



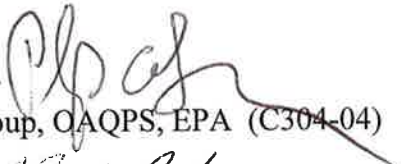
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711


MAR 4 2010

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Revision to Section 3.3.5 of the Second External Review Draft of the PM Urban Visibility Assessment

FROM: Philip A. Lorang, Leader 
Air Quality Analysis Group, OAQPS, EPA (C304-04)

Mark Schmidt 
Air Quality Analysis Group, OAQPS, EPA (C304-04)

TO: PM NAAQS Review Docket (EPA-HQ-OAR-2007-0492)

Attached is a revision to section 3.3.5, "Exclusion of Hours With Relative Humidity Greater Than 90 Percent From PM Light Extinction NAAQS Scenarios and Most Results," of the January 2010 Second External Review Draft of the Particulate Matter Urban-Focused Visibility Assessment. Compared to the version of this table in the second external review draft, this version correctly omits non-daylight hours which were inadvertently included in the earlier version, reports results for four study areas for which results were missing in the earlier version, and separates "mist" from "smoke/haze" to reflect that "mist" is a natural condition while "smoke/haze" is not always a natural condition.

Attachment

1 **3.3.5 Exclusion of Hours with Relative Humidity Greater than 90 Percent from PM**
2 **Light Extinction NAAQS Scenarios and Most Results**

3
4 As advised by CASAC as part of its comments on the first public review draft of this
5 assessment, EPA staff considered whether to structure the PM light extinction NAAQS scenarios
6 so that ambient data obtained during daylight hours in which relative humidity was greater than
7 90 percent would play no role in the indicator/form of the NAAQS, i.e., so that those data would
8 not enter into the calculation of the design value. EPA staff obtained hourly meteorological
9 parameters from National Weather Service monitoring sites near the 15 study sites (usually a
10 major airport), for 2005 through 2007, for all days in this period including days for which PM
11 observations to support estimates of PM light extinction are not available. Using these data,
12 EPA staff compared the occurrence of liquid precipitation, hail, other frozen precipitation, fog,
13 mist, and smoke/haze during daylight hours with humidity greater than 90 percent and during all
14 other daylight hours.³⁶ The first five of these conditions are generally considered natural causes
15 of reduced visibility. Table 3-6 presents this comparison.³⁷ The percentages of hours with each
16 of these five conditions individually are shown for the two sets of daylight hours. NWS
17 observations of these conditions are instantaneous, and are generally made about 50 minutes
18 after the hour. The relative humidity observations are made at the same time. It should be noted
19 that this analysis of the co-occurrence of high relative humidity and these five conditions uses
20 data from NWS sites other than the AQS sites that provided the data used to estimate PM light
21 extinction. AQS sites could not be used for this analysis because they generally do not report
22 similar weather condition data.

23 The comparison for the 15 sites shows that in the set of hours with relative humidity
24 above 90 percent, the frequencies of liquid precipitation (rain), other frozen precipitation (snow
25 and sleet), or fog ranged as high as 68 percent, and were considerably higher for the same
26 condition than in the set of hours with lower relative humidity. The frequencies of hail and mist
27 were all less than 0.5 percent and thus too low for meaningful comparisons. Moreover, except in

³⁶ The “smoke/haze” category is not an original NWS reporting category. It is a combination of two original NWS weather categories: smoke and haze. The explanation of these categories in the NWS documentation does not allow EPA staff to be confident that these terms have distinct and clear meanings that are uniformly applied across observation sites, so they have been combined in this presentation. As best EPA staff can determine, the combined category reflects some mix of smoke from burning biomass, smoke from industrial processes, dust from wind storms, volcanic ash, and general urban haze. Also, the reported conditions may be at some distance from the observation site.

³⁷ Compared to the version of this table in the second external review draft, this version correctly omits non-daylight hours which were inadvertently included in the earlier version, reports results for four study areas for which results were missing in the earlier version, and separates “mist” from “smoke/haze” to reflect that “mist” is a natural condition while “smoke/haze” is not always a natural condition.

1 Tacoma, the frequency of rain or fog at the observation moments during the hours with relative
2 humidity less than or equal to 90 percent was less than 8 percent. Also, a separate analysis (not
3 shown) indicated that rainy hours with lower relative humidity experience considerably less
4 accumulation than rainy hours with higher relative humidity. Based on this assessment, the 90%
5 relative humidity cutoff criteria is effective in that on average less than 6 percent of the daylight
6 hours are removed from consideration, yet those hours have on average about 10 times the
7 likelihood of rain, 6 times the likelihood of snow/sleet, and 34 times the likelihood of fog
8 compared to hours with 90% or less relative humidity.

9 Rain, snow/sleet, and fog cause a natural reduction in visibility, independent of PM
10 concentrations. To reduce the likelihood that a design value for a secondary PM NAAQS could
11 be affected by measurements made under natural weather conditions that reduce visibility, for
12 this assessment EPA staff eliminated from the design value definition any contribution from PM
13 light extinction values that come from any daylight hours with relative humidity above 90
14 percent.³⁸ Also, because PM light extinction during such hours is not as likely to be the primary
15 cause of adverse effects on the public, all figures and tables in the body of this document and in
16 Appendices that present PM light extinction values or statistics exclude values for such hours
17 (unless explicitly stated to include them), so that the patterns of PM light extinction during the
18 remaining daylight hours can be seen clearly. Figures and tables that present PM component
19 concentrations and relative humidity values are based on all daylight hours, however.

20 More information on this topic can be found in Appendix G, which reports by study area
21 the percentages of daylight hours that were excluded from design values, the distribution of the
22 excluded hours by time of day, and the percentage of days that had one or more daylight hours
23 eliminated. Appendix G also contains box plots which contrast the distributions of daylight 1-
24 hour PM light extinction values (and maximum daily daylight 1-hour PM light extinction, see
25 section 3.3.6) before and after this elimination step. The tile plots in Figure 3-12 also present
26 additional detailed information on the specific hours that had relative humidity values above 90
27 percent, and on the PM light extinction values during those and other daylight hours.

³⁸ Another consideration is that instruments used to measure light extinction could be adversely affected if allowed to operate without heating or other protective method (such as diffusion drying of incoming air) when relative humidity is very high. If protected, however, the measured light scattering would not reflect actual ambient conditions.

1 **Table 3-6 Comparison of Meteorological Parameters for Daylight Hours with Relative Humidity Greater than 90**
 2 **Percent and Other Daylight Hours, During 2005 -2007**
 3

Study Area	Daylight Hours with Relative Humidity <= 90%								Daylight Hours with Relative Humidity > 90%							
	Number of Hours	Percentage of Hours with Weather or Other Condition							Number of Hours	Percentage of Hours with Weather or Other Condition						
		Liquid Precip.	Hail	Other Frozen Precip.	Fog	Mist	Smoke/Haze	Any		Liquid Precip.	Hail	Other Frozen Precip.	Fog	Mist	Smoke/Haze	Any
Tacoma	10,326	12%	0%	0%	0%	0%	4%	14%	1,756	36%	0%	1%	10%	0%	43%	63%
Fresno	11,758	3%	0%	0%	1%	0%	15%	17%	342	25%	0%	1%	60%	0%	65%	93%
Los Angeles	11,419	2%	0%	0%	0%	0%	8%	9%	713	25%	0%	0%	12%	0%	52%	73%
Phoenix	12,123	1%	0%	0%	0%	0%	0%	1%	43	67%	0%	0%	30%	0%	40%	74%
Salt Lake City	11,810	4%	0%	2%	1%	0%	4%	8%	304	28%	0%	40%	42%	0%	69%	85%
Dallas	11,827	4%	0%	0%	1%	0%	5%	8%	223	68%	0%	2%	20%	0%	82%	91%
Houston	11,525	6%	0%	0%	1%	0%	6%	9%	645	42%	0%	0%	25%	0%	64%	75%
St. Louis	11,590	5%	0%	1%	1%	0%	10%	14%	583	56%	0%	8%	48%	0%	82%	91%
Birmingham	11,590	5%	0%	0%	1%	0%	9%	11%	486	56%	0%	0%	41%	0%	79%	86%
Atlanta	11,337	5%	0%	0%	1%	0%	10%	13%	867	50%	0%	0%	45%	0%	81%	88%
Detroit	11,484	5%	0%	3%	1%	0%	9%	14%	676	51%	0%	16%	39%	0%	76%	92%
Pittsburgh	10,603	5%	0%	3%	1%	0%	9%	14%	1,261	46%	0%	9%	12%	0%	72%	85%
Baltimore	11,321	4%	0%	1%	2%	0%	12%	14%	858	53%	0%	5%	38%	0%	80%	90%
Philadelphia	11,125	4%	0%	1%	1%	0%	8%	11%	878	47%	0%	3%	33%	0%	64%	84%
New York	11,799	7%	0%	1%	1%	0%	10%	14%	397	66%	0%	8%	48%	0%	86%	96%
Average	11,442	5%	0%	1%	1%	0%	8%	11%	669	48%	0%	6%	34%	0%	69%	84%