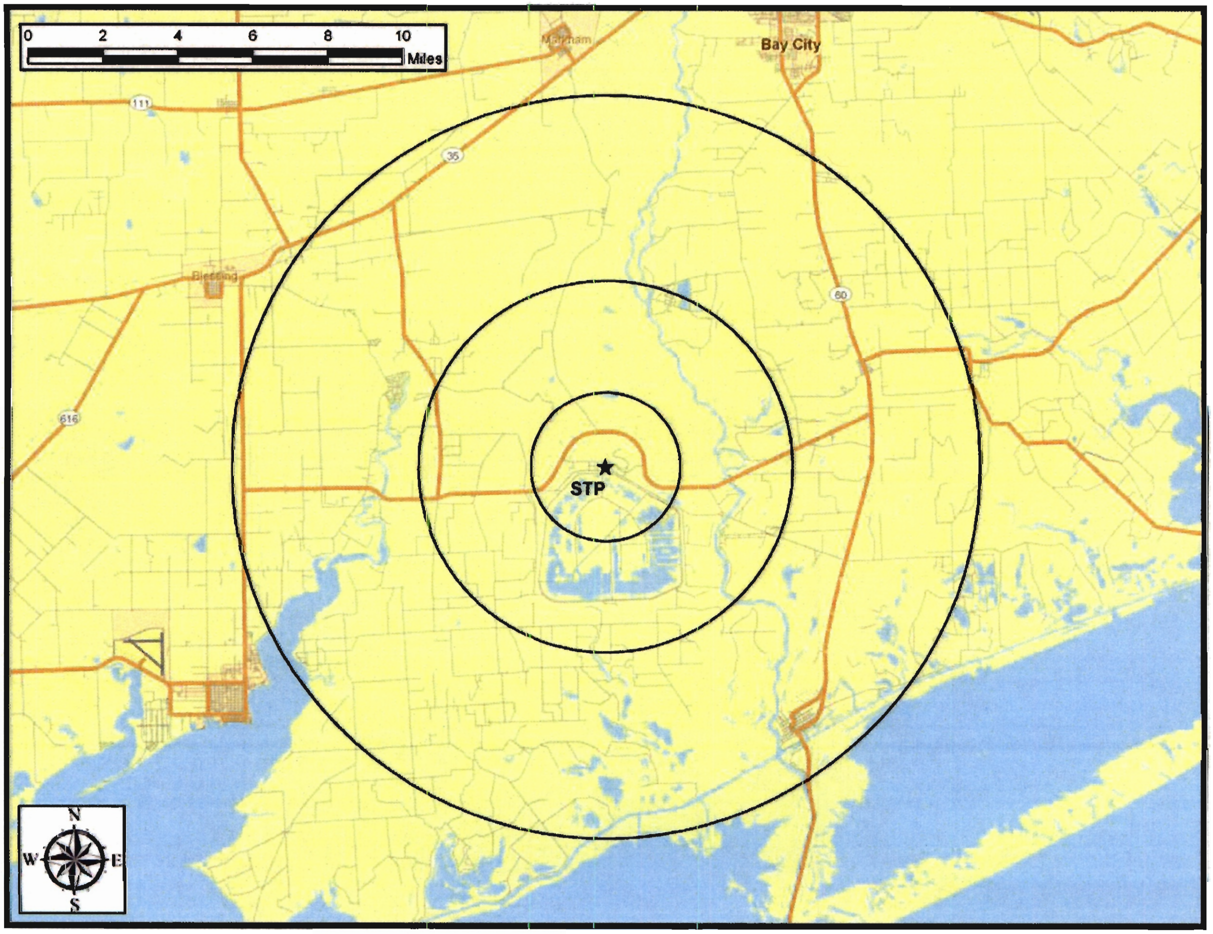
KLD ASSOCIATES, INC.

South Texas Project

Development of Evacuation Time Estimates



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EXECUTIVE SUMMARY

This report describes the analyses undertaken and the results obtained by a study to develop Evacuation Time Estimates (ETE) for the South Texas Project (STP) located in Matagorda County, Texas. Evacuation time estimates provide State and local governments with site-specific information needed for Protective Action decision-making.

In the performance of this effort, all available prior documentation relevant to Evacuation Time Estimates was reviewed. Other guidance is provided by documents published by Federal Government agencies. Most important of these are:

- Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG 0654/FEMA-REP-1, Rev. 2, 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 January, 2007 and extended over a period of 9 months. The major activities performed are briefly described in chronological sequence:

- Attended "kick-off" meetings with South Texas Project personnel and emergency management personnel representing state and local governments.
- Reviewed prior ETE reports prepared for STP and accessed U.S. Census data files for the year 2000. Studied Geographical Information Systems (GIS) maps of the area in the vicinity of STP, then conducted a field survey of the highway network.
- Synthesized this information to create an analysis network representing the highway system topology and capacities within the EPZ, and extending 15 miles radially from STP.
- Designed and sponsored a telephone survey of residents within the EPZ to gather focused data needs 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 Matagorda County at the kickoff meeting) were returned with data pertaining to employment, transients, and special facilities within the county.

- The traffic demand and trip-generation rates of evacuating vehicles were estimated from the gathered data. The trip generation rates reflect the estimated mobilization time (i.e., the time required by evacuees to prepare for the evacuation trip) that was computed using the results of the telephone survey of EPZ residents.

- Following Federal guidelines, the EPZ is subdivided into 11 Zones. The Zones are grouped within circular areas or within "keyhole" configurations (circles plus radial sectors) that define a total of 22 Evacuation Regions.

- The Matagorda Beach area has only one access road - FM 2031, which cuts through the STP EPZ. It is prudent to evacuate both the resident and transient population on the beach in the event of an emergency, since an escalation of the event or a change in wind direction could expose those evacuees on FM 2031 to the plume. Thus, it is assumed that in every scenario and for every region these people will be evacuated, and their vehicles will be included in the network traffic.

- 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). Two special scenarios involving a summer beach holiday, and the construction of a new unit at the STP site were considered.

- The Planning Basis for the calculation of ETE is:

  - A rapidly escalating accident at STP 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 pick up their children at the host school for a Site Area Emergency or higher. 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. Separate ETE are calculated for the transit-dependent evacuees.

Computation of ETE

A total of 264 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 22 Evacuation Regions to completely evacuate from that Region, under the circumstances defined for one of the 12 Evacuation Scenarios (22 x 12 = 264). 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 would apply 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. These voluntary evacuees could impede those others 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. In addition, impedance caused by voluntary evacuees originating their trips in the "shadow region" outside the EPZ and extending to a radial distance of 15 miles from STP, is likewise considered.

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 STP), 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. The plan takes the form of detailed schematics specifying: (1) the directions of evacuation travel to be facilitated, and other traffic movements to be discouraged; (2) the equipment needed (cones, barricades) and their deployment; (3) the locations of these "Traffic Control Points" (TCP); and (4) the number of traffic control personnel required.

Selected Results

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 STP site showing the layout of the 11 Zones that comprise, in aggregate, the Emergency Planning Zone (EPZ).
- Table 3-1 presents the estimates of permanent resident population in each Zone based on the 2000 Census data for Matagorda County. Census data showed a slight decrease (0.3%) in population numbers between 2000 and 2005. We conservatively estimate no change in population between year 2000 and 2007.
- Table 6-2 defines each of the 22 Evacuation Regions in terms of their respective groups of Zones.
- Table 6-3 lists the 12 Evacuation Scenarios.
- Tables 7-1C and 7-1D are compilations of Evacuation Time Estimates (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 8-4A presents ETE for the schoolchildren in good weather.
- Table 8-6A presents ETE for the transit-dependent population in good weather.

Conclusion

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

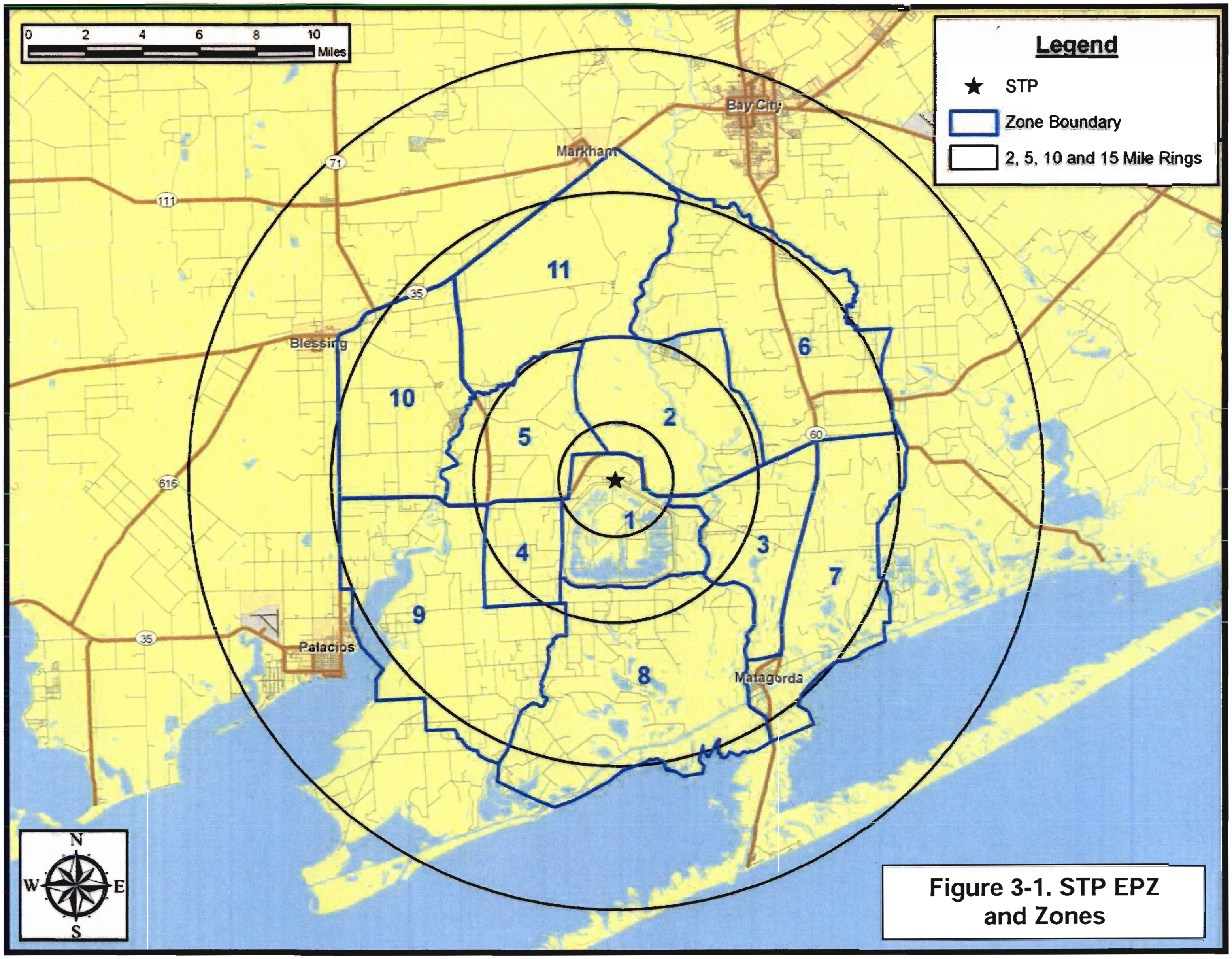

Figure 3-1. STP EPZ and Zones

Table 3-1. EPZ Permanent Resident Population		
Zone	**2000 Population**	**2007 Population**
1	0	0
2	40	40
3	402	402
4	56	56
5	82	82
6	650	650
7	518	518
8	0	0
9	237	237
10	692	692
11	198	198
TOTAL	**2,875**	**2,875**
	Population Growth:	**0%**

	2000 Population	2007 Population
Matagorda Beach*	116	116

*The 116 permanent residents in the Matagorda Beach area will be evacuated under all scenarios.

Table 6-2. Description of Evacuation Regions												
Region	Description	ZONE 1	2	3	4	5	6	7	8	9	10	11
R01	2 mile ring	■										
R02	5-mile ring	■	■	■	■	■						
R03	Full EPZ	■	■	■	■	■	■	■	■	■	■	■
Evacuate 2 mile ring and 5 miles downwind												
Region	Wind Direction (From) in Degrees	ZONE 1	2	3	4	5	6	7	8	9	10	11
R04	29 - 50	■			■							
R05	51 - 106	■			■	■						
R06	107 - 140	■				■						
R07	141 - 174	■	■			■						
R08	175 - 230	■	■									
R09	231 - 286	■	■	■								
R10	287 - 331	■		■								
R01*	332 - 28	■										
Evacuate 5 mile ring and downwind to EPZ boundary												
Region	Wind Direction (From) in Degrees	ZONE 1	2	3	4	5	6	7	8	9	10	11
R11	355 - 50	■	■	■	■	■			■	■		
R12	51 - 61	■	■	■	■	■			■	■	■	
R13	62 - 95	■	■	■	■	■				■	■	
R14	96 - 129	■	■	■	■	■				■	■	■
R15	130 - 163	■	■	■	■	■					■	■
R16	164 - 174	■	■	■	■	■	■				■	■
R17	175 - 219	■	■	■	■	■	■					■
R18	220 - 230	■	■	■	■	■	■					
R19	231 - 286	■	■	■	■	■	■	■				
R20	287 - 298	■	■	■	■	■		■				
R21	299 - 343	■	■	■	■	■		■	■			
R22	344 - 354	■	■	■	■	■		■	■	■		

Residents and Transients in the Matagorda Beach area are always evacuated.

* Note that evacuating the 2-mile ring and evacuating the 5-mile ring with wind from 332° to 28° both result in the evacuation of Region1. Thus, R01 is shown twice in the table above.

Table 6-3. Evacuation Scenario Definitions					
Scenario	**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	Summer	Weekend	Midday	Good	Holiday (Beachgoers)
12	Summer	Midweek	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		Summer	Summer
	Midweek		Weekend		Midweek Weekend		Midweek		Weekend		Midweek Weekend		Holiday	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)	(12)
Region Wind From:	Midday		Midday		Evening	Region Wind From:	Midday		Midday		Evening	Region Wind From:	Midday	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather		Good Weather	Rain	Good Weather	Rain	Good Weather		Beach Holiday	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ														
R01 2-mile ring	0:55	0:55	0:50	0:50	0:50	R01 2-mile ring	0:55	0:55	0:50	0:50	0:50	R01 2-mile ring	0:50	1:40
R02 5-mile ring	3:10	3:20	3:00	3:00	3:20	R02 5-mile ring	3:40	3:40	3:50	3:50	4:10	R02 5-mile ring	3:25	2:10
R03 Entire EPZ	4:00	4:00	3:40	3:40	4:00	R03 Entire EPZ	4:20	4:20	4:10	4:20	4:20	R03 Entire EPZ	3:50	3:40
2-Mile Ring and Downwind to 5 Miles														
R04 29° to 50°	1:00	1:00	2:30	2:30	2:50	R04 29° to 50°	1:00	1:00	2:50	2:50	2:50	R04 29° to 50°	2:30	1:40
R05 51° to 106°	1:50	1:50	3:25	3:25	3:30	R05 51° to 106°	1:50	1:50	3:40	3:40	3:40	R05 51° to 106°	3:25	1:40
R06 107° to 140°	1:30	1:30	2:50	2:50	2:40	R06 107° to 140°	1:30	1:30	2:50	2:50	2:50	R06 107° to 140°	2:50	1:40
R07 141° to 174°	1:50	1:50	2:50	2:50	2:40	R07 141° to 174°	1:50	1:50	2:50	2:50	2:50	R07 141° to 174°	2:50	1:50
R08 175° to 230°	1:00	1:00	1:30	1:30	1:30	R08 175° to 230°	1:00	1:00	1:30	1:30	1:30	R08 175° to 230°	1:30	1:40
R09 231° to 286°	3:00	3:00	2:50	2:50	3:00	R09 231° to 286°	3:30	3:30	3:40	3:40	4:00	R09 231° to 286°	3:25	2:00
R10 287° to 331°	3:00	3:00	2:50	2:50	3:00	R10 287° to 331°	3:30	3:30	3:40	3:40	4:00	R10 287° to 331°	3:25	2:00
R01 332° to 28°	0:55	0:55	0:50	0:50	0:50	R01 332° to 28°	0:55	0:55	0:50	0:50	0:50	R01 332° to 28°	0:50	1:40
5-Mile Ring and Downwind to EPZ Boundary														
R11 355° to 50°	3:50	3:50	3:40	3:40	3:50	R11 355° to 50°	4:10	4:10	4:10	4:20	4:20	R11 355° to 50°	3:25	2:50
R12 51° to 61°	3:40	3:40	3:20	3:30	3:50	R12 51° to 61°	4:10	4:10	4:10	4:10	4:20	R12 51° to 61°	3:25	3:00
R13 62° to 95°	3:40	3:40	3:20	3:30	3:50	R13 62° to 95°	4:10	4:10	4:10	4:10	4:20	R13 62° to 95°	3:25	3:00
R14 96° to 129°	3:50	3:50	3:30	3:30	3:50	R14 96° to 129°	4:10	4:10	4:10	4:10	4:20	R14 96° to 129°	3:25	3:10
R15 130° to 163°	3:30	3:30	3:00	3:00	3:30	R15 130° to 163°	4:00	4:00	4:00	4:00	4:10	R15 130° to 163°	3:25	2:50
R16 164° to 174°	3:50	3:50	3:20	3:30	3:50	R16 164° to 174°	4:10	4:10	4:10	4:10	4:20	R16 164° to 174°	3:30	3:40
R17 175° to 219°	4:00	4:00	3:40	3:40	4:00	R17 175° to 219°	4:10	4:10	4:10	4:20	4:20	R17 175° to 219°	3:35	3:40
R18 220° to 230°	3:50	3:50	3:40	3:40	4:00	R18 220° to 230°	4:10	4:10	4:10	4:20	4:20	R18 220° to 230°	3:35	3:30
R19 231° to 286°	3:50	3:50	3:40	3:40	3:50	R19 231° to 286°	4:10	4:10	4:10	4:20	4:20	R19 231° to 286°	3:50	3:30
R20 287° to 298°	3:20	3:20	3:00	3:00	3:30	R20 287° to 298°	3:50	3:50	4:00	4:00	4:10	R20 287° to 298°	3:40	2:30
R21 299° to 343°	3:20	3:20	3:00	3:00	3:30	R21 299° to 343°	3:50	3:50	4:00	4:00	4:10	R21 299° to 343°	3:40	2:30
R22 344° to 354°	3:50	3:50	3:40	3:40	3:50	R22 344° to 354°	4:10	4:10	4:10	4:20	4:20	R22 344° to 354°	3:40	3:00

Table 7-1D. Time To Clear The Indicated Area of 100 Percent of the Affected Population														
	Summer		Summer		Summer		Winter		Winter		Winter		Summer	Summer
	Midweek		Weekend		Midweek Weekend		Midweek		Weekend		Midweek Weekend		Holiday	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)	(12)
Region Wind From:	Midday		Midday		Evening	Region Wind From:	Midday		Midday		Evening	Region Wind From:	Midday	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather		Good Weather	Rain	Good Weather	Rain	Good Weather		Beach Holiday	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ														
R01 2-mile ring	1:00	1:00	1:00	1:00	1:00	R01 2-mile ring	1:00	1:00	1:00	1:00	1:00	R01 2-mile ring	1:00	2:00
R02 5-mile ring	6:00	6:10	5:10	5:10	5:10	R02 5-mile ring	6:00	6:00	5:10	5:10	5:10	R02 5-mile ring	5:10	6:00
R03 Entire EPZ	6:10	6:10	5:50	5:50	5:50	R03 Entire EPZ	6:10	6:10	5:50	5:50	5:50	R03 Entire EPZ	5:50	6:10
2-Mile Ring and Downwind to 5 Miles														
R04 29° to 50°	4:50	5:00	4:50	4:50	4:50	R04 29° to 50°	4:50	5:00	4:50	4:50	4:50	R04 29° to 50°	4:50	5:00
R05 51° to 106°	4:50	5:00	5:00	5:00	5:00	R05 51° to 106°	4:50	5:00	5:00	5:00	5:00	R05 51° to 106°	5:00	5:00
R06 107° to 140°	4:50	4:50	5:00	5:00	5:00	R06 107° to 140°	4:50	4:50	5:00	5:00	5:00	R06 107° to 140°	5:00	5:00
R07 141° to 174°	4:50	4:50	5:00	5:00	5:00	R07 141° to 174°	4:50	4:50	5:00	5:00	5:00	R07 141° to 174°	5:00	5:00
R08 175° to 230°	3:50	3:50	2:50	2:50	2:50	R08 175° to 230°	3:50	3:50	2:50	2:50	2:50	R08 175° to 230°	2:50	3:50
R09 231° to 286°	6:00	6:10	5:10	5:10	5:10	R09 231° to 286°	6:00	6:00	5:10	5:10	5:10	R09 231° to 286°	5:10	6:00
R10 287° to 331°	6:00	6:10	5:10	5:10	5:10	R10 287° to 331°	6:00	6:00	5:10	5:10	5:10	R10 287° to 331°	5:10	6:00
R01 332° to 28°	1:00	1:00	1:00	1:00	1:00	R01 332° to 28°	1:00	1:00	1:00	1:00	1:00	R01 332° to 28°	1:00	2:00
5-Mile Ring and Downwind to EPZ Boundary														
R11 355° to 50°	6:00	6:10	5:50	5:50	5:50	R11 355° to 50°	6:00	6:00	5:50	5:50	5:50	R11 355° to 50°	5:50	6:00
R12 51° to 61°	6:00	6:10	5:50	5:50	5:50	R12 51° to 61°	6:00	6:10	5:50	5:50	5:50	R12 51° to 61°	5:50	6:00
R13 62° to 95°	6:00	6:10	5:50	5:50	5:50	R13 62° to 95°	6:00	6:10	5:50	5:50	5:50	R13 62° to 95°	5:50	6:00
R14 96° to 129°	6:00	6:10	5:50	5:50	5:50	R14 96° to 129°	6:00	6:10	5:50	5:50	5:50	R14 96° to 129°	5:50	6:00
R15 130° to 163°	6:00	6:10	5:10	5:10	5:10	R15 130° to 163°	6:00	6:00	5:10	5:10	5:10	R15 130° to 163°	5:10	6:00
R16 164° to 174°	6:10	6:10	5:20	5:20	5:20	R16 164° to 174°	6:10	6:10	5:20	5:20	5:10	R16 164° to 174°	5:10	6:00
R17 175° to 219°	6:10	6:10	5:20	5:20	5:20	R17 175° to 219°	6:10	6:10	5:20	5:20	5:10	R17 175° to 219°	5:10	6:10
R18 220° to 230°	6:10	6:10	5:20	5:20	5:20	R18 220° to 230°	6:10	6:10	5:20	5:20	5:10	R18 220° to 230°	5:10	6:10
R19 231° to 286°	6:10	6:10	5:20	5:20	5:20	R19 231° to 286°	6:10	6:10	5:20	5:20	5:20	R19 231° to 286°	5:10	6:10
R20 287° to 298°	6:10	6:10	5:10	5:10	5:10	R20 287° to 298°	6:10	6:10	5:10	5:10	5:10	R20 287° to 298°	5:10	6:00
R21 299° to 343°	6:10	6:10	5:10	5:10	5:10	R21 299° to 343°	6:10	6:10	5:10	5:10	5:10	R21 299° to 343°	5:10	6:00
R22 344° to 354°	6:10	6:10	5:50	5:50	5:50	R22 344° to 354°	6:10	6:10	5:50	5:50	5:50	R22 344° to 354°	5:50	6:00

Table 8-4A. School Evacuation Time Estimates - Good Weather												
School	Driver Mobilization and Travel Time from Depot(min)	Loading Time (min)	Dist. to EPZ Boundary (mi.)		Travel Time to EPZ Bndry (min)	To Bndry ETE (min)	To Bndry ETE (hr:min)	Dist. EPZ Bndry to R.C.		Travel Time EPZ Bndry to RC (min)	ETE to R.C. (min)	ETE to R.C. (hr:min)
			Major Road	Local Road				Major Road	Local Road			
Matagorda County Schools												
Matagorda Elementary School	30	5	15	1.7	22	60	**1:00**	1.5	1.4	5	65	**1:05**
Tidehaven Middle School to Markham E.S.	30	5	7.8	0	10	45	**0:45**	0	1.0	2	50	**0:50**
Tidehaven High School to Markham E.S.	30	5	6.2	0	8	45	**0:45**	0	1.0	2	45	**0:45**
Tidehaven Middle School to Blessing E.S.	30	5	6.4	0	8	45	**0:45**	0	0.1	1	45	**0:45**
Tidehaven High School to Blessing E.S.	30	5	4.8	0	6	45	**0:45**	0	0.1	1	45	**0:45**
ETE rounded up to the nearest 5 minutes			**Average for EPZ:**			48	**0:48**	**Average:**		2	50	**0:50**

Table 8-6A. Transit-Dependent Evacuation Time Estimates - GOOD WEATHER														
	Single Wave						**Second Wave (After School Evacuation)**							
Route Number	**Mobilization and Travel Time to EPZ**	**Route Length (mi.)**	**Route Travel Time**	**Pickup Time**	**ETE (min)**	**ETE (hr:min)**	**Arrive at RC**	**Unload**	**Driver Rest**	**Return to EPZ**	**Route Travel Time**	**Pickup Time**	**ETE (min)**	**ETE (hr:min)**
1	150	6.3	13	15	180	**3:00**	50	5	15	2	26	15	115	**1:55**
2	150	17.0	34	15	200	**3:20**	50	5	15	2	68	15	155	**2:35**
3	150	5.5	11	15	180	**3:00**	50	5	15	2	22	15	110	**1:50**
				Average for EPZ:	**187**	**3:06**						**Average for EPZ:**	**127**	**2:06**

1. INTRODUCTION

This report describes the analyses undertaken and the results obtained by a study to update the existing Evacuation Time Estimates (ETE) for the South Texas Project (STP), located in Matagorda County, Texas. Evacuation time estimates provide State and local governments with site-specific information needed for Protective Action decision-making.

In the performance of this effort, all available prior documentation relevant to Evacuation Time Estimates was reviewed.

Other guidance is provided by documents published by Federal Government agencies. Most important of these are:

- Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, NUREG 0654/FEMA-REP-1, Rev. 2, 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 Matagorda County emergency management agencies and local and state law enforcement agencies, who provided valued guidance and contributed information contained in this report.

1.1 Overview of the ETE Update 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 South Texas Project.
   - Reviewed existing reports describing past evacuation studies.
   - Attended meetings with emergency planners from Matagorda County to identify issues to be addressed and resources available.
   - Conducted a detailed field survey of the Emergency Planning Zone (EPZ) highway system and of area traffic conditions.

- Obtained demographic data from census and state agencies.

- Conducted a random sample telephone survey of EPZ residents.

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

2. Estimated distributions of Trip Generation times representing the time required by various population groups (permanent residents, employees, and transients) to prepare (mobilize) for the evacuation trip. These estimates are primarily based upon the random sample telephone survey.
3. Defined Evacuation Scenarios. These scenarios reflect the variation in demand, 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 EPZ. Local and state police personnel have reviewed all traffic control plans.
5. Defined Evacuation Areas or Regions. The EPZ is partitioned into Zones which serve as a basis for the ETE analysis presented herein. Evacuation "Regions" are comprised of a group of contiguous Zones 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 prior studies, from data provided by local and state agencies and from the telephone survey.

   - Applied the procedures specified in the 2000 Highway Capacity Manual (HCM) to the data acquired during the field survey, to estimate the capacity of all highway segments comprising the evacuation routes.

   - 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 STP.

- 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 Regions and Evacuation Scenarios.
9. Documented ETE in formats responsive to NUREG 0654.
10. Calculated the ETE for all transit activities including those for schools and for the transit-dependent population.

Steps 4, 7 and 8 are iterated as described in Appendix D.

1.2 The South Texas Project Site Location

The STP is located in Matagorda County, Texas, approximately 13 miles south-southwest of Bay City, and 75 miles south-southwest of Houston. A portion of the EPZ is on the Gulf Coast (E/W Matagorda Bay) and Tres Palacios Bay. The area has many lakes, rivers, creeks, and a barrier island that attracts many transients. The area is sparsely populated; Matagorda is the largest community. Figure 1-1 displays the area surrounding the STP. This map identifies the communities in the area and the major roads.

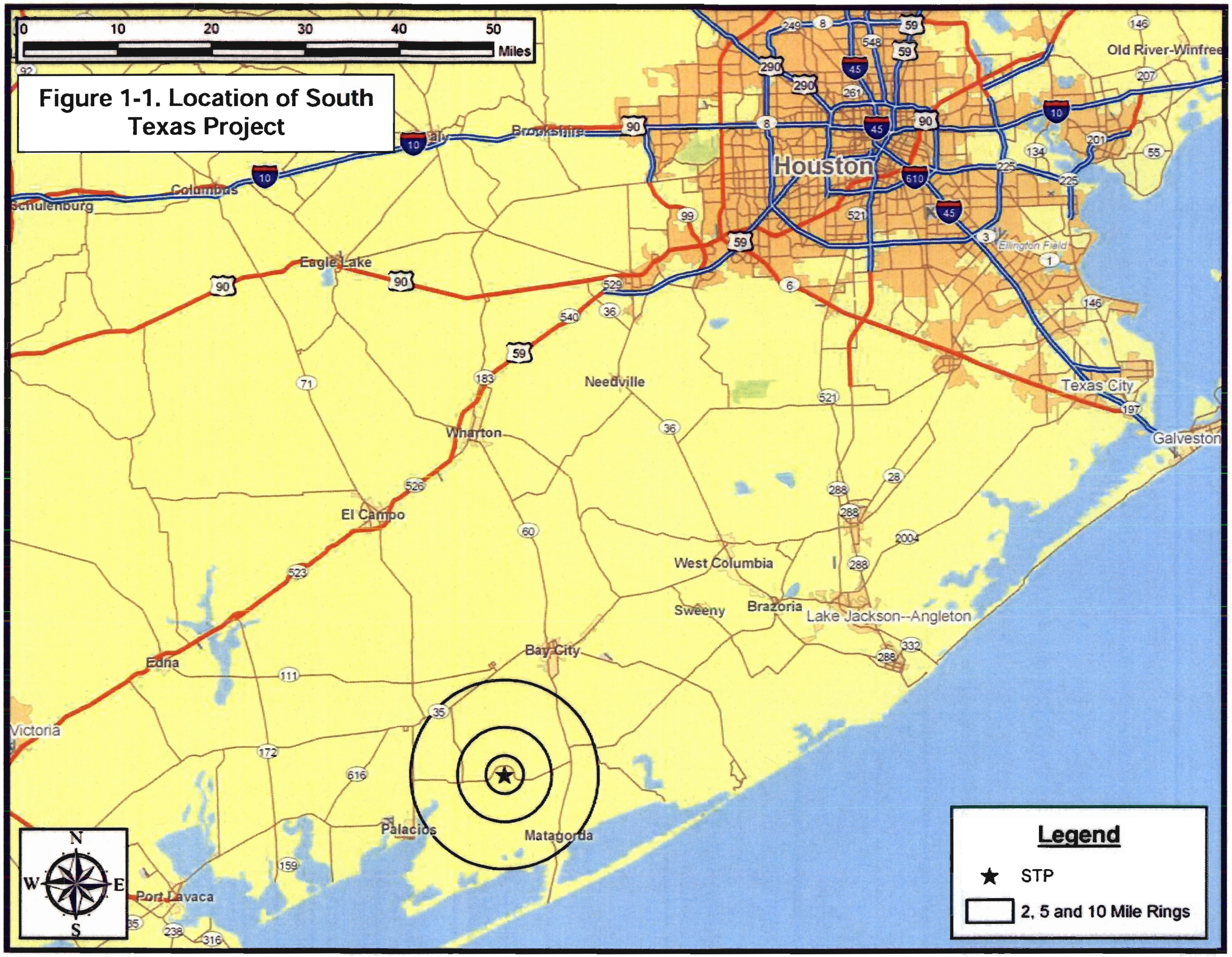

Figure 1-1. Location of South Texas Project

1.3 Preliminary Activities

Since this plan constitutes an update of an existing document, it was necessary to review the prior process and findings. These activities are described below.

Literature Review

KLD Associates was provided with copies of documents describing past studies and analyses leading to the development of emergency plans and of 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 highway system within the EPZ and for some distance outside. The characteristics of each section of highway were recorded. These characteristics include:

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

The data were then transcribed; this information was referenced while preparing the input stream for the IDYNEV System.

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 ETE overall 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 Highway Capacity Manual (HCM[1]). 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.

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 an update to an ETE is outlined in Appendix D. Appendix A is a glossary of terms.

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

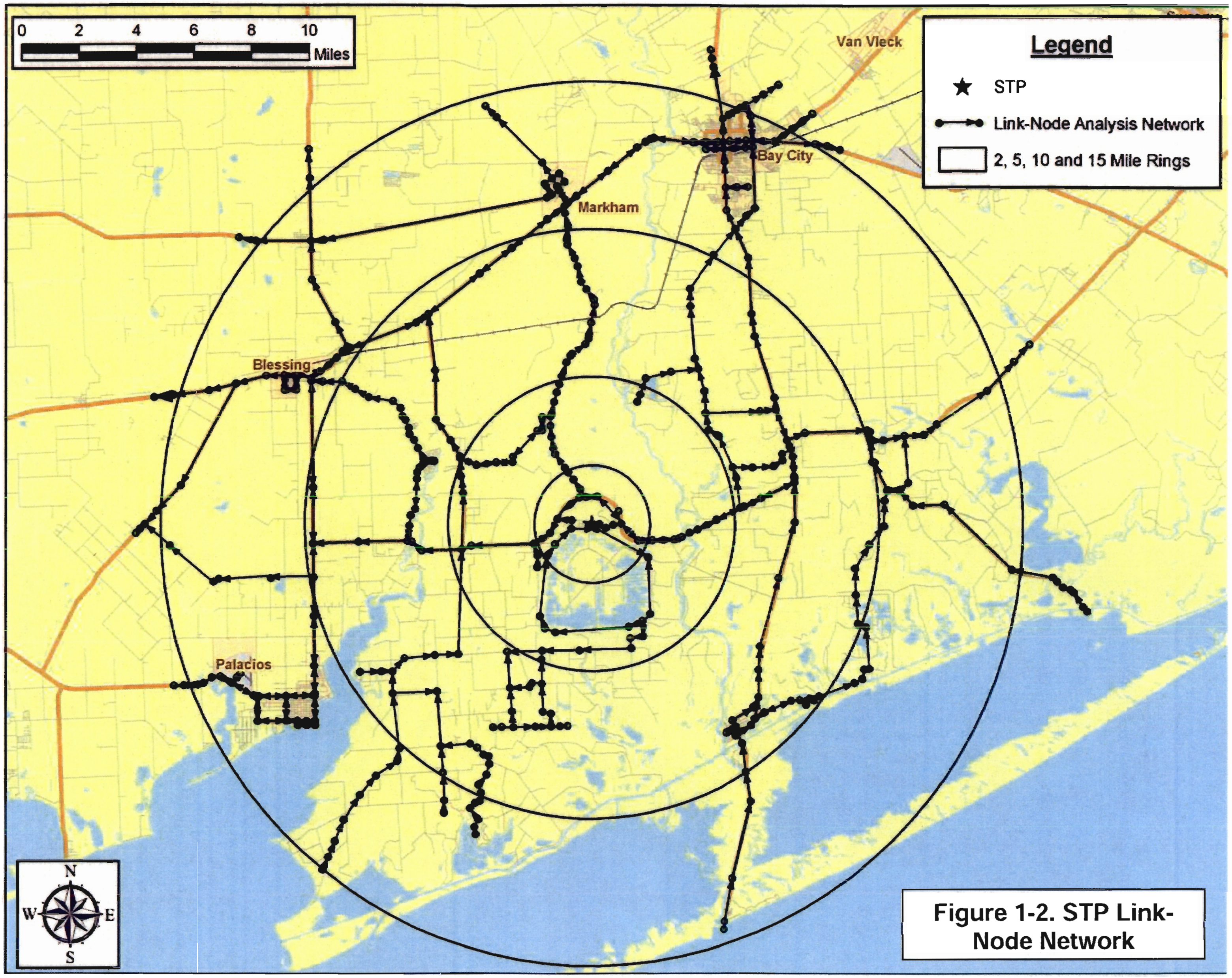


Figure 1-2. STP Link-Node Network

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 STP 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 STP.

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 exits 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. When performed properly, this procedure converges to yield an evacuation plan which best services the evacuating public.

1.4 Comparison with Prior ETE Study

Table 1-1 presents a comparison of the present ETE study with the 1994 study. The major factors contributing to the differences between the ETE values obtained in this study and those of the previous study can be summarized as follows:

- Vehicle occupancy rates based on the results of a telephone survey of EPZ residents.
- Voluntary and shadow evacuations are considered.
- Trip Generation times are based on the results of a telephone survey of EPZ residents, which resulted in significantly longer mobilization times than those assumed in the previous study.

Table 1-1. ETE Study Comparisons		
Topic	**Treatment**	
	Previous ETE Study	**Current ETE Study**
Resident Population Basis	1990 US Census block data used. Resident Population = 3,040	ArcGIS Software using 2000 US Census blocks; block centroid method used; population extrapolated to 2007. Population = 2,875
Resident Population Vehicle Occupancy	Average household size of 2.5 used. 1 person/evacuating vehicle.	2.38 persons/household, 1.43 evacuating vehicles/household yielding: 1.66 persons/vehicle
Employee Population	Employees grouped with transient population. 1 employee/vehicle.	Employees treated as separate population group. Employee estimates based on information provided by Matagorda County about major employers in the EPZ. 1.01 employees/vehicle based on phone survey results.
Voluntary evacuation from within EPZ in areas outside region to be evacuated	Not considered	50 percent of population within the circular portion of the region; 35 percent, in annular ring between the circle and the EPZ boundary (See Figure 2-1).
Shadow Evacuation	Not considered.	30% of people outside of the EPZ and within the shadow area (See Figure 7-2).
Network Size	349 links; 58 nodes.	574 Links; 389 Nodes.
Roadway Geometric Data	Field surveys conducted in 1994.	Field surveys conducted in 2007. Road capacities based on 2000 HCM.
School Evacuation	Direct evacuation to designated Reception Center/Host School.	Direct evacuation to designated Reception Center/Host School.

Table 1-1. ETE Study Comparisons		
Topic	**Treatment**	
	Previous ETE Study	**Current ETE Study**
Transit Dependent Population	Not considered.	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.
Ridesharing	Not considered.	50 percent of transit dependent persons will ride out with a neighbor or friend.
Trip Generation for Evacuation	Assumed mobilization times as follows: Permanent and seasonal residents between 30 and 150 minutes. Distribution based on assumptions. Employees and transients leave between 30 and 60 minutes. School buses leave between 30 and 90 minutes. All times measured from the Advisory to Evacuate.	Based on residential telephone survey of specific pre-trip mobilization activities: Residents with commuters returning leave between 45 minutes and 6 hours. Residents without commuters returning leave between 15 minutes and 5 hours. Employees and transients leave between 10 minutes and 2 hours. All times measured from the Advisory to Evacuate.
Traffic and Access Control	Not considered.	Traffic Control used in all scenarios to facilitate the flow of traffic outbound relative to STP.
Weather	Fair, Adverse and flooding.	Normal, or Rain. The capacity and free flow speed of all links in the network are reduced by 10% in the event of rain.

Table 1-1. ETE Study Comparisons		
Topic	**Treatment**	
	Previous ETE Study	**Current ETE Study**
Modeling	NETVAC simulation model, developed by EARTH TECH.	IDYNEV System: TRAD and PC-DYNEV.
Special Events	Peak Holiday.	Peak Holiday and New Plant Construction.
Evacuation Cases	35 Regions (single sector wind direction used) and 8 Scenarios producing 280 cases (some redundancy)	22 Regions (single sector wind direction used) and 12 Scenarios producing 264 unique cases
Evacuation Time Estimates Reporting	One ETE reported for each case. Results presented by Region and Scenario	ETE reported for 50th, 90th, 95th, and 100th percentile population. Results presented by Region and Scenario.
Evacuation Time Estimates for the entire EPZ.	Full EPZ – Summer Weekday: Good weather = 3:00 Full EPZ – Summer Weekend: Good weather = 3:05	For the 100th percentile: Summer Weekday Midday Good weather = 6:10 Summer Weekend Midday Good weather = 5:50 For the 95th percentile (recommended for use in making Protective Action decisions), these ETE are 4:00 and 3:40, respectively.

2. STUDY ESTIMATES AND ASSUMPTIONS

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

2.1 Data Estimates

1. Population estimates are based upon 2000 Census data, projected to year 2007. County-specific projections are based upon growth rates estimated by comparing the 2000 census data and 2005 census estimates. Estimates of employees who commute into the EPZ to work are based upon employment data obtained from county emergency management officials.
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[1].
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. Values of 2.38 persons per household and 1.43 evacuating vehicles per household are used.
6. The relationship between persons and vehicles for special facilities is as follows:
   a. Recreational Areas: 1 vehicle per family
   b. Employees: 1.01 employees per vehicle (telephone survey results)
7. Evacuation Time Estimates (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, also showing the values of ETE associated with the 50th, 90th and 95th percentiles of population. A Region is defined as a group of Zones that is issued the Advisory to Evacuate.

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

2.2 Study Methodological Assumptions

1. The ETE is defined as the elapsed time from the Advisory to Evacuate issued to a specific Region of the EPZ, and the time that Region is clear 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 Zones) 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, using the wind directions specified in the STP Offsite Protection Action Recommendations. These Regions, as defined, display irregular boundaries reflecting the geography of the Zones 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 extent of the Evacuation Region and the EPZ boundary, it is assumed that 35 percent of people will voluntarily evacuate. In the area between the EPZ boundary and a 15-mile 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 this area. (Appendix I) The basis for our assumptions on voluntary evacuation is testimony proffered by Dennis Miletti, a professor at Colorado State University, and one of the nations top disaster response experts, at Atomic Safety and Licensing Board (ASLB) hearings, which were deemed acceptable. There are limited data pertaining to nuclear evacuations in the United States. The numbers we use are Professor Miletti's best estimates based on his years of experience in evacuation planning and emergency preparedness.

6. A total of 12 “Scenarios” representing different seasons, time of day, day of week and weather are considered. Two special event scenarios are studied: the construction period of a new nuclear plant and a Holiday weekend with an extra 5,000 people on the beach. These Scenarios are tabulated below:

Scenario	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	Summer	Weekend	Midday	Good	Holiday Beachgoers
12	Summer	Midweek	Midday	Good	New Plant Construction

7. The models of the IDYNEV System were recognized as state of the art by Atomic Safety & Licensing Boards (ASLB) in past hearings. (Sources: Atomic Safety & Licensing Board Hearings on Seabrook and Shoreham; Urbanik[2]). The models have continuously been refined and extended since those hearings and have been independently validated by a consultant retained by the NRC.

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

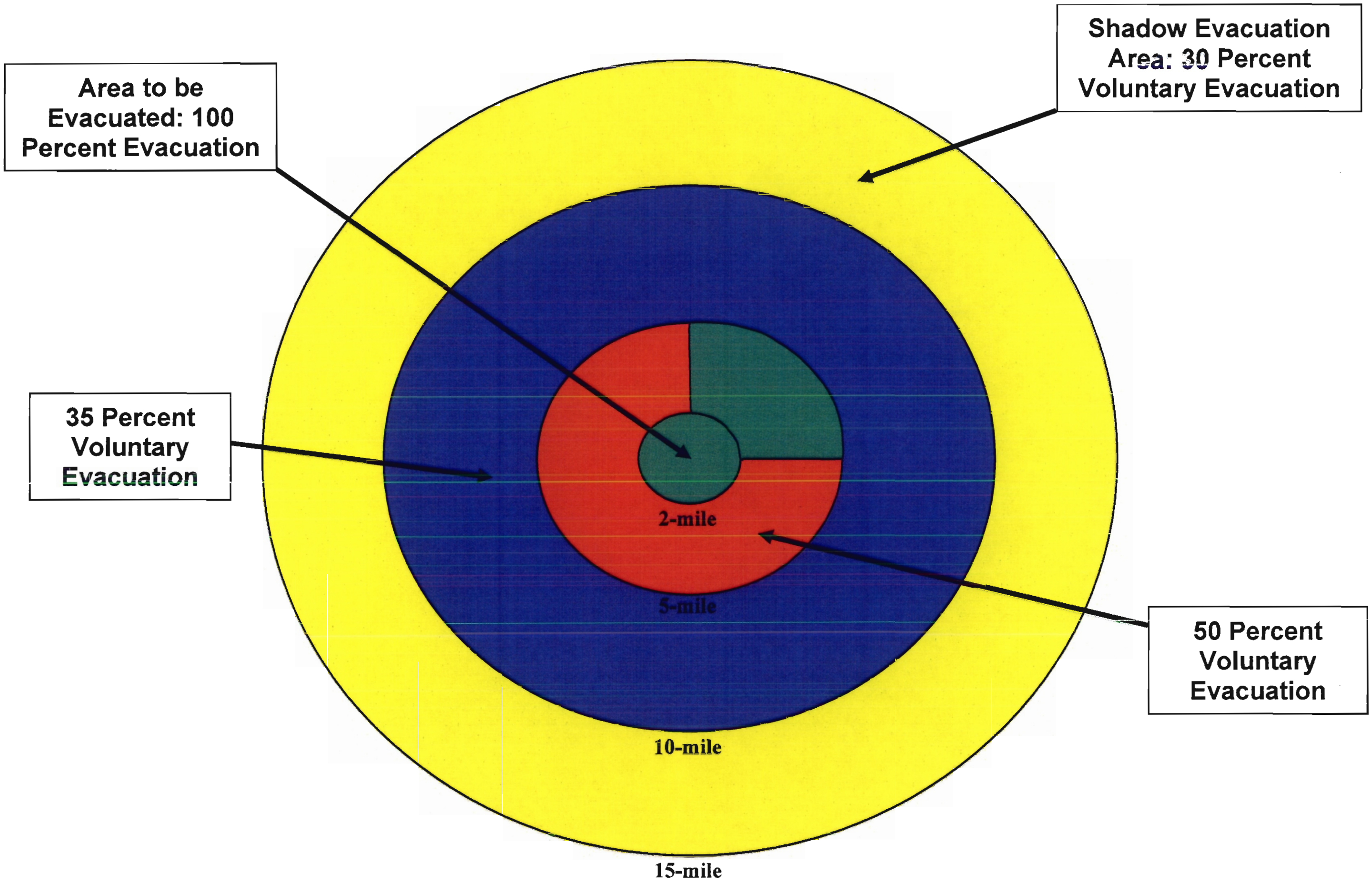


Figure 2-1. Voluntary Evacuation Methodology

2.3 Study Assumptions

1. The Planning Basis Assumption for the calculation of ETE is a rapidly escalating accident that requires evacuation, and includes the following:
    a. Advisory to Evacuate is announced coincident with the siren notification.
    b. Mobilization of the general population will commence within 10 minutes after siren notification.
    c. ETE are measured relative to the Advisory to Evacuate.
2. It is assumed that everyone within the group of Zones 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:
    a. Schools will be given the earliest notification possible so they can begin evacuating prior to notification of the general public, if conditions permit. In the case of a rapidly escalating accident, however, this may not be possible.
    b. 70 percent of households in the EPZ will await the return of a commuter before beginning their evacuation trip, based on the telephone survey results.
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. Traffic Control Points (TCP) within the EPZ will be staffed over time, beginning at the Advisory to Evacuate. Their number and location will depend on the Region to be evacuated and resources available. It is assumed that drivers will act rationally, travel in the directions identified in the plan, and obey all control devices and traffic guides.
7. Traffic Control Points (TCP) outside the EPZ should be established to facilitate evacuation flow to the Reception Centers.
8. Buses will be used to transport those without access to private vehicles:
    a. If schools are in session, transport (buses) will evacuate students before the issuance of an Advisory to Evacuate to the general public, directly to the assigned Reception Centers.
    b. School children, 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. The transit-dependent portion of the general population will be evacuated to reception centers by bus. It is reasonable to assume that some of these people will ride-share with family, neighbors, and friends, thus reducing the demand for buses. We assume that the percentage of people who rideshare is 50 percent. This assumption is based upon reported experience for other emergencies,[3] which cites previous evacuation experience.

10. Rain may occur for either winter or summer scenarios. In the case of rain, it is assumed that the rain begins 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:

Scenario	Highway Capacity*	Free Flow Speed*	Mobilization Time
Rain[4]	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 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.

[3] 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).

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

3. DEMAND ESTIMATION

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

1. An estimate of population within the Emergency Planning Zone (EPZ), stratified into groups (resident, employee, transient).

2. An estimate, for each population group, of mean occupancy per evacuating vehicle. This estimate is used to determine the number of evacuating vehicles.

3. An estimate of potential double-counting of vehicles.

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

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

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

- A resident who works and shops within the EPZ could be counted as a resident, again as an employee and once again as a shopper.
- A visitor who stays at a motel, spends time at a beach, 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 South Texas Project (STP) 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., beach or summer home) and then leave the area.
- 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 Zone and by polar coordinate representation (population rose). The STP EPZ has been subdivided into 11 Zones. These Zones are shown in Figure 3-1.

<u>Permanent Residents</u>

The primary source for estimating permanent population is 2000 U.S. Census data. The average household size (2.38 persons/household) and the number of evacuating vehicles per household (1.43 vehicles/household) were adapted from the telephone survey results.

Comparing census estimates available for the year 2005, with those for 2000, the yearly rate of population change was estimated and used to project the year 2000 resident population to a 2007 base year. According to census data, the population of Matagorda County <u>decreased</u> by 0.3 percent from April 1, 2000 to July 1, 2005. We conservatively estimate that the population remains unchanged, as shown in Table 3-1.

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 STP.

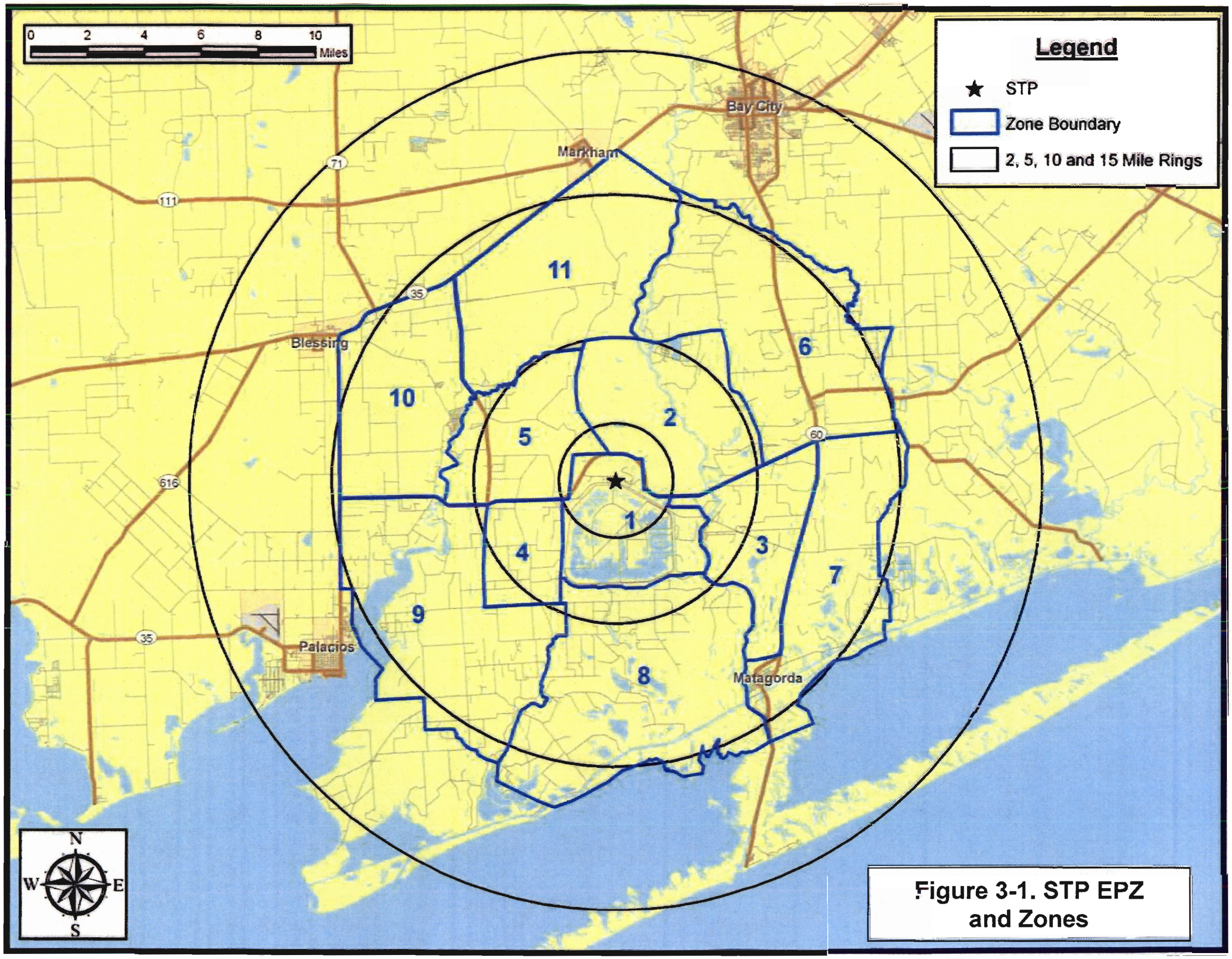


Figure 3-1. STP EPZ and Zones

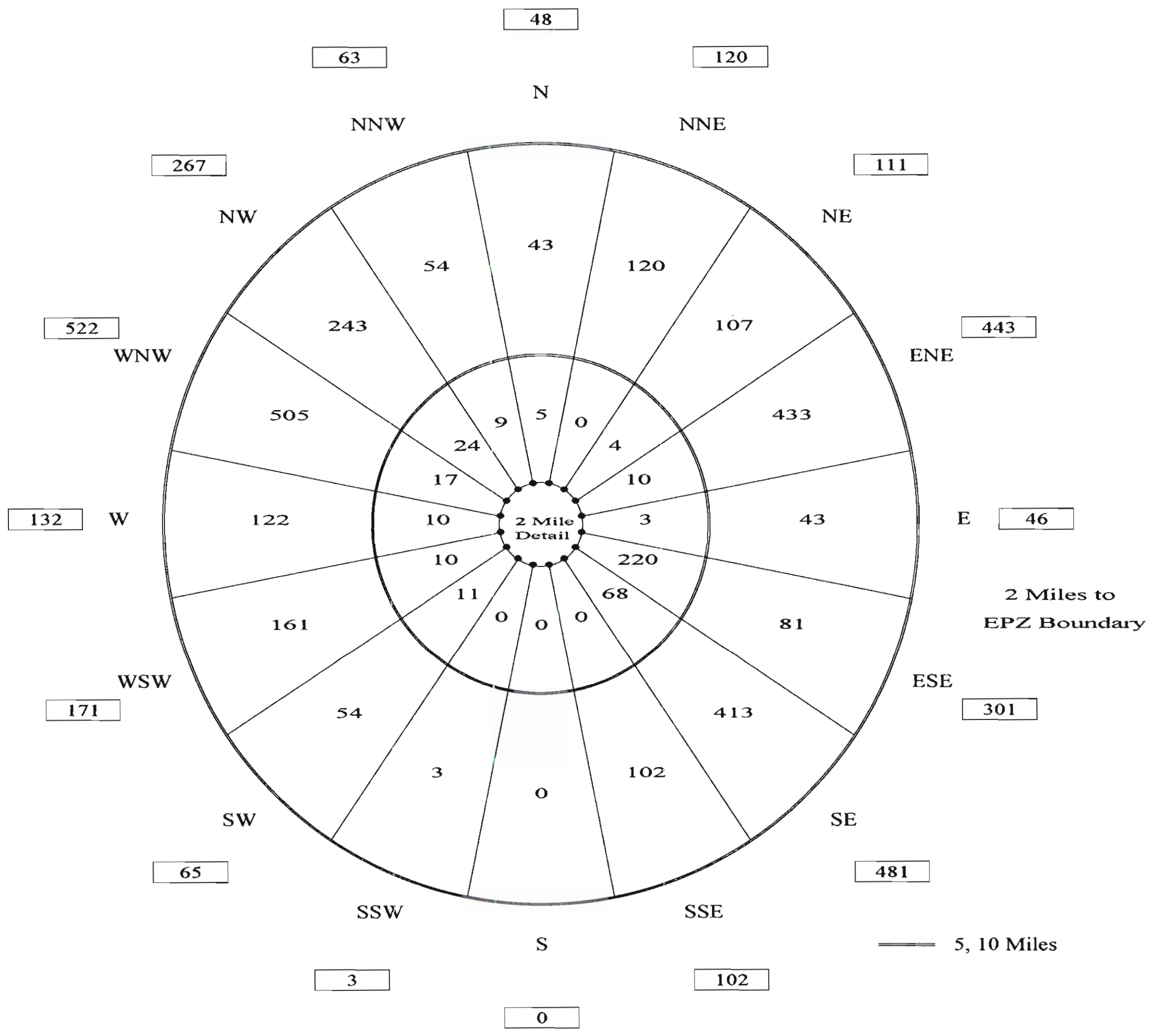
Table 3-1. EPZ Permanent Resident Population		
Zone	**2000 Population**	**2007 Population**
1	0	0
2	40	40
3	402	402
4	56	56
5	82	82
6	650	650
7	518	518
8	0	0
9	237	237
10	692	692
11	198	198
TOTAL	**2,875**	**2,875**
	Population Growth:	**0%**

	2000 Population	2007 Population
Matagorda Beach*	116	116

***The Matagorda Beach area has only one access road - FM 2031, which cuts through the STP EPZ. It is prudent to evacuate both the resident and transient population on the beach in the event of an emergency, since an escalation of the event or a change in wind direction could expose those evacuees on FM 2031 to the plume. Thus, it is assumed that in every scenario and for every region these people will be evacuated, and their vehicles will be included in the network traffic.**

Table 3-2. Permanent Resident Population and Vehicles by Zone		
Zone	**2007 Population**	**2007 Vehicles**
1	0	0
2	40	24
3	402	242
4	56	34
5	82	49
6	650	390
7	518	311
8	0	0
9	237	142
10	692	414
11	198	119
TOTAL	**2,875**	**1,725**

	2007 Population	2007 Vehicles
Matagorda Beach	116	70



Resident Population			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-2	0	0-2	0
2-5	391	0-5	391
5-10	2484	0-10	2875

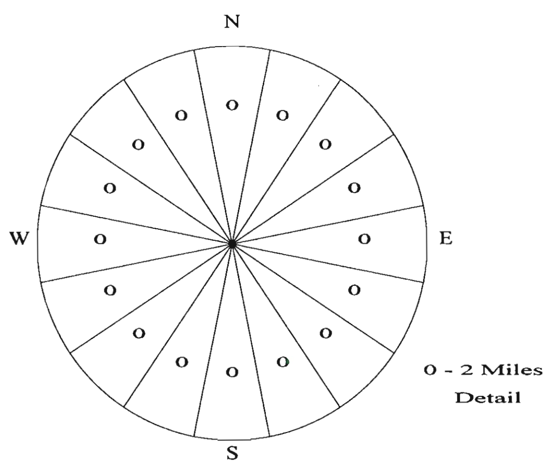
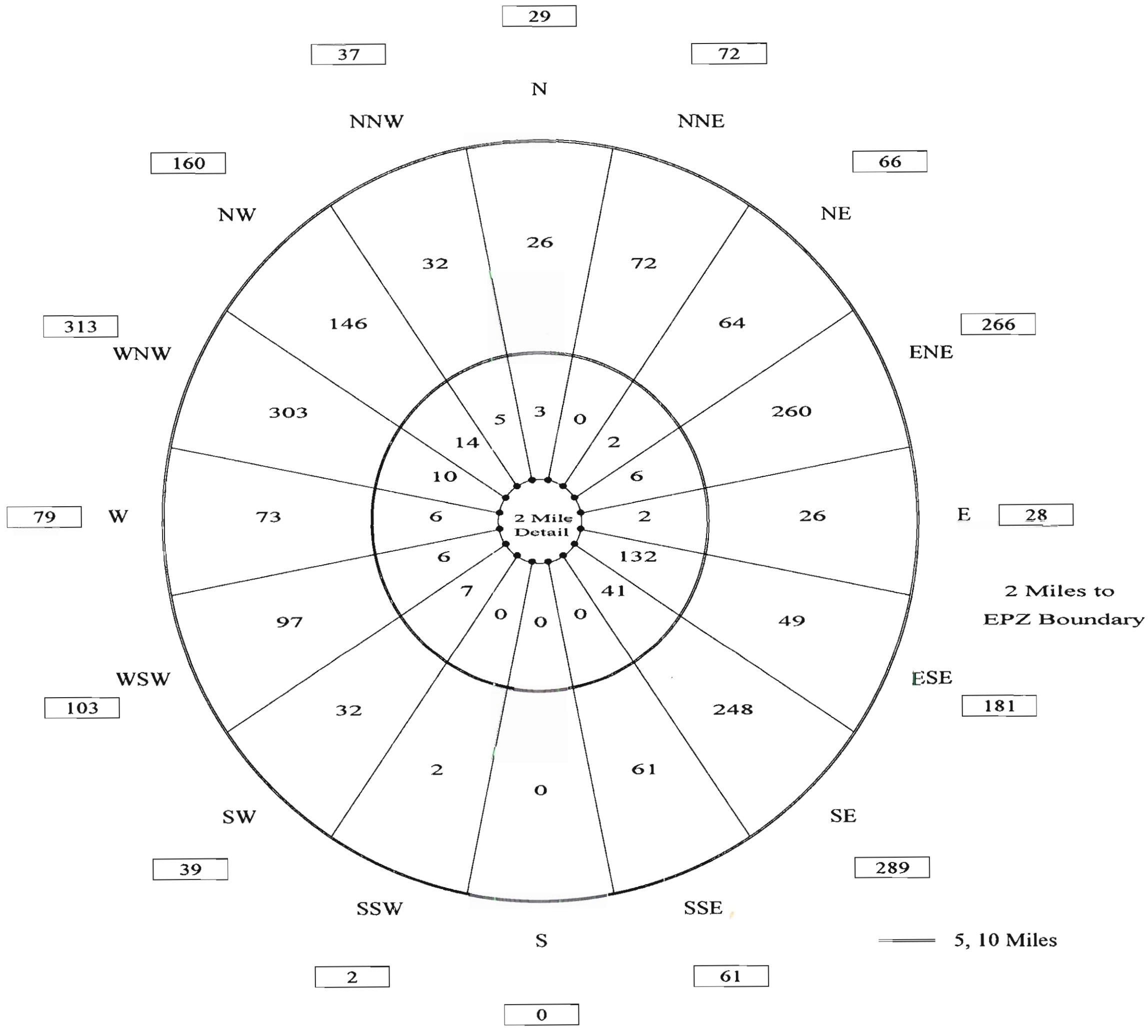


Figure 3-2. Permanent Residents by Sector



Resident Vehicles			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-2	0	0-2	0
2-5	234	0-5	234
5-10	1491	0-10	1725

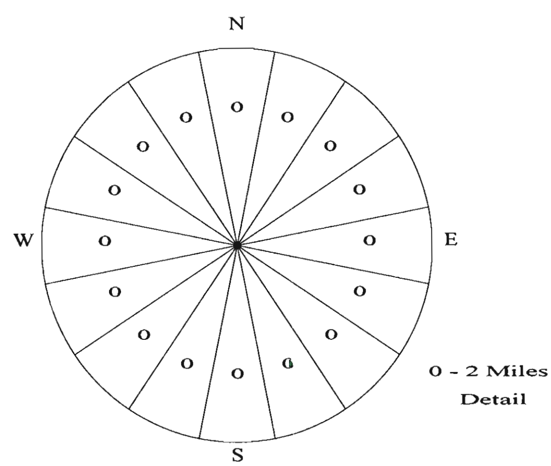


Figure 3-3. Permanent Resident Vehicles by Sector

Transient Population

Transient population groups are defined as those people who are not permanent residents and who enter the EPZ for a specific purpose (shopping, recreation). Transients may spend less than one day or stay overnight at camping facilities, hotels and motels. The South Texas Project EPZ has a number of areas that attract transients, including:

- Riverside Park and Campgrounds
- Matagorda Harbor
- Lighthouse RV Park

Estimates of the peak attendance at transient facilities were provided by County emergency management offices; the number of evacuating vehicles was also provided. Internet searches were also used to obtain more detailed information about these facilities and supplement the data provided. The transient population estimates are as follows:

Rio Colorado Golf Course

The Rio Colorado Golf Course is located nine miles north-northeast of STP, in Zone 6. This facility is busiest from March to November, when the daily average number of transients is estimated as 120 people, traveling in 60 vehicles.

Matagorda Harbor

Matagorda Harbor is located on the Intracoastal Waterway approximately nine miles southeast of STP, in Zone 7. It provides mooring for approximately 222 boats and has 26 RV spaces available to boat slip patrons. The peak attendance is estimated as 300 persons evacuating in 150 vehicles.

Lighthouse RV Park

The Lighthouse RV Park is located approximately seven miles east-southeast of STP. The number of transients during peak times is estimated to be 50 people, traveling in 25 vehicles.

Riverside Park and Campgrounds

The Riverside Park covers 100 acres on the eastern side of the Colorado River, approximately 10 miles north-northeast of STP. Patrons of the Park may be involved in a number of outdoor activities including fishing, camping, jet-skiing, and bird-watching. There are camp ground facilities and picnic sites. It is estimated that 180 people may be in the Park at peak times. The number of evacuating vehicles is estimated as 60.

Hotels and Motels

There are 3 motels in the EPZ; all of these facilities are located in Zone 7. Appendix E details the hotel data provided. The peak attendance at these motels is estimated as 110 people evacuating in 50 vehicles.

Seasonal Homes

The seasonal resident population data was taken from the previous ETE report (Earth Tech 1994), as updated information on seasonal homes was not available. A total of 2,817 seasonal residents were estimated to be residing within the EPZ. Since most of the seasonal dwellings are summer homes, 100% transient population was assumed for the summer weekend scenario. These homes are located in Zones 7, 9 and 10 and add a total of 1,693 evacuating vehicles to the evacuating traffic.

Matagorda Beach and Jetty Park

The beach, Jetty Park and fishing pier are busiest in the summer months. The weekend average number of visitors was estimated to be 1,000 people, driving 500 vehicles. However, on a Holiday there can be as many as 6,000 people on or near the beach. Although strictly outside of the EPZ, transients in this facility are evacuated under every scenario and are considered in the computation of ETE.

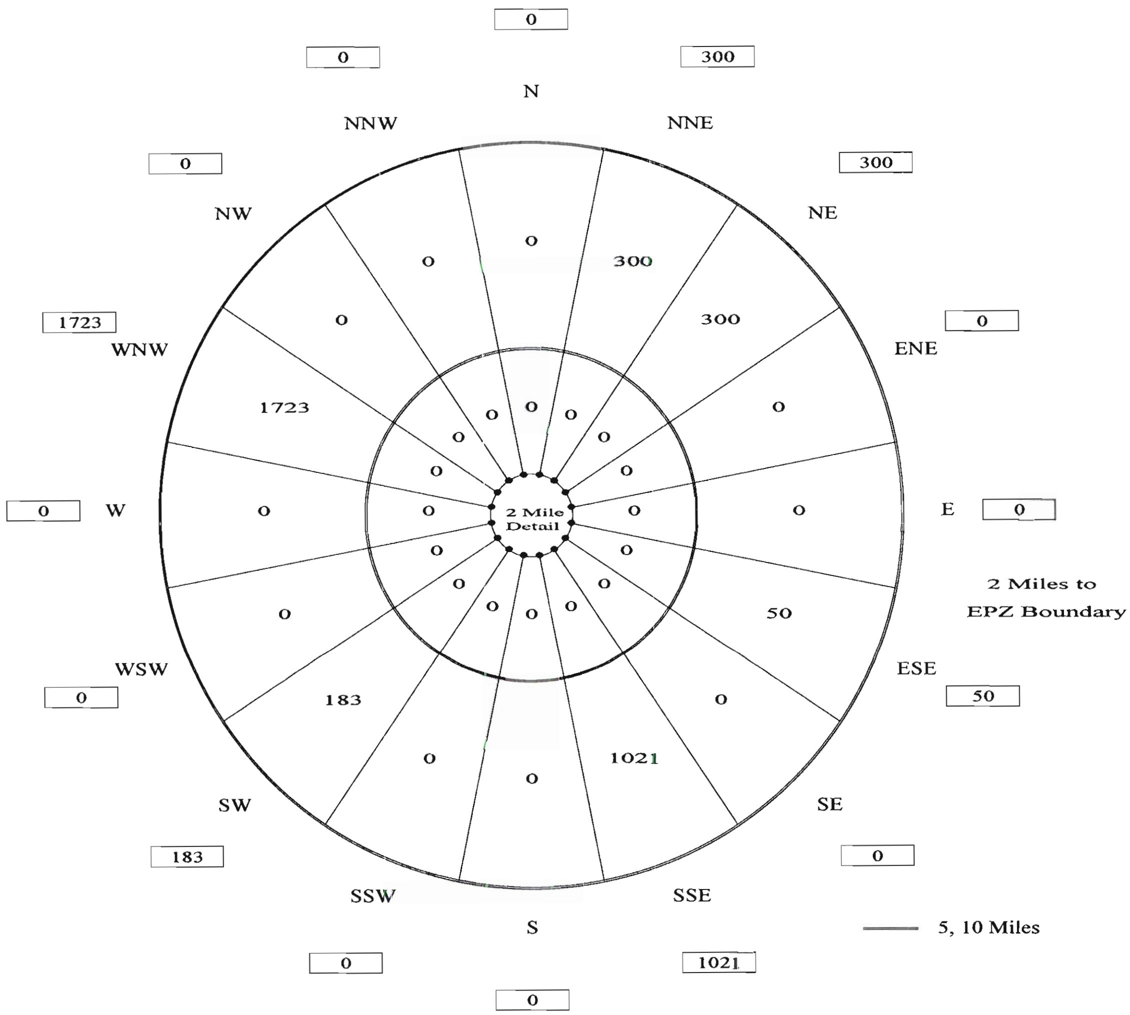
Matagorda Bay Nature Park

Matagorda Bay Nature Park is a 1,600-acre park and preserve at the mouth of the Colorado River. The park borders the Gulf of Mexico for two miles, has two miles of river frontage and hundreds of acres of coastal marshes and dunes. Patrons of the Park may partake in a number of outdoor activities including fishing, camping, and bird-watching. The RV Park can accommodate 70 vehicles. The number of transients during peak times is estimated to be 130 people, traveling in 70 vehicles.

Table 3-3. Summary of Transients by Zone		
Zone	**Transients**	**Transient Vehicles**
1	0	0
2	0	0
3	50	25
4	0	0
5	0	0
6	300	120
7	1,431	813
8	0	0
9	73	44
10	1,723	1,035
11	0	0
TOTAL	**3,577**	**2,037**

	Transients	**Transient Vehicles**
Matagorda Beach*	1,130	570

***The 1130 transients in the Matagorda Beach area will be evacuated under all scenarios**



Transient Population			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-2	0	0-2	0
2-5	0	0-5	0
5-10	3577	0-10	3577

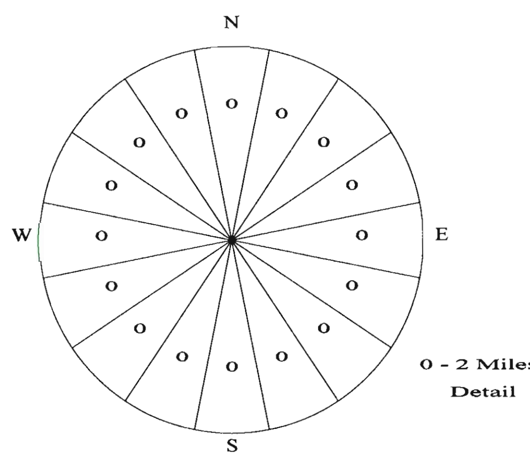
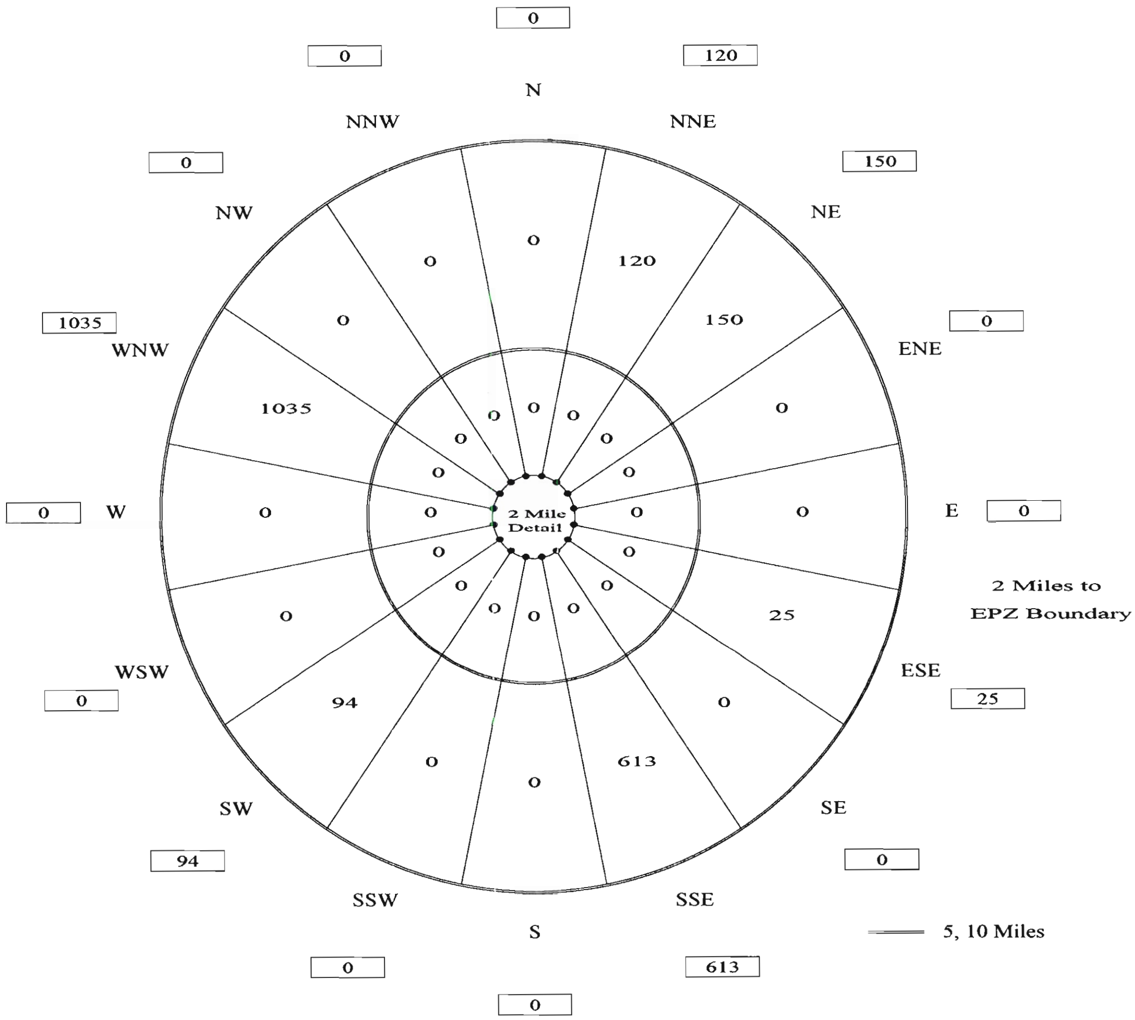


Figure 3-4. Transient Population by Sector



Transient Vehicles			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-2	0	0-2	0
2-5	0	0-5	0
5-10	2037	0-10	2037

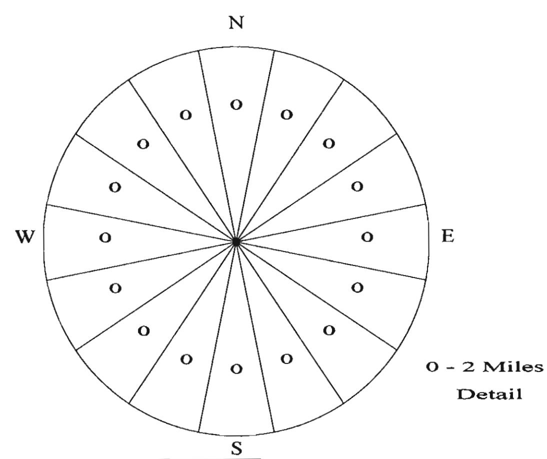


Figure 3-5. Transient Vehicles by Sector

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 live outside the EPZ and will evacuate along with the permanent resident population.

Data for major employers in the EPZ was provided by the Matagorda County emergency management office. The location of these facilities was mapped using GIS software. The GIS map was overlaid with the evacuation analysis network and employees were loaded onto appropriate links. The map of major employers in the EPZ can be seen in Appendix E.

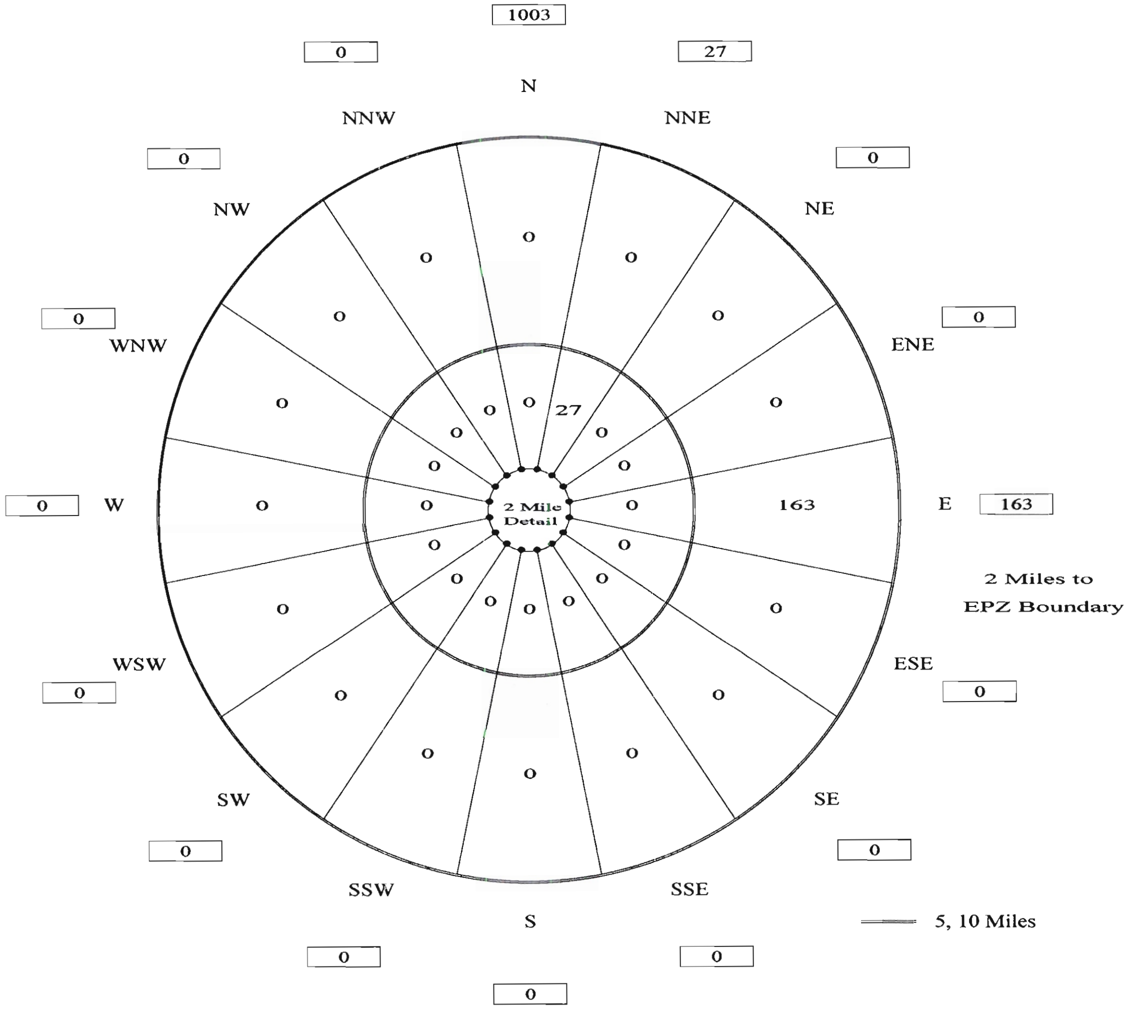
An occupancy of 1.01 persons per employee-vehicle obtained from the telephone survey, was used to determine the number of evacuating employee vehicles.

Table 3-4 presents non-EPZ resident employees and vehicle estimates by Zone. Figures 3-6 and 3-7 present these data by sector.

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 35). It is assumed that this traffic will continue to enter the EPZ during the first 90 minutes following the Advisory to Evacuate. We estimate approximately 600 vehicles enter the EPZ as external-external trips during this period.

Table 3-4. Summary of Non-EPZ Employees by Zone		
Zone	Total Non-EPZ Employees	Employee Vehicles
1	1,003	993
2	27	27
3	163	161
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
TOTAL	1,193	1,181



Employees			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-2	1003	0-2	1003
2-5	27	0-5	1030
5-10	163	0-10	1193

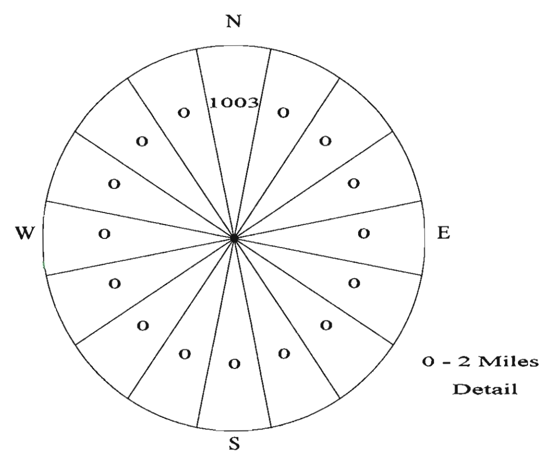
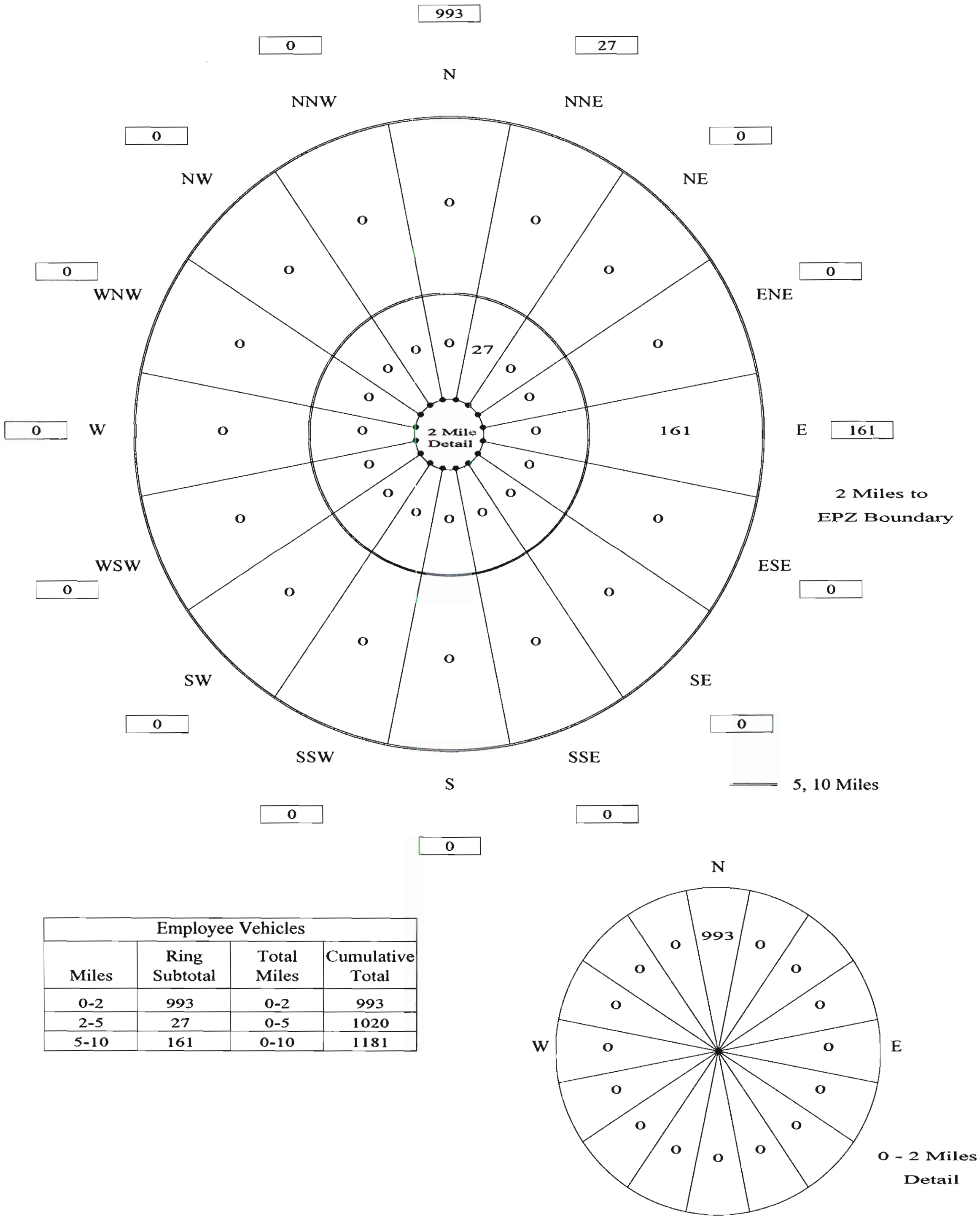


Figure 3-6. Non-Resident Employee Population by Sector



Employee Vehicles			
Miles	Ring Subtotal	Total Miles	Cumulative Total
0-2	993	0-2	993
2-5	27	0-5	1020
5-10	161	0-10	1181

Figure 3-7. Non-Resident Employee Vehicles by Sector

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 Highway Capacity Manual 2000).

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.

Because of the effect of weather on the capacity of a roadway, 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 and its sparse population, congestion arising from evacuation is likely to exist only at intersections where evacuation routes merge or cross. 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.

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 (Appendix G) identifies these locations (called Traffic Control Points, TCP) and the management procedures applied.

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

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

where:

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

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

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 $h_{sat}, F_1, F_2, \ldots$ 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.

<u>Capacity Estimation Along Sections of Highway</u>

The capacity of highway <u>sections</u> – 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.

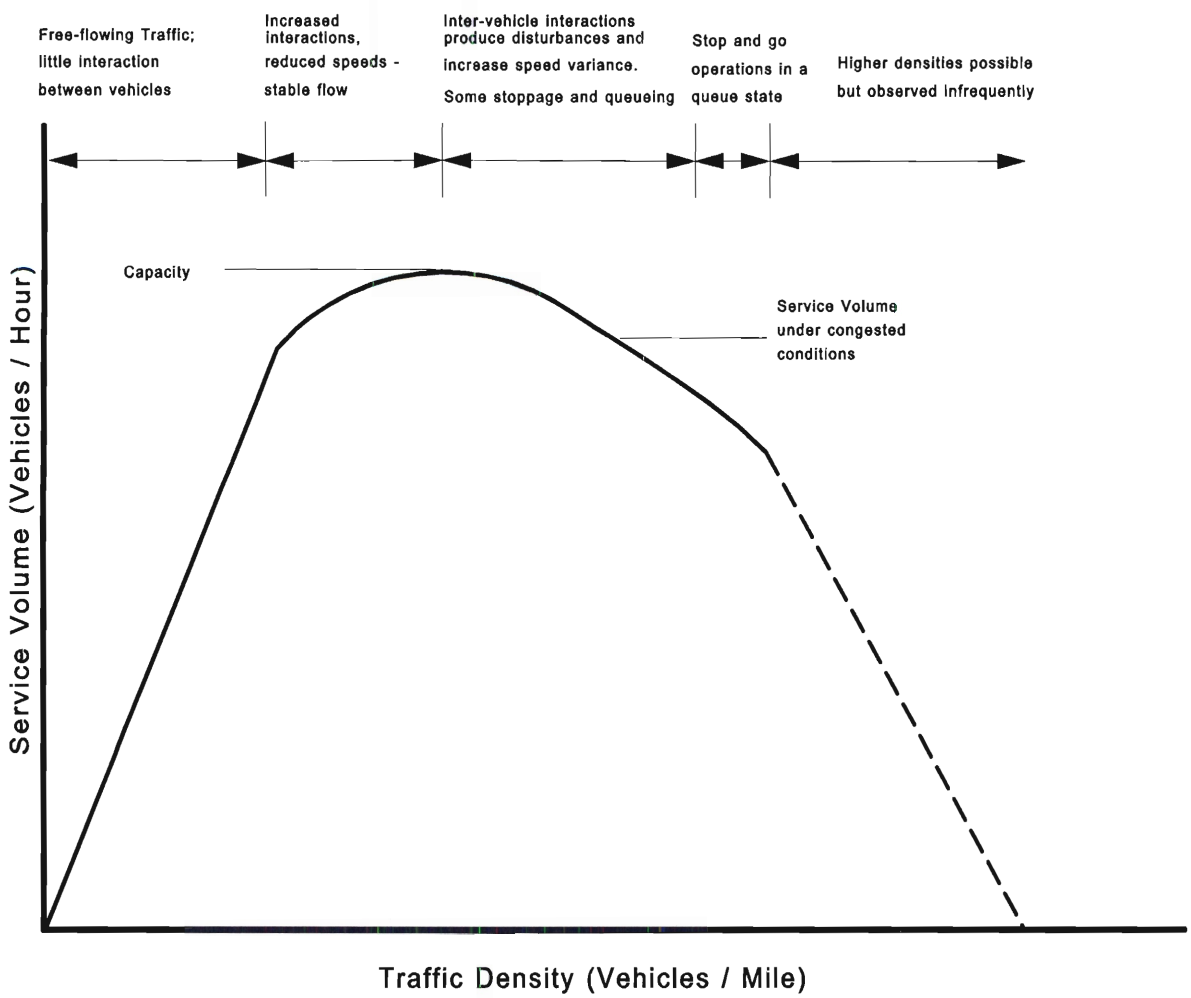


Figure 4-1. Fundamental Relationship Between Volume and Density

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.

Based on empirical data collected on freeways, we have employed a value of R=0.85. It is important to mention that some investigators, on analyzing data collected on freeways, conclude that little reduction in capacity occurs even when traffic is operating at Level of Service, *F*. While there is conflicting evidence on this subject, we adopt a conservative approach and use a value of capacity, V_F, that is applied during LOS F conditions; V_F, is lower than the specified capacity.

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.

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 Highway Capacity Manual 2000. 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 South Texas Project (STP) EPZ

As part of the development of the STP 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 STP EPZ consists primarily of two categories of roads and, of course, intersections:

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

Each of these classifications will be discussed.

Two-Lane Roads

Ref: HCM Chapter 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 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 Chapter 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 outside of urban areas within the EPZ, service traffic with free-speeds in this range. The actual time-varying speeds computed by the simulation model reflect the demand:capacity relationship and the impact of control at intersections.

Intersections

Ref: HCM Chapters 16, 17

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

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

5. ESTIMATION OF TRIP GENERATION TIME

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

Background

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

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

At each level, the Federal guidelines specify a set of Actions to be undertaken by the Licensee, and by State and Local offsite authorities. As a Planning Basis, we will adopt a conservative posture, in 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 possible.

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

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

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

For example, suppose one hour will elapse from the siren alert to the Advisory to Evacuate. In this case, it is reasonable to expect some degree of spontaneous evacuation and the start of mobilization activities 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 population within the EPZ approximates 6,850 persons (residents, employees, and transients) who are deployed over an area of approximately 314 square miles and 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 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 survey results. It is important to note that the shape and duration of the evacuation trip mobilization distribution is important at sites where traffic congestion is not expected to cause the evacuation time estimate to extend in time well beyond the trip generation period. The remaining discussion will focus on the application of the trip generation data obtained from the telephone survey, to the development of the STP ETE.

Fundamental Considerations

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

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

Event Number	Event Description
1	No-accident condition
2	Awareness of accident situation
3	Depart place of work to return home
4	Arrive home
5	Leave to evacuate the area

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

Event Sequence	Activity	Distribution
1 → 2	Public receives notification information	1
2 → 3	Prepare to leave work	2
2,3 → 4	Travel home	3
2,4 → 5	Prepare to leave for evacuation trip	4

These relationships are shown graphically in Figure 5-1.

An employee who lives outside the EPZ will follow sequence (e) of Figure 5-1; a resident of the EPZ who is at work, and will return home before beginning the evacuation trip will follow sequence (c) of Figure 5-1. Note that event 5, "Leave to evacuate the area," is conditional either on event 2 <u>or</u> on event 4. That is, activity 2 → 5 by a resident at home can be undertaken in parallel with activities 2 → 3, 3 → 4 and 4 → 5 by a commuter returning to that home, as shown in Figure 5-1 (a) and (c). Specifically, one adult member of a household can prepare to leave home (i.e. secure the home, pack clothing, etc.), while others are traveling home from work. In this instance, the household members would be able to evacuate sooner than if such trip preparation were deferred until all household members had returned home. For this study, we adopt the conservative posture that all activities will occur in 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).

<u>Time Distribution No. 1, Becoming Aware of Accident: Activity 1 → 2</u>

It is reasonable to expect 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. This distribution is given below:

<u>Distribution No. 1, Notification Time: Activity 1 → 2</u>

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

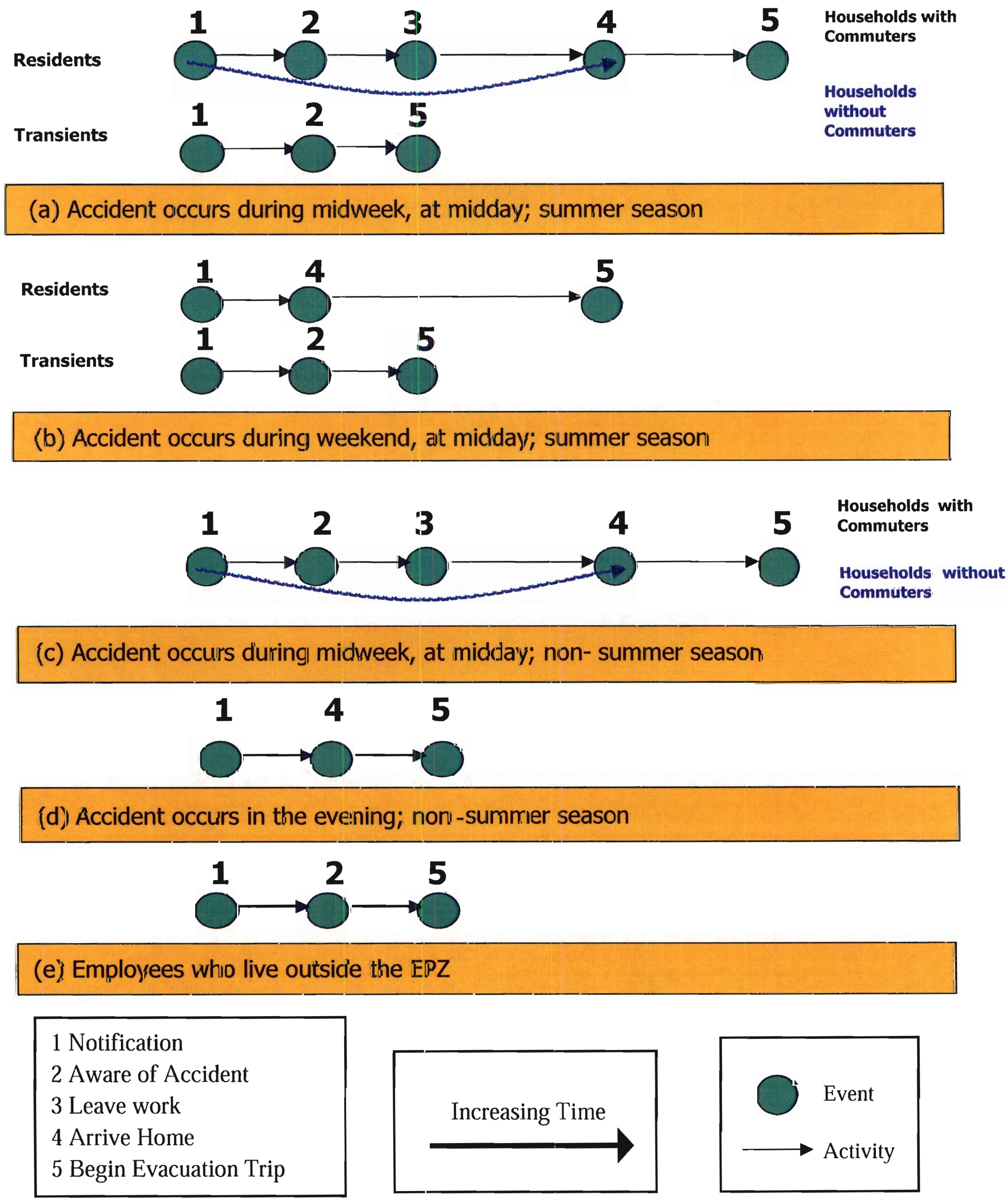


Figure 5-1. Events and Activities Preceding the Evacuation Trip

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

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

Elapsed Time (Minutes)	Cumulative Percent Employees Leaving Work
0	0
5	0
10	32
15	48
20	57
25	63
30	66
35	77
40	80
45	81
50	84
55	85
60	85
65	91
70	93
75	94
80	96
85	98
90	99
95	100

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

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

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

Elapsed Time (Minutes)	Cumulative Percent Returning Home
0	0
5	0
10	22
15	40
20	54
25	65
30	70
35	83
40	85
45	87
50	91
55	92
60	92
65	95
70	95
75	96
80	96
85	98
90	99
95	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

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

Elapsed Time (Minutes)	Cumulative Pct. Ready to Evacuate	Elapsed Time (Minutes)	Cumulative Pct. Ready to Evacuate	Elapsed Time (Minutes)	Cumulative Pct. Ready to Evacuate
0	0	95	70	190	89
5	0	100	71	195	90
10	4	105	71	200	91
15	9	110	71	205	91
20	13	115	73	210	91
25	19	120	74	215	91
30	25	125	76	220	92
35	31	130	78	225	92
40	34	135	81	230	92
45	36	140	84	235	92
50	38	145	84	240	93
55	44	150	84	245	93
60	50	155	85	250	94
65	56	160	85	255	95
70	60	165	85	260	97
75	64	170	85	265	98
80	67	175	86	270	99
85	68	180	87	275	100
90	69	185	88		

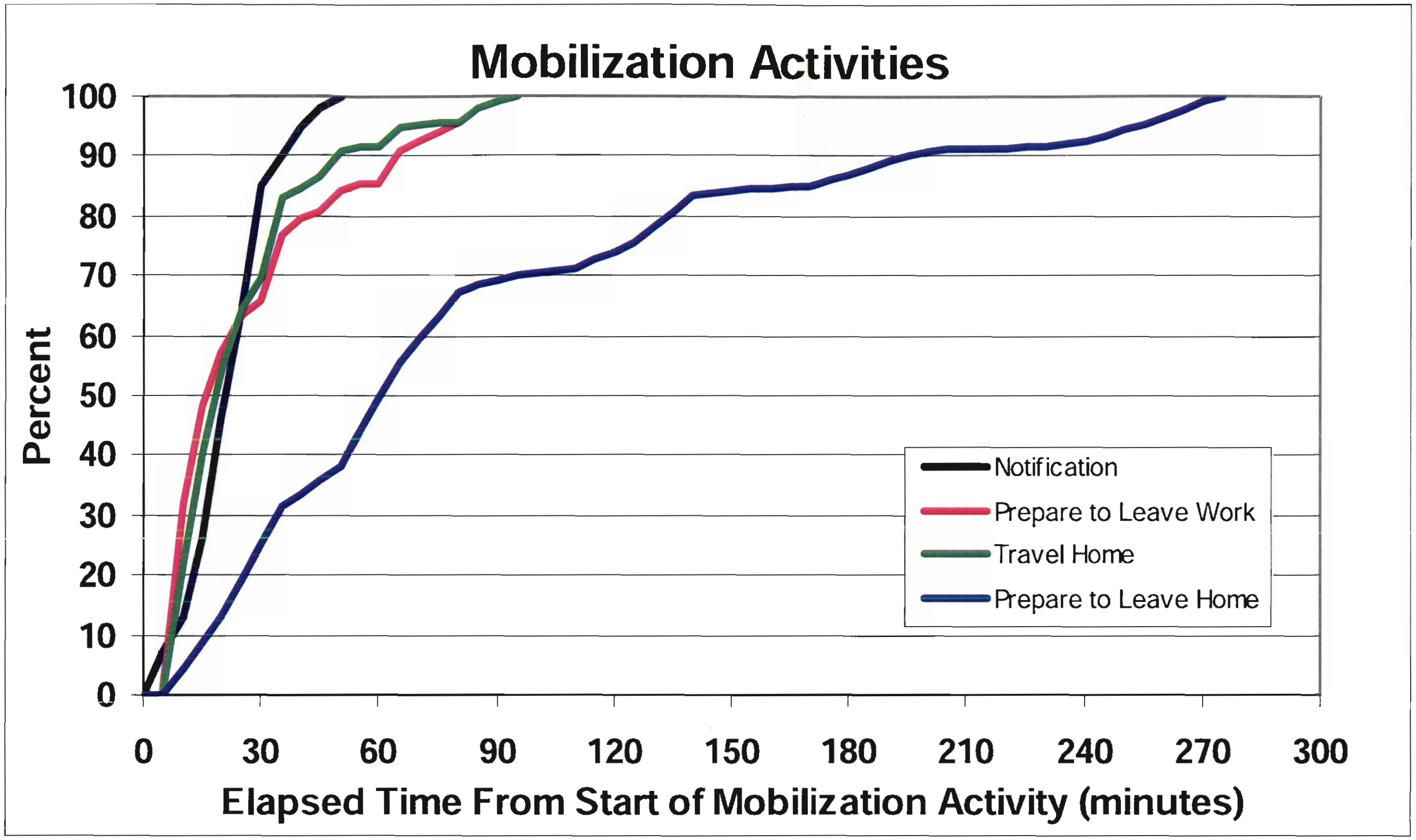


Figure 5-2. Evacuation Mobilization Activities

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 $\rightarrow$ 4) must precede Activity 4 $\rightarrow$ 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:		
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 who live outside, 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.

Figure 5-3 presents the combined trip generation distributions designated A, C, and D. These distributions are presented on the same time scale. 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.

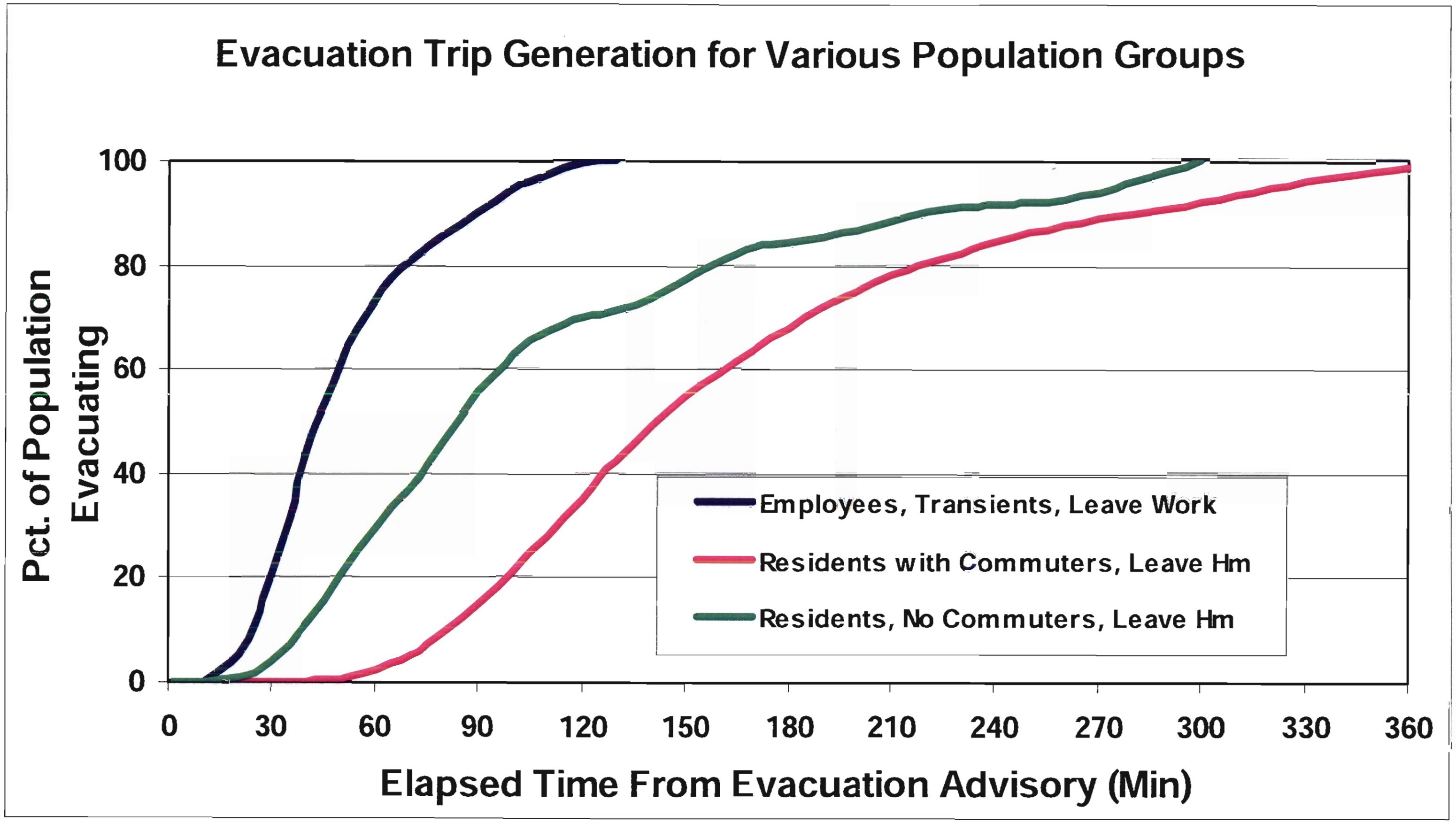


Figure 5-3. Comparison of Trip Generation Distributions

Table 5-1. Trip Generation 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	0	2	2
2	15	0	4	23	19
3	15	0	14	65	32
4	15	2	12	10	20
5	30	13	25	0	17
6	30	20	15	0	10
7	30	20	7	0	0
8	30	13	7	0	0
9	60	16	7	0	0
10	60	8	9	0	0
11	60	8	0	0	0
12	900	0	0	0	0

* The distribution from the telephone survey results was modified based on discussions with STP Emergency Planning Personnel. Nearly all of the employment in the EPZ is at STP; the modified distribution shown is based on data from STP emergency drills.

6. DEMAND ESTIMATION FOR EVACUATION SCENARIOS

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

Region — A grouping of contiguous evacuation Zones, 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.

The Zones are identified in Figure 6-1. Using the Zone information provided by STP personnel (Table 6-1), a total of 22 distinct Regions were defined, which encompass all the groupings of Zones considered. The regions are detailed in Table 6-2. Each keyhole consists of a circular area centered at the South Texas Project (STP) and an adjoining sector with a central angle of 10 degrees. These sectors extend to a distance of 5 miles from STP (Regions R04 to R10), or to the EPZ boundary (Regions R11 to R22). The wind direction defines the orientation of these Regions. Regions 1, 2 and 3 are circular areas centered at STP with radii of 2, 5 and 10 miles, respectively.

A total of 12 Scenarios were evaluated for all Regions. Thus, there are a total of 12x22=264 evacuation cases. Table 6-3 is a description of all Scenarios.

Each combination of region and scenario implies a specific population to be evacuated. Table 6-4 presents the percentage of each population group assumed to evacuate for each scenario. Table 6-5 presents the vehicle counts for each scenario.

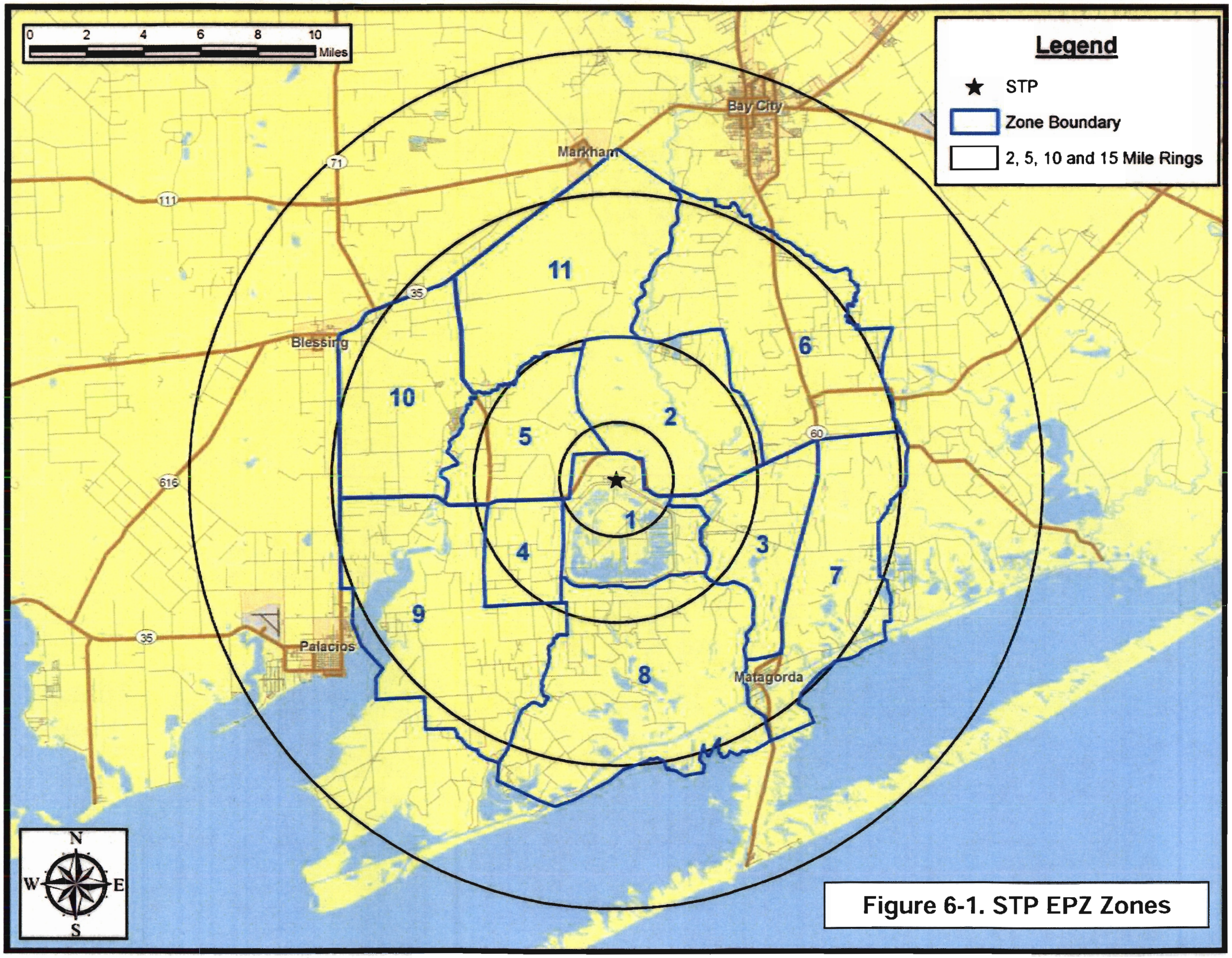


Figure 6-1. STP EPZ Zones

Table 6-1. Definition of Evacuation Regions											
WIND DIRECTION FROM IS BETWEEN	AFFECTED DOWNWIND SECTORS	EVACUATE ZONES						EVACUATE KEY HOLE ZONES			
		2 Mile Radius	KLD REGION	5 Mile Radius	KLD REGION	10 Mile Radius	KLD REGION	2 Mile Radius & 5 Miles Downwind	KLD REGION	5 Mile Radius and 10 Miles Downwind	KLD REGION
355° to 5°	H, J, K	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1	R1	1, 2, 3, 4, 5, 8, 9	R11
6° to 16°	H, J, K, L	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1	R1	1, 2, 3, 4, 5, 8, 9	R11
17° to 28°	J, K, L	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1	R1	1, 2, 3, 4, 5, 8, 9	R11
29° to 39°	J, K, L, M	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 4	R4	1, 2, 3, 4, 5, 8, 9	R11
40° to 50°	K, L, M	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 4	R4	1, 2, 3, 4, 5, 8, 9	R11
51° to 61°	K, L, M, N	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 4, 5	R5	1, 2, 3, 4, 5, 8, 9, 10	R12
62° to 73°	L, M, N	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 4, 5	R5	1, 2, 3, 4, 5, 9, 10	R13
74° to 84°	L, M, N, P	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 4, 5	R5	1, 2, 3, 4, 5, 9, 10	R13
85° to 95°	M, N, P	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 4, 5	R5	1, 2, 3, 4, 5, 9, 10	R13
96° to 106°	M, N, P, Q	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 4, 5	R5	1, 2, 3, 4, 5, 9, 10, 11	R14
107° to 118°	N, P, Q	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 5	R6	1, 2, 3, 4, 5, 9, 10, 11	R14
119° to 129°	N, P, Q, R	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 5	R6	1, 2, 3, 4, 5, 9, 10, 11	R14
130° to 140°	P, Q, R	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 5	R6	1, 2, 3, 4, 5, 10, 11	R15
141° to 151°	P, Q, R, A	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2, 5	R7	1, 2, 3, 4, 5, 10, 11	R15
152° to 163°	Q, R, A	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2, 5	R7	1, 2, 3, 4, 5, 10, 11	R15
164° to 174°	Q, R, A, B	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2, 5	R7	1, 2, 3, 4, 5, 6, 10, 11	R16
175° to 185°	R, A, B	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2	R8	1, 2, 3, 4, 5, 6, 11	R17
186° to 196°	R, A, B, C	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2	R8	1, 2, 3, 4, 5, 6, 11	R17
197° to 208°	A, B, C	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2	R8	1, 2, 3, 4, 5, 6, 11	R17
209° to 219°	A, B, C, D	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2	R8	1, 2, 3, 4, 5, 6, 11	R17
220° to 230°	B, C, D	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2	R8	1, 2, 3, 4, 5, 6	R18
231° to 241°	B, C, D, E	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2, 3	R9	1, 2, 3, 4, 5, 6, 7	R19
242° to 253°	C, D, E	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2, 3	R9	1, 2, 3, 4, 5, 6, 7	R19
254° to 264°	C, D, E, F	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2, 3	R9	1, 2, 3, 4, 5, 6, 7	R19
265° to 275°	D, E, F	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2, 3	R9	1, 2, 3, 4, 5, 6, 7	R19
276° to 286°	D, E, F, G	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 2, 3	R9	1, 2, 3, 4, 5, 6, 7	R19
287° to 298°	E, F, G	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 3	R10	1, 2, 3, 4, 5, 7	R20
299° to 309°	E, F, G, H	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 3	R10	1, 2, 3, 4, 5, 7, 8	R21
310° to 320°	F, G, H	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 3	R10	1, 2, 3, 4, 5, 7, 8	R21
321° to 331°	F, G, H, J	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1, 3	R10	1, 2, 3, 4, 5, 7, 8	R21
332° to 343°	G, H, J	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1	R1	1, 2, 3, 4, 5, 7, 8	R21
344° to 354°	G, H, J, K	1	R1	1, 2, 3, 4, 5	R2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	R3	1	R1	1, 2, 3, 4, 5, 7, 8, 9	R22

Table 6-2. Description of Evacuation Regions												
		ZONE										
Region	Description	1	2	3	4	5	6	7	8	9	10	11
R01	2 mile ring											
R02	5-mile ring											
R03	Full EPZ											
Evacuate 2 mile ring and 5 miles downwind												
		ZONE										
Region	Wind Direction (From) in Degrees	1	2	3	4	5	6	7	8	9	10	11
R04	29 - 50											
R05	51 - 106											
R06	107 - 140											
R07	141 - 174											
R08	175 - 230											
R09	231 - 286											
R10	287 - 331											
R01*	332 - 28											
Evacuate 5 mile ring and downwind to EPZ boundary												
		ZONE										
Region	Wind Direction (From) in Degrees	1	2	3	4	5	6	7	8	9	10	11
R11	355 - 50											
R12	51 - 61											
R13	62 - 95											
R14	96 - 129											
R15	130 - 163											
R16	164 - 174											
R17	175 - 219											
R18	220 - 230											
R19	231 - 286											
R20	287 - 298											
R21	299 - 343											
R22	344 - 354											

Residents and Transients in the Matagorda Beach area are always evacuated.

* Note that evacuating the 2-mile ring and evacuating the 5-mile ring with wind from 332° to 28° both result in the evacuation of Region1. Thus, R01 is shown twice in the table above.

Table 6-3. Evacuation Scenario Definitions					
Scenario	**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	Summer	Weekend	Midday	Good	Holiday (Beachgoers)
12	Summer	Midweek	Midday	Good	New Plant Construction

Table 6-4. 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	49%	51%	96%	75%	49%	0%	10%	100%	100%
2	49%	51%	96%	75%	49%	0%	10%	100%	100%
3	10%	90%	15%	100%	33%	0%	0%	100%	100%
4	10%	90%	15%	100%	33%	0%	0%	100%	100%
5	10%	90%	15%	65%	33%	0%	0%	100%	60%
6	49%	51%	100%	15%	50%	0%	100%	100%	100%
7	49%	51%	100%	15%	50%	0%	100%	100%	100%
8	10%	90%	15%	25%	33%	0%	0%	100%	100%
9	10%	90%	15%	25%	33%	0%	0%	100%	100%
10	10%	90%	15%	10%	33%	0%	0%	100%	60%
11	10%	90%	15%	100%	33%	100%	0%	100%	100%
12	49%	51%	96%	75%	49%	100%	10%	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 STP area for holiday beach goers for Scenario 11 and for construction workers (building a new unit at STP) for Scenario 12.

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

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

Table 6-5. 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	904	890	1,139	1,955	8,134	-	2	6	600	13,630
2	904	890	1,139	1,955	8,134	-	2	6	600	13,630
3	90	1,704	178	2,607	5,469	-	-	6	600	10,654
4	90	1,704	178	2,607	5,469	-	-	6	600	10,654
5	90	1,704	178	1,695	5,469	-	-	6	360	9,502
6	904	890	1,186	391	8,265	-	22	6	600	12,264
7	904	890	1,186	391	8,265	-	22	6	600	12,264
8	90	1,704	178	652	5,469	-	-	6	600	8,699
9	90	1,704	178	652	5,469	-	-	6	600	8,699
10	90	1,704	178	261	5,469	-	-	6	360	8,068
11	90	1,704	178	2,607	5,469	2,500	-	6	600	13,154
12	904	890	1,139	1,955	8,134	2,475	2	6	600	16,105

NOTE:
*Residents and transients at Matagorda Beach are included in these totals for the purpose of calculating ETE. Matagorda Beach is not within the EPZ.
** School Buses and Transit Buses are expressed in vehicle equivalents (1 bus= 2 vehicles). Therefore actual number of buses are 1/2 value shown.

7. GENERAL POPULATION EVACUATION TIME ESTIMATES (ETE)

This section presents the current results of the computer analyses using the IDYNEV System described in Appendices B, C and D. These results cover 22 regions within the STP EPZ and the 12 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 by interpolating the PC-DYNEV simulation model outputs which are generated at 10-minute intervals, then rounding these data to the nearest 5 minutes.

7.1 Voluntary Evacuation and Shadow Evacuation

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

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

Figure 7-2 presents the area identified as the Shadow Evacuation Region. This region extends radially from the boundary of the EPZ to a distance of 15 miles.

Traffic generated within this Shadow Evacuation Region, traveling away from the STP location, 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 and 7-4 illustrate the patterns of traffic congestion that arise for the case when the entire EPZ (Region R03) is advised to evacuate during the summer, weekend, midday period under good weather conditions (Scenario 3).

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

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

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

All highway "links" which experience LOS F are delineated in these Figures by a red line; all others are lightly indicated. Congestion develops rapidly around concentrations of population and traffic bottlenecks.

Figure 7-3 presents the congestion pattern 45 minutes after the Advisory to Evacuate (ATE). Congestion exists northbound on State Highway 60, primarily the result of those evacuating Matagorda Beach.

Figure 7-4 indicates that at 1 hour and 15 minutes after the ATE, congestion persists northbound on State Highway 60, especially through Wadsworth near the intersection with FM 521. Congestion persists outside of the EPZ, notably at the intersection of State Highway 60 and FM 2668, and to a lesser extent within Bay City. Traffic guides are recommended at the intersection of State Highway 60 and FM 2668 to facilitate the flow of evacuating traffic. All congestion in the shadow area is clear by 1 hour and 45 minutes after the ATE.

7.3 Evacuation Rates

Evacuation is a continuous process, as implied by Figures 7-3 and 7-4. Another format for displaying the dynamics of evacuation is depicted in Figure 7-5. 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 7-5, 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. It is reasonable to expect that some evacuees may delay or lengthen their mobilization activities and evacuate at a later time as a result; these ETE estimates do not (and should not) be distorted to account for these few laggards.

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 over the EPZ.

7.4 Guidance on Using ETE Tables

Tables 7-1A through 7-1D present the ETE values for all 22 Evacuation Regions and all 12 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
     - Weekend
   - The Time of Day
     - Midday
     - Evening
   - Weather Condition
     - Good Weather
     - Rain
   - Special Event (if any)
     - Holiday Beach Weekend
     - 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 *not* in session.
  - Winter, Spring and Autumn imply that public schools *are* in session.
- Time of Day: Midday implies the time over which most commuters are at work.

2. With the Scenario identified, now identify the **Evacuation Region**:
   - Determine the projected azimuth direction of the plume, as dictated by the wind direction. The wind direction is expressed in degrees, clockwise from North and represents the direction *from which* the wind originates.
   - Determine the distance that the Evacuation Region will extend from the South Texas Project. The applicable distances and their associated candidate Regions are given below:
     - 2 Miles (Region R01)
     - 5 Miles (Regions R02 and R04 through R10)
     - To EPZ Boundary (Regions R03 and R11 through R22)
   - Enter Table 7-2 and identify the applicable group of candidate Regions based on the distance that the selected Region extends from STP. 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.

<u>Example</u>

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

- Sunday, August 10th at 4:00 AM.
- The weather is good.
- Wind direction is from 300°.
- 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 good weather. Entering Table 7-1C these descriptors identify this combination of circumstances as being Scenario 5.

2. Enter Table 7-1C and locate the group entitled "Evacuate 5-Mile Ring and Downwind to EPZ Boundary". Under "Wind Direction", identify the 299° to 343° azimuth and read REGION R21 in the first column of that row.

3. Enter Table 7-1C to locate the data cell containing the value of ETE for Scenario 5 and Region R21. This data cell is in column (5) and in the row for Region R21; it contains the ETE value of **3:30**.

Table 7-1A. Time To Clear The Indicated Area of 50 Percent of the Affected Population

	Summer		Summer		Summer		Winter		Winter		Winter		Summer	Summer
	Midweek		Weekend		Midweek Weekend		Midweek		Weekend		Midweek Weekend		Holiday	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)	(12)
	Midday		Midday		Evening		Midday		Midday		Evening		Midday	Midday
Region Wind From:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind From:	Good Weather	Rain	Good Weather	Rain	Good Weather	Region Wind From:	Beach Holiday	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ														
R01 2-mile ring	0:40	0:40	0:40	0:40	0:40	R01 2-mile ring	0:40	0:40	0:40	0:40	0:40	R01 2-mile ring	0:40	0:50
R02 5-mile ring	0:55	0:55	1:05	1:05	1:05	R02 5-mile ring	0:55	0:55	1:05	1:05	1:10	R02 5-mile ring	1:45	1:00
R03 Entire EPZ	1:10	1:10	1:15	1:20	1:10	R03 Entire EPZ	1:10	1:10	1:15	1:20	1:25	R03 Entire EPZ	1:35	1:15
2-Mile Ring and Downwind to 5 Miles														
R04 29° to 50°	0:40	0:45	0:45	0:45	0:45	R04 29° to 50°	0:40	0:45	0:45	0:45	0:45	R04 29° to 50°	0:45	0:50
R05 51° to 106°	0:45	0:45	0:50	0:50	0:50	R05 51° to 106°	0:45	0:45	0:50	0:50	0:50	R05 51° to 106°	0:50	0:55
R06 107° to 140°	0:45	0:45	0:45	0:50	0:45	R06 107° to 140°	0:45	0:45	0:45	0:50	0:45	R06 107° to 140°	0:45	0:55
R07 141° to 174°	0:50	0:50	0:50	0:50	0:50	R07 141° to 174°	0:50	0:50	0:50	0:50	0:50	R07 141° to 174°	0:50	0:55
R08 175° to 230°	0:45	0:45	0:45	0:45	0:45	R08 175° to 230°	0:45	0:45	0:45	0:45	0:45	R08 175° to 230°	0:45	0:55
R09 231° to 286°	0:50	0:55	1:00	1:05	1:00	R09 231° to 286°	0:50	0:50	1:00	1:05	1:05	R09 231° to 286°	1:45	1:00
R10 287° to 331°	0:50	0:50	1:00	1:05	1:00	R10 287° to 331°	0:50	0:50	1:00	1:05	1:05	R10 287° to 331°	1:45	0:55
R01 332° to 28°	0:40	0:40	0:40	0:40	0:40	R01 332° to 28°	0:40	0:40	0:40	0:40	0:40	R01 332° to 28°	0:40	0:50
5-Mile Ring and Downwind to EPZ Boundary														
R11 355° to 50°	1:00	1:00	1:05	1:05	1:05	R11 355° to 50°	1:00	1:00	1:10	1:10	1:15	R11 355° to 50°	1:25	1:05
R12 51° to 61°	1:00	1:00	1:05	1:05	1:05	R12 51° to 61°	1:00	1:00	1:10	1:10	1:15	R12 51° to 61°	1:25	1:05
R13 62° to 95°	1:00	1:00	1:05	1:05	1:05	R13 62° to 95°	1:00	1:00	1:10	1:10	1:15	R13 62° to 95°	1:25	1:05
R14 96° to 129°	1:00	1:00	1:05	1:05	1:05	R14 96° to 129°	1:00	1:00	1:10	1:10	1:20	R14 96° to 129°	1:25	1:05
R15 130° to 163°	1:00	1:00	1:05	1:05	1:05	R15 130° to 163°	1:00	1:00	1:05	1:05	1:15	R15 130° to 163°	1:25	1:05
R16 164° to 174°	1:05	1:10	1:10	1:15	1:10	R16 164° to 174°	1:05	1:10	1:15	1:20	1:20	R16 164° to 174°	1:30	1:15
R17 175° to 219°	1:05	1:10	1:10	1:15	1:10	R17 175° to 219°	1:05	1:10	1:15	1:20	1:20	R17 175° to 219°	1:50	1:15
R18 220° to 230°	1:05	1:05	1:10	1:15	1:10	R18 220° to 230°	1:05	1:05	1:15	1:15	1:20	R18 220° to 230°	1:50	1:10
R19 231° to 286°	1:05	1:10	1:15	1:20	1:10	R19 231° to 286°	1:05	1:05	1:15	1:15	1:20	R19 231° to 286°	2:00	1:15
R20 287° to 298°	0:55	0:55	1:05	1:10	1:05	R20 287° to 298°	0:55	0:55	1:05	1:10	1:10	R20 287° to 298°	1:50	1:00
R21 299° to 343°	0:55	0:55	1:05	1:10	1:05	R21 299° to 343°	0:55	0:55	1:05	1:10	1:10	R21 299° to 343°	1:50	1:00
R22 344° to 354°	1:00	1:05	1:10	1:15	1:05	R22 344° to 354°	1:00	1:00	1:15	1:15	1:20	R22 344° to 354°	1:50	1:05

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

	Summer		Summer		Summer		Winter		Winter		Winter		Summer	Summer
	Midweek		Weekend		Midweek Weekend		Midweek		Weekend		Midweek Weekend		Holiday	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)	(12)
Region Wind From:	Midday		Midday		Evening	Region Wind From:	Midday		Midday		Evening	Region Wind From:	Midday	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather		Good Weather	Rain	Good Weather	Rain	Good Weather		Beach Holiday	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ														
R01 2-mile ring	0:55	0:55	0:50	0:50	0:50	R01 2-mile ring	0:55	0:55	0:50	0:50	0:50	R01 2-mile ring	0:50	1:20
R02 5-mile ring	2:10	2:20	2:10	2:10	2:30	R02 5-mile ring	2:30	2:40	2:50	2:50	3:00	R02 5-mile ring	3:10	1:50
R03 Entire EPZ	3:00	3:00	2:40	2:40	2:50	R03 Entire EPZ	3:30	3:30	3:20	3:20	3:40	R03 Entire EPZ	3:30	3:00
2-Mile Ring and Downwind to 5 Miles														
R04 29° to 50°	0:55	1:00	1:40	1:40	1:40	R04 29° to 50°	1:00	1:00	1:50	1:50	1:50	R04 29° to 50°	1:40	1:25
R05 51° to 106°	1:00	1:00	2:30	2:30	2:30	R05 51° to 106°	1:05	1:05	2:30	2:30	2:30	R05 51° to 106°	2:30	1:30
R06 107° to 140°	1:00	1:00	2:00	2:00	2:00	R06 107° to 140°	1:00	1:00	2:00	2:00	2:00	R06 107° to 140°	2:00	1:30
R07 141° to 174°	1:05	1:05	2:10	2:10	2:10	R07 141° to 174°	1:05	1:05	2:10	2:10	2:10	R07 141° to 174°	2:10	1:30
R08 175° to 230°	0:55	1:00	1:00	1:00	1:00	R08 175° to 230°	1:00	1:00	1:00	1:00	1:00	R08 175° to 230°	1:00	1:30
R09 231° to 286°	2:10	2:10	2:00	2:00	2:10	R09 231° to 286°	2:20	2:20	2:40	2:40	2:50	R09 231° to 286°	3:10	1:40
R10 287° to 331°	2:00	2:10	2:00	2:00	2:10	R10 287° to 331°	2:20	2:20	2:40	2:40	2:50	R10 287° to 331°	3:10	1:40
R01 332° to 28°	0:55	0:55	0:50	0:50	0:50	R01 332° to 28°	0:55	0:55	0:50	0:50	0:50	R01 332° to 28°	0:50	1:20
5-Mile Ring and Downwind to EPZ Boundary														
R11 355° to 50°	2:50	2:50	2:40	2:40	2:50	R11 355° to 50°	3:10	3:10	3:30	3:30	3:40	R11 355° to 50°	3:15	2:00
R12 51° to 61°	2:40	2:40	2:20	2:20	2:40	R12 51° to 61°	3:10	3:10	3:10	3:10	3:30	R12 51° to 61°	3:10	2:10
R13 62° to 95°	2:40	2:40	2:20	2:20	2:40	R13 62° to 95°	3:10	3:10	3:10	3:10	3:30	R13 62° to 95°	3:10	2:10
R14 96° to 129°	2:50	2:50	2:20	2:20	2:40	R14 96° to 129°	3:20	3:20	3:10	3:10	3:30	R14 96° to 129°	3:10	2:10
R15 130° to 163°	2:30	2:30	2:10	2:10	2:30	R15 130° to 163°	3:00	3:00	2:50	2:50	3:10	R15 130° to 163°	3:10	2:00
R16 164° to 174°	2:50	2:50	2:20	2:20	2:40	R16 164° to 174°	3:20	3:20	3:00	3:10	3:20	R16 164° to 174°	3:10	3:00
R17 175° to 219°	3:00	3:00	2:40	2:40	2:50	R17 175° to 219°	3:20	3:20	3:20	3:20	3:30	R17 175° to 219°	3:20	3:00
R18 220° to 230°	2:50	2:50	2:40	2:40	2:50	R18 220° to 230°	3:10	3:10	3:10	3:20	3:30	R18 220° to 230°	3:20	3:00
R19 231° to 286°	2:50	2:50	2:40	2:40	2:50	R19 231° to 286°	3:10	3:10	3:10	3:20	3:30	R19 231° to 286°	3:30	3:00
R20 287° to 298°	2:20	2:20	2:10	2:10	2:30	R20 287° to 298°	2:50	2:50	2:50	2:50	3:10	R20 287° to 298°	3:25	1:50
R21 299° to 343°	2:20	2:20	2:10	2:10	2:30	R21 299° to 343°	2:50	2:50	2:50	2:50	3:10	R21 299° to 343°	3:25	1:50
R22 344° to 354°	2:40	2:40	2:30	2:30	2:50	R22 344° to 354°	3:10	3:10	3:20	3:20	3:40	R22 344° to 354°	3:25	2:00

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

	Summer		Summer		Summer		Winter		Winter		Winter		Summer	Summer
	Midweek		Weekend		Midweek Weekend		Midweek		Weekend		Midweek Weekend		Holiday	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)	(12)
Region Wind From:	Midday		Midday		Evening	Region Wind From:	Midday		Midday		Evening	Region Wind From:	Midday	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather		Good Weather	Rain	Good Weather	Rain	Good Weather		Beach Holiday	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ														
R01 2-mile ring	0:55	0:55	0:50	0:50	0:50	R01 2-mile ring	0:55	0:55	0:50	0:50	0:50	R01 2-mile ring	0:50	1:40
R02 5-mile ring	3:10	3:20	3:00	3:00	3:20	R02 5-mile ring	3:40	3:40	3:50	3:50	4:10	R02 5-mile ring	3:25	2:10
R03 Entire EPZ	4:00	4:00	3:40	3:40	4:00	R03 Entire EPZ	4:20	4:20	4:10	4:20	4:20	R03 Entire EPZ	3:50	3:40
2-Mile Ring and Downwind to 5 Miles														
R04 29° to 50°	1:00	1:00	2:30	2:30	2:50	R04 29° to 50°	1:00	1:00	2:50	2:50	2:50	R04 29° to 50°	2:30	1:40
R05 51° to 106°	1:50	1:50	3:25	3:25	3:30	R05 51° to 106°	1:50	1:50	3:40	3:40	3:40	R05 51° to 106°	3:25	1:40
R06 107° to 140°	1:30	1:30	2:50	2:50	2:40	R06 107° to 140°	1:30	1:30	2:50	2:50	2:50	R06 107° to 140°	2:50	1:40
R07 141° to 174°	1:50	1:50	2:50	2:50	2:40	R07 141° to 174°	1:50	1:50	2:50	2:50	2:50	R07 141° to 174°	2:50	1:50
R08 175° to 230°	1:00	1:00	1:30	1:30	1:30	R08 175° to 230°	1:00	1:00	1:30	1:30	1:30	R08 175° to 230°	1:30	1:40
R09 231° to 286°	3:00	3:00	2:50	2:50	3:00	R09 231° to 286°	3:30	3:30	3:40	3:40	4:00	R09 231° to 286°	3:25	2:00
R10 287° to 331°	3:00	3:00	2:50	2:50	3:00	R10 287° to 331°	3:30	3:30	3:40	3:40	4:00	R10 287° to 331°	3:25	2:00
R01 332° to 28°	0:55	0:55	0:50	0:50	0:50	R01 332° to 28°	0:55	0:55	0:50	0:50	0:50	R01 332° to 28°	0:50	1:40
5-Mile Ring and Downwind to EPZ Boundary														
R11 355° to 50°	3:50	3:50	3:40	3:40	3:50	R11 355° to 50°	4:10	4:10	4:10	4:20	4:20	R11 355° to 50°	3:25	2:50
R12 51° to 61°	3:40	3:40	3:20	3:30	3:50	R12 51° to 61°	4:10	4:10	4:10	4:10	4:20	R12 51° to 61°	3:25	3:00
R13 62° to 95°	3:40	3:40	3:20	3:30	3:50	R13 62° to 95°	4:10	4:10	4:10	4:10	4:20	R13 62° to 95°	3:25	3:00
R14 96° to 129°	3:50	3:50	3:30	3:30	3:50	R14 96° to 129°	4:10	4:10	4:10	4:10	4:20	R14 96° to 129°	3:25	3:10
R15 130° to 163°	3:30	3:30	3:00	3:00	3:30	R15 130° to 163°	4:00	4:00	4:00	4:00	4:10	R15 130° to 163°	3:25	2:50
R16 164° to 174°	3:50	3:50	3:20	3:30	3:50	R16 164° to 174°	4:10	4:10	4:10	4:10	4:20	R16 164° to 174°	3:30	3:40
R17 175° to 219°	4:00	4:00	3:40	3:40	4:00	R17 175° to 219°	4:10	4:10	4:10	4:20	4:20	R17 175° to 219°	3:35	3:40
R18 220° to 230°	3:50	3:50	3:40	3:40	4:00	R18 220° to 230°	4:10	4:10	4:10	4:20	4:20	R18 220° to 230°	3:35	3:30
R19 231° to 286°	3:50	3:50	3:40	3:40	3:50	R19 231° to 286°	4:10	4:10	4:10	4:20	4:20	R19 231° to 286°	3:50	3:30
R20 287° to 298°	3:20	3:20	3:00	3:00	3:30	R20 287° to 298°	3:50	3:50	4:00	4:00	4:10	R20 287° to 298°	3:40	2:30
R21 299° to 343°	3:20	3:20	3:00	3:00	3:30	R21 299° to 343°	3:50	3:50	4:00	4:00	4:10	R21 299° to 343°	3:40	2:30
R22 344° to 354°	3:50	3:50	3:40	3:40	3:50	R22 344° to 354°	4:10	4:10	4:10	4:20	4:20	R22 344° to 354°	3:40	3:00

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

	Summer		Summer		Summer		Winter		Winter		Winter		Summer	Summer
	Midweek		Weekend		Midweek Weekend		Midweek		Weekend		Midweek Weekend		Holiday	Midweek
Scenario:	(1)	(2)	(3)	(4)	(5)	Scenario:	(6)	(7)	(8)	(9)	(10)	Scenario:	(11)	(12)
Region Wind From:	Midday		Midday		Evening	Region Wind From:	Midday		Midday		Evening	Region Wind From:	Midday	Midday
	Good Weather	Rain	Good Weather	Rain	Good Weather		Good Weather	Rain	Good Weather	Rain	Good Weather		Beach Holiday	New Plant Construction
Entire 2-Mile Region, 5-Mile Region, and EPZ														
R01 2-mile ring	1:00	1:00	1:00	1:00	1:00	R01 2-mile ring	1:00	1:00	1:00	1:00	1:00	R01 2-mile ring	1:00	2:00
R02 5-mile ring	6:00	6:10	5:10	5:10	5:10	R02 5-mile ring	6:00	6:00	5:10	5:10	5:10	R02 5-mile ring	5:10	6:00
R03 Entire EPZ	6:10	6:10	5:50	5:50	5:50	R03 Entire EPZ	6:10	6:10	5:50	5:50	5:50	R03 Entire EPZ	5:50	6:10
2-Mile Ring and Downwind to 5 Miles														
R04 29° to 50°	4:50	5:00	4:50	4:50	4:50	R04 29° to 50°	4:50	5:00	4:50	4:50	4:50	R04 29° to 50°	4:50	5:00
R05 51° to 106°	4:50	5:00	5:00	5:00	5:00	R05 51° to 106°	4:50	5:00	5:00	5:00	5:00	R05 51° to 106°	5:00	5:00
R06 107° to 140°	4:50	4:50	5:00	5:00	5:00	R06 107° to 140°	4:50	4:50	5:00	5:00	5:00	R06 107° to 140°	5:00	5:00
R07 141° to 174°	4:50	4:50	5:00	5:00	5:00	R07 141° to 174°	4:50	4:50	5:00	5:00	5:00	R07 141° to 174°	5:00	5:00
R08 175° to 230°	3:50	3:50	2:50	2:50	2:50	R08 175° to 230°	3:50	3:50	2:50	2:50	2:50	R08 175° to 230°	2:50	3:50
R09 231° to 286°	6:00	6:10	5:10	5:10	5:10	R09 231° to 286°	6:00	6:00	5:10	5:10	5:10	R09 231° to 286°	5:10	6:00
R10 287° to 331°	6:00	6:10	5:10	5:10	5:10	R10 287° to 331°	6:00	6:00	5:10	5:10	5:10	R10 287° to 331°	5:10	6:00
R01 332° to 28°	1:00	1:00	1:00	1:00	1:00	R01 332° to 28°	1:00	1:00	1:00	1:00	1:00	R01 332° to 28°	1:00	2:00
5-Mile Ring and Downwind to EPZ Boundary														
R11 355° to 50°	6:00	6:10	5:50	5:50	5:50	R11 355° to 50°	6:00	6:00	5:50	5:50	5:50	R11 355° to 50°	5:50	6:00
R12 51° to 61°	6:00	6:10	5:50	5:50	5:50	R12 51° to 61°	6:00	6:10	5:50	5:50	5:50	R12 51° to 61°	5:50	6:00
R13 62° to 95°	6:00	6:10	5:50	5:50	5:50	R13 62° to 95°	6:00	6:10	5:50	5:50	5:50	R13 62° to 95°	5:50	6:00
R14 96° to 129°	6:00	6:10	5:50	5:50	5:50	R14 96° to 129°	6:00	6:10	5:50	5:50	5:50	R14 96° to 129°	5:50	6:00
R15 130° to 163°	6:00	6:10	5:10	5:10	5:10	R15 130° to 163°	6:00	6:00	5:10	5:10	5:10	R15 130° to 163°	5:10	6:00
R16 164° to 174°	6:10	6:10	5:20	5:20	5:20	R16 164° to 174°	6:10	6:10	5:20	5:20	5:10	R16 164° to 174°	5:10	6:00
R17 175° to 219°	6:10	6:10	5:20	5:20	5:20	R17 175° to 219°	6:10	6:10	5:20	5:20	5:10	R17 175° to 219°	5:10	6:10
R18 220° to 230°	6:10	6:10	5:20	5:20	5:20	R18 220° to 230°	6:10	6:10	5:20	5:20	5:10	R18 220° to 230°	5:10	6:10
R19 231° to 286°	6:10	6:10	5:20	5:20	5:20	R19 231° to 286°	6:10	6:10	5:20	5:20	5:20	R19 231° to 286°	5:10	6:10
R20 287° to 298°	6:10	6:10	5:10	5:10	5:10	R20 287° to 298°	6:10	6:10	5:10	5:10	5:10	R20 287° to 298°	5:10	6:00
R21 299° to 343°	6:10	6:10	5:10	5:10	5:10	R21 299° to 343°	6:10	6:10	5:10	5:10	5:10	R21 299° to 343°	5:10	6:00
R22 344° to 354°	6:10	6:10	5:50	5:50	5:50	R22 344° to 354°	6:10	6:10	5:50	5:50	5:50	R22 344° to 354°	5:50	6:00

Table 7-2. Description of Evacuation Regions												
		ZONE										
Region	Description	1	2	3	4	5	6	7	8	9	10	11
R01	2 mile ring	X										
R02	5-mile ring	X	X	X	X	X						
R03	Full EPZ	X	X	X	X	X	X	X	X	X	X	X
Evacuate 2 mile ring and 5 miles downwind												
		ZONE										
Region	Wind Direction (From) in Degrees	1	2	3	4	5	6	7	8	9	10	11
R04	29 - 50	X			X							
R05	51 - 106	X			X	X						
R06	107 - 140	X				X						
R07	141 - 174	X	X			X						
R08	175 - 230	X	X									
R09	231 - 286	X	X	X								
R10	287 - 331	X		X								
R01*	332 - 28	X										
Evacuate 5 mile ring and downwind to EPZ boundary												
		ZONE										
Region	Wind Direction (From) in Degrees	1	2	3	4	5	6	7	8	9	10	11
R11	355 - 50	X	X	X	X	X			X	X		
R12	51 - 61	X	X	X	X	X			X	X	X	
R13	62 - 95	X	X	X	X	X				X	X	
R14	96 - 129	X	X	X	X	X				X	X	X
R15	130 - 163	X	X	X	X	X					X	X
R16	164 - 174	X	X	X	X	X	X				X	X
R17	175 - 219	X	X	X	X	X	X					X
R18	220 - 230	X	X	X	X	X	X					
R19	231 - 286	X	X	X	X	X	X	X				
R20	287 - 298	X	X	X	X	X		X				
R21	299 - 343	X	X	X	X	X		X	X			
R22	344 - 354	X	X	X	X	X		X	X	X		

Residents and Transients in the Matagorda Beach area are always evacuated.
* Note that evacuating the 2-mile ring and evacuating the 5-mile ring with wind from 332° to 28° both result in the evacuation of Region1. Thus, R01 is shown twice in the table above.

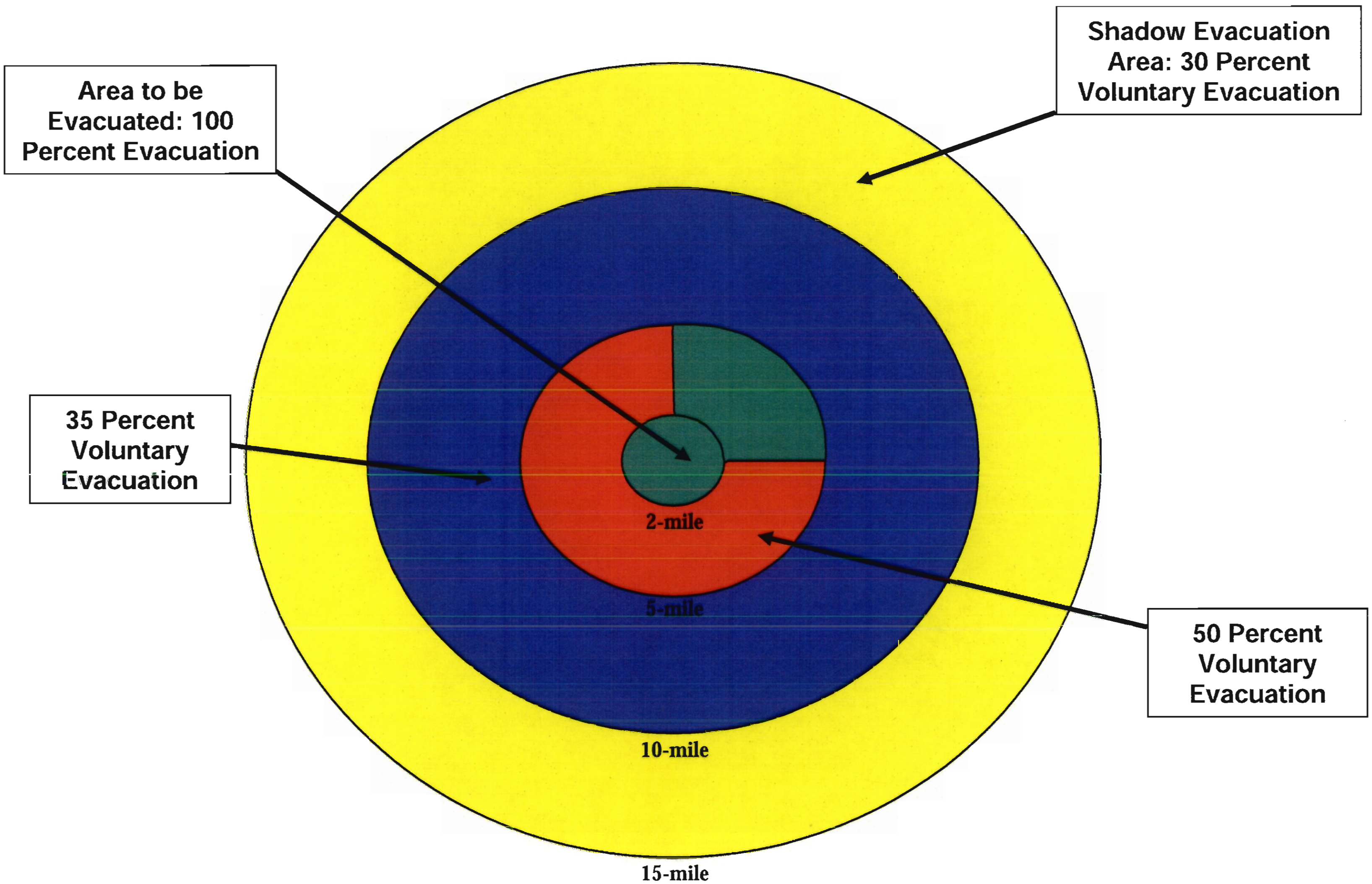


Figure 7-1. Assumed Evacuation Response

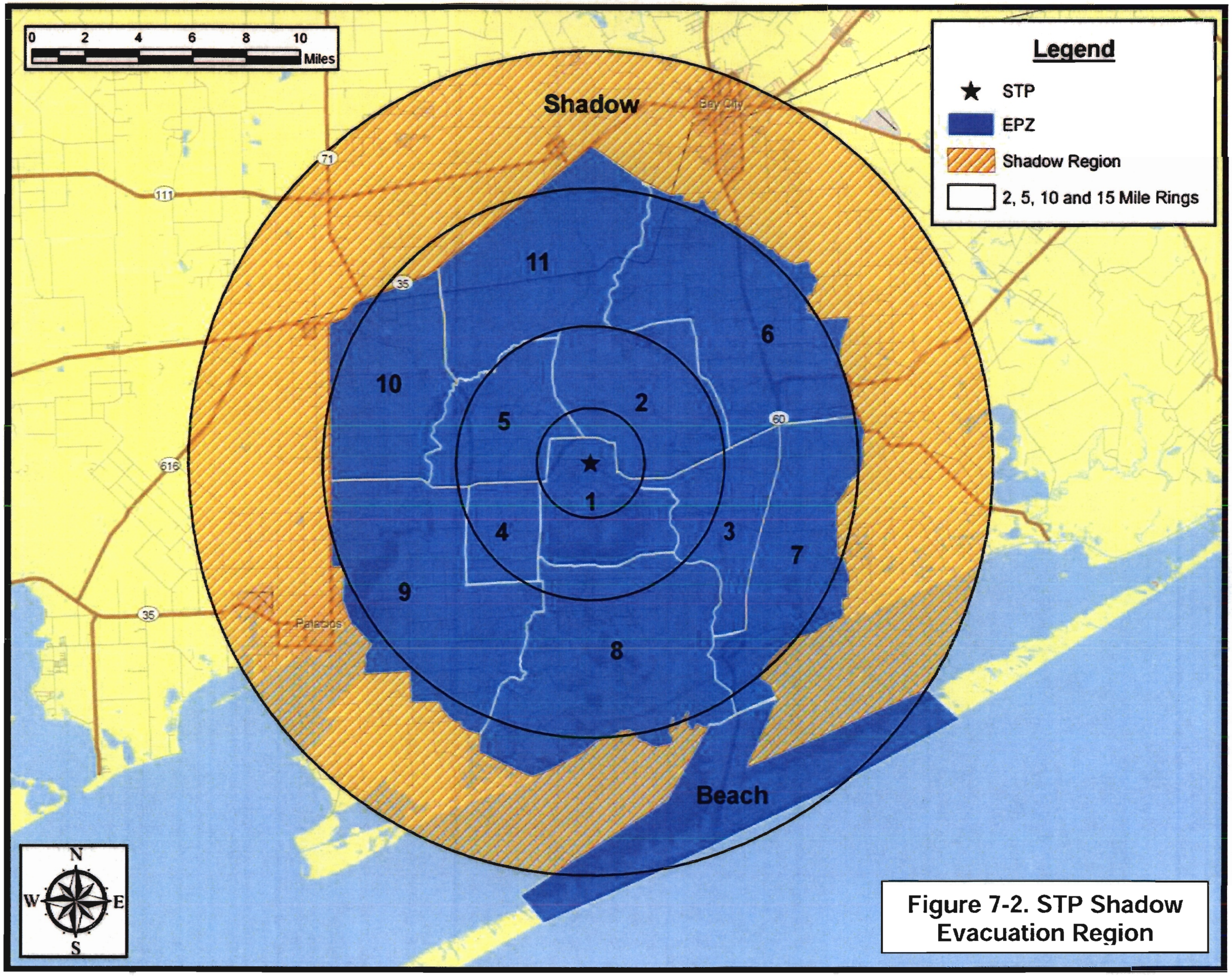


Figure 7-2. STP Shadow Evacuation Region

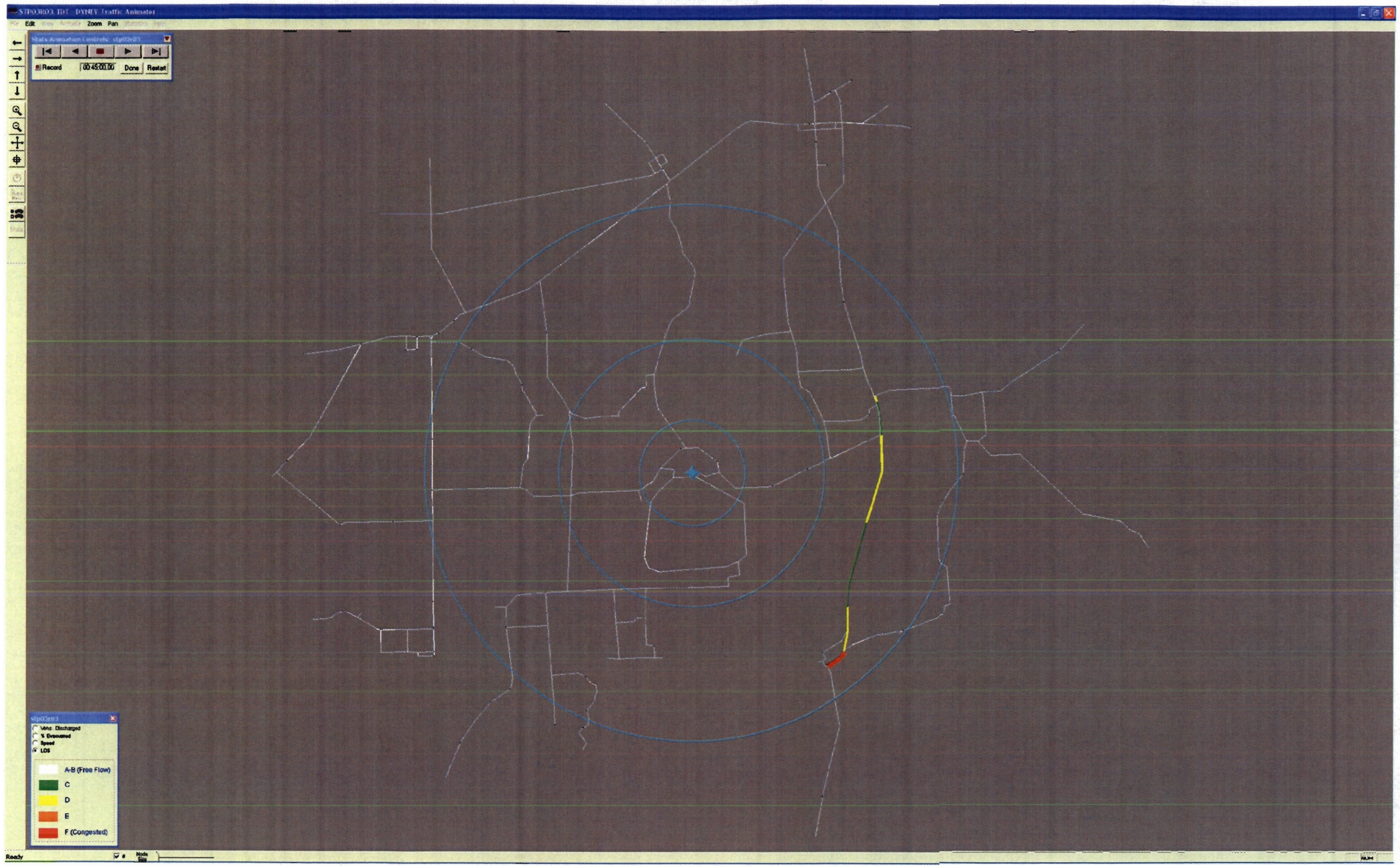


Figure 7-3. Traffic Congestion at 45 Minutes after the Advisory to Evacuate

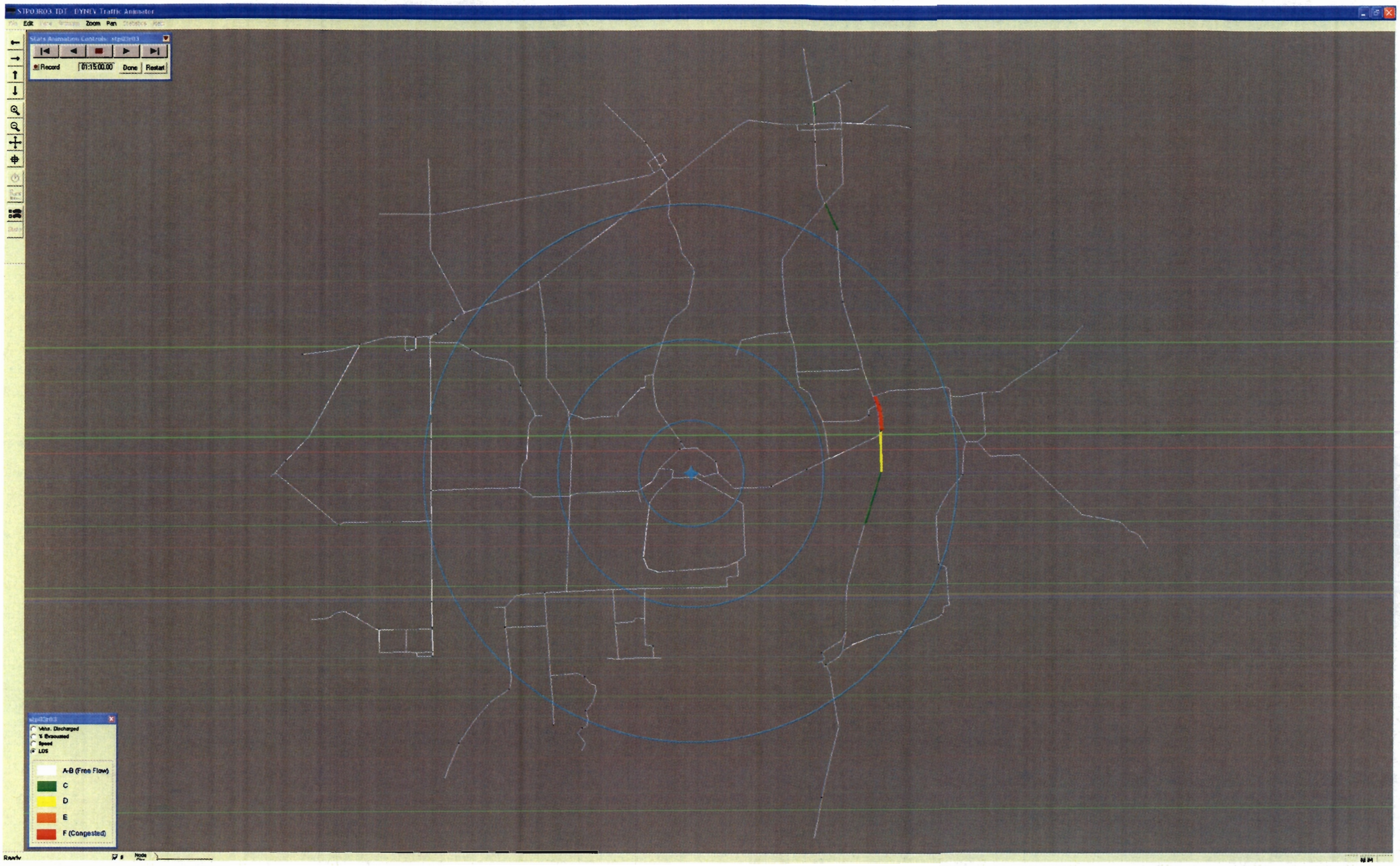


Figure 7-4 Traffic Congestion at 1 Hour and 15 Minutes after the Advisory to Evacuate

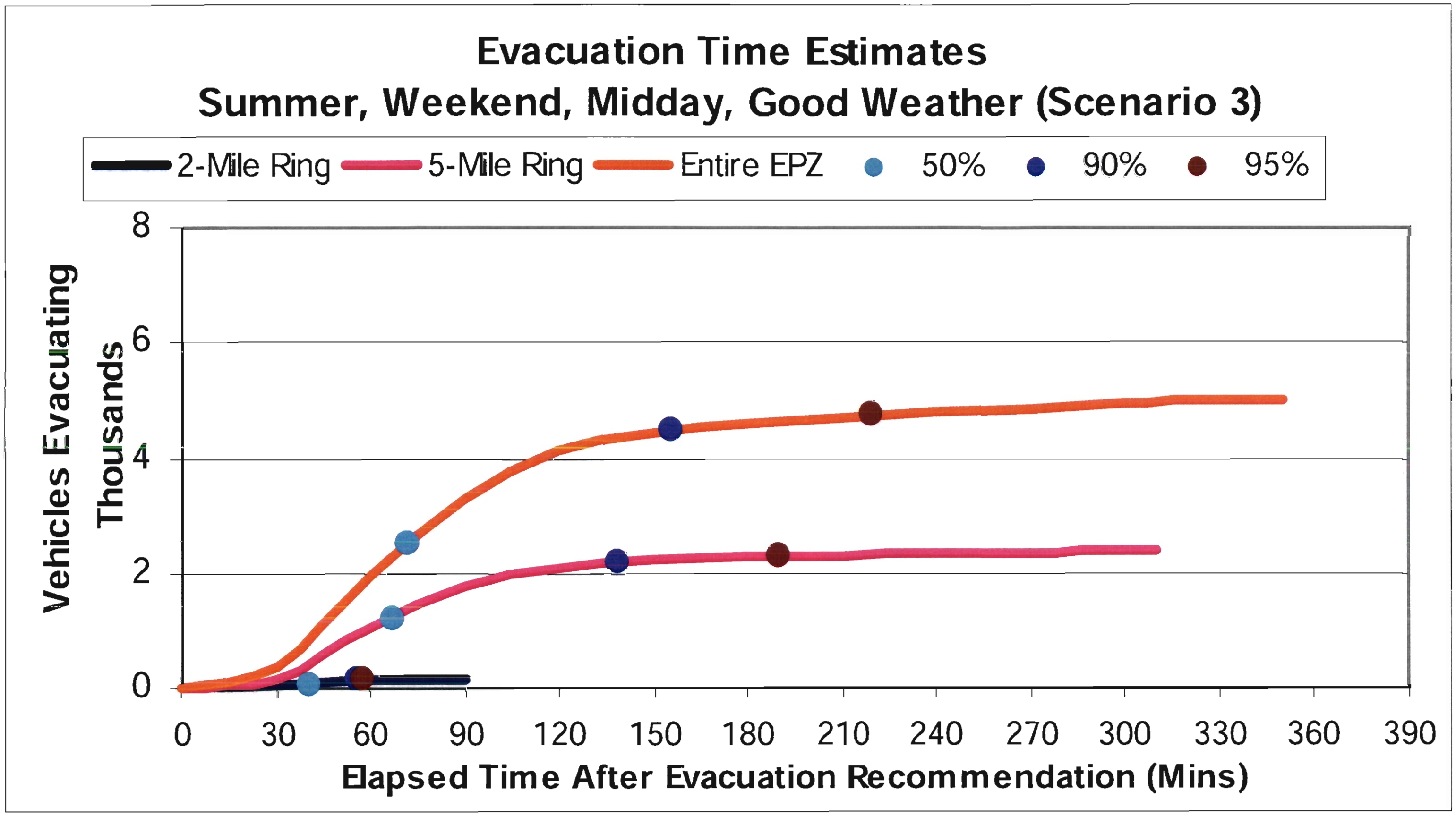


Figure 7-5. Evacuation Time Estimates for STP Summer, Weekend, Midday, Good Weather Evacuation of Region R03 (Entire EPZ)