



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
Office of Air Quality Planning and Standards (OAQPS)  
Research Triangle Park, North Carolina 27711

MEMORANDUM

**SUBJECT:** Comparison of the estimated number of exceedances of potential health effect benchmark levels on roads generated with and without ambient monitors located near major roadways.

**FROM:** Stephen E. Graham, EPA-OAQPS, Ambient Standards Group

**TO:** NO<sub>2</sub> NAAQS Review Docket (EPA-HQ-OAR-2006-0922)

**DATE:** April 18, 2008

Since completion of the Risk and Exposure Assessment to Support the Review of the NO<sub>2</sub> Primary National Ambient Air Quality Standard: Draft Technical Support Document (hereafter, 1<sup>st</sup> draft NO<sub>2</sub> TSD) in April 2008, an additional evaluation was performed for the air quality characterization. A sensitivity analysis was conducted to assess the extent of influence one of the identified uncertainties, i.e., the proximity of the ambient monitors to major roads used in the initial analysis, has on the estimated number of on-road NO<sub>2</sub> benchmark level exceedances.

The methods used in these calculations were the same as those used in the calculation of on-road NO<sub>2</sub> concentrations discussed in section 2.6 of the 1<sup>st</sup> draft NO<sub>2</sub> TSD. The estimated on-road concentration exceedances presented in this memo differ only in the particular ambient monitors used for generating the summary tables. In this additional analysis, monitors located within 100 meters of a major road were excluded from the analysis. As was done in the original analysis, the results for 2 scenarios (air quality concentrations representing “as is” and “with just meeting the current standard”) across 2 time periods (historic and recent) are presented here.

The tables of results included below are as follows:

- Table 1 contains a list of the monitors sited within 100 meters of a major road excluded from this analysis compared with the complete ambient monitoring data set used in the 1<sup>st</sup> draft NO<sub>2</sub> TSD.
- Tables 2 through 5 present the estimated number of exceedances of short-term (1-hour) potential health effect benchmark levels in a year occurring on roads using only those ambient monitors at a distance greater than 100 meters within each selected location.
- Tables 6 through 9 summarize the absolute difference in the number of exceedances and the percent reduction from the original on-road air quality characterization presented in the 1<sup>st</sup> draft NO<sub>2</sub> TSD.

Four locations analyzed in the 1<sup>st</sup> draft TSD did not have any ambient NO<sub>2</sub> monitors within 100 meters of a major road: Atlanta, Detroit, Jacksonville, and Provo. In addition, the two grouped locations (i.e., “Other CMSA” and “Not MSA”) did not have estimated monitor distances to major roads. Therefore, these six locations do not have additional results presented here. A total of 93 monitors were removed from the analysis based on the distance criterion (Table 1). This is nearly half of the 205 monitors from the named locations used in the on-road analysis presented in the 1<sup>st</sup> draft NO<sub>2</sub> TSD. Most of the ambient monitors removed were from locations with large ambient monitoring networks, such as Boston, New York, and Los Angeles.

**Table 1.** List of ambient NO<sub>2</sub> monitors located within 100 meters of a major road removed from the current on-road analysis.

<b>Location</b>	<b>Monitor ID</b>	<b>Distance To Road (m)</b>	<b>Location</b>	<b>Monitor ID</b>	<b>Distance To Road (m)</b>
Boston	230313002	70	Los Angeles	060710015	42
Boston	250051005	17	Los Angeles	060710017	64
Boston	250094004	15	Los Angeles	060710306	38
Boston	250250002	7	Los Angeles	060712002	81
Boston	250250021	7	Los Angeles	061110005	63
Boston	250250040	37	Los Angeles	061110007	89
Boston	250250042	26	Los Angeles	061111003	18
Boston	250270020	44	Los Angeles	061111004	56
Boston	250270023	49	Los Angeles	061112003	90
Boston	330110019	70	Miami	120110003	22
Boston	330110020	70	Miami	120860027	15
Boston	330150009	48	Miami	120864002	87
Boston	330150015	38	New York	090010113	8
Chicago	170310037	17	New York	090091123	14
Chicago	170310063	68	New York	340030001	82
Chicago	170310076	2	New York	340130016	6
Chicago	170313101	20	New York	340131003	25
Chicago	170313103	20	New York	340390004	37
Chicago	170318003	2	New York	340390008	99
Cleveland	390350060	2	New York	360050110	76
Cleveland	390350070	81	New York	360590005	32
Colorado Springs	080416005	79	New York	360610010	55
Denver	080310002	18	New York	360610056	62
Denver	080590006	65	New York	360810098	9
Denver	080590008	31	Philadelphia	100032004	82
Denver	080590009	99	Philadelphia	421010004	45
Denver	080590010	63	Philadelphia	421010047	66
El Paso	481410027	33	Phoenix	040133003	78
El Paso	481410044	38	Phoenix	040133010	7
Las Vegas	320030078	25	Phoenix	040134011	12
Las Vegas	320030539	11	St. Louis	171630010	18
Las Vegas	320030557	1	St. Louis	291831002	31
Las Vegas	320030601	52	St. Louis	291890004	95
Los Angeles	060370030	50	St. Louis	291890006	97
Los Angeles	060371002	58	St. Louis	291893001	5
Los Angeles	060371103	55	St. Louis	291897002	59
Los Angeles	060371301	29	St. Louis	295100072	43
Los Angeles	060371601	78	Washington DC	110010017	54
Los Angeles	060371701	15	Washington DC	245100040	14
Los Angeles	060374002	1	Washington DC	510130020	80
Los Angeles	060375001	10	Washington DC	510590018	54
Los Angeles	060376002	2	Washington DC	510591004	84
Los Angeles	060379002	61	Washington DC	510591005	50
Los Angeles	060655001	75	Washington DC	510595001	18
Los Angeles	060710001	64	Washington DC	511071005	75
Los Angeles	060710012	30	Washington DC	515100009	83
Los Angeles	060710014	18			

### **Estimated Number of Exceedances On Roads Using Ambient Air Quality (As Is)**

The estimated mean number of exceedances of the lowest potential health effect benchmark level (200 ppb, 1-hr average) on roads ranges from none at all to a maximum of 43 per year in Los Angeles using the historic ambient monitoring data (“as is”, Table 2). Median estimates were all zero except for Denver, Los Angeles, and Phoenix (4, 6, and 2 exceedances per year, respectively). The upper percentiles for estimated number of exceedances of the 200 ppb, 1-hr average level in most locations was between 20 and 60 per year, while a few location were estimated to contain up to a few hundred exceedances (e.g., Los Angeles and New York). The frequency of benchmark exceedances at all locations was lower when considering the higher benchmark levels (i.e., 250 and 300 ppb, 1-hr average).

The numbers of estimated exceedances using the more recent data were lower than those estimated using the historic monitoring data, consistent with the trends observed in the ambient NO<sub>2</sub> concentrations. Measures of central tendency at the selected locations range from 0 to 7 exceedances of 200 ppb, 1-hr average on roads, with most locations estimated to have a mean estimate of less than two (Table 3). The number of exceedances at the upper percentiles of the distribution are also lower compared to the historic data. Only Los Angeles was estimated to have greater than 100 exceedances at the 99<sup>th</sup> percentile, while most of the other locations were estimated to contain less than 70 exceedances of the lowest potential health effect benchmark level. Again, the frequency of benchmark exceedances at all locations was less when considering the higher levels (i.e., 250 and 300 ppb, 1-hr average), with most of the percentiles of the distribution estimated at five or less exceedances.

### **Estimated Number of Exceedances On Roads Using Ambient Air Quality Adjusted to Just Meeting the Current Standard**

As described previously in the 1<sup>st</sup> draft TSD (section 2.5), ambient monitoring concentrations were first adjusted to just meet the current standard (i.e., annual average NO<sub>2</sub> concentration of 0.053 ppm). A proportional roll-up method was selected to adjust the ambient concentrations, since all monitoring concentrations were below that of the current standard. Staff recognizes that it is extremely unlikely that NO<sub>2</sub> concentrations in these urban areas would rise to meet the current NAAQS and that there is considerable uncertainty with the simulation of conditions that just meet the current annual standard. As was done with the air quality “as is” above, the estimation of on-road concentrations followed (section 2.6, 1<sup>st</sup> draft TSD), using the adjusted NO<sub>2</sub> concentrations.

The estimated number of on-road NO<sub>2</sub> concentration exceedances of each of the potential health effect benchmark levels is greater when considering ambient concentrations adjusted to just meeting the current standard compared to using the “as is” ambient monitor data. While estimated numbers of exceedances for the more recent air quality data were lower than that of the historic data, mean and median estimates for most locations generally fell between several tens to a few hundreds for the lowest potential health effect benchmark level (Tables 4 and 5). The upper percentile estimates ranged from several hundred upwards to two thousand occurrences when considering the 200 ppb, 1-hr average benchmark level. Estimated exceedances of the higher potential health effect benchmark levels was lower than those estimated for the 200 ppb, 1-hr average, with most locations on average estimated to contain between ten and one hundred exceedances.

## **Comparison of Estimated Exceedances On Roads Generated With and Without Monitors Located Within 100 meters of a Major Road**

The estimated number of exceedances of the potential health effect benchmark levels on roads were compared using a data set containing all valid monitoring data (section 2.7, 1<sup>st</sup> draft NO<sub>2</sub> TSD) and a data set without monitors within 100 meters of a major road (the results presented in Tables 2 through 5). Most locations were estimated to contain fewer numbers of exceedances at all percentiles of the distribution in this current analysis, considering both the air quality data (as is) and concentrations adjusted to just meeting the current standard (Tables 6 through 9). The reduction in estimated numbers of exceedances is most notable at the higher percentiles of the distribution for both scenarios and both air quality analysis periods. The mean and median estimated numbers of exceedances on roads however, exhibited little differences for either the historic or recent “as is” air quality data. This may indicate that the use of monitors sited within 100 meters of a road to estimate on-road NO<sub>2</sub> concentrations in certain locations could overestimate the number of exceedances of potential health effect benchmark levels at the upper percentiles of the distribution. As described in the 1<sup>st</sup> draft NO<sub>2</sub> TSD (section 2.6), the relationship employed to estimate the on-road NO<sub>2</sub> concentrations carried the assumption that the ambient concentrations used were at a distance beyond significant impact from a roadway. The initial analysis was performed using all monitoring data available, noting the uncertainty associated with the inclusion of monitors within close proximity to major roads and the possible overestimation of the on-road NO<sub>2</sub> concentrations and exceedances (1<sup>st</sup> draft NO<sub>2</sub> TSD, section 2.8.6). The comparison here indicates that at the upper percentiles of the distribution, the numbers of exceedances in most locations may have been overestimated by a factor of two or less, for either air quality scenario and monitoring period.

A few locations exhibited an increase in the number of potential benchmark exceedances on roads, particularly at the upper percentiles of the distribution and when considering just meeting the current standard (e.g., Denver and St. Louis). This may indicate that the monitors remaining in the analysis within these locations are possibly impacted by a local source of NO<sub>2</sub> other than on road sources.

**Table 2.** Estimated number of exceedances of short-term (1-hour) potential health effect benchmark levels in a year on-roads, 1995-2000 historic NO<sub>2</sub> air quality (as is) without monitors within 100 meters of a major road.

Location <sup>2</sup>	Exceedances of 200 ppb <sup>1</sup>						Exceedances of 250 ppb <sup>1</sup>						Exceedances of 300 ppb <sup>1</sup>					
	mean	min	med	p95	P98	p99	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99
Boston	1	0	0	9	20	24	0	0	0	1	4	7	0	0	0	0	1	1
Chicago	7	0	0	41	97	118	1	0	0	6	23	30	0	0	0	0	3	7
Cleveland	2	0	0	19	27	31	0	0	0	1	5	5	0	0	0	1	1	1
Denver	8	0	4	36	46	53	2	0	1	10	12	15	1	0	0	4	6	7
Los Angeles	43	0	6	213	348	508	12	0	0	63	118	188	4	0	0	17	39	68
Miami	0	0	0	2	4	5	0	0	0	0	0	1	0	0	0	0	0	0
New York	13	0	0	92	155	212	3	0	0	21	44	55	1	0	0	4	10	14
Philadelphia	4	0	0	20	45	63	1	0	0	4	11	15	0	0	0	0	5	7
Washington	3	0	0	20	39	56	1	0	0	2	8	11	0	0	0	1	2	3
Colorado Springs	21	0	0	171	264	325	12	0	0	111	183	219	7	0	0	55	121	160
El Paso	4	0	0	20	31	39	1	0	0	5	7	8	0	0	0	0	2	2
Las Vegas	2	0	0	5	34	36	0	0	0	0	6	6	0	0	0	0	0	0
Phoenix	14	0	2	65	89	102	2	0	0	13	21	27	1	0	0	3	6	11
St. Louis	2	0	0	15	25	28	1	0	0	10	13	14	1	0	0	7	11	13

<sup>1</sup> The mean number of exceedances represents the number of exceedances occurring at all monitors in a particular location divided by the number of site-years across the monitoring period. The min, med, p95, p98, and p99 represent the minimum, median, 95<sup>th</sup>, 98<sup>th</sup>, and 99<sup>th</sup> percentiles of the distribution for the number of exceedances in any one year within the monitoring period.

<sup>2</sup> Atlanta, Detroit, Jacksonville, and Provo do not have any ambient NO<sub>2</sub> monitors within 100 meters of a major road.

**Table 3.** Estimated number of exceedances of short-term (1-hour) potential health effect benchmark levels in a year on-roads, 2001-2006 recent NO<sub>2</sub> air quality (as is) without monitors within 100 meters of a major road.

Location <sup>2</sup>	Exceedances of 200 ppb <sup>1</sup>						Exceedances of 250 ppb <sup>1</sup>						Exceedances of 300 ppb <sup>1</sup>					
	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99
Boston	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Chicago	4	0	0	17	44	69	0	0	0	1	5	10	0	0	0	0	1	1
Cleveland	2	0	0	16	23	23	0	0	0	4	5	6	0	0	0	2	3	3
Denver	4	0	0	25	40	53	0	0	0	3	6	7	0	0	0	0	1	1
Los Angeles	7	0	0	37	87	129	1	0	0	7	20	28	0	0	0	1	3	10
Miami	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
New York	3	0	0	22	45	72	1	0	0	3	10	16	0	0	0	0	1	2
Philadelphia	1	0	0	5	12	30	0	0	0	1	1	7	0	0	0	0	1	1
Washington	1	0	0	7	14	21	0	0	0	0	1	2	0	0	0	0	0	0
El Paso	1	0	0	4	8	9	0	0	0	1	1	1	0	0	0	0	0	0
Las Vegas	1	0	0	3	14	15	0	0	0	0	0	2	0	0	0	0	0	0
Phoenix	3	0	0	14	28	44	0	0	0	1	3	4	0	0	0	0	0	0
St. Louis	1	0	0	3	10	14	0	0	0	0	2	2	0	0	0	0	0	1

<sup>1</sup> The mean number of exceedances represents the number of exceedances occurring at all monitors in a particular location divided by the number of site-years across the monitoring period. The min, med, p95, p98, and p99 represent the minimum, median, 95<sup>th</sup>, 98<sup>th</sup>, and 99<sup>th</sup> percentiles of the distribution for the number of exceedances in any one year within the monitoring period.

<sup>2</sup> Atlanta, Detroit, Jacksonville, and Provo do not have any ambient NO<sub>2</sub> monitors within 100 meters of a major road. Colorado Springs did not have any NO<sub>2</sub> monitoring for years 2001-2006.

**Table 4.** Estimated number of exceedances of short-term (1-hour) potential health effect benchmark levels in a year on-roads, 1995-2000 historic NO<sub>2</sub> air quality adjusted to just meet the current standard (0.053 ppm annual average), without monitors within 100 meters of a major road.

Location <sup>2</sup>	Exceedances of 200 ppb <sup>1</sup>						Exceedances of 250 ppb <sup>1</sup>						Exceedances of 300 ppb <sup>1</sup>					
	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99
Boston	53	0	11	299	369	390	14	0	1	95	132	161	4	0	0	28	52	65
Chicago	111	0	32	498	615	707	36	0	2	195	289	364	13	0	0	86	153	196
Cleveland	157	1	83	457	586	700	51	0	13	215	269	306	18	0	1	102	131	149
Denver	497	0	111	2097	2304	2451	254	0	26	1467	1695	1930	126	0	12	866	1182	1286
Los Angeles	97	0	24	427	671	865	32	0	4	158	264	366	11	0	0	54	105	172
Miami	359	2	289	985	1201	1353	159	0	95	550	683	797	72	0	26	297	364	451
New York	50	0	5	313	475	602	14	0	0	103	175	230	4	0	0	35	64	81
Philadelphia	86	0	21	400	689	865	24	0	2	125	245	341	7	0	0	38	76	138
Washington	176	0	64	721	949	1073	60	0	9	316	411	478	23	0	1	133	217	247
Colorado Springs	308	0	80	1348	1792	1902	123	0	11	574	803	934	61	0	1	299	373	421
El Paso	152	0	67	545	997	1126	54	0	16	186	440	485	21	0	6	83	190	251
Las Vegas	106	0	6	663	894	1248	38	0	1	318	526	596	15	0	0	98	297	355
Phoenix	229	0	88	954	1293	1375	63	0	12	304	436	544	17	0	2	78	132	181
St. Louis	144	0	51	523	693	728	46	0	9	232	289	323	16	0	0	92	133	163

<sup>1</sup> The mean number of exceedances represents the number of exceedances occurring at all monitors in a particular location divided by the number of site-years across the monitoring period. The min, med, p95, p98, and p99 represent the minimum, median, 95<sup>th</sup>, 98<sup>th</sup>, and 99<sup>th</sup> percentiles of the distribution for the number of exceedances in any one year within the monitoring period.

<sup>2</sup> Atlanta, Detroit, Jacksonville, and Provo do not have any ambient NO<sub>2</sub> monitors within 100 meters of a major road.

**Table 5.** Estimated number of exceedances of short-term (1-hour) potential health effect benchmark levels in a year on-roads, 2001-2006 recent NO<sub>2</sub> air quality adjusted to just meet the current standard (0.053 ppm annual average), without monitors within 100 meters of a major road.

Location <sup>2</sup>	Exceedances of 200 ppb <sup>1</sup>						Exceedances of 250 ppb <sup>1</sup>						Exceedances of 300 ppb <sup>1</sup>					
	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99
Boston	14	0	1	100	166	193	2	0	0	16	30	37	0	0	0	2	3	7
Chicago	99	0	23	438	723	819	29	0	2	164	265	351	9	0	0	62	105	136
Cleveland	222	14	148	584	698	746	79	0	35	280	301	324	32	0	8	157	171	172
Denver	294	0	143	864	1249	1742	104	0	28	389	520	893	37	0	5	169	283	370
Los Angeles	76	0	16	376	591	766	21	0	1	116	203	278	6	0	0	34	70	97
Miami	344	3	261	978	1202	1319	158	0	82	602	779	849	70	0	23	289	486	523
New York	45	0	6	268	404	486	12	0	0	81	160	210	4	0	0	23	56	79
Philadelphia	151	0	48	662	856	1146	44	0	6	226	383	519	14	0	1	69	155	215
Washington	194	0	58	864	1219	1358	61	0	7	331	440	565	21	0	0	136	192	238
El Paso	364	4	225	1214	1604	1737	133	0	54	515	861	971	49	0	16	204	324	450
Las Vegas	214	0	23	1091	1769	1924	77	0	2	596	751	857	32	0	0	244	442	564
Phoenix	136	0	22	738	936	1072	28	0	1	153	207	258	5	0	0	31	52	60
St. Louis	211	0	109	748	1191	1236	67	0	14	293	435	568	23	0	2	143	197	226

<sup>1</sup> The mean number of exceedances represents the number of exceedances occurring at all monitors in a particular location divided by the number of site-years across the monitoring period. The min, med, p95, p98, and p99 represent the minimum, median, 95<sup>th</sup>, 98<sup>th</sup>, and 99<sup>th</sup> percentiles of the distribution for the number of exceedances in any one year within the monitoring period.

<sup>2</sup> Atlanta, Detroit, Jacksonville, and Provo do not have any ambient NO<sub>2</sub> monitors within 100 meters of a major road. Colorado Springs did not have any NO<sub>2</sub> monitoring for years 2001-2006.



**Table 6.** Reduction in the estimated number of exceedances (and percent reduction) of short-term (1-hour) potential health effect benchmark levels in a year on-roads, 1995-2000 historic NO<sub>2</sub> air quality (as is) without monitors within 100 meters of a major road compared with estimates from the 1<sup>st</sup> draft NO<sub>2</sub> TSD.

Location <sup>2</sup>	Reduction in Exceedances of 200 ppb <sup>1</sup>						Reduction in Exceedances of 250 ppb <sup>1</sup>						Reduction in Exceedances of 300 ppb <sup>1</sup>					
	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99
Boston	2 (67)	0 (0)	0 (0)	5 (36)	17 (46)	30 (56)	1 (100)	0 (0)	0 (0)	1 (50)	6 (60)	8 (53)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (67)
Chicago	5 (42)	0 (0)	0 (0)	38 (48)	45 (32)	65 (36)	1 (50)	0 (0)	0 (0)	9 (60)	8 (26)	23 (43)	0 (0)	0 (0)	0 (0)	2 (100)	3 (50)	3 (30)
Cleveland	8 (80)	0 (0)	0 (0)	55 (74)	81 (75)	98 (76)	2 (100)	0 (0)	0 (0)	11 (92)	25 (83)	44 (90)	1 (100)	0 (0)	0 (0)	0 (0)	9 (90)	16 (94)
Denver	-1 (-14)	0 (0)	-4 (nc) <sup>3</sup>	5 (12)	48 (51)	49 (48)	0 (0)	0 (0)	-1 (nc) <sup>3</sup>	-1 (-11)	5 (29)	18 (55)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Los Angeles	2 (4)	0 (0)	-2 (-50)	23 (10)	69 (17)	42 (8)	1 (8)	0 (0)	0 (0)	8 (11)	28 (19)	23 (11)	0 (0)	0 (0)	0 (0)	4 (19)	9 (19)	10 (13)
Miami	0 (0)	0 (0)	0 (0)	2 (50)	2 (33)	3 (38)	0 (0)	0 (0)	0 (0)	1 (100)	4 (100)	5 (83)	0 (0)	0 (0)	0 (0)	0 (0)	3 (100)	4 (100)
New York	7 (35)	0 (0)	1 (100)	17 (16)	75 (33)	172 (45)	2 (40)	0 (0)	0 (0)	7 (25)	21 (32)	74 (57)	0 (0)	0 (0)	0 (0)	1 (20)	4 (29)	17 (55)
Philadelphia	1 (20)	0 (0)	0 (0)	11 (35)	15 (25)	21 (25)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	-1 (-25)	0 (0)
Washington	1 (25)	0 (0)	0 (0)	3 (13)	4 (9)	2 (3)	-1 (nc) <sup>3</sup>	0 (0)	0 (0)	1 (33)	-1 (-14)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	-1 (-50)
Colorado Springs	-1 (-5)	0 (0)	0 (0)	-1 (-1)	0 (0)	-5 (-2)	-1 (-9)	0 (0)	0 (0)	-5 (-5)	-2 (-1)	-3 (-1)	-1 (-17)	0 (0)	0 (0)	-8 (-17)	-2 (-2)	-1 (-1)
El Paso	3 (43)	0 (0)	2 (100)	13 (39)	27 (47)	37 (49)	1 (50)	0 (0)	0 (0)	4 (44)	12 (63)	22 (73)	1 (100)	0 (0)	0 (0)	5 (100)	5 (71)	9 (82)
Las Vegas	4 (67)	0 (0)	0 (0)	32 (86)	32 (48)	61 (63)	1 (100)	0 (0)	0 (0)	11 (100)	9 (60)	13 (68)	1 (100)	0 (0)	0 (0)	6 (100)	11 (100)	11 (100)
Phoenix	22 (61)	0 (0)	1 (33)	191 (75)	230 (72)	288 (74)	12 (86)	0 (0)	0 (0)	94 (88)	179 (90)	253 (90)	6 (86)	0 (0)	0 (0)	23 (88)	97 (94)	170 (94)
St. Louis	0 (0)	0 (0)	0 (0)	-1 (-7)	0 (0)	7 (20)	-1 (nc) <sup>3</sup>	0 (0)	0 (0)	-9 (-900)	-5 (-63)	-2 (-17)	-1 (nc) <sup>3</sup>	0 (0)	0 (0)	-7 (nc) <sup>3</sup>	-7 (-175)	-3 (-30)

<sup>1</sup> The absolute difference in estimated number of exceedances reported in the 1<sup>st</sup> draft NO<sub>2</sub> TSD (includes monitors within 100 meters of major roads) and the current analysis (without monitors within 100 meters) at each of the given percentiles. The percent reduction from the initial estimated number of exceedances is given in parentheses. Negative numbers (and percents) indicates numbers of exceedances have increased in this analysis compared to that reported in the 1<sup>st</sup> draft NO<sub>2</sub> TSD for this scenario and time period.

<sup>2</sup> Atlanta, Detroit, Jacksonville, and Provo do not have any ambient NO<sub>2</sub> monitors within 100 meters of a major road.

<sup>3</sup> The percent reduction cannot be calculated since the initial number of estimated exceedances reported in the 1<sup>st</sup> draft NO<sub>2</sub> TSD was zero.

**Table 7.** Reduction in the estimated number of exceedances (and percent reduction) of short-term (1-hour) potential health effect benchmark levels in a year on-roads, 2001-2006 recent NO<sub>2</sub> air quality (as is) without monitors within 100 meters of a major road compared with estimates from the 1<sup>st</sup> draft NO<sub>2</sub> TSD.

Location <sup>2</sup>	Reduction in Exceedances of 200 ppb <sup>1</sup>						Reduction in Exceedances of 250 ppb <sup>1</sup>						Reduction in Exceedances of 300 ppb <sup>1</sup>					
	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99
Boston	1 (100)	0 (0)	0 (0)	2 (100)	8 (100)	16 (94)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	4 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Chicago	6 (60)	0 (0)	0 (0)	33 (66)	98 (69)	119 (63)	2 (100)	0 (0)	0 (0)	10 (91)	24 (83)	34 (77)	0 (0)	0 (0)	0 (0)	1 (100)	5 (83)	7 (88)
Cleveland	1 (33)	0 (0)	0 (0)	5 (24)	13 (36)	19 (45)	1 (100)	0 (0)	0 (0)	0 (0)	2 (29)	3 (33)	0 (0)	0 (0)	0 (0)	-1 (-100)	0 (0)	0 (0)
Denver	4 (50)	0 (0)	1 (100)	14 (36)	29 (42)	29 (35)	2 (100)	0 (0)	0 (0)	5 (63)	9 (60)	13 (65)	0 (0)	0 (0)	0 (0)	1 (100)	6 (86)	6 (86)
Los Angeles	4 (36)	0 (0)	0 (0)	33 (47)	44 (34)	54 (30)	1 (50)	0 (0)	0 (0)	6 (46)	9 (31)	20 (42)	0 (0)	0 (0)	0 (0)	1 (50)	4 (57)	3 (23)
Miami	0 (0)	0 (0)	0 (0)	3 (100)	6 (86)	11 (85)	0 (0)	0 (0)	0 (0)	2 (100)	5 (100)	5 (100)	0 (0)	0 (0)	0 (0)	2 (100)	4 (100)	5 (100)
New York	6 (67)	0 (0)	0 (0)	26 (54)	45 (50)	71 (50)	1 (50)	0 (0)	0 (0)	5 (63)	9 (47)	9 (36)	0 (0)	0 (0)	0 (0)	1 (100)	2 (67)	4 (67)
Philadelphia	0 (0)	0 (0)	0 (0)	1 (17)	2 (14)	-1 (-3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	-5 (-250)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Washington	0 (0)	0 (0)	0 (0)	-1 (-17)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
El Paso	0 (0)	0 (0)	0 (0)	2 (33)	1 (11)	6 (40)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (50)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Las Vegas	0 (0)	0 (0)	0 (0)	3 (50)	1 (7)	8 (35)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	1 (33)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Phoenix	0 (0)	0 (0)	0 (0)	7 (33)	16 (36)	17 (28)	0 (0)	0 (0)	0 (0)	1 (50)	2 (40)	3 (43)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
St. Louis	0 (0)	0 (0)	0 (0)	-1 (-50)	-3 (-43)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	-1 (-100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

<sup>1</sup> The absolute difference in estimated number of exceedances reported in the 1<sup>st</sup> draft NO<sub>2</sub> TSD (includes monitors within 100 meters of major roads) and the current analysis (without monitors within 100 meters) at each of the given percentiles. The percent reduction from the initial estimated number of exceedances is given in parentheses. Negative numbers (and percents) indicates numbers of exceedances have increased in this analysis compared to that reported in the 1<sup>st</sup> draft NO<sub>2</sub> TSD for this scenario and time period.

<sup>2</sup> Atlanta, Detroit, Jacksonville, and Provo do not have any ambient NO<sub>2</sub> monitors within 100 meters of a major road. Colorado Springs did not have any NO<sub>2</sub> monitoring for years 2001-2006.

**Table 8.** Reduction in the estimated number of exceedances (and percent reduction) of short-term (1-hour) potential health effect benchmark levels in a year on-roads, 1995-2000 historic NO<sub>2</sub> air quality adjusted to just meet the current standard (0.053 ppm annual average), without monitors within 100 meters of a major road compared with estimates from the 1<sup>st</sup> draft NO<sub>2</sub> TSD.

Location <sup>2</sup>	Reduction in Exceedances of 200 ppb <sup>1</sup>						Reduction in Exceedances of 250 ppb <sup>1</sup>						Reduction in Exceedances of 300 ppb <sup>1</sup>					
	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99
Boston	25 (32)	0 (0)	2 (15)	112 (27)	308 (45)	400 (51)	9 (39)	0 (0)	0 (0)	36 (27)	125 (49)	173 (52)	4 (50)	0 (0)	0 (0)	15 (35)	54 (51)	66 (50)
Chicago	61 (35)	0 (0)	29 (48)	229 (31)	386 (39)	463 (40)	23 (39)	0 (0)	5 (71)	108 (36)	223 (44)	279 (43)	9 (41)	0 (0)	0 (0)	51 (37)	77 (33)	126 (39)
Cleveland	164 (51)	0 (0)	112 (57)	588 (56)	635 (52)	739 (51)	73 (59)	0 (0)	25 (66)	351 (62)	394 (59)	455 (60)	33 (65)	0 (0)	4 (80)	202 (66)	249 (66)	243 (62)
Denver	-283 (-132)	0 (0)	-88 (-383)	-836 (-66)	-383 (-20)	-236 (-11)	-157 (-162)	0 (0)	-21 (-420)	-956 (-187)	-553 (-48)	-356 (-23)	-81 (-180)	0 (0)	-11 (-1100)	-638 (-280)	-600 (-103)	-378 (-42)
Los Angeles	3 (3)	0 (0)	-6 (-33)	62 (13)	120 (15)	62 (7)	1 (3)	0 (0)	-2 (-100)	15 (9)	54 (17)	66 (15)	1 (8)	0 (0)	0 (0)	8 (13)	22 (17)	12 (7)
Miami	4 (1)	-1 (-100)	-29 (-11)	60 (6)	133 (10)	74 (5)	3 (2)	0 (0)	-2 (-2)	29 (5)	54 (7)	-6 (-1)	0 (0)	0 (0)	6 (19)	19 (6)	32 (8)	-21 (-5)
New York	27 (35)	0 (0)	6 (55)	99 (24)	218 (31)	328 (35)	9 (39)	0 (0)	1 (100)	24 (19)	83 (32)	190 (45)	4 (50)	0 (0)	0 (0)	5 (13)	27 (30)	90 (53)
Philadelphia	28 (25)	0 (0)	6 (22)	170 (30)	108 (14)	77 (8)	8 (25)	0 (0)	2 (50)	56 (31)	63 (20)	23 (6)	2 (22)	0 (0)	0 (0)	14 (27)	28 (27)	0 (0)
Washington	43 (20)	0 (0)	37 (37)	131 (15)	121 (11)	112 (9)	13 (18)	0 (0)	9 (50)	35 (10)	46 (10)	47 (9)	4 (15)	0 (0)	1 (50)	25 (16)	3 (1)	23 (9)
Colorado Springs	-4 (-1)	0 (0)	-3 (-4)	-28 (-2)	-36 (-2)	-23 (-1)	-3 (-3)	0 (0)	0 (0)	-9 (-2)	-34 (-4)	-4 (0)	-1 (-2)	0 (0)	0 (0)	-5 (-2)	-2 (-1)	-5 (-1)
El Paso	26 (15)	0 (0)	15 (18)	147 (21)	-46 (-5)	-21 (-2)	3 (5)	0 (0)	8 (33)	29 (13)	-93 (-27)	-38 (-9)	0 (0)	0 (0)	2 (25)	-5 (-6)	-28 (-17)	-51 (-26)
Las Vegas	132 (55)	0 (0)	20 (77)	444 (40)	780 (47)	634 (34)	51 (57)	0 (0)	4 (80)	256 (45)	162 (24)	264 (31)	21 (58)	0 (0)	1 (100)	182 (65)	72 (20)	67 (16)
Phoenix	21 (8)	0 (0)	17 (16)	-1 (0)	33 (2)	60 (4)	20 (24)	0 (0)	5 (29)	75 (20)	30 (6)	19 (3)	16 (48)	0 (0)	1 (33)	103 (57)	164 (55)	183 (50)
St. Louis	4 (3)	0 (0)	-3 (-6)	97 (16)	178 (20)	238 (25)	0 (0)	0 (0)	-3 (-50)	27 (10)	67 (19)	109 (25)	0 (0)	0 (0)	0 (0)	7 (7)	30 (18)	37 (19)

<sup>1</sup> The absolute difference in estimated number of exceedances reported in the 1<sup>st</sup> draft NO<sub>2</sub> TSD (includes monitors within 100 meters of major roads) and the current analysis (without monitors within 100 meters) at each of the given percentiles. The percent reduction from the initial estimated number of exceedances is given in parentheses. Negative numbers (and percents) indicates numbers of exceedances have increased in this analysis compared to that reported in the 1<sup>st</sup> draft NO<sub>2</sub> TSD for this scenario and time period.

<sup>2</sup> Atlanta, Detroit, Jacksonville, and Provo do not have any ambient NO<sub>2</sub> monitors within 100 meters of a major road.

**Table 9.** Reduction in the estimated number of exceedances (and percent reduction) of short-term (1-hour) potential health effect benchmark levels in a year on-roads, 2001-2006 recent NO<sub>2</sub> air quality adjusted to just meet the current standard (0.053 ppm annual average), without monitors within 100 meters of a major road compared with estimates from the first draft NO<sub>2</sub> TSD.

Location <sup>2</sup>	Reduction in Exceedances of 200 ppb <sup>1</sup>						Reduction in Exceedances of 250 ppb <sup>1</sup>						Reduction in Exceedances of 300 ppb <sup>1</sup>					
	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99	mean	min	med	p95	p98	p99
Boston	73 (84)	0 (0)	11 (92)	358 (78)	587 (78)	797 (81)	21 (91)	0 (0)	1 (100)	121 (88)	233 (89)	293 (89)	7 (100)	0 (0)	0 (0)	36 (95)	90 (97)	125 (95)
Chicago	77 (44)	0 (0)	38 (62)	367 (46)	299 (29)	320 (28)	30 (51)	0 (0)	5 (71)	171 (51)	295 (53)	269 (43)	14 (61)	0 (0)	0 (0)	66 (52)	190 (64)	218 (62)
Cleveland	165 (43)	0 (0)	120 (45)	533 (48)	624 (47)	989 (57)	70 (47)	0 (0)	30 (46)	293 (51)	375 (55)	522 (62)	30 (48)	0 (0)	7 (47)	169 (52)	236 (58)	256 (60)
Denver	-17 (-6)	0 (0)	-30 (-27)	100 (10)	-16 (-1)	-182 (-12)	-17 (-20)	0 (0)	-6 (-27)	-52 (-15)	-90 (-21)	-336 (-60)	-9 (-32)	0 (0)	0 (0)	-44 (-35)	-80 (-39)	-87 (-31)
Los Angeles	30 (28)	0 (0)	7 (30)	157 (29)	197 (25)	127 (14)	10 (32)	0 (0)	1 (50)	70 (38)	87 (30)	85 (23)	4 (40)	0 (0)	0 (0)	25 (42)	45 (39)	53 (35)
Miami	62 (15)	0 (0)	45 (15)	195 (17)	143 (11)	97 (7)	35 (18)	0 (0)	31 (27)	67 (10)	76 (9)	74 (8)	18 (20)	0 (0)	12 (34)	78 (21)	56 (10)	65 (11)
New York	39 (46)	0 (0)	8 (57)	190 (41)	305 (43)	386 (44)	13 (52)	0 (0)	1 (100)	68 (46)	135 (46)	203 (49)	4 (50)	0 (0)	0 (0)	26 (53)	54 (49)	98 (55)
Philadelphia	23 (13)	0 (0)	12 (20)	64 (9)	117 (12)	38 (3)	7 (14)	0 (0)	1 (14)	13 (5)	0 (0)	2 (0)	2 (13)	0 (0)	0 (0)	8 (10)	-2 (-1)	12 (5)
Washington	14 (7)	0 (0)	25 (30)	10 (1)	-48 (-4)	-48 (-4)	2 (3)	0 (0)	3 (30)	-4 (-1)	-14 (-3)	-7 (-1)	0 (0)	0 (0)	1 (100)	-9 (-7)	-11 (-6)	-14 (-6)
El Paso	25 (6)	0 (0)	32 (12)	37 (3)	0 (0)	0 (0)	11 (8)	0 (0)	12 (18)	15 (3)	-3 (0)	0 (0)	5 (9)	0 (0)	4 (20)	17 (8)	26 (7)	-9 (-2)
Las Vegas	64 (23)	0 (0)	20 (47)	228 (17)	160 (8)	272 (12)	24 (24)	0 (0)	4 (67)	84 (12)	77 (9)	188 (18)	10 (24)	0 (0)	0 (0)	110 (31)	60 (12)	1 (0)
Phoenix	13 (9)	0 (0)	-3 (-16)	20 (3)	236 (20)	280 (21)	5 (15)	0 (0)	0 (0)	50 (25)	96 (32)	112 (30)	2 (29)	0 (0)	0 (0)	17 (35)	18 (26)	35 (37)
St. Louis	-29 (-16)	0 (0)	-40 (-58)	14 (2)	-91 (-8)	-20 (-2)	-8 (-14)	0 (0)	-6 (-75)	9 (3)	33 (7)	8 (1)	-3 (-15)	0 (0)	-1 (-100)	-16 (-13)	14 (7)	34 (13)

<sup>1</sup> The absolute difference in estimated number of exceedances reported in the 1<sup>st</sup> draft NO<sub>2</sub> TSD (includes monitors within 100 meters of major roads) and the current analysis (without monitors within 100 meters) at each of the given percentiles. The percent reduction from the initial estimated number of exceedances is given in parentheses. Negative numbers (and percents) indicates numbers of exceedances have increased in this analysis compared to that reported in the 1<sup>st</sup> draft NO<sub>2</sub> TSD for this scenario and time period.

<sup>2</sup> Atlanta, Detroit, Jacksonville, and Provo do not have any ambient NO<sub>2</sub> monitors within 100 meters of a major road. Colorado Springs did not have any NO<sub>2</sub> monitoring for years 2001-2006.