extends from LNP. 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.

<u>Example</u>

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 95 percent of the population from within the impacted Region.

Table J-1C is applicable because the 95th-percentile population is desired. Proceed as follows:

1. Identify the Scenario as summer, weekend, evening and raining. Entering Table J-1C, 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 group entitled “Evacuate 5-Mile Ring and Downwind to EPZ Boundary”. Under “Wind Direction Towards:”, identify the NE (northeast) azimuth and read REGION R05 in the first column of that row.

3. Enter Table J-1C to locate the data cell containing the value of ETE for Scenario 4 and Region R05. This data cell is in column (4) and in the row for Region R05; it contains the ETE value of **3:00**.

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		Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)
	Midday		Midday		Evening		Midday		Midday		Evening		Midday
Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ													
R01 2-mile ring	1:15	1:20	1:15	1:20	1:10	R01 2-mile ring	1:15	1:20	1:15	1:20	1:10	R01 2-mile ring	1:30
R02 5-mile ring	1:20	1:20	1:10	1:15	1:10	R02 5-mile ring	1:20	1:25	1:10	1:20	1:10	R02 5-mile ring	1:25
R03 Entire EPZ	1:25	1:30	1:20	1:25	1:15	R03 Entire EPZ	1:25	1:30	1:20	1:25	1:15	R03 Entire EPZ	1:40
2-Mile Ring and Downwind to 5 Miles													
Same As R01 SSE, S, SSW, SW, WSW, W	1:15	1:20	1:15	1:20	1:10	Same As R01 SSE, S, SSW, SW, WSW, W	1:15	1:20	1:15	1:20	1:10	Same As R01 SSE, S, SSW, SW, WSW, W	1:30
Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	1:20	1:20	1:10	1:15	1:10	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	1:20	1:25	1:10	1:20	1:10	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	1:25
5-Mile Ring and Downwind to EPZ Boundary													
R04 N	1:20	1:25	1:10	1:15	1:10	R04 N	1:20	1:25	1:15	1:15	1:10	R04 N	1:30
R05 NNE, NE	1:20	1:25	1:10	1:15	1:10	R05 NNE, NE	1:20	1:25	1:15	1:15	1:10	R05 NNE, NE	1:30
R06 ENE, E	1:20	1:25	1:15	1:15	1:10	R06 ENE, E	1:20	1:25	1:15	1:20	1:10	R06 ENE, E	1:30
R07 ESE, SE	1:25	1:25	1:15	1:20	1:15	R07 ESE, SE	1:25	1:25	1:15	1:20	1:15	R07 ESE, SE	1:35
R08 SSE	1:25	1:30	1:15	1:20	1:15	R08 SSE	1:25	1:30	1:20	1:20	1:15	R08 SSE	1:35
R09 S, SSW	1:25	1:30	1:15	1:20	1:10	R09 S, SSW	1:25	1:30	1:15	1:20	1:10	R09 S, SSW	1:35
R10 SW, WSW	1:25	1:30	1:15	1:20	1:15	R10 SW, WSW	1:25	1:30	1:15	1:25	1:15	R10 SW, WSW	1:30
R11 W	1:25	1:30	1:20	1:25	1:15	R11 W	1:25	1:30	1:20	1:25	1:15	R11 W	1:30
R12 WNW	1:20	1:25	1:15	1:20	1:10	R12 WNW	1:20	1:25	1:15	1:20	1:10	R12 WNW	1:25
R13 NW,NNW	1:20	1:25	1:15	1:20	1:10	R13 NW,NNW	1:20	1:25	1:15	1:20	1:10	R13 NW,NNW	1:25

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		Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)
	Midday		Midday		Evening		Midday		Midday		Evening		Midday
Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ													
R01 2-mile ring	2:15	2:25	2:10	2:20	2:00	R01 2-mile ring	2:15	2:25	2:10	2:20	2:00	R01 2-mile ring	3:00
R02 5-mile ring	2:25	2:30	2:10	2:20	2:05	R02 5-mile ring	2:20	2:30	2:10	2:20	2:05	R02 5-mile ring	3:00
R03 Entire EPZ	2:50	2:55	2:30	2:40	2:35	R03 Entire EPZ	2:50	2:55	2:35	2:45	2:35	R03 Entire EPZ	3:20
2-Mile Ring and Downwind to 5 Miles													
Same As R01 SSE, S, SSW, SW, WSW, W	2:15	2:25	2:10	2:20	2:00	Same As R01 SSE, S, SSW, SW, WSW, W	2:15	2:25	2:10	2:20	2:00	Same As R01 SSE, S, SSW, SW, WSW, W	3:00
Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	2:25	2:30	2:10	2:20	2:05	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	2:20	2:30	2:10	2:20	2:05	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	3:00
5-Mile Ring and Downwind to EPZ Boundary													
R04 N	2:40	2:40	2:20	2:30	2:25	R04 N	2:40	2:40	2:20	2:30	2:25	R04 N	3:00
R05 NNE, NE	2:40	2:40	2:20	2:30	2:25	R05 NNE, NE	2:40	2:40	2:20	2:30	2:25	R05 NNE, NE	3:00
R06 ENE, E	2:45	2:45	2:25	2:30	2:30	R06 ENE, E	2:45	2:45	2:25	2:30	2:30	R06 ENE, E	3:00
R07 ESE, SE	2:50	2:50	2:30	2:35	2:35	R07 ESE, SE	2:50	2:50	2:30	2:40	2:35	R07 ESE, SE	3:10
R08 SSE	2:45	2:50	2:30	2:40	2:30	R08 SSE	2:45	2:55	2:35	2:45	2:30	R08 SSE	3:20
R09 S, SSW	2:40	2:50	2:30	2:40	2:25	R09 S, SSW	2:45	2:55	2:35	2:50	2:25	R09 S, SSW	3:20
R10 SW, WSW	2:35	2:50	2:30	2:40	2:20	R10 SW, WSW	2:40	2:55	2:30	2:45	2:20	R10 SW, WSW	3:20
R11 W	2:35	2:50	2:30	2:40	2:20	R11 W	2:40	2:55	2:30	2:45	2:20	R11 W	3:20
R12 WNW	2:25	2:30	2:10	2:25	2:10	R12 WNW	2:25	2:30	2:15	2:25	2:10	R12 WNW	3:00
R13 NW,NNW	2:25	2:35	2:15	2:25	2:10	R13 NW,NNW	2:25	2:35	2:15	2:25	2:10	R13 NW,NNW	3:00

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

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

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		Weekend
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)
	Midday		Midday		Evening		Midday		Midday		Evening		Midday
Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind Towards:	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ													
R01 2-mile ring	5:00	5:00	5:00	5:00	5:00	R01 2-mile ring	5:00	5:00	5:00	5:00	5:00	R01 2-mile ring	5:00
R02 5-mile ring	5:00	5:00	5:00	5:00	5:00	R02 5-mile ring	5:00	5:00	5:00	5:00	5:00	R02 5-mile ring	5:00
R03 Entire EPZ	5:10	5:10	5:10	5:10	5:10	R03 Entire EPZ	5:10	5:10	5:10	5:10	5:10	R03 Entire EPZ	5:10
2-Mile Ring and Downwind to 5 Miles													
Same As R01 SSE, S, SSW, SW, WSW, W	5:00	5:00	5:00	5:00	5:00	Same As R01 SSE, S, SSW, SW, WSW, W	5:00	5:00	5:00	5:00	5:00	Same As R01 SSE, S, SSW, SW, WSW, W	5:00
Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	5:00	5:00	5:00	5:00	5:00	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	5:00	5:00	5:00	5:00	5:00	Same As R02 WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE	5:00
5-Mile Ring and Downwind to EPZ Boundary													
R04 N	5:10	5:10	5:05	5:10	5:10	R04 N	5:10	5:10	5:05	5:10	5:10	R04 N	5:10
R05 NNE, NE	5:10	5:10	5:05	5:10	5:10	R05 NNE, NE	5:10	5:10	5:05	5:10	5:10	R05 NNE, NE	5:10
R06 ENE, E	5:10	5:10	5:05	5:10	5:05	R06 ENE, E	5:10	5:10	5:05	5:10	5:05	R06 ENE, E	5:10
R07 ESE, SE	5:10	5:10	5:05	5:10	5:05	R07 ESE, SE	5:10	5:10	5:10	5:10	5:10	R07 ESE, SE	5:10
R08 SSE	5:10	5:10	5:10	5:10	5:10	R08 SSE	5:10	5:10	5:10	5:10	5:10	R08 SSE	5:10
R09 S, SSW	5:10	5:10	5:10	5:10	5:10	R09 S, SSW	5:10	5:10	5:10	5:10	5:10	R09 S, SSW	5:10
R10 SW, WSW	5:10	5:10	5:10	5:10	5:10	R10 SW, WSW	5:10	5:10	5:10	5:10	5:10	R10 SW, WSW	5:10
R11 W	5:10	5:10	5:10	5:10	5:10	R11 W	5:10	5:10	5:10	5:10	5:10	R11 W	5:10
R12 WNW	5:00	5:00	5:00	5:00	5:00	R12 WNW	5:00	5:00	5:00	5:00	5:00	R12 WNW	5:00
R13 NW,NNW	5:00	5:05	5:00	5:00	5:05	R13 NW,NNW	5:05	5:05	5:00	5:05	5:05	R13 NW,NNW	5:05

Table J-2. Description of Evacuation Regions									
		PAZ							
Region	Description	C1	C3	C4	L5	L6	L7	L8	M9
R01	2 mile ring				X				
R02	5-mile ring				X	X			
R03	Full EPZ	X	X	X	X	X	X	X	X
Evacuate 2 mile ring and 5 miles downwind									
		PAZ							
Region	Wind Direction Towards:	C1	C3	C4	L5	L6	L7	L8	M9
Refer to R02	WNW, NW, NNW, N, NNE, NE, ENE, E, ESE, SE				X	X			
Refer to R01	SSE, S, SSW, SW, WSW, W				X				
Evacuate 5 mile ring and downwind to EPZ boundary									
		PAZ							
Region	Wind Direction Towards:	C1	C3	C4	L5	L6	L7	L8	M9
R04	N				X	X	X	X	X
R05	NNE, NE				X	X		X	X
R06	ENE, E			X	X	X			X
R07	ESE, SE		X	X	X	X			X
R08	SSE	X	X	X	X	X			
R09	S, SSW	X	X		X	X			
R10	SW, WSW	X			X	X			
R11	W	X			X	X	X		
R12	WNW				X	X	X		
R13	NW, NNW				X	X	X	X	

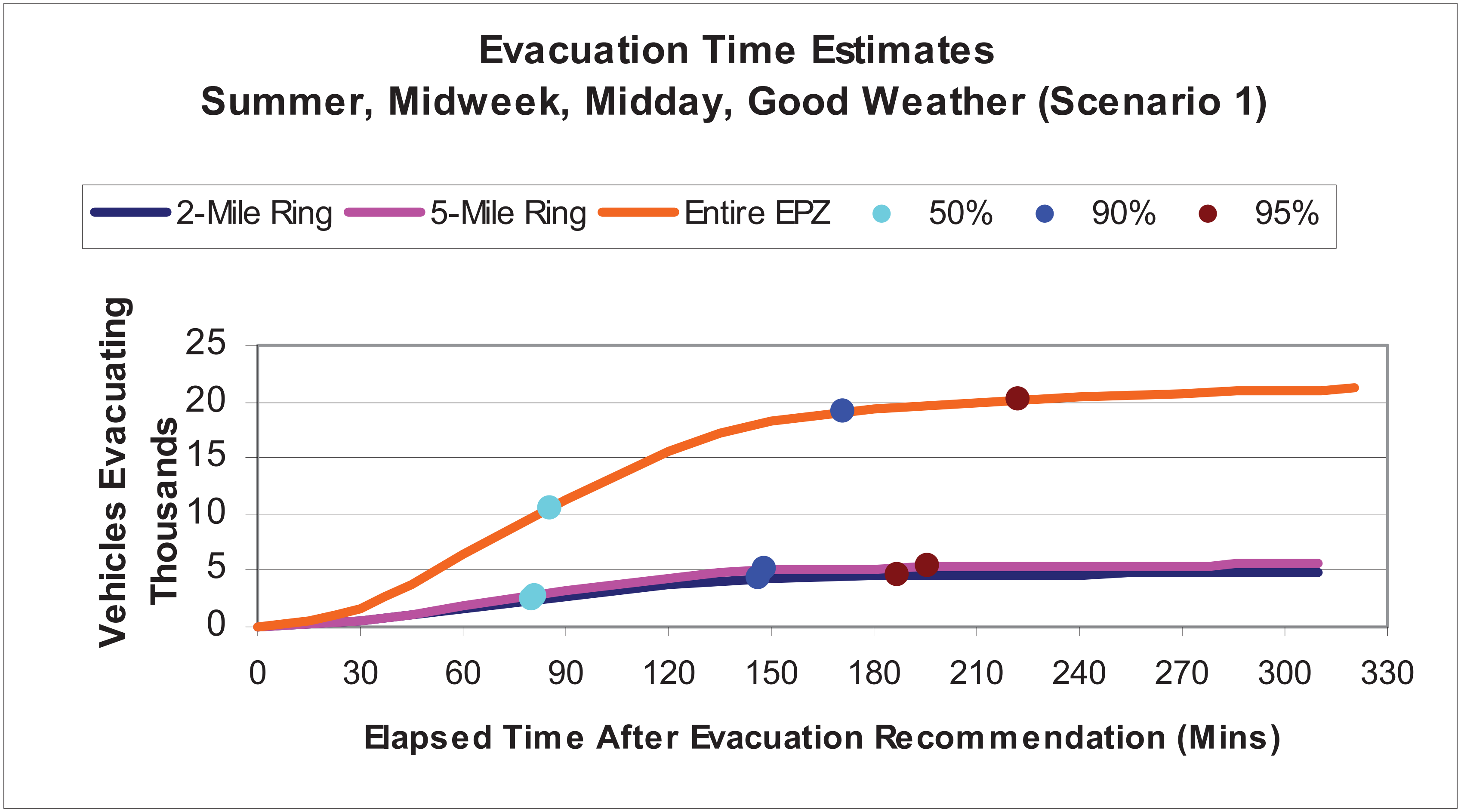


Figure J-1. Evacuation Time Estimates – Scenario 1 for Region R03 (Entire EPZ)

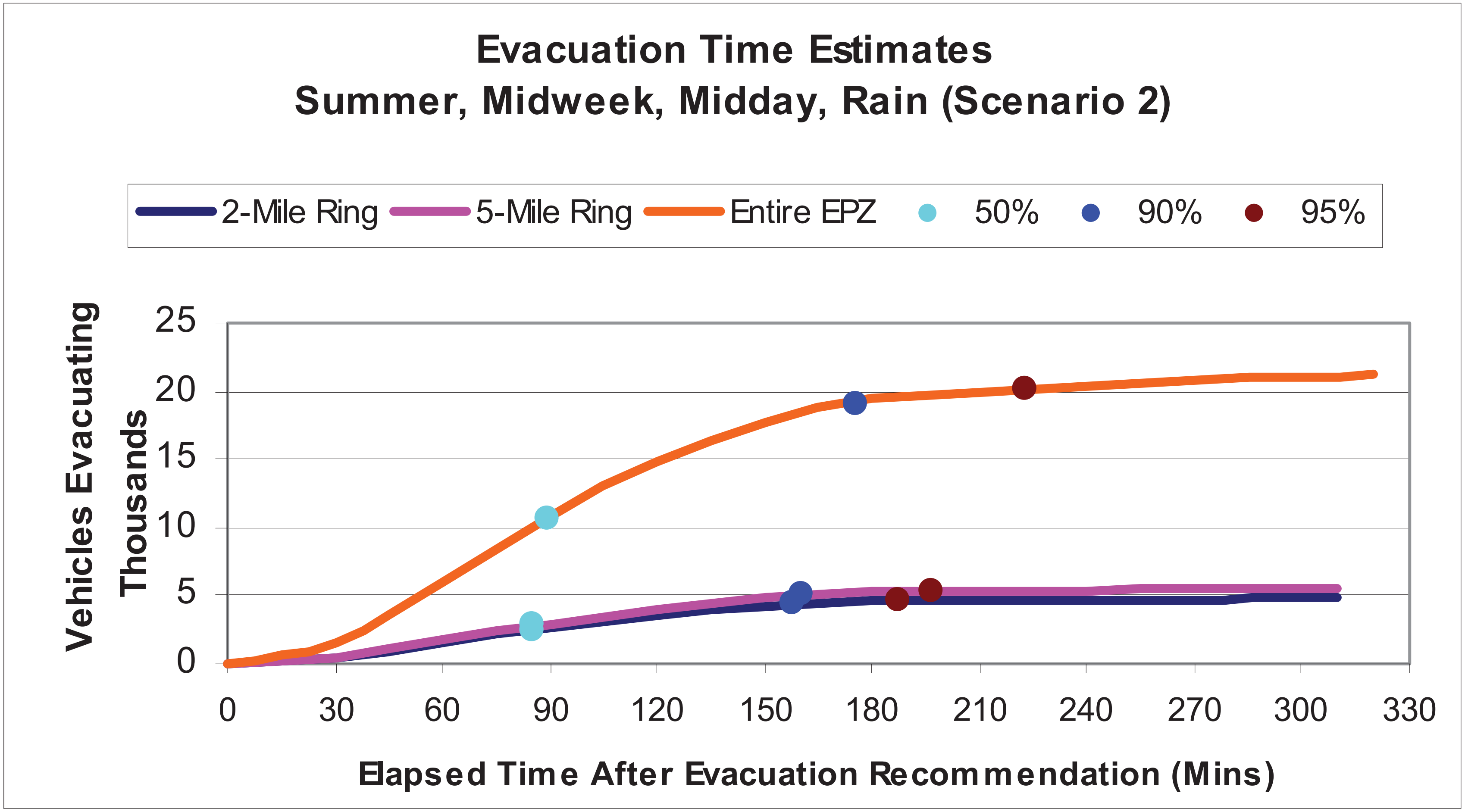


Figure J-2. Evacuation Time Estimates – Scenario 2 for Region R03 (Entire EPZ)

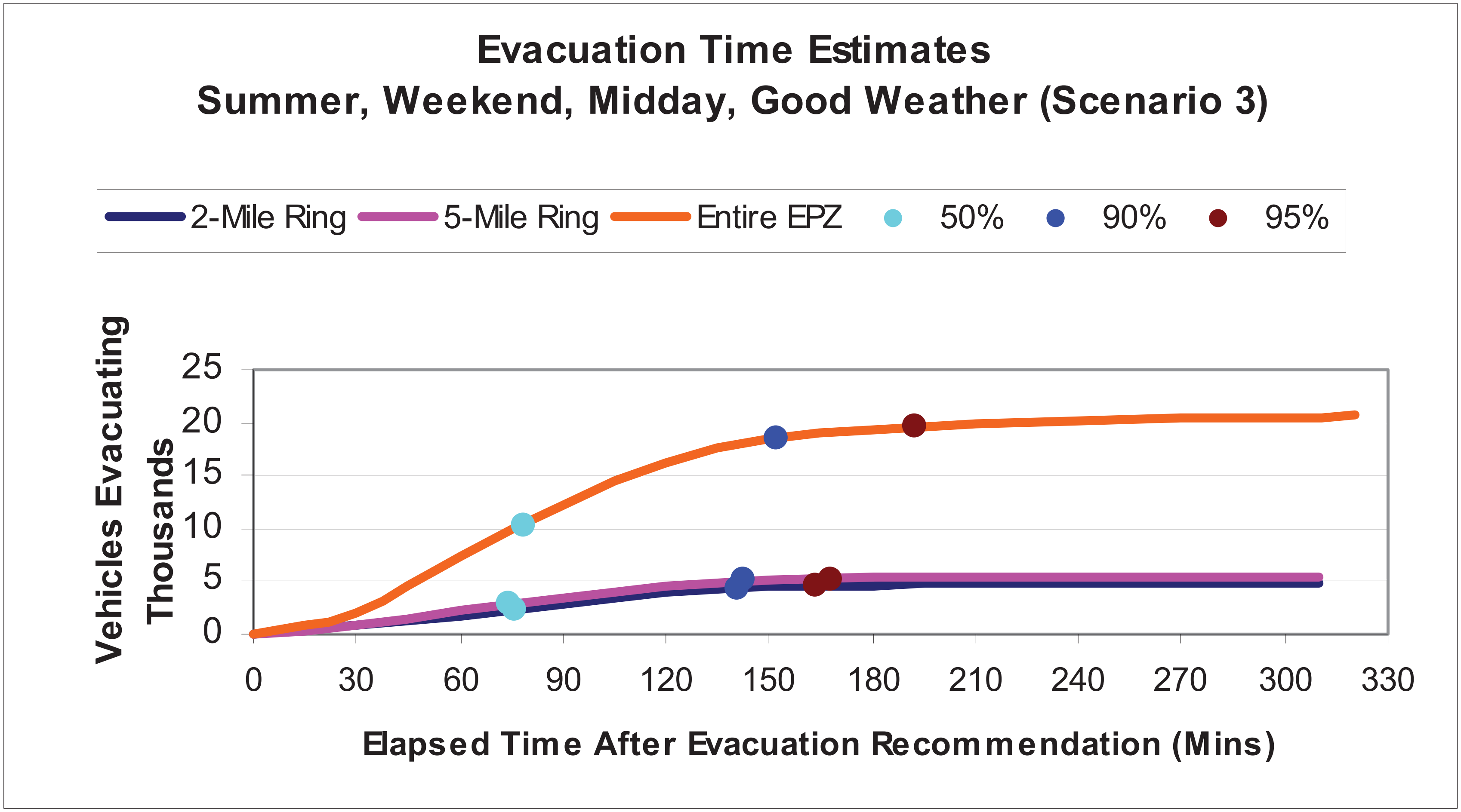


Figure J-3. Evacuation Time Estimates – Scenario 3 for Region R03 (Entire EPZ)

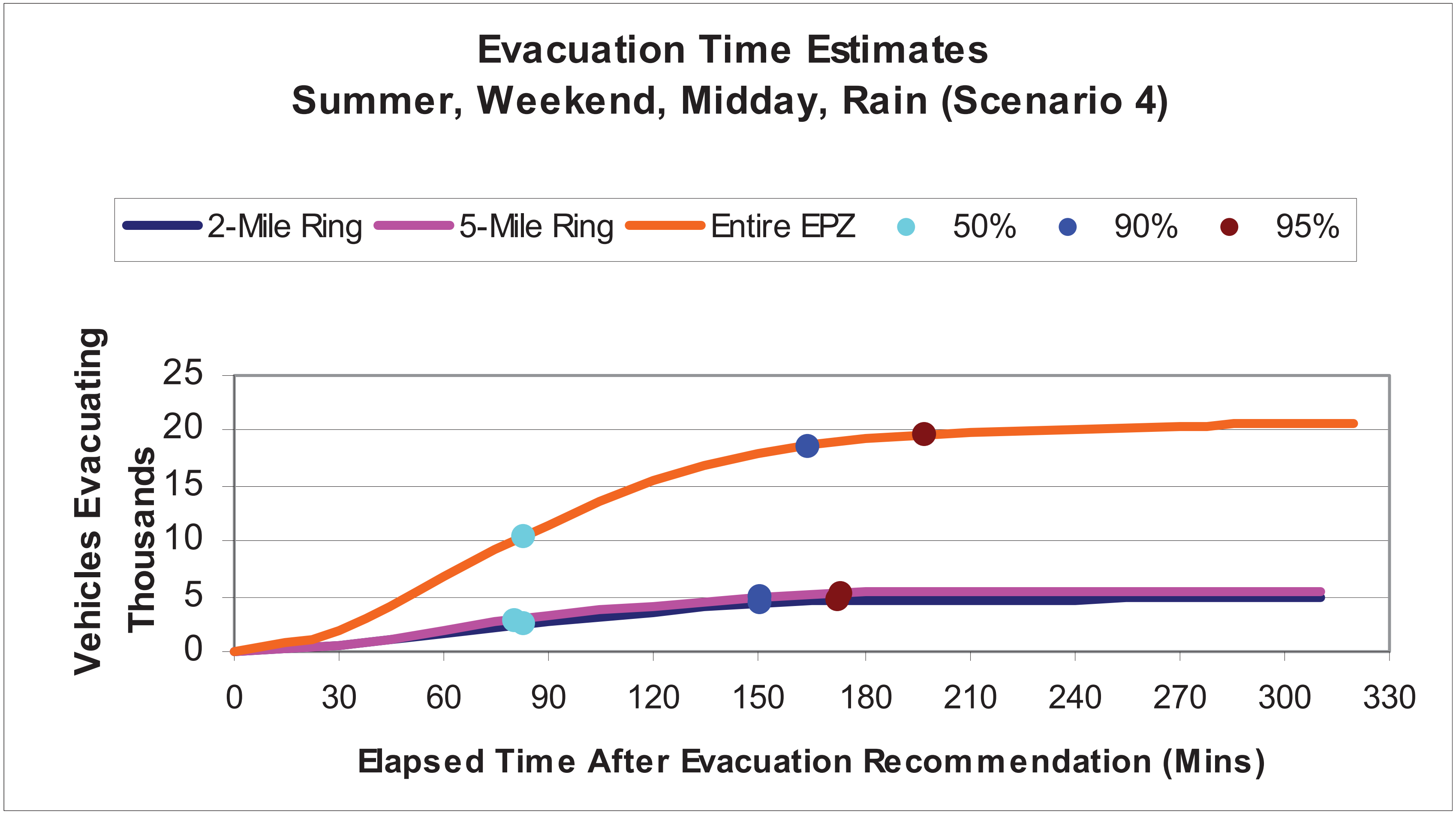


Figure J-4. Evacuation Time Estimates – Scenario 4 for Region R03 (Entire EPZ)

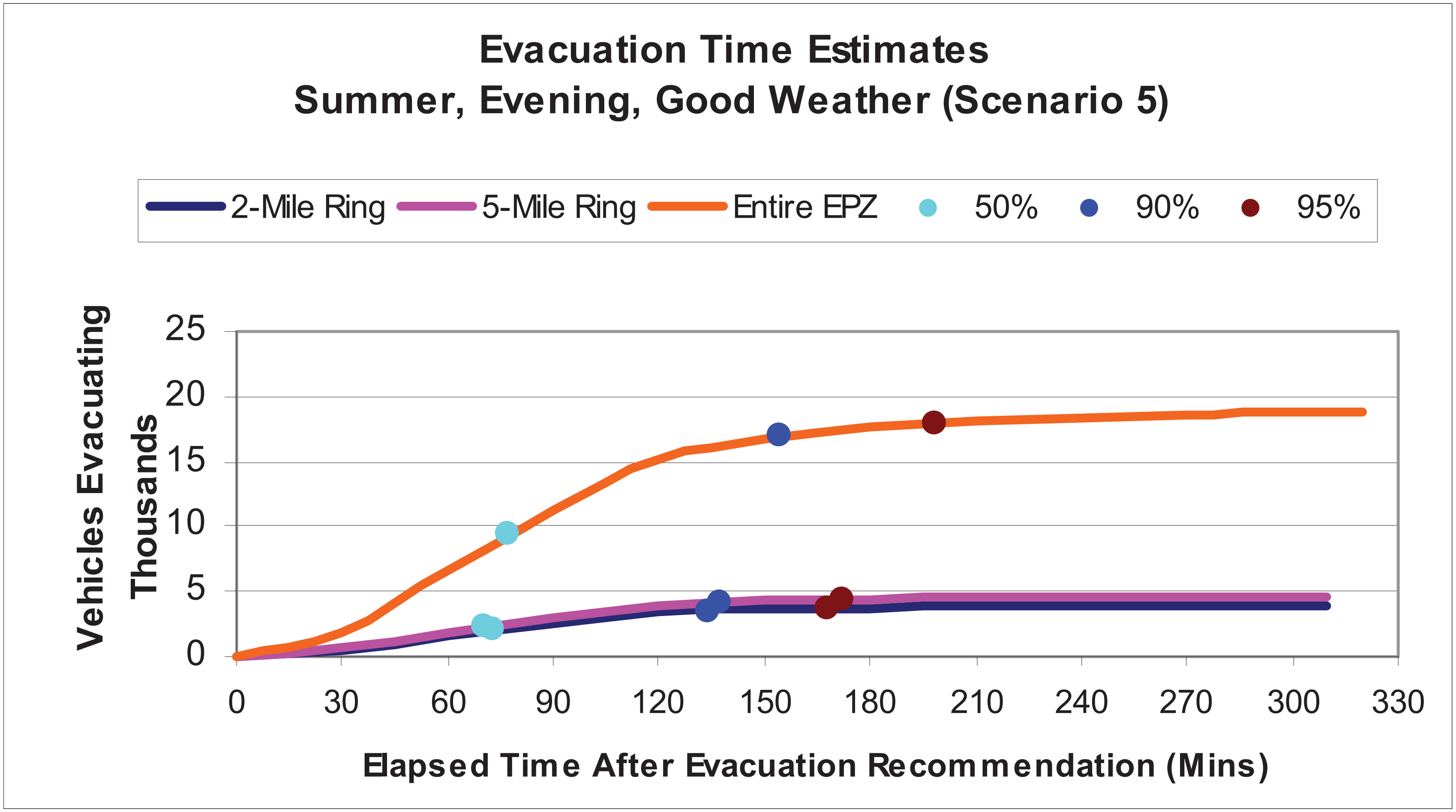


Figure J-5. Evacuation Time Estimates – Scenario 5 for Region R03 (Entire EPZ)

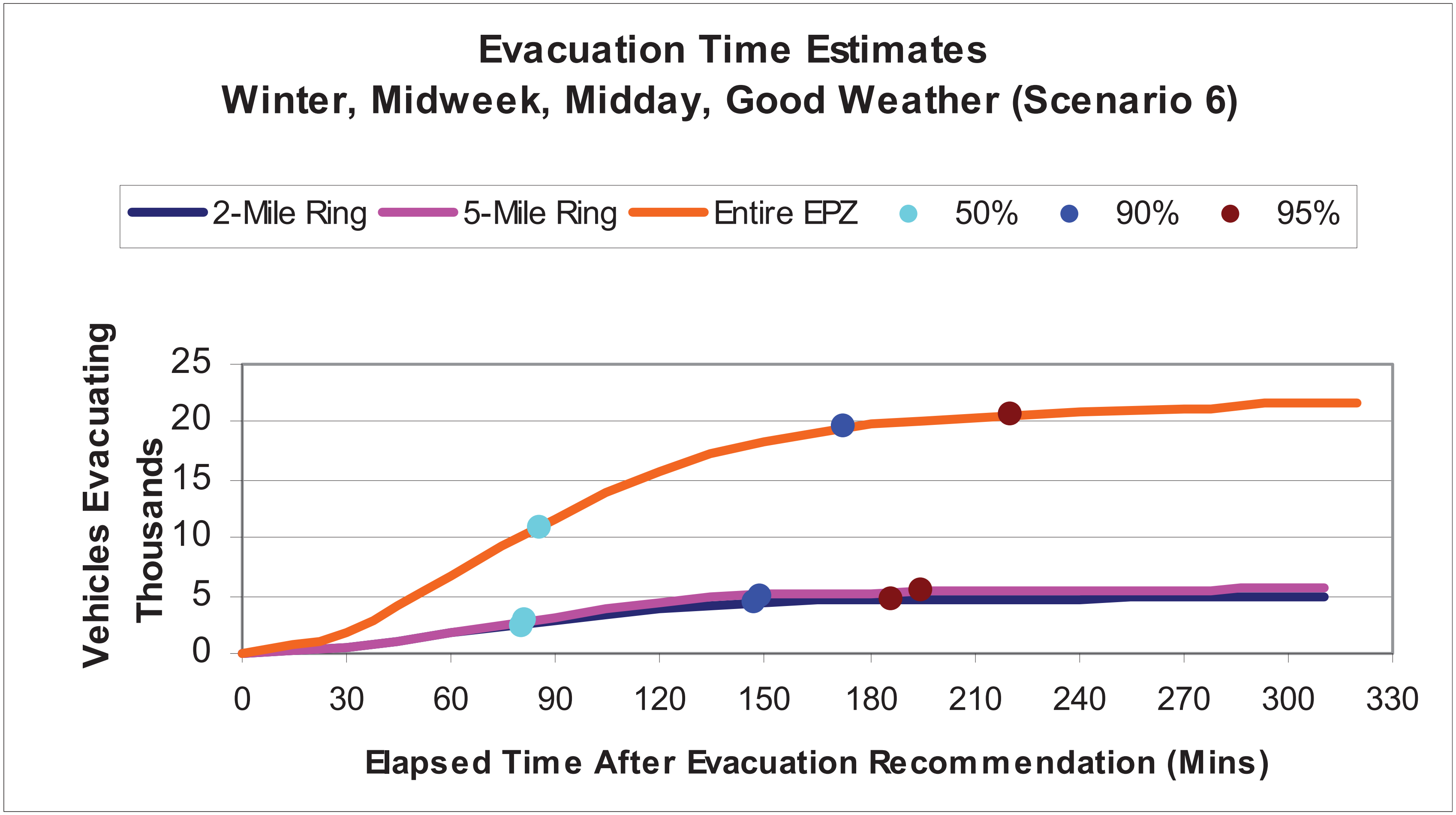


Figure J-6. Evacuation Time Estimates – Scenario 6 for Region R03 (Entire EPZ)

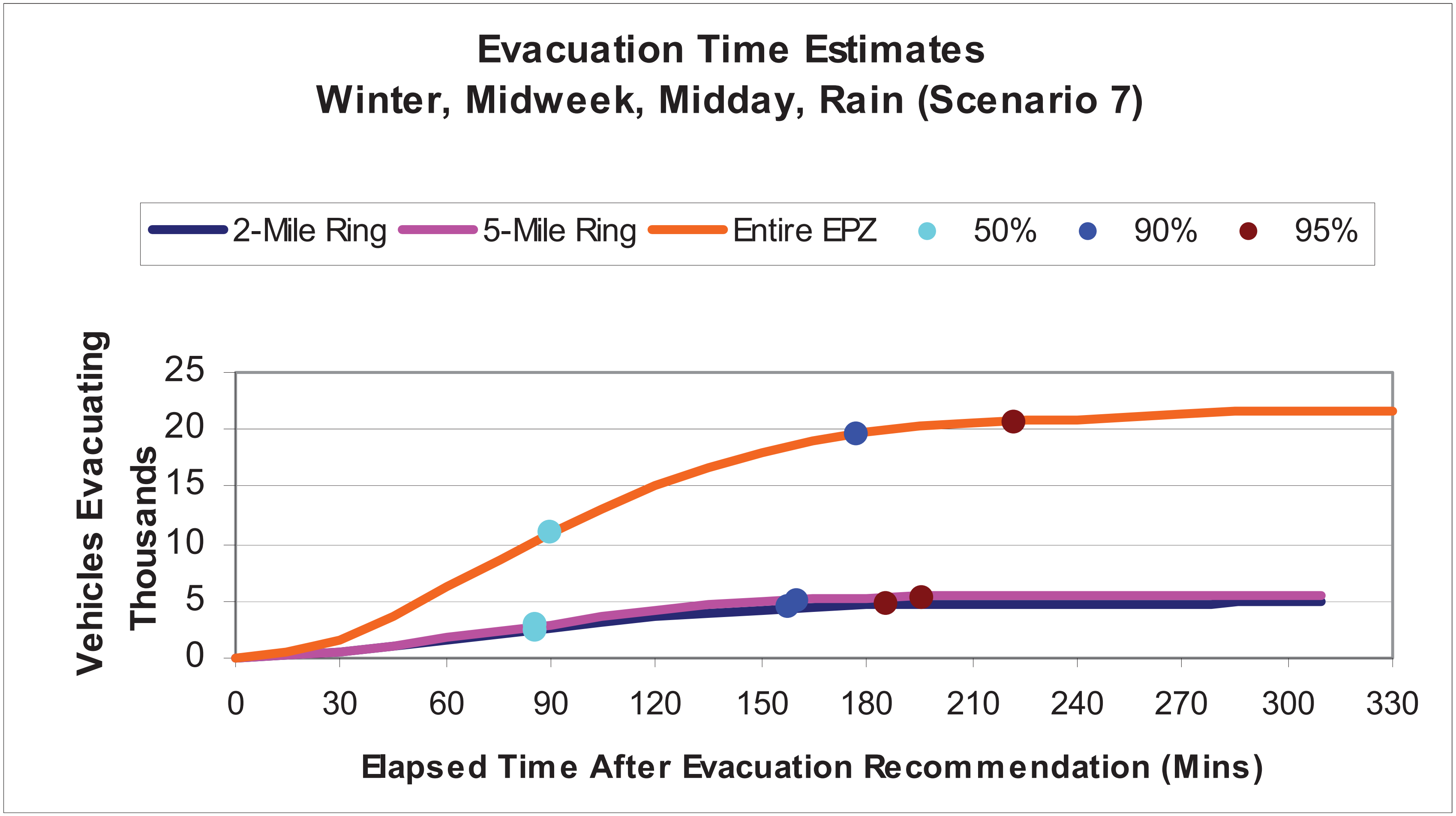


Figure J-7. Evacuation Time Estimates – Scenario 7 for Region R03 (Entire EPZ)

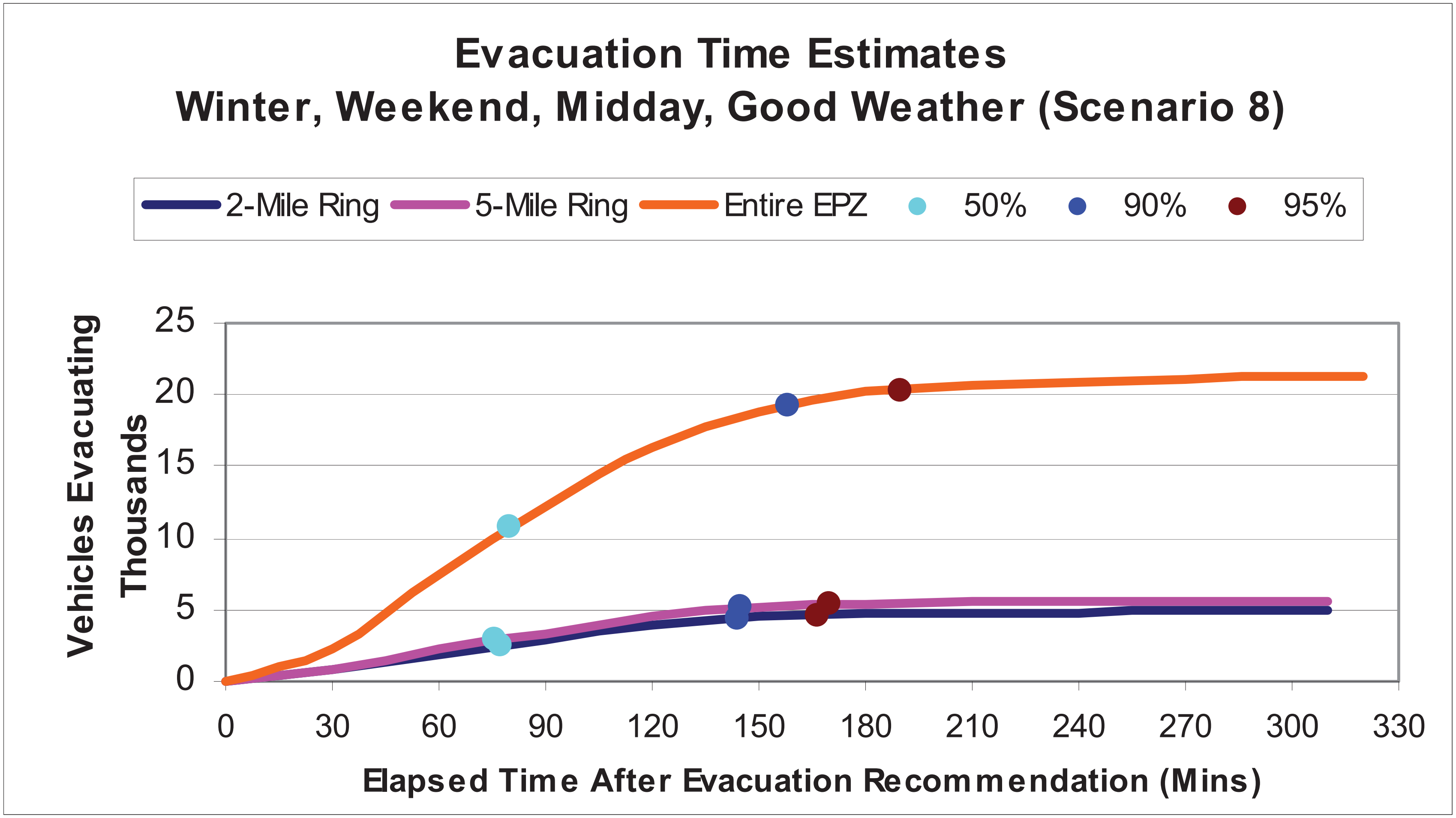


Figure J-8. Evacuation Time Estimates – Scenario 8 for Region R03 (Entire EPZ)

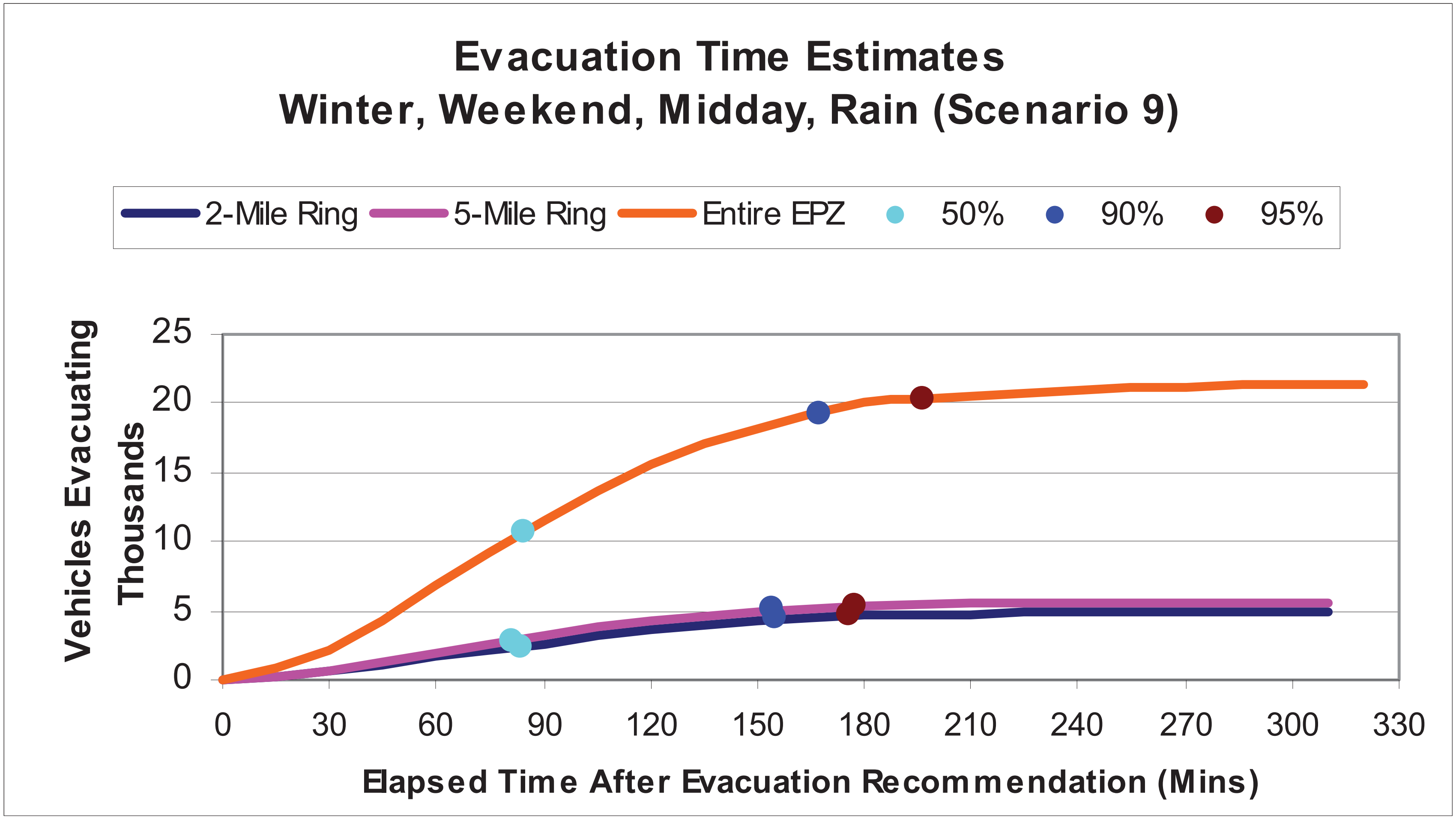


Figure J-9. Evacuation Time Estimates – Scenario 9 for Region R03 (Entire EPZ)

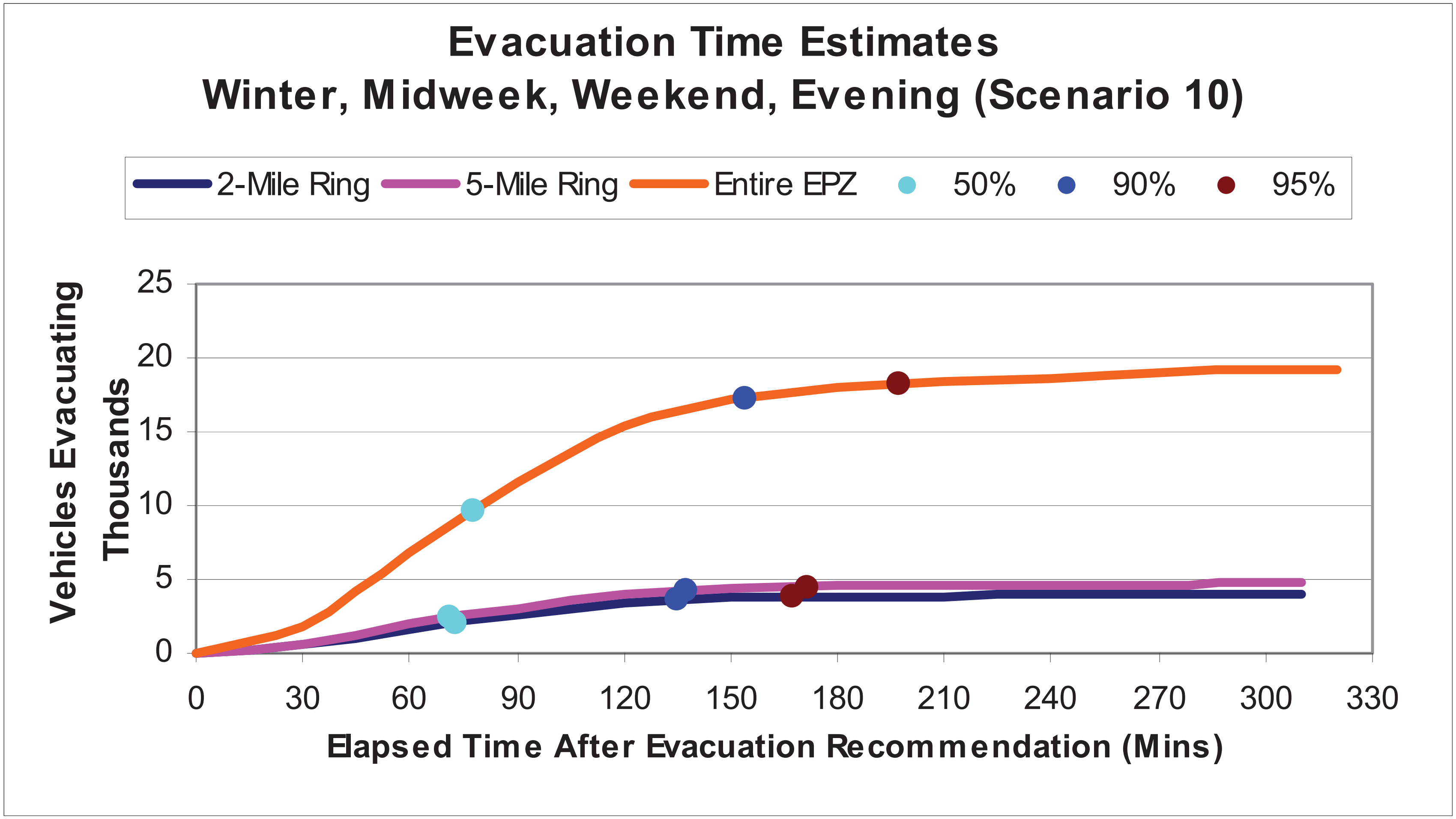


Figure J-10. Evacuation Time Estimates – Scenario 10 for Region R03 (Entire EPZ)

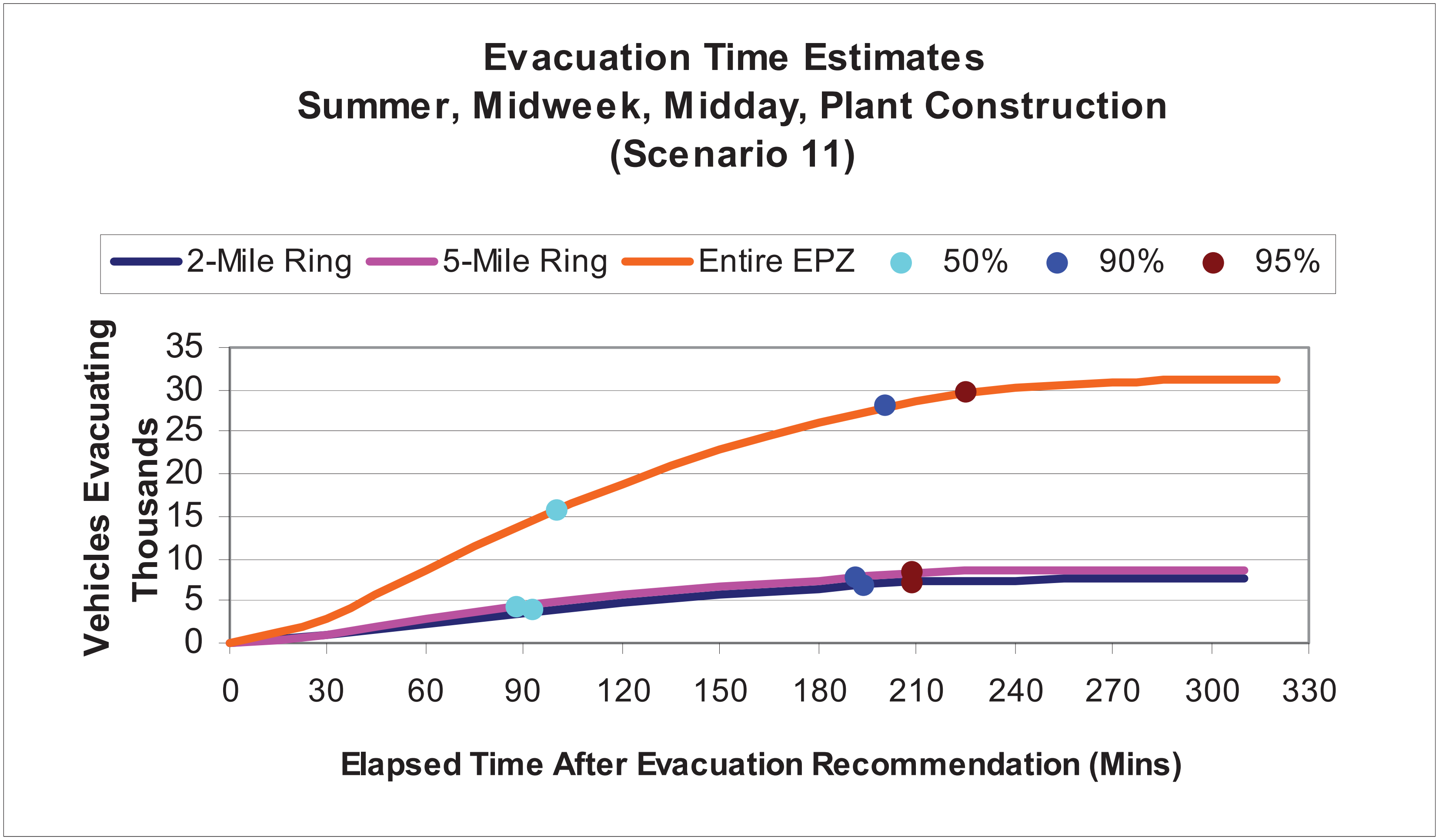


Figure J-11. Evacuation Time Estimates – Scenario 11 for Region R03 (Entire EPZ)

APPENDIX K

Evacuation Roadway Network Characteristics

APPENDIX K: EVACUATION ROADWAY NETWORK CHARACTERISTICS

Figure K-1 provides an overview of the link-node analysis network. The figure has been divided up into 17 more detailed figures (Figures K-2 through K-18) which show each of the links and nodes in the network. 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, which can be cross-referenced to Figures K-2 through K-18.

As mentioned in Section 1-3, the roadway characteristics were observed during the roadway survey; key roadway sections and intersections were video archived during the survey, including audio recordings of the comments made during the survey. A personal computer equipped with Geographical Information Systems (GIS) software was also used to note key observations during the survey. GIS shapefiles of the roadway characteristics and traffic control devices observed were created based on field observations and on the audio and video recordings.

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.

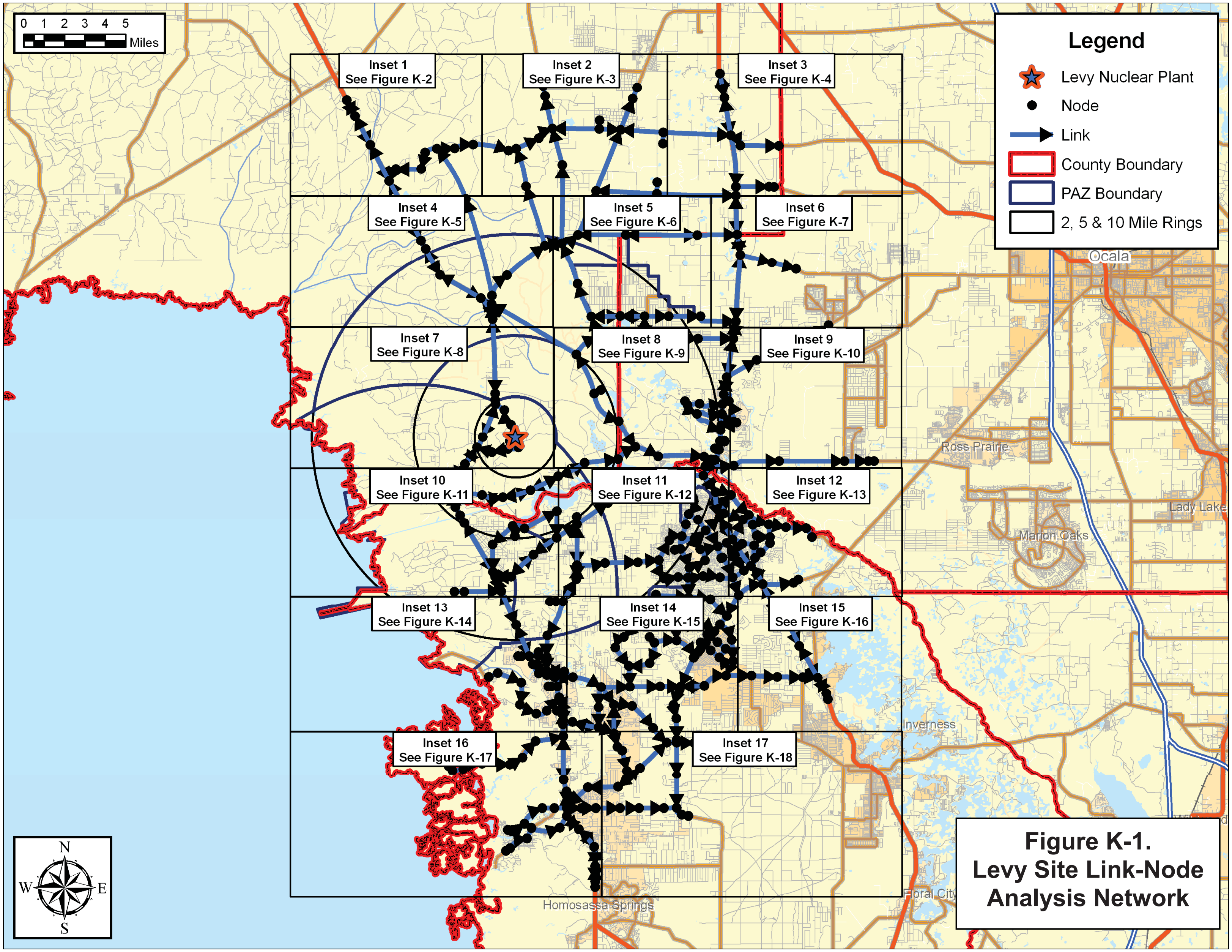


Figure K-1.
Levy Site Link-Node Analysis Network

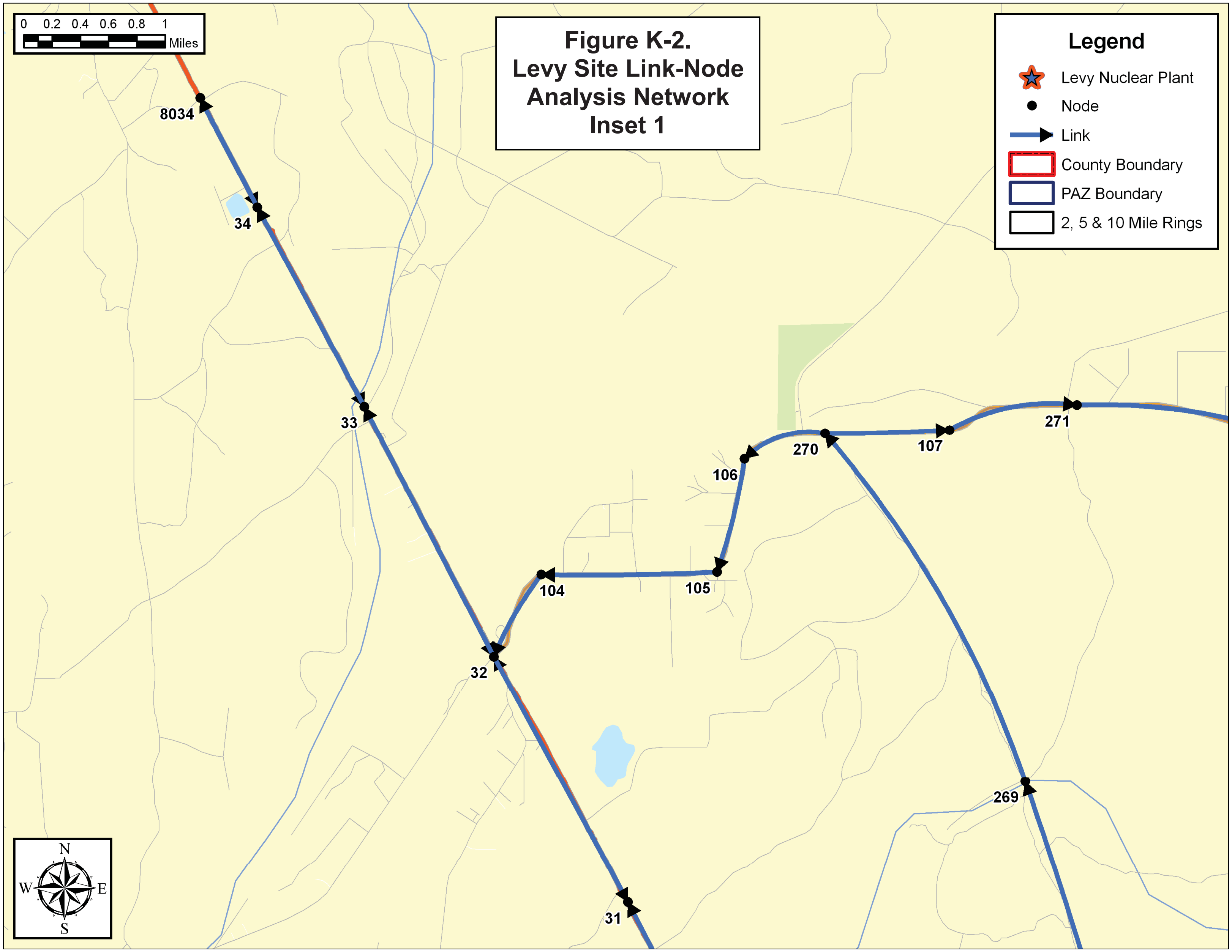


Figure K-2.
Levy Site Link-Node
Analysis Network
Inset 1
Legend
Levy Nuclear Plant
Node
Link
County Boundary
PAZ Boundary
2, 5 & 10 Mile Rings
0 0.2 0.4 0.6 0.8 1
Miles
8034
34
33
32
31
104
105
106
270
107
271
269
N
S
E
W

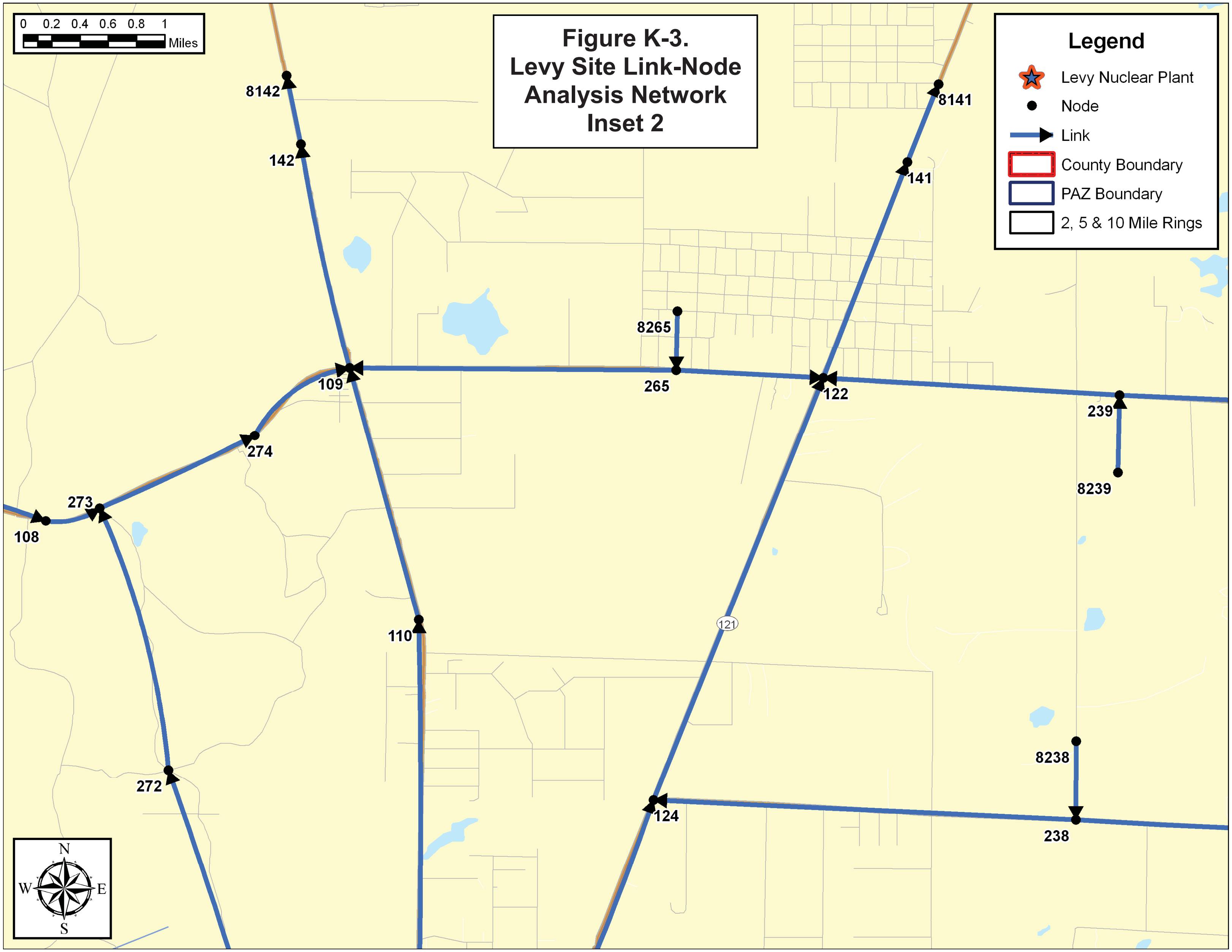


Figure K-3.
Levy Site Link-Node
Analysis Network
Inset 2
0 0.2 0.4 0.6 0.8 1
Miles
Legend
Levy Nuclear Plant
Node
Link
County Boundary
PAZ Boundary
2, 5 & 10 Mile Rings
8142
142
109
274
273
108
272
110
8265
265
122
8141
141
239
8239
121
124
8238
238
N
W
E
S

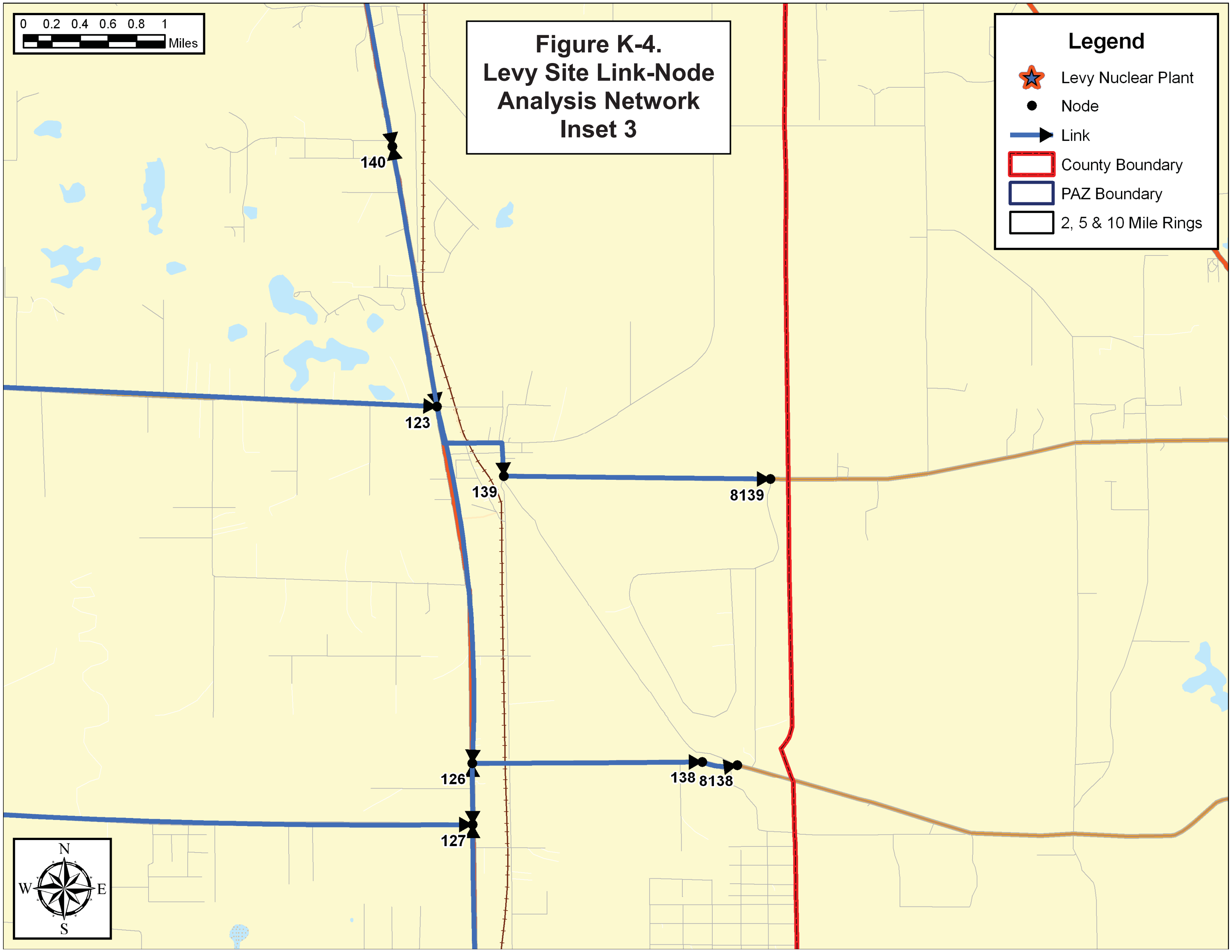


Figure K-4.
Levy Site Link-Node
Analysis Network
Inset 3
Legend
Levy Nuclear Plant
Node
Link
County Boundary
PAZ Boundary
2, 5 & 10 Mile Rings
0 0.2 0.4 0.6 0.8 1
Miles
N
W
E
S
140
123
139
8139
126
138
8138
127

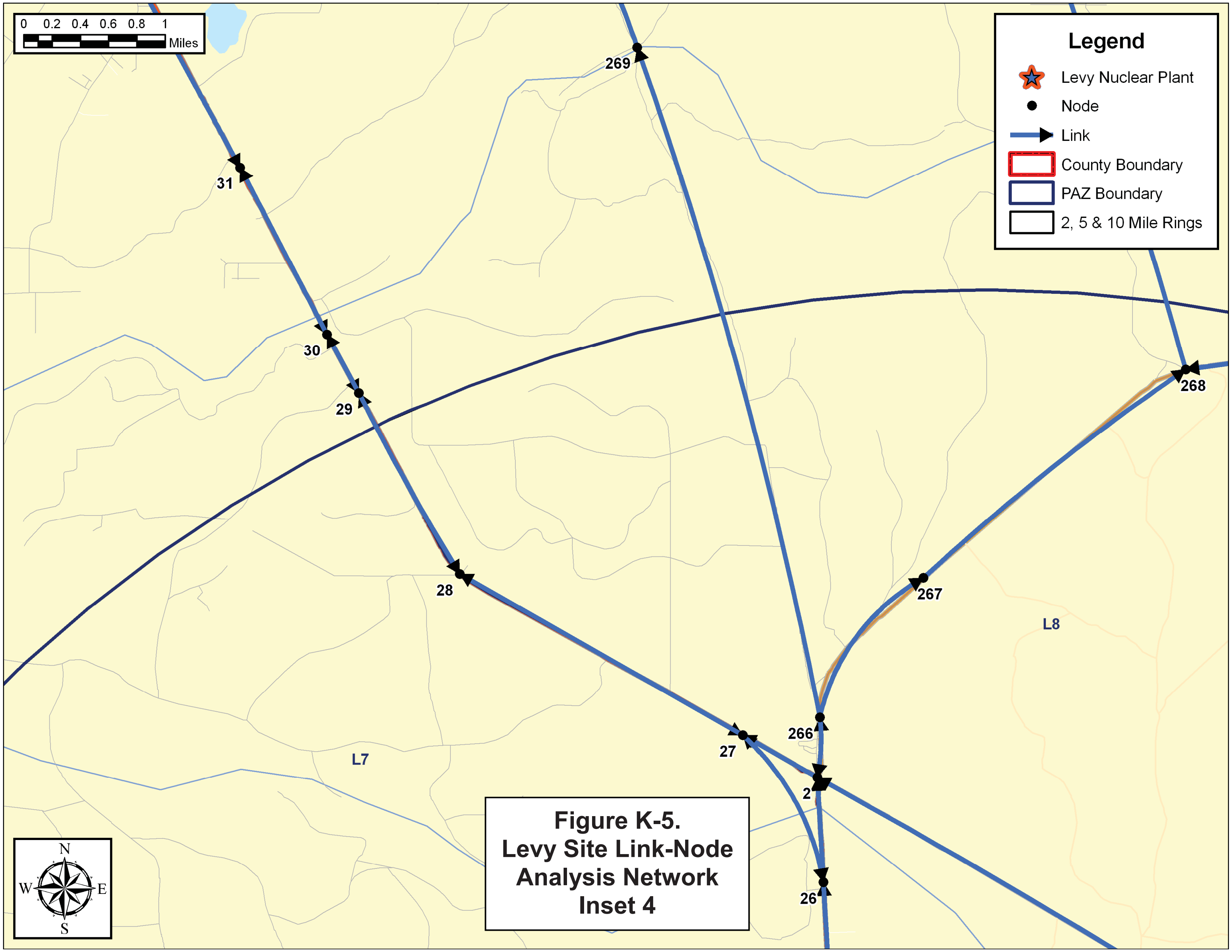


Figure K-5. Levy Site Link-Node Analysis Network Inset 4

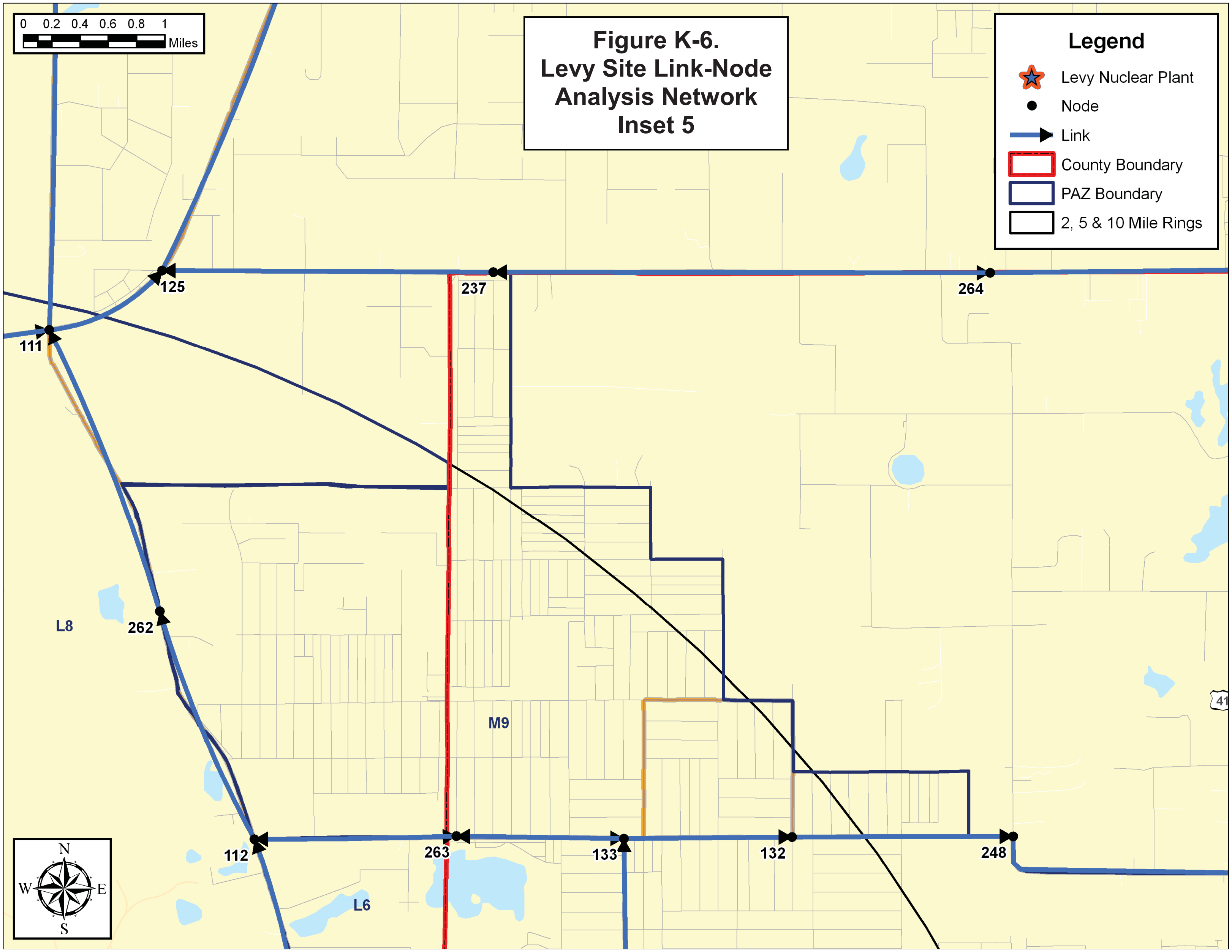


Figure K-6.
Levy Site Link-Node
Analysis Network
Inset 5
Legend
Levy Nuclear Plant
Node
Link
County Boundary
PAZ Boundary
2, 5 & 10 Mile Rings
0 0.2 0.4 0.6 0.8 1
Miles
N
E
S
W
111
125
237
264
262
112
263
133
132
248
L8
M9
L6
41

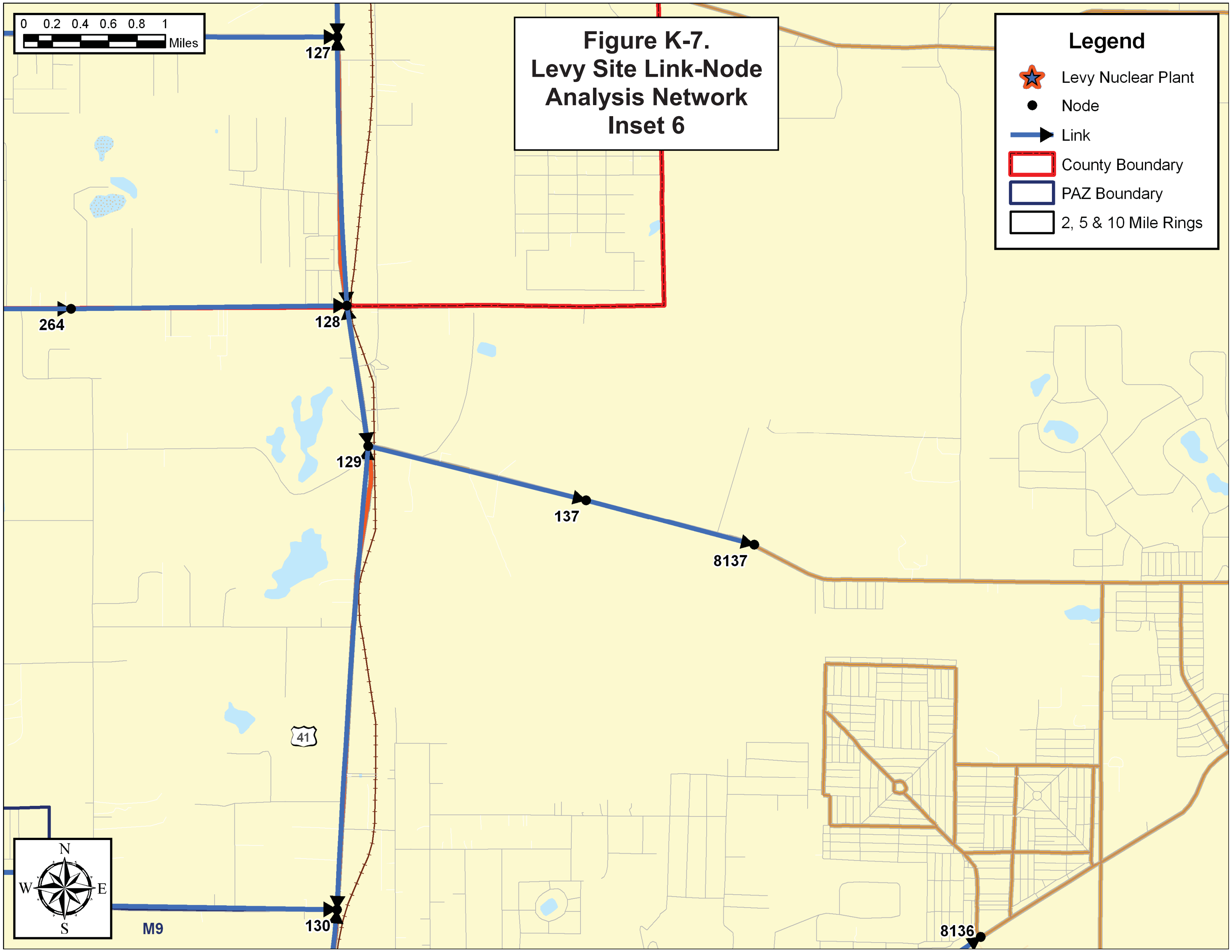
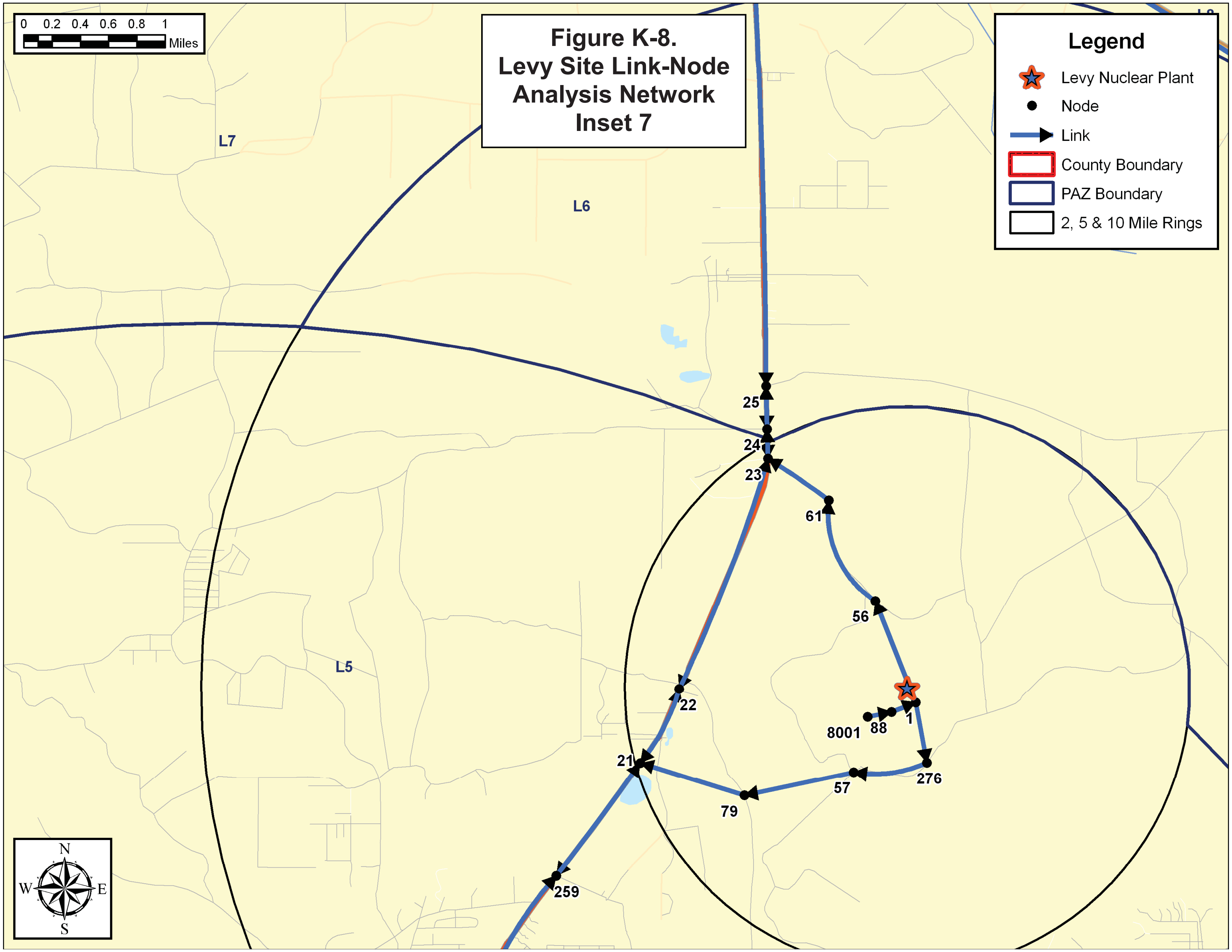


Figure K-7.
Levy Site Link-Node
Analysis Network
Inset 6
Legend
Levy Nuclear Plant
Node
Link
County Boundary
PAZ Boundary
2, 5 & 10 Mile Rings
0 0.2 0.4 0.6 0.8 1
Miles
127
128
264
129
137
8137
130
8136
M9
41
N
S
E
W

Figure K-8. Levy Site Link-Node Analysis Network Inset 7



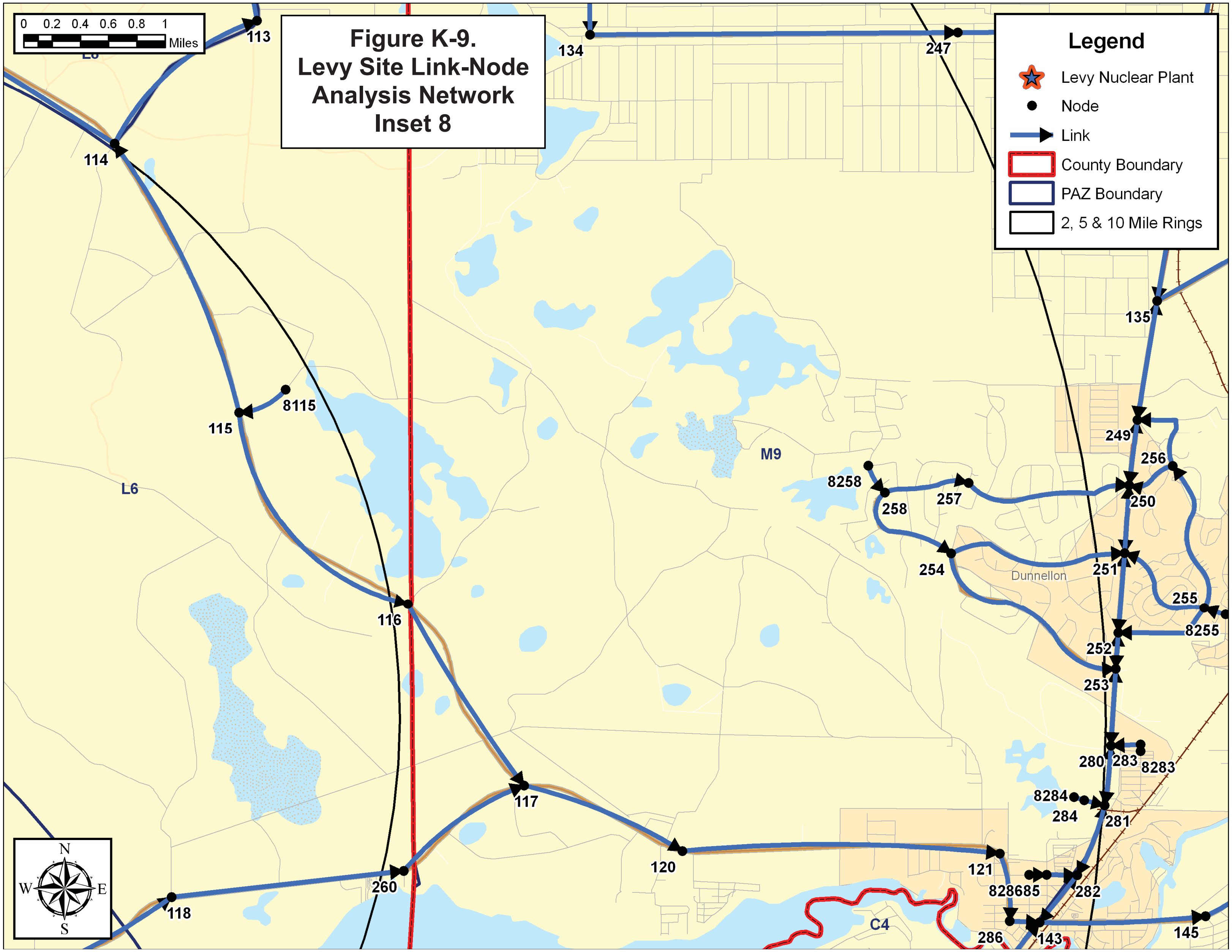


Figure K-9.
Levy Site Link-Node
Analysis Network
Inset 8
Legend
Levy Nuclear Plant
Node
Link
County Boundary
PAZ Boundary
2, 5 & 10 Mile Rings
0 0.2 0.4 0.6 0.8 1
Miles
N
S
E
W
113
114
115
8115
116
117
118
260
120
121
134
247
135
249
256
250
8258
258
257
254
251
Dunnellon
255
8255
252
253
280
283
8283
8284
284
281
828685
282
286
143
145
L6
M9
C4

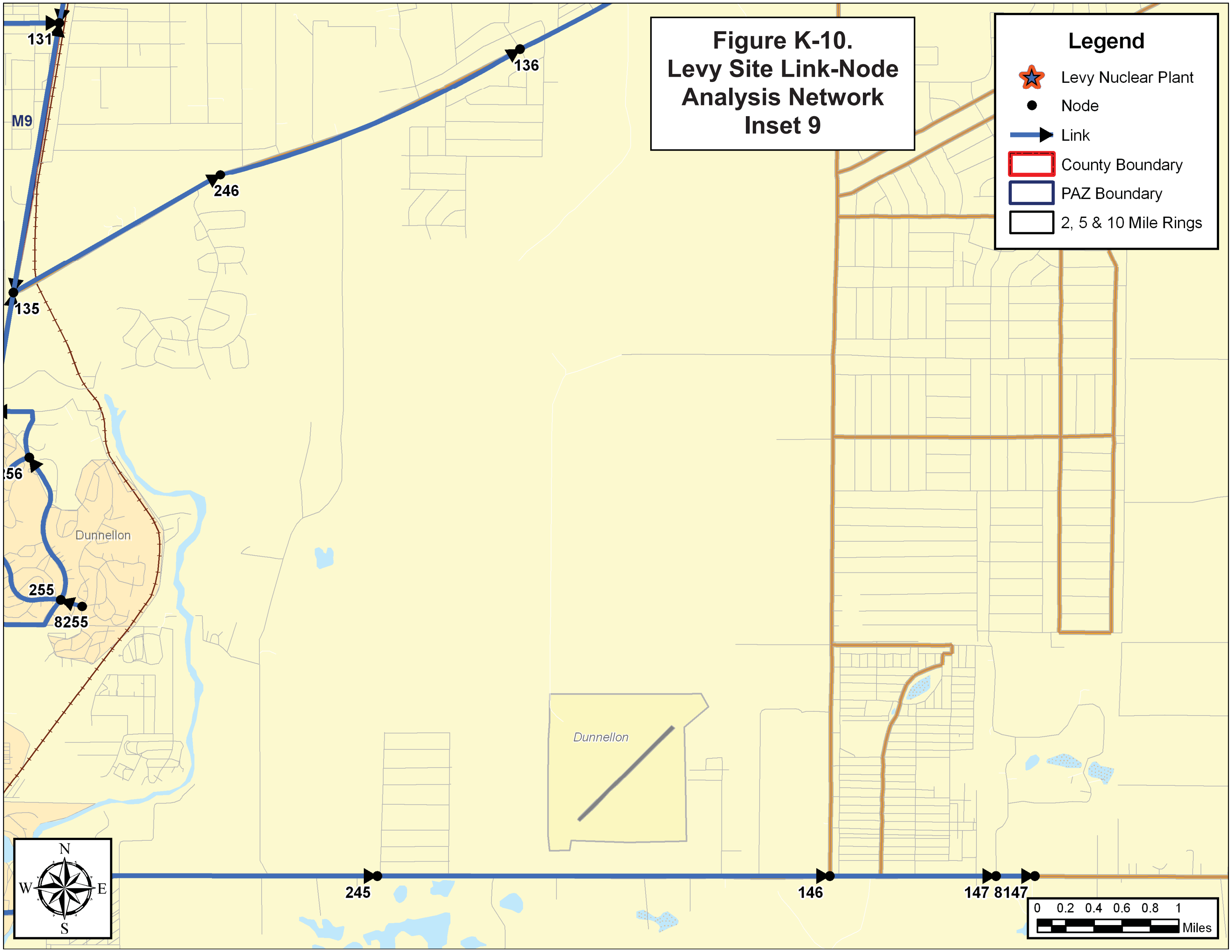


Figure K-10.
Levy Site Link-Node
Analysis Network
Inset 9
Legend
Levy Nuclear Plant
Node
Link
County Boundary
PAZ Boundary
2, 5 & 10 Mile Rings
131
136
M9
246
135
56
Dunnellon
255
8255
Dunnellon
245
146
147 8147
0 0.2 0.4 0.6 0.8 1
Miles
N
W
E
S

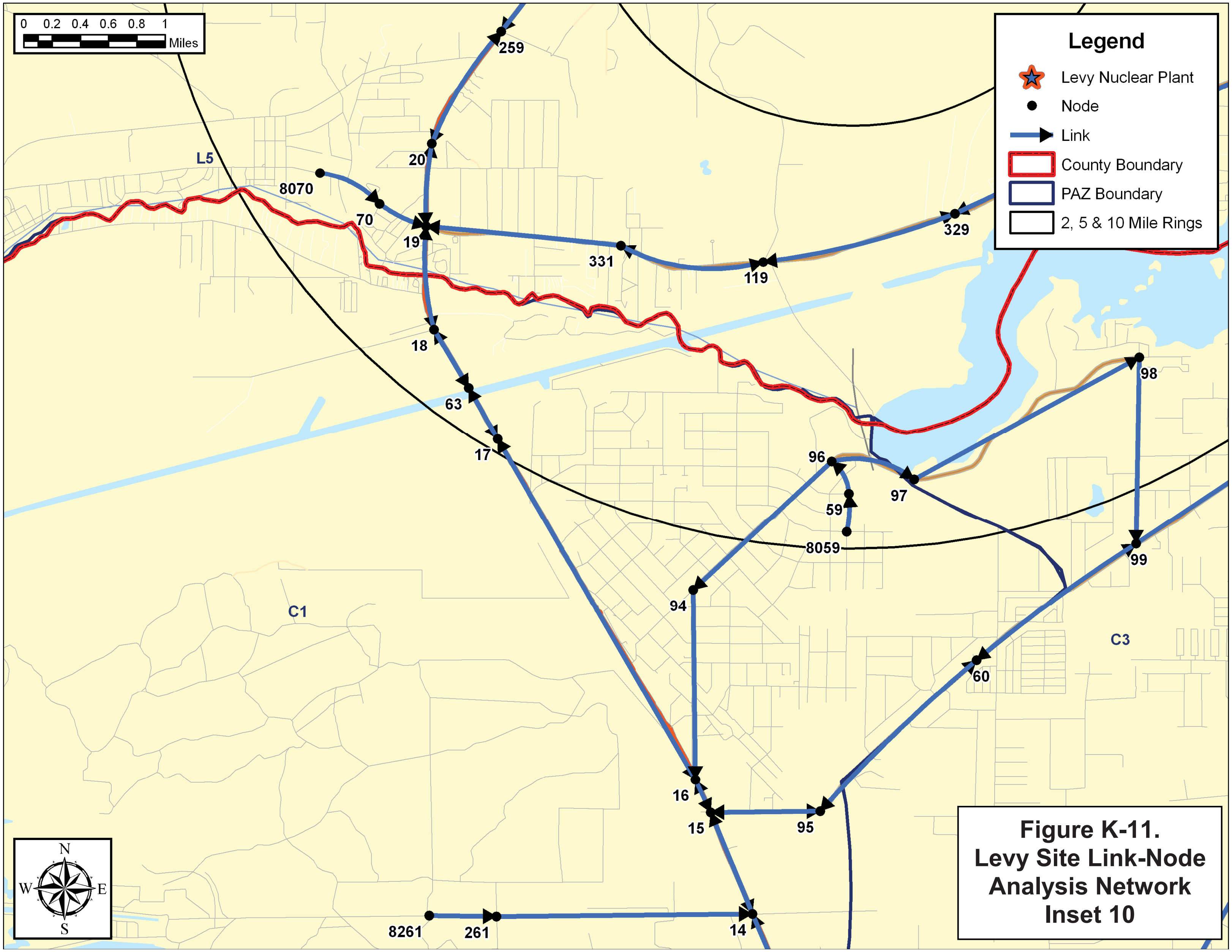


Figure K-11. Levy Site Link-Node Analysis Network Inset 10

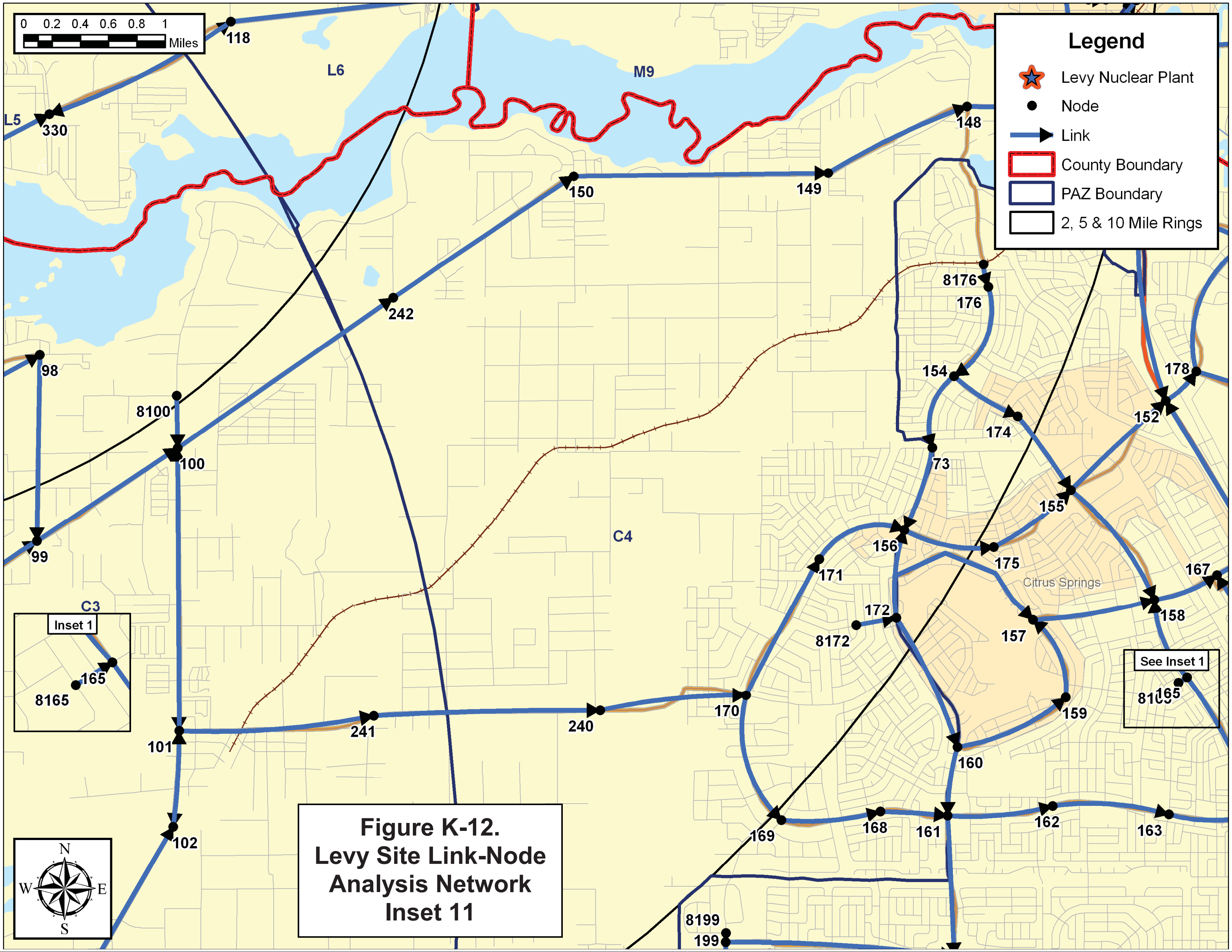


Figure K-12.
Levy Site Link-Node Analysis Network
Inset 11

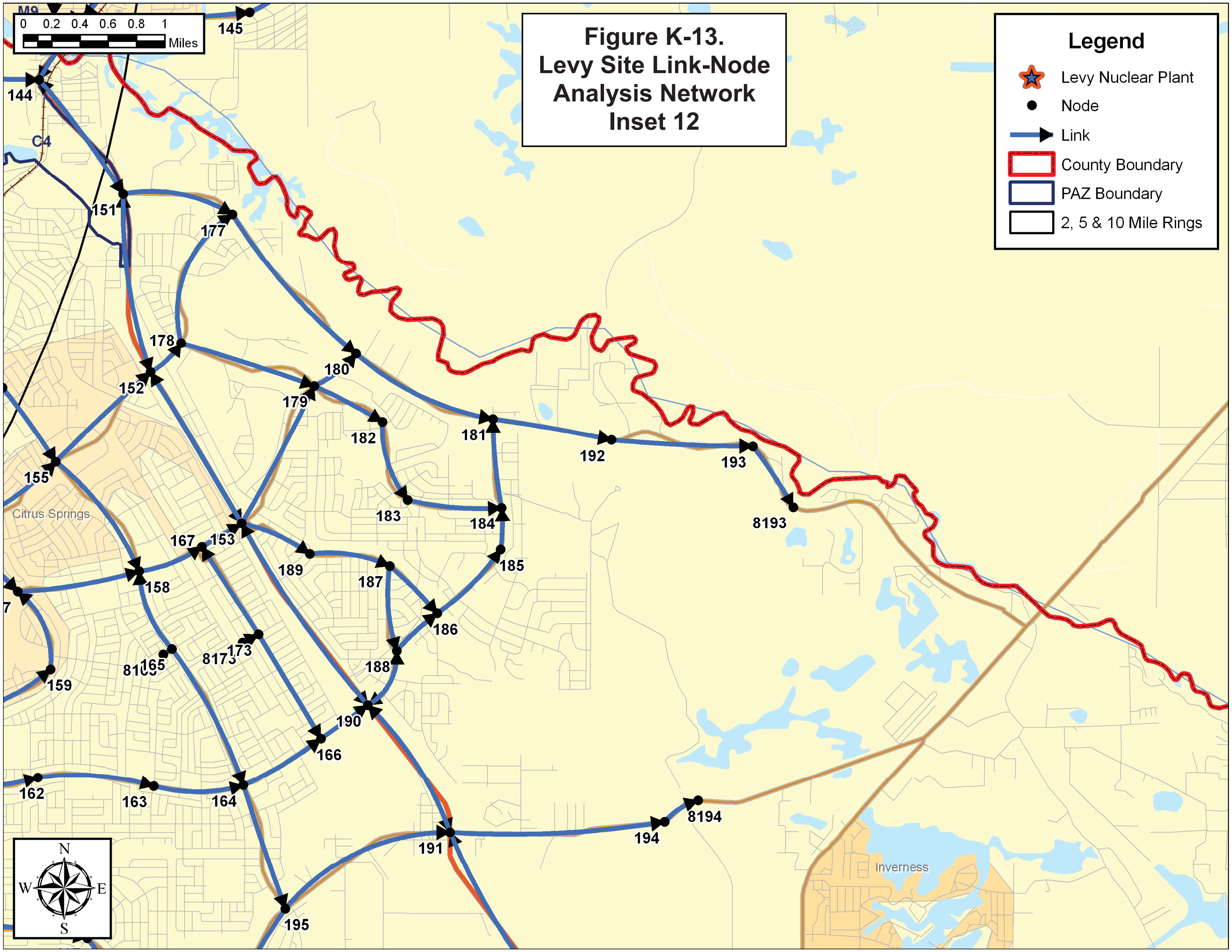


Figure K-13.
Levy Site Link-Node
Analysis Network
Inset 12
Legend
Levy Nuclear Plant
Node
Link
County Boundary
PAZ Boundary
2, 5 & 10 Mile Rings
0 0.2 0.4 0.6 0.8 1
Miles
Citrus Springs
Inverness
144
145
151
152
153
155
158
159
162
163
164
166
167
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
8193
8194
M9
C4

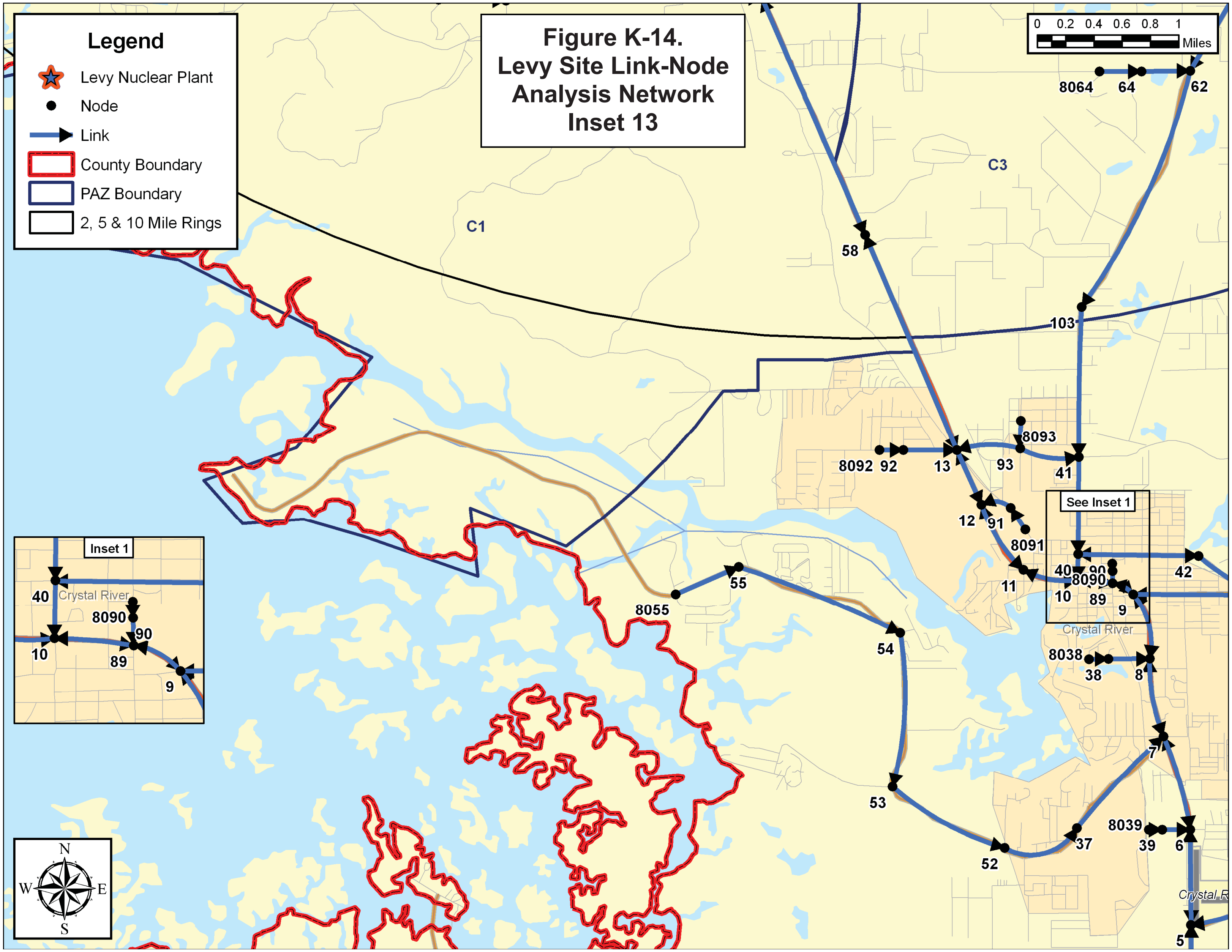


Figure K-14.
Levy Site Link-Node
Analysis Network
Inset 13
Legend
Levy Nuclear Plant
Node
Link
County Boundary
PAZ Boundary
2, 5 & 10 Mile Rings
0 0.2 0.4 0.6 0.8 1 Miles
C1
C3
Inset 1
See Inset 1
Crystal River
8064
64
62
58
103
8093
8092
92
13
93
41
12
91
8091
11
40
90
8090
10
89
9
42
8055
55
54
8038
38
8
7
53
52
37
8039
39
6
5
N
E
S
W

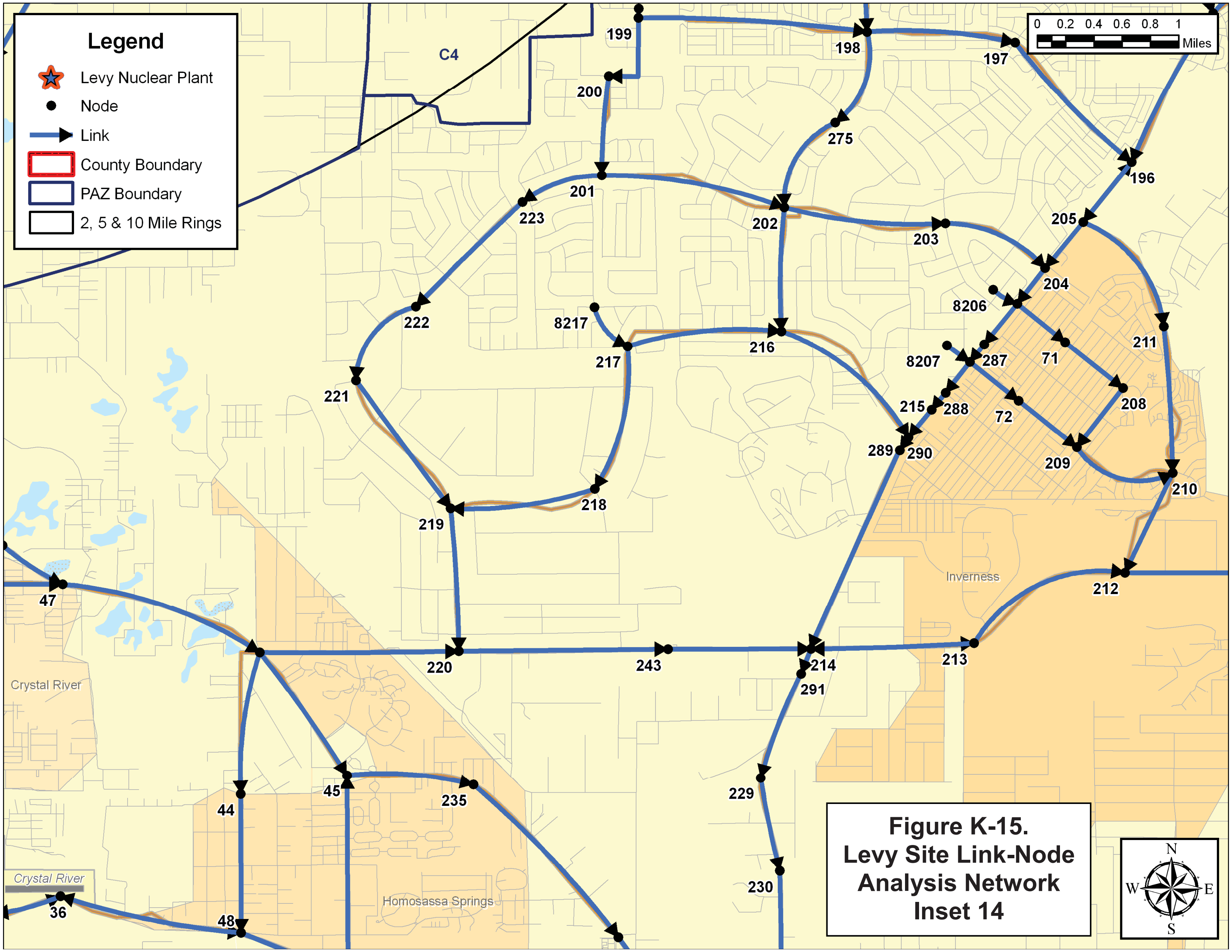


Figure K-15.
Levy Site Link-Node
Analysis Network
Inset 14

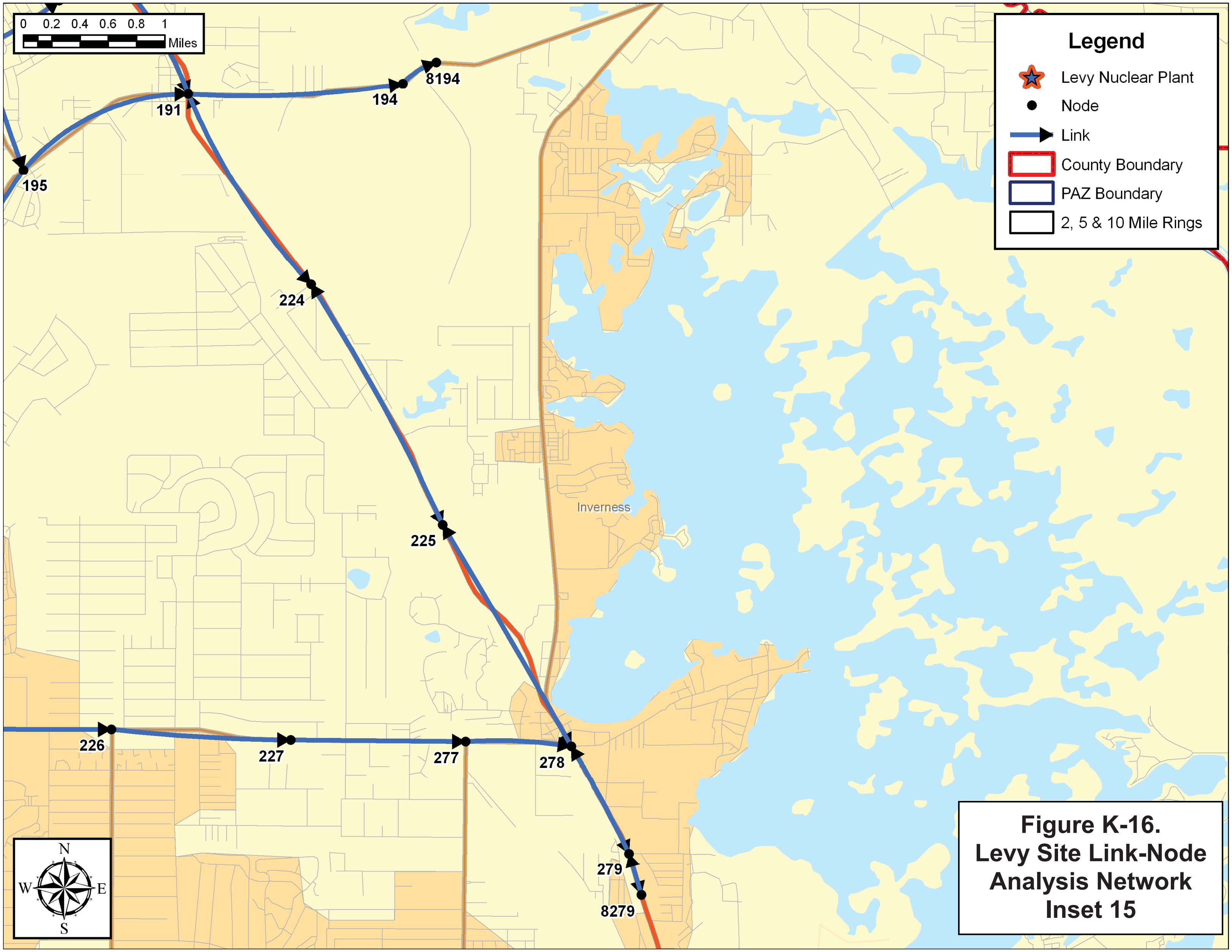


Figure K-16. Levy Site Link-Node Analysis Network Inset 15

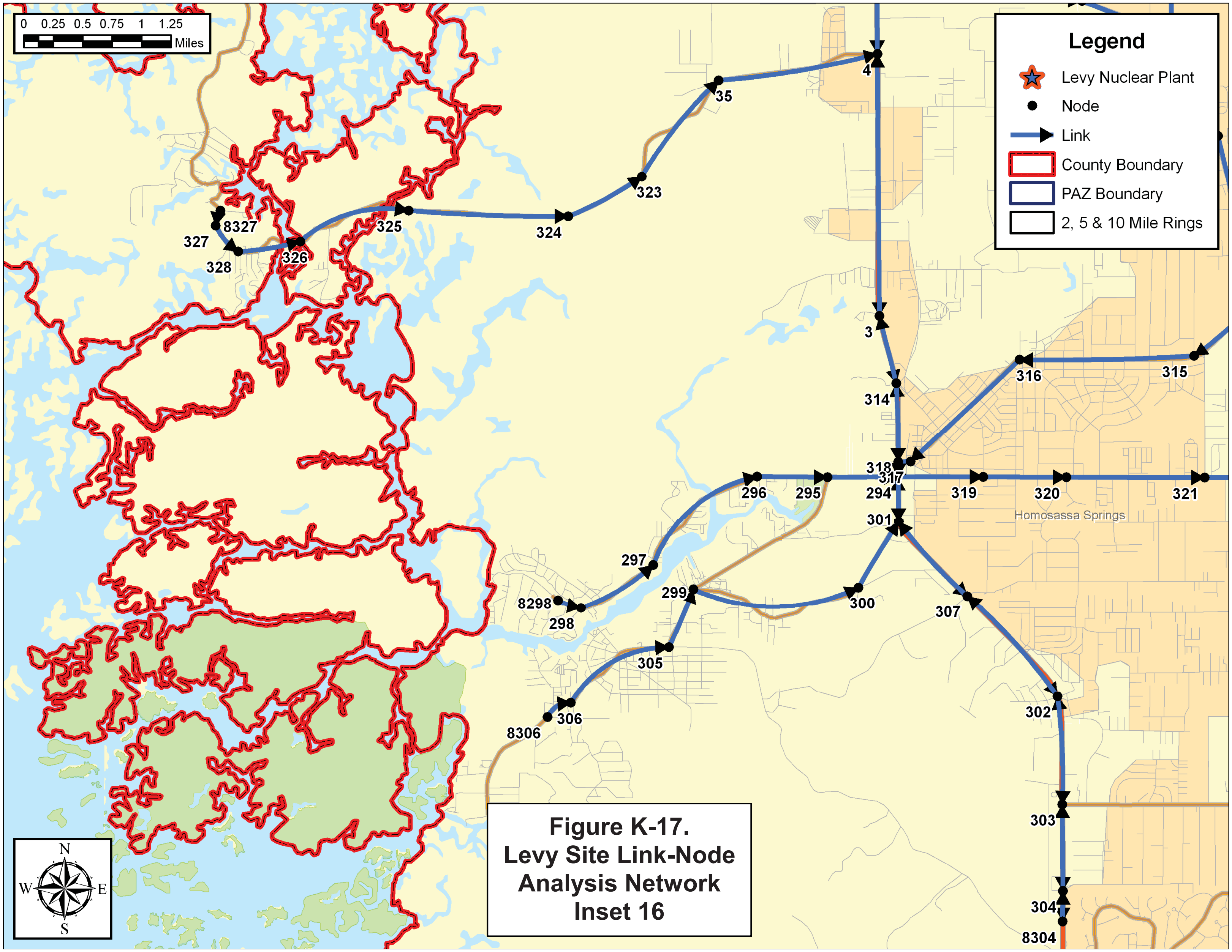


Figure K-17.
Levy Site Link-Node
Analysis Network
Inset 16

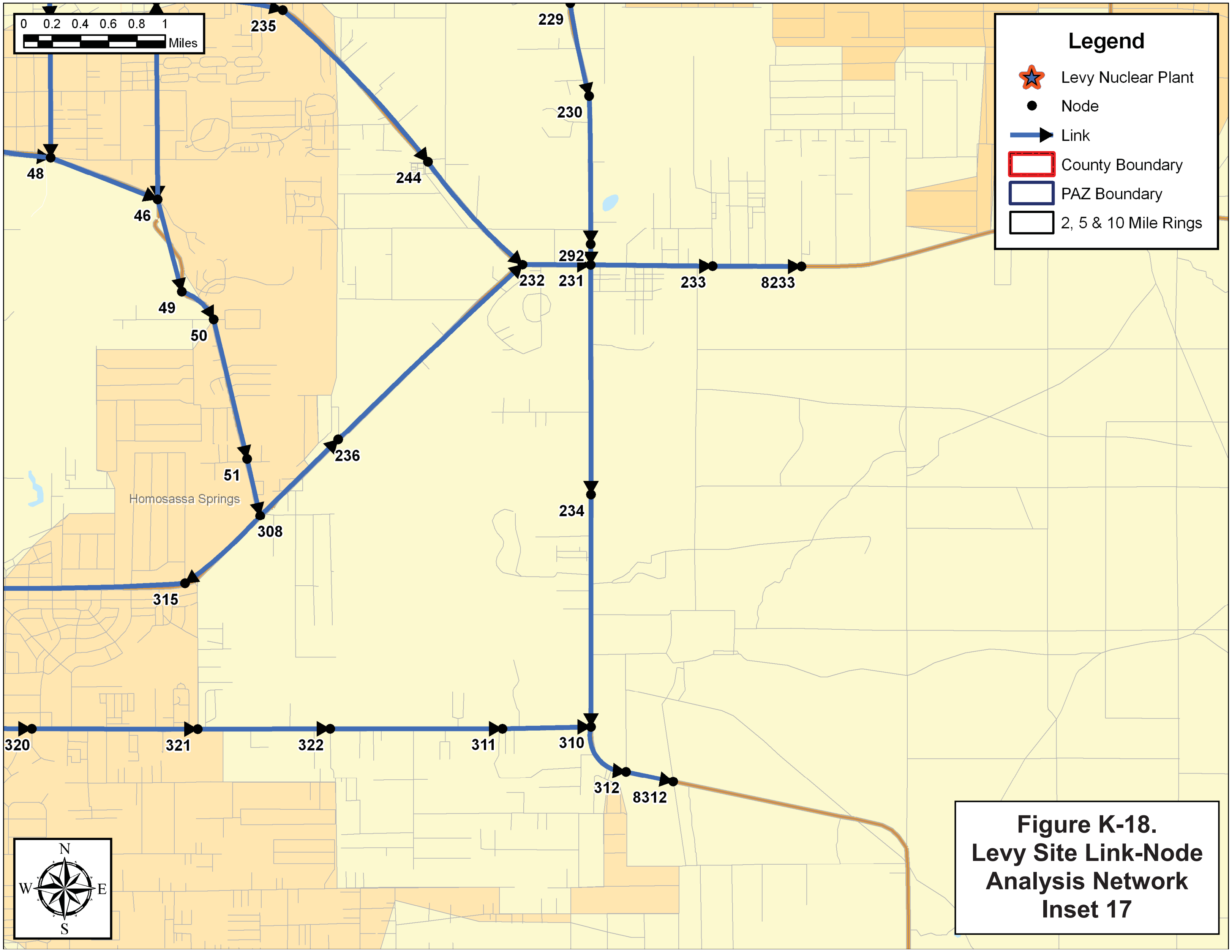


Figure K-18. Levy Site Link-Node Analysis Network Inset 17

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	**Downstream Node Number**	**Length (Miles * 100)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
1	56	78	1	1714	40
1	276	54	1	1714	40
2	27	61	1	1895	60
2	266	76	1	1714	40
3	4	223	2	1895	50
3	314	58	2	1895	60
4	3	223	2	1895	60
4	5	59	2	1895	50
5	4	59	2	1895	50
5	6	67	2	1895	50
5	36	47	1	1714	50
6	5	67	2	1895	50
6	7	68	2	1895	50
7	6	68	2	1895	50
7	8	57	3	1895	50
8	7	57	3	1895	50
8	9	46	3	1895	50
9	8	46	3	1895	50
9	47	88	2	1714	40
9	89	20	2	1714	40
10	11	39	2	1895	50
10	89	25	2	1714	40
11	10	39	2	1714	40
11	12	54	2	1895	40
12	11	54	2	1895	50
12	13	25	3	1714	50
13	12	25	3	1714	40
13	58	185	2	1714	50
14	15	79	2	1714	40
14	58	180	2	1714	50
15	14	79	2	1714	50
15	16	25	2	1714	40
15	95	82	1	1714	40
16	15	25	2	1714	40
16	17	281	2	1895	50
17	16	281	2	1714	40
17	63	42	1	1714	50

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	Downstream Node Number	Length (Miles * 100)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
18	19	71	2	1895	50
18	63	47	1	1714	50
19	18	71	2	1895	50
19	20	60	2	1895	50
19	331	139	1	1714	50
20	19	60	2	1895	50
20	259	95	2	1895	50
21	22	60	2	1895	50
21	259	98	2	1895	50
22	21	60	2	1895	50
22	23	169	2	1895	60
23	22	169	2	1895	50
23	24	28	2	1895	60
24	23	28	2	1895	60
24	25	33	2	1895	60
25	24	33	2	1895	60
25	26	367	3	1895	60
26	2	75	1	1895	60
26	25	367	2	1895	60
26	27	118	2	1714	60
27	26	118	2	1895	60
27	28	240	2	1895	60
28	27	240	2	1895	60
28	29	141	2	1895	60
29	28	141	2	1895	60
29	30	50	2	1895	60
30	29	50	2	1895	60
30	31	140	2	1895	60
31	30	140	2	1895	60
31	32	199	2	1895	60
32	31	199	2	1895	60
32	33	190	2	1895	60
33	32	190	2	1895	60
33	34	158	2	1895	60
34	33	158	2	1895	60
35	4	138	1	1714	50
36	5	47	1	1714	40

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	Downstream Node Number	Length (Miles * 100)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
36	48	130	1	1714	60
37	7	90	1	1895	40
38	8	29	1	1895	40
39	6	20	1	1714	40
40	10	17	2	1714	40
40	42	85	1	1714	40
41	40	67	1	1714	40
42	40	85	1	1714	40
42	47	52	1	1714	40
43	44	104	1	1714	40
43	45	106	2	1714	50
43	220	142	1	1714	50
44	48	94	1	1714	50
45	46	142	1	1714	50
45	235	92	2	1714	50
46	45	142	1	1714	40
46	49	68	1	1714	50
47	9	88	2	1895	50
47	43	145	2	1714	50
48	36	130	1	1714	50
48	46	83	1	1714	50
49	50	31	1	1714	50
50	51	102	1	1714	50
51	308	41	1	1714	50
52	37	52	1	1200	50
53	52	88	1	1200	50
54	53	115	1	1200	50
55	54	111	1	1200	50
56	61	72	1	1714	40
57	79	77	1	1714	40
58	13	185	2	1714	50
58	14	180	2	1714	50
59	96	25	1	1714	40
60	95	149	1	1714	40
60	99	143	1	1714	40
61	23	50	1	1714	40
62	102	135	1	1714	50

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	**Downstream Node Number**	**Length (Miles * 100)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
62	103	177	1	1714	50
63	17	42	1	1714	50
63	18	47	1	1714	50
64	62	41	1	1714	40
70	19	38	1	1714	40
71	208	51	1	1714	40
72	209	55	1	1714	40
73	156	59	1	1714	40
79	21	74	1	1714	40
88	1	18	1	1714	40
89	9	20	2	1714	40
89	10	25	2	1714	40
90	89	6	1	1714	40
91	12	16	1	1714	40
92	13	49	1	1714	40
93	13	30	1	1714	40
93	41	45	1	1714	40
94	16	136	1	1714	40
95	15	82	1	1714	40
95	60	149	1	1714	40
96	94	139	1	1714	40
96	97	60	1	1714	40
97	98	173	1	1714	40
98	99	126	1	1714	40
99	60	143	1	1714	40
99	100	119	1	1714	40
100	101	201	1	1714	50
100	242	190	1	1714	50
101	100	201	1	1714	40
101	102	68	1	1714	50
101	241	130	1	1714	50
102	62	135	1	1714	40
102	101	68	1	1714	50
103	41	109	1	1714	50
104	32	62	1	1714	50
105	104	129	1	1714	60
106	105	111	1	1714	60

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	**Downstream Node Number**	**Length (Miles * 100)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
107	271	92	1	1714	60
108	273	58	1	1714	60
109	142	154	1	1714	60
110	109	194	1	1714	60
111	110	382	1	1714	60
111	125	106	1	1714	60
111	268	77	1	1714	60
112	262	173	1	1714	60
112	263	144	1	1714	50
113	112	105	1	1714	50
114	2	483	1	1714	50
114	113	133	1	1714	60
115	114	210	1	1714	50
115	116	188	1	1714	50
116	117	150	1	1714	40
117	120	122	1	1714	60
118	260	165	1	1714	60
118	330	144	1	1714	60
119	329	140	1	1714	60
119	331	101	1	1714	50
120	121	226	1	1714	40
121	286	45	1	1714	40
122	141	162	1	1714	60
123	126	253	1	1895	60
123	139	213	1	1714	60
123	140	186	1	1895	60
124	122	321	1	1714	60
125	124	226	1	1714	60
126	123	253	1	1895	60
126	127	47	1	1895	60
126	138	171	1	1714	60
127	126	47	1	1895	60
127	128	187	1	1895	60
128	127	187	1	1895	60
128	129	105	1	1895	60
129	128	105	1	1895	60
129	130	328	1	1895	60

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	Downstream Node Number	Length (Miles * 100)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
129	137	158	1	1714	60
130	129	328	1	1895	60
130	131	84	1	1895	60
131	130	84	1	1895	60
131	135	192	1	1895	60
132	248	157	1	1714	60
133	132	111	1	1714	60
133	134	110	1	1714	50
133	263	126	1	1714	50
134	133	110	1	1714	50
134	247	261	1	1714	60
135	131	192	1	1895	60
135	246	165	1	1714	60
135	249	88	1	1895	60
140	123	186	1	1895	60
143	144	54	2	1714	40
143	145	117	1	1714	40
143	282	40	2	1714	40
144	143	54	2	1714	40
144	151	102	1	1714	60
145	245	225	1	1714	60
146	147	118	1	1714	60
148	144	61	1	1714	40
149	148	109	1	1714	50
150	149	180	1	1714	50
151	144	102	1	1714	40
151	152	130	1	1714	60
151	177	77	1	1714	60
152	151	130	1	1714	60
152	153	124	1	1714	60
152	178	32	1	1714	40
153	152	124	1	1714	60
153	179	111	1	1714	40
153	189	52	1	1714	40
153	190	156	1	1714	60
154	73	56	1	1714	40
154	174	53	1	1714	50

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	**Downstream Node Number**	**Length (Miles * 100)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
155	152	91	1	1714	40
155	158	98	1	1714	50
156	157	111	1	1714	40
156	175	63	1	1714	50
157	158	87	1	1200	50
158	167	48	1	1714	50
159	157	58	1	1714	40
160	159	84	1	1714	40
160	161	51	1	1714	50
161	162	75	1	1714	50
161	198	100	1	1714	50
162	163	82	1	1714	50
163	164	65	1	1714	50
164	166	63	1	1714	50
164	195	91	1	1714	50
165	158	85	1	1714	50
165	164	85	1	1714	50
166	190	41	1	1714	50
167	153	32	1	1714	40
168	161	48	1	1714	50
169	168	74	1	1714	50
170	169	92	1	1714	50
170	171	110	1	1714	50
171	156	84	1	1714	50
172	156	62	1	1714	50
172	160	100	1	1714	50
173	166	82	1	1714	50
173	167	76	1	1714	50
174	155	63	1	1714	50
175	155	68	1	1714	50
176	154	72	1	1714	40
177	180	133	1	1714	60
178	177	105	1	1714	40
178	179	97	1	1714	40
179	180	38	1	1714	40
179	182	55	1	1714	40
180	181	107	1	1714	60

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	**Downstream Node Number**	**Length (Miles * 100)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
181	192	90	1	1714	60
182	183	58	1	1714	40
183	184	66	1	1714	40
184	181	64	1	1714	40
185	184	30	1	1714	40
186	185	64	1	1714	40
187	186	44	1	1714	40
187	188	60	1	1714	40
188	186	40	1	1714	40
188	190	43	1	1714	50
189	187	57	1	1714	40
190	153	156	1	1714	60
190	188	43	1	1714	40
190	191	108	1	1714	60
191	190	108	1	1714	60
191	194	152	1	1714	60
191	224	163	1	1895	60
192	193	96	1	1714	60
195	191	141	1	1714	60
195	196	123	1	1714	40
196	195	123	1	1714	50
196	205	55	1	1714	40
197	196	120	1	1714	50
198	197	103	1	1714	40
198	275	80	1	1714	40
199	198	161	1	1714	50
199	200	41	1	1714	40
200	201	75	1	1714	50
201	202	133	1	1714	40
201	223	57	1	1714	50
202	203	112	1	1714	50
202	216	88	1	1714	40
203	204	100	1	1714	50
204	206	30	2	1714	40
205	196	55	1	1714	50
205	204	42	2	1714	50
205	211	84	2	1714	50

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	Downstream Node Number	Length (Miles * 100)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
206	71	42	1	1714	40
206	287	39	2	1714	40
207	72	44	1	1714	40
207	288	28	3	1714	40
208	209	57	1	1714	40
209	210	68	1	1714	50
210	212	80	2	1714	50
211	210	103	2	1714	50
212	213	126	1	1714	50
212	226	127	1	1714	50
213	212	126	1	1714	50
213	214	116	1	1714	50
214	213	116	1	1714	50
214	291	19	2	1714	60
215	290	14	3	1714	40
216	215	126	1	1714	40
217	216	104	1	1714	40
217	218	115	1	1714	40
218	219	99	1	1714	40
219	220	96	1	1714	50
220	243	149	1	1714	60
221	219	110	1	1714	40
222	221	78	1	1714	50
223	222	97	1	1714	50
224	191	163	1	1714	60
224	225	192	1	1895	60
225	224	192	1	1895	60
225	278	178	1	1895	60
226	227	126	1	1714	50
227	277	122	1	1714	50
229	230	68	1	1714	60
230	292	106	1	1714	40
231	233	86	2	1714	50
231	234	163	2	1895	60
232	231	52	2	1714	40
234	310	165	2	1714	60
235	244	148	2	1714	50

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	Downstream Node Number	Length (Miles * 100)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
236	232	173	1	1714	50
237	125	224	1	1714	60
237	264	352	1	1714	60
238	124	329	1	1714	60
238	127	355	1	1714	40
239	122	212	1	1714	60
239	123	330	1	1714	60
240	170	101	1	1714	50
241	240	170	1	1714	50
242	150	151	1	1714	50
243	214	100	1	1714	50
244	232	99	2	1714	50
245	146	319	1	1714	60
246	136	230	1	1714	60
247	131	173	1	1714	60
248	130	173	1	1714	60
249	135	88	1	1895	60
249	250	45	1	1714	45
250	249	45	1	1714	45
250	251	49	1	1714	45
251	250	49	1	1714	45
251	252	57	1	1714	45
252	251	57	1	1714	45
252	253	26	1	1714	45
253	252	26	1	1714	45
253	280	55	1	1714	40
254	251	120	1	1714	40
254	253	143	1	1714	40
255	251	68	1	1714	40
255	252	77	1	1714	40
255	256	106	1	1714	40
256	249	62	1	1714	40
256	250	35	1	1714	40
257	250	114	1	1714	40
258	254	63	1	1714	40
258	257	67	1	1714	40
259	20	95	2	1895	50

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	**Downstream Node Number**	**Length (Miles * 100)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
259	21	98	2	1895	50
260	117	104	1	1714	60
261	14	183	1	1714	40
262	111	220	1	1714	60
263	112	144	1	1714	50
263	133	126	1	1714	50
264	128	193	1	1714	60
264	237	352	1	1714	60
265	109	227	1	1714	60
265	122	109	1	1714	60
266	2	76	1	1714	50
266	267	99	1	1714	60
266	269	464	1	1714	40
267	268	235	1	1714	60
268	111	77	1	1714	60
268	272	312	1	1714	40
269	270	284	1	1714	40
270	106	60	1	1714	60
270	107	85	1	1714	60
271	108	175	1	1714	60
272	273	195	1	1714	40
273	274	97	1	1714	60
274	109	95	1	1714	60
275	202	73	1	1714	40
276	57	56	1	1714	40
277	278	74	1	1714	50
278	225	178	1	1895	60
278	279	132	1	1895	60
279	278	132	1	1895	60
280	253	55	1	1714	40
280	281	44	2	1714	40
281	280	44	2	1714	40
281	282	52	2	1714	40
282	143	40	2	1714	40
282	281	52	2	1714	40
283	280	18	1	1714	40
284	281	15	1	1714	40

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	**Downstream Node Number**	**Length (Miles * 100)**	**Full Lanes**	**Saturation Flow Rate (Veh/hr/ln)**	**Free Flow Speed (MPH)**
285	282	22	1	1714	40
286	143	21	1	1714	40
287	207	14	3	1714	40
288	215	15	3	1714	40
289	214	155	2	1714	50
290	289	22	2	1714	60
291	229	80	1	1714	60
292	231	15	2	1714	40
294	301	41	2	1714	40
294	318	13	2	1714	40
294	319	70	1	1714	60
295	294	60	1	1714	40
296	295	61	1	1500	30
297	296	120	1	1500	30
298	297	67	1	1500	30
299	300	136	1	1500	30
300	301	69	1	1714	40
301	294	41	2	1714	40
301	307	85	2	1714	50
302	303	91	2	1714	50
302	307	115	2	1714	50
303	302	91	2	1714	50
303	304	74	2	1714	50
304	303	74	2	1714	50
305	299	52	1	1500	30
306	305	98	1	1500	30
307	301	85	2	1714	40
307	302	115	2	1714	50
308	236	80	1	1714	50
308	315	74	1	1714	60
310	312	43	2	1895	60
311	310	63	1	1714	60
314	3	58	2	1895	60
314	318	67	2	1714	40
315	316	151	1	1714	60
316	317	125	1	1714	50
317	318	11	1	1714	40

Table K-1. Evacuation Roadway Network Characteristics					
Upstream Node Number	Downstream Node Number	Length (Miles * 100)	Full Lanes	Saturation Flow Rate (Veh/hr/ln)	Free Flow Speed (MPH)
318	294	13	2	1714	40
318	314	67	2	1714	40
319	320	75	1	1714	60
320	321	113	1	1714	60
321	322	96	1	1714	60
322	311	120	1	1714	60
323	35	103	1	1000	40
324	323	74	1	1000	40
325	324	134	1	1000	40
326	325	94	1	1000	40
327	328	29	1	1000	40
328	326	54	1	1000	40
329	119	140	1	1714	50
329	330	154	1	1714	60
330	118	144	1	1714	60
330	329	154	1	1714	60
331	19	139	1	1714	50
331	119	101	1	1714	50

APPENDIX L

Protective Action Zone Boundaries

APPENDIX L: PROTECTIVE ACTION ZONE BOUNDARIES

Zone C1: Bound on the north by the Yankeetown town boundary and the Levy County boundary. Bound on the east by Lake Rousseau, a line from a point on the southwestern shore of Lake Rousseau, at approximately 82.61° West and 29.01°North, to the northern end of Ira Martin Rd, a line between the northern end of Ira Martin Rd and the northern end of Cherry Hill Rd, a line between the northern end of Cherry Hill Rd and the intersection of Pomegranate Rd and Dunnellon Rd, Dunnellon Rd, the Crystal River Nuclear Plant's (CRNP) 5-mile boundary, USHY 19, the Crystal River town boundary, and State Park Rd. Bound on the south by the CRNP's 5-mile boundary. Bound on the west by the coastline.

Note: Zone C2 is not in use for the Levy Nuclear Plant

Zone C3: Bound on the north by the Citrus/Levy county boundary. Bound on the east by the CRNP's 10-mile boundary. Bound on the south by the Levy Nuclear Plant's (LNP) 10-mile boundary. Bound on the west by USHY 19, the CRNP's 5-mile boundary, Dunnellon Rd, a line between the intersection of Dunnellon Rd and Pomegranate Rd and the northern end of Cherry Hill Rd, a line between the northern end of Cherry Hill Rd and the northern end of Ira Martin Rd, and a line from the northern end of Ira Martin Rd to the Citrus/Levy county boundary.

Zone C4: Bound on the north by the Citrus/Levy and Citrus/Marion county boundaries. Bound on the east by USHY 41, the Citrus Springs town boundary, and Elkcam Rd. Bound on the south by the Pine Ridge town boundary. Bound on the west by the CRNP's 10-mile boundary.

Zone L5: Bound on the north by the CRNP's 10-mile boundary. Bound on the east by the Citrus/Levy county boundary. Bound on the south by the Withlacoochee River/Levy County boundary, and the Yankeetown town boundary. Bound on the west by a line between the southwestern-most point of the Yankeetown boundary and the CRNP's 10 mile boundary.

Zone L6: Bound on the north by the LNP's 5-mile boundary, STHY 337, and 120th St. Bound on the east by Halfmoon Rd and the Levy/ Marion county boundary. Bound on the south by the Citrus/Marion county boundary through Lake Rousseau. Bound on the west by the CRNP's 10-mile boundary and the LNP's 5 mile boundary.

Zone L7: Bound on the north by USHY 19. Bound on the east by STHY 121 and the Levy County boundary. Bound on the south by the CRNP's 10-mile

boundary. Bound on the west by the LNP's 10-mile boundary.

Zone L8: Bound on the north by the LNP's 10-mile boundary. Bound on the east by Ridgewood Rd, 95th St, a line between the west end of 95th St and STHY 337, and STHY 337. Bound on the south by the LNP's 5-mile boundary. Bound on the west by USHY 19.

Zone M9: Bound on the north by a line between STHY 337 and the west end of 95th St, 95th St, Ridgewood Rd, County Rd 545, Buena Vista Rd, Falcon Ave, Terrapin Dr, Amberjack Ave, Timberlake Rd, Indian Hill Dr, Viburnum Rd, Pine Bluffs Rd, a line from the western end of Pine Bluffs Rd to Sea Cliff Ave, 210th Ave, and 36th St. Bound on the east by USHY 41. Bound on the south by the Citrus/Marion county boundary through Lake Rousseau. Bound on the west by the Marion County boundary, Halfmoon Dr, 120th St, and STHY 337.

APPENDIX M

Procedure for Estimating Mobilization Time Based upon Survey Data

APPENDIX M: PROCEDURE FOR ESTIMATING MOBILIZATION TIME BASED UPON SURVEY DATA

The mobilization time data is obtained from a telephone survey, often with N = 500 to 1000 samples. The cumulative distribution or cumulative histogram can be plotted from the survey results.

Experience shows that the best fit pattern to the data is often a cumulative exponential distribution, shifted by T_0 minutes. For instance, refer to Figure M-1, which shows a hypothetical case in which:

> The population begins to leave only after $t = T_0 = 20$ minutes, and then follows the exponential distribution, and almost all are gone by $T_0 + T_1 = 320$ minutes.

Because this single-regime model is the most common in practice, this procedure addresses this case first. It also lays the basis for the additional cases.

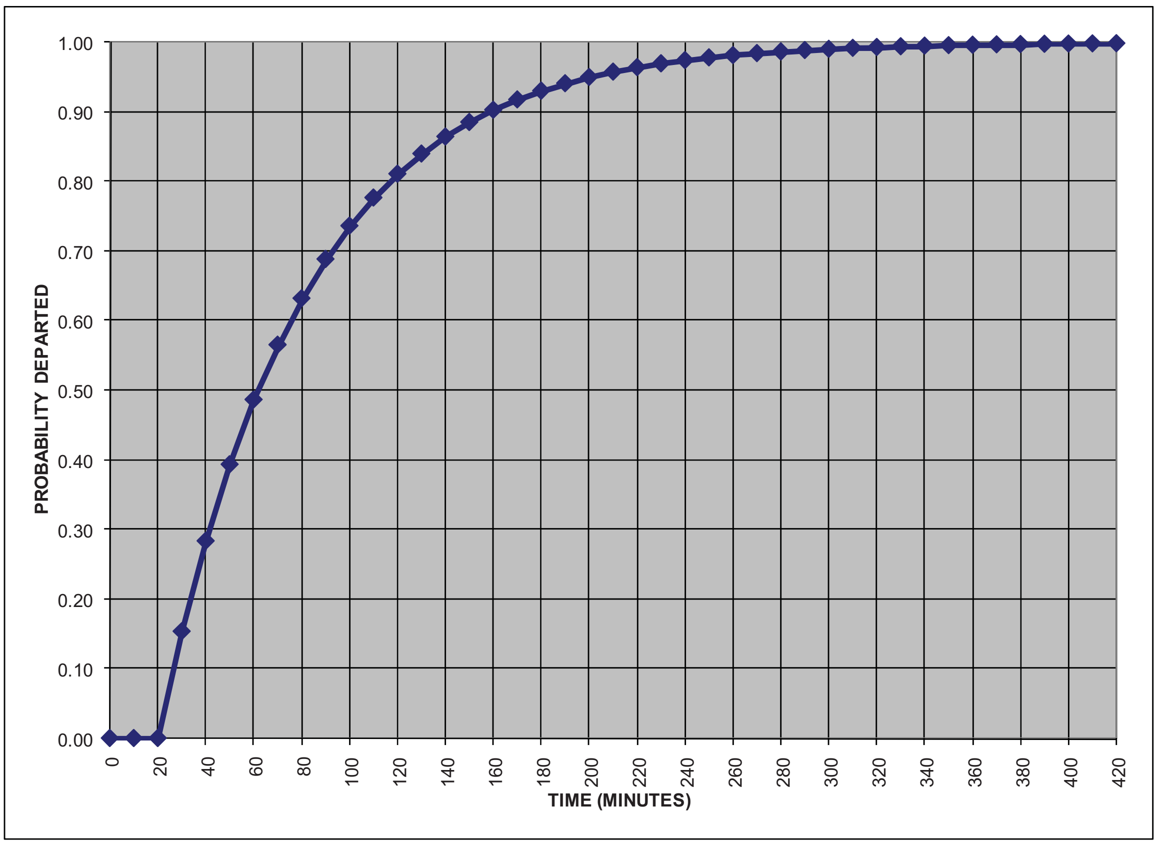


Figure M-1: Common Representation of Underlying Behavior

The form of the relation shown in Figure M-1 is

$$P_R(\text{departure time} \le t) = F(t) = \{1 - e^{-(t - T_0)/\tau}\} \quad \text{for } t \ge T_0$$
$$= 0 \quad \text{for } t < T_0 \qquad (1)$$

where P_R indicates the cumulative probability of a departure, "t" is any given time and "τ" is a constant referred to as the "time constant".

The relation can also be read as "the percentage of vehicles departed by time 't'".

The relation can also be expressed as shown in Figure M-2, namely as the probability density function of a departure at time "t". In this form, the relation is

$$f(t) = (1 / \tau)\, e^{-(t - T_0)/\tau} \quad \text{for } t \ge T_0 ,= 0 \text{ else} \qquad (2)$$

This can be read as "the relative probability of departing at time 't'". The probability of departing in the interval {t, t + Δt} is approximately $p(t) \simeq f(t)\,\Delta t$.

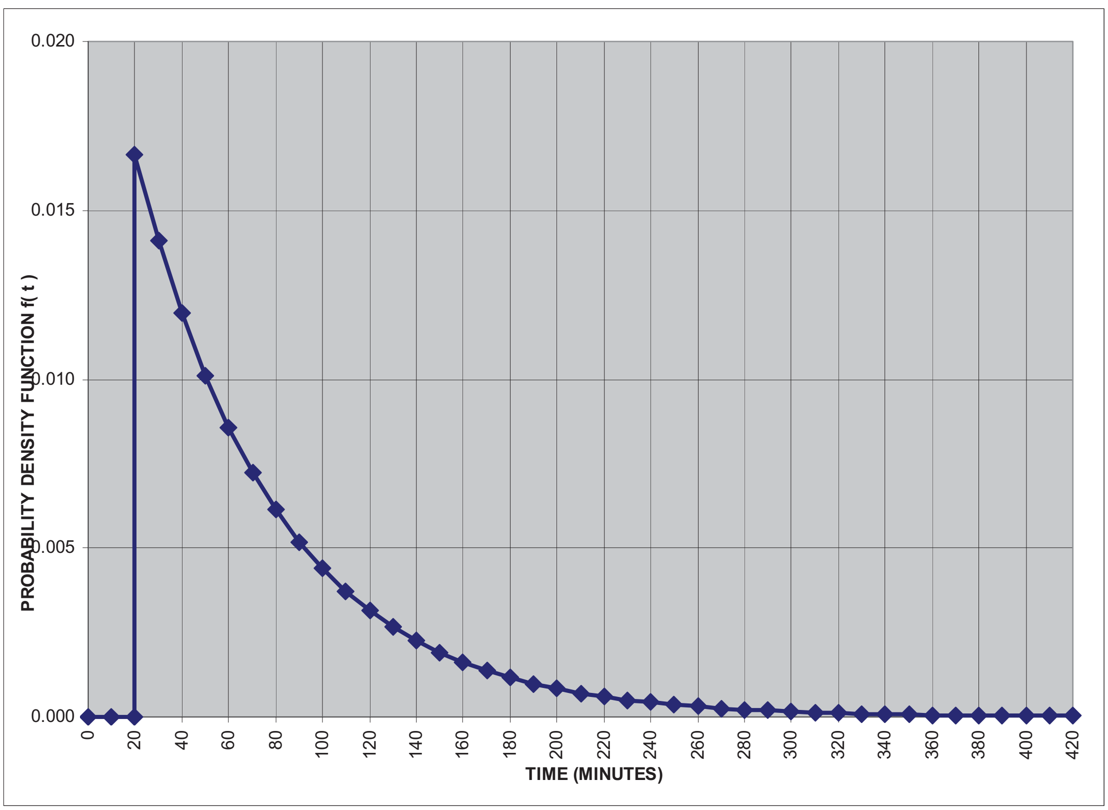


Figure M-2: The Probability Density Function f(t) Related to Figure M-1

Estimating T_0

The problem of estimating these curves from data is divided into two estimations: (1) estimate the time T_0 and (2) estimate the parameter τ. There are various methods for doing this. Based upon the sample sizes and the number of sampling intervals used in the survey, it has proven effective to

- Select a value of T_0
- Estimate τ based upon methods described in this document
- Iterate as needed

In practice, the choice of T_0 has been clear from the plot of the survey results.

For the remainder of this document, given an initial choice of T_0, you are to shift all the data (or data categories) by subtracting T_0. The net effect of this is to create a version of Figure M-2 with the curve starting at t = 0 rather than t = T_0.

Time Constant and Settling Time

In linear systems, it is common to say that the exponential curve has essentially settled to zero when either four or five time constants have passed. In fact,

$$e^{-(4t/\tau)} = e^{-4} = 0.018 \text{ or } 1.8\% \text{ of the original signal strength}$$

$$e^{-(5t/\tau)} = e^{-5} = 0.007 \text{ or } 0.7\% \text{ of the original signal strength}$$

Focus on the purpose of the analysis, which is to estimate "τ". The (shifted) Figure M-2 curve is idealized. When inspecting data and conceptually sketching a curve through the cumulative plot of the data, it is quite feasible to identify the "4τ" level of 98.2% of the data to the left (i.e. 1.8% remaining) whereas identifying the "5τ" level with 99.3% of the data generally proves elusive due to the presence of outliers in the data. Therefore, while recognizing that the curve truly settles in 5τ, this procedure calibrates τ based upon the 98.2% level.

> Therefore, as a key element of this procedure is to identify "τ", you will seek to establish the point at which the 1.8% threshold is passed in plots such as Figure M-2, or the 98.2% threshold is passed in plots such as Figure M-1 (shifted, in both cases).
>
> The identification may be done by reference to the cumulative data plot (usually aggregated by category, from the survey) or by reference to a smooth exponential curve through that data.
>
> Given that you are working with the curve up to the 4τ time, it can be truncated (brought to 100%) at any point thereafter.

For clarity:

Time constant is the constant "τ" shown in Equations 1 and 2. If the exponential relation is written in the form e^{-At}, then $\tau = 1 / A$.

Settling time is generally taken as five time constants. If the exponential relation is written in the form e^{-At}, then the settling time to the 1.8% level is 4 / A.

In either Figures M-1 or M-2, it is easy to estimate by inspection that the settling time to the 4τ level is about 260 seconds from the graph, including the T_0 component. Therefore, the "time constant" is $\tau = (260\text{-}20)/4 = 60$ and A = 1/60. A later section in this document will give guidance by which to estimate "τ", for more difficult cases.

Note that the exponential curve never reaches zero, but approaches zero asymptotically. The concept behind using this curve is that "essentially everyone" has departed by five time constants. In the ETE application, this defines the 100th percentile.

Other percentiles (50th, 90th, 95th) can be found on the basis of entering Figure M-1 on the vertical at the desired percentile and reading the corresponding time "t". The same can be achieved by solving Equation 1 for "t", given the percentile set on the left hand side of Equation 1.

From basic probability theory, it is known that the mean of the exponential distribution equals "1 / A" or "τ" (that is, one time constant). Let us formalize the procedure as:

Method 1 is estimating the settling time to the 4τ level by inspection as described above, and arriving at the estimated time constant "τ".

Method 2 for estimating the time constant is making it equal to the:

{ (estimated mean mobilization time) - T_0 },

computed from the observations (i.e. samples) obtained. It may be necessary to do this by using the centers of the categories, given the method of data collection and recording.

With the analytic form of the curve thus determined, the curve can be plotted on the same display as the data, and any major anomalies can be identified.

A "major anomaly" would be a cumulative analytic curve that has the data systematically lying to one side or the other of the analytic curve, which is drawn in the form of Equation 1. This would imply that the shifted exponential form is not a satisfactory representation of the data.

As an example, consider the hypothetical data shown in Table M-1, along with the computation of the estimated mean and estimated variance contained therein.

Table M-1: Estimation of {(Mean Mobilization Time) – T_0}

	minutes CATEGORIES			FROM CATEGORY OBSERVATIONS	
Cat #	FROM	TO	Observed	EST MEAN	EST STD
1	0	30	228	3420	51300
2	30	60	149	6705	301725
3	60	90	88	6600	495000
4	90	120	47	4935	518175
5	120	150	42	5670	765450
6	150	180	12	1980	326700
7	180	210	8	1560	304200
8	210	240	5	1125	253125
9	240	270	6	1530	390150
10	270	END	5	1425	406125
			590	34950	3811950

590 observations	6472 est variance
59.2 deduced mean	80.4 est std
	6.5 for conf bound on mean

With 95% confidence, mean is estimated		
to be between	**52.7**	minutes
and	**65.7**	minutes

The estimated time constant is therefore 59.2 minutes, given the particular sample used for this computation.

Note that the 95% confidence bound range on this estimate of the mean is from 52.7 to 65.7 minutes. A hypothesis that the mean is any value in this range would not be rejected[1].

Because the data tends to be aggregated into groups due to the survey (stated ranges are checked by the interviewer, rather than interviewee estimate of minutes, it is not necessarily true that Method 1 is markedly better than Method 2. Rather, the two results should be compared for "reasonableness".

[1] Indeed, for this illustration within this procedure, the true mean of the distribution that generated the "data" was 60 minutes. Normally, of course, this would not be known and the above estimate would be the best available.

Should there be a clear anomaly, one can expect the underlying hypothesis to be rejected in the next section.

A Goodness-of-Fit Test for the Hypothesized Curve

The hypothesis to be tested is that the underlying probability density function (pdf) is as described in Equation 2, with the constant “τ” or “A” determined by Methods 1 or 2 or an alternative method (described herein). In practice, one is to use Method 1 as the preferred method. *Should an analyst recommend another choice, it is to be discussed with the senior analyst and the quality control (QC) Officer.*

The statistical test to be used is chi-square goodness-of-fit test. A level of significance of $\alpha = 0.05$ will be used.

The procedure calls for the data to be divided into at least 5 categories, generally such that the shape of the curve to be calibrated is retained. More than 5 categories are preferred. The category widths need not be equal.

A number of standard statistical packages (e.g. SPSS, StatGraphics, MiniTab) contain the chi-square goodness of fit test. It can also be done on a spreadsheet.

Refer to Table M-2, which shows the results of a hypothetical set of survey data. The KLD spreadsheet accompanying this procedure was used. Note that:

1) There are at least five categories and at least 5 samples per category;
2) The last category is open-ended;
3) The categories are selected such that the “expected” bars do not obscure the fact that they represent the exponential distribution;
4) While the “observed” differs from the “expected”, it is within the range of natural variability for the number of samples and categories, so that the conclusion *in this illustration* is “do not reject the hypothesis”.

With that decision reached, one then proceeds to use the exponential distribution as descriptive of the phenomenon being modeled (e.g. the mobilization times) for the purpose of identifying where the sample distribution may be truncated.

Table M-2: Chi-Square Test on the Mobilization Distribution Above T_0

CHI-SQUARE TEST ON EXPONENTIAL DISTRIBUTION OF MOBILIZATION TIMES

time constant = **60** minutes LEVEL OF SIGNIFICANCE = **0.05**

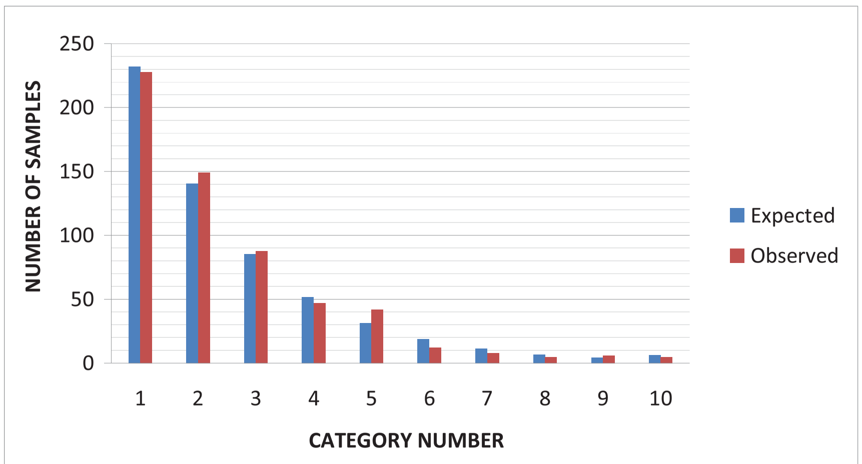
Cat #	CATEGORIES FROM	CATEGORIES TO	PROB WITH EXP DIST
1	0	**30**	0.393
2	30	**60**	0.239
3	60	**90**	0.145
4	90	**120**	0.088
5	120	**150**	0.053
6	150	**180**	0.032
7	180	**210**	0.020
8	210	**240**	0.012
9	240	**270**	0.007
10	270	END	0.011

	Expected	Observed	CHI-SQ
1	232	**228**	0.074
2	141	**149**	0.477
3	85	**88**	0.079
4	52	**47**	0.445
5	31	**42**	3.564
6	19	**12**	2.613
7	12	**8**	1.095
8	7	**5**	0.576
9	4	**6**	0.719
10	7	**5**	0.369
		590	**10.011** COMPUTED

Decision Point = **16.919**
with α above and df = {#categories - 1}

HYPOTHESIS: UNDERLYING DISTRIBUTION IS EXPONENTIAL, WITH PARAMETERS SHOWN

CONCLUSION
DO NOT REJECT HYPOTHESIS
implication: use the exponential relation



Notes

1. # categories ≥ 5, # samples per category ≥ 5
2. categories need not be equal span (range)
3. expected distribution should follow hypothesized curve, namely exponential (do not aggregate too much, particularly where curve changes quickly)
4. this spreadsheet starts with 10 categories, with the first nine each 1/2 of a time constant wide. The user can modify the red bold category ends, and can change the number of categories

Another Graphical Display, Involving the Natural Logarithm

It is interesting that if one takes the natural logarithm of both sides of Equation 2, the result is a linear relation, namely

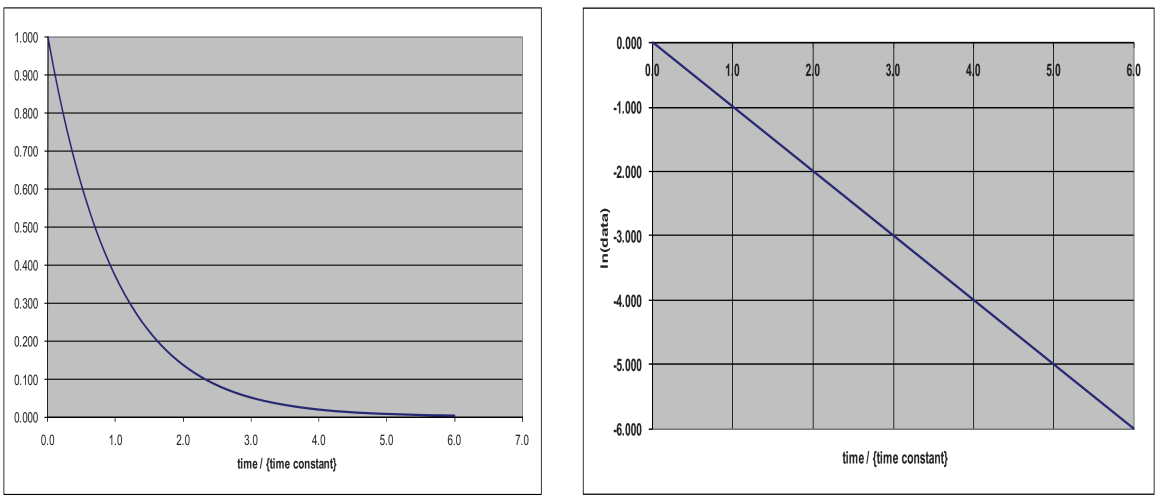
$$\ell n\{ f(t) \} = - \{ t / \tau \} + \ell n \{ 1 / \tau \}$$

or (3)

$$\ell n\{ f(t) \} = a + b\, t$$

where "b" is actually " – A" or " -1 / τ "

Refer to Figure M-3 for an illustration of how Equation 2 and 3 would plot, normalized to (t/τ), which is the same as saying plotting for τ = 1 just for illustration[2].



a) f(t) versus t/τ b) ℓn{ f(t) }versus t/τ

Figure M-3: Plot of Exponential Function

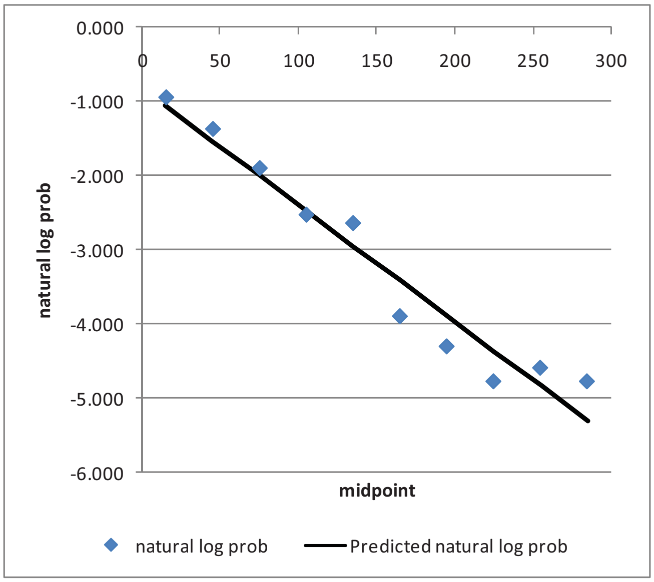
Figure M-4 shows the logarithmic plot of the "data" from Table M-1, with the trend line from the data. The "trend line" obtained in Excel is in fact the same as that resulting from a linear regression. If one does the regression using Data Analysis tools in Excel, the result is

Estimated time constant = 60.2 $\pm$ 11.7 minutes

For present purposes, let us define the use of the regression line in this format as Method 3 for arriving at an estimate of the time constant.

---

[2] At one time, it was common to use semi-log paper to plot this, with the scale on the paper taking care of the logarithmic conversion.



midpoint	natural log prob
15	-0.951
45	-1.376
75	-1.903
105	-2.530
135	-2.642
165	-3.895
195	-4.301
225	-4.771
255	-4.588
285	-4.771

Figure M-4: Plot of the Table M-1 "Data" in Logarithm Form for the Percent by Category

This is rather consistent with the Method 2 estimate of 59.2 $\pm$ 6.5 minutes.

Comparing the three "methods" side-by-side, Figure M-5 shows a negligible difference in the results, at least on a visual scale. The analyst is to use Method 1, but as this illustration demonstrates, the other methods yield comparable results, with no more than $\pm$ 2% on the 50^{th} percentile and $\pm$ 1% at the 90^{th}, 95^{th}, or 99^{th} percentiles. This is well within the natural variability of the statistics, given the number of samples and the inherent variability in the population. Consider Table M-3, as an illustration.

Table M-3: Percentile Results, for Different Methods

Percentiles indicated, in minutes			
	Method 1	Method 2	Method 3
50th	42	41	42
90th	138	136	139
95th	180	178	180
99th	271	271	273

Note: Add T_0 = 20 minutes for actual mobilization times

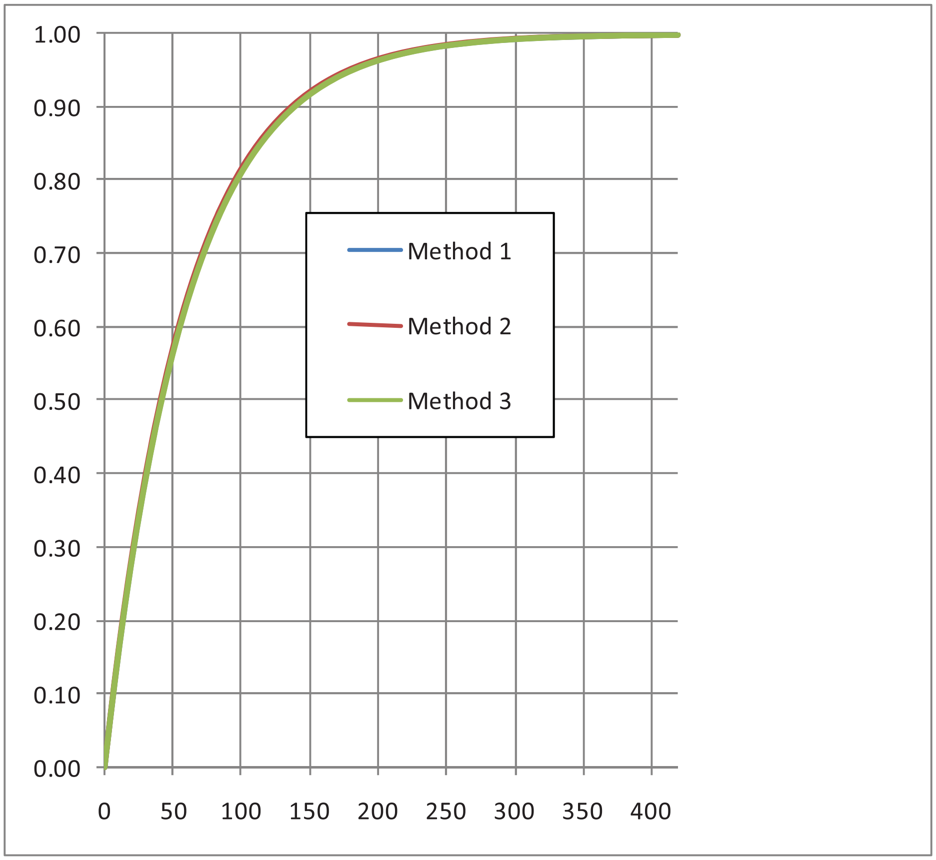


Figure M-5: Comparison of Three Methods of Estimating τ

Insights and Guidance for the Analyst

1) Method 1 is to be used as the default method. If another method is considered, it must be discussed with the senior analyst and reviewed by the QC officer.

2) Given the natural variability in the data and the survey sample sizes, any differences shown herein are within the expected variability of the results.

3) Table M-3 illustrates the variability that may arise, in terms of percentile values of the mobilization distribution. As shown in Figure M-3, the numbers that appear somewhat different in Table M-3 have little practical impact in Figure M-5.

4) All of the analysis and methods have focused on the most common model of a homogeneous population mobilizing. If there were more complex models (see the next section), the problem can be subdivided into "regimes" and the above techniques applied within each regime. Because

this is not as common, the analyst should review such cases with the senior analyst and QC officer when they occur.

5) Note that the "outlying" points typical of survey responses may shift the mean somewhat, but not in a major way. The methods used do not depend on the outliers as much as on the 98.2% level or the mean. That is, good estimates of the major percentiles can be obtained from the underlying curve, as illustrated in Figure M-5.

6) In reviewing work, the analyst may find that the mobilization curve is not continued past the 95th percentile or that it is sketched unevenly (poorly) past that point. Fortunately, as cited in #5, the time constant τ (whether estimated by Methods 1, 2, or 3) is the prime determinant of the curve and of the key percentiles.

7) The goodness-of-fit test is intended to assure that the hypothesis of an underlying exponential distribution is plausible. If it is not, the analyst can expect the result of "reject hypothesis" in the analysis illustrated in Table M-2.

8) Indeed, if the data in the Figure M-4 display is done at the time of the goodness-of-fit test, the analyst can then expect the data to not appear randomly distributed about the trend line. In particular, a range that has the values on only one side – notably toward the end – may represent a more complex underlying model.

The conclusion in #8 occurs infrequently, and the senior analyst should then be involved, with a review by the QC officer expected.

Other Model Forms

Three variations may occur, as illustrated in Figures M-6, M-7, and M-8:

- Figure M-6 shows a 2-regime model in which there are two distinct groups *that can be discerned* in the data. For instance, Group 1 may start to leave immediately and follow the basic model pattern. Group 2 may start some time later (due to returning home, etc) and then follow a shifted exponential, perhaps with a different time constant. The curve may also be shifted at t = 0.
- Figure M-7 shows a 3-regime model in which there are three distinct groups *that can be discerned* in the data. The curve may also be shifted at t = 0.
- Figure M-8 shows a delayed curve with a smooth rise (shown compared to the dashed basic model with $T_0 = 0$).

If and when the data displays these unexpected multi-regime patterns, the senior analyst is to be involved, and a special analysis is to be documented and submitted to the QC officer.

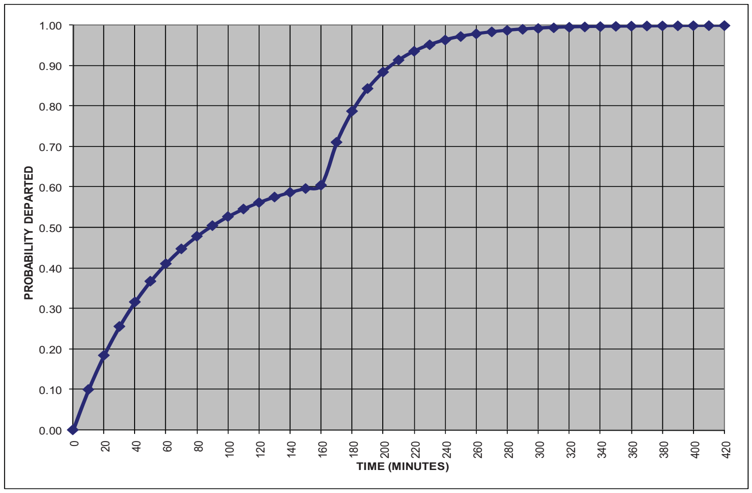


Figure M-6: 2-Regime Model

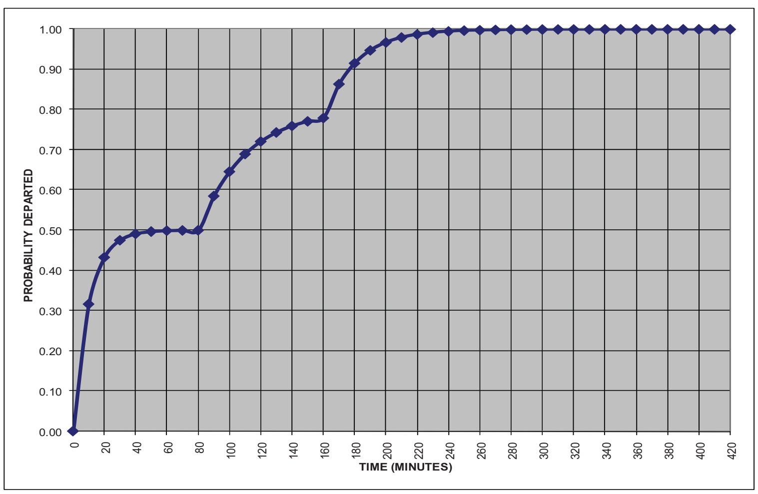


Figure M-7: 3-Regime Model

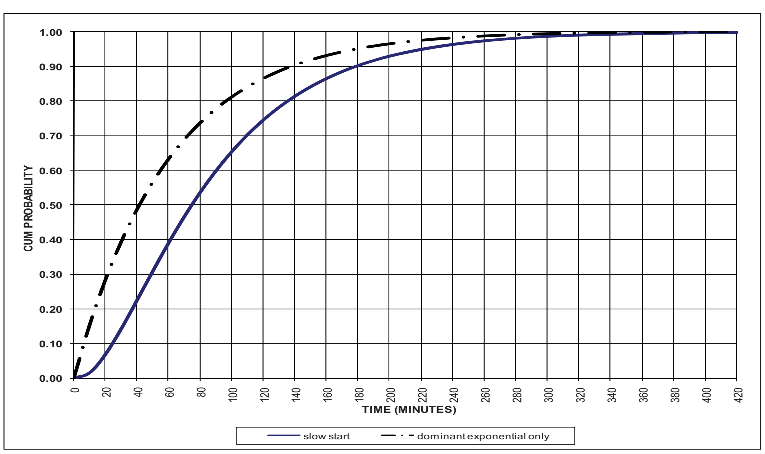


Figure M-8: Delayed Initiation Model, Compared to Basic Model