Table 6-1. Estimated Maximum Product Release at Selected Locations

Location	Station, ft	Upstream Valve	Downstream Valve	Detection + Valve Closure Time[a], Minutes: Upstream Valve	Detection + Valve Closure Time[a], Minutes: Downstream Valve	Maximum Drain Volume: bbl	Maximum Drain Volume: gal	Loss During Detection and Pipeline Shutdown[b]: bbl	Loss During Detection and Pipeline Shutdown[b]: Gal	Total Maximum Release: bbl	Total Maximum Release: gal
Fonwood Elementary, Northwood Elementary, and Langstead Primary Schools	75600 to 76400	Remote-controlled block valve	Manual block valve	5	120[c]	3,903	164,000	781	32,800	4,684	196,800
Buescher State Park	673338 to 679884	Manual block valve	Remote-controlled block valve	120[c]	5	2,333	98,000	781	32,800	3,114	130,800
Colorado River Crossing	710033	Remote-controlled block valve MLV G-1	Check valve and manually-operated block valve	5	5	1,245	52,300	781	32,800	2,026	85,100
Onion Creek Crossing	865867	Remote-controlled block valve	Remote-controlled block valve	5	5	4,310	179,600	781	32,800	5,091	212,400
Hillcrest Elementary School	861050	Remote-controlled block valve	Remote-controlled block valve	5	5	488	20,500	781	32,800	1,269	53,300
Brown Schools	888000	Remote-controlled block valve	Remote-controlled block valve	5	5	3,996	167,800	781	32,800	4,777	200,600
Shiloh Oaks Subdivision	891264	Remote-controlled block valve	Remote-controlled block valve	5	5	2,667	112,014	781	32,800	3,448	144,814
Karst Preserve	901500	Remote-controlled block valve	Remote-controlled block valve	5	5	3,964	166,500	781	32,800	4,745	199,300
Edwards Aquifer – General	875615 to 914682	Remote-controlled block valve[d]	Remote-controlled block valve	5	5	5,240	220,080	781	32,800	6,021	252,880

Table 6-1. (Continued)

Location	Station, Ft	Upstream Valve	Downstream Valve	Detection + Valve Closure Time[a], Minutes: Upstream Valve	Detection + Valve Closure Time[a], Minutes: Downstream Valve	Maximum Drain Volume: bbl	Maximum Drain Volume: gal	Loss During Detection & Pipeline Shutdown[b]: bbl	Loss During Detection & Pipeline Shutdown[b]: gal	Total Maximum Release: bbl	Total Maximum Release: gal
Cedar Valley Pump Station	959033	Remote-controlled block valve	Manual block valve	5	120[c]	5,470	229,740	781	32,800	6,251	262,540
Cenozoic Pecos Alluvium - A	2358249 to 2685651	Manual Block Valve	Remote-controlled block valve	120[c]	5	18,000	756,000	781	32,800	18,781	788,800
Cenozoic Pecos Alluvium - B	2727629 to 2940056	Manual Block Valve	Manual block valve	120[c]	120[c]	35,500	1,490,000	781	32,800	36,200	1523000

[a] Detection and closure of remote-controlled valves assumed to be 5 minutes
[b] Based on maximum flow of 225,000 barrels per day
[c] Assumes that leak is detected and line (including remote-controlled valve) is shut down in 5 minutes, manual block valves are closed within 2 hours
[d] Upstream remote-controlled valve is located at stationing 879965

Table 6-2. Pipeline Release Locations and Maximum Release Quantities for Cases Modeled

Release Location	Topographical Maximum Spill Surface Area, ft^2	Worst-Case Release Quantity, bbls
Hillcrest Elementary	1,020,632	1,269
Brown Schools	764,601	4,777
Shiloh Oaks Subdivision	982,217	3,448
Cedar Valley Pump Station	1,245,944	6,251

Table 6-3. Example CHARMâ Data Input Form

Complex Hazardous Air Release Model (CHARMâ)
Version 9.1

Title: Austin average met: CVPump/WC/262540gal/instant
Species: Gasoline: LH
Release type: Pool/lagoon description
Emergency response output: Pool fire radiation
X location: 0 ft
Y location: 0 ft
Isopleth conc. (ppm): . 4e+004 , 0 , 0
Building height: 0 ft Width: 0 ft
Source to building distance: 0 ft Direction: 0°
Liquid pool surface
height above ground: 0 ft
Amount released: 2.625e+005 gallons
Pool area: 4.45e+004 ft^2
Pool depth (calculated): 9.464 in
Pool temperature assumed to be ambient or boiling point
No pool mitigation time
Solar radiation pool evaporation efficiency: 1
Wetted tank surface area (liquid pool fire): 0 ft^2
Water fraction of spill surface (0 -> 1): 0.15
Surface is assumed to be dirt
Surface Specific Heat: 800 joules/kg K
Surface Thermal Conductivity: 0.32 w/m K
Surface Density: 1640 kg/m^3
Relative Pore Volume of Surface (0 ->1): 0.34
Darcy Constant of Surface: 2.8e-007 m

Table 6-4. Meteorological Parameters Used in the Modeling Analysis

Met Data:			
Relative Humidity:			68.93%
Ambient Temperature:			67.8°F
Ambient Pressure:			1 atms
Cloud Cover (tenths)			10
Stability Class: D (User supplied)			
Solar Radiation:			0.3 kW/m²
No inversion present			
Surface roughness:			30 cm
Wind measurement altitude:			10 m
Winds	Time	Direction	Speed
	00:00	SSE	7.66 mph

Table 6-5. Summary of CHARM® Modeling Results (maximum distances measured from pool centroid)

Release Location	Release Volume, bbls	Spill Surface Area, ft^2	Maximum Impact Distance (from Pool Centroid) ft					
			Flash Fire		Pool Fire			
					Oil		Gasoline	
			Oil	Gasoline	1 kW/m^2	4 kW/m^2	1 kW/m^2	4 kW/m^2
Hillcrest Elementary School	50	4140	36	165	396	207	476	246
	500	12800	60	482	685	353	819	415
	1269[1]	20300	73	514	858	439	1019	511
Brown Schools	50	4140	36	165	396	207	476	246
	500	12800	60	482	685	353	819	415
	1500	22100	76	491	894	458	1061	530
	4777	39000	96	603	1178	598	1390	686
Shiloh Oaks Subdivision	50	4140	36	165	396	207	476	246
	500	12800	60	482	685	353	819	415
	1500	22100	76	491	894	458	1061	530
	3448	33200	90	613	1089	555	1282	633
Cedar Valley Pump Station	50	4140	36	165	396	207	476	246
	500	12800	60	482	685	353	819	415
	1500	22100	76	491	894	458	1061	530
	6,251	44,500	101	489	1255	636	1485	734

[1] The worst-case release quantity for the Hillcrest segment (1,269 bbls) is less than the 1,500 bbl case; therefore, the 1,500 bbl case was not modeled.

Table 6-6. Summary of of CHARMò Modeling Results (maximum distances measured from pipeline)

			Maximum Impact Distance (From Pipeline), ft						
			Flash Fire		Pool Fire				
					Oil		Gasoline		
Release Location	Release Volume, bbls	Spill Surface Area, ft^2	Oil	Gasoline	1 kW/m^2	4 kW/m^2	1 kW/m^2	4 kW/m^2
Hillcrest Elementary School	50	4140	321	450	681	492	761	531
	500	12800	345	767	970	638	1104	700
	1269[1]	20300	358	799	1143	724	1304	797
Brown Schools	50	4140	66	195	426	237	506	276
	500	12800	90	572	715	383	849	445
	1500	22100	106	521	924	488	1091	560
	4777	39000	126	633	1208	628	1420	716
Shiloh Oaks Subdivision	50	4140	249	378	609	420	689	459
	500	12800	273	695	898	566	1032	628
	1500	22100	289	704	1107	671	1274	743
	3448	33200	303	826	1302	768	1495	846
Cedar Valley Pump Station	50	4140	965	1094	1325	1136	1405	1175
	500	12800	989	1411	1614	1282	1748	1344
	1500	22100	1005	1420	1823	1387	1990	1459
	6251	44500	1030	1418	2184	1565	2414	1663

[1] The worst-case release quantity for the Hillcrest segment (1,269 bbls) is less than the 1,500 bbl case; therefore, the 1,500 bbl case was not modeled.

Table 6-7. EA Relative Risk Assessment Model Probability of Failure Categories and Variables

Category	Variable
Third-Party Damage	
	Depth of Cover
	Activity Level
	Patrol Frequency and Effectiveness
	One-Call Effectiveness
	Public Education Activities
	Aboveground Exposures
	Right-of-Way Condition
Corrosion	
	Atmospheric Corrosion
	Internal Corrosion
	Buried Pipe Corrosion
	Cathodic Protection
	Buried Coating
	Interferences
	Mechanical Corrosion
	Line Inspection
Design	
	Pipe Strength
	System Safety Factor
	Fatigue Potential
	Surge Potential
	Integrity Tests
	Earth Movements
Incorrect Operations	
	Construction/Design
	Training
	Procedures
	Maps and Records
	Overpressure Potential
	Safety Systems
	Maintenance
	Communications
	Mechanical Error Preventors
	Risk Assessment

Table 6-8. One-Call Data on the Longhorn Pipeline from August 1, 1998 to April 1, 1999

County	Beginning Station (ft)	End Station (ft)	Feet of Pipeline in County	Total Calls	Cleared Calls	Dispatched Calls	Percent Calls Dispatched	Calls per 10 Feet of Pipeline	Code (2)
Austin	337659	489702	161023	77	31	46	60	0.0048	Medium
Bastrop	632229	810379	180150	255	53	202	79	0.0142	High
Bell	0	0	0	1	1	0	0	(1)	None
Blanco	1010656	1148496	131740	4	0	4	100	0.0003	Low
Brazoria	0	0	0	1	0	1	100	(1)	None
Brazos	0	0	0	5	1	4	80	(1)	None
Crane	2395852	2542522	113980	54	4	50	93	0.0047	Medium
Crockett	1934341	2071221	136880	0	0	0	0	0.0000	Low
Culberson	2952749	3225275	272529	0	0	0	0	0.0000	Low
Ector	0	0	0	2	0	2	100	(1)	None
El Paso	3578518	3666496	88603	0	0	0	0	0.0000	Low
Fayette	489702	632229	123127	18	5	13	72	0.0015	Medium
Galveston	0	0	0	3	3	0	0	(1)	None
Gillespie	1148496	1272896	124400	13	2	11	85	0.0010	Medium
Harris	0	265235	265039	10690	3853	6837	64	0.4033	High
Hays	957388	1010656	59368	46	8	38	83	0.0077	Medium
Hockley	0	0	0	1	0	1	100	(1)	None
Houston	0	0	0	1	0	1	100	(1)	None
Howard	0	0	0	1	1	0	0	(1)	None
Hudspeth	3225275	3578518	352615	0	0	0	0	0.0000	Low
Hunt	0	0	0	1	1	0	0	(1)	None
Kimble	1448456	1631959	183503	8	0	8	100	0.0004	Low
Lee	0	0	10400	4	0	4	100	0.0038	Medium
Llano	0	0	3339	0	0	0	0	0.0000	Low
Mason	1272896	1448456	172221	2	0	2	100	0.0001	Low
Menard	1631959	1651727	19768	0	0	0	0	0.0000	Low
Nueces	0	0	0	1	1	0	0	(1)	None
Orange	0	0	0	1	1	0	0	(1)	None
Reagan	2071221	2219167	137946	0	0	0	0	0.0000	Low
Reeves	2774200	2952749	178831	0	0	0	0	0.0000	Low
Schleicher	1651727	1934341	282614	2	0	2	100	0.0001	Low
Travis	810379	957388	147009	3739	1286	2453	66	0.2543	High
Upton	2219167	2395852	176685	19	1	18	95	0.0011	Medium
Waller	265235	337659	72445	30	11	19	63	0.0041	Medium
Ward	2542522	2774200	264068	0	0	0	0	0.0000	Low
Total			3658282	14979	5263	9716	65		

(1): Calls were received for counties where Longhorn Pipeline does not run.

(2): Code levels:
High – Calls per 10 feet (ft) of pip eline is greater than 0.01
Medium – Calls per 10 ft of pipeline is greater than 0.001
Low – Calls per 10 ft of pipeline is less than 0.001
None – Calls received in counties where there is no pipeline

Table 6-9. Longhorn Partners Pipeline – WES Risk Ranking Assessment of Highest Risk Sections

Beginning Station	Ending Station	Beginning Milepost	Ending Milepost	Population	Environmental Areas
196+39	218+04	3.7	4.1	High	Creek
350+34	364+43	6.6	6.9	High	Greens Bayou
517+40	531+35	9.8	10.1	High	Greens Bayou
901+48	915+18	17.1	17.3	High	Halls Bayou
1233+96	1247+66	23.4	23.6	High	Creek
1557+74	1571+44	29.5	29.8	High	H.C.F.C.D. Channel
1629+75	1644+95	30.9	31.2	High	Little White Oak Bayou
1801+38	1805+04	34.1	34.2	High	
1805+04	1988+71	34.2	37.7	High	
3362+42	3386+82	63.7	64.1	Low	Brazos River
6595+02	6726+91	124.9	127.4	High	Buescher State Park
6726+91	6805+44	127.4	128.9	Low	
6805+44	7089+91	128.9	134.3	Low	
7089+91	7111+88	134.3	134.7	Low	Colorado River
8407+37	8625+93	159.2	163.4	High	McKinney Falls State Park
8625+93	8665+27	163.4	164.1	High	Creek
8802+30	9152+68	166.7	173.3	High	Edwards Aquifer
9546+10	9559+30	180.8	181.0	Medium	Creek
10209+88	10485+21	193.4	198.6	High	Pedernales State Park

Table 6-10. Comparison of Attributes of Three Relative Risk Assessments

Comparison	EPC	WES	EA	Notes
Number of geographic sections for analysis	7	138	10,100+	
Average segment length	65.7 miles	5.0 miles	400 ft	1
Number of risk variables	~54	~54	~82	
Approximate pieces of information used to assess risks	~700	~13,800	~1,200,000	
Basis of model	Muhlbauer, 1996	Muhlbauer, 1996	Muhlbauer, 1996 (modified)	
Highest risk segments	Eckert to Bastrop	125-127 (Buescher State Park) 167-173 (Edwards Aquifer)	Miles 11-17 Miles 22-35 Miles 166-174	
Highest failure-probability segments	Kemper to Ft McKavet Crane to Kemper	34-37 64-67 (Brazos River)	Miles 11-22 Miles 172-176 Miles 357-453	
Highest consequence segments	Eckert to Bastrop	4-31 (various) 163 180	Miles 11 to 17 Miles 22 to 36 Miles 166 to 174	
Risk–range of scores, highest segment risk to lowest	16 to 58	30 to 125	Tier dependent	2, 5
Probability–range of scores (worst to best)	203 to 245	222 to 311	159 to 267	2
Consequence–range of scores (best to worst)	3.6 to 13.2	2.3 to 8.3	Tier 1 to Tier 3	3, 4, 5

1. EPC model covers only Kemper to Baytown section.
2. Higher numbers indicate more safety—reduced risk—for the risk and probability scores. Range is function of the choice of scaling factors.
3. Higher numbers indicate increased risk for the consequence score.
4. These consequence numbers are heavily dependent upon product characteristics, nearby receptors, and choice of scales used for spill score.
5. The EA Risk Model combines probability of failure scores with tier categories to evaluate relative risk.

Table 6-11. Comparison of EPC, WES, and EA Risk Model Features*

Issue	EPC	WES	Current (EA) Model
Surge potential	No difference noted	No difference noted	Higher weighting for surge; potential seen as "high" in some places
Fatigue	No fatigue issues	Differences, but unknown criteria	Higher weighting, potential seen
ROW	Unknown	ROW = "good"	Some poor ROW sections identified
Pipe strength	Standard pipe pressure/wall thickness calculations	Standard pipe pressure/wall thickness calculations	Penalty for pre-1970 ERW and for older girth welds
Earth movements	No differences in "earth movements" potential	No differences in "earth movements" potential	More variations seen; seismic; landslide; soils databases; model for scour
Cathodic protection	Qualitative system scoring	Qualitative system scoring	Actual test lead and CIS readings used
Coating	Qualitative coating condition scoring	Qualitative coating condition scoring	Qualitative coating condition scoring plus databases of repairs and visual inspections
ILI indications	Uncertain use of data	Uncertain use of data	Used previous ILI indications as direct evidence
Leak history	Uncertain use of data	Uncertain use of data	Used previous leaks
Repair history	Uncertain use of data	Uncertain use of data	Used previous repairs
Spread range	Uncertain use of data	Uncertain use of data	More detailed overland and subsurface spread model

*Where scores are constant across the entire length of the pipeline, it is assumed that the model does not detect differences in the issue and therefore does not assess the issue.

Table 6-12. Overall Impact Frequencies

Case	if…	Average Leak Rate per Mile-Year	Predicted Leak Count for 700 Miles and 50 Years	Impact	Overall Risk: Frequency of Impact over Life of Project	Overall Risk: Annual Frequency (x1000) for Impact	Notes
1	Industry average reportable leak rate applies	0.001	35	Drinking water contamination	0.27	5.35	
				Fatality	0.16	3.21	1
				Injury	0.72	14.42	1
				Recreational water contamination	2.80	55.96	
				Prime agricultural contamination	1.06	21.14	
				Wetlands contamination	1.65	32.92	
2	Pre-mitigation reportable leak rate continues	0.00077	26.8	Drinking water contamination	0.20	4.10	~10 reportables (>50 bbl) over 450 miles in 29 years
				Fatality	0.12	2.46	1
				Injury	0.553	11.05	1
				Recreational water contamination	2.14	42.88	
				Prime agricultural contamination	0.81	16.20	
				Wetlands contamination	1.26	25.22	
3	Pre-mitigation leak rate continues	0.00199	69.7	Drinking water contamination	0.23	4.69	26 leaks (some less than 50 bbl) over 450 miles in 29 years
				Fatality	0.14	2.82	1
				Injury	0.63	12.65	1
				Recreational water contamination	2.45	49.06	
				Prime agricultural contamination	0.93	18.53	
				Wetlands contamination	1.44	28.86	

Notes
1 Fatality and injury rates are based on DOT fatality and injury rates per reportable leak, applied to 700 miles.

Table 6-13. Segment-Specific Impact Frequencies

Case	if…	Average Leak Rate per Mile-Year	Predicted Leak Count for 700 Miles & 50 Years	Impact	Segment-Specific Risk (2500 ft of pipeline) Frequency (x 10^6) of Impact over Life of Project	Segment-Specific Risk (2500 ft of pipeline) Annual Frequency (x 10^6) for Impact	Notes
1	Industry average reportable leak rate applies	0.001	35	Drinking water contamination	181	3.62	
				Fatality	109	2.17	1
				Injury	488	9.76	1
				Recreational water contamination	1893	37.85	
				Prime agricultural contamination	715	14.30	
				Wetlands contamination	1502	30.03	3372 ft, special length for this receptor
2	Pre-mitigation reportable leak rate continues	0.00077	26.8	Drinking water contamination	139	2.77	~10 reportables (>50 bbl) over 450 miles in 29 years
				Fatality	83	1.66	1
				Injury	374	7.48	1
				Recreational water contamination	1450	29.01	
				Prime agricultural contamination	548	10.96	
				Wetlands contamination	1151	23.01	3372 ft, special length for this receptor
3	Pre-mitigation leak rate continues	0.00199	69.7	Drinking water contamination	159	3.17	26 leaks (some less than 50 bbl) over 450 miles in 29 years
				Fatality	95	1.90	1
				Injury	428	8.55	1
				Recreational water contamination	1659	33.18	
				Prime agricultural contamination	48.9	0.98	
				Wetlands contamination	1316	26.33	3372 ft. special length for this receptor

Notes

1 Fatality and injury rates are based on DOT fatality and injury rates per reportable leak, applied to 700 miles.

Table 6-14. Overall Impact Probabilities for Case 3

Case	If…	Average Leak Rate per Mile-Year	Estimated Leak Count for 700 Miles and 50 Years	Overall Impact Probability*		Annual Probability of One or More Impacts over Life of Project	Probability Chances in a Thousand	Annual Chances in a Thousand	Notes
				Impact	Probability of One or More Impacts over Life of Project				
3	Pre-mitigation leak rate estimate	0.00199 [1]	69.7	Drinking water contamination	20.9 percent	0.47%	209	4.68	
				Fatality	13.1%	0.28%	131	2.81	2
				Injury	46.9%	1.26%	469	12.6	2
				Recreational water contamination	91.4%	4.79%	914	47.9	
				Prime agricultural land contamination	60.4%	1.8%	604	18.36	
				Wetlands contamination	76.4%	2.84%	764	28.4	

* Overall impact probability is probability of one or more events in 50 years over 700 miles
* Overall impact probability, annual, is probability of one or more events in 1 year over 700 miles
Notes:
1 26 leaks (some less than 50 bbl) over 450 miles in 29 years
2 Fatality and injury rates are based on DOT fatality and injury rates per reportable leak, applied to 700 miles

Table 6-15. Segment-specific Impact Probabilities for Cases 3

Case	If…	Average Leak Rate per Mile-Year	Estimated Leak Count for 700 Miles and 50 Years	Impact Probability for Specific Locations*		Annual probability of one or More Impacts over Life of Project	Probability Chances in a Million	Annual Chances in a Million	Notes
				Impact	Probability of One or More Impacts over Life of Project				
3	Pre-mitigation leak rate estimate	0.00199 [1]	69.7	Drinking water contamination	0.0159%	0.000317%	159	3.17	
				Fatality	0.0095%	0.000190%	95	1.90	2
				Injury	0.0428%	0.000855%	428	8.55	2
				Recreational water contamination	0.166%	0.00332%	1658	33.2	
				Prime agricultural land contamination	0.0627%	0.001254%	627	12.54	
				Wetlands contamination	0.132%	0.00263%	1315	26.3	

* Impact probability for specific locations is probability of one or more events in 50 years per 2,500 ft
* Impact probability for specific locations, annual, is probability of one or more events in 1 year per 2,500 ft

Notes:

1 26 leaks (some less than 50 bbl) over 450 miles in 29 years

2 Fatality and injury rates are based on DOT fatality and injury rates per reportable leak, applied to 700 miles

Table 6-16. Average Frequency and Probability of Pipeline Spills for Whole Line, Pre-mitigation, by Spill Size Range

Spill Size Range (bbl)	Historical EPC No. of Spills	DOT/EPC Data Basis % of Spills in Size Range	Whole Line Frequency (spills/year)	Estimated Avg. Whole Line Probability of One or More Spills (DOT/EPC Basis)	
				1 Year	50 Years
5,000 or greater	1	1.54	2.22E-02	2.19E-02	6.70E-01
1500 - 4999	2	5.46	7.86E-02	7.56E-02	9.80E-01
500 - 1499	4	10.12	1.46E-01	1.36E-01	9.99E-01
50 - 499	3	26.84	3.87E-01	3.21E-01	1.00E+00
Less than 50	16	56.00	8.07E-01	5.54E-01	1.00E+00

Table 6-17. Average Frequency and Probability of Pump Station Spills for Whole Line, Pre-mitigation, by Spill Size Range

Spill Size Range (bbl)	Historical EPC No. of Spills	Historical EPC Pump Station Spill Distribution, %	Whole Line Frequency, Spills/Year (18 stations)	Estimated Avg. Whole Line Probability of One or More Spills (DOT/EPC Basis)	
				1 Year	50 Years
5000 or greater	3	2.04	2.33E-01	2.08E-01	1.00E+00
1500 - 4999	4	2.72	3.10E-01	2.67E-01	1.00E+00
500 - 1499	7	4.76	5.43E-01	4.19E-01	1.00E+00
50 - 499	34	23.13	2.64E+00	9.28E-01	1.00E+00
Less than 50	99	67.35	7.68E+00	1.00E+00	1.00E+00
Total	147	100.00	1.14E+01	1.00E+00	1.00E+00

Table 6-18. Summary of Common Individual Risks

Event	Chance for One Individual in a 50-Year Period *	Source/Basis of Estimate
Motor vehicle deaths	1 in 123	Accident Facts, 1997, p.78. Estimated based on reported death rate of 16.3 deaths/year per 100,000 persons for 1996.
Motor vehicle injuries	1 in 2	Accident Facts, 1997, p.78. Estimated based on reported total injuries of 2,600,000 for 1996 and a 1996 US population of 265,229,000 persons. Assumes total population exposed each year and constant population.
Pedestrian deaths (by motor vehicle accident)	1 in 870	Accident Facts, 1997, p.100. Estimated based on reported total deaths of 6,100 for 1996 and a 1996 US population of 265,229,000 persons. Assumes the entire population has the potential to be a pedestrian.
Falling deaths (public places)	1 in 1,000	Accident Facts, 1997, p.100. Estimated based on 5,300 reported deaths for 1996 and a 1996 US population of 265,229,000 persons. Excludes fall-related deaths at home and work.
Falling deaths (all locations)	1 in 380	Accident Facts, 1997, p.8. Estimated based on 1996 death rate of 5.3 deaths/year per 100,000 population. Includes unintentional fall related deaths in all locations (public, home and work).
Deaths from firearms in public places	1 in 10,600	Accident Facts, 1997, p.117. Estimated based on 500 reported deaths for 1996 and a 1996 US population of 265,229,000 persons. Excludes firearm-related deaths at home and work. Unintentional deaths only, homicides/ suicides excluded.
Recreational boating deaths	1 in 1,840	Based on report from National Association of State Boating Law Administrators (NASBLA). Factors Related to Recreational Boating Participation in the United States: A Review of the Literature. August 17, 2000. Pp. 5 and 62. 815 total deaths in 1998. Recreational boating participants of 74,847,000 in 1998 (approx. 29 percent of the total US population).
Tornado deaths (1999, states with reported tornado deaths)	1 in 16,600	National Climatic Data Center web site. Based on tornado data from 1999. 94 tornado deaths in 13 states. Total population of these 13 states of 78,000,000 (29 percent of the US population) was taken from the US Census Bureau web site for 1999.
Tornado deaths (1999, entire US)	1 in 58,000	National Climatic Data Center web site. Tornado data from 1999. 94 tornado deaths in 13 states. Total US population of 272,690,813 was taken from the US Census Bureau web site for 1999.

Table 6-18. Summary of Common Individual Risks (Continued)

Event	Chance for One Individual in a 50-Year Period *	Source/Basis of Estimate
Lightning deaths	1 in 119,000	National Climatic Data Center web site. Based on 46 lightning deaths in 1999. 1999 US population taken from Census Bureau (272,690,813).
Cancer deaths	1 in 10	American Cancer Society. Statistics taken from web site. Expected cancer deaths rate in 1999 of 563,100. Risk based on total 1999 US population.
Cancer deaths in males	1 in 9	American Cancer Society. Cancer Facts and Figures – 1997 from the ACS web site. Male: 219 deaths/year per 100,000 population.
Cancer deaths in females	1 in 14	American Cancer Society. Cancer Facts and Figures – 1997 from the ACS web site. Female: 142 deaths/year per 100,000 population.

* Chance for one individual in a 50-year period was calculated by multiplying the risk in one year by 50. For example, if the risk is one death/year per 100,000 population, then the risk for 50 years is 50 times the one-year risk or 50 deaths per 100,000 population (i.e., 1 in 2000 chance over a 50-year period).