County of Los Angeles Department of Public Works

Analysis of 85th Percentile 24-hour Rainfall Depth Analysis Within the County of Los Angeles

Water Resources Division
Hydrology Section

February 2004

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Introduction

Rainfall within the County of Los Angeles varies spatially. The Los Angeles Regional Water Quality Control Board (RWQCB) agreed to use a spatially distributed statistical rainfall distribution for water quality studies. The RWQCB allows the use of 85th percentile 24-hour rainfall event or the 0.75-inch event for Standard Urban Storm Water Mitigation Plan (SUSMP) and Best Management Practices (BMP) design hydrologic studies.

The 85th percentile 24-hour rainfall depths vary from 0.30 to 1.50 inches within the County of Los Angeles. This report provides the analysis used to determine the spatial distribution of the 85th percentile 24-hour rainfall within the County of Los Angeles.

Analysis

The County of Los Angeles Department of Public Works maintains an extensive network of rain gages throughout the county. The 85th percentile 24-hour rainfall spatial distribution analysis required selection of gages to represent rainfall throughout the county. The analysis began with the selection of ninety-nine rain gages. Rain gage selection was based on spatial distribution and rainfall record length. Historic precipitation data includes 40 to 80 years of rainfall at most of the selected gages. Most rain gages in the Antelope Valley had approximately 15 years of historic record available for analysis.

Percentile Analysis

Percentile analysis determines a data value for a specified percentage. For example, if the 85th percentile rainfall depth is analyzed and a value of 1.00 inches is determined, 85 percent of all rainfall events produce 1.00 inch or less of precipitation. The analysis includes 24-hour periods with measurable rainfall and excludes all other 24-hour periods. The analysis provided the average 24-hour rainfall, the 50th, 75th, 85th, 90th, 95th, and 99th percentile 24-hour rainfall depth at each rain gage. The average rainfall represents the sum of all 24-hour rainfall depths divided by the number of records. Appendix A provides the percentile analysis for each rain gage.

Statistical Analysis

A statistical analysis of the data sample confirmed the validity of the percentile analysis. Each data sample was broken into groups of 0.50-inch depths and plotted as a histogram. The probability of occurrence for each 0.50-inch group was determined. Plotting the cumulative probability for the groups resulted in values very similar to the percentile analysis values. The 85th percentile 24-hour rainfall depths ranged from 0.50 to 1.5 inches for the various gages distributed throughout the County. Appendix B shows the histogram, the probability distribution tables, and cumulative distribution chart for the ninety-nine gages analyzed.

Mapping 85th Percentile 24-hour Isohyets

A Geographic Information System (GIS) shape file was created using latitude and longitude coordinates for each rain gage. The GIS shape file also contained the data associated with the 24-hour rainfall analysis. The Spatial Analyst program extension was used with ArcView to create a rainfall grid based on the 85th percentile data for each gage. Contours were created from the grid file to represent the 85th percentile rainfall depth throughout the County of Los Angeles. These isohyets were compared to the NOAA 2-year 24-hour isohyets. The NOAA 2-year 24-hour isohyets reflect topographic influences on spatial rainfall patterns within the County of Los Angeles. The isohyets were also compared to county topography. Rain gages that caused anomalies in the isohyets were discarded. The final isohyetal map used ninety rain gages. The nine discarded gages had small data sets.

A new grid and isohyetal contours were produced after discarding the nine gages. The contours were again compared to the NOAA contours and topographic features in the county. In the County of Los Angeles, areas of higher elevation generally receive more rainfall due to changes in pressure and temperature. The isohyetal map of the 85th percentile 24-hour storm shows this orographic affect. Higher rainfall occurs over the mountains and hills.

Two dummy rain gages added near the county border keep the isohyetal distribution consistent with topography. Accurate portrayal of the isohyets along the Malibu Coast and in the Antelope Valley requires the dummy gages.

Appendix C contains the 85th percentile 24-hour isohyetal map, a map of the rain gage locations, and a description of the settings and process used to create the rainfall grid and contour lines in ArcView. This report also contains an electronic copy of all the data used for the 85th percentile 24-hour rainfall depth analysis.

Appendices

Appendix A

Summary of 24-hour Rain Gage Data

Summary of Rain Gage Data

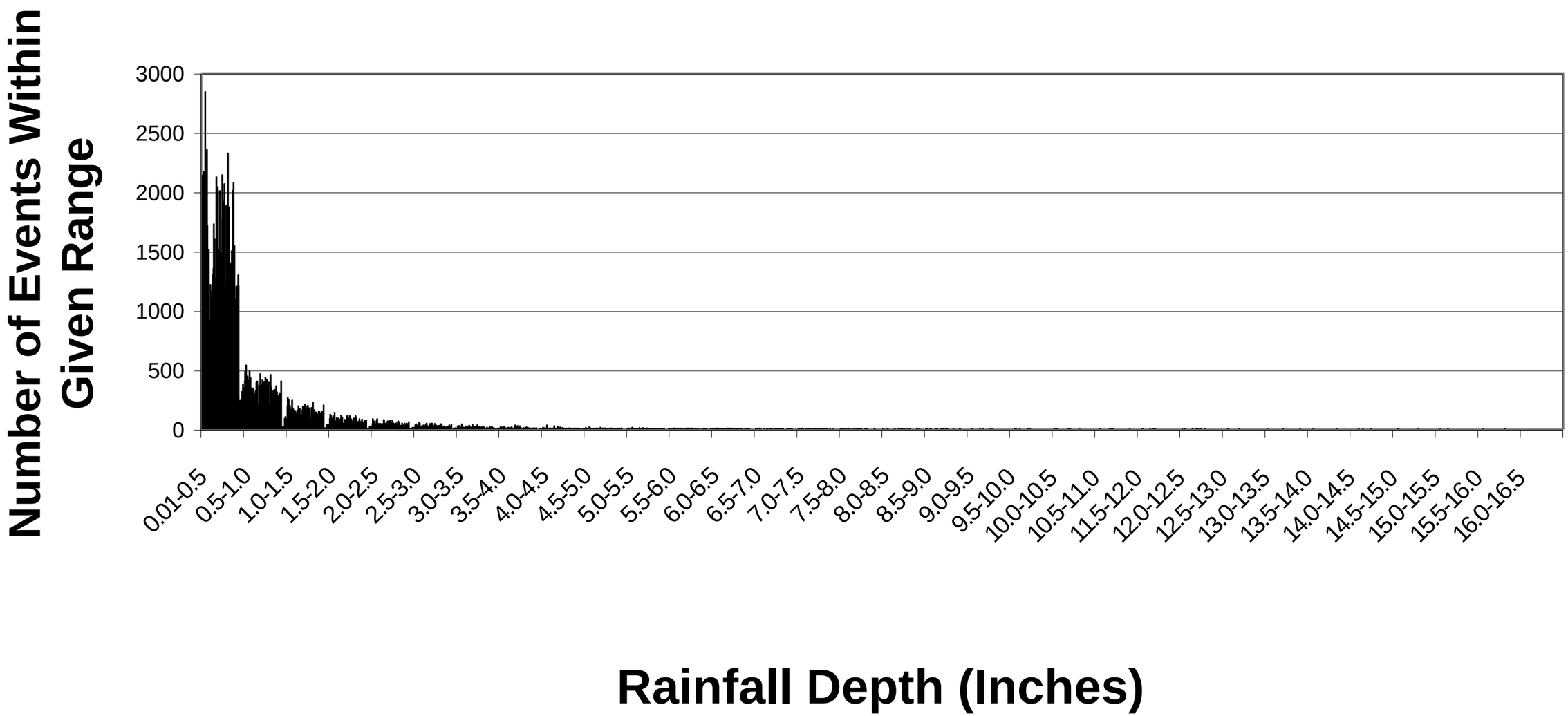
24-hour Rainfall Total								
Gage No.	**Gage Name**	**Mean**	**50th Percentile**	**75th Percentile**	**85th Percentile**	**90th Percentile**	**95th Percentile**	**99th Percentile**
5	Calabasas	0.57	0.24	0.74	1.10	1.41	2.07	4.23
6	Topanga Canyon Patrol Station	0.54	0.20	0.69	1.11	1.44	2.10	4.05
13	North Hollywood - Lakeside	0.53	0.23	0.66	1.06	1.40	2.02	3.69
17	Sepulveda Canyon at Mulholland Hwy.	0.44	0.24	0.77	1.26	1.64	2.31	4.31
23	Chatsworth Reservoir	0.47	0.20	0.60	0.94	1.23	1.82	3.34
43	Palos Verdes Estates	0.26	0.13	0.34	0.52	0.67	0.94	1.67
44	Point Vicente Lighthouse	0.28	0.10	0.34	0.55	0.75	1.07	2.00
53	Colby's Sleepy Hollow Ranch	0.70	0.26	0.80	1.36	1.85	2.74	5.63
63	Santa Anita Dam	0.55	0.20	0.69	1.12	1.53	2.20	4.16
82	Table Mountain	0.51	0.23	0.57	0.96	1.26	1.91	4.11
107	Downey Fire Station	0.50	0.28	0.66	0.97	1.25	1.77	3.00
120	Vincent Patrol Station	0.30	0.16	0.39	0.60	0.79	1.13	1.67
125	San Francisquito Canyon Power House #1	0.44	0.20	0.59	0.91	1.20	1.69	3.02
128	Elizabeth Lake - Warm Springs Camp	0.66	0.34	0.90	1.35	1.63	2.32	4.16
156	La Mirada - Standard Oil Company	0.43	0.17	0.45	0.72	0.95	1.43	2.84
172	Duarte	0.66	0.35	0.88	1.32	1.67	2.34	3.77
176	Altadena - Rubio Canyon	0.60	0.25	0.76	1.20	1.61	2.28	3.95
201	Puente Hills - Alta Mira Ranch	0.58	0.30	0.78	1.12	1.40	2.03	3.38
223	Big Dalton	0.50	0.14	0.59	1.00	1.38	2.11	3.82
225	Montana Ranch - Lakewood	0.44	0.24	0.60	0.88	1.10	1.57	2.69
227	San Gabriel - Bruington - Orton	0.56	0.27	0.75	1.15	1.45	2.03	3.58
237	Stone Canyon Reservoir	0.58	0.22	0.77	1.20	1.66	2.35	3.95
238	Hollywood Dam	0.48	0.21	0.63	0.96	1.27	1.92	2.93
277	Sawmill Mountain	0.65	0.27	0.89	1.38	1.77	2.32	4.39
283	Crystal Lake East Pine Flat	0.70	0.24	0.77	1.32	1.90	2.89	5.89
291	Los Angeles 96th and Central	0.49	0.30	0.65	0.92	1.18	1.60	2.96
293	Lake Los Angeles	0.49	0.23	0.69	1.01	1.31	1.87	3.10
298	Gorman Sherriff Station	0.39	0.12	0.37	0.60	0.82	1.25	2.29
299	Little Rock - Schwab	0.29	0.09	0.29	0.48	0.65	0.95	1.65
304	Sawpit Canyon - Deer Park	0.60	0.19	0.73	1.20	1.76	2.45	4.88
306	Zuma Beach	0.31	0.16	0.40	0.60	0.78	1.10	2.07
322	Munz Valley Ranch	0.47	0.26	0.60	0.90	1.15	1.67	2.99
334	Cogswell Dam	0.77	0.22	0.86	1.52	2.23	3.41	6.27
356	Spadra Pacific Colony	0.49	0.25	0.62	0.98	1.27	1.78	3.01
372	San Francisquito Canyon Power House #2	0.45	0.21	0.60	0.90	1.15	1.68	3.00
373	Brigg's Terrace - Pickens Canyon	0.65	0.16	0.63	1.13	1.56	2.33	4.20
379	San Gabriel Canyon East Fork	0.65	0.23	0.76	1.30	1.70	2.60	5.18
390	Morris Dam	0.55	0.19	0.67	1.12	1.52	2.26	4.31
391	Montebello Fire Department	0.51	0.17	0.54	0.87	1.13	1.56	3.05
405	Soledad Canyon	0.48	0.20	0.56	0.90	1.18	1.73	3.20
406	West Azusa	0.51	0.26	0.68	1.03	1.36	1.85	2.93
409	Pyramid Reservoir	0.54	0.17	0.63	1.07	1.50	2.29	4.41
425	San Gabriel Dam	0.63	0.20	0.75	1.28	1.79	2.61	4.83
434	Agoura	0.41	0.13	0.44	0.75	1.03	1.58	3.46
435	Monte Nido	0.47	0.20	0.60	0.96	1.28	1.79	3.46
438	Los Angeles-University of Southern Cal	0.60	0.32	0.75	1.10	1.43	2.05	4.22
443	Latigo Canyon - Beach Ranch	0.47	0.16	0.57	0.95	1.33	1.96	3.66
446	Aliso Canyon - Oat Mountain	0.57	0.27	0.74	1.13	1.45	2.10	3.57
447	Carbon Canyon	0.35	0.17	0.46	0.70	0.89	1.26	2.19
455	Lancaster State Highway Maintenance De	0.32	0.16	0.38	0.59	0.79	1.18	2.08
458	Zuma Canyon Patrol Station	0.48	0.22	0.60	0.90	1.20	1.80	3.17
491	Pacific Palisades	0.40	0.27	0.60	0.85	1.05	1.41	2.24
492	Chilao - State Highway Maintenance Sta	0.66	0.28	0.76	1.30	1.73	2.54	4.94
497	Claremont - Slaughter	0.47	0.21	0.61	0.96	1.27	1.85	3.07
517	Anderson Ranch	0.50	0.18	0.56	0.98	1.35	2.08	3.84
564	Llano	0.31	0.18	0.40	0.61	0.78	1.01	1.75
598	Neenach	0.36	0.14	0.45	0.69	0.93	1.35	2.75
610	Pasadena City Hall	0.48	0.18	0.60	1.00	1.35	2.00	3.54
619	San Antonio Canyon - Sierra Power Hous	0.44	0.11	0.40	0.70	1.00	1.71	4.29
627	San Gabriel Canyon Power House	0.48	0.17	0.59	1.00	1.37	2.04	3.56
634	Santa Monica	0.50	0.25	0.67	1.02	1.32	1.78	3.08
694	Big Tujunga Camp 15	0.58	0.29	0.71	1.10	1.50	2.05	4.29
716	Ducommons Street	0.47	0.24	0.62	0.94	1.24	1.74	3.33
735	Bell Canyon - Platt Ranch	0.37	0.13	0.43	0.74	0.98	1.55	2.99
750	Palmdale F.A.A. Airport	0.24	0.12	0.30	0.48	0.61	0.90	1.54
795	Pasadena - Jourdan	0.49	0.19	0.63	1.02	1.41	2.00	3.44
807	Ascot Reservoir	0.48	0.23	0.63	0.98	1.30	1.80	3.10
1006	San Pedro City Reservoir	0.27	0.14	0.36	0.53	0.69	1.02	1.60
1025	Malibu Beach - Dunne	0.33	0.16	0.43	0.64	0.84	1.17	2.20
1041	Santa Fe	0.53	0.27	0.71	1.09	1.40	1.93	3.18
1050	Old Topanga Canyon	0.50	0.18	0.60	1.01	1.38	2.04	3.67
1051	Canoga Park - Pierce College	0.50	0.20	0.65	1.00	1.33	1.95	3.56
1070	Manhattan Beach	0.41	0.22	0.54	0.82	1.05	1.39	2.39
1072	Little Tujunga Ranger Station	0.57	0.31	0.77	1.10	1.39	1.95	3.56
1074	Little Gleason	0.69	0.31	0.79	1.28	1.71	2.59	5.91
1081	Glendale - Gregg	0.55	0.24	0.71	1.11	1.45	2.09	3.79
1088	La Habra Heights - Mutual Water Co.	0.52	0.28	0.68	1.05	1.32	1.94	3.12
1107	La Tuna Debris Basin	0.55	0.30	0.70	1.07	1.40	1.89	3.49
1113	Dominguez Water Company	0.35	0.15	0.42	0.73	0.95	1.42	2.63
1242	Rocky Buttes Indian Museum	0.14	0.05	0.16	0.24	0.32	0.50	0.97
1243	Redman	0.26	0.10	0.29	0.44	0.60	0.88	2.65
1244	Lancaster - Roper	0.15	0.04	0.16	0.27	0.41	0.55	1.47
1246	Scott Ranch	0.14	0.08	0.20	0.40	0.60	0.96	1.51
1247	North Lancaster	0.13	0.04	0.12	0.24	0.32	0.50	0.80
1248	Mescal - Smith	0.22	0.08	0.20	0.36	0.60	1.20	2.32
1252	Palos Verdes Landfill	0.55	0.31	0.73	1.09	1.49	2.01	3.20
1253	Carson - County Sanitation	0.44	0.20	0.55	0.89	1.22	1.65	2.47
1259	Whittier Narrows Reclamation Plant	0.49	0.26	0.60	0.90	1.25	1.80	3.01
1262	Saugus Reclamation Plant	0.51	0.28	0.62	0.94	1.29	1.81	3.49
1263	Valencia Reclamation Plant	0.49	0.28	0.62	1.01	1.31	1.80	2.78
	Discarded Gages							
1248	Mescal - Smith	0.22	0.08	0.20	0.36	0.60	1.20	2.32
1249	Relay	0.32	0.08	0.20	0.30	0.46	0.60	1.15
1252	Palos Verdes Landfill	0.55	0.31	0.73	1.09	1.49	2.01	3.20
1253	Carson - County Sanitation	0.44	0.20	0.55	0.89	1.22	1.65	2.47
1259	Whittier Narrows Reclamation Plant	0.49	0.26	0.60	0.90	1.25	1.80	3.01
1262	Saugus Reclamation Plant	0.51	0.28	0.62	0.94	1.29	1.81	3.49
1263	Valencia Reclamation Plant	0.49	0.28	0.62	1.01	1.31	1.80	2.78

File: Final Gages Used for Rainfall Isohyet Analysis-85th Percentile-24hr Depth.xls
Worksheet: Gage Summary
Date: 03/16/2004

Appendix B

Statistical Analysis

24-hr Rainfall Depth Histogram



File: Probability Analysis of 85th Percentile 24-hr Rainfall.xls
Worksheet: Histogram
Date: 03/16/2004

Probability that Rainfall Depth will Occur in a Given Range

Rainfall Depth Inches / Gage #	5	6	10	13	17	23	25	43	44	53	57	63	82	107	120	125	128	156	172	176	201	223	225	227	237	238
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.01-0.5	0.660	0.666	0.674	0.670	0.652	0.710	0.722	0.831	0.816	0.643	0.586	0.685	0.715	0.659	0.806	0.708	0.577	0.767	0.581	0.632	0.611	0.715	0.698	0.649	0.647	0.688
0.5-1.0	0.168	0.151	0.162	0.166	0.148	0.151	0.151	0.120	0.120	0.146	0.146	0.142	0.141	0.195	0.127	0.159	0.194	0.137	0.197	0.179	0.199	0.133	0.178	0.168	0.163	0.169
1.0-1.5	0.081	0.082	0.069	0.076	0.081	0.065	0.067	0.032	0.038	0.076	0.075	0.070	0.068	0.079	0.051	0.069	0.100	0.048	0.098	0.073	0.097	0.060	0.069	0.088	0.074	0.071
1.5-2.0	0.037	0.038	0.034	0.035	0.050	0.032	0.028	0.011	0.014	0.046	0.051	0.040	0.030	0.029	0.007	0.029	0.061	0.022	0.056	0.047	0.041	0.034	0.027	0.043	0.047	0.024
2.0-2.5	0.019	0.027	0.024	0.021	0.023	0.017	0.013	0.003	0.006	0.029	0.035	0.025	0.016	0.020	0.005	0.018	0.029	0.011	0.026	0.024	0.022	0.022	0.015	0.022	0.023	0.023
2.5-3.0	0.010	0.011	0.017	0.012	0.014	0.011	0.010	0.001	0.002	0.017	0.026	0.014	0.010	0.007	0.001	0.007	0.016	0.008	0.013	0.017	0.012	0.011	0.006	0.015	0.019	0.015
3.0-3.5	0.010	0.007	0.004	0.009	0.010	0.006	0.003	0.001	0.001	0.011	0.019	0.007	0.007	0.005	0.002	0.004	0.008	0.002	0.011	0.012	0.008	0.009	0.004	0.003	0.012	0.004
3.5-4.0	0.004	0.006	0.006	0.003	0.007	0.003	0.002	0.000	0.001	0.010	0.010	0.005	0.003	0.003	0.000	0.002	0.004	0.002	0.008	0.006	0.006	0.008	0.001	0.006	0.006	0.002
4.0-4.5	0.003	0.004	0.002	0.003	0.005	0.002	0.002	0.000	0.000	0.003	0.015	0.003	0.001	0.001	0.000	0.002	0.004	0.001	0.004	0.003	0.001	0.003	0.001	0.003	0.004	0.003
4.5-5.0	0.002	0.004	0.002	0.002	0.002	0.001	0.001	0.000	0.000	0.004	0.009	0.002	0.003	0.000	0.000	0.001	0.001	0.002	0.002	0.003	0.001	0.000	0.001	0.001	0.002	0.001
5.0-5.5	0.002	0.001	0.002	0.001	0.002	0.000	0.001	0.000	0.000	0.002	0.006	0.002	0.002	0.001	0.000	0.000	0.002	0.000	0.001	0.001	0.001	0.001	0.000	0.001	0.002	0.000
5.5-6.0	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.003	0.004	0.001	0.000	0.000	0.000	0.000	0.003	0.000	0.001	0.001	0.000	0.000	0.000	0.001	0.002	0.000
6.0-6.5	0.000	0.001	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.002	0.003	0.001	0.000	0.000	0.000	0.000	0.002	0.000	0.001	0.001	0.000	0.001	0.000	0.000	0.001	0.000
6.5-7.0	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
7.0-7.5	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.002	0.002	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.001	0.000	0.000
7.5-8.0	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000
8.0-8.5	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.5-9.0	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
9.0-9.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.5-10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
10.0-10.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.5-11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.5-12.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0-12.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.5-13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0-13.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.5-14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0-14.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.5-15.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0-15.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.5-16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

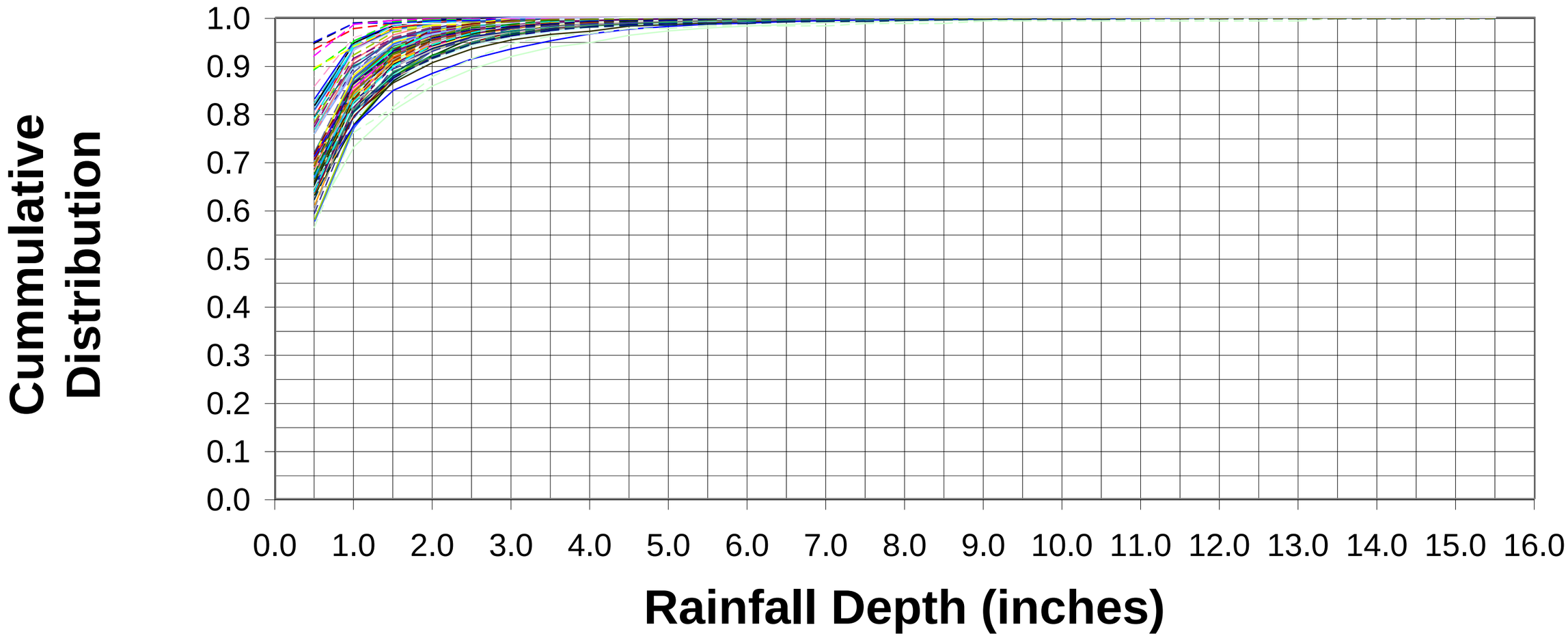
Rainfall Depth Inches / Gage #	277	283	291	293	298	299	304	306	322	334	352	356	372	373	379	390	391	405	406	409	425	434	435	438	443	446
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.01-0.5	0.631	0.651	0.660	0.675	0.760	0.818	0.669	0.796	0.689	0.655	0.717	0.689	0.702	0.638	0.660	0.685	0.659	0.705	0.665	0.692	0.658	0.761	0.693	0.618	0.697	0.637
0.5-1.0	0.147	0.148	0.206	0.170	0.137	0.130	0.130	0.137	0.178	0.121	0.164	0.165	0.165	0.157	0.145	0.141	0.185	0.161	0.176	0.139	0.147	0.127	0.157	0.211	0.145	0.176
1.0-1.5	0.091	0.066	0.075	0.071	0.058	0.035	0.074	0.045	0.068	0.072	0.066	0.073	0.066	0.079	0.073	0.071	0.085	0.061	0.076	0.068	0.070	0.057	0.072	0.077	0.066	0.090
1.5-2.0	0.053	0.042	0.026	0.041	0.023	0.010	0.040	0.010	0.031	0.036	0.024	0.035	0.033	0.043	0.044	0.039	0.032	0.035	0.040	0.032	0.042	0.023	0.033	0.040	0.038	0.041
2.0-2.5	0.036	0.028	0.013	0.020	0.014	0.004	0.037	0.006	0.016	0.030	0.014	0.015	0.017	0.031	0.023	0.024	0.016	0.016	0.023	0.026	0.028	0.013	0.019	0.018	0.021	0.022
2.5-3.0	0.013	0.018	0.009	0.011	0.002	0.001	0.014	0.004	0.008	0.021	0.006	0.012	0.007	0.020	0.020	0.012	0.009	0.007	0.010	0.012	0.017	0.005	0.010	0.009	0.014	0.014
3.0-3.5	0.011	0.012	0.008	0.007	0.003	0.001	0.011	0.001	0.005	0.017	0.003	0.005	0.005	0.008	0.010	0.006	0.007	0.006	0.004	0.010	0.013	0.006	0.007	0.012	0.006	0.010
3.5-4.0	0.006	0.006	0.001	0.002	0.001	0.001	0.006	0.000	0.004	0.014	0.002	0.001	0.005	0.009	0.008	0.010	0.004	0.002	0.003	0.007	0.009	0.001	0.003	0.004	0.004	0.003
4.0-4.5	0.004	0.011	0.000	0.001	0.001	0.000	0.005	0.000	0.001	0.009	0.001	0.003	0.002	0.003	0.004	0.005	0.001	0.003	0.001	0.004	0.004	0.001	0.003	0.004	0.002	0.003
4.5-5.0	0.003	0.003	0.001	0.000	0.001	0.001	0.004	0.000	0.001	0.006	0.000	0.001	0.001	0.003	0.004	0.002	0.001	0.001	0.001	0.003	0.003	0.002	0.001	0.002	0.001	0.002
5.0-5.5	0.002	0.004	0.001	0.001	0.001	0.000	0.002	0.000	0.000	0.005	0.001	0.000	0.000	0.001	0.002	0.001	0.000	0.001	0.000	0.004	0.001	0.002	0.000	0.002	0.001	0.002
5.5-6.0	0.002	0.002	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.002	0.000	0.000	0.000	0.002	0.002	0.002	0.000	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.003	0.001
6.0-6.5	0.000	0.001	0.000	0.000	0.001	0.000	0.002	0.000	0.000	0.003	0.000	0.000	0.000	0.002	0.002	0.000	0.001	0.002	0.000	0.001	0.002	0.001	0.000	0.000	0.000	0.000
6.5-7.0	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.001	0.000	0.001
7.0-7.5	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001
7.5-8.0	0.000	0.001	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.001	0.000	0.000
8.0-8.5	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
8.5-9.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
9.0-9.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
9.5-10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
10.0-10.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.5-11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.5-12.0	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0-12.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.5-13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0-13.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.5-14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0-14.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.5-15.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0-15.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.5-16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Probability that Rainfall Depth will Occur in a Given Range

Rainfall Depth Inches / Gage #	447	455	491	492	497	517	564	598	610	619	627	634	694	695	716	735	750	795	807	1005	1006	1025	1041	1050	1051	1070
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.5-1.0	0.759	0.809	0.782	0.644	0.708	0.697	0.794	0.776	0.708	0.797	0.715	0.671	0.648	0.566	0.699	0.762	0.860	0.692	0.683	0.673	0.826	0.785	0.661	0.700	0.693	0.721
1.0-1.5	0.153	0.123	0.151	0.166	0.148	0.144	0.146	0.140	0.140	0.104	0.134	0.169	0.170	0.196	0.161	0.133	0.100	0.154	0.168	0.200	0.118	0.137	0.165	0.141	0.155	0.165
1.5-2.0	0.051	0.042	0.038	0.066	0.067	0.066	0.046	0.042	0.068	0.036	0.062	0.085	0.080	0.053	0.072	0.049	0.027	0.064	0.070	0.072	0.040	0.048	0.087	0.068	0.070	0.074
2.0-2.5	0.022	0.012	0.012	0.044	0.034	0.037	0.007	0.012	0.034	0.020	0.035	0.035	0.046	0.063	0.032	0.022	0.010	0.039	0.037	0.028	0.011	0.014	0.039	0.037	0.033	0.022
2.5-3.0	0.007	0.006	0.011	0.029	0.020	0.020	0.001	0.014	0.020	0.008	0.023	0.022	0.026	0.037	0.015	0.014	0.002	0.023	0.023	0.015	0.002	0.008	0.021	0.022	0.019	0.009
3.0-3.5	0.004	0.003	0.005	0.016	0.011	0.015	0.003	0.007	0.013	0.009	0.015	0.007	0.008	0.032	0.011	0.008	0.002	0.011	0.007	0.008	0.001	0.002	0.012	0.010	0.009	0.005
3.5-4.0	0.003	0.003	0.000	0.011	0.007	0.006	0.000	0.005	0.006	0.009	0.005	0.004	0.003	0.016	0.004	0.004	0.000	0.007	0.005	0.001	0.000	0.002	0.006	0.009	0.009	0.002
4.0-4.5	0.001	0.000	0.000	0.008	0.002	0.006	0.001	0.002	0.004	0.004	0.006	0.002	0.004	0.005	0.006	0.005	0.000	0.004	0.005	0.003	0.000	0.001	0.003	0.004	0.004	0.001
4.5-5.0	0.000	0.001	0.000	0.005	0.001	0.001	0.001	0.001	0.002	0.004	0.003	0.002	0.005	0.011	0.003	0.001	0.000	0.002	0.002	0.000	0.000	0.000	0.004	0.002	0.002	0.000
5.0-5.5	0.000	0.000	0.001	0.002	0.000	0.002	0.000	0.000	0.002	0.001	0.002	0.002	0.002	0.000	0.001	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.001	0.003	0.002	0.001
5.5-6.0	0.000	0.000	0.000	0.003	0.001	0.001	0.000	0.001	0.000	0.002	0.000	0.001	0.000	0.005	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.000
6.0-6.5	0.000	0.000	0.000	0.002	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
6.5-7.0	0.000	0.001	0.000	0.001	0.000	0.002	0.000	0.000	0.001	0.003	0.000	0.000	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000
7.0-7.5	0.000	0.000	0.000	0.002	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000
7.5-8.0	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0-8.5	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.5-9.0	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0-9.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.5-10.0	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0-10.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.5-11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.5-12.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0-12.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.5-13.0	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0-13.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.5-14.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0-14.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.5-15.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0-15.5	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.5-16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Rainfall Depth Inches / Gage #	1072	1074	1076	1081	1088	1107	1113	1217	1242	1243	1244	1246	1247	1248	1249	1252	1253	1259	1262	1263
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.5-1.0	0.604	0.624	0.644	0.656	0.661	0.642	0.783	0.595	0.947	0.877	0.935	0.893	0.950	0.896	0.921	0.641	0.720	0.677	0.695	0.696
1.0-1.5	0.207	0.181	0.165	0.167	0.174	0.187	0.122	0.199	0.043	0.084	0.043	0.059	0.040	0.044	0.066	0.184	0.144	0.187	0.167	0.149
1.5-2.0	0.101	0.075	0.080	0.080	0.090	0.081	0.053	0.100	0.005	0.026	0.011	0.041	0.000	0.037	0.008	0.076	0.068	0.063	0.069	0.078
2.0-2.5	0.039	0.036	0.032	0.040	0.030	0.046	0.024	0.037	0.005	0.000	0.011	0.004	0.005	0.007	0.004	0.045	0.046	0.032	0.028	0.038
2.5-3.0	0.021	0.031	0.029	0.025	0.018	0.017	0.007	0.030	0.000	0.000	0.000	0.004	0.000	0.004	0.000	0.024	0.011	0.022	0.018	0.022
3.0-3.5	0.011	0.021	0.021	0.012	0.016	0.012	0.004	0.018	0.000	0.000	0.000	0.000	0.005	0.011	0.000	0.018	0.007	0.007	0.006	0.010
3.5-4.0	0.005	0.010	0.011	0.008	0.005	0.004	0.003	0.005	0.000	0.009	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.009	0.006	0.004
4.0-4.5	0.006	0.004	0.004	0.004	0.005	0.002	0.002	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.006	0.000
4.5-5.0	0.001	0.003	0.004	0.002	0.002	0.005	0.001	0.002	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.002	0.002	0.000
5.0-5.5	0.001	0.001	0.002	0.003	0.000	0.002	0.001	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
5.5-6.0	0.002	0.002	0.002	0.001	0.000	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000
6.0-6.5	0.000	0.001	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.002	0.000
6.5-7.0	0.001	0.003	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.0-7.5	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7.5-8.0	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.0-8.5	0.000	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8.5-9.0	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.0-9.5	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9.5-10.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.0-10.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10.5-11.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11.5-12.0	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.0-12.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12.5-13.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.0-13.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13.5-14.0	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.0-14.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14.5-15.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.0-15.5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15.5-16.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

24-hour Rainfall Depth - Cumulative Distribution

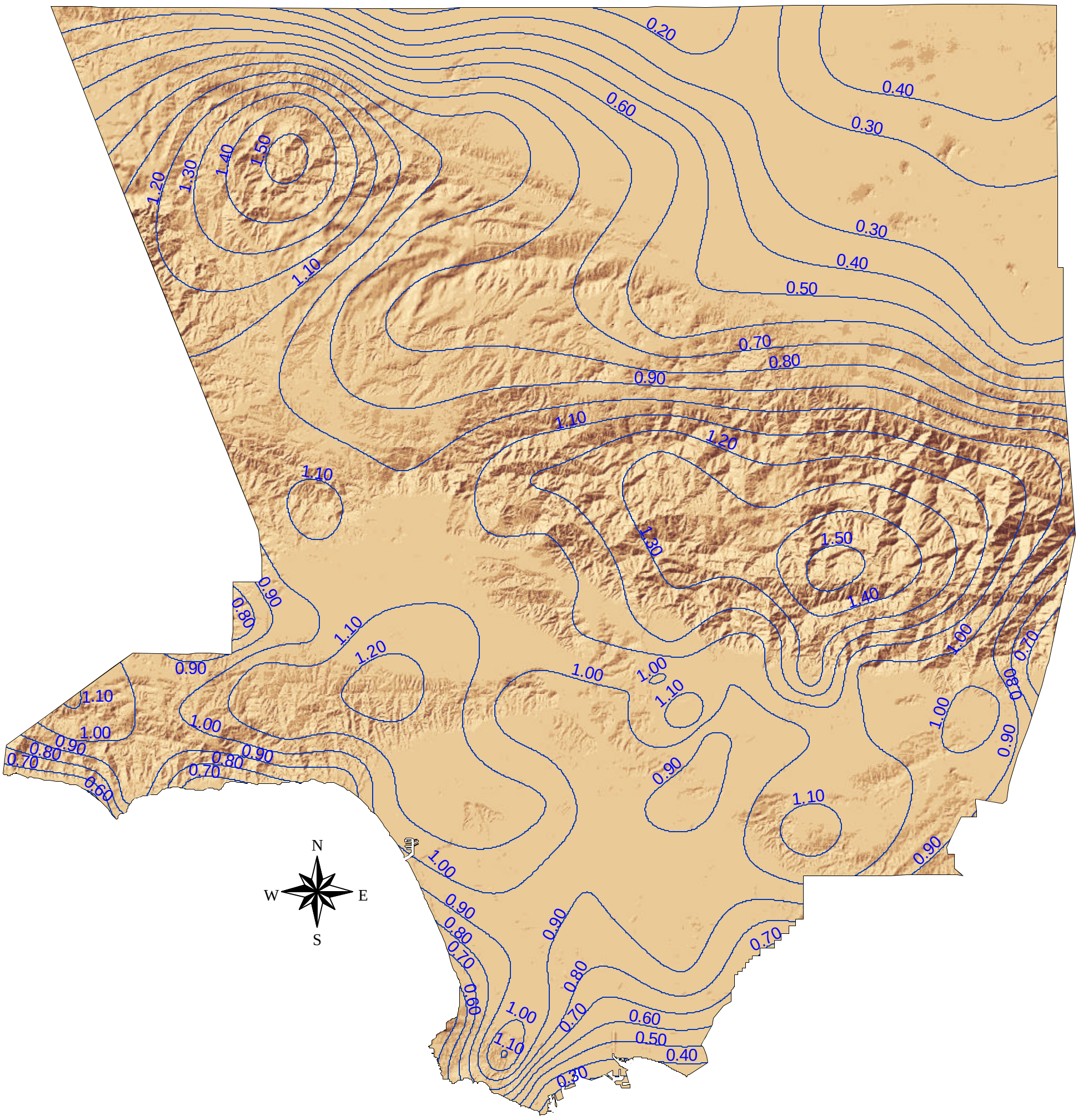


File: Probability Analysis of 85th Percentile 24-hr Rainfall.xls
Worksheet: CDF Graph
Date: 03/16/2004

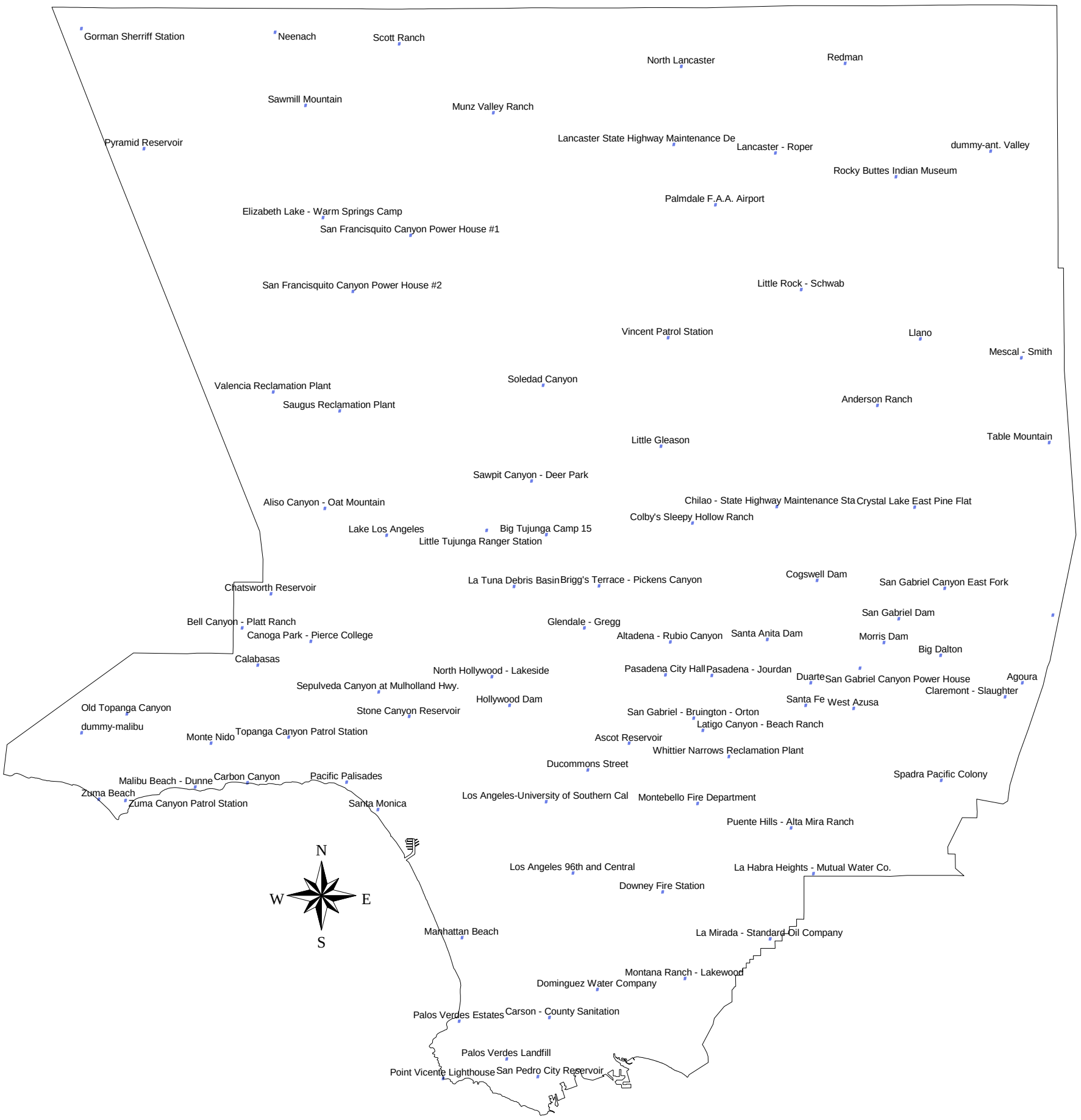
Appendix C

85th Percentile 24-hour Isohyetal Map and Rain Gage Locations

85th Percentile 24-hr Rainfall Isohyetal Map



85th Percentile 24-hr Isohyetal Map Gages



10 0 10 20 30 40 50 60 70 80 90 Miles

\# Rain Gage Name

File: final_85th-no_analyst-raingages.apr
Date: 02/10/2004

Procedure for Creating an Isohyetal Map

1. Create a shape file with rainfall depth data at given points throughout the county (rain gages).

2. Import shape file into ArcView and activate the Spatial Analyst extension.

3. Select the shape file with the rainfall data and then zoom to the extents of the shape file.

4. Choose the Interpolate Grid option from the Surface pull down menu.

5. Set the following levels for the input parameters:

    a. Output Extent – select the Same as Display option.
    b. Set the grid size at 1000.
    c. Leave the other settings alone and select the OK button.

6. Choose the spline method from the next pop-up menu.

7. Choose the data values corresponding to the contours desired (i.e., 85th percentile values).

8. Leave the weight value at 0.1.

9. Set the number of points to 50.

10. Select Tension as the type for the interpolation surface and select the OK button.

11. ArcView will create a grid file. If the grid file appears to be what was expected, select the grid file.

12. Select Create Contours from the Surface pull down menu.

13. Set the contour interval and the base (beginning) contour and select the OK button.

14. ArcView will create contours. Select Convert to Shape file from the Theme pull down menu.

15. Auto-label the contours and create a layout for the map.