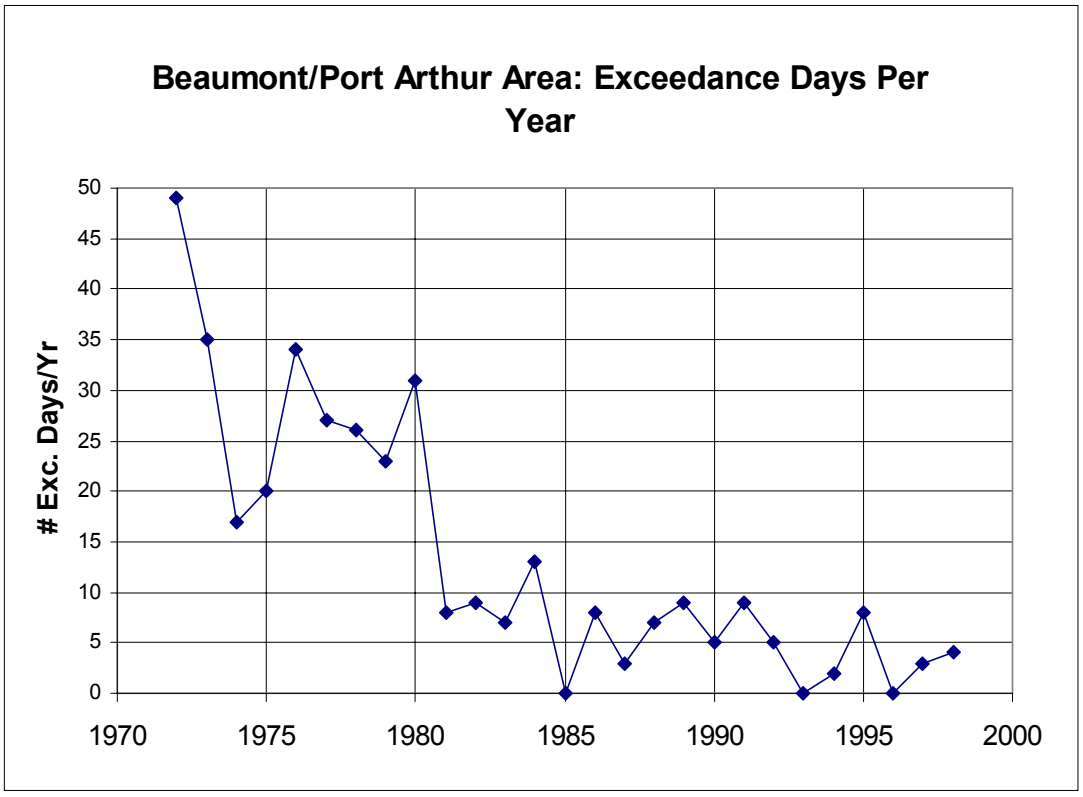
Appendix Q
Supplementary Air Quality Analyses for BPA

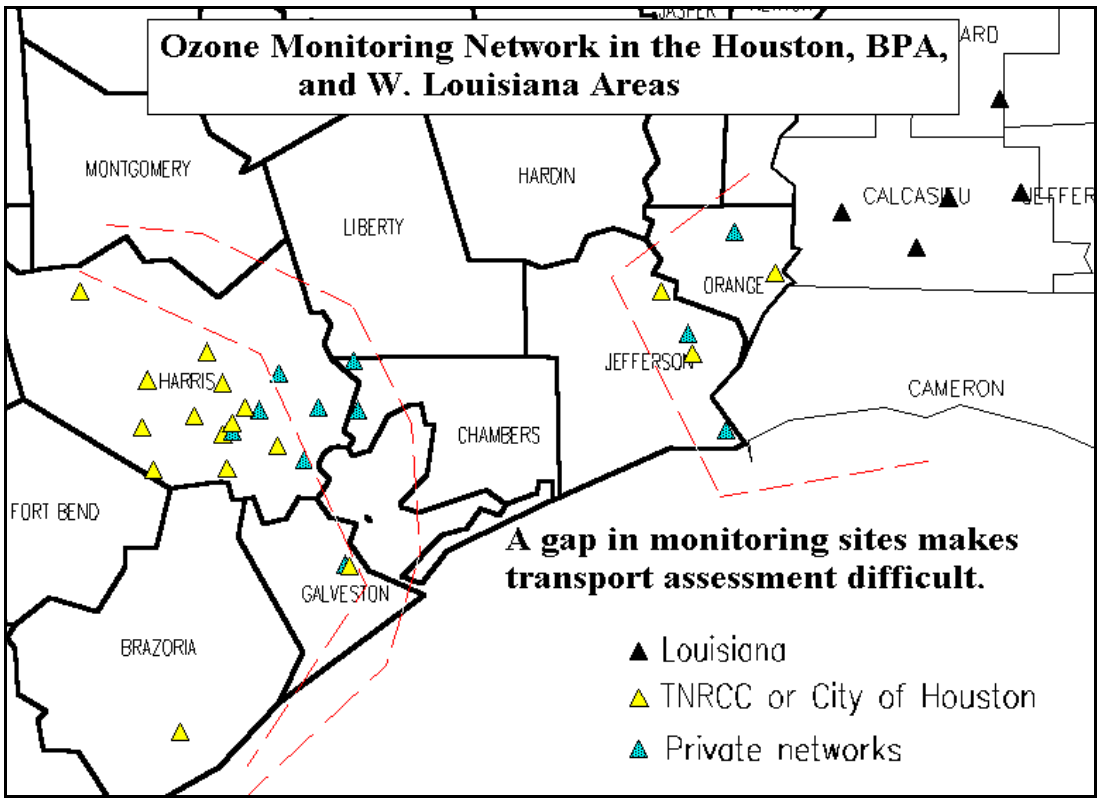
This document examines various pieces of evidence indicating that pollutant transport from HGA to the BPA area affects BPA ozone levels. The BPA area has made great strides over the past twenty-five years in decreasing ozone exceedances (Figure 1). The commission staff reported on downward trends in VOC ambient concentrations and emission levels in a May 1997 report titled "Decrease in Ambient Air Concentrations of Benzene, Toluene, and Total Xylenes in Southeast Texas" (TNRCC, Monitoring Operations Division). However, the trend in ozone exceedance day counts in recent years is very flat, and the Beaumont ozone monitor, with six exceedance days over the 1996-1998 period, is still noncompliant with the one-hour ozone NAAQS.

Figure 1. Number of exceedance days using TNRCC historical data



The ozone monitoring network for the HGA, BPA, and Western Louisiana areas is shown in Figure 2. The gap in ozone monitoring in the area between HGA and BPA is indicated. Such a gap makes transport study difficult. In particular, there is no monitor sited to serve as an "upwind site" for air moving from HGA to BPA. Further, access to the private network data is severely limited, which reduces the area covered by available monitors. In this analysis we use only the TNRCC network data and NWS meteorological data.

Figure 2. Monitoring network gap in Southeast Texas



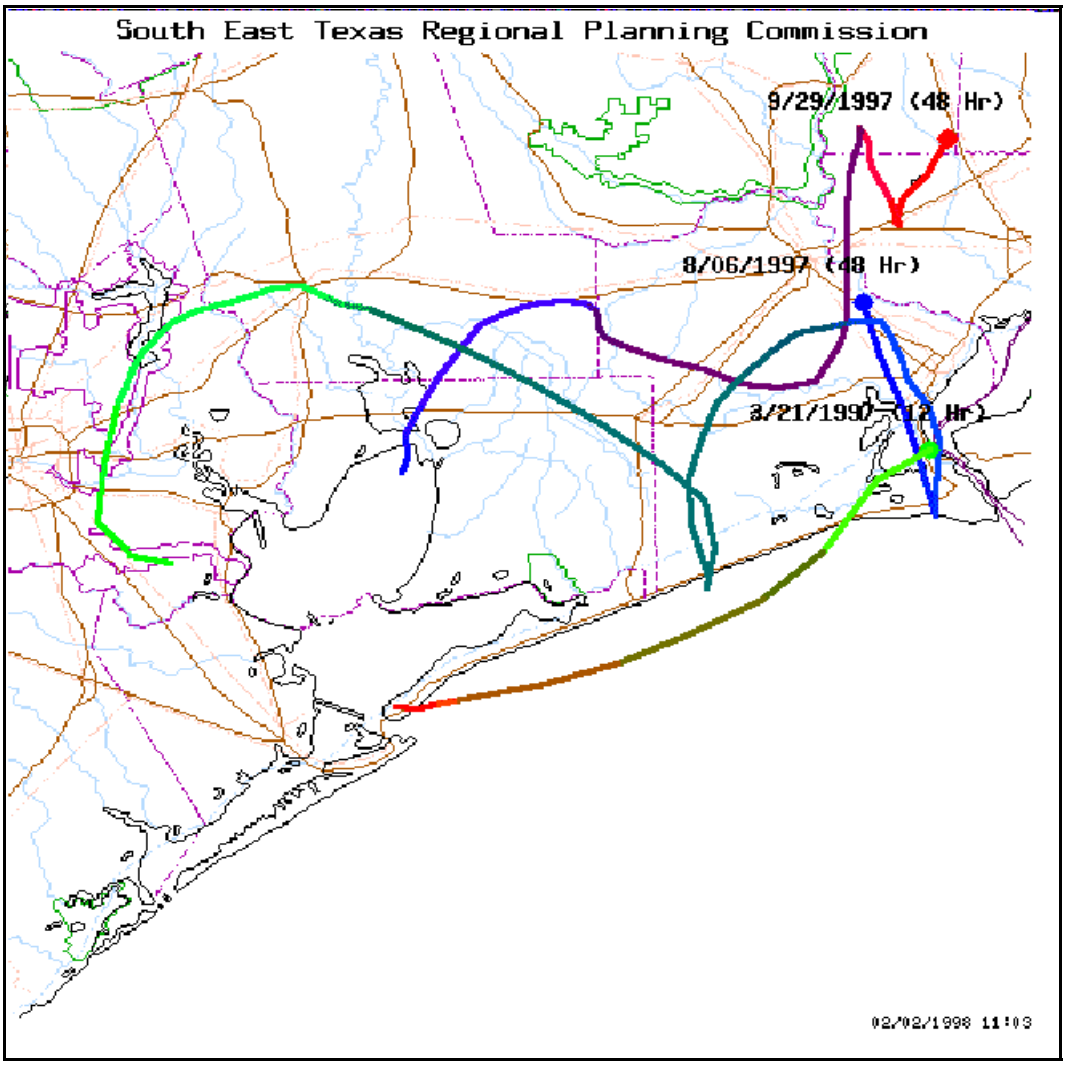
An Assessment of 1997 Back-Trajectories from Radian Corporation

During 1997, three exceedance days were monitored at TNRCC sites in the BPA nonattainment area. Using back-trajectories provided by Radian Corporation, one of the 1997 exceedances indicated clear transport from HGA into BPA (Figure 3). On the other two exceedance days, one sees some pattern of transport into the BPA area by going back considerably further in time. It should be noted that in taking a trajectory back many hours, it becomes increasingly difficult to determine the point from which the air parcels originated. Thus, the 48-hour back-trajectories must be viewed with extreme caution.

On March 21, 1997, the first of the three exceedance days, the Beaumont (133 ppb) and West Orange (169 ppb) sites exceeded the ozone standard of 125 ppb. Exceedances were also recorded at several sites in nearby Louisiana. Figure 3 shows that when the air mass is taken back 12 hours from the BPA sites measuring exceedances, the air mass is seen to originate in eastern Harris County and the Ship Channel industrial area. The agency concludes that this was clearly a transport episode.

On Aug. 6, 1997, the Beaumont (130 ppb) site exceeded the standard. Figure 3 shows a back-trajectory beginning on the evening of August 6 and going back 48 hours.

Figure 3. 1997 ozone exceedance back-trajectories from the SETRPC draft report



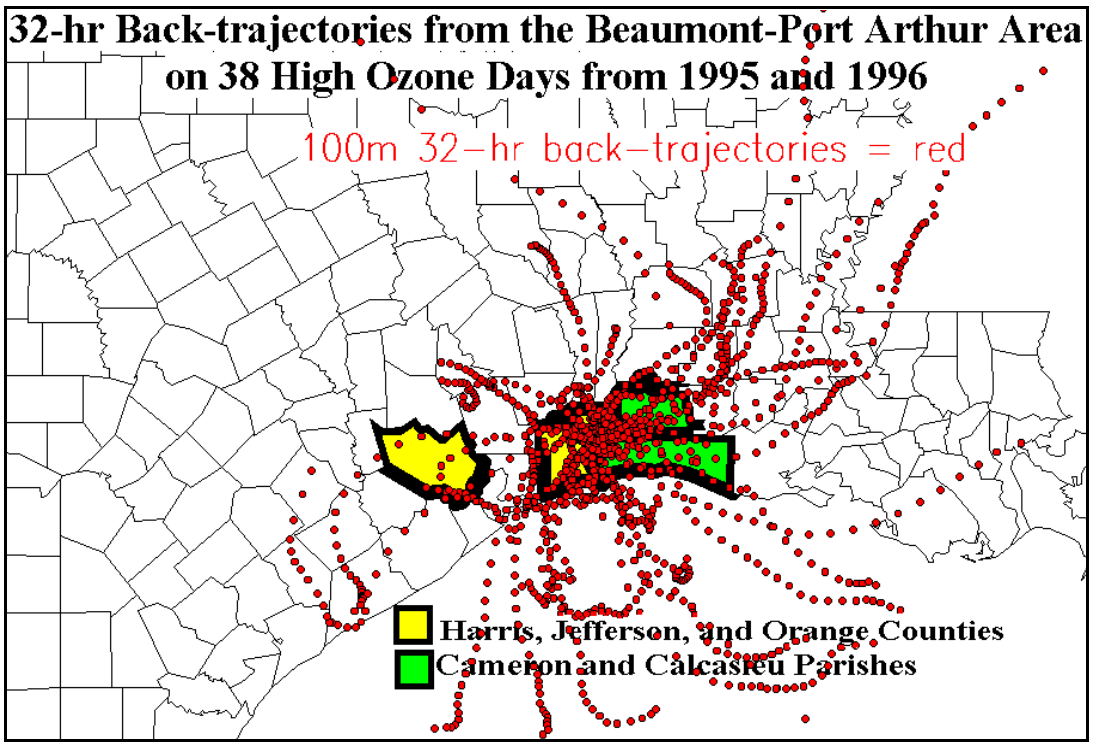
The meteorology on Aug. 5 and 6, 1997 supported the flow reversal circulation, so the back-trajectory shows looping. The third exceedance occurred on Sept. 29, with Beaumont (154) and West Orange (156) exceeding the standard. One of the Louisiana sites also recorded an exceedance on Sept. 29. Figure 3 illustrates the back-trajectory beginning on the evening of September 29 and going back 48 hours. It also shows the effect of flow reversals. For these two back-trajectories, agency staff believes that more research must be conducted before it can be concluded that these were transport events. It appears that the air parcels spent considerable time near source areas within BPA, whereas the March 21, 1997 episode is clearly a case of air transported directly from HGA to BPA.

Hysplit Back-Trajectories for 1995 and 1996

Back-trajectories for high ozone days in BPA from 1995 and 1996 are shown in Figure 4. By "high ozone day" we refer to days on which any public regulatory monitor in the area had a maximum 8-hour average of 85 ppb or above. The reason for focusing on 8-hour averages rather than 1-hour averages is

that pollutant transport is more likely to affect a longer averaging time due to the dispersion and diffusion of a plume. Figure 4 shows only four candidate back-trajectories for movement from HGA to BPA: July 9, 10, and 12, 1995, and October 5, 1995. Only one of these was a 1-hour exceedance day (10/5). This is four days out of 38 high days in this two-year period, suggesting that the majority of high ozone days cannot be attributed to transport from HGA.

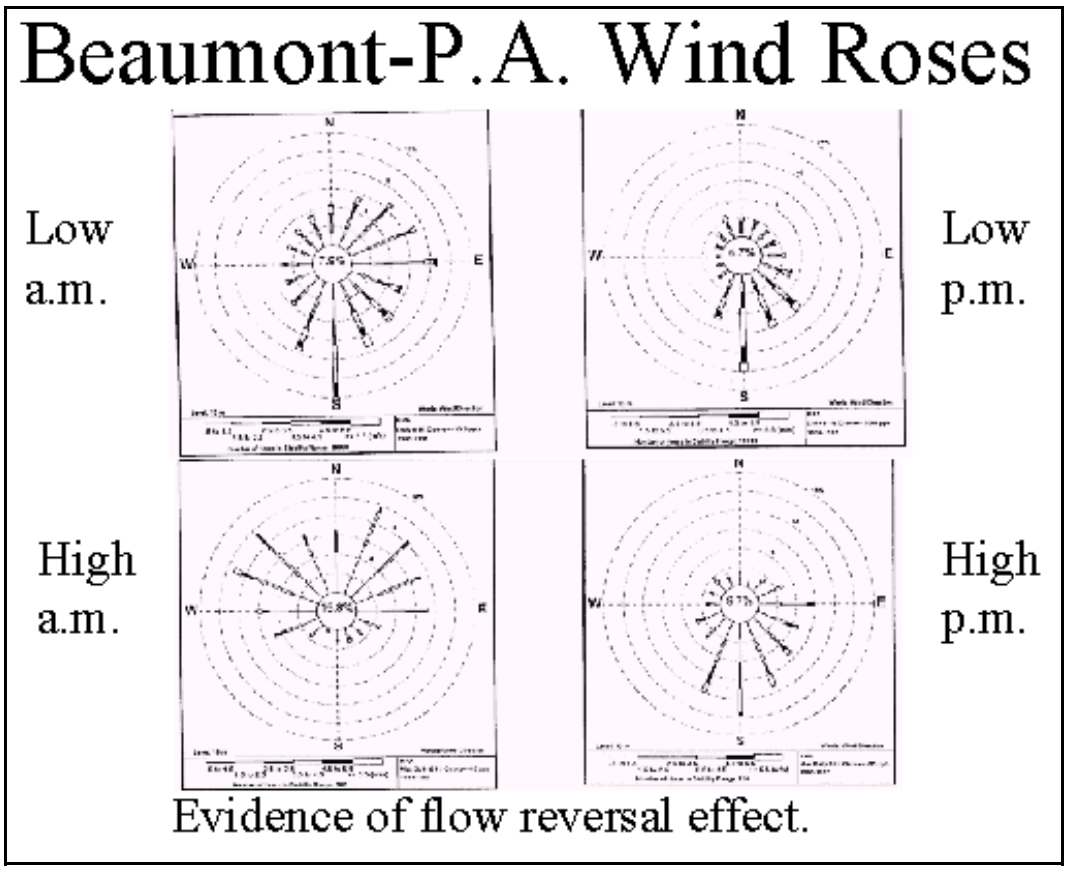
Figure 4. Hysplit back-trajectories



Wind Rose Analysis

Flow reversal appears to be the main factor in ozone exceedances in the BPA area. This is shown in Figure 5, which compares the morning and afternoon wind roses for high and low ozone days. In this case, a "high ozone day" is defined as above, and a "low ozone day" is a day on which no area public regulatory monitor exceeded 60 ppb for an maximum 8-hour average. The prevailing morning wind on high ozone days is from the north at low speeds, and the prevailing afternoon wind is from the south at low speeds. This is characteristic of flow reversals at the surface which, when coupled with transported pollutants, contribute to ozone accumulation.

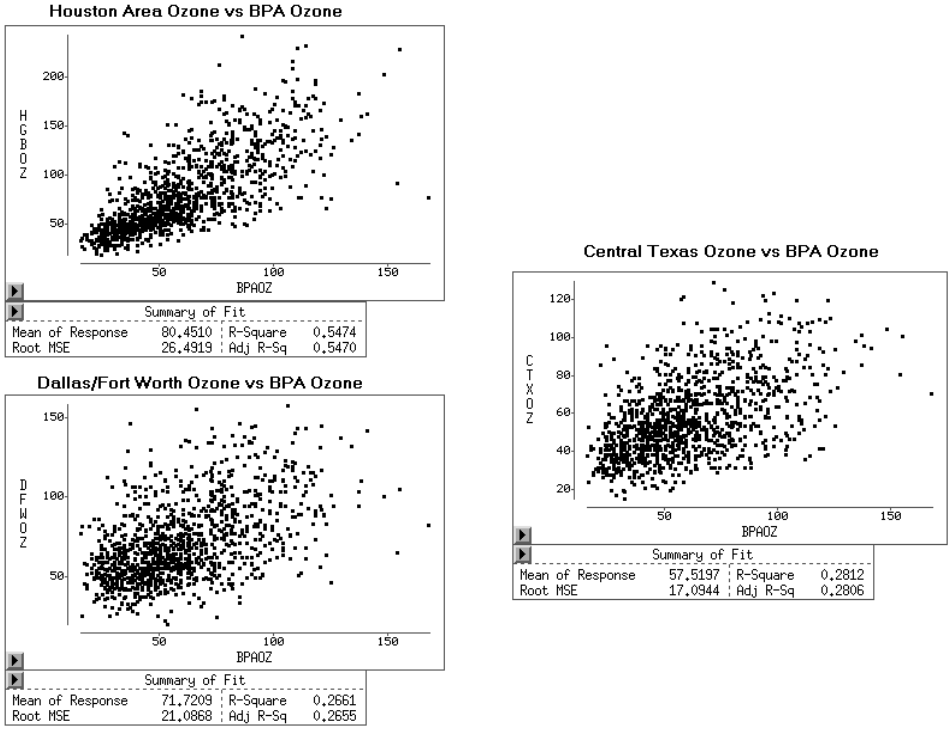
Figure 5: Comparison of morning to afternoon, high ozone to low ozone day winds



Analysis of Ambient Data

The scatter plots of the daily area-wide ozone 1-hour maximum during the March through October period for 1993 through 1997 between urban areas (HGA vs BPA, DFW vs BPA, and Central Texas vs BPA) appear in Figure 6. The BPA data matches the HGA data better than any other urban area's data (R^2 = 54% for HGA, 26-28% for other areas). This shows the clear relationship between these two closely spaced urban/industrial areas.

Figure 6. Scatter plots of area high one-hour values



The years 1996, 1997, and 1998 are used to determine the current compliance status for the BPA area. Table 1 contains exceedance day counts by year and by monitor using two numbers: 1) the total number of exceedances for that site during the year, and 2) the number in parentheses, indicating how many of those exceedances might be attributed to transport based on back-trajectories and surface and upper air data analysis. The 1-hour ozone standard is written so that each monitor is allowed three expected exceedances in a three-year period. If clear transported exceedances were omitted, the BPA area would still fail to comply with the NAAQS.

Table 2 contains a list of monitor-days from 1991 through 1998 on which the wind direction of arrival characteristics over the midnight to noon period (CST) was similar to those of March 21, 1997. One observes that there are several days for which the surface winds at the CAMS site indicate transport from the west. Since wind speeds aloft are likely to be considerably higher than at the surface, the possibility exists that these exceedances may have been caused in part by transport from the HGA area. One suspected transport day from 1998 is shown, but its morning and afternoon wind speeds have not been

tabulated.

In summary, the monitoring data clearly indicate that some BPA exceedances are caused by transport. The data shows that BPA would be closer to compliance in recent years, but for exceedances affected by pollutant transport from HGA.

Table 1. Monitored ozone exceedances in the BPA nonattainment area

Localized Area	1996	1997	1998
Beaumont	0	3 (1)	3 (1)
Port Arthur	0	0	0
West Orange	0	2 (1)	1

Numbers in parentheses indicate number of exceedances for which trajectory analysis shows potential transport from HGA.

Table 2. Suspected one-day transport exceedances, 1991-1998

Date	Site Name	Oz1hrpk[1]	Wdr_am[2]	Wsr-am mph[3]	Wdr_pm[4]	Wsr_pm mph[5]
10/12/91	Beaumont C02	200	218	1.34	129	0.75
10/12/91	Port Arthur C28	140	240	5.11	202	1.95
10/12/91	West Orange C09	160	247	3.86	181	1.82
02/29/92	Port Arthur C28	127	234	5.59	208	5.37
10/25/92	West Orange C09	137	257	0.54	185	4.30
05/23/94	West Orange C09	127	283	1.90	190	5.31
10/05/95	Beaumont C02	126	238	1.92	284	6.53
03/21/97	Beaumont C02	133	249	2.41	219	3.10
03/21/97	West Orange C09	169	262	2.93	205	7.29
07/16/98	Beaumont C02	129	not calc.	not calc.	not calc.	not calc.

[1]Oz1hrpk = daily peak one-hour ozone value, parts per billion
[2]Wdr_am = morning wind direction angle, degrees measured clockwise from north
[3]Wsr-am mph = morning wind speed average, miles per hour
[4]Wdr_pm = afternoon wind direction angle, degrees measured clockwise from north
[5]Wsr_pm mph = afternoon wind speed average, miles per hour