memorandum

Abt Associates Inc.

Date: January 30, 2007

To: Harvey Richmond, EPA/OAQPS

From: Ellen Post, Abt Associates Inc.

Subject: Additional Tables of Lung Function Risk Estimates Associated with Ozone Exposures Based on 2003 Air Quality Data

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Since completion of the technical support document (TSD) for the ozone health risk assessment in December 2006, we've calculated additional lung function risk estimates for those locations that were not included in the results in the TSD for 2003. The methods used in these calculations are the same as those used in the calculation of lung function risk estimates for the TSD and are explained in detail in Section 3 of the TSD. The tables of results included below are as follows:

Tables 1 and 2 contain estimates of the numbers and percents, respectively, of all children (ages 5-18) engaged in moderate exertion experiencing at least one lung function response associated with exposure to O_3 under a recent year of air quality and when O_3 concentrations just meet the current and each of two alternative daily maximum 8-hour standards in each of the 12 locations in the risk assessment. Lung function responses included in the tables are changes in FEV1 $\geq$ 10%, $\geq$ 15%, and $\geq$ 20%. Table 3 contains estimates of the numbers of occurrences of lung function response (defined as changes in FEV1 $\geq$ 10%, $\geq$ 15%, and $\geq$ 20%) associated with exposure to O_3 under a recent year of air quality and when O_3 concentrations just meet the current and each of two alternative daily maximum 8-hour standards among all children (ages 5-18) engaged in moderate exertion in each of the 12 locations in the risk assessment.

These additional tables share some features with several tables contained in the TSD. Table 1 in this memo has the same basic format as Tables 3-16 (for 2004) and 3-17 (for 2002) in the TSD in that it contains results for all 12 locations for the current and alternative standards for each of the three definitions of lung function response (changes in FEV1 $\geq$ 10%, $\geq$ 15%, and $\geq$ 20%). Similarly, Table 2 in this memo has the same basic format as Tables 3-18 and 3-19, and Table 3 has the same basic format as Tables 3-12 and 3-13 in the TSD. The three tables in this memo share other features with Tables 3-20 through 3-23 in Section 3.2.2.2.1 of the TSD in that they focus on exposure to O_3 under a recent year of air quality and when O_3 concentrations just meet the current and each of two alternative daily maximum 8-hour standards.

Table 1. Number of All Children (Ages 5-18) Engaged in Moderate Exertion Estimated to Experience At Least One Lung Function Response Associated with Exposure to O_3 Concentrations That Just Meet the Current and Alternative Daily Maximum 8-Hour Standards, for Location-Specific O_3 Seasons: Based on Adjusting 2003 O_3 Concentrations*

Location	Number of All Children (in 1000s) Estimated to Experience at Least One Lung Function Response Associated with O_3 Concentrations that Just Meet the Current and Alternative O_3 Standards**			
	A Recent Year of Air Quality	0.084/4***	0.074/4	0.064/4
	Response = Decrease in FEV_1 Greater Than or Equal to 10%			
Atlanta	82 (61 - 121)	62 (43 - 96)	42 (26 - 68)	27 (15 - 43)
Boston	78 (55 - 117)	65 (44 - 100)	43 (26 - 70)	27 (14 - 44)
Chicago	132 (92 - 201)	109 (72 - 171)	73 (43 - 118)	46 (23 - 74)
Cleveland	56 (42 - 78)	32 (21 - 49)	21 (12 - 34)	13 (6 - 22)
Detroit	118 (91 - 161)	62 (42 - 96)	42 (25 - 68)	27 (14 - 43)
Houston	142 (114 - 187)	56 (38 - 89)	37 (23 - 60)	21 (11 - 33)
Los Angeles	582 (494 - 726)	120 (88 - 187)	66 (46 - 102)	26 (17 - 40)
New York	466 (362 - 633)	239 (161 - 369)	156 (93 - 252)	96 (48 - 156)
Philadelphia	143 (112 - 192)	86 (61 - 127)	55 (35 - 88)	33 (18 - 54)
Sacramento	43 (35 - 59)	19 (14 - 30)	12 (9 - 19)	7 (5 - 10)
St. Louis	61 (47 - 85)	45 (33 - 68)	30 (19 - 47)	19 (11 - 31)
Washington, DC	137 (103 - 194)	81 (54 - 125)	53 (31 - 84)	32 (16 - 52)
	Response = Decrease in FEV_1 Greater Than or Equal to 15%			
Atlanta	30 (17 - 46)	20 (8 - 33)	12 (2 - 22)	6 (0 - 14)
Boston	28 (13 - 44)	21 (8 - 35)	12 (2 - 23)	6 (0 - 14)
Chicago	44 (19 - 72)	33 (11 - 58)	19 (2 - 38)	11 (0 - 24)
Cleveland	22 (13 - 33)	10 (3 - 17)	6 (1 - 11)	3 (0 - 7)
Detroit	50 (31 - 71)	20 (7 - 34)	11 (2 - 22)	6 (0 - 14)
Houston	64 (43 - 88)	17 (5 - 30)	10 (1 - 19)	5 (0 - 11)
Los Angeles	293 (209 - 386)	35 (8 - 62)	17 (2 - 33)	6 (0 - 13)

Location	Number of All Children (in 1000s) Estimated to Experience at Least One Lung Function Response Associated with O_3 Concentrations that Just Meet the Current and Alternative O_3 Standards**			
	A Recent Year of Air Quality	0.084/4***	0.074/4	0.064/4
New York	202 (129 - 286)	77 (29 - 129)	42 (6 - 82)	22 (0 - 51)
Philadelphia	64 (41 - 89)	30 (15 - 48)	16 (4 - 29)	8 (0 - 17)
Sacramento	18 (11 - 25)	6 (2 - 10)	3 (0 - 6)	2 (0 - 3)
St. Louis	25 (15 - 36)	16 (8 - 25)	9 (2 - 16)	5 (0 - 10)
Washington, DC	56 (32 - 82)	26 (9 - 44)	14 (2 - 28)	7 (0 - 17)
	Response = Decrease in FEV_1 Greater Than or Equal to 20%			
Atlanta	8 (2 - 18)	4 (1 - 11)	2 (0 - 7)	1 (0 - 4)
Boston	7 (2 - 16)	5 (1 - 12)	2 (0 - 7)	1 (0 - 4)
Chicago	10 (2 - 25)	6 (1 - 19)	3 (0 - 11)	1 (0 - 6)
Cleveland	7 (3 - 14)	2 (0 - 6)	1 (0 - 3)	0 (0 - 2)
Detroit	17 (8 - 32)	4 (1 - 11)	2 (0 - 7)	1 (0 - 4)
Houston	24 (12 - 42)	3 (0 - 10)	1 (0 - 6)	1 (0 - 3)
Los Angeles	127 (72 - 207)	6 (0 - 20)	2 (0 - 10)	1 (0 - 4)
New York	72 (35 - 132)	16 (3 - 44)	6 (0 - 24)	3 (0 - 14)
Philadelphia	24 (12 - 43)	8 (2 - 18)	3 (0 - 9)	1 (0 - 5)
Sacramento	6 (2 - 11)	1 (0 - 3)	1 (0 - 2)	0 (0 - 1)
St. Louis	8 (3 - 15)	4 (1 - 9)	2 (0 - 5)	1 (0 - 3)
Washington, DC	19 (8 - 36)	6 (1 - 15)	2 (0 - 8)	1 (0 - 5)

*Numbers are median (0.5 fractile) numbers of children. Numbers in parentheses below the median are 95% credible intervals based on statistical uncertainty surrounding the O_3 coefficient.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest 1000.

***These 8-hr average standards, denoted m/n, are characterized by a concentration of m ppm and an nth daily maximum. So, for example, the current standard is 0.084/4 -- 0.084 ppm, 4th daily maximum 8-hr average. These nth daily maximum standards require that the average of the 3 annual nth daily maxima over a 3-year period be at or below the specified level (e.g., 0.084 ppm).

Table 2. Percent of All Children (Ages 5-18) Engaged in Moderate Exertion Estimated to Experience At Least One Lung Function Response Associated with Exposure to O_3 Concentrations That Just Meet the Current and Alternative Daily Maximum 8-Hour Standards, for Location-Specific O_3 Seasons: Based on Adjusting 2003 O_3 Concentrations*

Location	Percent of All Children Estimated to Experience at Least One Lung Function Response Associated with O_3 Concentrations that Just Meet the Current and Alternative O_3 Standards**			
	A Recent Year of Air Quality	0.084/4***	0.074/4	0.064/4
	Response = Decrease in FEV_1 Greater Than or Equal to 10%			
Atlanta	8.8% (6.5% - 12.9%)	6.6% (4.6% - 10.3%)	4.5% (2.8% - 7.3%)	2.9% (1.6% - 4.6%)
Boston	7.3% (5.2% - 10.9%)	6% (4.1% - 9.3%)	4% (2.4% - 6.5%)	2.5% (1.3% - 4.1%)
Chicago	6.7% (4.7% - 10.3%)	5.6% (3.7% - 8.7%)	3.7% (2.2% - 6%)	2.3% (1.2% - 3.8%)
Cleveland	9.4% (7.1% - 13.3%)	5.3% (3.5% - 8.3%)	3.6% (2.1% - 5.8%)	2.3% (1.1% - 3.7%)
Detroit	10.8% (8.3% - 14.7%)	5.7% (3.8% - 8.8%)	3.9% (2.3% - 6.2%)	2.5% (1.2% - 4%)
Houston	13.2% (10.6% - 17.4%)	5.2% (3.6% - 8.3%)	3.5% (2.2% - 5.6%)	1.9% (1% - 3.1%)
Los Angeles	16.1% (13.7% - 20.1%)	3.3% (2.4% - 5.2%)	1.8% (1.3% - 2.8%)	0.7% (0.5% - 1.1%)
New York	11.4% (8.8% - 15.5%)	5.8% (3.9% - 9%)	3.8% (2.3% - 6.2%)	2.4% (1.2% - 3.8%)
Philadelphia	12.1% (9.5% - 16.2%)	7.2% (5.2% - 10.8%)	4.6% (3% - 7.4%)	2.8% (1.5% - 4.6%)
Sacramento	10.5% (8.5% - 14.3%)	4.6% (3.4% - 7.2%)	3% (2.1% - 4.7%)	1.6% (1.1% - 2.5%)
St. Louis	10.5% (8.1% - 14.6%)	7.8% (5.6% - 11.6%)	5.1% (3.3% - 8.1%)	3.2% (1.9% - 5.3%)
Washington, DC	9.2% (6.9% - 13%)	5.4% (3.6% - 8.3%)	3.5% (2.1% - 5.6%)	2.2% (1.1% - 3.5%)
	Response = Decrease in FEV_1 Greater Than or Equal to 15%			
Atlanta	3.3% (1.8% - 5%)	2.2% (0.9% - 3.6%)	1.3% (0.2% - 2.4%)	0.7% (0% - 1.5%)
Boston	2.6% (1.2% - 4.1%)	2% (0.8% - 3.3%)	1.1% (0.2% - 2.1%)	0.6% (0% - 1.3%)
Chicago	2.2% (1% - 3.7%)	1.7% (0.6% - 3%)	1% (0.1% - 1.9%)	0.5% (0% - 1.2%)
Cleveland	3.8% (2.2% - 5.6%)	1.7% (0.6% - 2.9%)	0.9% (0.1% - 1.9%)	0.5% (0% - 1.2%)
Detroit	4.5% (2.8% - 6.5%)	1.8% (0.7% - 3.1%)	1% (0.2% - 2%)	0.6% (0% - 1.3%)
Houston	6% (4% - 8.2%)	1.6% (0.5% - 2.8%)	0.9% (0.1% - 1.8%)	0.5% (0% - 1%)

Location	Percent of All Children Estimated to Experience at Least One Lung Function Response Associated with O_3 Concentrations that Just Meet the Current and Alternative O_3 Standards**			
	A Recent Year of Air Quality	0.084/4***	0.074/4	0.064/4
Los Angeles	8.1% (5.8% - 10.7%)	1% (0.2% - 1.7%)	0.5% (0% - 0.9%)	0.2% (0% - 0.4%)
New York	4.9% (3.1% - 7%)	1.9% (0.7% - 3.2%)	1% (0.2% - 2%)	0.5% (0% - 1.2%)
Philadelphia	5.4% (3.5% - 7.5%)	2.6% (1.2% - 4%)	1.3% (0.3% - 2.5%)	0.7% (0% - 1.5%)
Sacramento	4.4% (2.8% - 6.2%)	1.4% (0.4% - 2.4%)	0.8% (0.1% - 1.5%)	0.4% (0% - 0.8%)
St. Louis	4.3% (2.6% - 6.2%)	2.8% (1.4% - 4.3%)	1.5% (0.4% - 2.7%)	0.8% (0% - 1.7%)
Washington, DC	3.7% (2.2% - 5.5%)	1.7% (0.6% - 2.9%)	0.9% (0.1% - 1.9%)	0.5% (0% - 1.1%)
	Response = Decrease in FEV_1 Greater Than or Equal to 20%			
Atlanta	0.9% (0.2% - 1.9%)	0.5% (0.1% - 1.2%)	0.2% (0% - 0.7%)	0.1% (0% - 0.4%)
Boston	0.7% (0.2% - 1.5%)	0.4% (0.1% - 1.1%)	0.2% (0% - 0.6%)	0.1% (0% - 0.4%)
Chicago	0.5% (0.1% - 1.3%)	0.3% (0% - 1%)	0.1% (0% - 0.6%)	0.1% (0% - 0.3%)
Cleveland	1.2% (0.5% - 2.4%)	0.3% (0.1% - 1%)	0.1% (0% - 0.5%)	0.1% (0% - 0.3%)
Detroit	1.6% (0.7% - 2.9%)	0.4% (0.1% - 1%)	0.2% (0% - 0.6%)	0.1% (0% - 0.3%)
Houston	2.2% (1.1% - 3.9%)	0.3% (0% - 0.9%)	0.1% (0% - 0.5%)	0.1% (0% - 0.3%)
Los Angeles	3.5% (2% - 5.7%)	0.2% (0% - 0.6%)	0.1% (0% - 0.3%)	0% (0% - 0.1%)
New York	1.8% (0.8% - 3.2%)	0.4% (0.1% - 1.1%)	0.2% (0% - 0.6%)	0.1% (0% - 0.3%)
Philadelphia	2% (1% - 3.6%)	0.7% (0.2% - 1.5%)	0.2% (0% - 0.8%)	0.1% (0% - 0.4%)
Sacramento	1.4% (0.6% - 2.7%)	0.3% (0% - 0.8%)	0.1% (0% - 0.5%)	0% (0% - 0.2%)
St. Louis	1.3% (0.5% - 2.6%)	0.7% (0.2% - 1.6%)	0.3% (0% - 0.9%)	0.1% (0% - 0.5%)
Washington, DC	1.2% (0.6% - 2.4%)	0.4% (0.1% - 1%)	0.1% (0% - 0.5%)	0.1% (0% - 0.3%)

*Percents are median (0.5 fractile) percents of children. Percents in parentheses below the median are 95% credible intervals based on statistical uncertainty surrounding the O_3 coefficient.

**Incidence was quantified down to estimated policy relevant background levels. Percents are rounded to the nearest tenth.

***These 8-hr average standards, denoted m/n, are characterized by a concentration of m ppm and an nth daily maximum. So, for example, the current standard is 0.084/4 -- 0.084 ppm, 4th daily maximum 8-hr average. These nth daily maximum standards require that the average of the 3 annual nth daily maxima over a 3-year period be at or below the specified level (e.g., 0.084 ppm).

Table 3. Estimated Number of Occurrences of Lung Function Response Associated with Exposure to O_3 Concentrations That Just Meet the Current and Alternative Daily Maximum 8-Hour Standards Among All Children (Ages 5-18) Engaged in Moderate Exertion, for Location-Specific O_3 Seasons: Based on Adjusting 2003 O_3 Concentrations*

Location	Number of Occurrences (in 1000s) of Lung Function Response Associated with O_3 Concentrations that Just Meet the Current and Alternative O_3 Standards**			
	A Recent Year of Air Quality	0.084/4***	0.074/4	0.064/4
	Response = Decrease in FEV1 Greater Than or Equal to 10%			
Atlanta	688 (240 - 1235)	541 (158 - 996)	400 (86 - 758)	283 (40 - 555)
Boston	573 (172 - 1057)	489 (128 - 920)	366 (67 - 712)	265 (28 - 535)
Chicago	1041 (321 - 1896)	884 (237 - 1636)	645 (121 - 1235)	453 (48 - 897)
Cleveland	418 (144 - 749)	277 (64 - 523)	211 (34 - 413)	156 (14 - 315)
Detroit	762 (295 - 1335)	473 (121 - 883)	363 (66 - 700)	269 (28 - 536)
Houston	886 (413 - 1473)	383 (119 - 675)	229 (60 - 398)	57 (19 - 64)
Los Angeles	5689 (2811 - 9336)	1467 (345 - 2696)	719 (135 - 1307)	103 (34 - 91)
New York	2782 (1115 - 4844)	1682 (445 - 3136)	1263 (234 - 2437)	883 (94 - 1764)
Philadelphia	958 (389 - 1658)	649 (197 - 1183)	481 (105 - 909)	345 (45 - 676)
Sacramento	437 (173 - 763)	232 (58 - 432)	168 (30 - 322)	105 (11 - 208)
St. Louis	447 (174 - 785)	351 (116 - 635)	259 (64 - 484)	184 (30 - 356)
Washington, DC	882 (303 - 1588)	594 (144 - 1122)	440 (74 - 859)	309 (29 - 624)
	Response = Decrease in FEV1 Greater Than or Equal to 15%			
Atlanta	163 (25 - 392)	120 (10 - 311)	82 (2 - 233)	55 (0 - 169)
Boston	131 (18 - 332)	107 (10 - 285)	74 (2 - 217)	50 (0 - 161)
Chicago	236 (25 - 596)	192 (13 - 509)	131 (2 - 379)	87 (0 - 272)
Cleveland	102 (19 - 241)	59 (4 - 162)	42 (1 - 126)	29 (0 - 95)
Detroit	196 (47 - 439)	103 (9 - 275)	73 (2 - 214)	51 (0 - 162)
Houston	250 (77 - 505)	87 (6 - 215)	50 (1 - 128)	15 (0 - 27)
Los Angeles	1682 (587 - 3280)	312 (12 - 844)	149 (2 - 413)	29 (0 - 45)

Location	Number of Occurrences (in 1000s) of Lung Function Response Associated with O_3 Concentrations that Just Meet the Current and Alternative O_3 Standards**			
	A Recent Year of Air Quality	0.084/4***	0.074/4	0.064/4
New York	737 (198 - 1612)	370 (35 - 977)	256 (7 - 745)	168 (0 - 533)
Philadelphia	253 (66 - 552)	149 (19 - 374)	100 (4 - 281)	67 (0 - 206)
Sacramento	110 (22 - 248)	49 (2 - 134)	34 (0 - 99)	20 (0 - 63)
St. Louis	113 (24 - 255)	82 (11 - 201)	55 (3 - 150)	36 (0 - 109)
Washington, DC	217 (43 - 513)	128 (10 - 348)	88 (2 - 261)	58 (0 - 188)
	Response = Decrease in FEV1 Greater Than or Equal to 20%			
Atlanta	23 (2 - 100)	14 (1 - 75)	8 (0 - 52)	5 (0 - 36)
Boston	17 (2 - 82)	13 (1 - 67)	7 (0 - 47)	4 (0 - 33)
Chicago	29 (2 - 145)	21 (1 - 120)	12 (0 - 84)	7 (0 - 57)
Cleveland	16 (4 - 64)	6 (0 - 37)	4 (0 - 27)	2 (0 - 19)
Detroit	35 (9 - 122)	12 (1 - 64)	7 (0 - 47)	4 (0 - 34)
Houston	51 (15 - 153)	10 (0 - 53)	5 (0 - 31)	2 (0 - 8)
Los Angeles	389 (134 - 1052)	32 (1 - 196)	14 (0 - 94)	3 (0 - 16)
New York	142 (40 - 461)	44 (3 - 231)	24 (0 - 164)	13 (0 - 111)
Philadelphia	49 (14 - 159)	20 (2 - 93)	10 (0 - 64)	5 (0 - 44)
Sacramento	18 (3 - 67)	5 (0 - 31)	3 (0 - 22)	2 (0 - 13)
St. Louis	19 (4 - 69)	11 (1 - 50)	6 (0 - 35)	3 (0 - 24)
Washington, DC	36 (9 - 137)	15 (1 - 81)	8 (0 - 57)	4 (0 - 38)

*Numbers are median (0.5 fractile) numbers of occurrences. Numbers in parentheses below the median are 95% credible intervals based on statistical uncertainty surrounding the O_3 coefficient.

**Incidence was quantified down to estimated policy relevant background levels. Incidences are rounded to the nearest 1000.

***These 8-hr average standards, denoted m/n, are characterized by a concentration of m ppm and an nth daily maximum. So, for example, the current standard is 0.084/4 -- 0.084 ppm, 4th daily maximum 8-hr average. These nth daily maximum standards require that the average of the 3 annual nth daily maxima over a 3-year period be at or below the specified level (e.g., 0.084 ppm).