2003 ATR Analysis Report

**Division of Multimodal Programs
Kentucky Transportation Cabinet**

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ATR Analysis Report

I.   Introduction

Automated Traffic Recorders (ATRs, also known as permanent counters) are the foundation of traffic monitoring for planning and design purposes. ATRs collect data continuously, providing the only true annual data that can be used for factoring shorter data samples. Since traffic data plays a necessary role in traffic forecasting and other key highway activities, ATRs are vital.

This report presents and analyzes data collected by the Division of Planning of the Kentucky Transportation Cabinet, providing the following:

- List of current KYTC ATRs (Table 1)
- Graphical High Hour Analysis of Selected ATRs (Appendix 1)
- Historical K-factor Analysis (Appendix 2A & 2B)
- Hourly Volume Distributions of Selected ATRs (Appendix 3)

II.   ATR Locations/Background

Kentucky has 75 ATRs (See Table 1). These ATRs all collect traffic volume data, with some also collecting vehicle classification data. The ATRs were chosen to provide an adequate sample size for each functional class and to provide data on key strategic corridors within Kentucky.

Kentucky ATRs typically use loops for presence sensors and Peek ADRs for data recorders. Data is collected nightly and processed daily.

KYTC uses ATRs to provide these key sources of information:

- Functional class k-factors and d-factors used for traffic forecasting and for the Highway Performance Management System
- Weekly/monthly factors used to factor short-term counts
- Peak hour factors used for highway capacity analysis
- Typical hourly distributions of volume by functional class

III.   High Hour Analysis

Since ATRs collect data continuously, they can be used to determine traffic patterns over an entire year's time. The transportation engineering profession has determined that the appropriate analysis unit to design highways is the 30th Highest Hour of the year (See Highway Capacity Manual, reference 1). The 30th Highest Hour of the year is the basis of the "k-factor" which equals the 30th Highest Hour divided by the average annual daily traffic (AADT or ADT).

KYTC's traffic forecasting program uses the k-factors determined by the ATR program as the basis for the design hour volume (DHV).

DHV = K * ADT.

The 2003 ATR Data Report (see reference 2) lists the 100 highest hours for each ATR along with the k-factor. Additional analysis was performed on selected ATRs to examine the sensitivity of the k-factors both graphically and statistically. This analysis is located in Appendix 1, which contains graphs of 13 selected ATRs for these intervals:

- All hours collected (8,760 if available)
- The top 500 hours
- The top 100 hours

Table 2 shows the location, functional class and ATR # of the selected ATRs used for the ATR high hour analysis. Table 3 gives the results of the ATR analysis, demonstrating that there is a small difference (.81% or 7% absolute difference) between the average 30th highest hour (11.3%) and the 50th highest hour (10.49%). There is a slightly more significant difference (1.41% or 12.5% absolute difference) between the 30th highest hour (11.3%) and the 100th highest hour (9.89%). This analysis suggests that consideration should be given for use of a different design criteria than the 30th highest hour.

Another useful item that can be gleaned from the curves and data summary is based on the difference between a typical high hour count made in a portable count and the actual 30th highest hour. This relationship is useful for traffic forecasting, since k-factors are needed for project forecasts in areas where ATRs are not available. The Division of Multimodal Programs has used this formula:

Portable Count High Hour + 2% = Actual K-factor

Assuming that the 200th highest hour is a reasonable approximation of the actual 30th highest hour, one can graphically examine the 13 selected ATRs and see that the difference between 200th highest hour and the 30th highest hour ranges from 1% to 4%, with an average difference of 1.95% (see Table 3). Therefore, the above equation does a reasonable job of estimating the actual 30th highest hour.

IV. K-factor Trends

Another area of investigation is how k-factors change over time. Traffic forecasts require estimates of the future design hour volume, but using the same k-factor to determine this might not be accurate, since k-factors tend to decrease as the ADT increases. K-factor trends are visible in the K-factor history from 1996 to 2002 by FC (Table 4A), by ATR (Table 4B), and graphically (Appendix 2).

V. Hourly Volume Distributions

Another useful set of information that was derived from the selected ATRs is hourly volume distributions. Hourly volume distributions can be used to synthesize traffic counts based on less than 24 hours of data or even no actual hourly data. The hourly volume distributions are contained in Appendix 3. These distributions are intended to be a Kentucky-specific version of the hourly volume distributions provided in NCHRP 187 (3).

VI. References

1. <u>Highway Capacity Manual 2000</u>, TRB 2001.

2. <u>2002 ATR Data Report</u>, Division of Planning, KYTC, 2003.

3. NCHRP 187 Quick-Response Urban Travel Estimation Techniques and Transferable Parameters Users Guide, TRB, 1978.

TABLE 1
KYTC Automated Traffic Recorders

ATR #	County	Route	Milepoint	K Factor	FC	2002 ADT
1	Franklin	US 60	0	14.6%	6	3,629
2	Jefferson	FS 8720	1.57	11.9%	17	3,547
3	Franklin	Collins Lane	0.4	13.2%	17	4,983
4	McCracken	CS 1132	0.6	15.2%	17	2,938
6	Wolfe	KY 15	11.68	16.4%	7	1,150
7	Hardin	US 31 W	29.589	10.3%	14	18,583
8	Grayson	US 62	12.096	N/A	7	2,234
10	Graves	US 45	6.2	N/A	7	1,604
12	Pike	US 23	38.14	9.8%	2	22,294
13	Carter	US 60	20.029	10.6%	7	3,028
14	Jefferson	KY 1142	1.4	9.5%	16	12,593
15	Union	US 60	4.188	12.9%	6	3,103
16	Grant	US 25	17.464	10.7%	7	6,612
17	Daviess	US 60	6.083	10.3%	12	17,048
18	Harlan	US 119	10.026	9.9%	2	10,142
19	Shelby	KY 2861	0	N/A	8	1,136
20	Clark	TR 9000	1.33	10.4%	2	12,641
21	Jefferson	US 31 E	14.635	8.5%	14	21,501
22	Shelby	I-64	36	10.3%	1	39,224
23	Grant	I-75	164.193	16.1%	1	41,200
24	Marion	US 68	10.69	11.2%	16	10,453
25	Mercer	US 127	2.236	10.7%	2	15,895
26	Bourbon	US 68	4.183	10.7%	2	8,197
27	Pendleton	US 27	5.731	10.1%	6	3,875
28	Trimble	US 42	10.049	10.6%	7	1,970
29	Menifee	US 460	4.955	10.3%	6	3,547
30	Estill	KY 52	19.081	N/A	7	1,346
31	Bell	US 25 E	19.035	9.9%	2	10,874
32	Pulaski	US 27	5.734	9.8%	2	7,257
33	Russell	US 127	6.429	14.8%	2	2,424
34	Adair	KY 80	20.058	11.1%	7	3,719
35	Hancock	US 60	12.578	12.3%	2	4,502
36	Ohio	KY 54	9.558	N/A	7	1,117
37	Butler	US 231	16.086	10.7%	7	2,486
38	Logan	US 68	2.574	11.5%	2	3,522
39	Marshall	US 641	18.236	13.1%	6	4,719
40	Muhlenberg	WK 9001	57.1	11.7%	2	8,518
41	Elliott	KY 7	11.373	11.3%	6	3,139
42	Boyd	US 23	0.1	11.9%	2	10,753
43	Floyd	KY 1428	4.185	10.4%	8	2,654
45	Warren	US 231	1.4	9.7%	16	13,056
47	Carter	I-64	170.857	10.4%	1	15,709
48	Henry	I-71	34.56	9.7%	1	26,442
49	Kenton	KY 371	3.17	9.3%	17	33,347
50	Hardin	I-65	89.178	12.1%	1	35,350
51	Lyon	I-24	37.3	11.3%	1	24,435
52	Lewis	KY 546	15.1	9.8%	2	58,657
53	Woodford	BG 9002	69.608	10.8%	2	17,084
54	Nelson	BG 9002	37.6	13.1%	2	9,577
55	Owen	US 127	4.1	13.1%	6	3,438

TABLE 1
KYTC Automated Traffic Recorders

ATR #	County	Route	Milepoint	K Factor	FC	2002 ADT
56	Floyd	KY 114	11	12.3%	2	11,787
58	Henderson	US 41	18.6	10.6%	14	36,887
60	Woodford	US 60	0.2	11.9%	2	14,733
63	Boone	I-75	176.1	9.9%	11	101,292
65	Jessamine	US 27	1.6	9.3%	2	20,707
66	Boyle	US 127	1.5	10.4%	14	22,177
70	Pike	US 119	2.3	10.2%	2	11,794
71	Barren	TR 9008	9.2	10.2%	12	6,585
72	Bullitt	I-65	106.5	5.8%	1	49,316
73	Owsley	KY 11	13.3	11.3%	7	4,655
74	Fayette	I-64	73.8	10.4%	11	29,578
75	Fayette	KY 4	3.5	10.7%	12	55,194
76	Laurel	DB 9006	9.2	10.5%	2	7,240
77	Lawrence	US 23	5.6	10.0%	2	9,405
80	Jefferson	US 31E	7.85	9.3%	14	28,176
84	Jefferson	KY 61	0.1	9.5%	14	23,615
90	Fayette	I-75	100.5	9.4%	11	60,862
91	Simpson	I-65	2.048	10.7%	1	40,969
92	Jefferson	I-64	2.6	10.0%	11	69,270
93	Kenton	I-75	188	8.5%	11	144,680
94	Jefferson	I-264	15	9.4%	11	140,519
96	Campbell	I-471	1.9	10.6%	11	90,607
97	Campbell	I-275	76.4	N/A	11	72,152
98	Jefferson	I-265	16.134	10.8%	11	65,883
99	Jefferson	I-65	133.414	8.8%	11	121,754

TABLE 2
ATRs Used for Analysis

Functional Class	ATR #	County	Location
1	23	Grant	south of Crittenden, 1.8 miles south of KY 491
2	53	Woodford	Woodford County, 1.5 miles west of US 70
6	1	Franklin	Shelby County line, about .5 miles west of KY 151
6	29	Menifee	west of Frenchburg, 3.8 miles west of KY 36
7	16	Hardin	north of Dry Ridge, 2.2 miles north of KY 22
8	19	Shelby	south of Shelbyville, 2.7 miles south of US 60
8	43	Floyd	east of Prestonsburg, 2.1 miles east of KY 3
11	98	Jefferson	Louisville Urban Area, Johnson School Overpass
12	75	Fayette	between US 60 and US 68
14	7	Hardin	Radcliff, about 2.4 miles north of KY 144
14	66	Boyle	Danville, between KY 34 & KY 37 on US 127 Bypass
16	45	Warren	Bowling Green, between Kenton St. & Fairground
17	3	Franklin	Collins Lane (MP 0.40) Frankfort, West of KY 676

TABLE 3
ATR Analysis Summary

ATR #	K Factor	FC	1999 ADT (based on valid hours)	VALID HOURS (8760 possible)	30th highest hour (pct of aadt)	1st highest hour (pct of aadt)	50th highest hour (pct of aadt)	100th highest hour (pct of aadt)	200th highest hour (pct of aadt)	STD DEV	STD DEV FROM MEAN (30th)	STD DEV FROM MEAN (1st)	STD DEV FROM MEAN (50th)	STD DEV FROM MEAN (100th)	STD DEV FROM MEAN (200th)	% DIFF 30th and 50th	% DIFF 30th and 100th	% DIFF 30th and 200th
19	N/A	8	1133	6264	11.21	15.18	10.68	9.97	9.27	2.79	2.52	3.94	2.33	2.08	1.83	0.53	1.24	1.94
43	12.60%	8	2740	4608	13.36	16.86	9.96	9.12	8.65	3.00	3.07	4.24	1.93	1.65	1.50	3.39	4.23	4.71
29	10.30%	6	3641	7656	9.67	10.41	9.39	9.06	8.60	2.60	2.12	2.40	2.01	1.89	1.71	0.27	0.60	1.07
1	13.00%	6	4724	7632	17.27	24.75	13.59	11.90	11.03	3.26	4.01	6.30	2.89	2.37	2.10	3.68	5.38	6.24
3	13.40%	17	5207	5832	12.27	23.93	12.00	11.66	11.02	3.32	2.44	5.95	2.36	2.25	2.06	0.27	0.61	1.25
16	10.50%	7	6574	7944	11.07	15.53	10.50	9.95	9.38	2.89	2.39	3.93	2.19	2.00	1.80	0.58	1.13	1.69
14	9.50%	16	12273	7872	8.86	11.29	8.73	8.56	8.30	2.54	1.84	2.80	1.79	1.73	1.63	0.13	0.29	0.55
45	10.10%	16	13909	4656	9.66	10.59	9.51	9.12	8.77	2.84	1.94	2.27	1.88	1.75	1.62	0.15	0.55	0.89
53	10.90%	2	16875	7128	10.77	12.91	10.35	9.55	8.90	2.57	2.57	3.40	2.41	2.10	1.84	0.41	1.21	1.87
66	10.50%	14	21955	4440	10.50	11.19	10.23	9.81	9.15	2.77	2.29	2.54	2.19	2.04	1.80	0.27	0.69	1.35
7	10.30%	14	22368	7128	9.59	10.45	9.43	9.24	8.95	2.69	2.02	2.34	1.96	1.88	1.78	0.16	0.36	0.64
23	16.10%	1	47049	6576	12.13	18.86	10.95	9.66	8.79	2.39	3.34	6.16	2.84	2.30	1.94	1.18	2.46	3.34
75	10.80%	12	53427	6960	11.03	11.67	10.89	10.61	10.22	2.86	2.40	2.62	2.35	2.25	2.11	0.14	0.42	0.81
98	11.10%	11	59804	5160	10.88	11.58	10.66	10.31	9.83	2.63	2.55	2.81	2.47	2.33	2.15	0.22	0.57	1.04
AVG	11.47%		19406	6418	11.30	14.66	10.49	9.89	9.35	2.80	2.53	3.69	2.26	2.04	1.85	0.81	1.41	1.96

TABLE 4A
K-Factor History by Functional Class

FC	1996	1997	1998	1999	2000	2001	2002	Expected 2003	Annual Change
1	11.2	11.2	11	10.8	10.6	10.3	10.4	10.14	-0.26
2	11.6	11.8	11.6	11.3	11	10.8	10.6	10.46	-0.14
6	12.5	11.1	11.5	11.5	11.5	11.3	11.1	10.98	-0.12
7	12.3	11.1	11.5	11.5	11.5	11.5	11.6	11.39	-0.21
8	11.2	11.3	11.3	11.5	11.5	11.6	11.6	11.72	0.12
11	10.7	10.8	10.5	10.4	10.4	10.2	10	9.95	-0.05
12	11.2	10.1	10.7	10.7	10.7	10.9	10.7	10.73	0.03
14	10.2	10.8	10.2	10.4	10.4	10.3	10.2	10.24	0.04
16	9.9	10.1	10.3	10.2	10.2	9.9	9.8	9.94	0.14
17	13.2	13.2	12.3	12.7	12.7	12.7	12.6	12.44	-0.16

TABLE 4B
K-Factor History by ATR

ATR #	1994	1995	1996	1997	1998	1999	2000	2001	2002
1	13.2%	12.7%	12.5%	12.6%	12.7%	12.6%	12.7%	13.0%	14.6%
2	12.0%	12.1%	12.1%	12.2%	11.7%	12.2%	12.6%	11.7%	11.9%
3	12.8%	13.0%	12.9%	13.2%	12.8%	13.2%	12.7%	13.4%	13.2%
4	10.1%		10.9%			10.6%		15.2%	15.2%
6	10.9%	11.1%	10.3%	11.1%	10.6%	11.1%	16.8%	11.5%	16.4%
7	10.0%	10.1%	10.3%	9.9%	10.0%	9.9%	10.0%	10.3%	10.3%
8	11.3%	11.1%	11.3%	10.8%	10.8%	10.8%	10.5%		
10	10.6%	10.6%	10.6%	10.5%	10.9%	10.6%	10.1%		
12	10.3%	10.1%	10.2%	10.0%	10.0%	10.0%	10.1%	10.0%	9.8%
13	12.2%	11.1%	10.7%	11.1%	11.4%	11.1%	11.7%	11.1%	10.6%
14	9.6%	9.6%	9.6%	9.6%	9.3%	9.6%	9.6%	9.5%	9.5%
15	10.4%	10.2%	10.3%	10.9%	9.7%	10.9%	10.4%	13.0%	12.9%
16	10.7%	11.5%	10.6%	10.6%	10.7%	10.6%	10.8%	10.5%	10.7%
17		10.3%	10.4%	10.1%	10.2%	10.1%	10.4%	12.8%	10.3%
18	10.0%	11.9%	9.9%	9.8%	9.6%	9.8%	9.8%	9.9%	9.9%
19	11.8%	11.2%	11.5%	11.3%	12.6%	11.3%	14.6%		
20								10.4%	10.4%
21	8.6%	8.5%	8.5%	10.6%	24.8%	10.6%	8.5%	8.8%	8.5%
22	10.9%	10.6%	10.7%	10.7%	10.6%	10.7%	10.4%	10.4%	10.3%
23	11.9%	11.5%	11.6%	10.7%	10.9%	10.7%	10.8%	16.1%	16.1%
24	10.8%	11.2%	11.3%	11.2%	11.3%	11.2%	11.5%	11.4%	11.2%
25	10.7%	10.6%	10.6%	10.6%	10.5%	10.6%	11.0%	10.7%	10.7%
26	11.2%	11.1%	10.8%	10.7%	10.5%	10.7%	10.8%	10.9%	10.7%
27	10.4%	9.9%	10.0%	10.2%	16.8%	11.0%	10.6%	10.2%	10.1%
28	11.8%	12.7%	11.5%	11.5%	11.6%	11.5%	10.9%	10.9%	10.6%
29	10.7%	10.2%	10.0%	10.9%	10.5%	10.9%	10.1%	10.3%	10.3%
30	12.8%	12.0%	11.7%	11.7%	11.2%	11.7%	11.9%		
31	10.4%	11.0%	10.1%	10.1%	9.9%	10.1%	10.1%	9.9%	9.9%
32	10.9%	14.7%	13.7%	10.1%	9.9%	10.1%	10.1%	9.9%	9.8%
33	16.9%	16.4%	17.4%	16.0%	14.6%	13.2%	13.9%	14.8%	14.8%
34	10.8%	10.9%	10.7%	10.4%	9.8%	10.4%	10.4%	11.2%	11.1%
35	11.7%	11.5%	15.7%	15.2%	14.7%	15.2%	13.4%	13.4%	12.3%
36	12.8%	12.2%	12.3%	12.7%	12.2%	12.7%	0.0%		
37	14.7%	14.7%	13.6%	12.9%	12.1%	12.9%	12.0%	11.7%	10.7%
38	11.3%	11.4%	11.6%	14.0%	11.3%	14.0%	11.1%	11.5%	11.5%
39	14.8%	15.4%	14.9%	13.2%	14.5%	13.2%	12.9%	13.1%	13.1%
40								11.7%	11.7%
41	10.8%	10.5%	10.3%	10.6%	12.2%	10.6%	10.4%	10.3%	11.3%
42	10.4%	12.0%	10.2%	9.8%	9.8%	9.8%	9.6%	9.5%	11.9%
43	10.6%	10.4%	10.4%	10.4%	13.5%	10.4%	10.1%	12.6%	10.4%
45	9.6%	9.4%	9.3%	9.2%	13.4%	9.2%	10.0%	10.1%	9.7%
47	11.3%	10.9%	10.7%	10.8%	10.4%	10.9%	9.3%	10.7%	10.4%
48	10.6%	10.5%	9.8%	10.9%	9.1%	9.2%	9.7%	9.5%	9.7%
49	9.5%	10.2%	10.4%	10.9%		10.9%	9.4%	9.3%	9.3%
50	11.2%	10.7%	10.4%	11.2%	9.4%	11.2%	10.1%	9.8%	12.1%
51	12.7%	11.3%	11.0%	10.4%	10.6%	10.4%	10.5%	10.6%	11.3%
52	10.5%	10.9%	10.3%	11.8%	9.4%	11.8%	9.7%	9.6%	9.8%
53	11.7%	11.6%	11.4%	11.3%	11.3%	11.3%	11.1%	10.9%	10.8%
54								13.1%	13.1%
55								13.1%	13.1%
56								12.3%	12.3%

TABLE 4B
K-Factor History by ATR

58								10.6%	10.6%
60			12.0%	12.0%	12.1%	12.0%	11.9%	11.9%	11.9%
63					12.5%	8.7%	9.4%	11.1%	9.9%
65					14.4%	10.4%	10.6%	10.6%	9.3%
66					10.9%	11.1%	10.5%	10.4%	
70	11.1%	12.9%	11.1%	10.0%	10.6%	10.0%	10.0%	10.1%	10.2%
71	11.5%	12.4%	18.1%	10.7%	10.2%	10.9%	10.1%	10.1%	10.2%
72	8.5%	10.8%			8.4%	7.7%	7.9%	5.8%	5.8%
73	10.2%	14.9%	5.9%	10.9%	11.6%	10.9%	11.4%	10.9%	11.3%
74	11.8%	12.3%				10.0%	12.0%		10.4%
75	11.5%	11.6%	11.5%	11.1%	11.2%	11.1%	10.9%	10.8%	10.7%
76					14.2%	14.1%	10.5%	10.5%	10.5%
77					12.0%	11.9%	9.6%	9.9%	10.0%
80					9.4%	10.1%	9.5%	9.4%	9.3%
84	9.8%	10.0%	9.8%	10.1%	10.1%	9.8%	9.6%	9.4%	9.5%
90	10.2%	10.2%	10.1%			9.7%	9.9%	9.6%	9.4%
91		10.5%	10.8%	9.9%	10.2%	14.5%	10.6%	10.2%	10.7%
92		10.6%	11.2%	11.9%	11.1%	11.9%	10.5%	10.2%	10.0%
93		8.9%	9.3%	8.4%	8.4%	8.4%	8.2%	8.3%	8.5%
94	10.1%	10.4%	10.1%	10.4%	10.0%	10.4%	10.1%	10.3%	9.4%
96	10.2%	17.9%	10.3%	10.7%	10.8%	10.7%	10.1%	10.9%	10.6%
97	10.5%	10.8%	10.6%	11.4%	10.9%	11.4%	10.3%		
98	11.3%	10.9%	11.3%	11.4%		11.4%	13.9%	11.1%	10.8%
99	9.1%	9.1%	9.3%	9.0%	10.0%	9.0%	11.3%	8.6%	8.8%

APPENDIX 1
High Hour Distributions
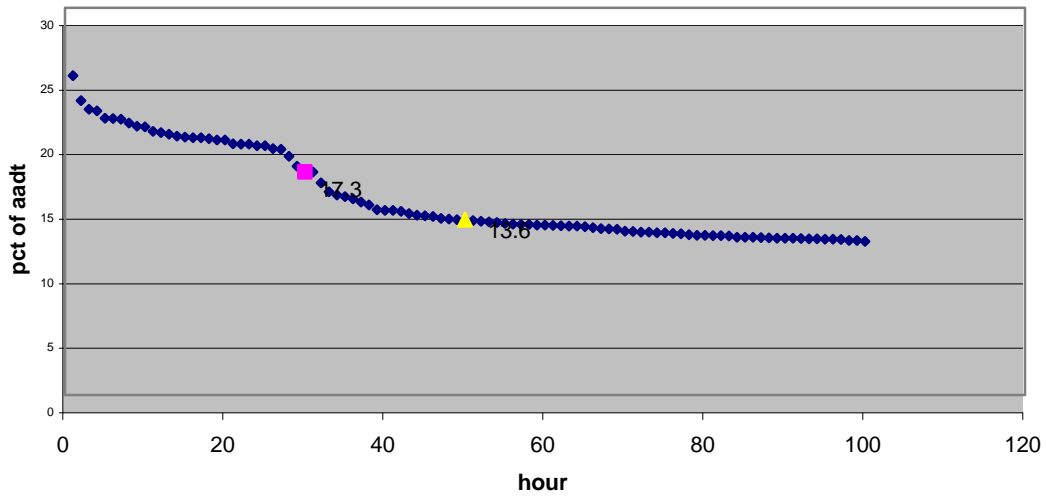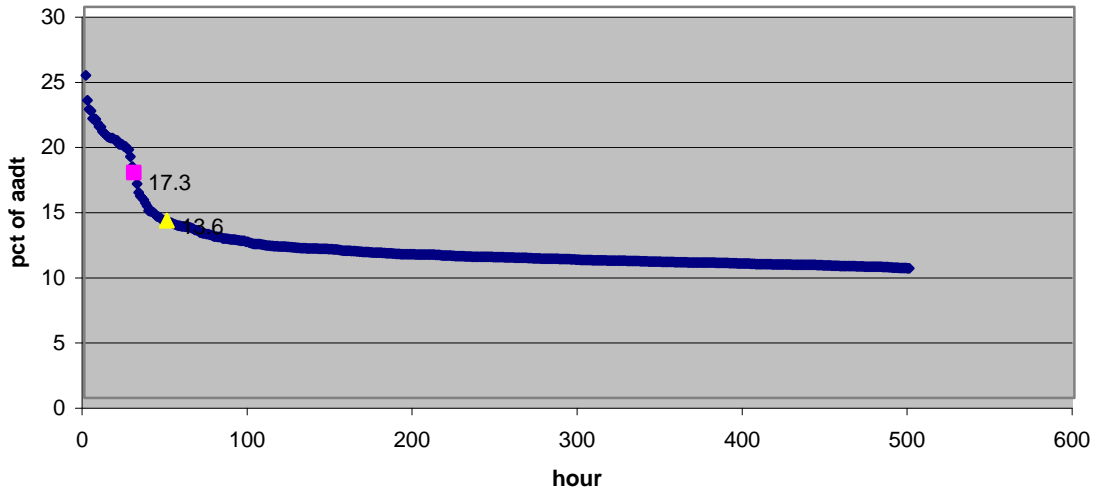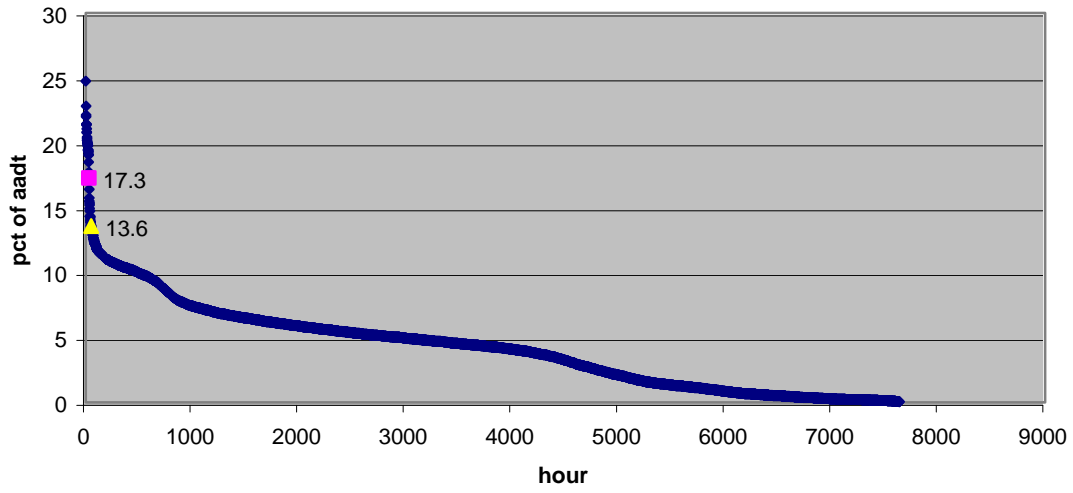
ATR 1

APPENDIX 1
High Hour Distributions

ATR 7
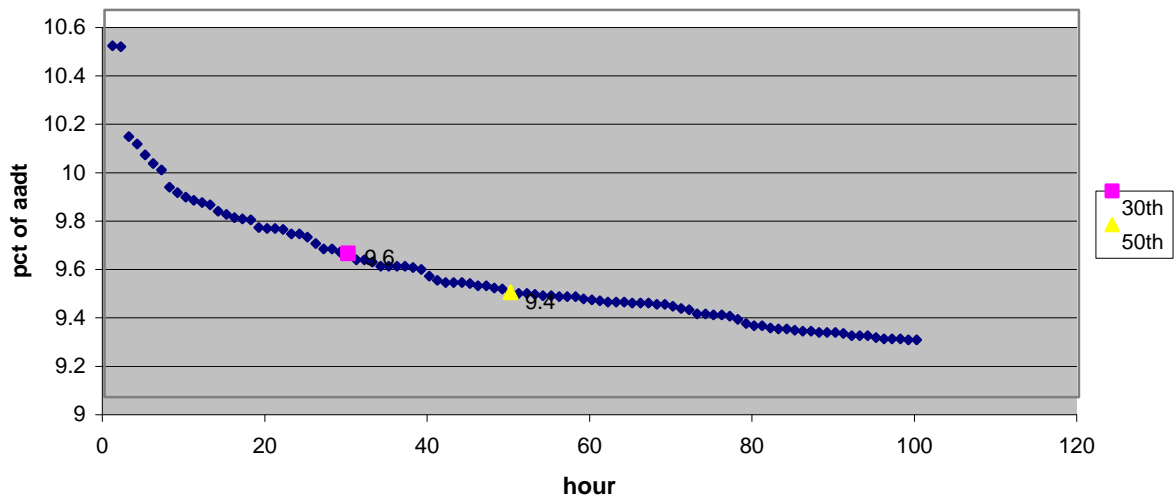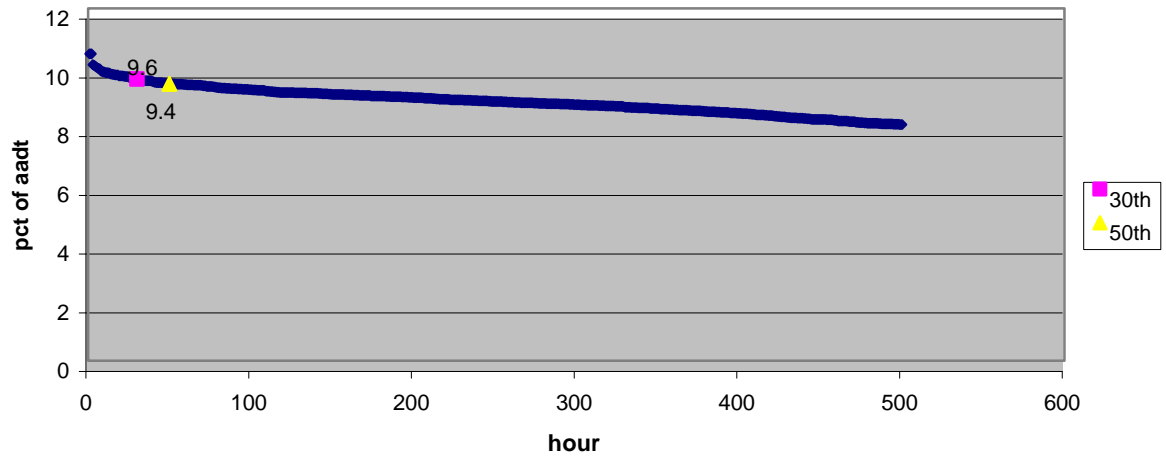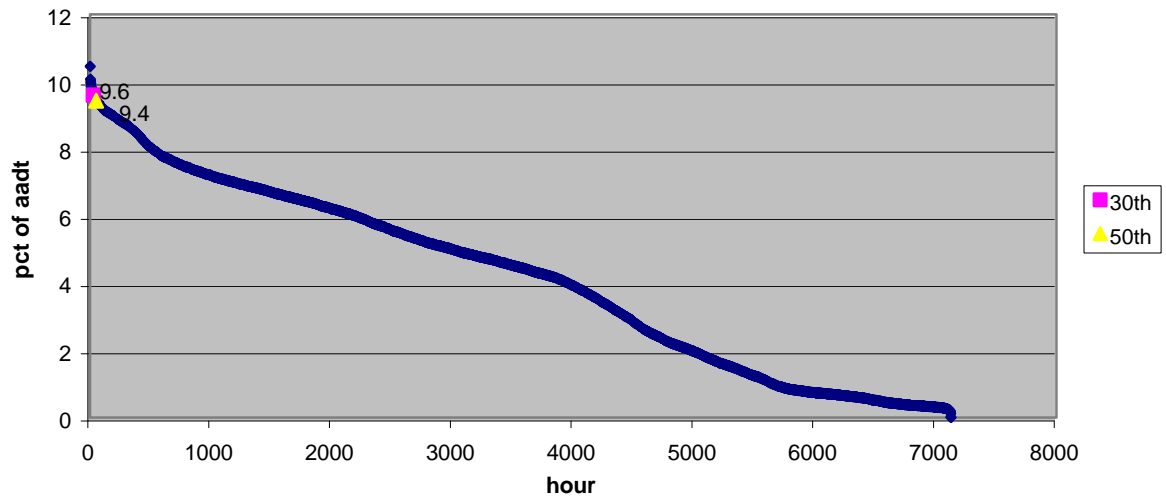
APPENDIX 1
High Hour Distributions

ATR 14
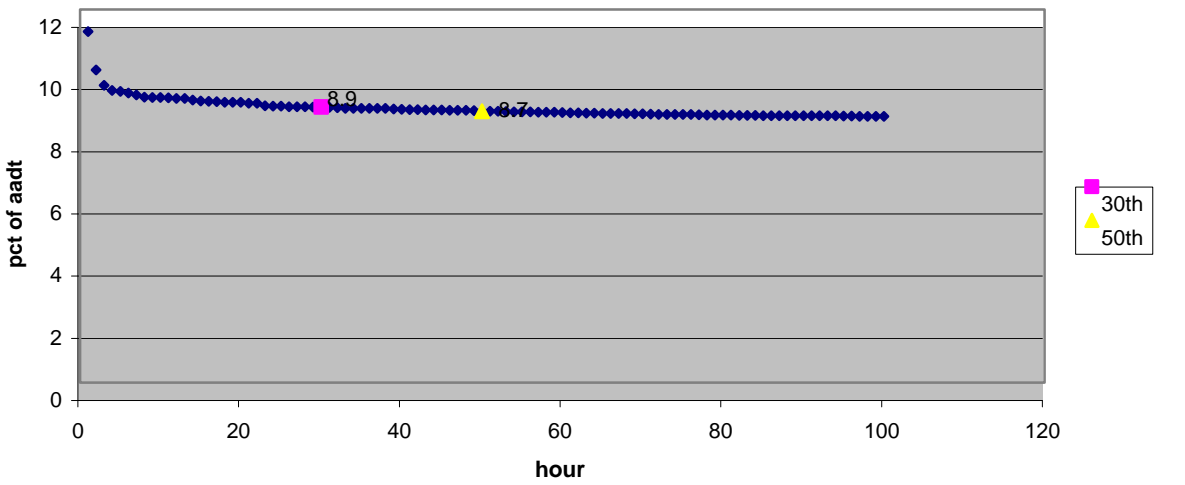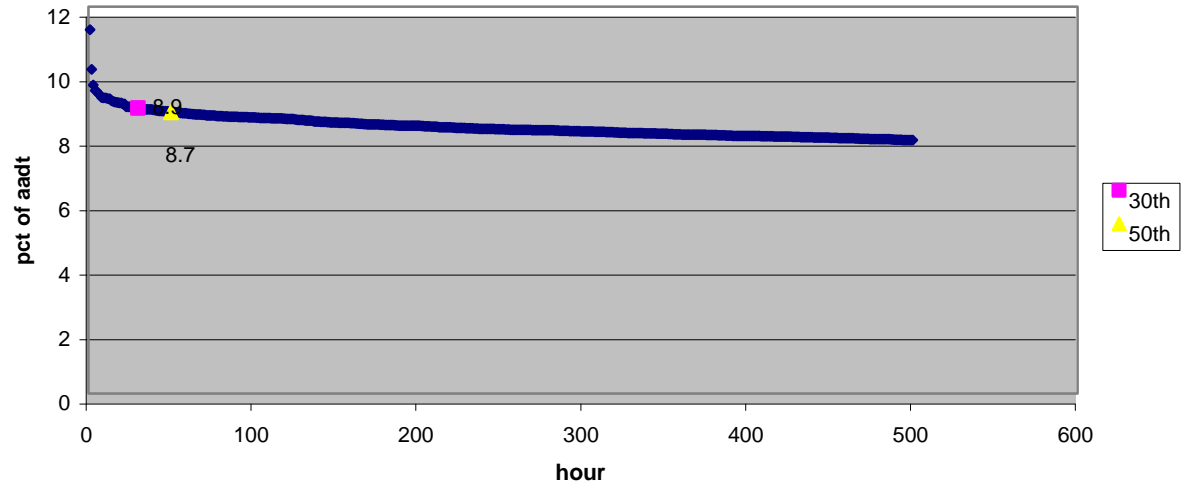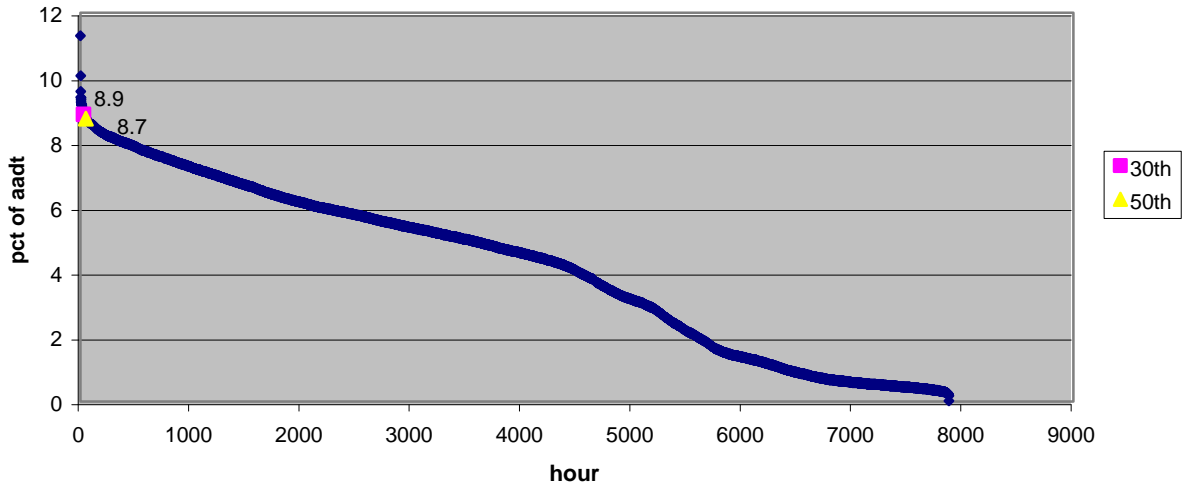
APPENDIX 1
High Hour Distributions

ATR 16
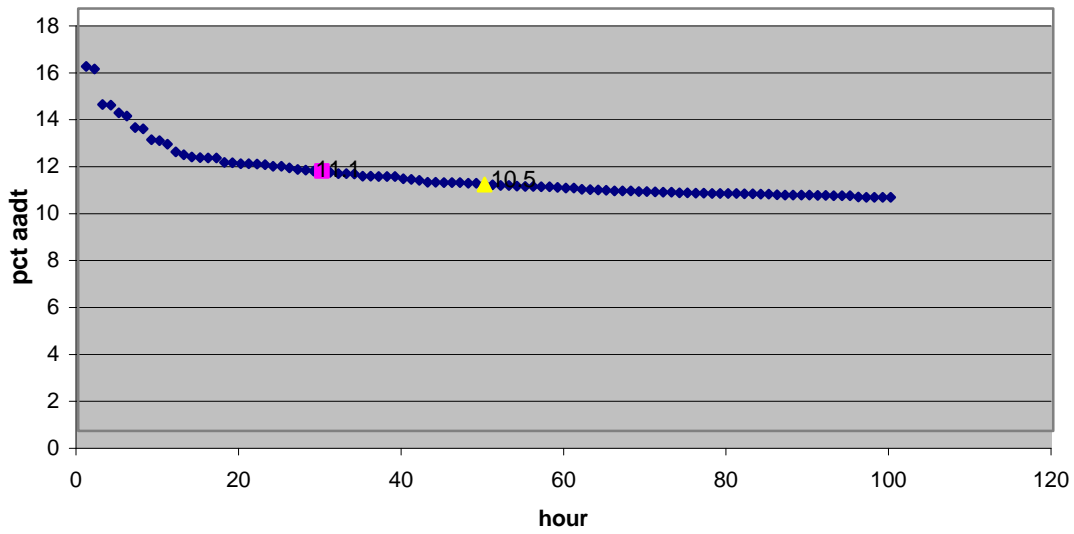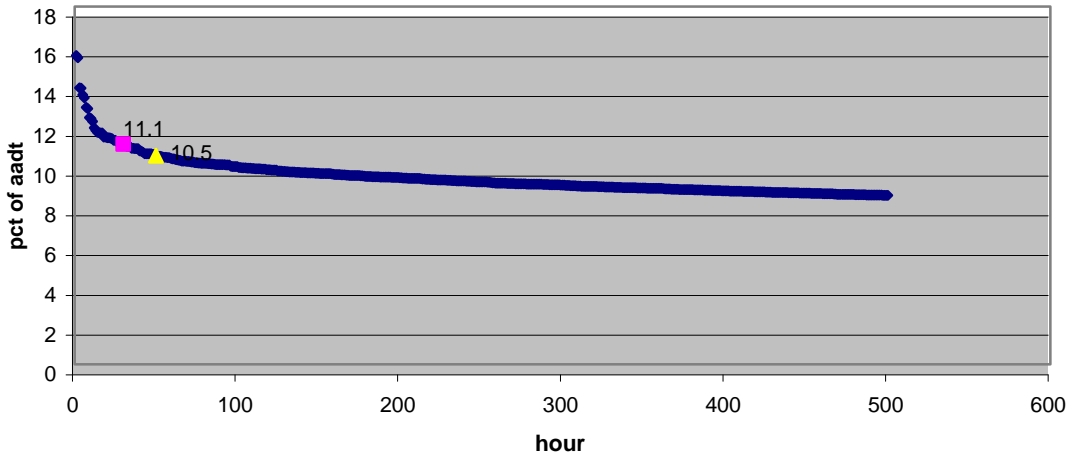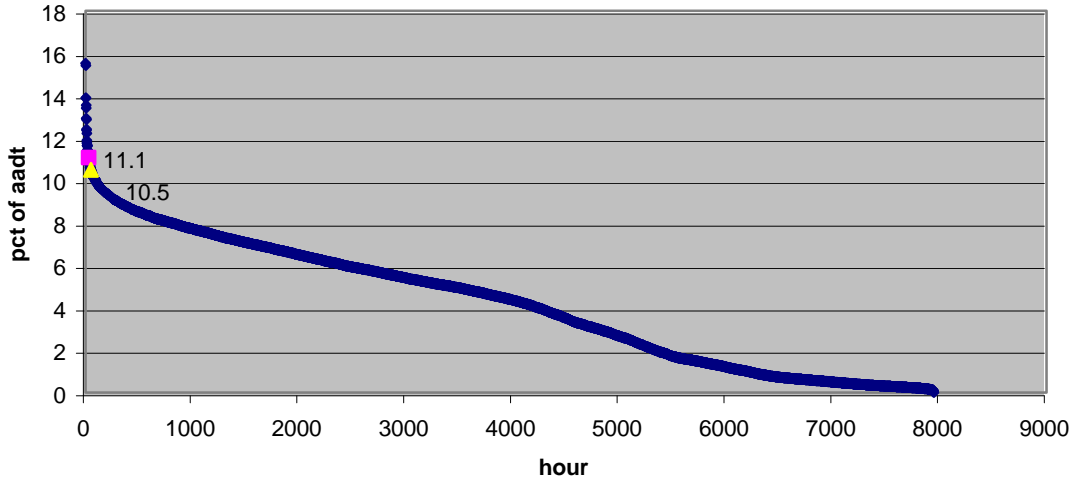
APPENDIX 1
High Hour Distributions

ATR 19
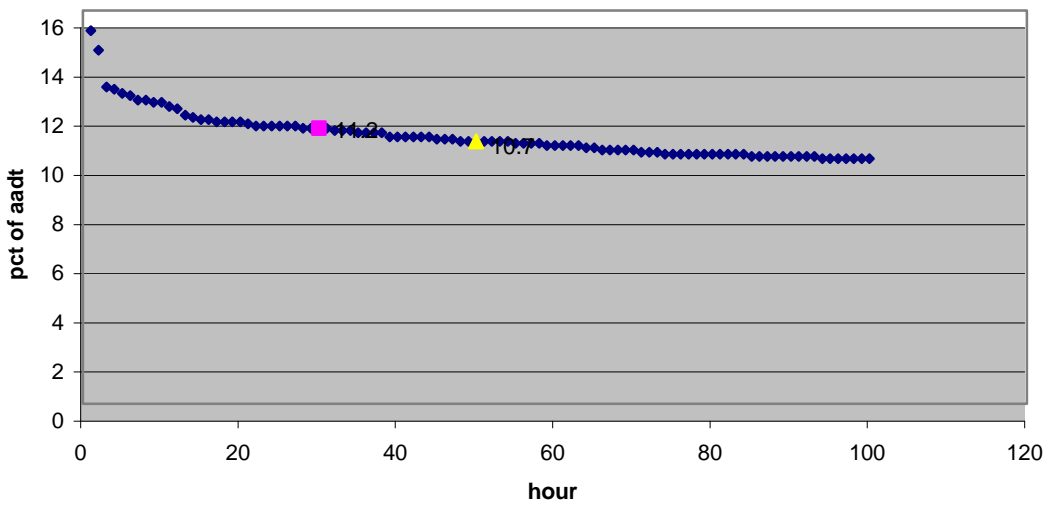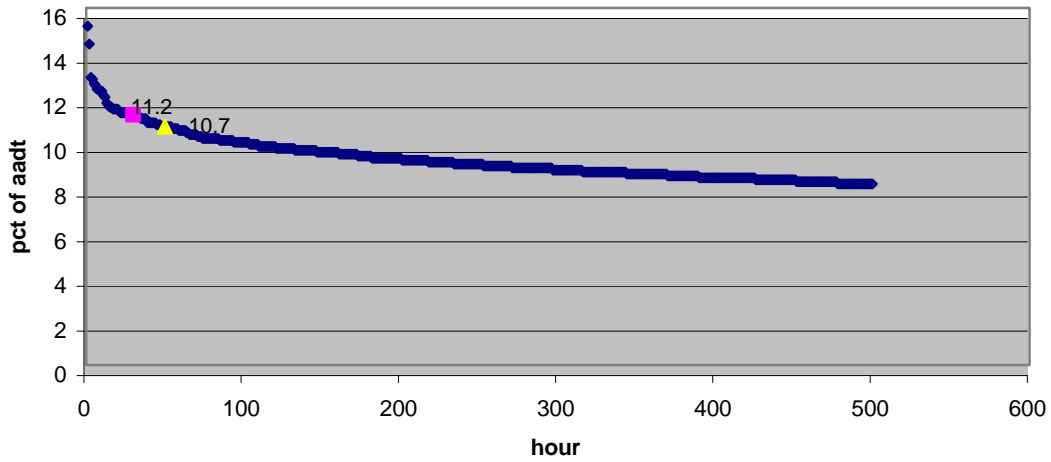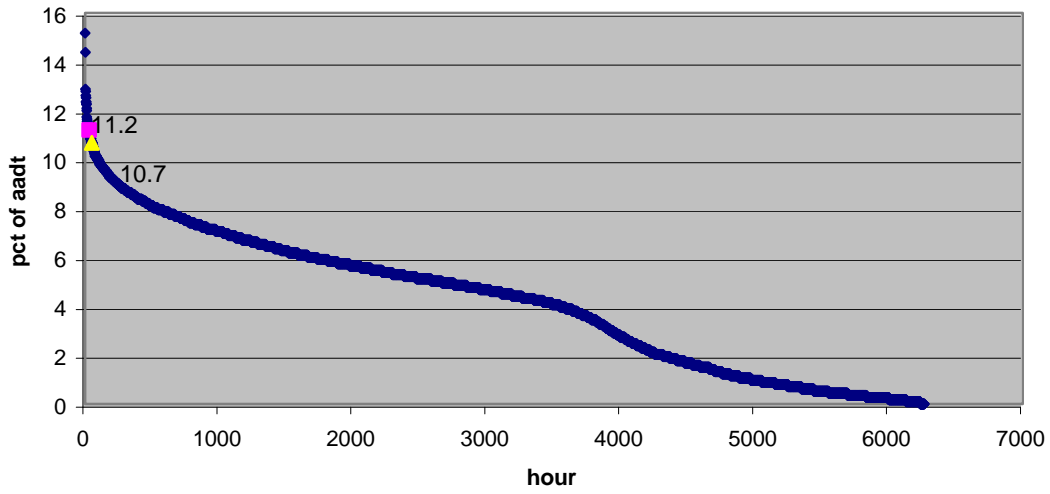
APPENDIX 1
High Hour Distributions

ATR 23
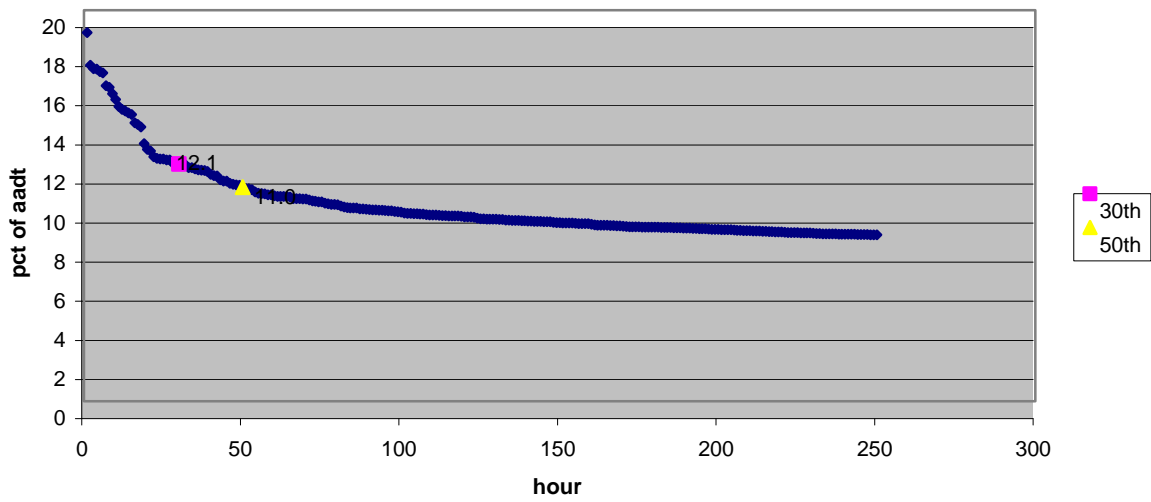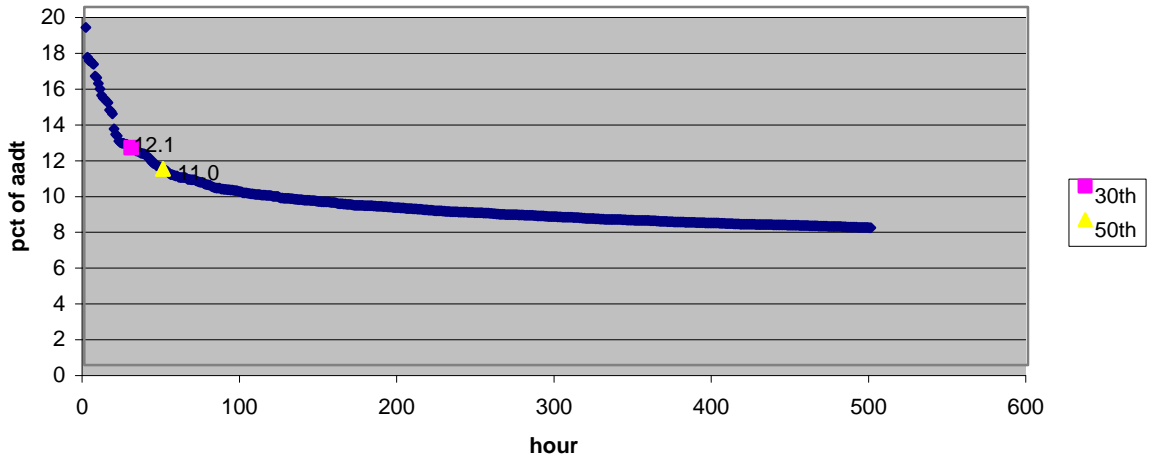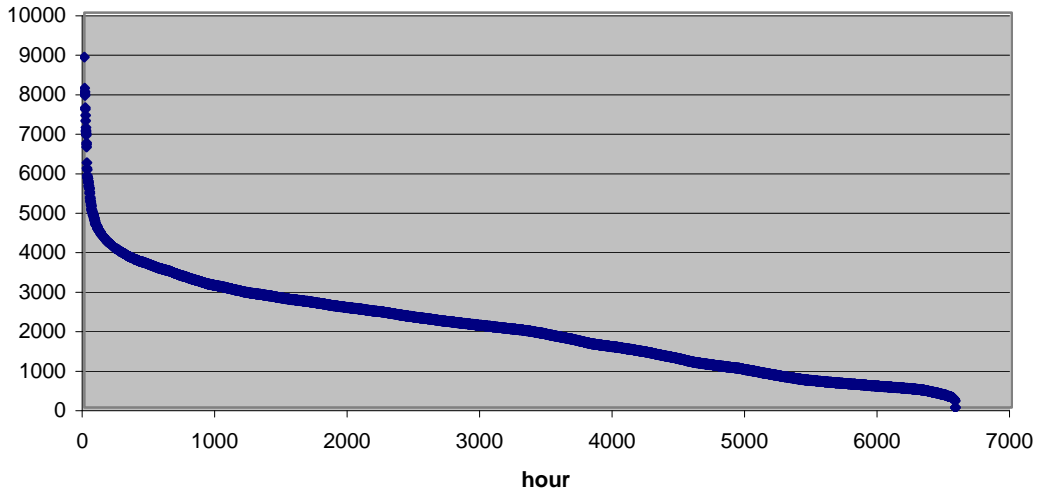
APPENDIX 1
High Hour Distributions

ATR 29
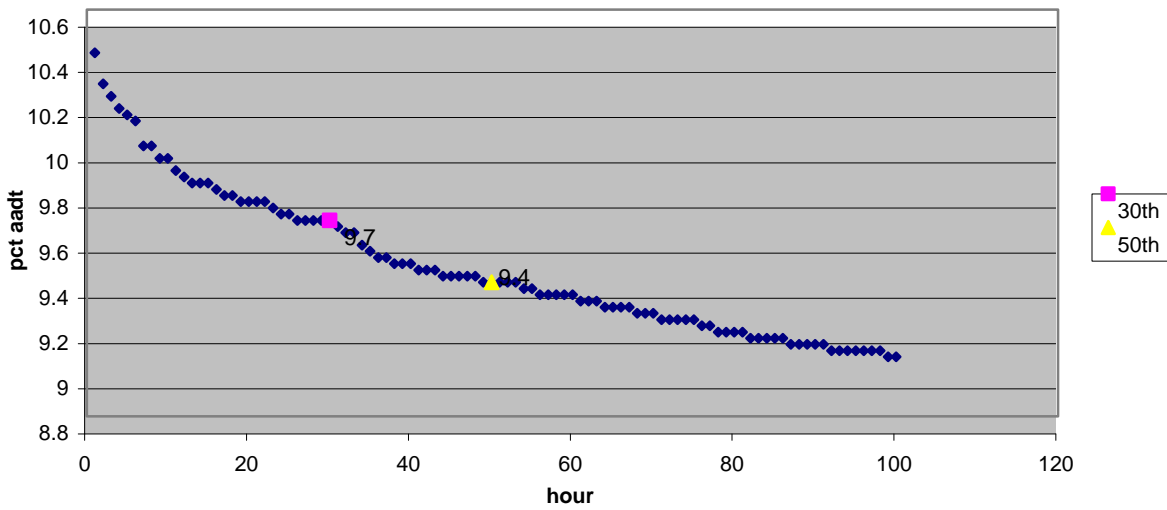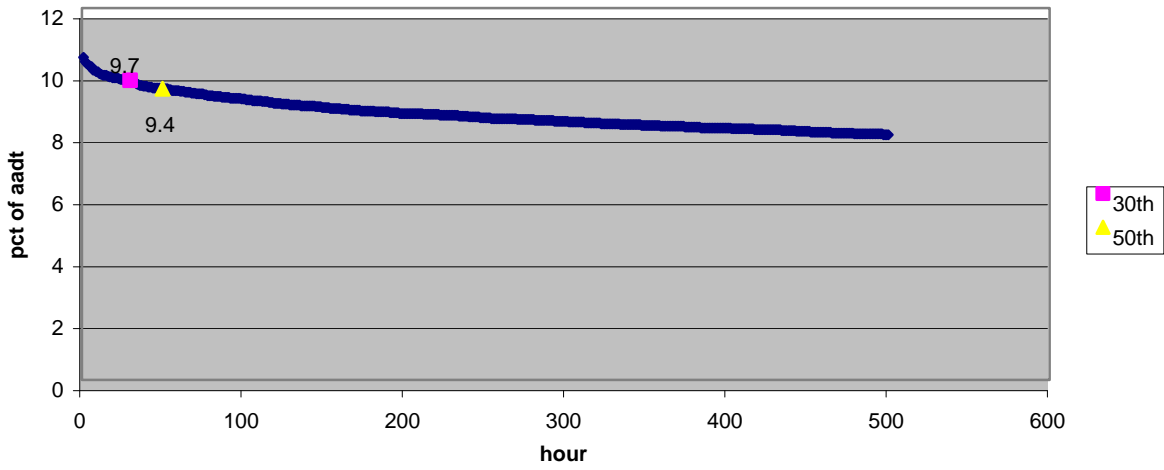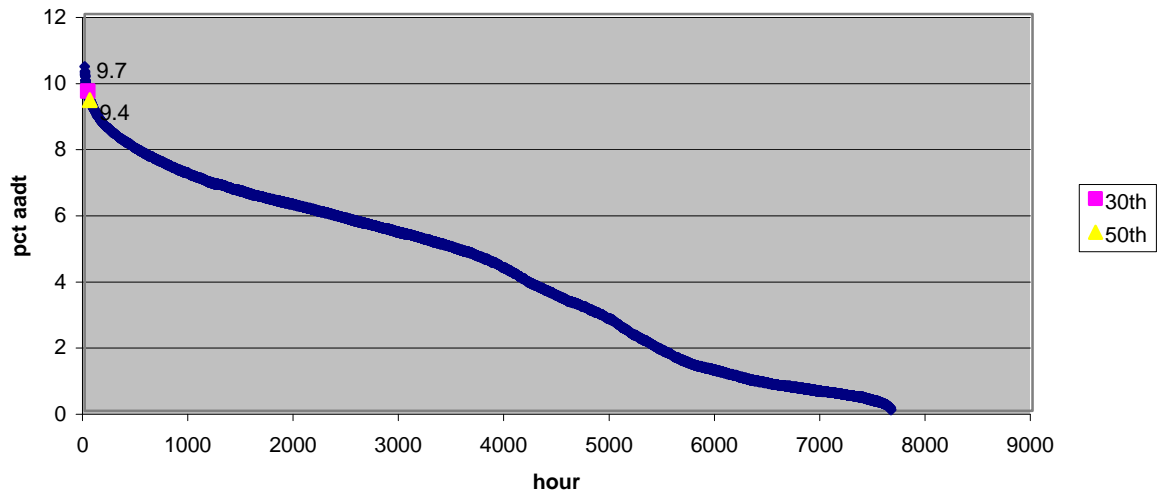
APPENDIX 1
High Hour Distributions

ATR 43
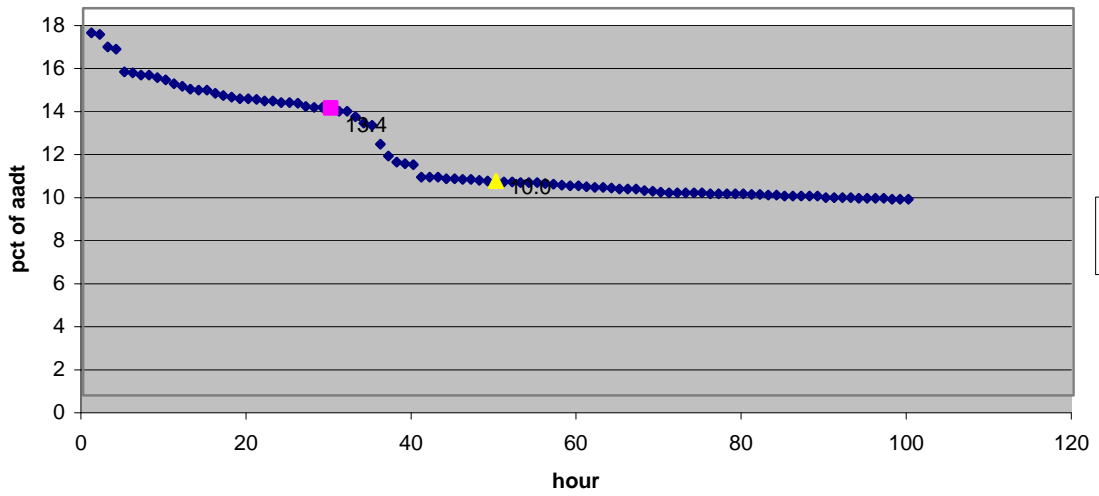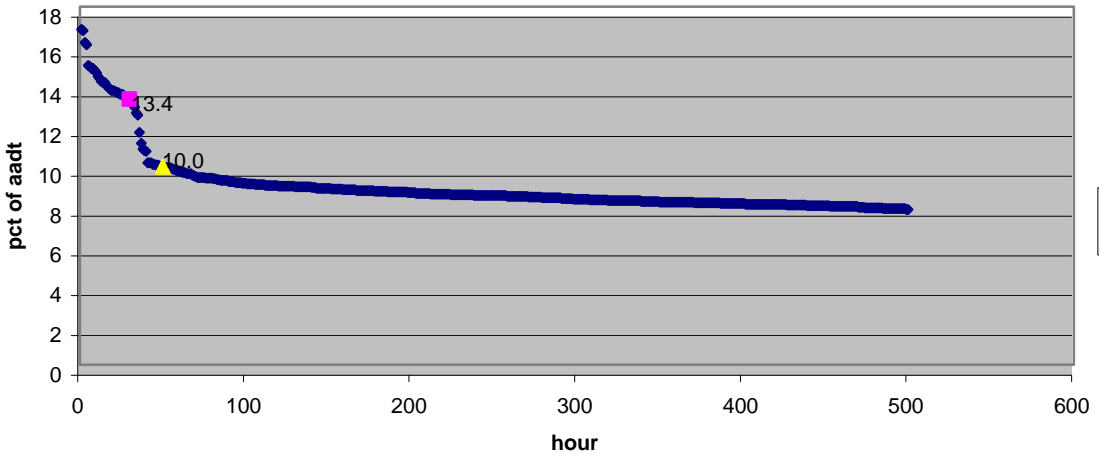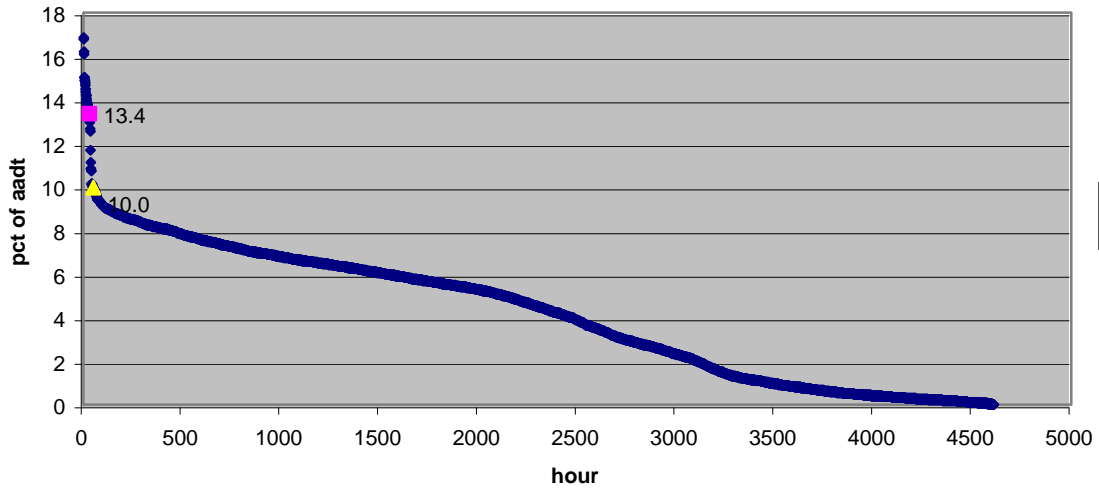
APPENDIX 1
High Hour Distributions

ATR 45
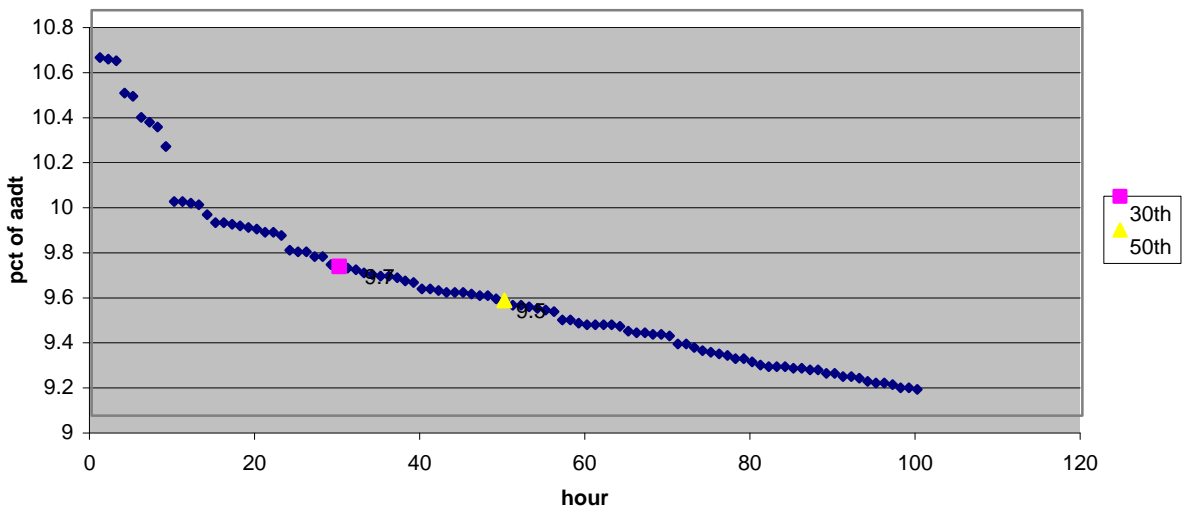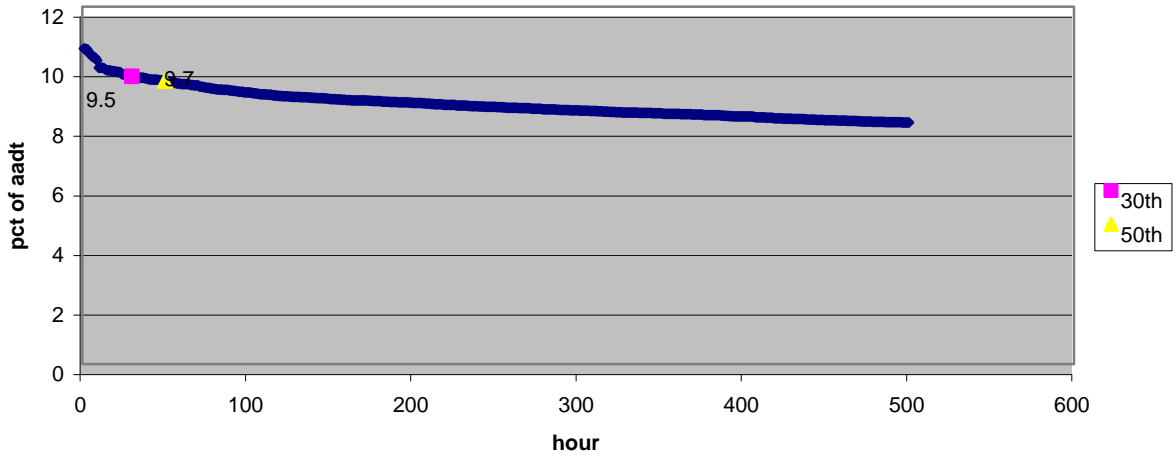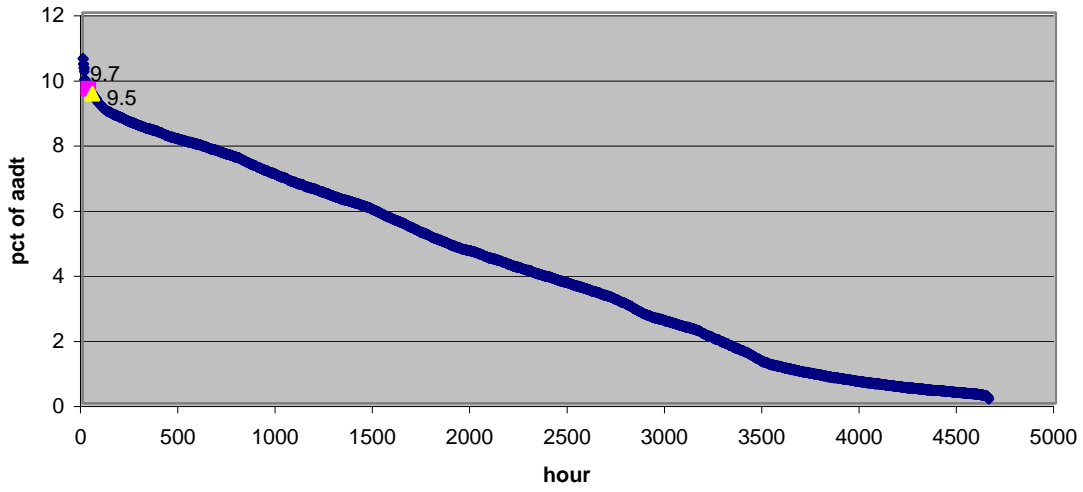
APPENDIX 1
High Hour Distributions

ATR 53
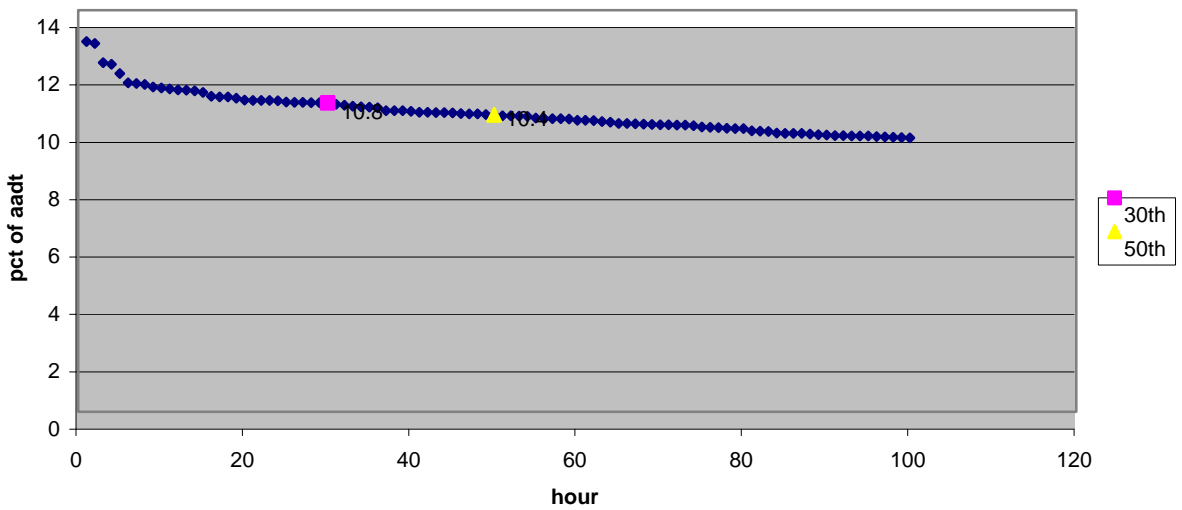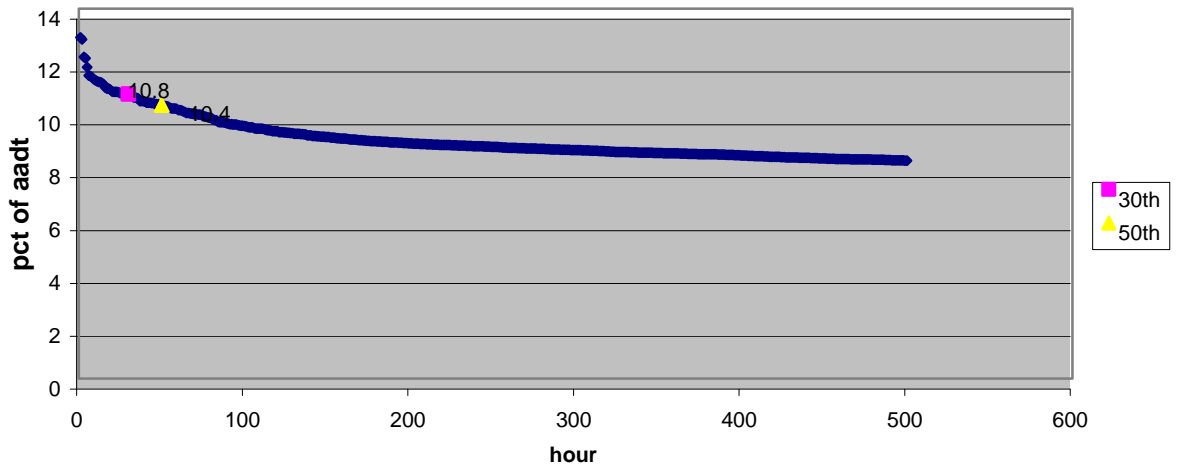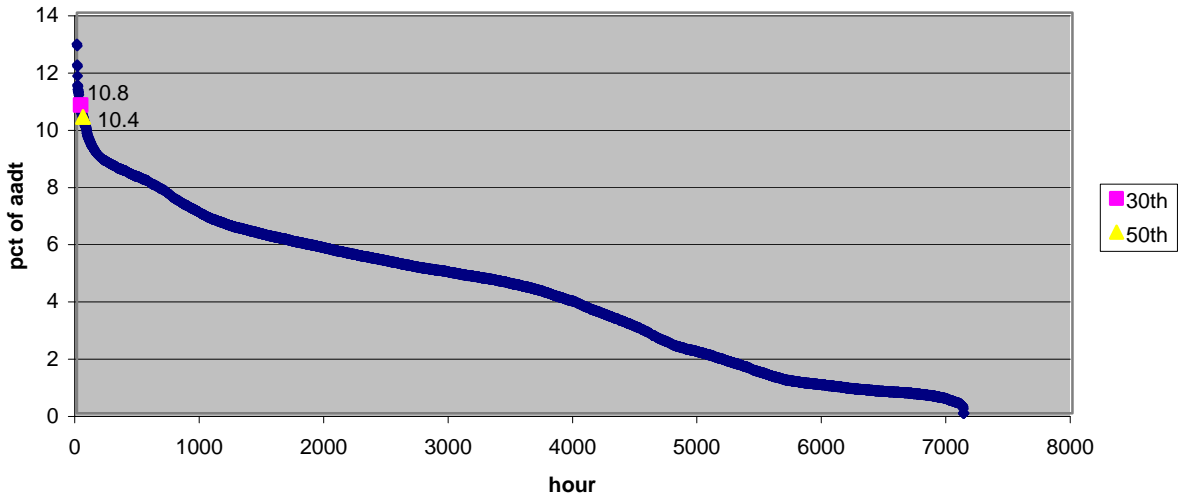
APPENDIX 1
High Hour Distributions

ATR 66
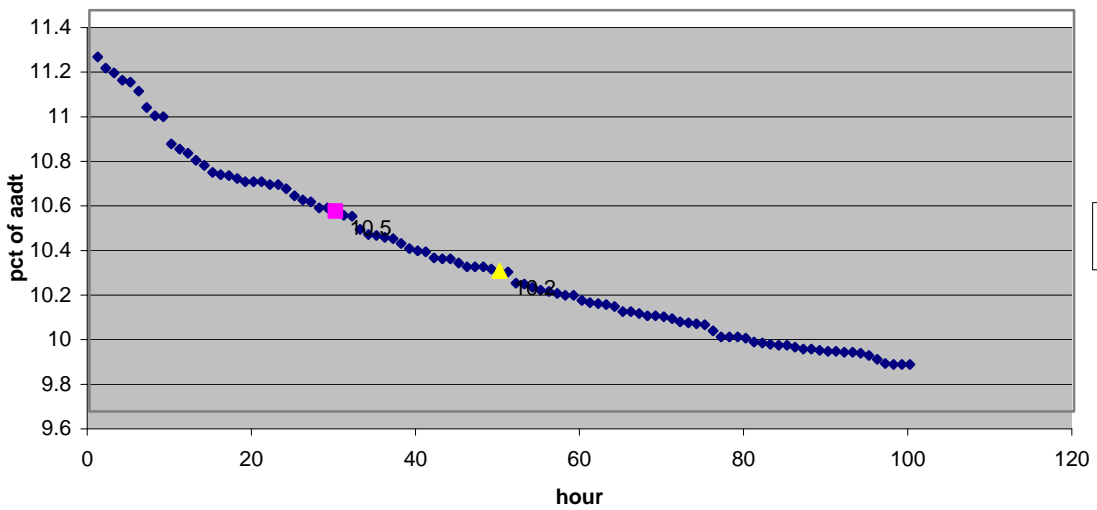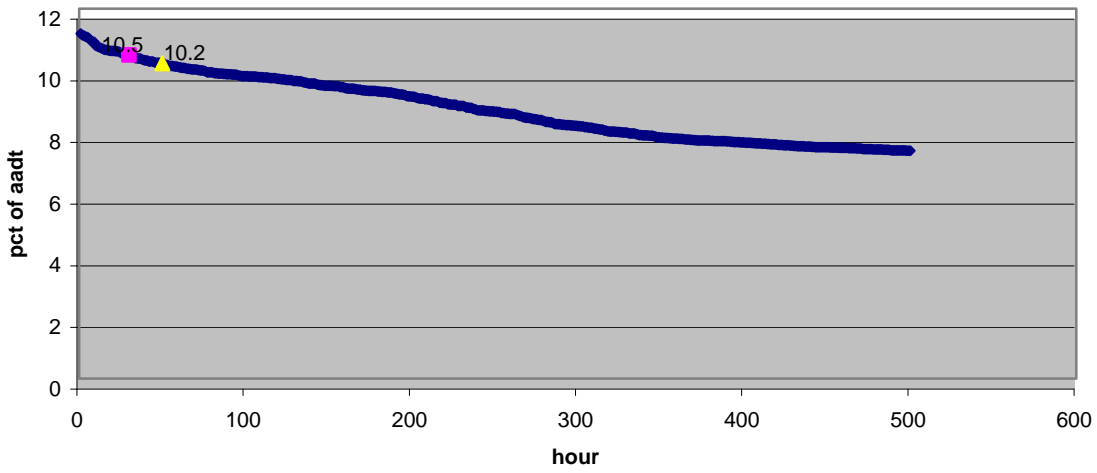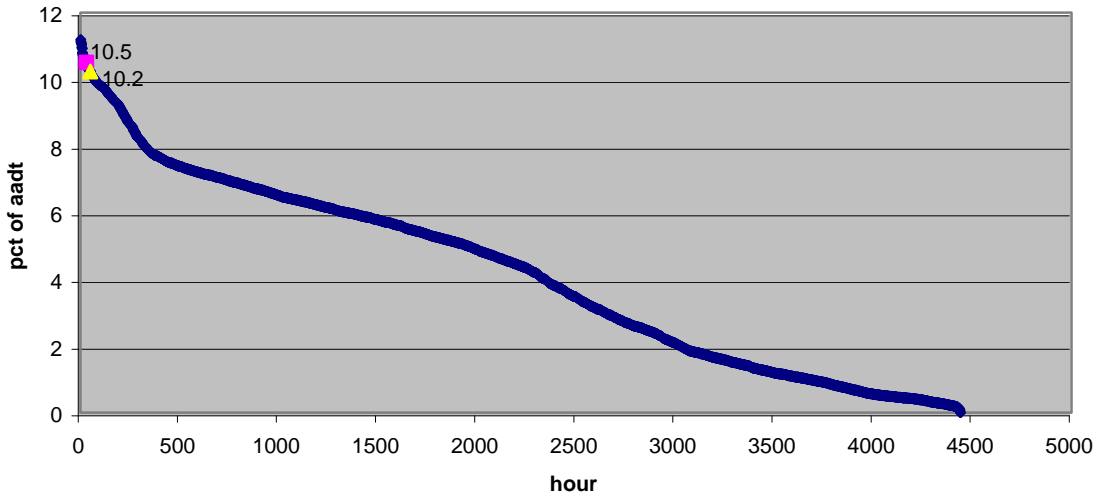
High Hour Distributions

ATR 75
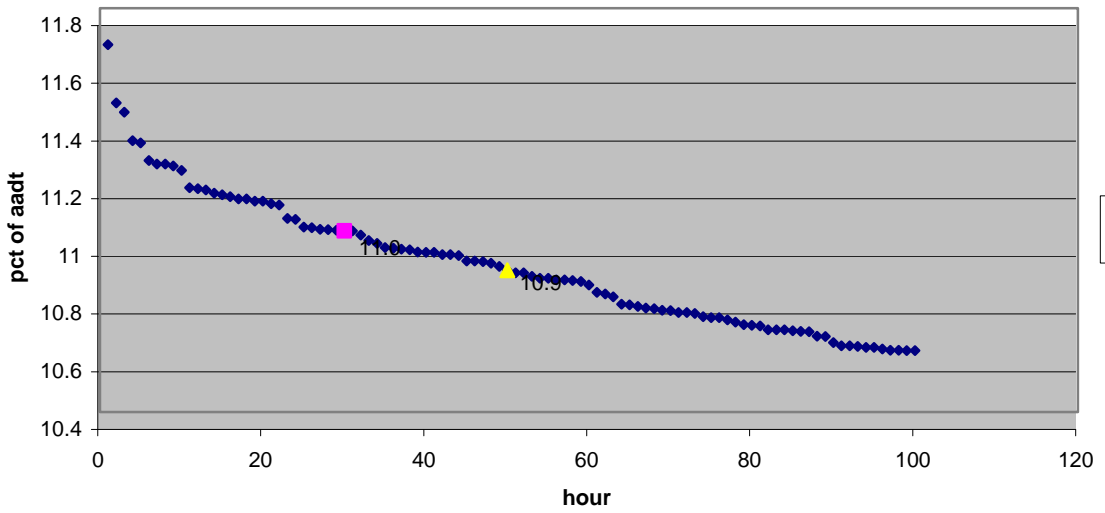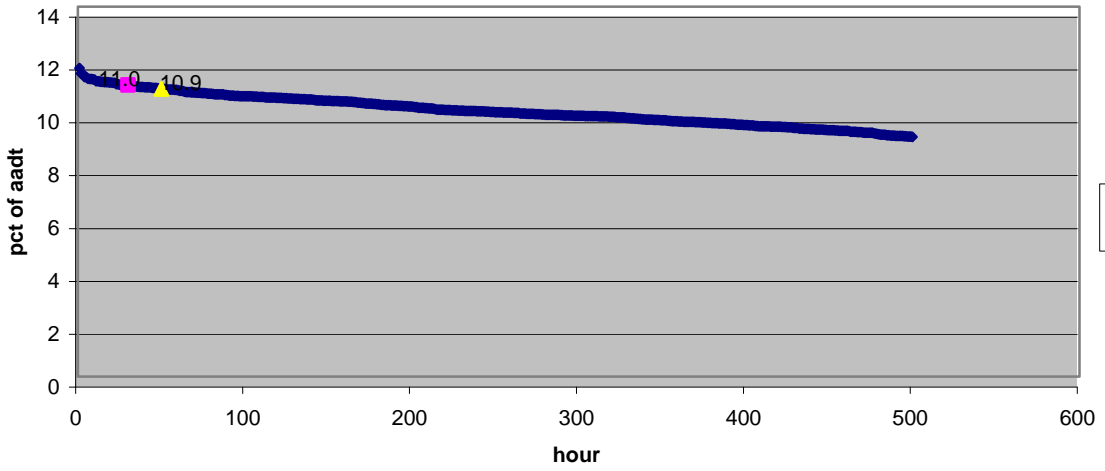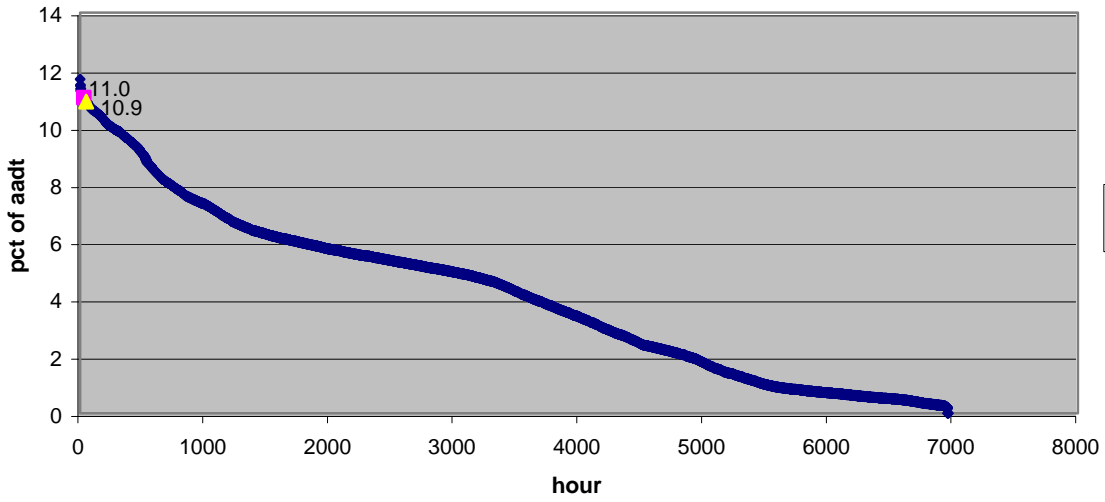
High Hour Distributions

ATR 98
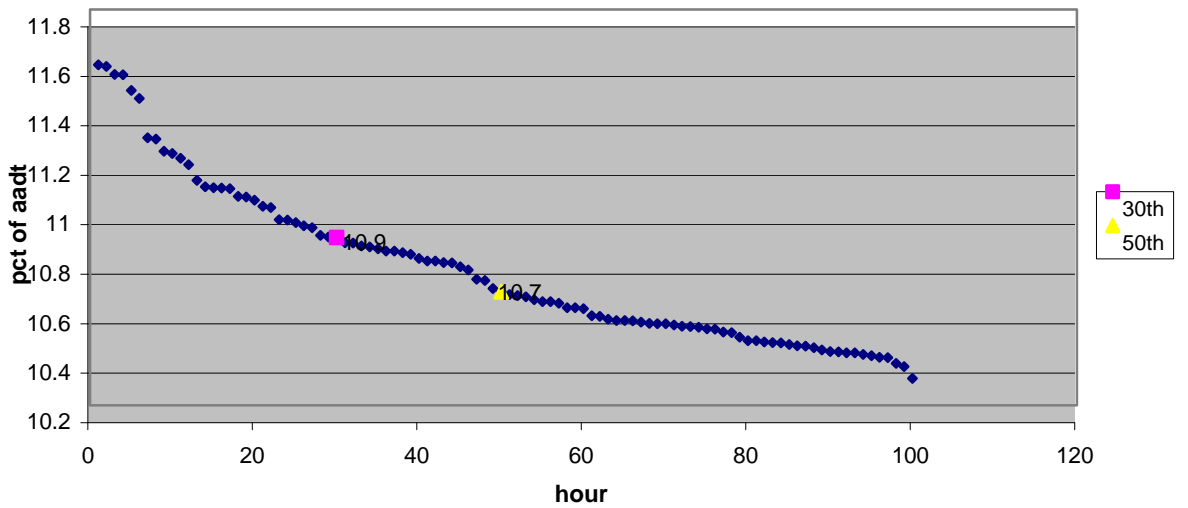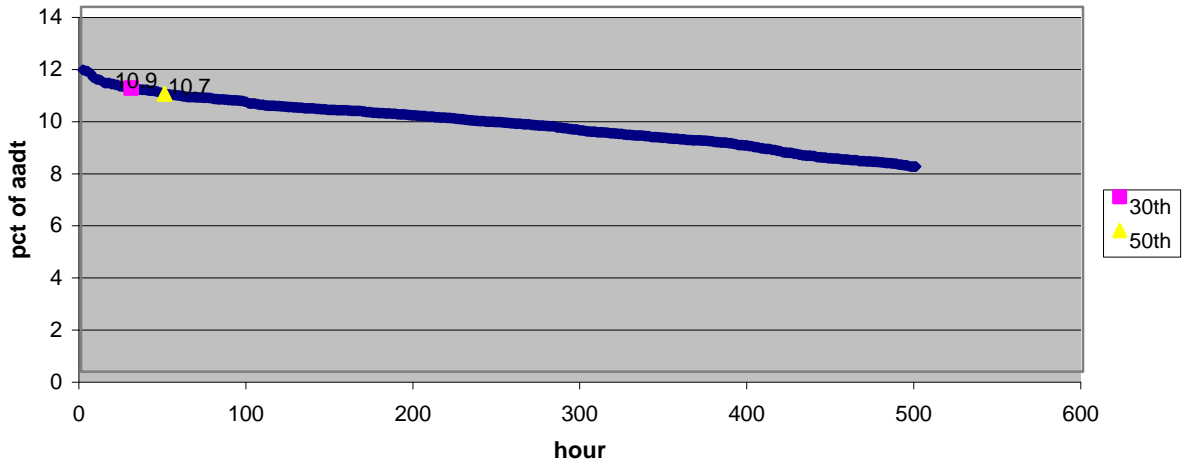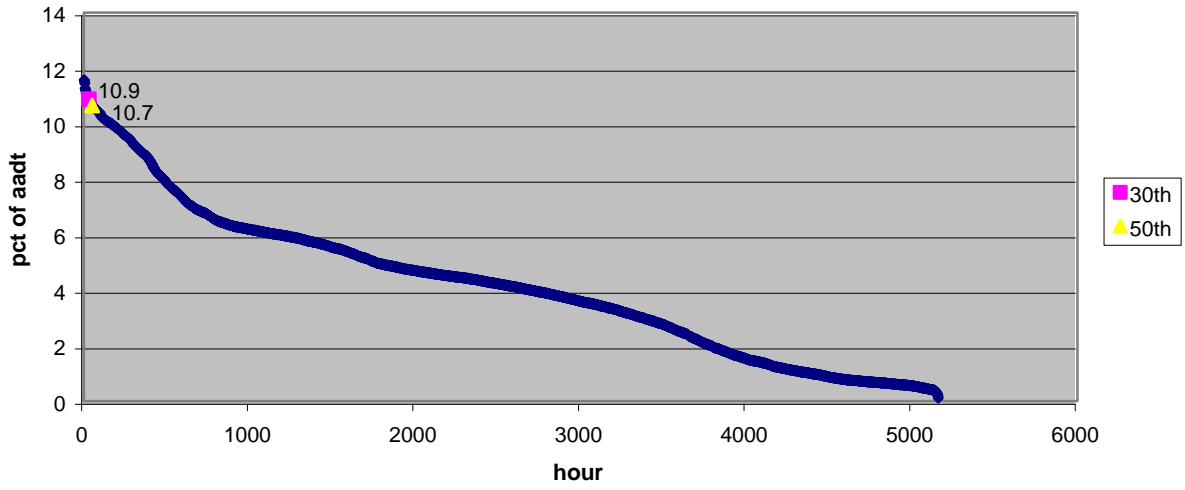
APPENDIX 2A
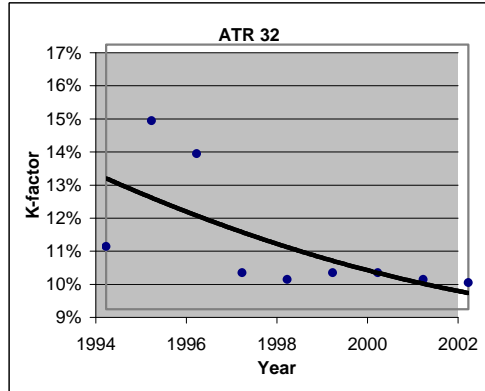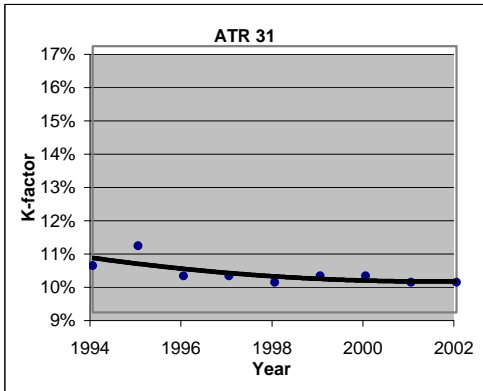**K-factor History By Functional Class**
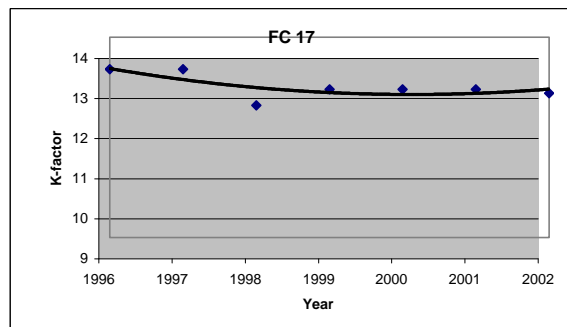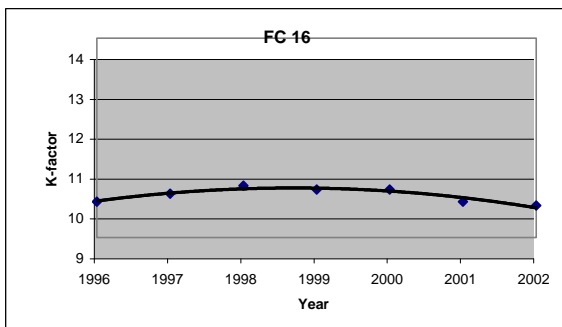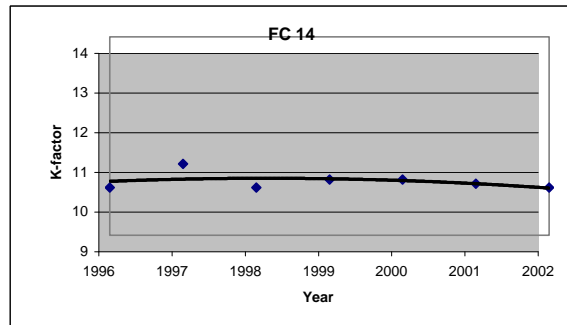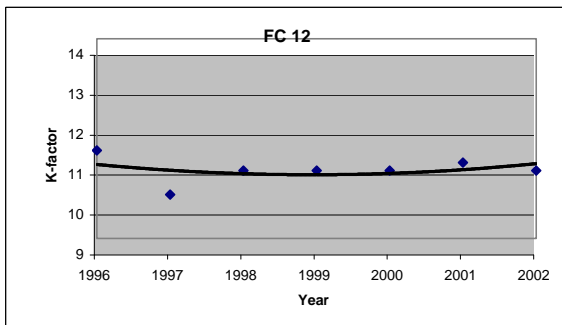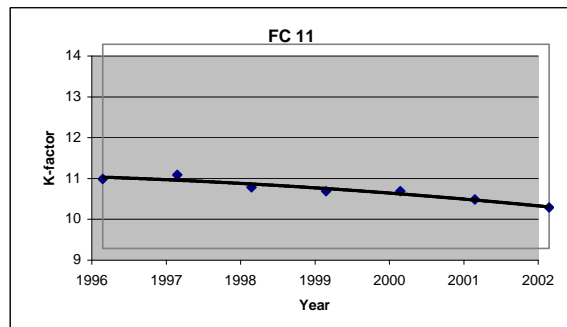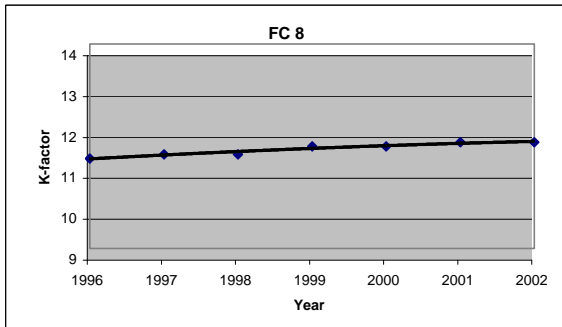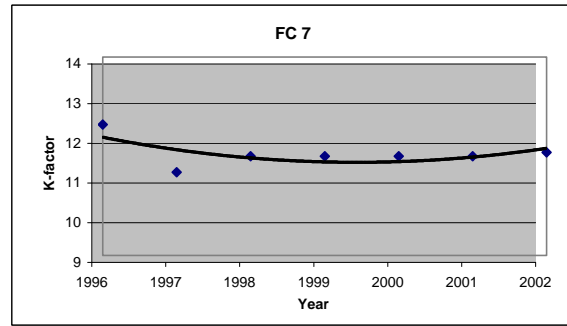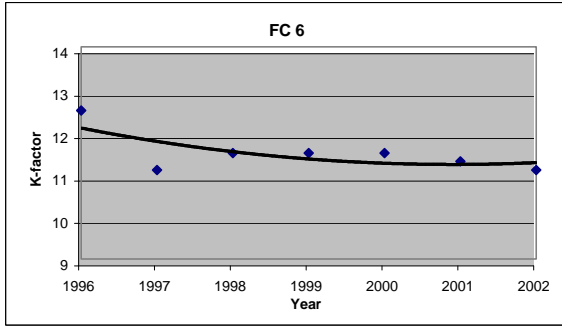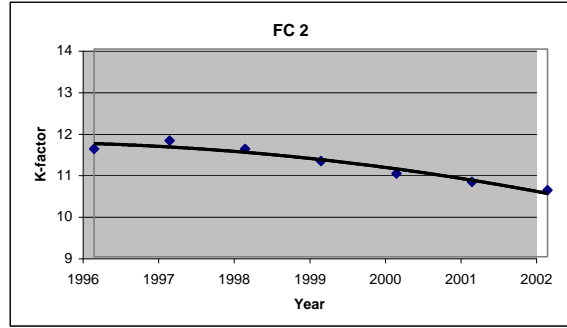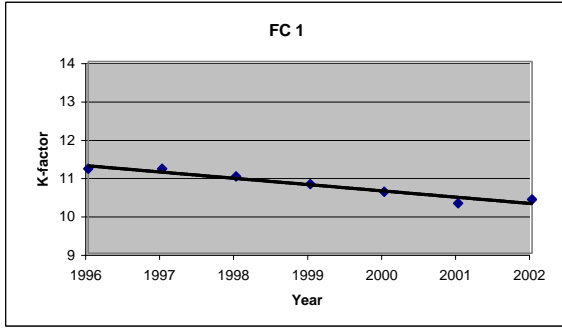
APPENDIX 2B
K-Factor History by ATR
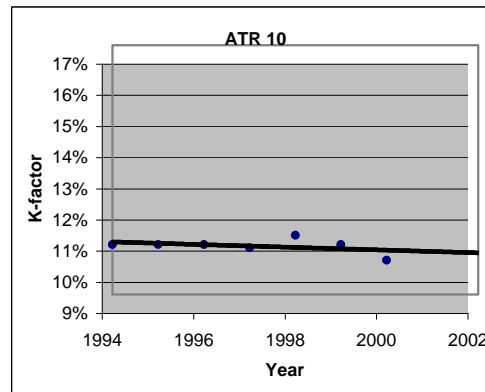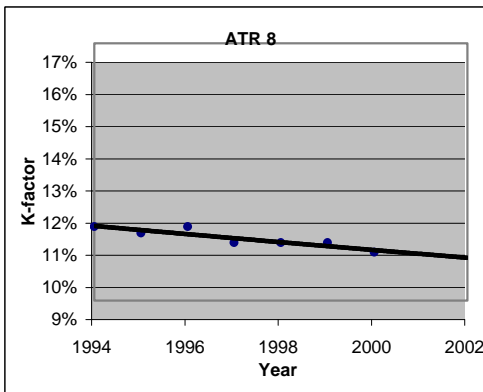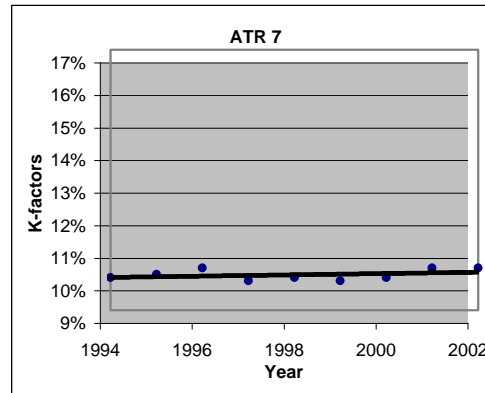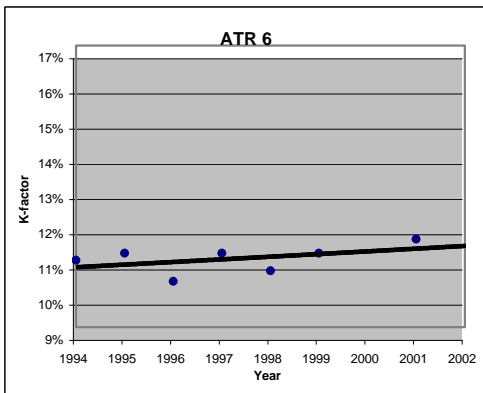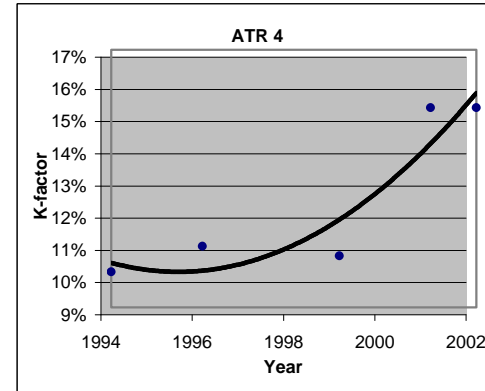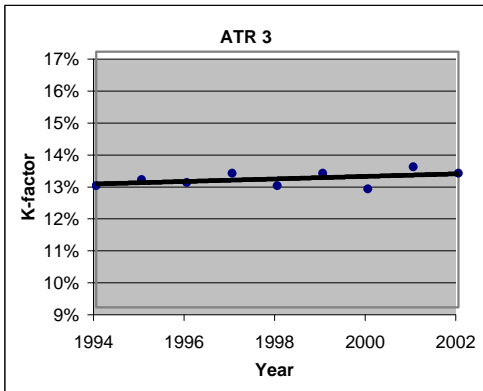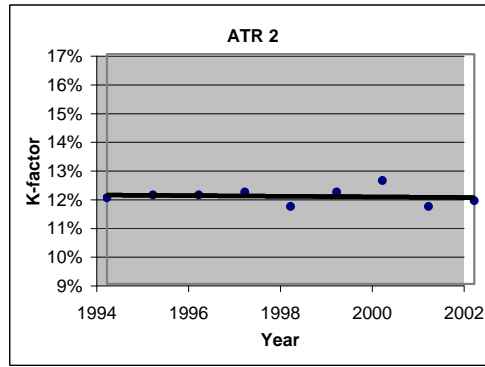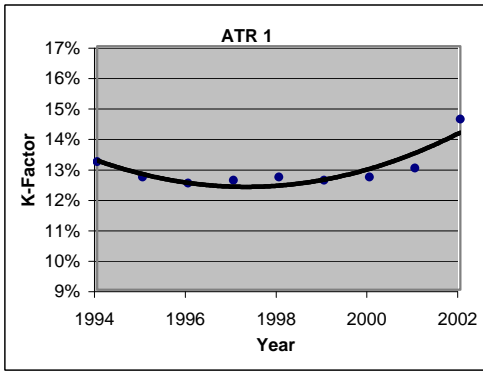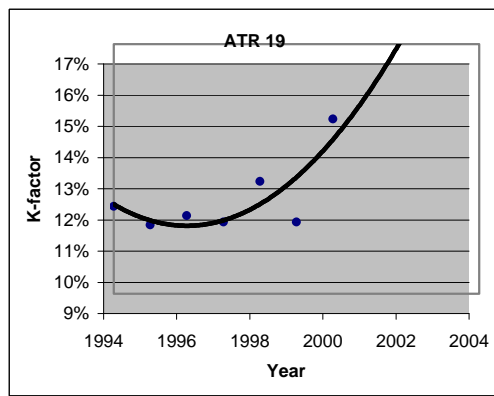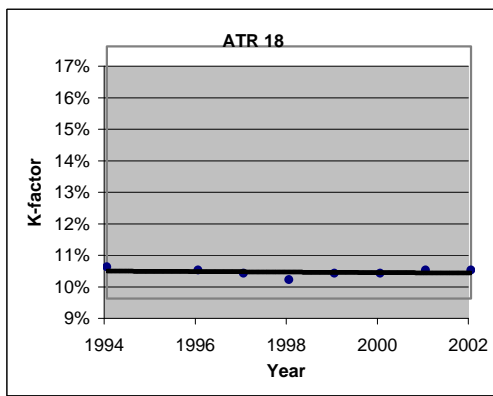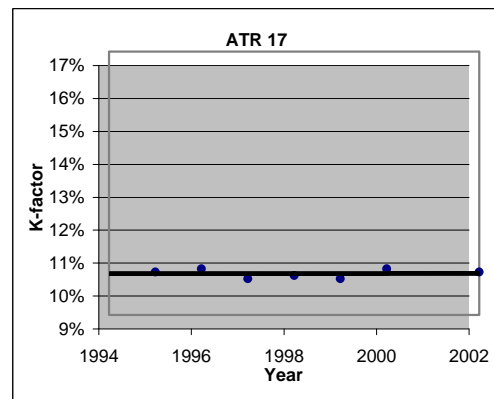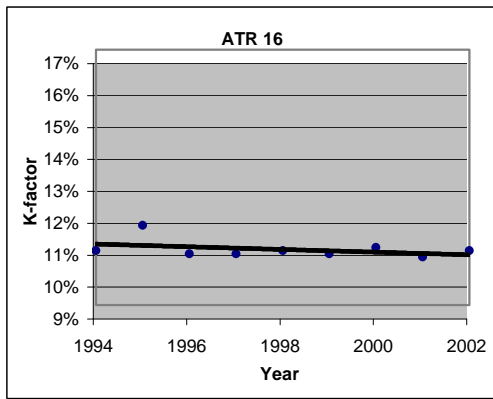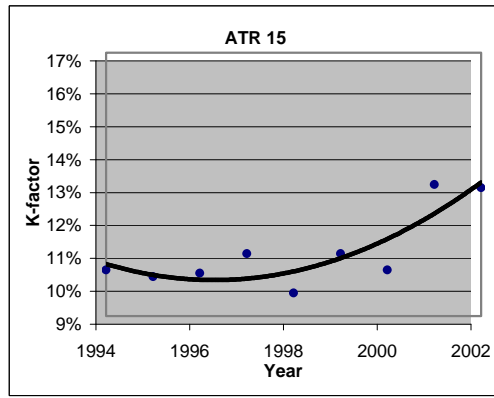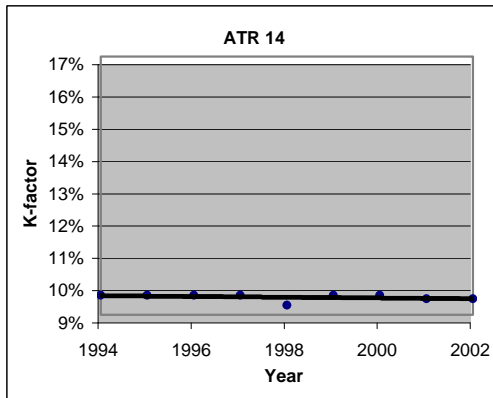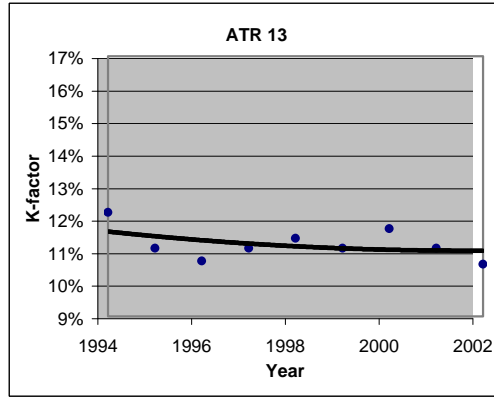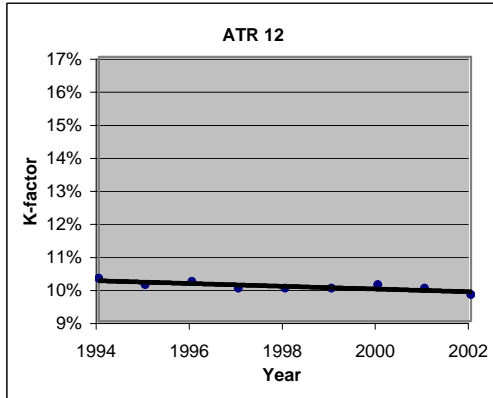
K-Factor History by ATR

ATR 12

ATR 13

ATR 14

ATR 15

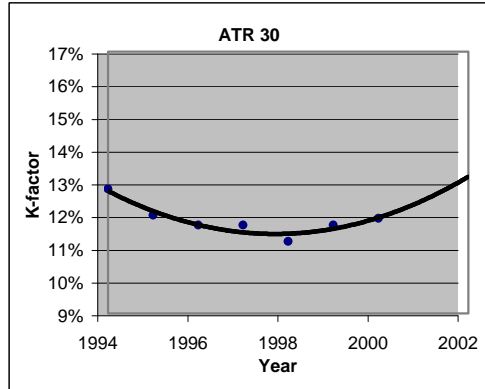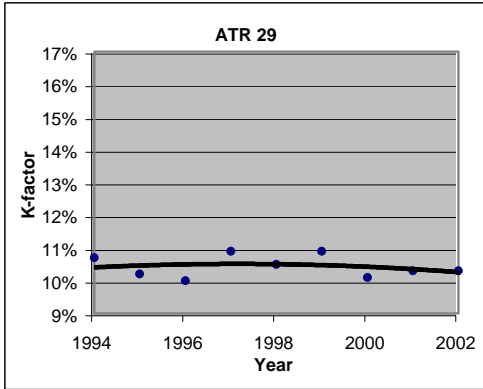ATR 16

ATR 17

ATR 18

ATR 19

APPENDIX 2B
K-Factor History by ATR

K-Factor History by ATR

ATR 37

ATR 38

ATR 39

ATR 41

ATR 42

ATR 43

ATR 45

ATR 47

APPENDIX 2B
K-Factor History by ATR

APPENDIX 2B
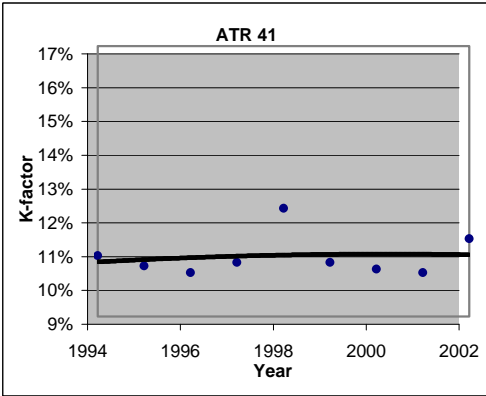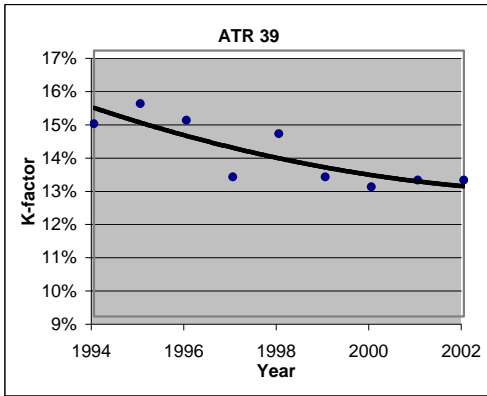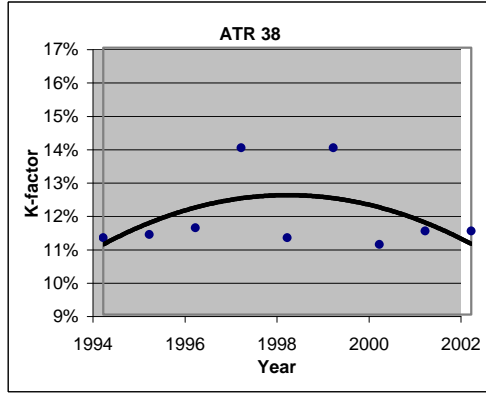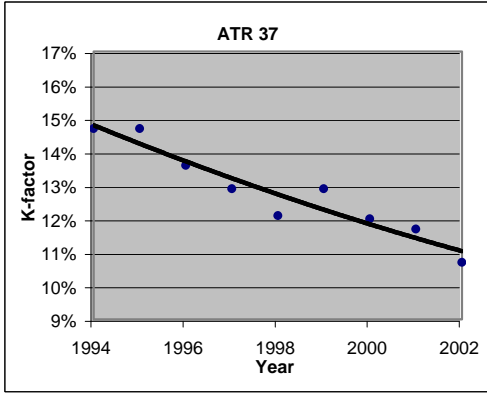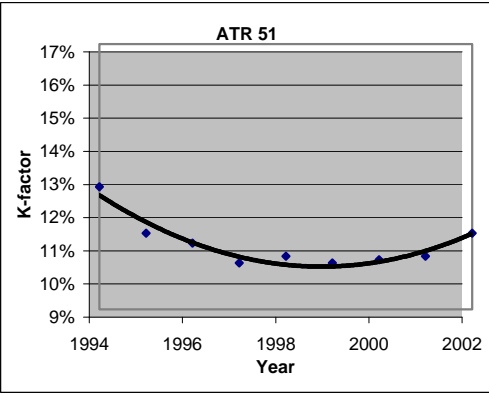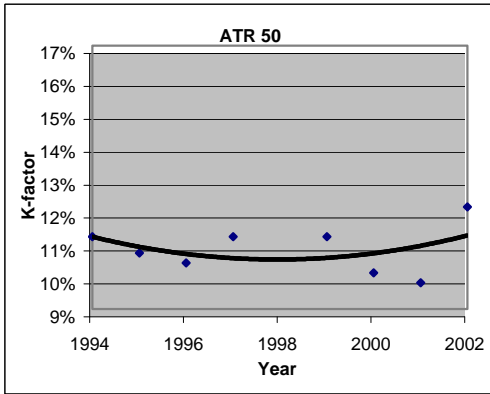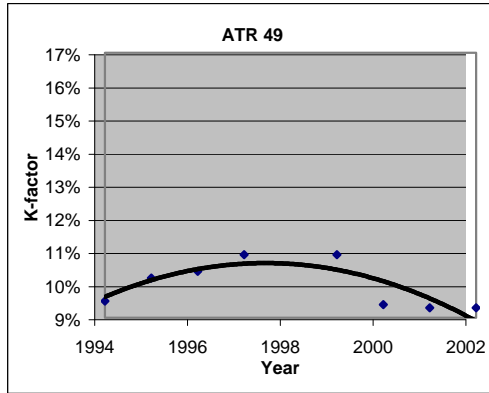# K-Factor History by ATR

K-Factor History by ATR

APPENDIX 2B
K-Factor History by ATR

ATR 94

ATR 96

ATR 97

ATR 98

ATR 99
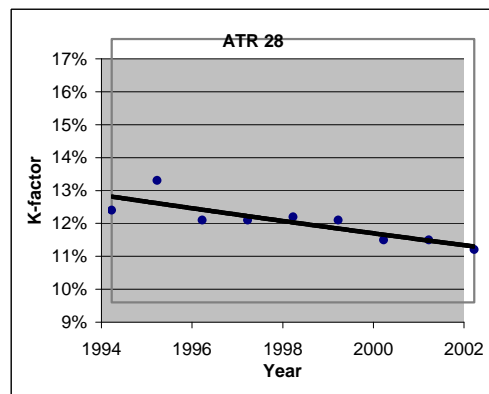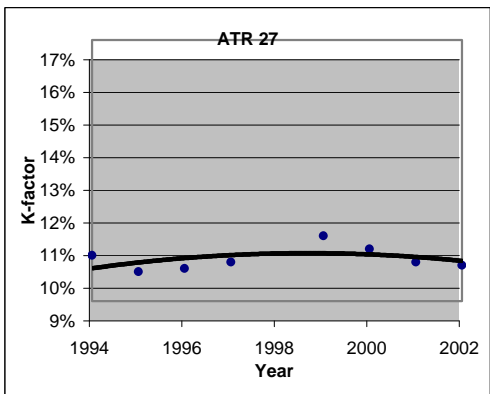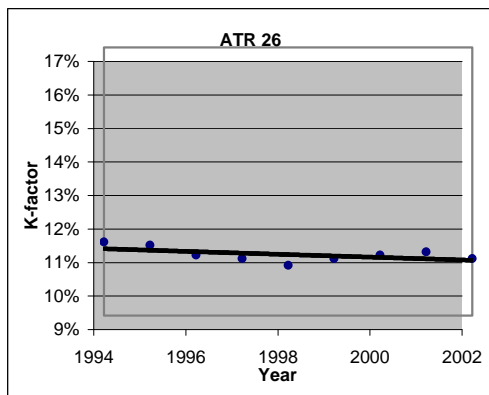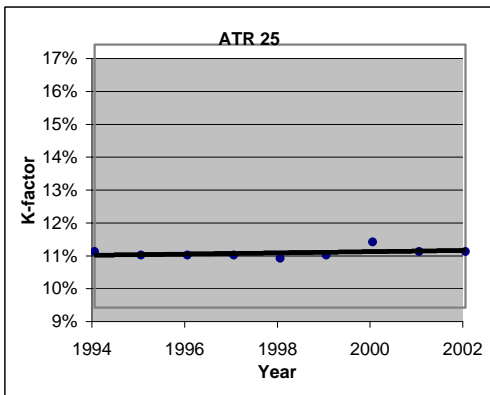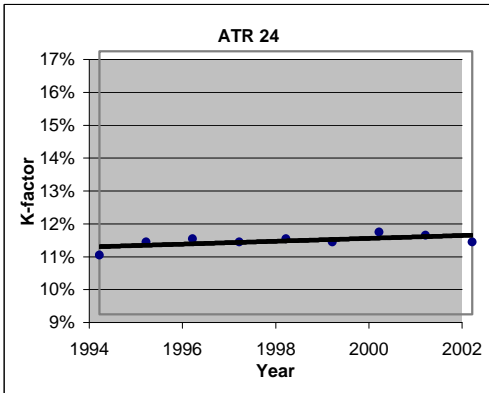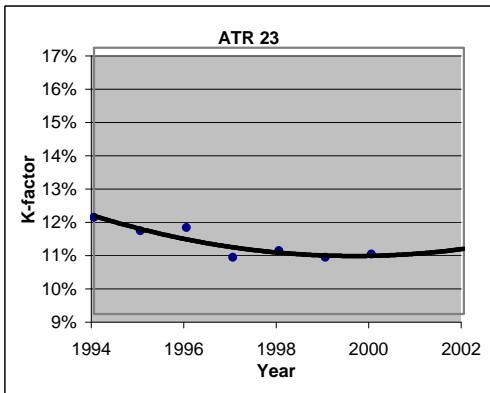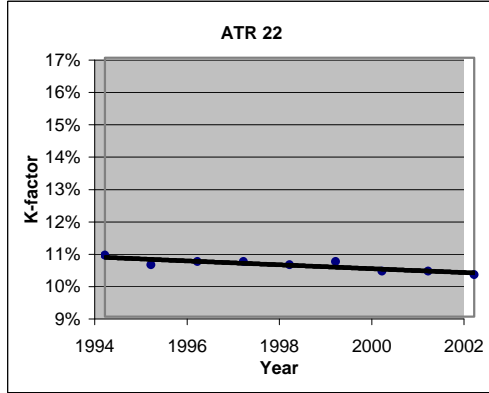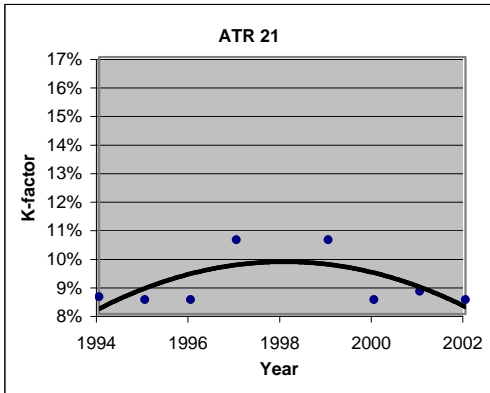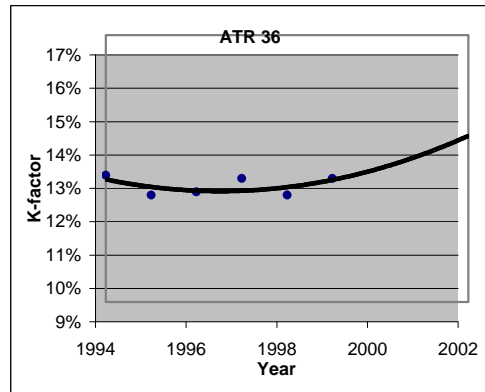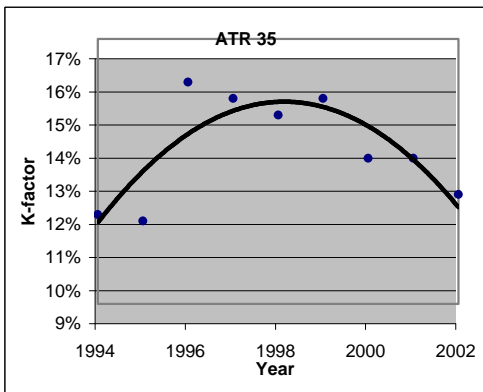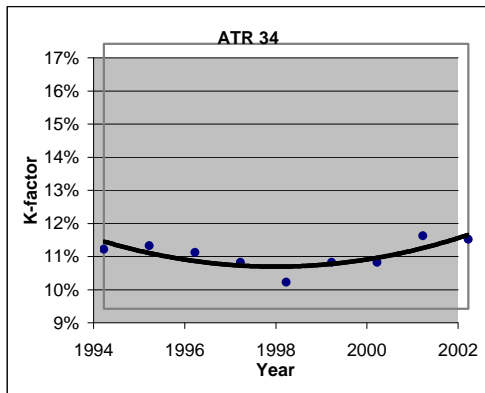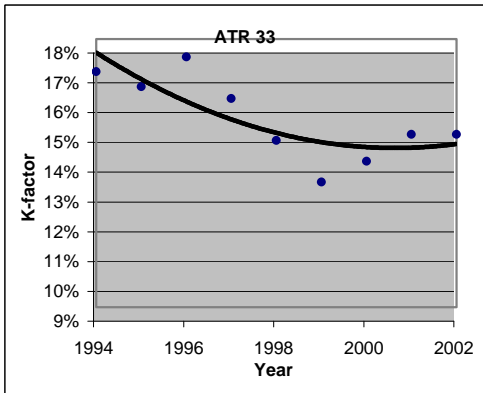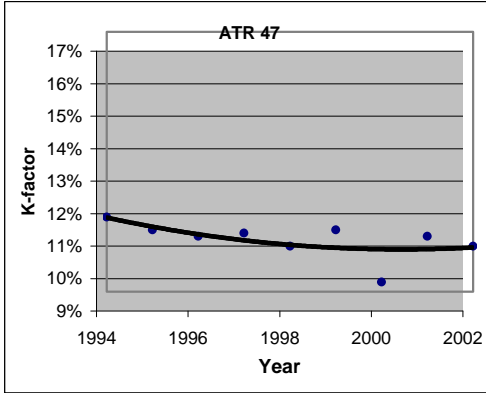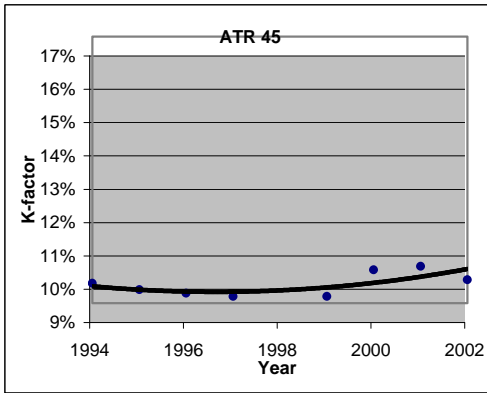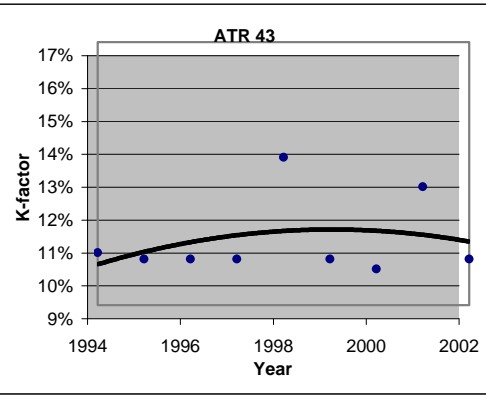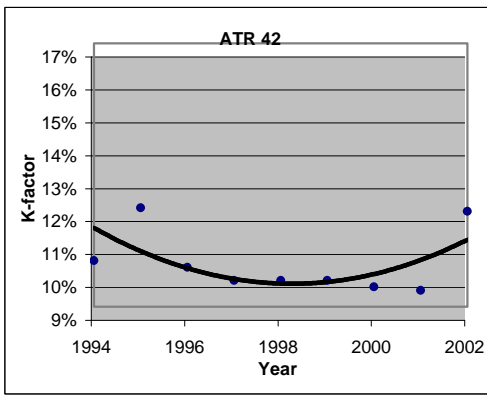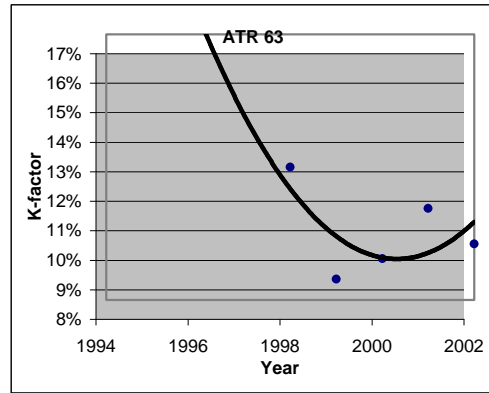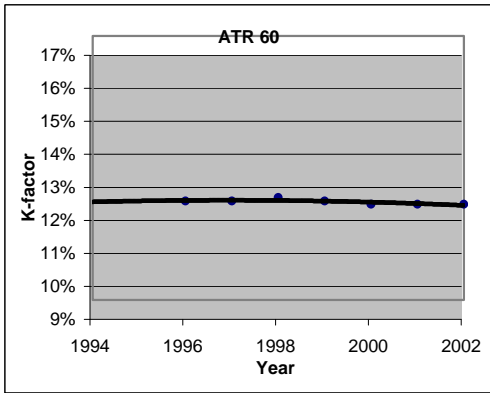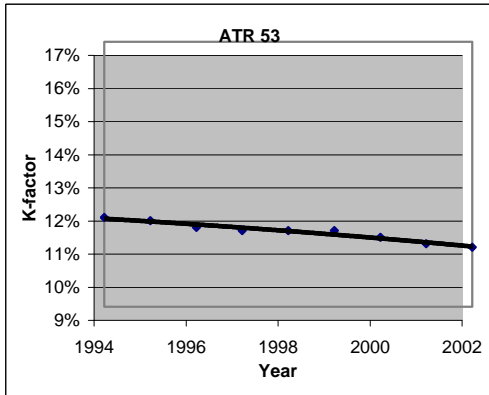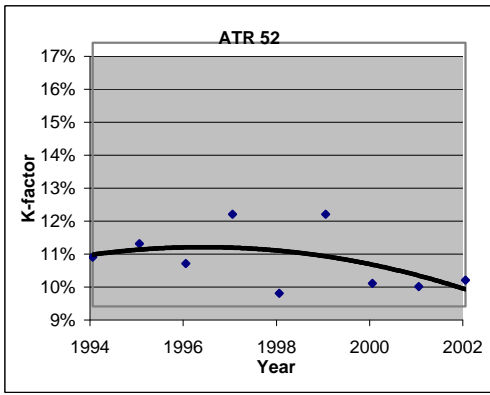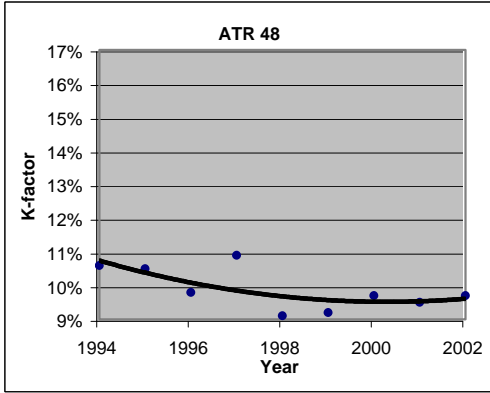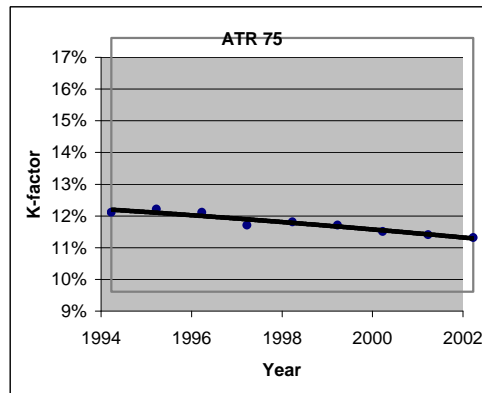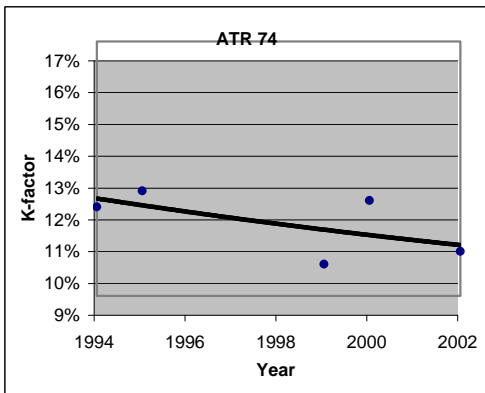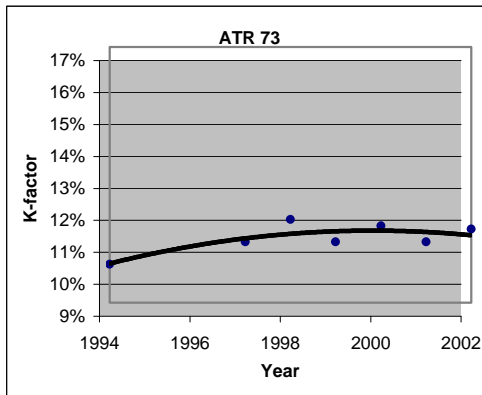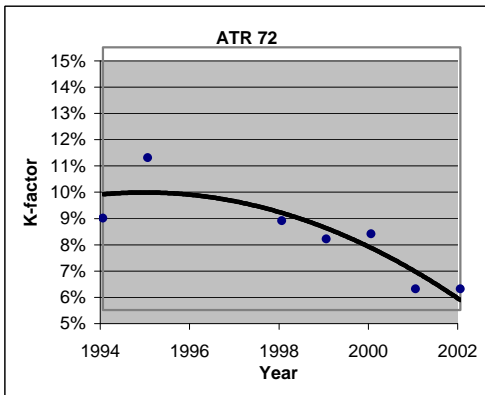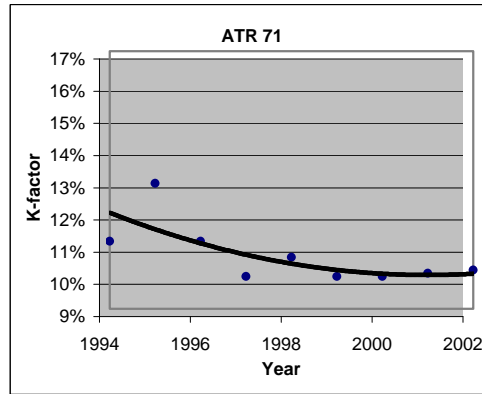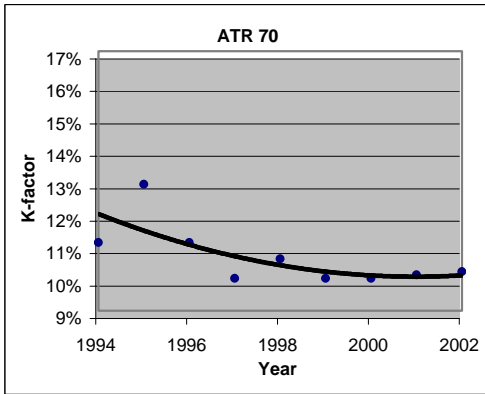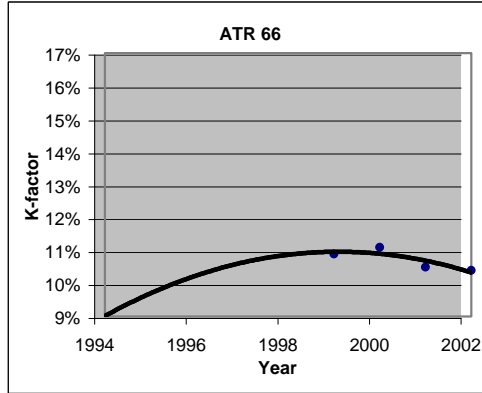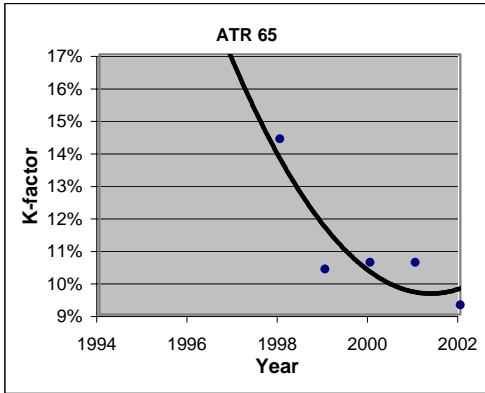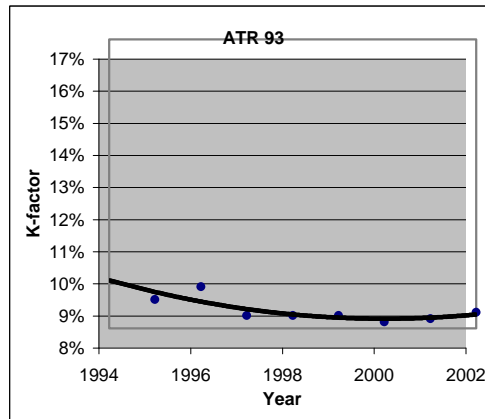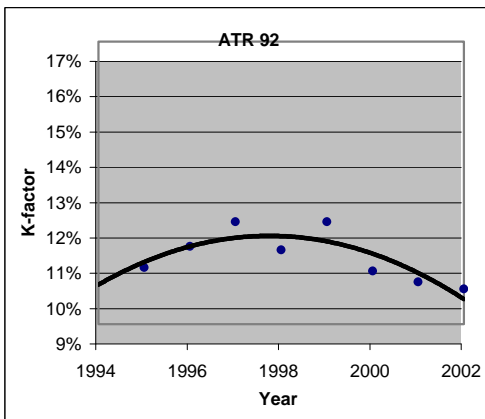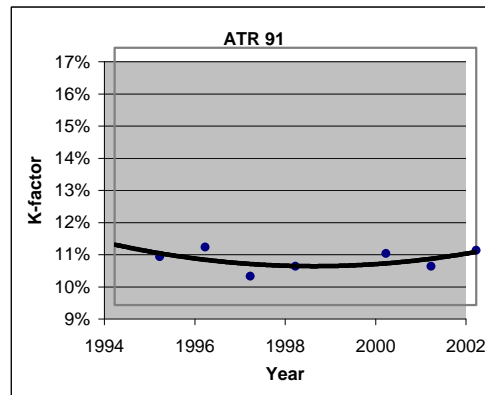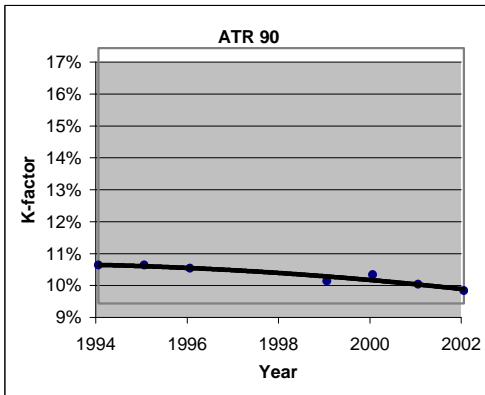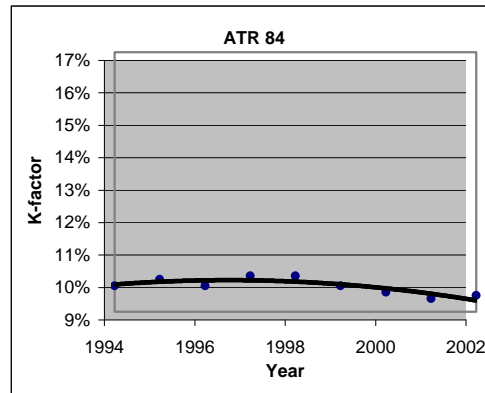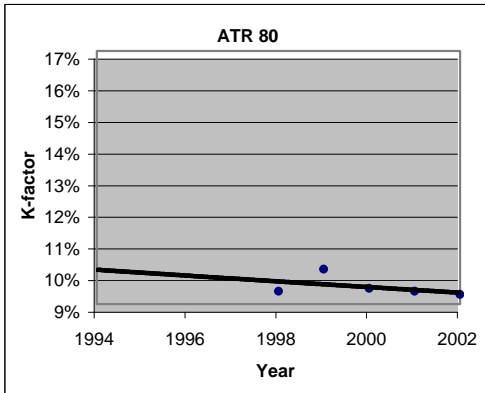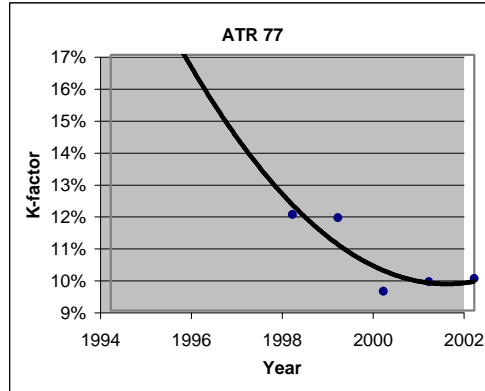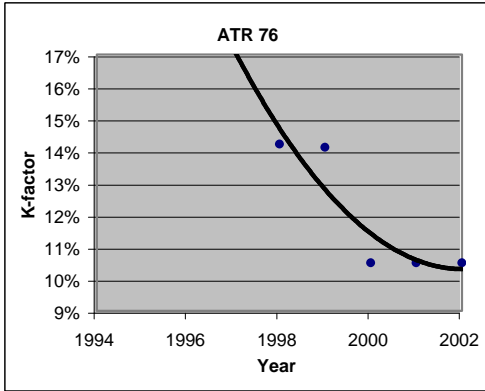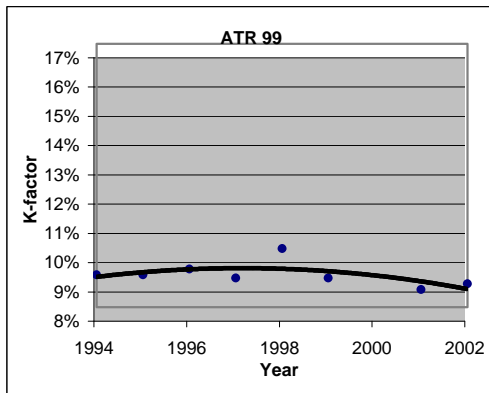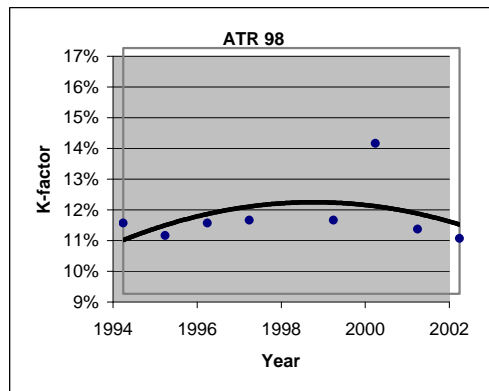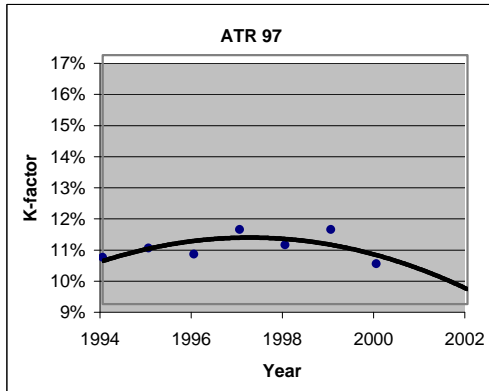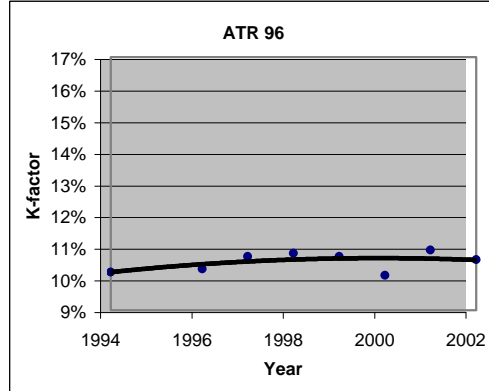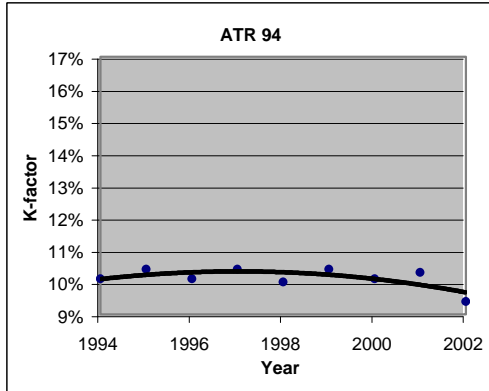
APPENDIX 3
Hourly Volume Percentage by Functional Class

FC 1: Rural Interstate

Hour	Percentage
24:00 - 1:00	1.72
1:00 - 2:00	1.33
2:00 - 3:00	1.17
3:00 - 4:00	1.15
4:00 - 5:00	1.4
5:00 - 6:00	2.33
6:00 - 7:00	3.4
7:00 - 8:00	4.48
8:00 - 9:00	4.48
9:00 - 10:00	5.02
10:00 - 11:00	5.55
11:00 - 12:00	5.75
12:00 - 13:00	5.8
13:00 - 14:00	6.09
14:00 - 15:00	6.47
15:00 - 16:00	6.8
16:00 - 17:00	6.83
17:00 - 18:00	6.56
18:00 - 19:00	5.77
19:00 - 20:00	4.85
20:00 - 21:00	4.06
21:00 - 22:00	3.55
22:00 - 23:00	3.03
23:00 - 24:00	2.42

Source: ATR 23

FC 2: Rural Principal Arterial

Hour	Percentage
24:00 - 1:00	1.1
1:00 - 2:00	0.78
2:00 - 3:00	0.68
3:00 - 4:00	0.69
4:00 - 5:00	0.94
5:00 - 6:00	1.95
6:00 - 7:00	4.81
7:00 - 8:00	7.71
8:00 - 9:00	5.73
9:00 - 10:00	4.72
10:00 - 11:00	4.66
11:00 - 12:00	4.78
12:00 - 13:00	5.03
13:00 - 14:00	5.21
14:00 - 15:00	5.76
15:00 - 16:00	6.97
16:00 - 17:00	8.25
17:00 - 18:00	8.62
18:00 - 19:00	6.28
19:00 - 20:00	4.37
20:00 - 21:00	3.64
21:00 - 22:00	3.18
22:00 - 23:00	2.44
23:00 - 24:00	1.72

Source: ATR 53
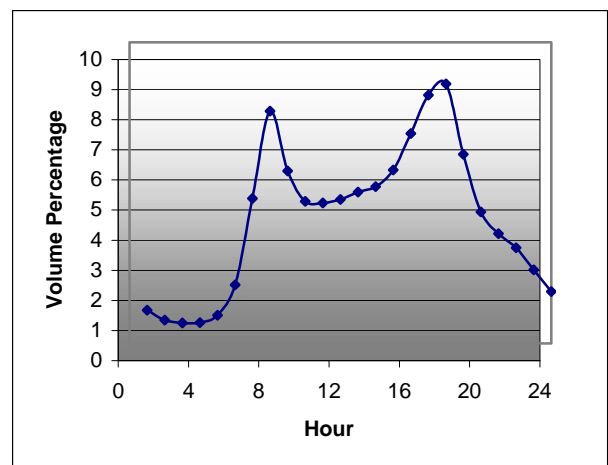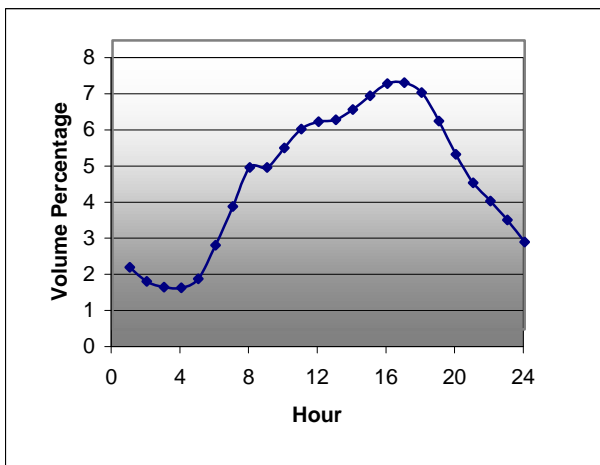
* Hourly volume percentages come from an average of 1999 weekday ATR data.

APPENDIX 3
Hourly Volume Percentage by Functional Class

FC 6: Rural Minor Arterial

Hour	Percentage
24:00 - 1:00	0.76
1:00 - 2:00	0.45
2:00 - 3:00	0.36
3:00 - 4:00	0.41
4:00 - 5:00	0.81
5:00 - 6:00	2.13
6:00 - 7:00	5.17
7:00 - 8:00	7.67
8:00 - 9:00	5.45
9:00 - 10:00	4.67
10:00 - 11:00	4.79
11:00 - 12:00	4.98
12:00 - 13:00	5.36
13:00 - 14:00	5.61
14:00 - 15:00	6.04
15:00 - 16:00	7.58
16:00 - 17:00	9.13
17:00 - 18:00	8.56
18:00 - 19:00	6.20
19:00 - 20:00	4.26
20:00 - 21:00	3.48
21:00 - 22:00	2.90
22:00 - 23:00	1.95
23:00 - 24:00	1.34

Source: ATR 1 & ATR 29

FC 7: Rural Major Collector

Hour	Percentage
24:00 - 1:00	0.74
1:00 - 2:00	0.37
2:00 - 3:00	0.28
3:00 - 4:00	0.28
4:00 - 5:00	0.62
5:00 - 6:00	1.39
6:00 - 7:00	2.81
7:00 - 8:00	5.45
8:00 - 9:00	4.94
9:00 - 10:00	4.20
10:00 - 11:00	4.81
11:00 - 12:00	5.40
12:00 - 13:00	5.83
13:00 - 14:00	6.32
14:00 - 15:00	6.87
15:00 - 16:00	7.88
16:00 - 17:00	8.49
17:00 - 18:00	8.83
18:00 - 19:00	7.19
19:00 - 20:00	5.63
20:00 - 21:00	4.48
21:00 - 22:00	3.50
22:00 - 23:00	2.30
23:00 - 24:00	1.40

Source: ATR 16

* Hourly volume percentages come from an average of 1999 weekday ATR data.

APPENDIX 3
Hourly Volume Percentage by Functional Class

FC 8: Rural Minor Collector

Hour	Percentage
24:00 - 1:00	0.78
1:00 - 2:00	0.47
2:00 - 3:00	0.31
3:00 - 4:00	0.27
4:00 - 5:00	0.61
5:00 - 6:00	1.21
6:00 - 7:00	3.48
7:00 - 8:00	6.74
8:00 - 9:00	5.53
9:00 - 10:00	4.83
10:00 - 11:00	5.07
11:00 - 12:00	5.57
12:00 - 13:00	5.95
13:00 - 14:00	5.74
14:00 - 15:00	6.21
15:00 - 16:00	7.43
16:00 - 17:00	7.94
17:00 - 18:00	8.46
18:00 - 19:00	6.67
19:00 - 20:00	5.09
20:00 - 21:00	4.20
21:00 - 22:00	3.43
22:00 - 23:00	2.32
23:00 - 24:00	1.74

Source: ATR 19 & ATR 43

FC 11: Urban Interstate

Hour	Percentage
24:00 - 1:00	0.95
1:00 - 2:00	0.6
2:00 - 3:00	0.57
3:00 - 4:00	0.61
4:00 - 5:00	1.21
5:00 - 6:00	2.95
6:00 - 7:00	5.33
7:00 - 8:00	8.29
8:00 - 9:00	5.88
9:00 - 10:00	4.15
10:00 - 11:00	3.91
11:00 - 12:00	4.11
12:00 - 13:00	4.37
13:00 - 14:00	4.67
14:00 - 15:00	5.71
15:00 - 16:00	7.25
16:00 - 17:00	8.63
17:00 - 18:00	9.38
18:00 - 19:00	6.16
19:00 - 20:00	4.22
20:00 - 21:00	3.52
21:00 - 22:00	3.21
22:00 - 23:00	2.57
23:00 - 24:00	1.75

Source: ATR 98

* Hourly volume percentages come from an average of 1999 weekday ATR data.

APPENDIX 3
Hourly Volume Percentage by Functional Class

FC 12: Urban Other Freeway

Hour	Percentage
24:00 - 1:00	0.73
1:00 - 2:00	0.44
2:00 - 3:00	0.44
3:00 - 4:00	0.54
4:00 - 5:00	0.70
5:00 - 6:00	2.00
6:00 - 7:00	4.89
7:00 - 8:00	8.32
8:00 - 9:00	6.50
9:00 - 10:00	4.51
10:00 - 11:00	4.39
11:00 - 12:00	4.96
12:00 - 13:00	5.41
13:00 - 14:00	5.34
14:00 - 15:00	5.85
15:00 - 16:00	7.42
16:00 - 17:00	8.68
17:00 - 18:00	8.90
18:00 - 19:00	6.07
19:00 - 20:00	4.20
20:00 - 21:00	3.38
21:00 - 22:00	2.89
22:00 - 23:00	2.04
23:00 - 24:00	1.37

Source: ATR 75

FC 14: Urban Principal Arterial

Hour	Percentage
24:00 - 1:00	0.84
1:00 - 2:00	0.54
2:00 - 3:00	0.40
3:00 - 4:00	0.38
4:00 - 5:00	0.89
5:00 - 6:00	2.13
6:00 - 7:00	4.64
7:00 - 8:00	5.99
8:00 - 9:00	4.62
9:00 - 10:00	4.34
10:00 - 11:00	4.84
11:00 - 12:00	6.44
12:00 - 13:00	6.99
13:00 - 14:00	6.02
14:00 - 15:00	6.45
15:00 - 16:00	7.95
16:00 - 17:00	8.44
17:00 - 18:00	7.44
18:00 - 19:00	6.23
19:00 - 20:00	4.64
20:00 - 21:00	3.65
21:00 - 22:00	2.77
22:00 - 23:00	2.01
23:00 - 24:00	1.41

Source: ATR 7 & ATR 66
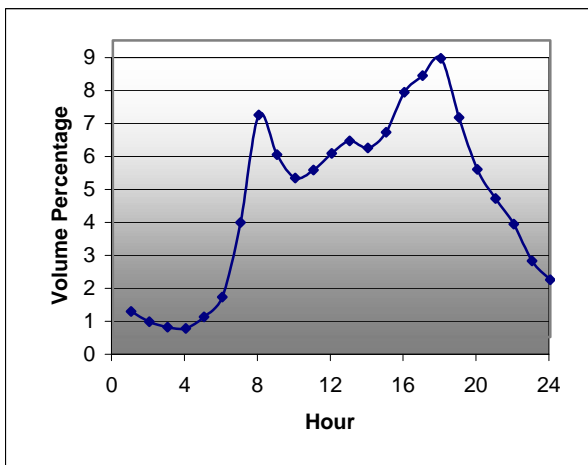
* Hourly volume percentages come from an average of 1999 weekday ATR data.

APPENDIX 3
Hourly Volume Percentage by Functional Class
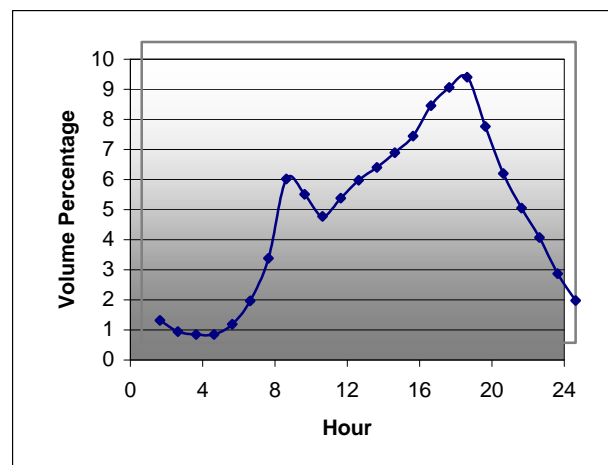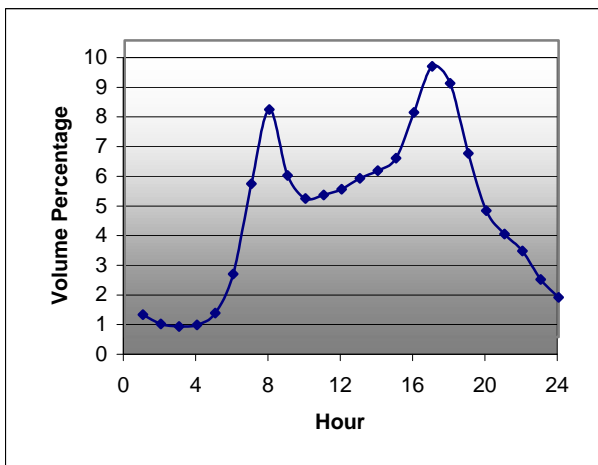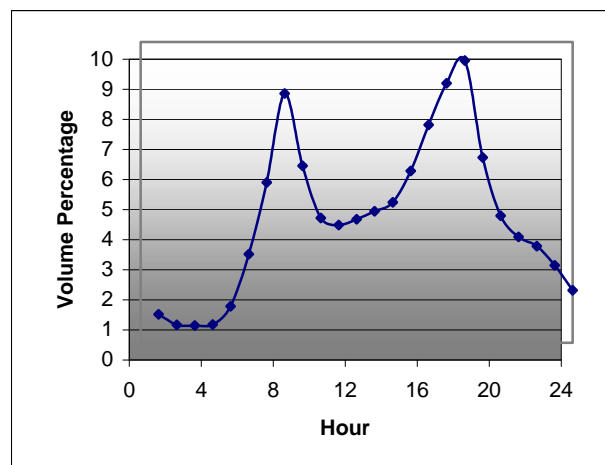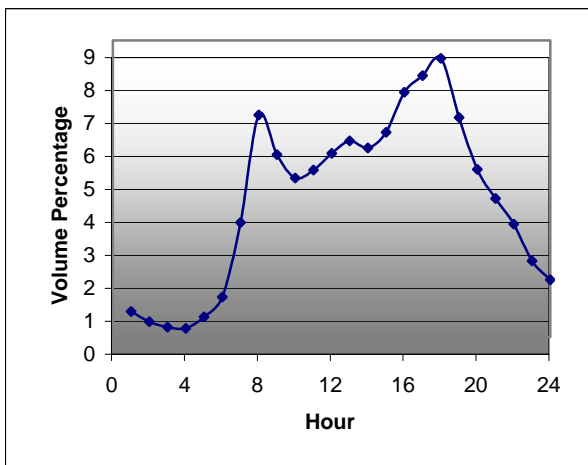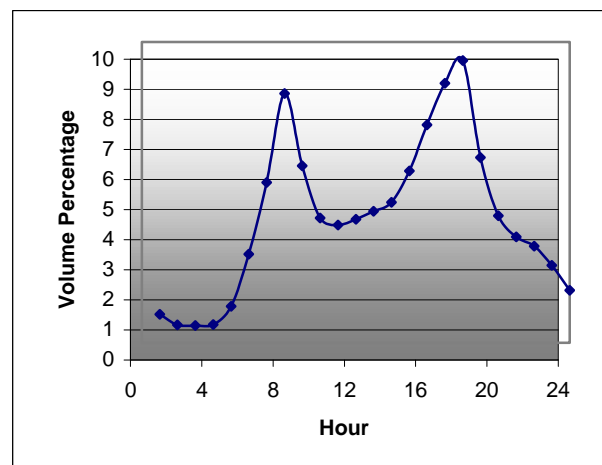
FC 16: Urban Minor Arterial

Hour	Percentage
24:00 - 1:00	0.78
1:00 - 2:00	0.47
2:00 - 3:00	0.31
3:00 - 4:00	0.27
4:00 - 5:00	0.61
5:00 - 6:00	1.21
6:00 - 7:00	3.48
7:00 - 8:00	6.74
8:00 - 9:00	5.53
9:00 - 10:00	4.83
10:00 - 11:00	5.07
11:00 - 12:00	5.57
12:00 - 13:00	5.95
13:00 - 14:00	5.74
14:00 - 15:00	6.21
15:00 - 16:00	7.43
16:00 - 17:00	7.94
17:00 - 18:00	8.46
18:00 - 19:00	6.67
19:00 - 20:00	5.09
20:00 - 21:00	4.20
21:00 - 22:00	3.43
22:00 - 23:00	2.32
23:00 - 24:00	1.74

Source: ATR 14 & ATR 45

FC 17: Urban Collector

Hour	Percentage
24:00 - 1:00	0.95
1:00 - 2:00	0.6
2:00 - 3:00	0.57
3:00 - 4:00	0.61
4:00 - 5:00	1.21
5:00 - 6:00	2.95
6:00 - 7:00	5.33
7:00 - 8:00	8.29
8:00 - 9:00	5.88
9:00 - 10:00	4.15
10:00 - 11:00	3.91
11:00 - 12:00	4.11
12:00 - 13:00	4.37
13:00 - 14:00	4.67
14:00 - 15:00	5.71
15:00 - 16:00	7.25
16:00 - 17:00	8.63
17:00 - 18:00	9.38
18:00 - 19:00	6.16
19:00 - 20:00	4.22
20:00 - 21:00	3.52
21:00 - 22:00	3.21
22:00 - 23:00	2.57
23:00 - 24:00	1.75

Source: ATR 3

* Hourly volume percentages come from an average of 1999 weekday ATR data.

Data Analysis Methodology

Steps for obtaining ATR Data graphs (30HV)

The following is the data analysis procedure used for the 1999 ATR data obtained from the Division of Planning:

1. Save the data file that contains all the ATR records for the year and open it in excel.

2. Delineate the string of digits as follows: 123|12|1|1|12|1|12|1|12|…………
   The digits correspond to: county|ATR|direction|road class|year|month|day|day of the week|hour| then the 12 hourly traffic counts (should already be delineated).

3. If all the records do not fit in one excel sheet, find a cut off point and delete all records in the original data file that were successfully transferred to excel. Save these remaining records in a new file and open it in another excel file or worksheet using the above delineation. The original data file will not be used anymore.

4. Add a header row in both excel files at the top of the data and label the columns as shown in step 2. AutoFit all data and put an AutoFilter on the top row. Do a sort ascending for the entire data set by month and then date.

5. Go to column J (or any of the traffic count columns) and filter out the blanks (choose non-blanks). Now filter the ATR number to be worked on. Also filter the data down to one direction.

6. Open a third excel file, copy all data from the first excel file and paste it into the third. Repeat this from the second into the third just below the other data. Label this worksheet in the third excel file by ATR # and Direction #. Now select the next tab worksheet file and copy and paste the other direction as described above. Label this worksheet as well, like above except with the different direction.

7. We are now done with the first 2 excel files and will concentrate just on the third. AutoFit and put an AutoFilter on both worksheets. Also do a data sort on both sheets by month then day.

8. Check to see if both sheets have the same number of records and the days correlate. If they do not, use various filter techniques to delete records of days that are not recorded for both directions. Also make sure all records are for the same year, delete all unwanted records for a different year.

9. When matching data for both directions is obtained, a third worksheet will be used to sum the hourly traffic counts for both directions. Begin to copy one column of traffic counts from one direction and paste it on the third worksheet. Proceed for this one direction by copying each column of traffic data (columns J-U) and pasting them in one continuous column in the third worksheet. Do the same for the other direction making sure to copy and paste in the same order (columns J-U). Be sure to paste this continuous column in the third sheet next to the other direction's traffic counts.

10. Make sure both columns have the same number of records before proceeding. Sum up the values for the individual hours for both directions in column C. Now do a sort descending for the entire data set for column C.

11. Get the total number of days for the valid data by dividing the number of hours observed (the number of records) by 24. Then get a sum for column C and divide it by number of days to get an ADT.

12. In column D rank records by putting 1 in the first row, 2 in the second row, and so on till the end of the summed hourly records. In column E get a percentage of ADT by dividing the summed traffic count in column C by the ADT obtained previously and multiplying by 100. Get this for all records.

13. Now graph columns D and E for all the records, the top 1000 records, the top 500, the top 250, and the top 100. In addition add another series in the graphs to mark the 30th highest volume as a percentage of ADT. Label the graphs accordingly.

Steps for obtaining Hourly Distribution

1. Insert 3 new worksheets within the third excel file (the same file with the individual ATR data and graphs).

2. Copy all data from the first from the first two worksheets (the ones labeled by ATR # and direction #) and paste it into one of the newly created worksheets. Be sure to include a header row.

3. Sort all the data ascending by the hour column (I). The data is now split between hour 1 records and hour 13 records. Insert a row to sum up hours 1, 2, 3…12. Go to the end of the data to sum hours 13, 14, 15…24.

4. Go to another blank sheet that has been created. Label columns A-L of row one 1, 2, 3…12. Label columns A-L of row four 13, 14, 15…24. Copy the summed values from the previous worksheet and paste them under rows one and four matching the hours accordingly.

5. Sum up the total traffic counts in column M, with the total in M-7. In row 3 divide the individual traffic counts by the total and multiply by 100. Do the same for row 6. This will yield a percent distribution for the ATR for each hour of the day. As a check add up the percentages to equal 100.

6. To obtain weekday and weekend distributions separately, first copy the above distribution matrix to rows 12 and 23. Label the first weekday and second weekend.

7. Copy all data from both directions as described in step 2 to the unused worksheet. Now sort the entire data set ascending by hour then by day of the week.

8. Insert rows to obtain sums for hours 1-12 day 1, hours 1-12 days 2-6, hours 1-12 day 7, hours 13-24 day 1, hours 13-24 days 2-6, and hours 13-24 day 7. Now in the main hourly distribution worksheet, for weekday in row 13 copy in values for hours 1-12 days 2-6. Do the same for row 16, values for hour's 13-24 days 2-6. Make sure to sum only weekday values for column M and generate the distribution percentages accordingly.

9. For weekend distributions, in row 24 sum hours' 1-12 day 1 and hours 1-12 day 7 into the appropriate cells. Do the same for row 27, summing the totals for hour's 13-24 day 1 and hours 13-24 day 7. Make sure M column totals are correct. Generate the distribution percentages accordingly.